NATIONAL CURRICULUM FOR CANADIAN ANESTHESIOLOGY RESIDENCY

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NOTE: As a convention in this document, plain text denotes skills and knowledge that apply to the specialty training at the graduate level of a non-subspecialized Anesthesiologist.
MEDICAL EXPERT

1 Airway Evaluation and Management - See also Ear, Nose and Throat (Section 7)

Upon completion of this training, the competent Anesthesiologist shall demonstrate advanced knowledge and proficiency in all the objectives related to airway evaluation and management listed below.

A) Basic Science

1.1 Demonstrate knowledge of the structure and function of upper and lower airways, including but not limited to:
   1.1.1 Nose, mouth, teeth, tongue
   1.1.2 Nasopharynx, oropharynx, pharynx
   1.1.3 Epiglottis, larynx, glottis, vocal cords, valleculae
   1.1.4 Cartilages
   1.1.5 Sensory and motor innervation
   1.1.6 Conducting and respiratory airways: trachea, bronchi, bronchioles, alveoli

1.2 Demonstrate knowledge of the physiology and pathophysiology of ventilation and respiration, including but not limited to:
   1.2.1 Control of breathing
   1.2.2 Central nervous system
   1.2.3 Diaphragm and accessory muscles

B) Airway Obstruction

1.3 Demonstrate knowledge of the etiologies of airway obstruction

1.4 Demonstrate knowledge of the complications of airway obstruction, including but not limited to:
   1.4.1 Hypercarbia/acidosis
   1.4.2 Hypoxia
   1.4.3 Aspiration

C) Basic Airway Management

1.5 Demonstrate knowledge and expertise in basic airway management for the patient with an upper airway obstruction
1.6 Acute Airway Obstruction

1.6.1 Demonstrate proficiency in immediate recognition and management of the patient with an acutely obstructed airway, including but not limited to:

1.6.1.1 Basic Life Support (BLS) protocols:
   1.6.1.1.1 Assessing patient responsiveness
   1.6.1.1.2 Obtaining assistance
   1.6.1.1.3 Patient positioning
   1.6.1.1.4 Recovery position
   1.6.1.1.5 Chin lift, head tilt, jaw thrust
   1.6.1.1.6 Indications for and use of pharmacologic agents, including management of laryngospasm
   1.6.1.1.7 Rescue breathing
   1.6.1.1.8 Cardiopulmonary resuscitation

1.7 Bag-Valve-Mark Ventilation

1.7.1 Demonstrate knowledge and expertise in patient ventilation using bag-valve-mask devices, including but not limited to:

1.7.1.1 Selection of appropriately-sized masks
1.7.1.2 Assembly, use, and trouble-shooting of self-inflating ventilation devices
1.7.1.3 Two-person mask ventilation techniques
1.7.1.4 Role of positive end expiratory pressure (PEEP) valve
1.7.1.5 Role of reservoir bag

1.8 Basic Airway Adjuncts

1.8.1 Demonstrate understanding of the use of basic adjuncts to overcome acute airway obstruction including appropriate sizing and insertion techniques, including but not limited to:

1.8.1.1 Oropharyngeal airway
1.8.1.2 Nasopharyngeal airway

D) Oxygen Delivery Systems

1.9 Demonstrate an understanding of systems designed for delivery of oxygen to the patient, including but not limited to:

1.9.1 Oxygen sources
1.9.2 Wall oxygen systems and specifications
1.9.3 High pressure oxygen supply
1.9.4 Diameter Index Safety System (DISS)
1.9.5 Quick-connect systems
1.9.6 Flowmeters
1.9.7 Cylinder sizes, pressures, capacities
1.9.8 Regulators and flowmeters
1.9.9 Nasal Cannulae
1.9.10 Flow rates and delivered oxygen
1.9.11 Capnography
1.9.12 Face masks
1.9.13 Types: Simple, Venturi, Non-rebreathing
1.9.14 Flow rates and delivered oxygen

E) Universal Precautions - See Infectious Disease (Section 14)

1.10 Demonstrate knowledge and understanding of the role of universal precautions in patient care, including airway management using face shields, barrier masks, gloves

F) Airway Evaluation

1.11 Demonstrate advanced knowledge and expertise in assessment of patient airways, particularly those features predisposing to difficulty in airway management

1.11.1 Elicit a satisfactory patient history, including but not limited to:
   1.11.1.1 Review of old records
   1.11.1.2 History of prior encounters with anesthetics
   1.11.1.3 Dental/soft tissue damage

1.11.2 Perform a complete physical examination, including but not limited to:
   1.11.2.1 Mallampati score
   1.11.2.2 Thyromental distance
   1.11.2.3 Upper lip bite test
   1.11.2.4 Range of motion of neck
   1.11.2.5 Neck circumference
   1.11.2.6 Mandible, mouth opening
   1.11.2.7 Other predictors of airway difficulty
      1.11.2.7.1 Dentition
      1.11.2.7.2 Tongue
1.11.2.7.3 Gender
1.11.2.7.4 Age
1.11.2.7.5 Body habitus/obesity
1.11.2.7.6 Facial hair
1.11.2.7.7 Medical conditions, tumours, trauma, pregnancy

1.11.2.8 Investigations
1.11.2.8.1 Demonstrate appropriate use and understanding of diagnostic testing and imaging where results may impact the planning of a patient’s pre-operative and post-operative airway and ventilatory management, including but not limited to:

   1.11.2.8.1.1 Pulmonary function testing (vitalometry)
   1.11.2.8.1.2 Blood gas testing
   1.11.2.8.1.3 Flow-volume loops

G) Communicator Competencies
1.12 Demonstrate appropriate communication skills regarding the patient airway, evaluation and planning

   1.12.1 Provide clear communication of pre-operative findings/concerns/plans to the patient
   1.12.2 Provide accurate written documentation of pre-operative assessment and patient discussion for colleagues
   1.12.3 Provide accurate written documentation of intra-operative airway findings
   1.12.4 Identify the patient with a difficult airway and be able to:

       1.12.4.1 Write a “Difficult Airway Letter”
       1.12.4.2 Communicate this finding with the patient and family, and other physicians including the family physician
       1.12.4.3 Recommend wearing a MedicAlert bracelet

H) Airway Management Techniques
1.13 Demonstrate knowledge and expertise in airway management using endotracheal intubation

   1.13.1 Describe the indications for intubation

       1.13.1.1 Airway obstruction unrelieved by basic maneuvers
       1.13.1.2 Oxygenation and Ventilation
       1.13.1.3 Management of hypoxia, hypercarbia
       1.13.1.4 Ventilatory support
1.13.1.5 Airway protection
1.13.1.6 Trauma/burns
1.13.1.7 Obtunded patient
1.13.1.8 Tracheobronchial toilet/suctioning
1.13.1.9 Anesthetics and surgery
1.13.1.10 Cases in which muscle relaxants are required
1.13.1.11 Surgery around head and neck
1.13.1.12 Airway procedures
1.13.1.13 Bronchoscopy, biopsies, therapeutic procedures

1.13.2 Route of intubation

1.13.2.1 Orotracheal intubation
1.13.2.2 Nasotracheal intubation
   1.13.2.2.1 Surgical and anatomic indications
   1.13.2.2.2 Considerations
   1.13.2.2.3 Contraindications
   1.13.2.2.4 Blind nasal intubation

1.13.2.3 Transtracheal intubation
   1.13.2.3.1 In situ via tracheotomy stoma
   1.13.2.3.2 Considerations of fresh tracheotomy versus mature stoma

1.13.2.4 Urgent non-elective endobronchial intubation
1.13.2.5 Technique/considerations using standard endotracheal tube

1.13.3 Intubation

1.13.3.1 Demonstrate knowledge and expertise in managing normal and difficult airways using direct laryngoscopy and intubation, with appropriate use of adjuncts where necessary:

1.13.3.1.1 Preparation
   1.13.3.1.1.1 Equipment choice
   1.13.3.1.1.2 Appropriate laryngoscope blade size
   1.13.3.1.1.3 Appropriate endotracheal tube size
   1.13.3.1.1.4 Equipment check
   1.13.3.1.1.5 Monitors
1.13.3.1.1.6 Suction
1.13.3.1.1.7 Alternative airway devices, airways

1.13.3.1.2 Direct laryngoscopy
1.13.3.1.2.1 Curved blades
1.13.3.1.2.2 Straight blades
1.13.3.1.2.3 Levering blades
1.13.3.1.2.4 Other specialized blades

1.13.3.1.3 Indirect laryngoscopy techniques
1.13.3.1.3.1 Demonstrate knowledge and expertise in managing normal and difficult airways using alternatives to direct laryngoscopy, including but not limited to:
   1.13.3.1.3.1.1 Fibreoptic laryngoscopes
   1.13.3.1.3.1.2 Rigid fiberoptic laryngoscopes
   1.13.3.1.3.1.3 Shikani, Bullard, etc.
   1.13.3.1.3.1.4 Flexible fiberoptic laryngoscopes
   1.13.3.1.3.1.5 Video laryngoscopes
   1.13.3.1.3.1.6 Glidescope, McGrath laryngoscope, etc.

1.13.3.1.4 Adjuncts to facilitate endotracheal tube placement
1.13.3.1.4.1 Gum elastic bougie
1.13.3.1.4.2 Stylesets
1.13.3.1.4.3 Malleable
1.13.3.1.4.4 Lighted (e.g. Trachlight, Tubestat)
1.13.3.1.4.5 Maneuvers to facilitate visualization
1.13.3.1.4.6 Optimal patient positioning
1.13.3.1.4.7 BURP (backward upward rightward position)
1.13.3.1.4.8 OELM (optimal external laryngeal manipulation)

1.13.3.1.5 Confirmation of intubation
1.13.3.1.5.1 Visualization
1.13.3.1.5.2 Auscultation
1.13.3.1.5.3 Capnography
1.13.3.1.5.4 Radiography
1.13.4 Management of extubation

1.13.4.1 Demonstrate an understanding of the methods of and considerations for airway management at the extubation phase, including but not limited to:

1.13.4.1.1 Airway toilet, suctioning
1.13.4.1.2 Awake extubation criteria
1.13.4.1.3 Deep extubation technique
1.13.4.1.4 Post-extubation stridor
1.13.4.1.5 Extubation of the patient with a difficult airway

1.13.5 Supraglottic devices

1.13.5.1 Demonstrate knowledge and proficiency in airway management using supraglottic devices, including but not limited to:

1.13.5.1.1 Indications and contraindications of different supraglottic devices
1.13.5.1.2 Elective use as alternative to endotracheal intubation
1.13.5.1.3 Laryngeal mask airway (LMA)
1.13.5.1.4 LMA – ProSeal
1.13.5.1.5 LMA – Classic
1.13.5.1.6 Emerging alternatives
1.13.5.1.7 Conduit for endotracheal intubation
1.13.5.1.8 Use of specific types of LMA as a conduit for endotracheal intubation
1.13.5.1.9 Emergent use in difficult airway algorithms
1.13.5.1.10 CVCI (Cannot Ventilate, Cannot Intubate) situation

1.13.6 Complications of airway management

1.13.6.1 Demonstrate an understanding of and an ability to recognize and treat the complications of airway management, including but not limited to:

1.13.6.1.1 Errors of endotracheal tube placement
1.13.6.1.2 Endobronchial intubation
1.13.6.1.3 Overinsertion
1.13.6.1.4 Patient repositioning, neck flexion
1.13.6.1.5 Esophageal intubation
1.13.6.1.6 Airway trauma
Dental trauma  
Soft tissue trauma  
Post-extubation stridor  
Nasal trauma for nasal intubation  
Aspiration  
Prevention  
Fasting guidelines  
Anti-reflux pre-treatment strategies  
Role of cricoid pressure  
Management  
Current guidelines, role of bronchoscopy, lavage, antibiotics, other

I) The Difficult Airway

I.14 Demonstrate advanced knowledge and skills for the recognition and management of predicted and unexpected difficult airways. The anesthesiologist must demonstrate knowledge of a range of safe options for securing difficult airways. The anesthesiologist must also demonstrate appropriate communication, management and technical skills in doing so

1.14.1 General Considerations

1.14.1.1 Demonstrate a sound working knowledge of the difficult airway algorithms and current accepted airway guidelines. The anesthesiologist must understand and be able to utilize the considerations and recommendations for difficult airway management, including but not limited to:

1.14.1.1.1 Predicted versus unpredicted difficult airway  
1.14.1.1.2 Awake versus asleep strategy  
1.14.1.1.3 Failed intubation strategy  
1.14.1.1.4 Cannot ventilate, cannot intubate strategy  
1.14.1.1.5 Calling for assistance  
1.14.1.1.6 Special considerations in the pediatric and obstetric populations

1.14.2 Further classification of difficult airways into descriptive categories:

1.14.2.1 Difficult mask ventilation  
1.14.2.2 Difficult laryngoscopy  
1.14.2.3 Difficult intubation  
1.14.2.4 Difficult ventilation
1.14.3 Predicted Difficult Airway

1.14.3.1 Demonstrate knowledge and proficiency in formulating an approach to the recognized difficult airway. The anesthesiologist must understand and be able to weigh alternative strategies.

1.14.3.1.1 Formulation of a management plan:

1.14.3.1.1.1 Intubation versus alternatives
1.14.3.1.1.2 Supraglottic devices
1.14.3.1.1.3 Regional anesthesia
1.14.3.1.1.4 Awake versus asleep intubation
1.14.3.1.1.5 Fibreoptic versus videolaryngoscopic techniques
1.14.3.1.1.6 Other devices
1.14.3.1.1.7 Lighted stylet
1.14.3.1.1.8 Other approaches:

1.14.3.1.1.8.1 Retrograde wire or catheter-assisted intubation
1.14.3.1.1.8.2 Patient preparation for awake intubation
1.14.3.1.1.8.3 Psychological, communication of plan/concerns
1.14.3.1.1.8.4 Pharmacological
1.14.3.1.1.8.5 Anti-sialogogue
1.14.3.1.1.8.6 Anxiolytic
1.14.3.1.1.8.7 Strategies for uncooperative patients
1.14.3.1.1.8.8 Airway topicalization techniques
1.14.3.1.1.8.9 Local anesthetic pharmacology
1.14.3.1.1.8.10 Nerve block techniques
1.14.3.1.1.8.11 Aerosolized, spray, contact, injection

1.14.4 Unpredicted Difficult Airway

1.14.4.1 Demonstrate an ability to deal with unexpected difficult airways. The anesthesiologist must understand and be able to apply the guidelines provided in difficult airway algorithms, including the role of supraglottic devices, surgical airways, and patient wake-up options.

1.14.4.2 Describe the principles of anesthesia crisis resource management and the various types of human error when faced with an unanticipated difficult airway.
1.14.5 The Surgical Airway

1.14.5.1 Demonstrate a working knowledge of surgical options for emergency airway management. The anesthesiologist must demonstrate knowledge of the use of at least one cricothyrotomy kit or approach:

1.14.5.1.1 Mini-tracheostomy
1.14.5.1.2 Cricothyrotomy
1.14.5.1.3 Jet ventilation
1.14.5.1.4 Contraindications to surgical airway techniques

1.14.6 Extubation of the Difficult Airway Patient

1.14.6.1 Demonstrate an understanding of the implications for airway management during the extubation of the difficult airway patient. The anesthesiologist should be able to demonstrate consideration of the following additional concerns:

1.14.6.1.1 The patient with a wired jaw
1.14.6.1.2 The patient with airway edema
1.14.6.1.3 Extubation over an introducer
1.14.6.1.4 Assessment for readiness for extubation
2 Ambulatory Anesthesiology

A) Ambulatory Anesthesiology Settings

2.1 Demonstrate an understanding of the various settings and administrative structures required for ambulatory Anesthesiology, including but not limited to:

2.1.1 Hospital based centers
2.1.2 Hospital affiliated centers
2.1.3 Freestanding centers e.g. dental offices, cosmetic surgery clinics, endoscopy clinics

2.2 Demonstrate knowledge with respect to guidelines or standards pertaining to the design and resources required for ambulatory Anesthesiology sites, including but not limited to:

2.2.1 Anesthetics and life support equipment
2.2.2 Monitors
2.2.3 Drugs – in particular drugs required to manage emergencies including Malignant Hyperthermia
2.2.4 Special equipment
   2.2.4.1 Difficult airway
   2.2.4.2 Regional anesthesia
2.2.5 Site physical design
   2.2.5.1 Basic knowledge of O.R. design requirements and standards per Canadian Anesthesiologists Society (CAS)
   2.2.5.2 Managing gas supplied in tanks, adequacy of reserve supply, downstream pressure regulation & monitoring
   2.2.5.3 O.R. ventilation and waste gas scavenging as per CAS recommendations
   2.2.5.4 Equipment maintenance and servicing
   2.2.5.5 Awareness that provincial guidelines specify requirements for number and qualifications of ancillary staff
   2.2.5.6 Provincial Colleges of Physicians and Surgeons role in accrediting non-hospital facilities
   2.2.5.7 Abortion guidelines for non-hospital facilities
B) Pre-operative assessment of patients

2.3 Demonstrate an understanding of the factors related to appropriate patient selection and appropriateness of surgical procedures for ambulatory surgery, including but not limited to:

2.3.1 Obtain a thorough and pertinent medical history
2.3.2 Perform a thorough physical examination
2.3.3 Obtain appropriate and pertinent tests and consultations, including but not limited to:
   2.3.3.1 Laboratory tests
   2.3.3.2 Imaging studies
   2.3.3.3 Electrocardiograms
   2.3.3.4 Specialist consultations

2.3.4 Identify and evaluate any pre-existing comorbid conditions
   2.3.4.1 Provisions for pre-operative screening through record review, interview & examination and directed consultations to reduce late cancellations as well as morbidity & mortality
   2.3.4.2 American Society of Anesthesiologists (ASA) Status and appropriateness for ambulatory care
   2.3.4.3 Body Mass Index (BMI) stratification
   2.3.4.4 Anesthetics for pediatric cases in non-hospital facilities
   2.3.4.5 Hormone Replacement Therapy (HRT)/Birth Control Pill (BCP) discontinuation

2.3.5 Select eligible patients for ambulatory anesthesia based on:
   2.3.5.1 Type of surgery
   2.3.5.2 Duration of surgery
   2.3.5.3 Potential for blood transfusions
   2.3.5.4 Potential severity of perioperative complications
   2.3.5.5 Post-operative care

2.3.6 Special considerations for pediatric patients
   2.3.6.1 Former premature patients
   2.3.6.2 Comorbid conditions including obstructive sleep apnea
   2.3.6.3 Patients with upper respiratory tract infections
   2.3.6.4 Airway challenges
C) Pre-operative patient preparation

2.4 Demonstrate knowledge with respect to preparing patients for ambulatory surgery with respect to:

2.4.1 NPO status
   2.4.1.1 Ensure appropriate NPO status based on timing of surgery
   2.4.1.2 Provide a rationale for NPO policies
   2.4.1.3 Establish an appropriate NPO policy for ambulatory site

2.4.2 Pre-existing medication management-order or withhold chronically administered medications as appropriate

2.4.3 Pre-operative medications – order anxiolytics, sedatives, analgesics in the peri-operative period as appropriate for an ambulatory setting

2.4.4 Preparation for discharge planning – provision of clear instructions to patients and families

D) Anesthetic techniques

2.5 Demonstrate an approach to anesthetic techniques appropriate for ambulatory surgery, including but not limited to:

2.5.1 General Anesthesia
   2.5.1.1 Describe drugs and techniques appropriate for use in an ambulatory care setting

2.5.2 Regional Anesthesia
   2.5.2.1 Demonstrate knowledge of regional anesthetic techniques appropriate for ambulatory surgery and the benefits and drawbacks of such techniques

2.5.3 Monitored Anesthesia Care
   2.5.3.1 Demonstrate an understanding of the use of monitored anesthesia care in the ambulatory setting

E) Anesthesia care for surgical procedures

2.6 Demonstrate knowledge with respect to procedures appropriate for ambulatory surgery

2.6.1 Provide safe and competent anesthesia care for adult and pediatric patients for surgical procedures for:
   2.6.1.1 Otolaryngology
   2.6.1.2 Vascular surgery
   2.6.1.3 General surgery
2.6.1.4 Orthopaedic surgery
2.6.1.5 Urologic surgery
2.6.1.6 Gynaecologic surgery
2.6.1.7 Plastic/cosmetic surgery
2.6.1.8 Dental surgery
2.6.1.9 Ophthalmology
2.6.1.10 Diagnostic imaging

F) Postoperative care

2.7 Demonstrate an understanding of the requirements for postoperative care in an ambulatory setting, including but not limited to:

2.7.1 Post Anesthesia Care Unit (PACU)
   2.7.1.1 Describe and arrange appropriate monitoring of the patient following completion of surgery
   2.7.1.2 Identify and manage post-operative complications
   2.7.1.3 Describe discharge criteria to Post Recovery Care
   2.7.1.4 Provide appropriate post-operative pain management
   2.7.1.5 Provide appropriate post-operative nausea and vomiting management

2.7.2 Post Recovery Care
   2.7.2.1 Describe process for post-operative teaching and instructions
   2.7.2.2 Assure post-operative follow up plans
   2.7.2.3 Describe discharge criteria for discharge home

2.7.3 Unplanned admission
   2.7.3.1 Describe process for unplanned admission to hospital for patients failing to meet discharge criteria or for patients with post-operative complications requiring hospital admission

G) Emergency Situations

2.8 Demonstrate an ability to recognize and treat potential emergency situations in the ambulatory setting, including disposition of the patient

2.8.1 See Complications
2.8.2 Evacuation plans/procedures (particularly in free standing facilities) including fire safety
H) Quality Control/Assurance

2.9 Demonstrate an ability to identify parameters requiring monitoring for Quality Control/Assurance:

2.9.1 Peri-operative complications
2.9.2 Unplanned hospital admissions
2.9.3 Post-operative nausea and vomiting
2.9.4 Post-operative pain control
2.9.5 Peri-operative mortality
3 Autonomic Nervous System

A) Functional Anatomy and Physiology of the Autonomic Nervous System

3.1 Demonstrate an understanding of the anatomy and physiology of the autonomic system including relevant pathophysiology and pharmacology and describe the:

3.1.1 Functional anatomy and physiology of the sympathetic nervous system
3.1.2 Functional anatomy and physiology of the parasympathetic nervous system
3.1.3 Functional anatomy and physiology of the enteric nervous system
3.1.4 Adrenergic and cholinergic receptors and the physiologic effects of their receptor agonists and antagonists
3.1.5 Signal transduction, up-regulation and down-regulation of adrenergic receptors

B) Function of the Autonomic Nervous System

3.2 Demonstrate an understanding of the function of the autonomic system

3.2.1 Describe the responses of effector organs by stimulation of sympathetic and parasympathetic nerves

3.2.1.1 Heart
3.2.1.2 Blood vessels
3.2.1.3 Bronchial tree
3.2.1.4 Gastrointestinal tract
3.2.1.5 Eye
3.2.1.6 Pancreas
3.2.1.7 Sweat glands

3.2.2 Explain the Harlequin syndrome
3.2.3 Explain the function of the autonomic nervous system in visceral pain

3.2.3.1 Throat
3.2.3.2 Lungs
3.2.3.3 Heart uterus
3.2.3.4 Small and large bowel
3.2.3.5 Pancreas
3.2.3.6 Vagina
3.2.3.7 Testicles
3.2.3.8 Celiac ganglion block
3.2.4 Explain the effect of stellate ganglion block on upper limb blood circulation and sympathetic lumbar ganglion block on lower limb blood circulation.
3.2.5 Explain Marey's law.
3.2.6 Explain the Bainbridge reflex.
3.2.7 Explain the Valsalva manoeuvre.
3.2.8 Explain the Bezold-Jarsich reflex.

C) Pharmacology of the Autonomic Nervous System
3.3 Demonstrate an understanding of the pharmacology of the autonomic system.
3.3.1 Describe the synthesis, storage, release, inactivation and metabolism of norepinephrine and epinephrine.
3.3.2 Describe the synthesis, storage, release, and inactivation of acetylcholine.
3.3.3 Name the more frequently used $\alpha$ and $\beta$-agonists, both direct and indirect, and explain their clinical effect.
3.3.4 Explain the effects of $\alpha$ and $\beta$-blockers.
3.3.5 Explain the effects of calcium channel blockers on the blood vessels.
3.3.6 Explain the effects of $\alpha_2$-blockers in regard to pain.
3.3.7 Explain the effects of antihypertensive drugs on the autonomic nervous system, including drugs affecting the renin-angiotensin system.
3.3.8 Explain the effects of antidepressant drugs on the autonomic nervous system, including Monoamine Oxidase Inhibitors (MAOIs) and tricyclic antidepressants.
3.3.9 Explain the relation between antiemetic drugs and the autonomic nervous system.
3.3.10 Explain the relation between tocolytic drugs and the autonomic nervous system.
3.3.11 Describe the effects of anticholinergic and adrenergic drugs on a transplanted heart.
3.3.12 Describe the effects of epinephrine injection in the presence of volatile anesthetics.

D) Autonomic Dysfunction
3.4 Demonstrate an understanding of the pathophysiology of the autonomic nervous system with respect to the following conditions:
3.4.1 Explain pheochromocytoma effects.
3.4.2 Explain autonomic dysreflexia.
3.4.3 Describe assessment of diabetic autonomic neuropathy.
3.4.4 Describe autonomic changes with aging
3.4.5 Explain the oculocardiac reflex
3.4.6 Describe the effects of aging on the autonomic nervous system
3.4.7 Describe the surgical stress syndrome
4 Cardiovascular Anesthesia

A) General Objectives

4.1 Upon completion of this training, the Anesthesiologist shall demonstrate knowledge and proficiency in all the objectives listed below.

4.2 The subspecialist in cardiovascular anesthesia shall demonstrate proficiency in all of the above plus these additional specific objectives. A competent Anesthesiologist shall demonstrate knowledge of the principles of these objectives, but not be expected to perform these objectives.

B) Cardiac anesthesia

4.3 Demonstrate knowledge with respect to the following:

4.3.1 Basic Science

4.3.1.1 Coronary anatomy and physiology

4.3.1.1.1 Describe the normal coronary anatomy and common variants, including being able to describe the vascular supply of the major cardiac chambers and cardiac conduction systems.

4.3.1.1.2 Describe the normal structure of coronary arteries and the determinants of arteriolar tone.

4.3.1.1.3 Describe the determinants of coronary artery blood flow, myocardial oxygen supply and myocardial oxygen demand, including differences between the right and left ventricles.

4.3.1.1.4 Describe the pathogenesis of myocardial ischemia, including the pathology of atherosclerotic heart disease, dynamic stenosis, collateral circulation and coronary steal.

4.3.1.1.5 Describe the pathogenesis of perioperative ischemia and infarction, including similarities and differences from Myocardial Infarction (MI) in the ambulatory (non-surgical) setting.

4.3.1.2 Cardiac physiology

4.3.1.2.1 Describe the phases of the cardiac cycle and relate these to the electrocardiogram.

4.3.1.2.2 Discuss the determinants of cardiac output (heart rate and stroke volume), including those variables which influence stroke volume (preload, afterload, contractility).

4.3.1.2.3 Describe commonly used indices of systolic function, such as dP/dt, Ejection Fraction (EF), and End Systolic Pressure Volume Relationship (ESPVR); pressure volume loops.

4.3.1.2.4 Describe the determinants of normal diastolic function and understand its importance in the normal function of the heart.
as well as describe conditions associated with abnormal diastolic function

4.3.1.2.5 Describe the differences between the function of the left and right ventricle, and the interaction between the two

4.3.1.2.6 Describe the normal anatomy, structure and function of the four heart valves

4.3.1.2.7 Describe the pericardium anatomy and understand the physiologic consequences of diseases of the pericardium

4.3.1.3 Electrophysiology

4.3.1.3.1 Describe the normal anatomy of the cardiac conduction system

4.3.1.3.2 Describe the phases of cellular action potentials, including the major associated ion currents

4.3.1.3.3 Describe the automaticity of the cardiac conduction system, understanding the differences between the SA node, AV node, Bundle of His and Purkinje fibres

4.3.1.3.4 Describe excitation-contraction coupling, and how electrical activation of the myocyte leads to contraction and relaxation

4.3.1.4 Neurohumoral regulation of the heart

4.3.1.4.1 Describe the sympathetic and parasympathetic innervation of the heart

4.3.1.4.2 Describe the interaction of the sympathetic nervous system (SNS) and parasympathetic nervous system (PSNS) with cardiac variables, including heart rate, contractility, relaxation as well and venous and arteriolar tone

4.3.1.4.3 Describe the major receptor mechanisms involved with the autonomic innervation of the heart, including Acetyl Choline, α and β receptors, as well as their stimulants and actions

4.3.1.4.4 Describe the major hormonal systems which regulate cardiac function, including the rennin-angiotensin system, natriuretic peptides, vasopressin and catecholamines

4.3.1.4.5 Describe major cardiac reflex systems, such as the:

4.3.1.4.5.1 Baroreceptor reflex

4.3.1.4.5.2 Chemoreceptor reflex

4.3.1.4.5.3 Bezold-Jarisch reflex

4.3.1.4.5.4 Vagal manoeuvres

4.3.1.4.5.5 Cushing’s reflex
4.3.1.5 Vascular anatomy and physiology
   4.3.1.5.1 Describe the anatomy of the pulmonary vasculature
   4.3.1.5.2 Describe the regulation of pulmonary artery tone, including autonomic and humoral mechanisms
   4.3.1.5.3 Describe the impact of pulmonary vascular resistance on the function of the right ventricle
   4.3.1.5.4 Describe the anatomy of the aorta, including major branches
   4.3.1.5.5 Describe the vascular supply of the major organs and the four limbs
   4.3.1.5.6 Describe the autonomic and humoral control of vascular smooth muscle, and how these systems regulate arterial and venous tone

4.3.1.6 Embryology (see also pediatric anesthesia section)
   4.3.1.6.1 Demonstrate a basic understanding of cardiac embryology
   4.3.1.6.2 Demonstrate awareness of how this relates to major congenital cardiac diseases, such as:
      4.3.1.6.2.1 Patent ductus arteriosus
      4.3.1.6.2.2 Coarctation of the aorta
      4.3.1.6.2.3 Major abnormalities of the great vessels, such as transposition
      4.3.1.6.2.4 Major valvular abnormalities, such as Ebstein’s anomaly, pulmonary atresia, and Tetralogy of Fallot
      4.3.1.6.2.5 Hypoplastic heart syndromes
      4.3.1.6.2.6 Atrial Septal Defect (ASD)
      4.3.1.6.2.7 Ventricular Septal Defect (VSD)
   4.3.1.6.3 Describe normal fetal circulation and understand the differences between adult and fetal circulation
   4.3.1.6.4 Describe the normal transition from fetal to adult circulation, especially as it relates to the immediate post-natal period

4.3.1.7 Demonstrate an ability to apply the aforementioned principles in management with respect to the immediate assessment and management, and pharmacology and perioperative monitoring

4.3.2 Clinical assessment
   4.3.2.1 Demonstrate the ability to:
      4.3.2.1.1 Take a focused cardiac history
4.3.2.1.2 Complete a focused physical examination of the cardiovascular system
4.3.2.1.3 Interpret relevant laboratory data
4.3.2.1.4 Interpret the summary reports of advanced cardiac investigations such as:
   4.3.2.1.4.1 Vascular studies such as the ankle-brachial index and carotid Doppler studies
   4.3.2.1.4.2 Holter monitors
   4.3.2.1.4.3 Myocardial stress tests
   4.3.2.1.4.4 Myocardial perfusion studies
   4.3.2.1.4.5 Left – and – right-sided cardiac catheterization studies
   4.3.2.1.4.6 Static echocardiography reports
4.3.2.1.5 Relate the above to relevant perioperative assessment
4.3.2.1.6 Compile the above to arrive at relevant anesthetic considerations and risks

4.3.3 Pathophysiology
4.3.3.1 Demonstrate an understanding of the pre-existing cardiac disease in planning for non-cardiac as well as cardiac surgery for patients with cardiac disease. The anesthesiologist must demonstrate an ability to manage patients with:
   4.3.3.1.1 Medically optimized pre-existing cardiac disease
      4.3.3.1.1.1 Anti-anginals
      4.3.3.1.1.2 Anti-hypertensives
      4.3.3.1.1.3 Anti-dysrrhythmics
      4.3.3.1.1.4 Diuretics
   4.3.3.1.2 Thoracic Aortic Disease (atheroma, aneurysms, dissections)
   4.3.3.1.3 Coronary Artery Disease - See Critical Care (Sections 6.10, 6.11)
      4.3.3.1.3.1 Acute myocardial ischemia
      4.3.3.1.3.2 Myocardial infarction
      4.3.3.1.3.3 Complications of myocardial infarction such as dysrhythmia, VSD, Congestive Heart Failure (CHF), Mitral Regurgitation (MR), Left Ventricular aneurysm, pseudoaneurysm
      4.3.3.1.3.4 Management in the face of recent thrombolytic and anti-
platelet therapy

4.3.3.1.3.5 The implications of recent Percutaneous Coronary Intervention (PCI) and coronary stent placement

4.3.3.1.4 Valvular heart disease

4.3.3.1.4.1 Aortic Stenosis (AS)
4.3.3.1.4.2 Aortic Regurgitation (AR)
4.3.3.1.4.3 Mitral Stenosis (MS)
4.3.3.1.4.4 Mitral Regurgitation (MR)
4.3.3.1.4.5 Pulmonary Stenosis (PS)
4.3.3.1.4.6 Tricuspid Regurgitation (TR)

4.3.3.1.5 Cardiac tamponade

4.3.3.1.6 Constructive pericarditis

4.3.3.1.7 Cardiomyopathies

4.3.3.1.7.1 Dilated
4.3.3.1.7.2 Restrictive
4.3.3.1.7.3 Obstructive (Hypertrophic Obstructive Cardiomyopathy (HOCM) with or without Systolic Anterior Motion (SAM), Dynamic left ventricular obstruction in the elderly)

4.3.3.1.8 Cardiogenic shock

4.3.3.1.8.1 Right sided congestive heart failure (CHF), pulmonary hypertension
4.3.3.1.8.2 Left sided CHF from diastolic and/or systolic dysfunction

4.3.3.1.9 Aberrant conduction including: Wolf Parkinson White (WPW)), dysrhythmia, ablation procedures (procedures in the Electrophysiology (EP) lab

4.3.3.1.10 Pacemaker and Automatic Implantable Cardioverter Defibrillator (AICD) insertion

4.3.3.1.11 Valve replacement or repair surgery

4.3.3.1.12 Mitral valve assessment for repair

4.3.3.1.13 Cardiac tumors

4.3.3.1.14 Urgent and non-urgent cardiac re-operation

4.3.3.1.15 Cardiac transplant

4.3.3.1.16 Heparin induced thrombocytopenia
4.3.3.1.17  Heparin resistance
4.3.3.1.18  Sudden acute and sub-acute ventricular and supra-ventricular arrhythmia
4.3.3.1.19  Adult Congenital Heart Disease
4.3.3.1.20  Acute Pulmonary emboli and chronic thrombo-embolic pulmonary hypertension
4.3.3.1.21  Endocarditis

4.3.4  Perioperative management of Cardiac Surgery

4.3.4.1  Demonstrate knowledge of special issues related to Cardiac Surgery and Anesthesiology
4.3.4.2  Demonstrate knowledge of the indications for elective and emergent coronary artery bypass graft (CABG) surgery
4.3.4.3  Demonstrate knowledge of the indications for intra-aortic balloon pump (IABP)
4.3.4.4  Demonstrate knowledge of the pathophysiology and management of complications after cardiac surgery such as bleeding, graft occlusion, early and late arrhythmia, stroke, tamponade and neuro-cognitive dysfunction
4.3.4.5  Demonstrate knowledge of antifibrinolytics and their role in blood conservation
4.3.4.6  Demonstrate knowledge of Cardiopulmonary Bypass CPB and its physiologic effects and complications
4.3.4.7  Methods of blood conservation in cardiac and non-cardiac surgery including cell savers
4.3.4.8  Heparin-induced thrombocytopenia HIT and new/novel anticoagulants (e.g. recombinant Hirudin, Argatroban, bivilirudin)
4.3.4.9  Anesthesia for procedures in the cath lab (eg: Atrial fibrillation ablation, Patent foramen ovale (PFO) closure, percutaneous valve replacement)
4.3.4.10 Patient-prothesis mismatch (PPM) after valve replacement
4.3.4.11 Protamine reactions
4.3.4.12 Circulatory arrest
4.3.4.13 Cardiovascular Intensive Care Unit (ICU) care
4.3.4.14 Fast-track cardiac anesthesia and surgery
4.3.4.15 Cardioplegia
4.3.4.16 Left and right ventricular assist devices, Bi-VAD and artificial heart
4.3.4.17 Heart and heart-lung transplantation
4.3.4.18 Temporary pacemaker utilization post cardiac surgery
4.3.4.19 Ischemic preconditioning and volatile anesthetic preconditioning
4.3.4.20 Resource utilization and cost effectiveness techniques in cardiac anesthesiology, surgery and Cardiovascular (CV) intensive care

4.3.5 Pharmacology

4.3.5.1 Demonstrate knowledge with respect to mechanism of action, pharmacokinetics and pharmacodynamics, indications, contraindications, side effects, complications, dose, antidote, interactions, and anesthetic implications of:

4.3.5.1.1 Sympathomimetics, α- and β- adrenergic antagonists
4.3.5.1.2 Phosphodiesterase inhibitors
4.3.5.1.3 Calcium sensitizing agents (levosimendan)
4.3.5.1.4 Peripheral vasodilators, including the nitrates;
4.3.5.1.5 Calcium-channel blockers
4.3.5.1.6 Diuretics
4.3.5.1.7 Other anti-hypertensive agents
4.3.5.1.8 Other anti-dysrhythmic drugs, including digitalis
4.3.5.1.9 Prostaglandins
4.3.5.1.10 Nitric Oxide
4.3.5.1.11 Anti-fibrinolytic agents
4.3.5.1.12 Anti-platelet agents
4.3.5.1.13 Thrombolytics
4.3.5.1.14 Heparin and non-heparin anticoagulants
4.3.5.1.15 Protamine
4.3.5.1.16 Drugs for pulmonary hypertension
4.3.5.1.17 Use of epidurals and spinal cord stimulation in myocardial ischemia

4.3.5.2 Demonstrate knowledge with respect to effects on the cardiovascular system for the following agents:

4.3.5.2.1 IV induction agents
4.3.5.2.2 Sedatives
4.3.5.2.3 Opioids
4.3.5.2.4 Volatile anesthetics
4.3.5.2.5 Nitrous oxide
4.3.5.2.6 Local anesthetics
4.3.5.2.7 Neuromuscular blocking agents
4.3.5.2.8 Anti-cholinesterases and cholinergic agonists
4.3.5.2.9 Anti-cholinergic agents
4.3.5.2.10 NSAIDs and Cox-2 inhibitors

4.3.5.3 Demonstrate knowledge with respect to the current indications for and recommendations regarding pharmacologic agents to minimize perioperative ischemic complications (e.g. ASA, β-blockers, statins, etc.)

4.3.6 Monitoring

4.3.6.1 Demonstrate an ability to:

4.3.6.1.1 Interpret a 12-lead ECG for ischemia, infarction and arrhythmia. Recognize the limitations of ECG monitoring, and be aware of the sensitivity/specificity of ECG as ischemia monitor

4.3.6.1.2 Describe the common placements of intra-operative ECG monitoring leads. Understand the limitations of 3- and 5-lead systems as compared to 12-lead ECG for diagnosing ischemia and arrhythmia. Be familiar with alternative lead placements and their indications. Be aware of the common artifacts present on intra-operative ECG monitors

4.3.6.1.3 Demonstrate principals of non-invasive and invasive BP monitoring and its pitfalls

4.3.6.1.4 Discuss resonant frequency, damping, etc.

4.3.6.1.5 Secure large-bore peripheral intravenous, arterial (radial, brachial and femoral) and central venous (internal jugular, subclavian and femoral) access

4.3.6.1.6 Set up and insert a Pulmonary Artery (PA) catheter. Be able to assess right-sided catheterization variables, including central venous pressure (CVP), pulmonary artery pressure (PAP), pulmonary capillary wedge pressure (PCWP) and cardiac output (CO). Be able to interpret mixed-venous blood gases, and determine whole-body oxygen delivery and consumption. Understand the indications, limitations and complications of pulmonary artery (PA) catheters in critical care settings

4.3.6.1.7 Discuss non-invasive methods of estimating CO and limitations

4.3.6.1.8 Demonstrate an understanding of the laboratory monitoring of the acid-base, oxygen carrying, coagulation and inflammatory components of the hematologic system

4.3.6.1.9 Demonstrate an understanding of Thromboelastogram monitoring
4.3.6.10 Transesophageal Echocardiogram (TEE)

4.3.6.10.1 Describe the indications and contraindications of perioperative TEE in the cardiac and non-cardiac surgical settings

4.3.6.10.2 Demonstrate an understanding of the sensitivity and specificity of TEE in the early detection of myocardial dysfunction, volume assessment, venous air embolism, valvular dysfunction and anatomical abnormalities

4.3.6.10.3 Achieve National Board of Echocardiography Certification in the performance and interpretation of perioperative transesophageal echocardiography

C) Vascular Anesthesia

4.4 Demonstrate an understanding of the anatomy and physiology relevant to the management of patients presenting for vascular surgery, including but not limited to:

4.4.1 Anatomy, Physiology and Pathophysiology

4.4.1.1 Demonstrate knowledge of the basic sciences as applicable to Anesthesiology, including vascular anatomy, and pertinent physiology

4.4.1.2 The anatomy and physiology of spinal blood supply

4.4.1.3 Describe the physiologic consequences of aortic cross clamping

4.4.1.3.1 Thoracic

4.4.1.3.2 Abdominal supraceliac

4.4.1.3.3 Abdominal infrarenal

4.4.1.4 The pathology of atherosclerotic disease

4.4.1.5 The major diseases of the aorta:

4.4.1.5.1 Aortic aneurysm

4.4.1.5.2 Aortic dissection

4.4.1.5.3 Aortic occlusive disease

4.4.1.5.4 Embolic disease and ischemic limb

4.4.1.5.5 Connective tissue disease

4.4.1.5.6 Aortitis

4.4.1.5.7 Aortic injury after blunt trauma

4.4.1.6 The anesthesiologist must demonstrate an ability to apply the aforementioned knowledge in management with respect to patient assessment and management, pharmacology and perioperative
monitoring

4.4.2 Clinical Assessment

4.4.2.1 Demonstrate an understanding of:

4.4.2.1.1 A comprehensive preoperative assessment

4.4.2.1.2 The presence of coexisting diseases particularly related to Coronary Artery Disease (as per cardiac considerations) the implications of vascular disease on end organs e.g. kidneys, CNS

4.4.2.1.3 The clinical skills necessary to general internal medicine and intensive care including the ability to investigate, diagnose, and manage appropriately factors that influence a patient's medical and surgical care

4.4.2.1.4 Recognize that prior to provision of anesthetic care specific medical intervention and modification of risk factors may be required

4.4.3 Clinical Management of Vascular Surgery

4.4.3.1 Demonstrate an understanding of the following considerations:

4.4.3.1.1 The differences of clamping at various levels of the aorta

4.4.3.1.2 Management of patients and the hemodynamic effects of aortic cross clamping

4.4.3.1.3 Intra-operative support

4.4.3.1.4 Manage the following cases on the descending aorta:

4.4.3.1.4.1 Thoracic aneurysm repair

4.4.3.1.4.2 Abdominal aneurysm repair

4.4.3.1.4.3 Aortic dissection

4.4.3.1.4.4 Renal protection and supra-celiac clamps

4.4.3.1.4.5 Spinal cord protection during thoracic aortic surgery

4.4.3.1.4.6 Repair of the ruptured aneurysm

4.4.3.1.5 Peripheral vascular surgery

4.4.3.1.6 Carotid endarterectomy

4.4.3.1.7 Amputation

4.4.3.1.8 Post-operative management of adult patients for aortic, peripheral vascular and carotid procedures
4.4.3.1.9 Demonstrate competence in all technical procedures commonly employed in vascular anesthetic procedures, including

4.4.3.1.9.1 Airway management
4.4.3.1.9.2 Cardiovascular resuscitation
4.4.3.1.9.3 Patient monitoring and life support
4.4.3.1.9.4 General, and regional anesthetic techniques
4.4.3.1.9.5 Analgesic techniques
4.4.3.1.9.6 Postoperative care

4.4.3.1.10 Manage massive transfusions and its inherent complications

4.4.3.1.11 Demonstrate knowledge in the use of spinal drainage for thoracic aneurysm repair

4.4.3.1.11.1 Indications
4.4.3.1.11.2 Contraindications
4.4.3.1.11.3 Methodology
4.4.3.1.11.4 Monitoring
4.4.3.1.11.5 Complications

4.4.3.1.12 Manage diseases of the ascending aorta and aortic arch

4.4.4 Pharmacology - See Cardiac Anesthesia (Section 4.1.5)

4.4.5 Monitoring

4.4.5.1 Demonstrate an understanding of monitoring standards for vascular surgery, including but not limited to:

4.4.5.1.1 Monitoring brain function during Carotid Endarterectomy
4.4.5.1.2 Monitoring spinal cord during thoracic aortic surgery
4.4.5.1.3 Activated Clotting Time (ACT)
4.4.5.1.4 Invasive monitoring
4.4.5.1.5 Special issues related to vascular anesthesia

4.4.6 Pain Management

4.4.6.1 Demonstrate knowledge of the principles of management of patients with postoperative pain following abdominal and peripheral vascular procedures, including but not limited to:

4.4.6.1.1 Epidural analgesia
4.4.6.1.2 Risks of neuraxial anesthesia with antiplatelet agents,
intraoperative heparinization and other alterations in coagulation status

4.4.6.1.3 Patients with chronic pain due to chronic vascular insufficiency

4.4.6.1.4 Phantom limb pain - advantages and disadvantages of regional versus general anesthesia for Carotid endarterectomy (CEA)
5 Complications of Anesthesia

5.1 Upon completion of this training, the Anesthesiologist shall demonstrate the ability to:

5.1.1 Assess a patient’s potential for complications based on comorbidities and planned procedures
5.1.2 Obtain informed consent
5.1.3 Prevent potential complications
5.1.4 Manage potential complications
5.1.5 Arrange appropriate patient disposition
5.1.6 Document complications appropriately
5.1.7 Disclose relevant information to the patient
5.1.8 Arrange appropriate debriefing and quality assurance measures

A) Complications of Anesthesia in General

5.2 Awareness under anesthesia
5.3 Allergy and anaphylaxis
5.4 Extravasation of drugs and fluids
5.5 Drug interactions
5.6 Bacteremia
5.7 Hyper-/hypotension
5.8 Tachy-/bradycardia
5.9 Hyper-/hypocarbia
5.10 Hypoxemia
5.11 Hyper-/hypothermia
5.12 Raised airway pressure
5.13 Cardiac arrest and ACLS protocols
5.14 Intraoperative fires/burns

B) Complications of Regional Anesthesia - See Regional Anesthesia (Section 27.5)

C) Complications of Medication Administration

5.15 Demonstrate an understanding of the complications related to administration of anesthetics and other drugs:

5.15.1 Inhalation Anesthetics - See Volatile Agents (Section 34.6)
5.15.2 Intravenous Induction Agents and Sedatives - See Pharmacology (Section
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23.6)

5.15.3 Narcotics/Opioids - See Pharmacology (Section 23.7)
5.15.4 Antiemetics and Anticholinergics - See Pharmacology (Section 23.8)
5.15.5 Neuromuscular Blocking Agents - See Neuromuscular Junction (Section 17.2)
5.15.6 Reversal Agents (CNS and Neuromuscular) - See Neuromuscular junction (Section 17.4)
5.15.7 Local Anesthetic Agents - See Regional Anesthesia (Section 27.5)
5.15.8 Non-anesthetic drugs commonly used in the OR
   5.15.8.1 Vasoactive drugs
   5.15.8.2 Electrolyte solutions
   5.15.8.3 Bronchodilators
   5.15.8.4 Anticonvulsants
   5.15.8.5 Corticosteroids
   5.15.8.6 Antibiotics
   5.15.8.7 Antifibrinolytics
   5.15.8.8 Anticoagulants and their reversal agents

D) Allergy - See Immunology (Section 13.4)

E) Fluid Management

5.16 Demonstrate an understanding of the complications related to fluid and blood product administration including:
   5.16.1 Fluid [See Critical Care (Section 6.4)]
   5.16.2 Blood products [See Hematology (Section 11.6)]

F) Airway [See Airway (Sections 1.2.2., 1.3.2., 1.8.4)]

G) Monitoring - See Monitoring and Equipment (Section 15.13)

5.17 Failure to secure access
5.18 Arterial/venous trauma including tears, fistula formation
5.19 Arterial occlusion
5.20 Pneumo-/hemothorax

H) Patient Positioning

5.21 Complications relating to changing positions
5.22 Pressure: nerves and eyes, vascular structures, skin
5.23 Stretching: nerves, particularly brachial plexus
5.24 Management of emergencies in prone position
5.25 Venous air embolism
5.26 Inadequate organ perfusion

I) Type of surgery
5.27 Laparoscopic
5.28 Thoracic
5.29 Neuro
5.30 Vascular (e.g. spinal cord ischemia with Abdominal Aortic Aneurysm (AAA)
5.31 Orthopedics (e.g. fat embolism, hypotension from reaction to cement with arthroplasty)

J) Ventilation - See Critical Care (Section 6.3)
5.32 Conventional
5.33 Non-conventional
5.34 Non-invasive

K) Occupational Hazards for Anesthesiologists and other OR personnel
5.35 Demonstrate an understanding of the potential risks to themselves and others when dealing with high risk patients and situations in the operating room, including but not limited to:
5.35.1 Needle stick
5.35.2 Infections – needle, airborne, contact
5.35.3 Inhalation of agents
5.35.4 Violent patient – Assault – physical, verbal
5.35.5 Lifting patients – back and other injuries
5.35.6 Post Traumatic Stress Disorder (PTSD) after adverse events
5.35.7 Fatigue
5.35.8 Substance abuse
6  Critical Care

Upon completion of this training, the Anesthesiologist must demonstrate an understanding of all the facets of critical care medicine including principles of management of the critically ill patient, acute resuscitation, trauma management and crisis resource management.

A) Monitoring - See Monitoring (Section 15.13)

B) Airway management - See Airway (Section 1)

6.1  Demonstrate an in depth understanding of airway management in the critically ill patient

C) Mechanical ventilation

6.2  Demonstrate an understanding of the various models of mechanical ventilation used in critical care, their indications, contraindications and side effects:

6.2.1  Indications for and contraindications of non-invasive and invasive positive pressure ventilation

6.2.2  Hemodynamic effects of positive pressure ventilation: Heart-lung interaction

6.2.3  Modes of ventilation

6.2.3.1  Controlled mechanical ventilation (CMV)

6.2.3.2  Synchronized intermittent mandatory ventilation (SIMV)

6.2.3.3  Pressure support ventilation

6.2.3.4  Pressure control ventilation

6.2.3.5  Non-invasive positive pressure ventilation

6.2.3.6  High frequency oscillation

6.2.4  Ventilator induced lung injury and it’s prevention and Adult Respiratory Distress Syndrome (ARDS) net protocol

6.2.5  Managing patient-ventilator dysynchrony

6.2.6  Weaning from mechanical ventilation

6.2.7  Monitoring ventilatory therapy

6.2.7.1  Arterial and venous blood gases

6.2.7.2  Pulse oximetry

6.2.7.3  Ventilator graphics
6.2.8 Sedation and paralysis for mechanical ventilation

6.2.8.1 Pharmacology of common sedative and analgesic agents

6.2.8.2 Indications for neuromuscular blockade and pharmacology of neuromuscular blocking agents

6.2.8.3 Complications of prolonged mechanical ventilation and neuromuscular blockade + Myopathy of critical illness

D) Management of fluid, electrolyte and acid-base disorders

6.3 Demonstrate an understanding of fluid and electrolyte disturbances encountered in critical care management and their management

6.3.1 Normal distribution of total body water and electrolytes

6.3.2 Options for fluid replacement

6.3.2.1 Crystalloids

6.3.2.2 Synthetic colloids

6.3.2.3 Albumin

6.3.3 Management of electrolyte abnormalities

6.3.3.1 Hyponatremia

6.3.3.2 Hypernatremia

6.3.3.3 Hypokalemia

6.3.3.4 Hyperkalemia

6.3.3.5 Hypocalcemia

6.3.3.6 Hypomagnesemia

6.3.3.7 Hypo and hyperphosphatemia

6.3.4 Classification of metabolic acidosis

E) Nutrition

6.4 Demonstrate an understanding, but not in depth knowledge, of the nutritional needs of the critically ill patient and an approach to management thereof:

6.4.1 Options for nutritional replacement

6.4.1.1 Enteral feeding

6.4.1.2 Total Parenteral Nutrition (TPN)

6.4.2 Estimation of resting energy expenditure – the Harris - Benedict equation
F) Transfusion therapy - See Hematology (Section 11)

6.5 Demonstrate an understanding of transfusion therapy as it applies to the critically ill patient

G) Hemodynamic management of shock

6.6 Demonstrate an understanding of the various forms of shock and the management thereof:

   6.6.1 Pathophysiology of shock
   6.6.2 Hypovolemic shock
   6.6.3 Septic shock
   6.6.4 Cardiogenic shock
   6.6.5 Obstructive shock
      6.6.5.1 Pulmonary embolism
      6.6.5.2 Pericardial tamponade
      6.6.5.3 Tension pneumothrax
      6.6.5.4 Air embolism
      6.6.5.5 Amniotic fluid embolism

   6.6.6 Distributive shock
      6.6.6.1 Spinal shock
      6.6.6.2 Anaphylactic shock
      6.6.6.3 Systemic inflammatory response system (SIRS)

   6.6.7 Fluid therapy

   6.6.8 Pharmacology of and critical indications for vasopressors and inotropic therapy

H) Management of Hypertension

6.7 Demonstrate an understanding of the causes and management of hypertension in the critically ill patient, including but not limited to:

   6.7.1 Pharmacology of antihypertensive agents
   6.7.2 Diagnosis and management of hypertensive crisis
I) **Respiratory Failure**

6.8 Demonstrate an approach to the management of critically ill patients in respiratory failure, including but not limited to:

6.8.1 Differential diagnosis of respiratory failure
6.8.2 Acute Respiratory Distress Syndrome (ARDS)
6.8.3 Hospital acquired pneumonia
6.8.4 Chronic obstructive pulmonary disease
6.8.5 Ventilator associated pneumonia
6.8.6 Severe community acquired pneumonia
6.8.7 Management of acute asthma
6.8.8 Pulmonary hypertension
6.8.9 Thoracentesis
6.8.10 Chest tube insertion and management

J) **Acute Coronary Syndromes (ACS)**

6.9 Demonstrate an understanding of the diagnosis and management of acute coronary syndromes, including but not limited to:

6.9.1 Pharmacologic management of ACS
6.9.2 Percutaneous coronary angioplasty and stenting
6.9.3 Coronary artery bypass grafting
6.9.4 Management of cardiac failure
   6.9.4.1 Pharmacology
   6.9.4.2 Supportive care
   6.9.4.3 Intra-aortic balloon pump

6.9.5 Complications of myocardial infarction
   6.9.5.1 Acute mitral regurgitation
   6.9.5.2 Ventricular septal defect
   6.9.5.3 Ventricular free wall rupture
   6.9.5.4 Ventricular aneurysm
K) **Management of arrhythmias and cardiac arrest**

6.10 Demonstrate an in depth knowledge of the Advanced Cardiac Life Support (ACLS) protocols and an approach to the management of arrhythmias and cardiac arrest, including but not limited to:

6.10.1 ACLS guidelines for the management of:

   6.10.1.1 Ventricular tachycardia (VT), (including polymorphic VT), and ventricular fibrillation
   6.10.1.2 Asystole
   6.10.1.3 Atrial flutter and fibrillation
   6.10.1.4 Other supraventricular tachycardias
   6.10.1.5 Symptomatic bradycardia
   6.10.1.6 AV block
   6.10.1.7 Wolff – Parkinson – White syndrome

6.10.2 Principles of safe cardioversion and defibrillation

6.10.3 Transthoracic and transvenous pacing

6.10.4 Management of the pacemaker dependent patient, patient with an automatic implantable cardiac defibrillator (AICD)

6.10.5 Management of a patient with an AICD

6.10.6 Pharmacology of antiarrhythmic therapy

L) **Infectious diseases - See Infectious Disease (Sections 14.2, 14.6)**

6.11 Demonstrate an approach to the diagnosis and management of infectious diseases in the critically ill patient

M) **Neurocritical care**

6.12 Demonstrate knowledge of issues encountered with neurocritical care unit patients, including but not limited to:

   6.12.1 Management of severe head trauma and raised intracranial pressure (ICP)
   6.12.2 Management of cerebrovascular accident due to ischemic stroke
   6.12.3 Intracranial hemorrhage
   6.12.4 Subarachnoid hemorrhage
   6.12.5 Status epilepticus
   6.12.6 Differential diagnosis and management of decreased level of consciousness and coma
   6.12.7 Management of agitation and delirium
6.12.8 Guillaine – Barre syndrome
6.12.9 Spinal shock

N) Pulmonary embolism and thromboembolic disease
6.13 Diagnosis of deep vein thrombosis and pulmonary embolism
6.14 Principles of prophylactic and therapeutic anticoagulant therapy
6.15 Diagnosis and management of massive pulmonary embolism

O) Acute and Chronic Renal Failure - See Renal/ Urologic (Section 29.3)
6.16 Demonstrate knowledge of the management of the critically ill patient with renal failure, including but not limited to:
   6.16.1 Management of the critically ill patient with chronic renal failure
   6.16.2 Differential diagnosis and management of acute renal failure
   6.16.3 Management of rhabdomyolysis
   6.16.4 Management of hyperkalemia
   6.16.5 Hepatorenal syndrome
   6.16.6 Principles of hemodialysis and continuous renal replacement therapy: acute vs. chronic
   6.16.7 Hemodialysis, use in poisoning

P) Management of Acute and Chronic Hepatic Failure - See Hepatobiliary (Section 12.3)
6.17 Demonstrate knowledge of the management of the critically ill patient with hepatic failure, including but not limited to:
   6.17.1 Differential diagnosis and management of acute and fulminant hepatic failure
   6.17.2 Indications for urgent liver transplantation
   6.17.3 Management of complications of hepatic failure
      6.17.3.1 Cerebral edema
      6.17.3.2 Hepatic encephalopathy
      6.17.3.3 Coagulopathy
      6.17.3.4 Ascites
      6.17.3.5 Spontaneous bacterial peritonitis
Q) Gastrointestinal Emergencies

6.18 Demonstrate knowledge of the management of the critically ill patient presenting with gastrointestinal emergencies, including but not limited to:

6.18.1 Differential diagnosis and management of upper and lower gastrointestinal bleeding
6.18.2 Differential diagnosis and management of peritonitis
6.18.3 Prevention and management of aspiration
6.18.4 Disorders of bowel mobility
6.18.5 Prevention of stress ulceration
6.18.6 Management of acute pancreatitis
6.18.7 Intestinal ischemia
6.18.8 Acute magacolon
6.18.9 Abdominal compartment syndrome

R) Endocrine Emergencies

6.19 Demonstrate knowledge of the management of the critically ill patient presenting with endocrine emergencies, including but not limited to:

6.19.1 Diabetic knowledge
6.19.2 Hyperosmolar nonketotic coma
6.19.3 Hyperthyroidism and Thyroid storm
6.19.4 Hypothyroidism and myxedema coma
6.19.5 Hypercalcemia
6.19.6 Adrenal insufficiency
6.19.7 Diabetes insipidus
6.19.8 Syndrome of inappropriate antidiuretic hormone (ADH)

S) Management of Poisoning and Drug-Related Complications

6.20 Demonstrate knowledge of the management of patients after poisonings, drug overdoses and exposure to agents used in bioterrorism, including but not limited to:

6.20.1 Evaluation and supportive care of the patient with suspected poisoning
6.20.2 Salicylates
6.20.3 Methanol/ethylene glycol/isopropyl alcohol
6.20.4 Sedative agents
   6.20.4.1 Barbiturates
6.20.4.2 Benzodiazepines

6.20.5 Antipsychotic agents
   6.20.5.1 Phenothiazines
   6.20.5.2 Lithium

6.20.6 Antidepressants
   6.20.6.1 Monoamine oxidase inhibitors
   6.20.6.2 Tricyclic antidepressants

6.20.7 Acetaminophen
6.20.8 Narcotics
6.20.9 Beta blockers
6.20.10 Calcium channel blockers
6.20.11 Digitalis
6.20.12 Carbon monoxide
6.20.13 Organophosphate poisoning
6.20.14 Cyanide

T) Drug Related Syndromes
6.21 Diagnose and manage idiosyncratic drug reactions, including but not limited to:
   6.21.1 Serotonin syndrome
   6.21.2 Malignant hyperthermia (MH)
   6.21.3 Neuroleptic malignant syndrome

U) Critical care of the trauma patient
6.22 Demonstrate in depth knowledge of the management of the trauma patient, including but not limited to:
   6.22.1 Principles of Advanced Trauma Life Support (ATLS)
      6.22.1.1 Primary survey
      6.22.1.2 Secondary survey
      6.22.1.3 Tertiary survey

6.22.2 Supportive care
   6.22.2.1 Management of hypovolemia
6.22.2.2  Management of hypothermia
6.22.2.3  Management of coagulopathy
6.22.2.4  Management of abdominal compartment syndrome

6.22.3  Evaluation and management of:
  6.22.3.1  Blunt trauma
  6.22.3.2  Penetrating trauma
  6.22.3.3  Crush injury
  6.22.3.4  Thoracic trauma
  6.22.3.5  Abdominal trauma

6.22.4  Evaluation and management of neurologic trauma
  6.22.4.1  Head injury and raised intracranial pressure
  6.22.4.2  Spinal cord injury and spinal shock
  6.22.4.3  Determination of brain death
  6.22.4.4  Management of the brain dead organ donor

6.22.5  Burns
6.22.6  Airway management of the trauma patient

V) Obstetrical Critical Care - See Obstetrics 18.10

6.23  Demonstrate knowledge of obstetrical conditions requiring critical care management, including but not limited to:
  6.23.1  Pre-eclampsia/eclampsia
  6.23.2  HELLP syndrome
  6.23.3  Respiratory critical care of the pregnant patient
    6.23.3.1  Pneumonia
    6.23.3.2  ARDS
    6.23.3.3  Asthma
    6.23.3.4  Respiratory failure
  6.23.4  Postpartum hemorrhage
    6.23.4.1  Amniotic fluid embolism
    6.23.4.2  Abruption placenta
    6.23.4.3  Disseminated intravascular coagulation
6.23.4.4 Uterine rupture

6.23.5 Management of cardiac arrest in pregnancy
6.23.6 Thromboembolic disease in pregnancy
6.23.7 Postpartum care of the parturient with cardiovascular disease
   6.23.7.1 Acute coronary syndrome
   6.23.7.2 Valvular heart disease
   6.23.7.3 Postpartum cardiomyopathy

W) Postoperative Care

6.24 Demonstrate knowledge of the management of patients requiring critical care admission after major surgical procedures, including but not limited to:
   6.24.1 Cardiac surgery
   6.24.2 Thoracic surgery
   6.24.3 Vascular surgery
      6.24.3.1 Abdominal aortic aneurysm
      6.24.3.2 Revascularization of the lower limb
      6.24.3.3 Carotid endarterectomy
   6.24.4 Solid organ transplant
   6.24.5 Major abdominal surgery
      6.24.5.1 Hepatic resection
      6.24.5.2 Pancreatectomy
      6.24.5.3 Esophagectomy
      6.24.5.4 Bowel resection
   6.24.6 Fluid and electrolyte management after major surgery

X) Ethical principles of Critical Care management

6.25 Demonstrate knowledge of ethical concerns related to management of critically ill patients, including but not limited to:
   6.25.1 Patient confidentiality and privacy legislation
   6.25.2 Patient autonomy
   6.25.3 Principles of informed consent and decision making
   6.25.4 Next of kin designation
6.25.5 End of life decision making
6.25.6 Organ procurement for transplantation
6.25.7 Management and review of adverse events
6.25.8 Communication with families in crisis
6.25.9 Cultural aspects of Critical Care

Y) Principles of crisis management and team leadership

6.26 Demonstrate knowledge of crisis resource management and team leadership in critical situations, including but not limited to:

6.26.1 Leadership
6.26.2 Resource assessment and allocation
6.26.3 Situational awareness
6.26.4 Communication and collaboration during a crisis
7 Ear, Nose and Throat Surgery

See also Airway (Section 1)

Upon completion of this training, the competent Anesthesiologist shall demonstrate advanced knowledge and clinical proficiency in all the objectives listed below

A) General ENT Considerations:

7.1 Demonstrate knowledge of the general considerations for providing anesthetics for ENT procedures and communicate closely with the surgeon and operating room personnel regarding perioperative airway management concerns, including but not limited to:

7.1.1 Preoperative Patient Concerns
   7.1.1.1 Co-morbid conditions (e.g. smoking, COPD, alcohol, cancer)
   7.1.1.2 Spectrum of patients, Pediatric to elderly

7.1.2 Airway Anatomy – See Airway 1.1

7.1.3 Shared and Remote Airway Considerations
   7.1.3.1 Implications of limited physical and visual access during anesthetic
   7.1.3.2 Specialized endotracheal tubes to facilitate surgical access
   7.1.3.3 Vigilance against airway disconnections and kinking during surgical maneuvers
   7.1.3.4 Occult bleeding into the airway during surgery
   7.1.3.5 Throat packs
   7.1.3.6 Use of nitrous oxide and muscle relaxants

7.1.4 Difficult Airway
   7.1.4.1 Implications of presenting disease process
      7.1.4.1.1 Tumours and mass effects
      7.1.4.1.2 Post surgical or irradiation scarring
      7.1.4.1.3 Congenital deformities
      7.1.4.1.4 Foreign bodies
      7.1.4.1.5 Trauma
      7.1.4.1.6 Infections, abscesses

7.1.4.2 Considerations for appropriate endotracheal tube type, size and placement
   7.1.4.2.1 Microlaryngoscopy tubes
7.1.4.2.2 Laser tubes
7.1.4.2.3 Nasal versus oral intubation
7.1.4.2.4 Oral and nasal RAE tubes

7.1.4.3 Control of ventilation and oxygenation
7.1.4.3.1 Awake airway control
7.1.4.3.2 Intravenous versus inhalation induction
7.1.4.3.3 Other options – surgery under local anesthetic

7.1.4.4 Emergence and extubation strategies
7.1.4.4.1 Re-examination of airway for bleeding/clots
7.1.4.4.2 Deep extubation versus awake extubation
7.1.4.4.3 Consideration of throat packs, nasal packing

B) Endoscopy and Airway Infections

7.2 Demonstrate knowledge of the anesthetic concerns and goals for endoscopy, with proficient evaluation and management of the patient. The anesthesiologist must also be able to manage patients presenting with acute infections that threaten airway patency, including epiglottitis and abscesses

7.2.1 Considerations of presenting complaints
7.2.1.1 Hoarseness, stridor, hemoptysis
7.2.1.2 Foreign body aspiration
7.2.1.3 Airway trauma
7.2.1.4 Papillomatosis
7.2.1.5 Tumours
7.2.1.6 Stenosis
7.2.1.7 Vocal cord problems

7.2.2 Procedural considerations
7.2.2.1 Biopsies, bleeding, obstruction
7.2.2.2 Lasers
7.2.2.3 Positioning
7.2.2.4 Intubation and ventilation challenges
7.2.2.4.1 Awake intubation, inhalation versus intravenous inductions
7.2.2.5 Jet ventilation
7.2.2.6 Rigid versus flexible endoscope

C) Nasal Cavity Search

7.3 Demonstrate knowledge of the considerations for nasal cavity surgery, and demonstrate expertise in managing these cases

7.3.1 Considerations of presenting complaints
7.3.1.1 Nasal obstruction, polyps, infections
7.3.1.2 Associated problems, e.g. Asthma, allergies, cystic fibrosis
7.3.1.3 Epistaxis – trauma, coagulopathy, hemodynamic stability

7.3.2 Procedural considerations
7.3.2.1 Use of vasoconstrictors
7.3.2.1.1 Cocaine, alternatives to cocaine e.g. phenylephrine, oxymetazoline

7.3.2.2 Throat packs
7.3.2.3 Occult blood loss
7.3.2.4 Patient immobility vs. Short case lengths
7.3.2.5 Post-op nasal packing, bleeding, positioning

D) Laser Surgery of the Upper Airway

7.4 Demonstrate advanced knowledge and practical skills in managing laser surgery cases

7.4.1 Basic laser science
7.4.1.1 Types of surgical lasers and indications
7.4.1.1.1 Short wavelength lasers
7.4.1.1.2 Infrared lasers

7.4.2 Safety considerations
7.4.2.1 Protection of patient and personnel
7.4.2.1.1 Eye protection
7.4.2.1.2 Skin protection
7.4.2.2 Airway fires
7.4.2.2.1 Prevention strategies
  7.4.2.2.1.1 Surgeon techniques
  7.4.2.2.1.2 Gas mix
  7.4.2.2.1.3 ETT modifications

7.4.2.3 Fire management protocol

E) Tonsillectomy and Adenoidectomy
7.5 Demonstrate knowledge of the concerns for and management of tonsil and adenoid surgery, particularly in the pediatric patient

7.5.1 Indications and pre-operative evaluation
  7.5.1.1 Chronic/recurrent upper respiratory tract infection
  7.5.1.2 Pediatric obstructive sleep apnea
  7.5.1.2.1 Adeno-tonsillar hypertrophy

  7.5.1.3 Bleeding dyscrasias
  7.5.1.4 Loose teeth

7.5.2 Procedural considerations
  7.5.2.1 Induction and maintenance technique
  7.5.2.2 ETT, NTT, LMA
  7.5.2.3 Deep extubation vs. awake extubation
  7.5.2.4 Airway toilet
  7.5.2.5 Re-operation for bleeding after adenotonsillectomy
    7.5.2.5.1 Chronology of bleeding
    7.5.2.5.2 Coagulopathy
    7.5.2.5.3 Full stomach
    7.5.2.5.4 Airway difficulty
    7.5.2.5.5 Hemodynamic stability, blood loss

  7.5.2.6 Role of NSAIDs
  7.5.2.7 Postoperative nausea and vomiting and the use of antiemetic agents
F) Major Head and Neck Cancer Surgery

7.6 Demonstrate knowledge of the anesthetic considerations of major head and neck surgery, with appropriate expertise to manage these cases

7.6.1 Patient condition/comorbidities/optimization
   7.6.1.1 Smoking, COPD, alcohol
   7.6.1.2 Elderly, malnutrition
   7.6.1.3 Cardiovascular disease
   7.6.1.4 Prior irradiation, chemotherapy

7.6.2 Airway patency or compromise
   7.6.2.1 Tumour mass effects
   7.6.2.2 Indirect nasopharyngoscopy
   7.6.2.3 Stridor, hoarseness, airway bleeding
   7.6.2.4 Edema, inflammation, fibrosis

7.6.3 Intra-operative management
   7.6.3.1 Consideration for awake tracheotomy
   7.6.3.2 Monitoring
      7.6.3.2.1 Invasive monitoring
      7.6.3.2.2 Post-operative monitoring
      7.6.3.2.3 Nerve identification by surgeon
      7.6.3.2.4 Avoidance of muscle relaxation

7.6.3.3 Case length
   7.6.3.3.1 Temperature control
   7.6.3.3.2 Blood loss considerations

7.6.3.4 Hemodynamic instability
   7.6.3.4.1 Surgical stimulation of carotid sinus, stellate ganglion

7.6.3.5 Free flap considerations
   7.6.3.5.1 Avoidance of vasoconstrictors
   7.6.3.5.2 Temperature control
G) Tracheostomy

7.7 Demonstrate knowledge of the pathological processes necessitating tracheotomy, and provide expert anesthetic management of the patient with or undergoing tracheotomy

7.7.1 Indications for:

7.7.1.1 Emergent tracheotomy for airway obstruction
   7.7.1.1.1 Epiglottitis
   7.7.1.1.2 Upper airway tumours

7.7.1.2 Elective tracheotomy
   7.7.1.2.1 For pulmonary toilet
      7.7.1.2.1.1 Prolonged orotracheal intubation
   7.7.1.2.2 During major head and neck cancer surgery
   7.7.1.2.3 Chronic ventilatory failure

7.7.2 Anesthetic options for emergency tracheostomy
   7.7.2.1 Awake tracheostomy under local anesthetic
   7.7.2.2 General anesthetic
      7.7.2.2.1 Awake fibreoptic intubation
   7.7.2.3 Management of loss of tracheostomy with fresh stoma

7.7.3 Trans-tracheal intubation
   7.7.3.1 Patient with pre-existing tracheal stoma

H) Surgery for Obstructive Sleep Apnea

7.8 Demonstrate knowledge of the pathophysiological changes resulting from obstructive sleep apnea and their implications for perioperative anesthetic management for all types of surgical procedures. The anesthesiologist must be able to provide expert clinical care for the patient with sleep apnea presenting for corrective surgery, with recognition of the following considerations:

7.8.1 Diagnosis of obstructive sleep apnea
   7.8.1.1 Presumptive indicators in patient history and physical exam
   7.8.1.2 Definitive indicators and severity classification from formal sleep studies
7.8.2 Physiological derangements
  7.8.2.1 Cardiopulmonary
    7.8.2.1.1 Ischemic changes, arrhythmias, pulmonary and systemic hypertension

  7.8.2.2 Behavioural
    7.8.2.2.1 Somnolence, cognition

  7.8.2.3 Sensitivity to respiratory depressants

7.8.3 Management of the obstructive sleep apnea patient
  7.8.3.1 Intraoperative
    7.8.3.1.1 Intubation, extubation, and airway management considerations

  7.8.3.2 Post-operative considerations
    7.8.3.2.1 Ongoing need for CPAP or BiPAP mask

I) Ear Surgery

7.9 Demonstrate knowledge of the considerations for various surgeries on the external and internal ear structures and demonstrate expertise in the care of patients presenting for ear surgery

  7.9.1 Anesthetic considerations
    7.9.1.1 Variety of procedures
      7.9.1.1.1 Myringotomy
      7.9.1.1.2 Myringoplasty, tympanoplasty
      7.9.1.1.3 Mastoidectomy

    7.9.1.2 Identification/preservation of facial nerve
      7.9.1.2.1 Monitoring

    7.9.1.3 Nitrous oxide, muscle relaxants

    7.9.1.4 Positioning

    7.9.1.5 Post-operative nausea and vomiting
8 Endocrinology

A) Pancreatic disorders: diabetes mellitus

8.1 Demonstrate knowledge with respect to the types of Diabetes Mellitus, the treatment regimens and anticipated complications. The anesthesiologist must demonstrate an approach to:

8.1.1 The evaluation of the diabetic patient, including the associated complications, and an approach to a treatment plan to obtain adequate metabolic control in the perioperative period

8.1.2 Demonstrate an ability to establish a perioperative preparation protocol in relation to the type and severity of diabetes mellitus and the anticipated surgical procedures

8.1.3 Describe the implications of tight perioperative glucose level control on patient outcome

8.2 Acute problems: Demonstrate knowledge regarding the pathophysiology and management of acute emergencies related to DM including ketoacidosis and hyperosmolar coma

B) Thyroid Dysfunction: Hypo and Hyperthyroidism

8.3 Demonstrate knowledge regarding the pathophysiology and clinical manifestations of hyper and hypo-thyroidism and the effects on anesthetic management. The anesthesiologist must demonstrate an approach to evaluation and management of the patient with thyroid dysfunction including effects of therapy

8.4 Acute problems: Describe the pathophysiology of thyroid storm and myxedema coma, their clinical manifestations and the treatment modalities

C) Parathyroid Dysfunction: Hypo and Hyperparathyroidism

8.5 Demonstrate knowledge with respect to:

8.5.1 The evaluation of parathyroid gland function with respect to calcium metabolism and the treatment modalities used to ensure normocalcemia

8.5.2 The anesthetic considerations of patients with parathyroid dysfunction

8.6 Describe the pathophysiology of hypo and hyper-calcemic states, their clinical manifestations and the treatment of these conditions

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D) Adrenal Dysfunction

8.7 Demonstrate knowledge of the physiology of the adrenal cortex and medulla and the implications of acute and chronic adrenal dysfunction in the perioperative period as manifested by:

8.7.1 Pheochromocytoma: pathophysiology, clinical manifestations, preoperative preparation and perioperative management
8.7.2 Cushing syndrome: Etiology, pathophysiology, clinical manifestations and perioperative management
8.7.3 Adrenal insufficiency: Etiology of primary and secondary Addison’s disease. Preoperative evaluation and management of patients with suppression of the pituitary axis due to long term steroid use
8.7.4 Acute adrenal crisis: Diagnosis and Management

8.8 Manage the patient receiving corticosteroid therapy presenting for anesthesia and surgery

E) Posterior Pituitary Dysfunction: Syndrome of Inappropriate Anti-diuretic Hormone SIADH and Diabetes Insipidus

8.9 Demonstrate knowledge of the normal pituitary function and evaluation of the patient with Posterior pituitary dysfunction including the pathophysiology, differential diagnosis, treatment, and anesthetic considerations of SIADH and diabetes insipidus

F) Anterior Pituitary Dysfunction: Panhypopituitarism and Acromegaly

8.10 Demonstrate knowledge of the pathophysiology, clinical manifestations and treatment of acute and chronic panhypopituitarism. The anesthesiologist must demonstrate an understanding of the pathophysiology, clinical presentation and treatment of the acromegalic patient and must describe the anesthetic considerations for patients with acromegaly

G) Carcinoid Syndrome

8.11 List the clinical manifestations of carcinoid syndrome and the anesthetic considerations arising from them
9  Ethics

A) Upon completion of this training, the anesthesiologist must demonstrate an understanding of ethical principles as they apply to clinical practice:

9.1  Describe the major ethical theories, perspectives and principles
   9.1.1  Theories: deontological, teleological
   9.1.2  Perspectives: duty, virtue, principles, utilitarian/consequentialist, feminist, communitarian
   9.1.3  Principles
   9.1.4  Georgetown four: beneficence, non-maleficence, respect for persons, (autonomy,) justice
   9.1.5  Demonstrate knowledge that there are others: truth-telling, promise-keeping

9.2  Recognize that there are ethical components in decisions doctors need to make every day; ethics is not just found in the “hard choices”

9.3  Demands for inappropriate care/ineffective therapy
   9.3.1  Describe the concept of “futility”; when it may apply, its hazards
   9.3.2  Who decides goals of care?

9.4  End of Life Care
9.5  With-holding vs. withdrawing care (no ethical difference)
9.6  The concept of brain death and its diagnosis
   9.6.1  Organ donation
   9.6.2  DCD: Donation after Cardiac Death

9.7  Demonstrate an understanding of the ethical basis and use of the principle of informed choice
   9.7.1  Consent/Refusal
   9.7.2  Jehovah’s Witnesses

9.8  Describe how to assess capacity, know the regulations and principles governing Substitute Decision Makers (for relevant province)

9.9  Describe the effect of difference in value systems
   9.9.1  Religious, cultural, ethnic
   9.9.2  Have ways to deal with difference
9.10  Recognize and respect Diversity
   9.10.1  Gender, religious, cultural, ethnic, sexual, age, disability (mental & physical)

9.11  Respect privacy & confidentiality and know the difference
   9.11.1  Occasions when confidentiality is commonly at risk
   9.11.2  Occasions when confidentiality is legitimately breached
   9.11.3  Statutory reporting, harm to self & others

9.12  Truth Telling
   9.12.1  Disclosure of diagnosis/Breaking bad news
   9.12.2  Disclosure of error

9.13  The patient with a DNR order coming to the OR
10 Geriatrics

Upon completion of this training, the Anesthesiologist must demonstrate knowledge of the physiologic, pharmacologic and pathologic changes accompanying the aging process. The anesthesiologist must demonstrate knowledge of the impact that these changes have on the safe anesthetic management of the elderly patient.

Goals & Objectives

A) Physiology and Pathophysiology in the Geriatric Patient

10.1 Demonstrate knowledge of the following issues related to the geriatric population compared to non-geriatric adults, including but not limited to:

- Anatomic changes
- Physiologic changes
- Anesthetic considerations

10.1.1 Central Nervous System
10.1.2 Autonomic Nervous System
10.1.3 Cardiovascular System
10.1.4 Respiratory System
10.1.5 Gastrointestinal System
10.1.6 Renal System
10.1.7 Hepatic System
10.1.8 Musculoskeletal
10.1.9 Thermoregulation
10.1.10 Hematologic System Preoperative Evaluation/Assessment of the Geriatric Patient

B) Perioperative management

10.2 Evaluate and prepare the geriatric patient for anesthesia

10.2.1 Comorbidities and the Geriatric Patient

10.2.1.1 Elicit appropriate history and perform physical examination of the elderly patient to identify existing comorbid conditions
10.2.1.2 Obtain appropriate investigations and consultation for optimizing elderly patient prior to surgery
10.2.1.3 Demonstrate knowledge of pre-existing comorbidities of body systems and the impact they have in the safe anesthesia management of the elderly patient
10.2.2  Preoperative Testing
10.2.2.1  Demonstrate appropriate rationale, selection and use of ancillary testing based on planned surgical procedure and patient health status
10.2.2.2  Demonstrate appropriate knowledge in interpretation of diagnostic tests

C) Pharmacology and the Geriatric Patient

10.3  Pharmacodynamics
10.3.1  Demonstrate knowledge of differences in pharmacokinetics in the elderly patient based upon differences in:
   10.3.1.1  Absorption
   10.3.1.2  Distribution
   10.3.1.3  Metabolism
   10.3.1.4  Excretion

10.4  Pharmacokinetics
10.4.1  Describe changes in the pharmacodynamics, pharmacokinetics, rationale for selection and appropriate use of agents routinely used in anesthesia practice, including but not limited to:
   10.4.1.1  Intravenous induction agents
   10.4.1.2  Muscle relaxants
   10.4.1.3  Opioids
   10.4.1.4  Benzodiazepines
   10.4.1.5  Volatile agents including nitrous oxide
   10.4.1.6  Local anesthetics

D) Anesthesia and the Geriatric Patient

10.5  Provide perioperative care for geriatric patients by being able to discuss evidence related to choice of anesthetic technique and post operative outcome in this patient population
10.5.1  General Anesthesia in the Geriatric Patient
   10.5.1.1  Discuss the physiologic effects of general anesthesia in the elderly patient
   10.5.1.2  Discuss indications, contraindications and risks associated with the use of general anesthesia specific to the elderly
   10.5.1.3  Provide safe, competent general anesthesia for all major and minor surgical procedures
10.5.2 Regional Anesthesia in the Geriatric Patient - See Regional (Section 27)

10.5.2.1 Describe the alterations in anatomy, physiology, pharmacology and complications specific to the geriatric patient of the following techniques:

10.5.2.1.1 Epidural Anesthesia
10.5.2.1.2 Spinal Anesthesia
10.5.2.1.3 Head and neck blocks
10.5.2.1.4 Upper extremity blocks
10.5.2.1.5 Lower extremity blocks

E) Perioperative Complications in the Geriatric Patient

10.6 Demonstrate an understanding of the potential complications related to anesthetizing geriatric patients and be able to discuss the:

- Contributing risk factors
- Strategies to minimize risk of complications
- Investigation and management

Of the following conditions:

10.6.1 Post operative cognitive dysfunction/Post operative delirium
10.6.2 Cardiovascular complications
10.6.3 Respiratory complications
10.6.4 Hepatic complications
10.6.5 Renal complications

F) Post Operative Pain Management in the Geriatric Patient

10.7 Provide effective pain management in geriatric patients

10.7.1 Discuss the importance of post operative pain management in this patient population
10.7.2 Discuss risk, benefits and complications of various routes, agents and modalities for delivery of agents for post operative pain management
G) **Post Operative Recovery and the Geriatric Patient**

10.8 Anticipate and manage postoperative recovery of geriatric patients.

10.8.1 Discuss age-related impediments to recovery of preoperative function and independence

10.8.2 Advocate on behalf of patients with respect to postoperative recovery of function and independence
11 Hematology

Upon completion of this training, the competent anesthesiologist must demonstrate knowledge of the following:

A) Physiology of oxygen transport:

11.1 Physiology of oxygen delivery and oxygen consumption
11.2 Physiologic adaptive responses to (euvolemic) anemia
11.3 Impaired oxygen delivery
11.4 Clinical and laboratory indicators of shock
11.5 Understand the concepts of VO2 for tissue metabolic processes, DO2, oxygen, extraction ratio, DO2 crit (critical threshold of oxygen delivery)
11.6 Be able to calculate arterial oxygen content

The anesthesiologist will demonstrate knowledge of the pathophysiology, clinical presentation, laboratory investigation, and perioperative management of patients with the following conditions:

(*In collaboration with a haematologist. In emergency situations, there may not be sufficient time for this collaboration to occur, in which case the consultant anesthesiologist will be expected to manage such patients independently)

B) Hemoglobinopathies

11.7 Methemoglobin, including precipitation by some pharmacologic agents (nitric oxide, nitroglycerine, nitroprusside), and pharmacology of methylene blue
11.8 Sulfhemoglobin
11.9 Carboxyhemoglobin
11.10 Anemias
   11.10.1 Acute blood loss: predict increased risk of acute blood loss, clinical signs of acute blood loss, perioperative management, strategies to minimize blood loss
   11.10.2 Management of the patient who refuses transfusions of blood products
   11.10.3 Chronic blood loss/anemia secondary to deficiency of iron, B12, folic acid
   11.10.4 Anemia of chronic disease, anemia of chronic renal failure, aplastic anemia, anemia associated with liver failure
   11.10.5 Hemolytic anemias, including but not limited to:
      11.10.5.1 Congenital sphherocytosis
      11.10.5.2 G6PD deficiency
      11.10.5.3 Immune haemolytic anemias (e.g. Drug-induced, hypersplenism)
Sickle cell disease, including prevention, end organ complications and pain management

11.10.5.4

Mechanical etiologies (e.g. Mechanical heart valve)

11.10.5.5

Thalassemia

11.10.6

Polycythemia

11.10.6.1 Primary polycythemias

11.10.6.2 Secondary to hypoxemia

C) Physiology of Normal Hemostasis

11.11 Role of vasculature

11.12 Platelets (adhesion, activation, aggregation, and various factors involved with platelet function)

11.13 Protein coagulation factors

11.14 Physiologic mechanisms to limit the coagulation: Antithrombin, Tissue Factor Pathway Inhibitor, Protein C and Protein S, and the fibrinolytic system

11.15 Alterations seen in the normal postoperative period (and the effect on postoperative DVT), normal pregnancy, the newborn, trauma, sepsis, shock and cancer

11.16 Laboratory to assess the coagulation system

11.17 Laboratory monitoring of the various pharmacological agents

11.18 Minimum acceptable levels for laboratory testing to allow for normal surgical hemostasis, provision of spinal and epidural anesthesia (platelet count, factor levels, INR, fibrinogen level)

D) Pharmacology: Anticoagulants/Antifibrinolytics

11.19 Pharmacodynamics (mechanism of action)

11.20 Pharmacokinetics (dose, clinical duration of action, etc.)

11.21 Clinical pharmacology (indications, side effects, complications and contraindications)

11.22 Describe the impact on INR, PTT, TT, fibrinogen level, fibrin degradation products.

11.23 Perioperative use of:

11.23.1 Protamine

11.23.2 Vitamin K

11.23.3 Desmopressin (DDAVP)

11.23.4 Recombinant activated Factor VII (rFVIIa)
11.24 Perioperative management of anticoagulant or antiplatelet agents, including but not limited to:

- 11.24.1 Coumadin
- 11.24.2 Heparin (both unfractioned and low molecular weight)
- 11.24.3 Agents used as alternatives to patients who have a history of heparin induced thrombocytopenia
- 11.24.4 Platelet inhibitors such as cyclooxygenase inhibitors (e.g. ASA, NSAIDS)
- 11.24.5 ADP inhibitors (e.g. Clopidogrel, ticlid)
- 11.24.6 Glycoprotein IIB IIIA inhibitors (e.g. Abciximab)
- 11.24.7 Phosphodiesterase inhibitors (e.g. Persantine)
- 11.24.8 Anti-fibrinolytic agents (e.g. aminocaproic acid, tranexamic acid, aprotinin)

The anesthesiologist will demonstrate knowledge of the pathophysiology, clinical presentation, laboratory investigation, and perioperative management of patients with the following conditions:

(*In collaboration with a haematologist. In emergency situations, there may not be sufficient time for this collaboration to occur, in which case the consultant anesthesiologist will be expected to manage such patients independently)

**E) Disorders of Coagulation**

11.25 Congenital “bleeders”

- 11.25.1 Hemophilia A*
- 11.25.2 Hemophilia B*
- 11.25.3 Von Willebrand’s disease *

11.26 Congenital “clotters”

- 11.26.1 Protein C deficiency *
- 11.26.2 Protein S deficiency *
- 11.26.3 Antithrombin deficiency *
- 11.26.4 Other thrombophilias *

11.27 Acquired “bleeders”

- 11.27.1 Effects of anticoagulant drugs or antiplatelet drugs
- 11.27.2 Dilutional thrombocytopenia or dilution of procoagulants
11.27.3 DIC
11.27.4 Liver disease
11.27.5 Massive blood transfusion (see transfusion medicine)
11.27.6 Hypothermia
11.27.7 Thrombocytopenia due to PIH, drug-induced, ITP, etc.
11.27.8 Effects of extracorporeal circulation
11.27.9 Sepsis

11.28 Acquired “clotters”
11.28.1 Heparin-induced thrombocytopenia *
11.28.2 TTP *
11.28.3 Antiphospholipid Antibody Syndrome *

11.29 Hematologic Emergencies
11.29.1 New diagnosis of acute leukemia (blast crisis) especially acute promyelocytic leukemia
11.29.2 TTP
11.29.3 Hyperviscosity syndrome
11.29.4 Acute thrombosis
11.29.5 Acquired hemophilia

F) Blood Products

11.30 Regarding the following blood products:

- RBC
- Frozen Plasma (FP)
- Prothrombin Complex Concentration (PCC) (Octaplex)
- Platelets
- Cryoprecipitate

The competent anesthesiologist will demonstrate knowledge of the following:

11.30.1 Indications
11.30.2 Physiology
11.30.3 Risks
11.30.4 Benefits
11.30.5  Management of complications, including but not limited to:
  11.30.5.1  Febrile reactions
  11.30.5.2  Allergic reactions
  11.30.5.3  Volume overload
  11.30.5.4  Transfusion-related acute lung injury (TRALI)
  11.30.5.5  Acute and delayed haemolytic reactions
  11.30.5.6  Sepsis
  11.30.5.7  Coagulopathy
  11.30.5.8  Electrolyte disturbances
  11.30.5.9  Hypothermia
  11.30.5.10  Transfusion-associated graft vs. host disease (TA-GVHD)
  11.30.5.11  Immune-related effects
  11.30.5.12  Transfusion-transmitted diseases (hepatitis B and C, HIV etc.)
  11.30.5.13  Effect of age of stored RBC’s
  11.30.5.14  Effect on 2-3 DPG

11.30.6  Associated administration, including but not limited to:
  11.30.6.1  Informed consent
  11.30.6.2  Identification and verification of both the patient and the blood product
  11.30.6.3  Preparation and administration of the blood product (including the safe use of diluents, filters and filter size, blood administration sets, iv cannula size, and blood warmers including rapid infusion devices)
  11.30.6.4  Documentation

G) Blood banking
11.31  Demonstrate a working knowledge of blood bank procedures
  11.31.1  Clerical procedures
  11.31.2  Serologic procedures
    11.31.2.1  Uncrossmatched (emergency release) RBC’s
    11.31.2.2  Type-specific uncrossmatched RBC’s
    11.31.2.3  Computer assisted and serological crossmatches
    11.31.2.4  Type and screen
    11.31.2.5  Frozen plasma
    11.31.2.6  Platelets
H) Reduction of use of Homologous Blood Products:

11.32 Demonstrate a working knowledge of:

11.32.1 Methods used to reduce blood loss
   11.32.1.1 Patient position
   11.32.1.2 Controlled hypotension (including the physiology, indications, contraindications, and technique, including the pharmacologic agent(s) used)
   11.32.1.3 Regional anesthesia
   11.32.1.4 Pharmacologic agents (e.g. antifibrinolytic agents, role of recombinant activated Factor VII (rFVIIa))

11.32.2 Alternatives to blood products and their risks and benefits

11.32.3 Use of crystalloids

11.32.4 Use of colloids
   11.32.4.1 Physiologic effects of colloids in comparison to crystalloids
   11.32.4.2 Understand the crystalloid/colloid controversy
   11.32.4.3 Compare starch vs. albumen

11.32.5 Management the patient (preoperative discussion, intraoperative and postoperative management) who refuses blood products for religious or other reasons

11.32.6 Calculate “allowable blood loss”

11.32.7 Demonstrate a working knowledge of:
   11.32.7.1 Preoperative autologous donation (PAD)
   11.32.7.2 Directed donation
   11.32.7.3 Haemoglobin-based oxygen carriers, and perfluorocarbon emulsions
   11.32.7.4 Erythropoietin therapy
   11.32.7.5 Acute normovolemic hemodilution
   11.32.7.6 Perioperative RBC salvage and autotransfusion (including indications, contraindications, complications and technique)
12 Hepatobiliary

Upon completion of this training, the competent Anesthesiologist must demonstrate knowledge of the anatomy and physiology of the hepatic system

A) Anatomy and physiology of the liver and biliary tract

12.1 Functional anatomy
12.2 Blood supply/control of hepatic blood flow
12.3 Physiologic functions of the liver
   12.3.1 Glucose homeostasis
   12.3.2 Fat metabolism
   12.3.3 Protein synthesis: drug binding/coagulation/ester linkages hydrolysis
   12.3.4 Drug and hormone metabolism
   12.3.5 Bilirubin formation and excretion

12.4 Effect of anesthesia on hepatic function

B) Hepatic Pharmacology

12.5 Demonstrate knowledge of the pharmacology relevant to the hepatic system
   12.5.1 Pharmacokinetics and pharmacodynamics
   12.5.2 Describe the mechanisms of hepatic drug elimination:
      12.5.2.1 Changes in hepatic blood flow
      12.5.2.2 Ability to biotransform (intrinsic clearance)
      12.5.2.3 Changes in binding of drugs; biotransformation
      12.5.2.4 Bile excretion

   12.5.3 Knowledge of altered response to drugs in cirrhotic patient
   12.5.4 Knowledge of possible hepatotoxic drugs

C) Pathophysiology

12.6 Demonstrate knowledge of:
   12.6.1 Postoperative hepatic dysfunction:
      12.6.1.1 Differential diagnosis
      12.6.1.2 Approach to determine etiology
12.6.2 Pre-, intra-, and post-hepatic dysfunction
12.6.3 Halothane hepatitis
12.6.4 Viral Hepatitis
   12.6.4.1 Types
   12.6.4.2 Transmission
   12.6.4.3 Course
   12.6.4.4 Prevention
   12.6.4.5 Hazards to healthcare providers

12.6.5 Other forms of hepatitis and the implications thereof:
   12.6.5.1 Alcoholic
   12.6.5.2 Other drugs/toxins
   12.6.5.3 Infection – non – viral hepatitis
   12.6.5.4 Autoimmune

12.6.6 Liver failure/ End stage liver disease
   12.6.6.1 Etiologies
   12.6.6.2 Child’s classification for preoperative prediction of surgical risk
   12.6.6.3 Complications (systemic review)
   12.6.6.4 Anesthetic management

12.6.7 Anesthetic management for acute or chronic alcoholism
12.6.8 Anesthetic management for a patient with a previous liver transplant

D) Anesthesia for Hepatobiliary Procedures

12.7 Demonstrate knowledge and understanding of anesthesia and the hepatic system. The anesthesiologist must demonstrate knowledge of the pathology that can alter normal hepatobiliary physiology and the non-physiologic insults to which patients might be subjected during hepatobiliary procedures. This will help the anesthesiologist optimize preoperative preparation, intra-operative anesthetic management and post-anesthetic care of these patients

12.8 Demonstrate knowledge of the considerations of, and to independently provide anesthetic care for patients presenting for, the following procedures:
   12.8.1 Cholecystectomy: open and laparoscopic
   12.8.2 Endoscopic biliary tract procedures
   12.8.3 Pancreatic resection
12.8.4 Biliary duct reconstruction
12.8.5 Whipples’ procedure
12.8.6 Liver resections
12.8.7 Liver donation
12.8.8 T.I.P.S. procedure
12.8.9 Liver transplant
13 Immunology and Rheumatology

A) Physiology

13.1 Demonstrate knowledge of the basic physiology of the immune system, including but not limited to:

13.1.1 Cellular immunity, roles of T-lymphocytes (helper T-lymphocytes, suppressor T-lymphocytes, cytotoxic T-lymphocytes
13.1.2 Cell-mediated immunity and its role in rejection of transplanted organs
13.1.3 Autoimmunity diseases
13.1.4 Humoral immunity, role of B-lymphocytes, plasma cells, types of antibodies, antigens, allergens and IgE antibodies
13.1.5 The complement system, the two pathways of activation (classic or immunologic pathway and alternative or non-immunologic pathway), their roles in antigen-antibody activation, autoimmune diseases, and bacterial infections, and the production of C2a and C5a
13.1.6 The four types of hypersensitivity (allergic) responses (type I to type IV reactions)

B) Immunological Diseases

13.2 The anesthesiologist shall, in collaboration with the appropriate consultant (time permitting), manage the patient with the following disorders presenting for surgical or obstetric management:

13.2.1 Hereditary angioedema in C1 esterase inhibitor protein deficiency
13.2.2 Congenital and acquired immunodeficiency states
13.2.3 HIV/ AIDS
13.2.4 Selective IgA deficiency and anaphylaxis associated with blood transfusions
13.2.5 Cold autoimmune diseases: (e.g. cryoglobulinemia, cold Hemagluttin disease, paroxysmal cold hemoglobinuria)
13.2.6 Amyloidosis

C) Autoimmune disease

13.3 The anesthesiologist shall, in collaboration with the appropriate consultant (time permitting), manage the patient with the following autoimmune disorders presenting for surgical or obstetric management. The anesthesiologist shall be well-versed on the anesthetic considerations of the individual autoimmune diseases

13.3.1 Organ-specific autoimmune diseases
13.3.1.1 Type 1 diabetes mellitus
13.3.1.2 Myasthenia gravis
13.3.1.3 Grave’s disease
13.3.1.4 Addison’s disease
13.3.1.5 Autoimmune haemolytic anemia

13.3.2 Systemic autoimmune diseases
13.3.2.1 Rheumatoid arthritis
13.3.2.2 Rheumatic fever
13.3.2.3 Ankylosing spondylitis
13.3.2.4 Systemic lupus erythematosus
13.3.2.5 Scleroderma
13.3.2.6 IgA deficiency
13.3.2.7 Sarcoidosis

D) Pre-existing Allergies

13.4 For the following conditions, the specialist anesthesiologist shall demonstrate an understanding of:

- Pathophysiology
- Clinical manifestations
- Investigation
- Management

13.4.1 Protamine allergy
13.4.2 Latex allergy
13.4.3 Metabisulfite allergy
13.4.4 Volatile agent allergic hepatitis
13.4.5 Transfusion reaction
13.4.6 Intravenous contrast media allergy
13.4.7 Food allergies associated with drug or medical substance allergies
   13.4.7.1 Eggs/ propofol
   13.4.7.2 Banana/ kiwi /latex
   13.4.7.3 Fish/ protamine
   13.4.7.4 Shellfish/ iodine prep
13.4.8 Drug reactions, distinguished from non-allergic adverse drug side effect (drug toxicity from a drug level above a therapeutic range, drug-drug interaction, idiosyncratic non-allergic drug effect (e.g. genetic deficiency of an enzyme)

13.4.8.1 Anaphylaxis
13.4.8.2 Drug-induced release of histamine (anaphylactoid)
13.4.8.3 Activation of the complement system

E) Transplantation: (See Transplantation 33.9)

F) Systemic Inflammatory Response Syndrome (SIRS)

13.5 Demonstrate knowledge of the SIRS and its role in multi-organ failure in the critically-ill patient and assess such patients presenting for surgery

G) Rheumatology/Connective Tissue Disorders

13.6 Demonstrate knowledge of the pathophysiology, clinical presentation, natural history, treatment modalities and multisystemic implications of the connective tissue disorders. The anesthesiologist must demonstrate an understanding of the anesthetic considerations of the following diseases:

13.6.1 Epidermolysis bullosa
13.6.2 Scleroderma
13.6.3 Systemic lupus erythematosus
13.6.4 Rheumatoid arthritis
13.6.5 Ankylosing spondylitis
13.6.6 Marfan syndrome
14 Infectious Diseases

A) Prevention of Infection

14.1 Describe the measures necessary for the prevention of infections, including but not limited to:

14.1.1 Mechanism of transmission of selected infectious diseases; tuberculosis, MRSA, C difficile, viral hepatitis

14.1.2 Isolation measures
   14.1.2.1 Universal precautions
   14.1.2.2 Droplet precautions
   14.1.2.3 Airborne precautions

14.1.3 Effect of tracheal intubation on the development of infectious complications

14.1.4 Aseptic technique

14.1.5 Management of needle stick injuries

B) Infectious Syndromes

14.2 Demonstrate knowledge regarding infectious syndromes, including but not limited to:

14.2.1 Infections syndromes leading to uni or multi-systemic decompensation, including the differential diagnosis and treatment modalities

14.2.2 Participate in the treatment of a patient in septic shock

14.2.3 Infection in the immunocompromised host

14.2.4 Pathophysiology of sepsis and multiorgan failure

14.2.5 Infection in solid organ and marrow transplant patients

14.2.6 Community acquired infection
   14.2.6.1 Community acquired pneumonia
   14.2.6.2 Meningitis and encephalitis
   14.2.6.3 Genitor-urinary sepsis
   14.2.6.4 Intra-abdominal sepsis
      14.2.6.4.1 Perforated viscus
      14.2.6.4.2 Cholecystitis and ascending cholangitis
      14.2.6.4.3 Pancreatitis
      14.2.6.4.4 Spontaneous bacterial peritonitis
14.2.6.5 Soft tissue infection – severe cellulitis and necrotizing fasciitis
14.2.6.6 Head and neck infection
  14.2.6.6.1 Epiglottitis
  14.2.6.6.2 Ludwig’s angina
14.2.6.7 Bacterial endocarditis

14.2.7 Prevention and management of nosocomial infection
  14.2.7.1 Line-related bloodstream infection
  14.2.7.2 Clostridia difficile colitis
  14.2.7.3 Hospital acquired pneumonia

14.2.8 Clostridial myonecrosis
14.2.9 Tetanus
14.2.10 Toxic shock syndrome
14.2.11 Infections with group A streptococci
14.2.12 Herpes zoster (See pain management objectives Section 21)

C) Patients with Immunodeficiency Syndromes
14.3 Demonstrate knowledge of the problems related to, and anesthetic considerations of, immunodeficiency syndromes, including but not limited to:
  14.3.1 AIDS
  14.3.2 Chemotherapy
  14.3.3 Transplantation

D) Antibiotic Prophylaxis
14.4 Demonstrate knowledge of the rationale behind surgical antibiotic prophylaxis for wound infection. The anesthesiologist must demonstrate knowledge of the indications and considerations for the prevention of endocarditis and be able to administer the appropriate doses of the antibiotics indicated

E) Upper Respiratory Tract Infections
14.5 Demonstrate knowledge of the issues related to the management of patients with current or recent upper respiratory tract infections
F) Pharmacology

14.6 Pharmacology, spectrum, and complications of antibacterial, antiviral and antifungal therapy

14.7 Major anti-infectious agents

14.7.1 Indications

14.7.2 Complications related to their use (toxicity, superinfection)

14.7.3 Microbiological techniques used to make adjustment to therapy (dosage, culture)

14.8 Explain the role of the different treatment modalities for the management of a patient with septic shock (support treatment, antibiotics, surgery, protein C, activated, etc.)
15 Monitoring and Equipment

Upon completion of this training, the Anesthesiologist shall demonstrate an understanding of the principles of monitoring as they apply to perioperative care, including knowledge of the CAS guidelines for perioperative monitoring:

A) Monitoring

15.1 Pressure Measurement

15.1.1 Demonstrate knowledge of the principles of measurement, including but not limited to:

15.1.1.1 Principles of Measurement

15.1.1.1.1 Define the various units (joules, kilopascals) commonly used in Anesthesiology

15.1.1.1.2 Describe how most anesthesia monitors measure force (Newton’s 2nd Law)

15.1.1.2 Static Pressure Measurement

15.1.1.2.1 Describe the principle of measuring static columns of fluid (CVP)

15.1.1.2.2 Define 1 atmosphere of pressure

15.1.1.3 Dynamic Pressure Management

15.1.1.3.1 Demonstrate knowledge of how modern pressure transducers work

15.1.1.3.2 Describe the effects of compliance in these systems

15.1.1.3.3 Describe the characteristics of the pressure versus time waveform in clinical practice

15.1.1.4 Signal-Processed Pressure Monitor

15.1.1.4.1 Use a non-invasive blood pressure (NIBP) monitor properly

15.1.1.4.2 Describe how a NIBP cuff works (how systolic, MAP and diastolic pressure are determined)

15.1.1.4.3 Describe the different false readings associated with NIBP

15.2 Flow Measurement

15.2.1 Demonstrate knowledge of the principles behind flow measurement, including but not limited to:

15.2.1.1 Principles of Flow

15.2.1.1.1 Describe the differences between flow and velocity
15.2.1.2 Describe the relationship between pressure and flow

15.2.1.3 Describe the different forces that can act on fluids (gravity, pressure gradient, and viscous force/friction)

15.2.1.4 Demonstrate knowledge of the Bernoulli equation and its relevance in Anesthesiology

15.2.1.5 Demonstrate knowledge of the relevance of the Reynolds number in Anesthesiology

15.2.1.2 Mass/Volume Flow Meters

15.2.1.2.1 Describe how cardiac output is measured using thermodilution and the potential errors associated with it

15.2.1.3 Velocity/Flow Measurements

15.2.1.3.1 Describe how pilot tubes are used in anesthetic monitors

15.2.1.3.2 Describe how a venturi tube works and its relationship to the Bernoulli equation

15.2.1.4 Balance-of-Pressure Flow Meters

15.2.1.4.1 Describe how the Thorpe and Bourdon flowmeters work and their applications in everyday anesthetic practice

15.3 Sound Measurement

15.3.1 Demonstrate knowledge of the principles of sound measurement and its application to monitoring, including but not limited to:

15.3.1.1 Principles of Sound

15.3.1.1.1 Describe how Doppler ultrasound works

15.3.1.1.2 Describe what sound waves are and how they travel

15.3.1.2 Passive – Stethoscope

15.3.1.2.1 Describe how different clinical conditions create different sounds heard using the stethoscope

15.3.1.2.2 Describe the basic components of a stethoscope

15.3.1.3 Active – Echo, Doppler

15.3.1.3.1 Demonstrate knowledge of the principles and physics of TEE

15.3.1.3.2 Demonstrate knowledge of the principles and physics of Doppler
15.3.1.3.3 Describe the principles and features of ultrasound and its use in vascular access and nerve localization

15.4 Electricity
15.4.1 Demonstrate knowledge of the principles of electricity use in monitoring and the principles of electrical safety, including but not limited to:

15.4.1.1 Describe the differences between AC and DC current
15.4.1.2 Demonstrate knowledge of micro and macroshock
15.4.1.3 Demonstrate knowledge of the principles behind electrical isolation in the operating room
15.4.1.4 Demonstrate knowledge of passive electrical examination

15.4.1.4.1 EKG – describe how the EKG senses electrical impulses and the problems processing these signals
15.4.1.4.2 EEG – know that the signal strength is 1/10th of that in an EKG
15.4.1.4.3 BIS (and other monitors of depth of anesthesia)
    15.4.1.4.3.1 Know how a BIS monitor works
    15.4.1.4.3.2 Know how to interpret the BIS index
    15.4.1.4.3.3 Know how the various BIS levels correlate clinically

15.4.1.5 Active Electrical Examination
15.4.1.5.1 Somatosensory Evoked Potentials (SSEPs)
    15.4.1.5.1.1 Know how SSEPs are measured
    15.4.1.5.1.2 Know the clinical uses of SSEPs in the OR
    15.4.1.5.1.3 Know how different anesthetic agents affect measurement of SSEPs

15.4.1.5.2 Motor Evoked Potentials (MEPs)
    15.4.1.5.2.1 Know the uses and limitations of MEPs
    15.4.1.5.2.2 Know how different anesthetic agents effect measurement of MEPs

15.5 Measurement Utilizing Light
15.5.1 Demonstrate knowledge of the principles of light transmission and its’ utility in various forms of monitoring, including but not limited to:

15.5.1.1 Principles of light
    15.5.1.1.1 Demonstrate knowledge of the difference between sound and electromagnetic waves (i.e. different speeds, different propagation waves)
15.5.1.2 Define the Beer-Lambert Law and know how it relates to various anesthetic monitors

15.5.1.3 Demonstrate knowledge of how the different Light Monitors work – Capnometer (mainstream and sidestream), Agent Analyzer Capnometer

15.5.1.3.1 Describe how the Capnometer works

15.5.1.3.2 Know the different wavelengths of light measured

15.5.1.3.3 Describe the different phases in a CO2 waveform and identify clinical correlations in various waveforms

15.5.1.2 Pulse Oximeters function

15.5.1.2.1 Describe the four different species of haemoglobin measured

15.5.1.2.2 Demonstrate knowledge of how fractional haemoglobin saturation is determined

15.5.1.2.3 Describe how the Beer-Lambert equation relates to the pulse oximeter

15.5.1.3 Raman Scattering

15.5.1.3.1 Describe how Raman scattering works

15.5.1.3.2 Describe the difference between Raman scattering and absorption based gas analysis

15.6 Temperature Measurement

15.6.1 Demonstrate knowledge of the principles of temperature measurement, including but not limited to:

15.6.1.1 Principles of Temperature

15.6.1.1.1 Define specific heat and a calorie

15.6.1.2 Temperature Monitors

15.6.1.2.1 Describe the three techniques for measuring temperature

15.6.1.2.2 Describe the three electrical techniques for measuring temperature:

15.6.1.2.2.1 Resistance Thermometer

15.6.1.2.2.2 Thermistor

15.6.1.2.2.3 Thermocouple
15.7 Neuromuscular Monitors

15.7.1 Demonstrate knowledge of the principles of monitoring of the neuromuscular system, including but not limited to:

15.7.1.1 Describe how a peripheral nerve stimulator works

15.7.1.2 Describe the different patterns of nerve stimulation

15.7.1.2.1 Single twitch

15.7.1.2.2 Train of Four (TOF)

15.7.1.2.3 Tetanic

15.7.1.2.4 Post Tetanic

15.7.1.2.5 Double burst stimulation (DBS)

15.8 Cardiovascular Monitors

15.8.1 Demonstrate knowledge of the monitoring of the cardiovascular system, including but not limited to:

15.8.1.1 Electrocardiography

15.8.1.2 Monitoring arterial blood pressure

15.8.1.2.1 Non-invasive blood pressure monitoring

15.8.1.2.2 Invasive arterial blood pressure monitoring

15.8.1.2.2.1 Sites of cannulation

15.8.1.2.2.2 Indications, contraindications

15.8.1.2.2.3 Complications

15.8.1.2.2.4 Insertion technique

15.8.1.2.2.5 Function of the catheter – transducer system and sources of error

15.8.1.3 Monitoring central venous pressure

15.8.1.3.1 Principles of sterile technique and prevention of line-related blood stream infections

15.8.1.3.2 Complications and principles of safe insertion technique

15.8.1.3.3 Sites of cannulation

15.8.1.3.4 Ultrasound guided insertion technique

15.8.1.3.5 Physiology of central venous pressure monitoring and sources of error

15.8.1.3.6 Waveform analysis
15.8.1.4 Pulmonary artery catheter insertion and monitoring

15.8.1.4.1 Indications and contraindications

15.8.1.4.2 Insertion technique

15.8.1.4.3 Sources of error and principles of trouble shooting

15.8.1.4.4 Principles of monitoring cardiac output, pulmonary artery pressure, pulmonary artery occlusion pressure and calculation of work indices and vascular resistance

15.8.1.4.5 Waveform analysis

15.8.1.4.6 Estimation of fluid responsiveness: Systolic pressure variation and transthoracic thermodilution

15.8.1.4.7 Continuous mixed venous oximetry

15.8.1.5 Echocardiography

15.8.1.5.1 Indications for, strengths and limitations of transthoracic and transesophageal echocardiography

B) Equipment

15.9 Inhaled Anesthetic Delivery Systems

15.9.1 Demonstrate knowledge of the principles behind the functionality of vaporizers and gas delivery systems

15.9.1.1 Gas delivery systems

15.9.1.1.1 Storage and delivery of anesthetic gases via pipelines and cylinders

15.9.1.1.2 Anesthesia breathing circuits

15.9.1.2 Gas laws

15.9.1.2.1 Boyle’s law, Charles’ Law, Henry’s Law, Graham’s law of diffusion, Dalton’s law of partial pressures

15.9.1.2.2 Partial pressure

15.9.1.2.3 Blood / gas solubility

15.9.1.3 Anesthetic Machine

15.9.1.3.1 Demonstrate in depth knowledge of the anesthetic machines:

15.9.1.3.1.1 Demonstrate knowledge about the safety features of the anesthetic machine

15.9.1.3.1.2 Describe the CSA/ASA standards for anesthetic machines
15.9.1.3.1.3 Pipeline and Cylinder gas supply
15.9.1.3.1.4 Pressure failure mechanisms
15.9.1.3.1.5 Flow meter and proportioning systems
15.9.1.3.1.6 Breathing circuits
  15.9.1.3.1.6.1 Bain
  15.9.1.3.1.6.2 Circle

15.9.1.3.1.7 Vaporizers
15.9.1.3.1.8 CO2 absorption
15.9.1.3.1.9 Anesthesia ventilators
15.9.1.3.1.10 Scavenger systems
15.9.1.3.1.11 Low-flow anesthesia
15.9.1.3.1.12 Perform a complete pre-use check of the machine

15.10 Equipment Cleaning and Sterilization
  15.10.1 Demonstrate knowledge of the methods of cleaning and sterilizing equipment and the advantages and limitations of these methods

15.11 Lasers
  15.11.1 Demonstrate knowledge of the principles of the physics of laser use
    15.11.1.1 Describe the three ways that laser light is different than ordinary light
      15.11.1.1.1 Monochromatic
      15.11.1.1.2 Coherent
      15.11.1.1.3 Collimated
    15.11.1.2 Describe the essential components in a laser
    15.11.1.3 Demonstrate knowledge about the different lasers available in the OR
      15.11.1.3.1 CO2
      15.11.1.3.2 Argon
      15.11.1.3.3 Krypton
      15.11.1.3.4 Holmium
      15.11.1.3.5 Nd:YAG
    15.11.1.4 Describe the potential hazards of lasers in the OR and how to
protect against them

15.11.1.5 Describe the Airway Fire Protocol

15.12 Ultrasound Machines

15.12.1 Demonstrate knowledge of the principles of ultrasound technology

15.12.1.1 Ultrasound Principles

15.12.1.1.1 Describe the principles of US
15.12.1.1.2 Describe how M-mode and Two-dimensional Echocardiography work

15.12.1.2 TEE

15.12.1.2.1 Describe the design and the basic waveforms seen with a TEE
15.12.1.2.2 List the indications, limitations and complications of use

15.12.1.3 Regional Ultrasound

15.12.1.3.1 Describe the basic structures seen with ultrasound and identify nerves
16 Neurology/ Neurosurgical Anesthesiology

Upon completion of this training, the Anesthesiologist shall demonstrate proficiency in all of the objectives listed below

A) Basic Science

16.1 Demonstrate knowledge and an understanding of the anatomic, physiologic, and pharmacologic principles that are unique to the neurosurgical patient, including but not limited to:

16.1.1 Anatomy
   16.1.1.1 Basic anatomy of the central nervous system, including the spinal cord and meninges
   16.1.1.2 Anatomy of the Circle of Willis
   16.1.1.3 Vascular supply to the spinal cord
   16.1.1.4 Cellular anatomy of the blood brain barrier

16.1.2 Physiology
   16.1.2.1 Cerebral blood flow
   16.1.2.2 Determinants of cerebral perfusion pressure
   16.1.2.3 Cerebral metabolic rate for oxygen
   16.1.2.4 Cerebral pressure autoregulation
   16.1.2.5 Carbon dioxide reactivity
   16.1.2.6 Response to hypoxia
   16.1.2.7 Flow metabolism coupling
   16.1.2.8 Production, flow and re-absorption of cerebral spinal fluid
   16.1.2.9 Effects of hypo and hyperthermia

16.1.3 Pharmacology
   16.1.3.1 Direct and indirect effects of intravenous and inhaled anesthetic agents on cerebral physiology
   16.1.3.2 Basic principles of neuroprotection and neuroresuscitation
   16.1.3.3 Mechanism of action of osmotic diuretics
   16.1.3.4 Prevention and treatment of vasospasm
   16.1.3.5 Controlled hypo- and hypertension
   16.1.3.6 Anesthetic consideration of anticonvulsants
B) Neurological diseases

16.2 Demonstrate the ability to independently provide anesthesia care for:

16.2.1 Patients with increased intracranial pressure at risk of hemiation
   16.2.1.1 Supratentorial tumors
   16.2.1.2 Posterior fossa tumors

16.2.2 Patients with traumatic neurological diseases
   16.2.2.1 Spinal cord injury
      16.2.2.1.1 Cervical: unstable cervical spine
      16.2.2.1.2 Thoracic: autonomic hyperreflexia
      16.2.2.1.3 Lumbar

   16.2.2.2 Traumatic Brain Injury

16.2.3 Patients with cerebrovascular diseases
   16.2.3.1 Carotid stenosis
   16.2.3.2 Stroke
      16.2.3.2.1 Embolic
      16.2.3.2.2 Hemorrhagic

   16.2.3.3 Intracranial aneurysms
   16.2.3.4 Arteriovenous malformations
   16.2.3.5 Cerebral hyperperfusion

16.2.4 Patients with common neurological disorders
   16.2.4.1 Parkinson’s disease
   16.2.4.2 Multiple Sclerosis

16.2.5 Patients with common non-traumatic disorders of the spine
   16.2.5.1 Cervical or lumbar disc herniation
   16.2.5.2 Spinal stenosis
   16.2.5.3 Spondylopatheis, including Ankylosing spondylitis

16.2.6 Patients with neuroendocrine disorders
   16.2.6.1 Hypopituitarism
16.2.6.2 Hyperpituitarism
16.2.6.3 Diabetes Insipidus
16.2.6.4 Syndrome of inappropriate ADH secretion
16.2.6.5 Cerebral salt wasting syndrome

16.2.7 Patients with congenital neurological diseases
16.2.7.1 Cerebral Palsy
16.2.7.2 Meningomyeloceole
16.2.7.3 Chiari Malformations
16.2.7.4 Dandy-Walker complex
16.2.7.5 Craniosynostosis
16.2.7.6 Tethered spinal cord

C) Anesthesia for Neurosurgical Procedures

16.3 Surgical procedures
16.3.1 Demonstrate knowledge of the implications of, and provide anesthetic care for neurosurgical patients presenting with the following conditions:

16.3.1.1 Intracranial Masses
  16.3.1.1.1 Supratentorial tumour resection
  16.3.1.1.2 Posterior fossa tumour resection
  16.3.1.1.3 Pituitary tumour resection

16.3.1.2 Traumatic Brain Injury
  16.3.1.2.1 Evacuation of subdural hematoma, acute vs. chronic
  16.3.1.2.2 Evacuation of epidural hematoma
  16.3.1.2.3 Evacuation of intracranial hemorrhage
  16.3.1.2.4 Decompressive craniectomy

16.3.1.3 Intra and Extracranial Vascular disease
  16.3.1.3.1 Intracranial aneurysm clipping
  16.3.1.3.2 Intracranial Arteriovenous malformation resection
  16.3.1.3.3 Carotid endarterectomy

16.3.1.4 Hydrocephalus
  16.3.1.4.1 Ventriculoperitoneal or atrial shunt placement
16.3.1.4.2 External ventricular drain placement

16.3.1.5 Epilepsy
16.3.1.5.1 Epilepsy surgery
16.3.1.5.2 Awake craniotomy

16.3.1.6 Interventional Neuroradiology
16.3.1.6.1 Intracranial aneurysm coiling
16.3.1.6.2 Arteriovenous malformation embolization
16.3.1.6.3 Carotid artery stenting

16.3.1.7 Surgery of the Spine
16.3.1.7.1 Laminectomy/Disectomy/Decompression
16.3.1.7.2 Spinal instrumentation/fusion
16.3.1.7.3 Spinal cord tumour resection

16.3.1.8 Pediatric Neurosurgery
16.3.1.8.1 Surgery for meningomyelocele
16.3.1.8.2 Craniectomy for craniosynostosis
16.3.1.8.3 Untetherineg of spinal cord

16.4 Perioperative Management
16.4.1 Management of neurosurgical anesthesia emergencies
16.4.1.1 Acute increase in intracranial pressure
16.4.1.2 Venous air embolism
16.4.1.3 Intraoperative aneurysm rupture
16.4.1.4 Seizure
16.4.1.5 Postoperative failure to awaken

16.4.2 Management of fluid therapy in the neurosurgical patient
16.4.3 Patients requiring intraoperative neurological monitoring
16.4.3.1 Electroencephalography, including bispectral analysis
16.4.3.2 Somatosensory Evoked Potentials
16.4.3.3 Motor evoked potentials
16.4.3.4 Wake up test
17 Neuromuscular Junction

Upon completion of this training, the competent Anesthesiologist shall demonstrate in depth knowledge of the neuromuscular junction and its’ relevance in anesthesia:

A) Neuromuscular Junction physiology

17.1 Demonstrate an ability to:
   17.1.1 Describe a synapse: the motor neuron and the muscle fiber
   17.1.2 Describe the nerve action potential
   17.1.3 Describe the formation of neurotransmitters at the motor nerve ending
      17.1.3.1 Acetylcholine synthesis
      17.1.3.2 Storage
      17.1.3.3 Release
      17.1.3.4 Recycling
   17.1.4 Explain acetylcholinesterase action
   17.1.5 Describe a postjunctonal receptor
   17.1.6 Explain how a postjunctonal receptor works
   17.1.7 Explain the effects of the prejunctonal receptor on nerve transmission
   17.1.8 Explain the quantal theory at the neuromuscular junction
   17.1.9 Describe the action potential across nerve membrane, including sodium and calcium channels

B) Pharmacology of Muscle Relaxants

17.2 Demonstrate an ability to:
   17.2.1 Explain the action of neuromuscular relaxants, nondepolarizing and depolarizing, on prejunctonal and postjunctonal receptors
   17.2.2 Explain a desensitization block
   17.2.3 Explain how certain drugs can affect neuromuscular relaxants effects
      17.2.3.1 Volatile agents
      17.2.3.2 Antibiotics
      17.2.3.3 Calcium
      17.2.3.4 Local anesthetics
      17.2.3.5 Antiepileptics
      17.2.3.6 Diuretics
      17.2.3.7 Channel blocks and other effects
17.2.4 Pharmacology of succinylcholine
   17.2.4.1 Pharmacokinetics and pharmacodynamics
   17.2.4.2 Indications
   17.2.4.3 Contraindications
   17.2.4.4 Butyrylcholinesterase activity and reversal of succinylcholine
   17.2.4.5 Drug interactions and adverse effects

17.2.5 Pharmacology of non-depolarizing neuromuscular blocking agents
   17.2.5.1 Pharmacokinetics and pharmacodynamics
   17.2.5.2 Potency
   17.2.5.3 Metabolism and elimination
   17.2.5.4 Clinical management and dosage
   17.2.5.5 Drug interactions and adverse effects
   17.2.5.6 Indications
   17.2.5.7 Contraindications

C) Prejunctional, Immature and Extrajunctional Receptors

17.3 Describe the “fade” phenomenon with neuromuscular relaxants through a prejunctional effect, and the effect of different neuromuscular relaxants on that phenomenon

17.4 Explain how immature and extrajunctional receptors form, and the effects of depolarizing neuromuscular relaxants on such receptors

17.5 Describe the myopathy following long term administration of neuromuscular relaxants during critical illness

D) Neuromuscular Reversal

17.6 Demonstrate in depth knowledge of the reversal of neuromuscular blockade
   17.6.1 Explain how antagonists of neuromuscular block works
      17.6.1.1 Neostigmine
      17.6.1.2 Pyridostigmine
      17.6.1.3 Edrophonium
      17.6.1.4 Suggamadex®
17.6.2 Explain the role of anticholinergic drugs in neuromuscular reversal
   17.6.2.1 Atropine
   17.6.2.2 Glycopyrrolate

17.6.3 Describe the effects of neuromuscular relaxants on the autonomic nervous system
17.6.4 Explain the influence of neuromuscular diseases on neuromuscular relaxants effects
17.6.5 Explain the influence of age, obesity on neuromuscular relaxants effects
17.6.6 Describe the determinants of speed and adequacy of reversal of neuromuscular blockers
17.6.7 Describe the side effects of anticholinesterase agents

E) Monitoring Neuromuscular Blockade
17.7 Demonstrate the ability to monitor blockade of the neuromuscular junction
   17.7.1 Peripheral nerve stimulation – patterns used
   17.7.2 Assessment of complete/adequate reversal
   17.7.3 Clinical indications of reversal

F) Pathology
17.8 Demonstrate knowledge of the pathophysiology, clinical presentation, classification, and perioperative management of patients with the following conditions:
   17.8.1 Myasthenia Gravis
   17.8.2 Eaton-Lambert syndrome
18 Obstetrical Anesthesia

General Issues

Upon completion of this training, the competent Anesthesiologist must demonstrate the ability to function as part of a team with obstetricians, nursing staff, nurse midwives, neonatologists and pediatricians to provide optimal medical, obstetric, and anesthetic care for parturients and their fetuses/neonates.

A) Maternal Physiology

18.1 Demonstrate knowledge of:

18.1.1 Maternal physiology: time course and changes during gestation
   18.1.1.1 Cardiovascular adaptations to pregnancy
   18.1.1.2 Pulmonary, respiratory, and airway changes
   18.1.1.3 Gastrointestinal, hematologic, and renal changes
   18.1.1.4 Central nervous system changes

18.1.2 Minimum Alveolar Concentration MAC and local anesthetic adjustments during pregnancy

18.1.3 Approach to CPR in parturient, awareness of need for delivery of baby

B) Fetal and Placental Physiology

18.2 Demonstrate knowledge of:

18.2.1 Placental development, structure and inability to auto regulate placental flow
18.2.2 Placental gas exchange, nutrient transport, drug transfer
18.2.3 Antenatal fetal evaluation (growth, fluid, position, biophysical profile)
18.2.4 Fetal circulation
18.2.5 Fetal and neonatal effects of maternally administered anesthetic drugs
18.2.6 Fetal adaptations to hypoxia
18.2.7 Fetal heart rate patterns during labour and their response to hypoxia or asphyxia
18.2.8 Impact on fetus of drop in maternal cardiac output
18.2.9 Interpret fetal heart rate patterns during labour
C) Neonatal Physiology

18.3 Demonstrate knowledge of:
18.3.1 Intrapartum fetal resuscitation
18.3.2 Neonatal physiologic adaptations to extrauterine life
18.3.3 Resuscitation of the newborn – NRP protocol
18.3.4 Predict the likelihood of need for resuscitation
18.3.5 Recognize the neonate needing resuscitation
18.3.6 Initiate resuscitation of a neonate

D) Obstetric Management of Labour

18.4 Demonstrate knowledge of:
18.4.1 Physiology of labour and the smooth muscle of the uterus
18.4.2 The stages of labour and typical duration
18.4.3 Effect of uterine contractions on placental exchange and fetal oxygenation
18.4.4 Indications for analgesia during labour
18.4.5 Effect of analgesia on labour and delivery
18.4.6 Effect on labour of maternal hydration, position, hyperventilation, hypotension
18.4.7 Recognition and management of uterine hypertonus or hyperstimulation
18.4.8 Commonly used drugs in obstetrics including indications, contraindications, classification, and therapeutic uses and side effects of:
18.4.8.1 Oxytocin, carbitocin
18.4.8.2 Ergotamine
18.4.8.3 Prostaglandins, hemabate
18.4.8.4 Magnesium sulphate
18.4.8.5 Uterine relaxants
18.4.8.6 Magnesium sulphate
18.4.8.7 Nitroglycerine

E) Labour Analgesia and Anesthesia

18.5 Anatomy and physiology of labour pain
18.5.1 Describe the pain pathways for stages of labour
18.5.2 Describe the anatomy of spinal and epidural space
Labour analgesia - See also Regional anesthesia (27.1, 27.5)

18.6.1 Demonstrate knowledge and discuss the following:

- Indications
- Contraindications
- Mechanism of action
- Pharmacokinetics/ pharmacodynamics
- Maternal Side effects
- Fetal effects
- Effects on Uterine blood flow
- Complications
- Management of complications

For the following analgesic options:

- 18.6.1.1 Non-pharmacologic options
- 18.6.1.2 Opioids – IV, IM, SC, IV PCA
- 18.6.1.3 Inhaled N2O
- 18.6.1.4 Neuraxial opioids (Intrathecal and epidural)
- 18.6.1.5 Spinal-single shot
- 18.6.1.6 Combined spinal/ epidural
- 18.6.1.7 Continuous spinal catheter technique
- 18.6.1.8 Epidural Local anesthetics
- 18.6.1.9 Pudendal and paracervical blocks

F) Anesthesia for Obstetrical surgery

18.7 Demonstrate knowledge and discuss:

- Indications
- Contraindications
- Mechanism of action
- Pharmacokinetics/ pharmacodynamics
- Maternal Side effects
- Fetal effects
- Effects on Uterine blood flow
- Complications
- Management of complications
For the following anesthetic options:

18.7.1  Regional Anesthesia for Cesarean Section
   18.7.1.1  Spinal
   18.7.1.2  Epidural
   18.7.1.3  Conversion of labour analgesia epidural for anesthesia
   18.7.1.4  Combined spinal-epidural

18.7.2  General Anesthesia for Cesarean Section
   18.7.2.1  Indications for general endotracheal anesthesia
   18.7.2.2  Risks for morbidity and mortality associated with general anesthetic (GA) in parturient
   18.7.2.3  Ventilatory requirements of parturients
   18.7.2.4  Drug choices and doses for induction and maintenance for caesarean or operative delivery
   18.7.2.5  Impact on the fetus of the induction to delivery and uterine incision to delivery time intervals
   18.7.2.6  Appropriate pre-op assessment of the parturient for GA
   18.7.2.7  Physiologic changes of pregnancy impacting on GA management
   18.7.2.8  Demonstrate knowledge of how to:
      18.7.2.8.1  Develop and execute a plan for general endotracheal anesthesia based on the physiologic and physical changes of pregnancy
      18.7.2.8.2  Perform a rapid sequence induction
      18.7.2.8.3  Recognize and outline management of a difficult airway based on physical examination
      18.7.2.8.4  Outline a failed intubation plan
      18.7.2.8.5  Outline a plan for postoperative management of patient following GA
      18.7.2.8.6  Recognize pulmonary aspiration of gastric contents and outline a plan for the PACU and postoperative care of a patient who has aspirated
   18.7.2.9  Inherent maternal anesthetic risk of urgent or emergent delivery
   18.7.2.10 Surgical and anesthetic management of bleeding during delivery, including drug therapy, surgical manoeuvres, transfusion therapy

18.7.3  Anesthesia for other obstetric surgery
   18.7.3.1  Retained placenta
18.7.3.2 Double set-up
18.7.3.3 Postpartum tubal ligation
18.7.3.4 Insertion/ removal of suture for cervical incompetence

18.7.4 Post Operative Pain Control
18.7.4.1 Demonstrate knowledge of:
   18.7.4.1.1 The various components of multimodal analgesic techniques used after caesarean or vaginal delivery. These include the use of:
      18.7.4.1.1.1 Neuraxial opioids
      18.7.4.1.1.2 Parenteral opioids
      18.7.4.1.1.3 Non-steroidal anti-inflammatory drugs
      18.7.4.1.1.4 Adjunctive drugs
      18.7.4.1.1.5 Local anesthetics
   18.7.4.1.2 Transfer of drugs into breast milk and the effects on the neonate

18.7.4.2 Demonstrate an ability to:
   18.7.4.2.1 Recognize and manage inadequate postpartum analgesia
   18.7.4.2.2 Provide appropriate post operative pain management
   18.7.4.2.3 Recognize and treat side effects of postoperative pain modalities used

G) Obstetrical complications and their management
18.8 Demonstrate knowledge of:
   18.8.1 The management of maternal ante – or postpartum hemorrhage
      18.8.1.1 Uterine rupture
      18.8.1.2 Abruption or atony
      18.8.1.3 Placenta previa or accrete
      18.8.1.4 Retained placenta

   18.8.2 The treatment for maternal embolic events
   18.8.3 Amniotic fluid
      18.8.3.1 Air
      18.8.3.2 Thrombus
18.8.4 Management of fetal emergencies – prolapsed vasa previa
18.8.5 Management of intra-uterine fetal death

H) Medical diseases during pregnancy and their peri-operative management

18.9 Demonstrate knowledge of:
- How the disease impacts on pregnancy
- How pregnancy impacts on the disease
- The obstetric implications and management of the disease

For the following diseases:

18.9.1 Hypertensive disorders of pregnancy
  18.9.1.1 Classification of hypertensive disorders during pregnancy
  18.9.1.2 Epidemiology of preeclampsia – risk factors
  18.9.1.3 Pathophysiology of preeclampsia as a multisystem disease
  18.9.1.4 Medical/obstetric management of preeclampsia
    18.9.1.4.1 Term vs. preterm fetus
    18.9.1.4.2 Mild vs. severe diseases
    18.9.1.4.3 Assessment of fetal well being
    18.9.1.4.4 Seizure prophylaxis and management; magnesium sulphate effects
    18.9.1.4.5 Antihypertensive therapy
    18.9.1.4.6 Management of oliguria
    18.9.1.4.7 Indications for invasive monitoring
  18.9.1.5 Anesthetic selection for and management of the preeclamptic parturient
    18.9.1.5.1 Labour and vaginal delivery
    18.9.1.5.2 Abdominal delivery – non-urgent
    18.9.1.5.3 Abdominal delivery – urgent

18.9.2 Morbid obesity
  18.9.2.1 The anesthetic considerations for morbidly obese parturient
  18.9.2.2 The use of regional anesthesia in morbidly obese patients
  18.9.2.3 The management of general anesthesia in obese patients
18.9.3 Respiratory disease knowledge
18.9.3.1 Asthma
18.9.3.2 ARDS

18.9.4 Cardiac disease knowledge
18.9.4.1 Demonstrate an understanding of when invasive monitors are needed for delivery and postpartum care
18.9.4.2 Demonstrate an understanding of the pathophysiology and management of parturients with:
   18.9.4.2.1 Congenital heart disease
   18.9.4.2.1.1 Left to right shunt
   18.9.4.2.1.2 Right to left shunts (Tetrology of Fallot)
   18.9.4.2.1.3 Pulmonary hypertension (Eisenmenger’s Syndrome)
   18.9.4.2.1.4 Coarctation of aorta

18.9.4.3 IIdiopathic Hypertrophic Subaortic Sclerosis IHSS/ Hypertrophic Obstructive Cardiomyopathy (HOCM)
18.9.4.4 Ischemic heart disease
18.9.4.5 Valvular heart disease
   18.9.4.5.1 Aortic stenosis
   18.9.4.5.2 Aortic insufficiency
   18.9.4.5.3 Mitral stenosis
   18.9.4.5.4 Mitral regurgitation

18.9.4.6 Peripartum cardiomyopathy

18.9.5 Endocrine disease
18.9.5.1 Demonstrate knowledge of diabetes mellitus
18.9.5.2 Demonstrate knowledge of thyroid disease
   18.9.5.2.1 Hyperthyroidism
   18.9.5.2.2 Hypothyroidism

18.9.5.3 Describe the impact of these conditions on the pregnancy and vice versa
18.9.5.4 Pheochromocytoma
18.9.5.5 Manage glucose control in the parturient during caesarean or vaginal delivery

18.9.6 Hematologic and coagulation disorders
   18.9.6.1 Demonstrate knowledge of anemias
   18.9.6.2 Demonstrate knowledge of coagulation disorders
   18.9.6.3 Demonstrate knowledge of the guidelines concerning regional anesthesia and anticoagulation

18.9.7 Miscellaneous disorders
   18.9.7.1 Renal disease
   18.9.7.2 Liver disease
   18.9.7.3 Musculoskeletal disorders
   18.9.7.4 Scoliosis
   18.9.7.5 Rheumatoid arthritis
   18.9.7.6 Spina bifida cystica
   18.9.7.7 Autoimmune disorders
   18.9.7.8 Prior back surgery including Harrington rod placement

I) Anesthetic management of non-obstetric surgery during pregnancy
   18.10 Demonstrate an understanding of considerations for elective surgery during pregnancy
   18.11 Discuss potential teratogenicity of medications
   18.12 Demonstrate an understanding of considerations for trauma or emergency surgery during pregnancy
   18.13 Demonstrate an understanding of when fetal monitoring is needed during maternal surgery
   18.14 Physiology of pregnancy as it might impact cardiovascular, respiratory and transfusion decisions during surgery
   18.15 Discuss risks of elective surgery with patients and colleagues

J) Ethical issues
   18.16 Demonstrate awareness of potential for maternal-fetal conflicts of interest
      18.16.1 General anesthesia for stat caesarean delivery in face of perceived fetal jeopardy

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18.17 Demonstrate respect for all moral and religious points of view
   18.17.1 Jehovah Witness patient

18.18 Demonstrate awareness of fetal development and current limits of viability
18.19 Recognize own ethical attitudes versus patient’s moral concerns
18.20 Demonstrate willingness to arrange for non-prejudicial transfer of care, if necessary
18.21 Recognize need for timely consultation on difficult moral and legal issues

**K) Morbidity and mortality**

18.22 Discuss major causes of morbidity and mortality in pregnant patients
18.23 Discuss anesthesia related morbidity and mortality in pregnant patients

**L) Ultrasound**

18.24 Describe the physics of ultrasound used in medical practice
18.25 Describe the relevant ultrasound anatomy of the neuraxis
18.26 Perform ultrasound examination of the neuraxis for regional techniques
18.27 Perform regional techniques under ultrasound guidance
19 Ophthalmology

Upon completion of this training, the Anesthesiologist shall demonstrate knowledge of the relevant anatomy and physiology of the eye

A) Anatomy and Physiology

19.1 Demonstrate an ability to:

19.1.1 Describe the anatomy of the eye including chambers, relevant blood supply and innervation

19.1.1.1 Describe the occulo-cardiac reflex (OCR) including determinants that predispose patients, and intraoperative management of the OCR

19.1.2 Describe the determinants of intra-ocular pressure (IOP) and factors that influence it

19.1.3 Describe the pathophysiology of glaucoma

B) Anesthetic Considerations

19.2 Demonstrate an ability to independently provide anesthesia for patients undergoing ophthalmic surgery with respect to:

19.2.1 Preoperative Evaluation

19.2.1.1 Identify the common medical conditions associated with patients having ocular surgery

19.2.2 Pharmacologic Interventions

19.2.2.1 Describe the drugs commonly used in ophthalmologic patients including mydriatics, miotics, and topical and systemic drugs used to decrease IOP

19.2.2.2 Describe the systemic effects of the aforementioned medications

19.2.2.3 Describe the ocular effects of systemic medications

19.2.3 Effects of Anesthesia on IOP or Retinal Perfusion

19.2.3.1 Describe the perioperative factors that will increase or decrease IOP and influence retinal perfusion

19.2.4 Anesthetic Technique

19.2.4.1 IV sedation

19.2.4.1.1 Identify the drugs used to provide sedation and the side effects and complications associated with those drugs
19.2.4.2  Topical anesthesia
   19.2.4.2.1  Describe the local anesthetics commonly used to provide topical anesthesia to the eye

19.2.4.3  Regional anesthesia
   19.2.4.3.1  Describe retrobulbar and peri-bulbar blocks. Know the indications and contra-indications for these blocks
   19.2.4.3.2  Describe the complications including globe perforation, optic nerve damage, hemorrhage and total spinal associated with these blocks and the management thereof

19.2.4.4  General anesthesia
   19.2.4.4.1  Describe the issues surrounding limited access to the airway, the importance of smooth induction and emergence
   19.2.4.4.2  Demonstrate an understanding of the significance of Ketamine, nitrous oxide, and succinylcholine on the eye

19.2.5  Post Operative Nausea and Vomiting Prophylaxis
   19.2.5.1  Appreciate the importance of PONV prophylaxis in eye surgery

C) Specific Eye Surgery

19.3  Demonstrate an understanding of the concerns for specific surgical procedures and an ability to provide anesthetic management for:
   19.3.1  Open eye injury / ruptured globe
   19.3.2  Strabismus repair
   19.3.3  Retinal detachment surgery
   19.3.4  Retinal surgery for vitreous hemorrhage
       19.3.4.1  Know the significance of the intravitreous gas bubble
   19.3.5  Cataract surgery
   19.3.6  Oculoplastics
       19.3.6.1  Blephoraplasty
       19.3.6.2  Dacrocystorhinostomy (DCR)
       19.3.6.3  Ptosis repair
       19.3.6.4  Orbital reconstruction
19.3.7  Corneal transplant
19.3.8  Removal of foreign body
19.3.9  Conjunctival – pterygium
19.3.10 Laser surgery
19.3.11 Enucleation of the eye
20 Orthopedic Surgery

Upon completion of this training, the Anesthesiologist must demonstrate knowledge of the issues related to providing anesthetic care for patients undergoing orthopedic surgery with respect to:

A) General considerations:

20.1 Preoperative Assessment
20.2 Co-morbid medical conditions
20.3 Associated chronic pain
20.4 Use of anti-coagulants
20.5 Local, Regional or General
20.6 Positioning
20.7 Tourniquet
20.8 Cement – Methyl methacrylate
20.9 Fat embolism, PE
20.10 DVT prophylaxis
20.11 Infection
20.12 Compartment syndrome
20.13 Blood loss – transfusion sparing techniques, cell save, etc.
20.14 Multi-modal analgesia

B) Limb Fractures

20.15 Provide anesthetic care for patients with fractures taking into account the following concerns:

20.15.1 Urgent vs. emergent
20.15.2 Open vs. closed fractures
20.15.3 Compound vs. simple
20.15.4 Neurovascular compromise
20.15.5 Compartment syndrome
20.15.6 Hemorrhage
C) Joint Replacements

20.16 Provide anesthetic care for patients presenting for joint replacement taking into account the following concerns:

20.16.1 Age, Co-morbidities
   20.16.1.1 RA
   20.16.1.2 OA
   20.16.1.3 AS

20.16.2 Chronic pain

20.16.3 Positioning
   20.16.3.1 Beach chair
   20.16.3.2 Lateral

20.16.4 Tourniquet

20.16.5 Cement

20.16.6 Blood loss

20.16.7 Post op pain, regional techniques

20.16.8 Rehabilitation, mobilization, physiotherapy

20.16.9 Anti-coagulation

D) Tendon/Ligament Reconstruction

20.17 Provide anesthetic care for patients presenting for tendon/ligament reconstruction

E) Spine

20.18 Principles of Anesthesiology for spinal decompression/ stabilization surgery

20.18.1 Demonstrate an understanding of the concerns related to spinal surgery with respect to:

   20.18.1.1 Spinal cord anatomy and physiology
   20.18.1.2 Stable vs. Unstable
   20.18.1.3 Emergency vs. Elective
   20.18.1.4 Instrumentation
   20.18.1.5 Spinal shock
   20.18.1.6 Spinal cord compromise
   20.18.1.6.1 Protection
20.18.1.6.2 Precautions
20.18.1.6.3 Awake positioning

20.18.1.7 Spinal cord monitoring
  20.18.1.7.1 SSEP
  20.18.1.7.2 Wake up tests

20.18.1.8 Post operative neurological assessment
20.18.1.9 Considerations of dural tear
20.18.1.10 Prolonged OR
20.18.1.11 Post-operative respiratory function
20.18.1.12 Implications of surgery on different levels of the spine:
  20.18.1.12.1 C-spine
    20.18.1.12.1.1 Unstable vs. stable c-spine
    20.18.1.12.1.2 Anterior and posterior approach
    20.18.1.12.1.3 Airway management, Shared airway
    20.18.1.12.1.4 Lack of access
    20.18.1.12.1.5 Awake positioning
  20.18.1.12.2 T-spine
    20.18.1.12.2.1 One lung ventilation
    20.18.1.12.2.2 Blood loss
    20.18.1.12.2.3 Embolism
    20.18.1.12.2.4 Autonomic hyper-reflexia
  20.18.1.12.3 L-spine
    20.18.1.12.3.1 Implications of prone position
    20.18.1.12.3.2 Disc/laminectomy
    20.18.1.12.3.3 Spine decompression +/- fusion
    20.18.1.12.3.4 Implications of bone graft/coral graft
20.19 Scoliosis Surgery

20.19.1 Provide anesthetic care for patients presenting for scoliosis surgery with respect to:

20.19.1.1 Pre-op assessment
  20.19.1.1.1 Pediatric vs. adult
  20.19.1.1.2 Co-morbidities (MS, CP etc.)

20.19.1.2 Respiratory function
20.19.1.3 Cardiovascular function
20.19.1.4 Anesthetic management
20.19.1.5 Prone positioning
20.19.1.6 Blood loss
20.19.1.7 VAE

20.20 Spinal Cord Tumours

20.20.1 Demonstrate an understanding of the concerns related to spinal cord tumours with respect to:

20.20.1.1 Blood loss
20.20.1.2 Neurological compromise
20.20.1.3 Primary vs. metastases – radiation, chemotherapy etc.

F) Pelvic Surgery

20.21 Demonstrate an understanding of the concerns related to pelvic surgery with respect to:

20.21.1 Urgent vs. Emergent
20.21.2 Major trauma and associated injuries
20.21.3 Blood loss
20.21.4 Prolonged procedure

G) Ambulatory Orthopedics

20.22 Demonstrate an understanding of the concerns related to ambulatory surgery with respect to:

20.22.1 Arthroscopic surgery
20.22.2 Pain management
  20.22.2.1 Regional anesthetic techniques
  20.22.2.2 Ambulatory plexus techniques
H) Pediatric Orthopedics

20.23 Demonstrate an understanding of the concerns related to pediatric patients with respect to:

- 20.23.1 Considerations of pediatric patients
- 20.23.2 Emergent vs. elective
- 20.23.3 Co-morbid conditions
- 20.23.4 Congenital conditions
- 20.23.5 Prolonged surgery
- 20.23.6 Temperature regulation
21 Pain Management

A) Acute Pain

Upon completion of this training, the Anesthesiologist shall demonstrate an understanding of the anatomy and physiology, and an approach to management, of acute pain.

The subspecialist in Acute Pain Management shall demonstrate proficiency in all of the above plus these additional specific objectives. A competent Anesthesiologist shall demonstrate knowledge of the principles of these objectives, but not be expected to perform these objectives.

21.1 Anatomy and Physiology of Pain

21.1.1 Demonstrate knowledge of the anatomy and physiology of acute pain:

21.1.1.1 Pain Pathways
- 21.1.1.1.1 Describe the structure of nerve fibers that contribute to pain
- 21.1.1.1.2 Describe the gross anatomic pathways at the peripheral, spinal, brainstem, thalamic and cortical levels that are involved in the perception of pain

21.1.1.2 Pain Transduction
- 21.1.1.2.1 List and describe the function of the major neuromodulators involved in the perception of pain at each anatomic level
- 21.1.1.2.2 Explain the mechanisms involved in central and peripheral sensitization
- 21.1.1.2.3 Describe the role and mechanism of mediators of inflammation in the pain process
- 21.1.1.2.4 Describe the role and mechanism of gene expression in the pain process

21.1.1.3 Neuroendocrine Stress Response
- 21.1.1.3.1 Describe the systems affected by the stress response, and the overall impact on each of those systems
- 21.1.1.3.2 Describe the extent to which the stress response is modified by analgesia, the theoretical effect of such modification on surgical outcomes, and the extent to which the modification of stress response has been shown to affect outcomes

21.1.1.4 Neuropsychological
- 21.1.1.4.1 Describe the affective and functional aspects of the pain experience and incorporate them into an analgesic plan
21.2 Assessment of Pain

21.2.1 Demonstrate knowledge of the methods used for assessment of acute pain:

21.2.1.1 Objective vs. Subjective

21.2.1.1.1 Explain the relevance of objective assessment relative to patient self-reports, and create useful assessment plans based on these principles

21.2.1.2 Characterization of Pain

21.2.1.2.1 Assess the relative contributions of somatic, inflammatory, functional and neuropathic processes in a given patient’s pain problem

21.2.1.3 Pain Rating Scales

21.2.1.3.1 Describe the visual analog scale (VAS), numeric, verbal and FACES rating scales, including their relative advantages and disadvantages, and apply them in clinical practice

21.3 Analgesic Interventions

21.3.1 Demonstrate knowledge of the various approaches to acute pain management and ability to provide effective management of acute pain

21.3.1.1 Multimodal and Regional Analgesia

21.3.1.1.1 Describe the multimodal approach to analgesia, including its benefits and limitations

21.3.1.1.2 Advocate with other disciplines to create effective policies for multimodal therapies

21.3.1.1.3 Describe the relative merits of different co-analgesics and select an appropriate co-analgesic regimen to improve analgesia and minimize risk or side effects

21.3.1.1.4 Identify common impediments to analgesia and modify therapy appropriately

21.3.1.1.5 Discuss the advantages, disadvantages, indications, contraindications and complications of the regional techniques listed in the above section as they apply to acute pain management

21.3.1.2 Systemic Pharmacological Interventions

21.3.1.3 General Analgesic Pharmacology

21.3.1.3.1 Describe and utilize the pharmacokinetics and analgesic therapies taking into account the characteristics of specific agents and routes of administration
Discuss the use of intrathecal/epidural administration of opioids and adjuncts

Identify patients with special pharmacokinetic and pharmacodynamics characteristics and modify therapy appropriately

21.3.1.4 Patient-Controlled Analgesia PCA

21.3.1.4.1 Describe the pharmacokinetic rationale behind Patient Controlled Analgesia (PCA)

21.3.1.4.2 List and manage the potential risks for PCA

21.3.1.4.3 Devise appropriate management protocols for PCA

21.3.1.4.4 Prescribe PCA appropriately

21.3.1.4.5 Utilize different routes for PCA-intravenous, subcutaneous, Epidural, oral

21.3.1.4.6 Describe the agents which may be used for PCA

21.4 Analgesic Agents

21.4.1 Demonstrate knowledge and an ability to use the various groups of analgesics available for management of acute pain and be able to describe the various analgesics according to the properties of each agent, including but not limited to:

- Describe the indications, contraindications, advantages and disadvantages of the agents including issues specific to all routes of administration
- List the systemic effects of each agent
- Identify and minimize the complications and side effects
- Contrast the pharmacokinetic and dynamic characteristics of different agents
- Select the appropriate dose, and route of administration for each agent

21.4.1.1 Opioids

21.4.1.1.1 Describe the mechanism of action of opioids

21.4.1.1.2 Describe the types of opioid receptors with reference to their functions and distribution in the body

21.4.1.1.3 Develop protocols and policies to govern the administration of opioids in the perioperative setting

21.4.1.2 NSAIDs

21.4.1.2.1 Describe the mechanism of action of NSAIDs

21.4.1.2.2 Develop protocols and policies to govern the administration of NSAIDs in the perioperative setting
21.4.1.3 Acetaminophen
21.4.1.3.1 Describe the mechanism of action of acetaminophen
21.4.1.3.2 Develop protocols and policies to govern the administration of acetaminophen in the perioperative setting

21.4.1.4 Topical Analgesics
21.4.1.4.1 Identify appropriate situations and agents for topical analgesia
21.4.1.4.2 Discuss the relative advantages and disadvantages of this route with specific reference to the agent and the situation
21.4.1.4.3 Prescribe topical opioids appropriately
21.4.1.4.4 Describe the indications, contraindications and rationale for the use of other topical analgesics
21.4.1.4.5 Describe the use of topical agents to a patient

21.4.1.5 NMDA Antagonists
21.4.1.5.1 Contrast the pharmacokinetic and pharmacodynamics characteristics of NMDA antagonists
21.4.1.5.2 Describe the mechanism of action of NMDA antagonists
21.4.1.5.3 Develop protocols and policies to govern the administration of NMDA antagonists in the perioperative setting

21.4.1.6 Anticonvulsants
21.4.1.6.1 Describe the indications, contraindications, advantages and disadvantages of anticonvulsants in acute pain management
21.4.1.6.2 Describe the analgesic mechanism of action and anticonvulsants
21.4.1.6.3 Develop protocols and policies to govern the administration of anticonvulsants in the perioperative setting

21.4.1.7 Alpha-Agonists
21.4.1.7.1 Describe the mechanism of action of alpha-agonists
21.4.1.7.2 Develop protocols and policies to govern the administration of Alpha-agonists in the perioperative setting
21.4.1.7.3 Select the appropriate agent, dose, and route of administration for acute pain management in the spectrum of patients and procedures
21.4.1.8 Antidepressants

21.4.1.8.1 Describe the mechanisms of action of Antidepressants with respect to acute pain management

21.4.1.8.2 Develop protocols and policies to govern the administration of antidepressants in the perioperative setting

21.4.1.8.3 Select the appropriate agent, does, and route of administration for acute pain management in the spectrum of patients and procedures relevant to his/her level of training

21.4.1.9 Tramadol

21.4.1.9.1 Identify and minimize related complications and side effects

21.4.1.9.2 Describe the mechanism of action of Tramadol

21.4.1.10 Cannabinoids

21.4.1.10.1 Describe the indications, contraindications, advantages and disadvantages of cannabinoids including issues specific to all relevant routes of administration

21.4.1.10.2 Describe the types of cannabinoids available (THC/synthetic THC analogue/THC/CBD & marijuana)

21.4.1.10.3 List the systemic effects of cannabinoids including variations specific to particular routes of administration

21.4.1.10.4 Identify and minimize related complications and side effects

21.4.1.10.5 Describe the mechanism of action of cannabinoids with respect to analgesia

21.4.1.10.6 Develop protocols and policies to govern the administration of cannabinoids in the perioperative setting

21.5 Non-Pharmacologic Interventions

21.5.1 Demonstrate an understanding and ability to use/prescribe non-pharmacologic interventions for the management of acute pain

21.5.1.1 Recognize the importance of non-pharmacologic factors in analgesia

21.5.1.2 Support allied health professional in provision of non-pharmacologic interventions

21.5.1.3 Trans-cutaneous electrical nerve stimulation TENS

21.5.1.3.1 Explains the theoretical mechanism of TENS in analgesia

21.5.1.3.2 Discuss the efficacy of TENS in acute pain management

21.5.1.3.3 Coordinate access to TENS as a non-pharmacologic adjunct in appropriate situations
21.6  Outcomes of Acute Pain Management

21.6.1  Demonstrate knowledge of the outcomes relevant to the various modalities of analgesia used for management of acute pain

21.6.1.1  Outcomes

21.6.1.1.1  Discuss the extent to which analgesia may contribute to patient outcomes, and the mechanisms for such contribution

21.6.1.1.2  Design analgesia plans that optimize recovery for patients

21.6.1.1.3  Advocate with other disciplines to implement appropriate multimodal recovery plans

21.6.1.2  Addiction, Tolerance and Substance Abuse

21.6.1.2.1  Identify and distinguish between tolerance, dependence and addiction

21.6.1.2.2  Identify the special physiological, psychological, pharmacokinetic and pharmacodynamics issues in the tolerant or abusing patient

21.6.1.2.3  Recognize addictive behaviour and warning signs of substance abuse

21.6.1.2.4  Educate allied health and other medical professional to the risks and appropriate management of tolerance and addiction in relation to acute analgesic therapy

21.6.1.2.5  Describe the biopsychosocial aspects of substance abuse and its interaction with analgesic therapy

21.6.1.2.6  Generate an appropriate acute pain plan in cooperation with the patient setting realistic analgesic and functional goals

21.6.1.2.7  Recognize and treat opioid withdrawal

B) Chronic Pain

The Anesthesiologist shall demonstrate an understanding of the anatomy and physiology and an approach to management of chronic pain

21.7  Anatomy and physiology of pain

21.7.1  Demonstrate knowledge of the anatomy and physiology of the development and management of chronic pain, including but not limited to:

21.7.1.1  Pain Pathways

21.7.1.1.1  Describe the structure of nerve fibers that contribute to pain

21.7.1.1.2  Describe the gross anatomic pathways at the peripheral, spinal, brainstem, thalamic and cortical levels that are involved in the perception of pain

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21.7.1.2 Pain Transduction

21.7.1.2.1 List and describe the function of the major neuromodulators involved in the perception of pain at each anatomic level

21.7.1.2.2 Explain the mechanisms involved in central and peripheral, spinal, brainstem, thalamic and cortical levels that are involved in the perception of pain

21.7.1.3 Neuroendocrine Stress Response

21.7.1.3.1 Describe the systems affected by the stress response, and the overall impact on each of those systems

21.7.1.3.2 Describe the specific changes within each of the affected systems that lead to the overall functional impact on those systems

21.7.1.3.3 Describe the extent to which the stress response is modified by analgesia, the theoretical effect such modification on surgical outcomes, and the extent to which the modification of stress response has been shown to affect outcomes

21.8 Assessment of pain

21.8.1 Demonstrate knowledge of the methods used for assessment of chronic pain, including but not limited to:

21.8.1.1 Objective vs. Subjective

21.8.1.1.1 Delineate between nociceptive (somatic and visceral) and neuropathic

21.8.1.1.2 Explain the relevance of objective assessment relative to patient self-reports, and create useful assessment plans based on these principles

21.8.1.1.3 Assess the relative contributions of somatic, inflammatory, functional and neuropathic processes in a given patient’s pain problem

21.8.1.1.4 Perform a comprehensive assessment of the patient in pain, including functional and psychosocial impacts

21.8.1.1.5 Interpret the results of multidimensional pain indices, and compare the clinical utility of different instruments

21.8.1.2 Pain Rating Scales

21.8.1.2.1 Describe the VAS, numeric, verbal and FACES rating scales, including their relative advantages and disadvantages, and apply them in clinical practice
21.9 Analgesia, outcomes, and goals of therapy

21.9.1 Rehabilitative and Functional Outcomes
- 21.9.1.1 Describe the affective and functional aspects of the pain experience and incorporate them into an analgesic plan
- 21.9.1.2 Generate an appropriate plan in cooperation with the patient setting realistic analgesic and functional goals
- 21.9.1.3 Coordinate a multidisciplinary pain management plan, making appropriate use of allied health professionals and resources

21.9.2 Tolerance, Addiction and Substance Abuse
- 21.9.2.1 Identify and distinguish between tolerance, dependence and addiction
- 21.9.2.2 Identify the special physiological, psychological, pharmacokinetic and pharmacodynamics issues in the tolerant or abusing patient
- 21.9.2.3 Recognize addictive behaviour and warning signs of substance abuse
- 21.9.2.4 Educate allied health and other medical professional to the risks and appropriate management of tolerance and addiction in relation to chronic analgesic therapy
- 21.9.2.5 Describe the biopsychosocial aspects of substance abuse and its interaction with chronic analgesic therapy
- 21.9.2.6 Generate an appropriate comprehensive long-term plan in cooperation with the patient setting realistic analgesic and functional goals

21.10 Analgesic Interventions

21.10.1 Demonstrate knowledge of the various approaches to chronic pain management and ability to provide effective management of chronic pain

21.10.1.1 Multimodal and Regional Analgesia
- 21.10.1.1.1 Describe the multimodal approach to analgesia, including its benefits and limitations
- 21.10.1.1.2 Advocate with other disciplines to create effective policies for multimodal therapies
- 21.10.1.1.3 Describe the relative merits of different co-analgesics
- 21.10.1.1.4 Select an appropriate co-analgesic regimen to improve analgesia and minimize risk or side effects in a spectrum of patients
- 21.10.1.1.5 Identify common impediments to analgesia and modify therapy appropriately
- 21.10.1.1.6 Discuss the advantages, disadvantages, indications,
contraindications and complications of the regional techniques as they apply to chronic pain management

21.10.1.1.7 Identify and manage complications and adverse effects of regional analgesic techniques in an ambulatory chronic pain population

21.10.1.2 Pharmacologic Interventions

21.10.1.2.1 General Analgesic Pharmacology

21.10.1.2.1.1 Describe and utilize the pharmacokinetics of analgesic therapies taking into account the characteristics of specific agents and the relative advantages and disadvantages of multiple routes of administration

21.10.1.2.1.2 Predict the differences in effect expected with oral, rectal, transcutaneous, IM, IV, and SC administration of analgesic agents and modify therapy to utilize these routes appropriately

21.10.1.2.1.3 Identify patients with special pharmacokinetic and dynamic characteristics and modify therapy appropriately

21.10.1.2.1.4 Collaborate with hospital pharmacists and allied health professionals to implement policies that take into account the relative advantages and disadvantages of different routes of administration

21.10.1.2.2 PCA

21.10.1.2.2.1 Describe the pharmacokinetic rationale behind PCA

21.10.1.2.2.2 List and manage the potential risks of PCA

21.10.1.2.2.3 Devise appropriate management protocols for PCA

21.10.1.2.2.4 Prescribe PCA appropriately

21.10.1.2.2.5 Diagnose and address common complications

21.10.1.2.2.6 Utilize different routes for PCA-IV, SC, Epidural, oral

21.10.1.2.2.7 Utilize different agents or combinations for PCA, and provide a rationale based on advantages and disadvantages
21.11 Analgesic agents

21.11.1 Demonstrate knowledge and an ability to use the various groups of analgesics available for management of acute pain and be able to describe the various analgesics according to the properties of each agent, including but not limited to:

- Describe the indications, contraindications, advantages and disadvantages of the agents including issues specific to all routes of administration
- List the systemic effects of each agent
- Identify and minimize the complications and side effects
- Contrast the pharmacokinetic and dynamic characteristics of different agents
- Select the appropriate dose, and route of administration for each agent

21.11.1.1 Topical Analgesics

21.11.1.1.1 Identify appropriate situations and agents for topical analgesia

21.11.1.1.2 Discuss the relative advantages and disadvantages of this route with specific reference to the agent and the situation

21.11.1.1.3 Prescribe topical opioids appropriately

21.11.1.1.4 Describe the indications, contraindications and rationale for the use of other topical analgesics

21.11.1.1.5 Describe the use of topical agents to a patient

21.11.1.2 Opioids

21.11.1.2.1 Describe the mechanism of action of opioids

21.11.1.2.2 Describe the types of opioid receptors with reference to their functions and distribution in the body

21.11.1.2.3 Develop protocols and policies to govern the administration of opioids in the perioperative setting

21.11.1.2.4 Intrathecal/epidural route

21.11.1.2.5 Mechanisms to avoid/reverse opioid tolerance (opioid rotation; use of antagonists etc.)

21.11.1.2.6 Detoxification protocols (slow vs. rapid detox)

21.11.1.2.7 Discuss opioid conversions – equipotency; iv:po conversions

21.11.1.2.8 Methadone

21.11.1.3 NSAIDs

21.11.1.3.1 Describe the mechanism of action of NSAIDs

21.11.1.3.2 Develop protocols and policies to govern the administration of NSAIDs in the chronic pain setting

21.11.1.3.3 NSAIDs vs. Cox-2
21.11.1.4 **Acetaminophen**

- 21.11.1.4.1 Describe the mechanism of action of Acetaminophen
- 21.11.1.4.2 Develop protocols and policies to govern the administration of acetaminophen in the chronic pain setting

21.11.1.5 **NMDA Antagonists**

- 21.11.1.5.1 Describe the mechanism of action of NMDA antagonists
- 21.11.1.5.2 Describe the role of excitatory amino acids in pain and sensitization
- 21.11.1.5.3 Develop protocols and policies to govern the administration of NMDA antagonists in the chronic pain setting
- 21.11.1.5.4 Methadone in chronic pain – titration protocol; mechanism of action; conversion; ways of administering: methadone license

21.11.1.6 **Anticonvulsants**

- 21.11.1.6.1 Describe the analgesic mechanism of action of anticonvulsants
- 21.11.1.6.2 Develop protocols and policies to govern the administration of anticonvulsants in the perioperative setting
- 21.11.1.6.3 IV lidocaine therapy

21.11.1.7 **Alpha-agonists**

- 21.11.1.7.1 Describe the mechanism of action of Alpha-agonists
- 21.11.1.7.2 Develop protocols and policies to govern the administration of Alpha-agonists in the chronic pain setting

21.11.1.8 **Antidepressants**

- 21.11.1.8.1 Describe the mechanisms of action antidepressants with respect to analgesia
- 21.11.1.8.2 Develop protocols and policies to govern the administration of antidepressants in the chronic pain setting

21.11.1.9 **Tramadol**

- 21.11.1.9.1 Identify and minimize related complications and side effects
- 21.11.1.9.2 Describe the mechanism of action of Tramadol

21.11.1.10 **Cannabinoids**

- 21.11.1.10.1 Describe the indications, contraindications, advantages and
disadvantages of cannabinoids including issues specific to all relevant routes of administration

21.11.1.10.2 List the systemic effects of cannabinoids including variations specific to particular routes of administration

21.11.1.10.3 Identify and minimize related complications and side effects

21.11.1.10.4 Describe the mechanism of action of cannabinoids with respect to analgesia

21.11.1.10.5 Develop protocols and policies to govern the administration of cannabinoids in the perioperative setting

21.12 Non-Pharmacologic Interventions

21.12.1 Demonstrate knowledge and ability to use/prescribe non-pharmacologic interventions for the management of acute pain

21.12.2 Recognize the importance of non-pharmacologic factors in analgesia

21.12.3 Support allied health professional in provision of non-pharmacologic interventions TENS and acupuncture

21.12.4 Explain the theoretical mechanism of TENS in analgesia

21.12.5 Discuss the efficacy of TENS in chronic pain management

21.12.6 Coordinate access to TENS as a non-pharmacologic adjunct in appropriate situations

21.12.6.1 Other Non-Pharmacologic Interventions

21.12.6.1.1 Use of Biofeedback

21.12.6.1.2 Chiropractic interventions

21.12.6.1.3 Massage

21.12.6.1.4 Physiotherapy – ultrasound/interferential/TENS etc.

21.12.6.2 Spinal Cord and Peripheral Nerve Stimulation

21.12.6.2.1 Identify clinical situations in which stimulation may be of benefit

21.12.6.2.2 Describe the purported mechanism of action of stimulation

21.12.6.2.3 Coordinate access to stimulation for appropriate patients

21.12.6.2.4 Discuss the relative advantages, disadvantages, indications and contraindications of stimulation for chronic pain

21.12.6.2.5 Identify complications of implanted stimulators

21.12.6.2.6 Demonstrate an understanding of the use of Intrathecal pumps/spinal & epidural catheters

21.12.6.2.7 Common drugs – opioids/baclofen/LA/clonidine/ketamine

21.12.6.2.8 How to titrate/wean po/iv drugs in this situation
22 Pediatric Anesthesia

A) Basic Science

Upon completion of this training, the competent Anesthesiologist must demonstrate knowledge and an understanding of the anatomic, physiologic, psychological and pharmacological features which are unique to the pediatric population including the maturation process which takes place in all systems.

22.1 Anatomy/ Physiology

22.1.1 Demonstrate knowledge of:

22.1.1.1 The Respiratory System

22.1.1.1.1 Anatomic features of the neonatal, infant, pediatric and adolescent airway

22.1.1.1.2 The physiology of the respiratory system and its’ maturation over time with respect to

22.1.1.1.2.1 Control of respiration

22.1.1.1.2.2 Compliance

22.1.1.1.2.3 Lung volumes

22.1.1.1.2.4 Oxygen consumption/metabolic rate

22.1.1.1.2.5 Normal values for different stages of development

22.1.1.1.2.6 Pediatric basic and advanced life support

22.1.1.2 The Cardiovascular System

22.1.1.2.1 The anatomy and physiology relevant to the transitional circulation

22.1.1.2.2 Maturation of the myocardium and the autonomic nervous system

22.1.1.2.3 Normal values for different stages of development

22.1.1.2.4 Pediatric basic and advanced life support

22.1.1.3 The Central Nervous System

22.1.1.3.1 Anatomy – size, fontanelles

22.1.1.3.2 Physiology – Intracranial pressure and volume, cerebral blood flow, autoregulation

22.1.1.4 The Genitourinary System

22.1.1.4.1 Renal maturation

22.1.1.4.2 Fluid and electrolyte management
22.1.1.4.3 Fluid distribution
22.1.1.4.4 Maintenance requirements
22.1.1.4.5 Hydration

22.1.1.5 The Gastrointestinal/Hepatic System
22.1.1.5.1 Feeding, fasting guidelines
22.1.1.5.2 Glucose control
22.1.1.5.3 Maturation of hepatic function

22.1.1.6 Thermoregulation
22.1.1.6.1 Body surface area
22.1.1.6.2 Ability to thermoregulate
22.1.1.6.3 Heat loss

22.1.1.7 Psychological Issues
22.1.1.7.1 Anxiety and understanding and coping mechanism in different age groups and premedication
22.1.1.7.2 Separation, effects of hospitalization
22.1.1.7.3 Parental anxiety
22.1.1.7.4 Consent in the pediatric population

22.2 Pharmacology
22.2.1 Demonstrate an understanding of the variations in drug handling in infants and children as a result of differences in

22.2.1.1 Pharmacokinetics/ pharmacodynamics
22.2.1.1.1 Absorption
22.2.1.1.2 Volume of distribution
22.2.1.1.3 Protein binding
22.2.1.1.4 Pharmacokinetics/Pharmacodynamics
22.2.1.1.5 Metabolism
22.2.1.1.6 Clearance
22.2.1.1.7 Excretion
22.2.1.1.8 Toxicity
B) Pain Management

22.3 Demonstrate knowledge of options for perioperative analgesia and the indications, contraindications, advantages and disadvantages of each modality in the pediatric population, including but not limited to:

22.3.1 Systemic analgesia
22.3.2 Local infiltration
22.3.3 Regional nerve blocks
22.3.4 Neuraxial analgesia

22.4 Demonstrate competence in ordering continuous opioid infusions, PCA and epidural orders
22.5 Demonstrate competence in performing single shot caudal blocks
22.6 Demonstrate knowledge of age-specific equipment

C) Coexisting Diseases in Pediatric Patients

22.7 The Anesthesiologist must demonstrate the ability to independently provide anesthetic care for:

22.7.1 Full term infants, former preterm infants, children and adolescents presenting for common surgical procedures

22.7.2 Children with cardiovascular diseases
   22.7.2.1 ASD, VSD, PDA
   22.7.2.2 Postoperative repaired simple lesions
   22.7.2.3 Cardiomyopathies
   22.7.2.4 Heart transplant recipients
   22.7.2.5 Demonstrate an understanding of the anesthetic management of very premature infants

22.7.3 Pediatric patients with respiratory diseases
   22.7.3.1 Upper respiratory tract infections
   22.7.3.2 Asthma, including management of status asthmaticus
   22.7.3.3 Cystic Fibrosis
   22.7.3.4 Chronic Lung Disease
   22.7.3.5 Stridor
22.7.4 Patients with diseases of the gastrointestinal tract
   22.7.4.1 Hepatobiliary disease
   22.7.4.2 Gastroesophageal reflux
   22.7.4.3 Feeding disorders

22.7.5 Patients with Neuromuscular diseases
   22.7.5.1 Hydrocephalus
   22.7.5.2 Spina bifida
   22.7.5.3 Cerebral palsy
   22.7.5.4 Seizure disorders, including management of status epilepticus
   22.7.5.5 Duchenne’s Muscular Dystrophy
   22.7.5.6 Myotonic Dystrophy
   22.7.5.7 Developmental delay

22.7.6 Patients with Infectious diseases
   22.7.6.1 Septic shock
   22.7.6.2 Communicable diseases
      22.7.6.2.1 HIV
      22.7.6.2.2 Hepatitis
      22.7.6.2.3 TB

22.7.7 Patients with Endocrine/metabolic diseases
   22.7.7.1 Diabetes
   22.7.7.2 Thyroid diseases
   22.7.7.3 Mucopolysaccharidoses
   22.7.7.4 Obesity
   22.7.7.5 Mitochondrial diseases

22.7.8 Patients with Hematologic diseases/malignancies
   22.7.8.1 Anemias including Sickle cell disease, Thalassemia
   22.7.8.2 Bleeding disorders: hemophilia, Von Willebrand’s disease
   22.7.8.3 Others: ITP, leukemia
   22.7.8.4 Malignancies
   22.7.8.5 Mediastinal masses
22.7.9 Psychological
   22.7.9.1 Perioperative anxiety in pediatric patients presenting for multiple types of surgery

22.7.10 Children with more common syndromes
   22.7.10.1 Down’s syndrome
   22.7.10.2 Mental retardation
   22.7.10.3 Malignant hyperthermia syndrome
   22.7.10.4 Pierre Robin Sequence, Crouzon syndrome, Goldenhar syndrome, Treacher Collins syndrome etc.
   22.7.10.5 Epidermolysis Bullosa

D) Anesthesia for Surgical Procedures

22.8 The Anesthesiologist must be able to demonstrate understanding of the implications of, and to independently provide anesthetic care for children presenting for:

22.8.1 Neonatal/Infant Surgery
   22.8.1.1 Pyloromyotomy
   22.8.1.2 Inguinal hernia repair
   22.8.1.3 Laparotomy

22.8.2 Demonstrate and understanding of the principles of anesthetic management for:
   22.8.2.1 Tracheo-esophageal fistula repair
   22.8.2.2 Omphalocoele
   22.8.2.3 Gastrochisis
   22.8.2.4 Necrotizing enterocolitis
   22.8.2.5 Congenital diaphragmatic hernia

22.8.3 General Surgery
   22.8.3.1 Emergency surgery and the implications thereof:
      22.8.3.1.1 Full stomach
      22.8.3.1.2 Evaluation and Resuscitation
      22.8.3.1.3 Fluid and electrolytes
      22.8.3.1.4 Trauma surgery
      22.8.3.1.5 Laparoscopic surgery
22.8.3.1.6 Antireflux surgery
22.8.3.1.7 Cholecystectomy/splenectomy

22.8.3.2 Demonstrate and understanding of the principles of anesthetic management for:
22.8.3.2.1 Liver transplant surgery
22.8.3.2.2 Lung transplantation
22.8.3.2.3 Thoracic surgery including the need for lung isolation

22.8.4 Otolaryngology
22.8.4.1 Tonsillectomy and adenoidectomy (bleeding tonsil)
22.8.4.2 Myringotomy
22.8.4.3 Mastoidectomy
22.8.4.4 Thyroidectomy
22.8.4.5 Tympanoplasty
22.8.4.6 Removal of foreign body from the airway/esophagus
22.8.4.7 Epiglottitis

22.8.5 Demonstrate and understanding of the principles of anesthetic management for:
22.8.5.1 Neonatal airway surgery
22.8.5.2 Laryngeal/tracheal reconstruction
22.8.5.3 Airway papillomas
22.8.5.4 Laryngoscopy (diagnostic/therapeutic)
22.8.5.5 Bronchoscopy (rigid/flexible)
22.8.5.6 Tracheostomy

22.8.6 Orthopedic Surgery
22.8.6.1 Fracture reduction
22.8.6.2 Hip reconstruction
22.8.6.3 Soft tissue surgery
22.8.6.4 Spinal surgery

22.8.7 Plastic Surgery
22.8.7.1 Cleft lip/palate repair
22.8.7.2  Burn debridement/skin graft
22.8.7.3  Correction of congenital limb deformities

22.8.8  Neurosurgery
  22.8.8.1  V-P shunt insertion, revision
  22.8.8.2  Tumour resection
  22.8.8.3  Drainage of extra/subdural hematoma
  22.8.8.4  Raised ICP
  22.8.8.5  Myelomingocele repair

22.8.9  Urology
  22.8.9.1  Circumcision, Hypospadias repair
  22.8.9.2  Ureteric reimplantation
  22.8.9.3  Cystoscopy
  22.8.9.4  Nephrectomy
  22.8.9.5  Insertion Peritoneal Dialysis catheter
  22.8.9.6  Renal transplant

22.8.10  Ophthalmology
  22.8.10.1  Strabismus repair
  22.8.10.2  Cataract surgery
  22.8.10.3  Glaucoma
  22.8.10.4  Eyelid surgery
  22.8.10.5  Laser for retinopathy of prematurity

22.8.11  Cardiac Surgery
  22.8.11.1  Pacemaker insertion
  22.8.11.2  Cardiac catheterization
  22.8.11.3  Coarctation repair
  22.8.11.4  PDA ligation

22.8.12  Dental Surgery
  22.8.12.1  Dental extractions/restorations
  22.8.12.2  Orthognathic surgery
22.8.13 Remote Locations
   22.8.13.1 MRI/CT
   22.8.13.2 Interventional radiology procedures
   22.8.13.3 Medical procedures: e.g. Bone marrow aspiration/biopsy, LP, gastroscopy, colonoscopy, joint injections

22.8.14 Perioperative/PACU issues
   22.8.14.1 Demonstrate the ability to evaluate and manage common problems which may arise perioperatively:
      22.8.14.1.1 Criteria for day surgery, especially for prematures
      22.8.14.1.2 Un-cooperative patient
      22.8.14.1.3 Delirium
      22.8.14.1.4 Post extubation stridor
      22.8.14.1.5 Pain
      22.8.14.1.6 Nausea and vomiting
      22.8.14.1.7 Laryngospasm
      22.8.14.1.8 Anaphylaxis
23 Pharmacology

Upon completion of this training, the Anesthesiologist shall demonstrate knowledge of the terminology and principles relevant to the pharmacology of all agents

A) Terminology: Definitions and distinctions

23.1 Hyperactivity
23.2 Hypersensitivity
23.3 Tolerance
23.4 Tachyphylaxis
23.5 Synergism
23.6 Antagonism
23.7 Potency of drugs
23.8 Efficacy of drugs

B) Transfer of drugs between compartments

23.9 Demonstrate an ability to:
   23.9.1 Describe the following processes:
      23.9.1.1 Passive diffusion
      23.9.1.2 Active transport
      23.9.1.3 Facilitated diffusion

   23.9.2 Explain the impact of the pKa of drugs and of the acidic or basic state on their transfer between compartments

   23.9.3 Explain the different aspects of biding of drugs to proteins, and describe the impact of various factors affecting the binding, such as age, sex, liver and kidney function and placental membranes

C) Transit of drugs

23.10 Intake
   23.10.1 Explain and describe the specific properties of the following routes of administration:
      23.10.1.1 Oral
      23.10.1.2 Sublingual
      23.10.1.3 Transcutaneous
      23.10.1.4 Intramuscular
23.10.1.5 Subcutaneous
23.10.1.6 Neuraxial
23.10.1.7 Inhalational
23.10.1.8 Intravenous

23.11 Distribution
23.11.1 Describe the various properties, processes and structures involved in the distribution of drugs and their impact on drug action:
23.11.1.1 Water and lipid solubility
23.11.1.2 Ionisation
23.11.1.3 Binding to proteins and tissues
23.11.1.4 Placental transfer
23.11.1.5 Blood brain barrier
23.11.1.6 Perfusion gradients

23.12 Elimination
23.12.1 Demonstrate an ability to:
23.12.1.1 Define clearance, extraction ratio, intrinsic clearance
23.12.1.2 Describe the components of clearance of drugs by the kidney and liver. Explain the impact of changes of blood flow in both organs and of the variability of intrinsic clearance by the liver
23.12.1.3 Explain the impact of alterations of liver function and blood flow on the extraction process
23.12.1.4 Describe the main pathways of drug metabolism: biotransformation (phase 1 reactions) and conjugation (phase II)
23.12.1.5 Describe the impact of various factors affecting biotransformation
   23.12.1.5.1 Individual variability
   23.12.1.5.2 Age
   23.12.1.5.3 Sex
   23.12.1.5.4 Exposure to other substances (induction and inhibition)
   23.12.1.5.5 Liver and kidney disease

D) Pharmacokinetic Principles
23.13 Demonstrate an ability to:
23.13.1 Define the term pharmacokinetics
23.13.2 Explain the evolution from perfusion models to compartmental
pharmacokinetics

23.13.3 Define: rate constant, half-times, (elimination half-time, context sensitive half-time), half life, volumes of distribution

23.13.4 Explain the distinction between zero and first order kinetics, and between one, two and three compartments pharmacokinetic models

23.13.5 Explain the impact of changes in liver and renal function on kinetics

23.13.6 Describe the links between the kinetics of drugs and their transit

E) Pharmacodynamic Principles

23.14 Define pharmacodynamics

23.15 Describe the information provided by the following elements of dose-response curves

23.15.1 Potency

23.15.2 Slope of curves

23.15.3 Efficacy

23.15.4 Variability

23.16 Explain the time lag between end of injections or infusions and drug effect

23.17 Describe the impact of factors affecting this time lag:

23.17.1 Organ perfusion

23.17.2 Partition coefficients

23.17.3 Rate of transit

23.17.4 Drug receptor affinity

23.17.5 Delay between receptor exposure and drug effect

23.18 Describe the elements governing drug-receptor interaction

23.18.1 Law of mass action

23.18.2 Affinity for receptors

23.18.3 Spare receptors

23.18.4 Ion channels

23.18.5 Guanosine nucleotide-binding proteins (G proteins)

23.18.6 Second messenger

23.19 Define biophase and explain the interrelationship between kinetics, dynamics and effect

23.20 Explain the differences between agonists, partial agonists and antagonists
23.21 Drug interactions

23.21.1 Explain the overall benefits and pitfalls of the drug interaction processes in Anesthesiology

23.21.2 Describe mechanisms which create interactions

23.21.2.1 Physico-chemical properties of drugs
23.21.2.2 Interference with transit of drugs
23.21.2.3 Competition of binding sites
23.21.2.4 Enzyme induction and inhibition

F) Anesthetic Drugs

23.22 Demonstrate in-depth knowledge of the following:

- Mechanism of action
- Pharmacokinetics and dynamics
- Dose range
- Clinical effects/ complications
- Indications
- Contraindications
- Drug interactions

For each of the following drugs:

23.22.1 Intravenous induction agents and sedatives

23.22.1.1 Propofol
23.22.1.2 Pentothal
23.22.1.3 Ketamine
23.22.1.4 Etomidate
23.22.1.5 Midazolam

23.22.2 Narcotics/Opioids and adjuncts - See also Pain 23.1.3 21.4

23.22.2.1 Fentanyl
23.22.2.2 Remifentanil
23.22.2.3 Sufentanil
23.22.2.4 Alfentanil
23.22.2.5 Morphine
23.22.2.6 Hydromorphone
23.22.2.7 Meperidine
23.22.3 Muscle relaxants - See Neuromuscular Junction 17B
23.22.4 Reversal agents - See Neuromuscular Junction 17 D
23.22.5 Antiemetics - See Post Anesthesia Care Unit 25 C
23.22.6 Volatiles - See Volatiles 34
23.22.7 Vasopressors and inotropes - See Autonomic Nervous System 3 D, Cardiovascular 4.3.5

23.22.8 Miscellaneous
  23.22.8.1 Intravenous lidocaine
  23.22.8.2 Naloxone
  23.22.8.3 Flumazenil
24 Plastic Surgery

A) Thermal Injuries

24.1 The Anesthesiologist must demonstrate an understanding of the pathophysiology of burns and the relevance to anesthetic management

24.1.1 Burns
   24.1.1.1 Describe the types of burns including thermal, chemical and electrical burns
   24.1.1.2 Describe the initial assessment and resuscitation of the burn patient
   24.1.1.3 Describe the anesthetic considerations of the burn patient presenting for plastic procedures
       24.1.1.3.1 Skin flaps
       24.1.1.3.2 Split thickness skin grafts
       24.1.1.3.3 Dressing changes
   24.1.1.4 Describe the use of hyperbaric oxygen in the treatment of burns and carbon monoxide poisoning

24.1.2 Cold Injuries
   24.1.2.1 Describe the anesthetic considerations of the patient presenting with frostbite
   24.1.2.2 Describe the use of hyperbaric oxygen in the treatment of frostbite

B) Anesthesia for Limb Reimplantation

24.2 The Anesthesiologist must demonstrate an understanding of the concerns related to limb reimplantation with respect to:
   24.2.1 The general and regional anesthetic options for limb reimplantation
   24.2.2 Manoeuvres used to increase digital blood flow
   24.2.3 General principles of prolonged procedures
       24.2.3.1 Temperature maintenance
       24.2.3.2 Fluid and blood loss
       24.2.3.3 Pressure point padding

C) Anesthesia for Free Flap and Pedicle Flap Surgery

24.3 The Anesthesiologist must demonstrate an understanding of:
   24.3.1 General and regional anesthetic options for free flap and pedical flap
surgery

24.3.2 The factors that influence flap perfusion including fluids/temperature/vasoactive substances

24.3.3 Common co-morbidities of patients presenting for flap surgery
   24.3.3.1 Cancer
   24.3.3.2 Infection
   24.3.3.3 Paraplegia
   24.3.3.4 Quadriplegia

24.3.4 The indications for hyperbaric oxygen therapy for flap preservation

24.3.5 The post operative complications of surgery
   24.3.5.1 Flap necrosis
   24.3.5.2 Infection/sepsis

D) Cosmetic Surgery

24.4 The Anesthesiologist must demonstrate an understanding of the anesthetic implications of the following surgeries
   24.4.1 Liposuction
   24.4.2 Breast augmentation, reduction mammoplasty, and amstopexy
   24.4.3 Abdominoplasty
   24.4.4 Facelift, neck lift, brow lift, and blepharoplasty
   24.4.5 Rhinoplasty
   24.4.6 Facial laser resurfacing

E) Minor Hand Procedures

24.5 The Anesthesiologist must demonstrate an understanding of the anesthetic concerns for patients undergoing hand surgery including:
   24.5.1 The anesthetic options for minor hand procedures
   24.5.2 The advantages/disadvantages and complications of the various anesthetic techniques
      24.5.2.1 Local infiltration
      24.5.2.2 IV block
      24.5.2.3 Peripheral nerve block
      24.5.2.4 General anesthesia
F) Craniofaial

24.6 Adult Craniofacial
   24.6.1 Demonstrate knowledge of the anesthetic concerns for adult patients undergoing craniofacial surgery including:
      24.6.1.1 Facial reconstructive surgery
      24.6.1.2 Maxillo-facial trauma

24.7 Pediatric Craniofacial
   24.7.1 Describe the anesthetic implications of the following pediatric craniofacial surgeries:
      24.7.1.1 Cleft lip/palate surgery
      24.7.1.2 Ear reconstruction
25 Post-Anesthetic Care Unit (PACU)

Upon completion of this training, the Anesthesiologist must demonstrate an understanding of the structure and function of the PACU and an ability to identify, prevent and treat common problems arising in the PACU

A) Physical and Staffing Requirements

25.1 Demonstrate knowledge of the physical and staffing requirements of the PACU, including but not limited to:
   25.1.1 Space
   25.1.2 Personnel
   25.1.3 Equipment
   25.1.4 Monitoring
   25.1.5 Medications, IV fluids

B) Patient Management

25.2 Demonstrate an understanding of the considerations for patients entering the PACU and an approach to management of patients in the PACU, including but not limited to:
   25.2.1 Fluid and electrolyte management
      25.2.1.1 Goals of resuscitation
      25.2.1.2 Accurate measures of preload
      25.2.1.3 Fluid responsiveness
   25.2.2 Pain management: indications/contraindications of multimodal approach including local anesthetics, regional and neuroaxial blocks, opioids, NSAIDS and adjuncts including acetaminophen, gabapentin, Ketamine and tricyclic antidepressants
   25.2.3 Antiemetics
   25.2.4 Monitoring guidelines
   25.2.5 Discharge criteria

C) Complications

25.3 Identify and manage common problems in the PACU, including but not limited to:
   25.3.1 Respiratory complications
      25.3.1.1 Chronic obstructive pulmonary disease (COPD)
      25.3.1.2 Aspiration
25.3.1.3  Negative pressure pulmonary edema

25.3.2  Hypoxemia and hypoventilation
   25.3.2.1  Assessment of ventilation
   25.3.2.2  Recognition and diagnosis
   25.3.2.3  Oxygen delivery systems including BIPAP and CPAP

25.3.3  Recognition and treatment of upper airway obstruction, stridor, aspiration, obstructive sleep apnea

25.3.4  Hypotension and Hypertension
   25.3.4.1  Diagnosis and management
   25.3.4.2  Shock

25.3.5  Cardiac complications
   25.3.5.1  Myocardial ischemia/chest pain
   25.3.5.2  Brady-/tachycardia
   25.3.5.3  Dysrhythmias
   25.3.5.4  Cardiogenic shock
   25.3.5.5  Pulmonary edema

25.3.6  Anaphylaxis

25.3.7  Inadequate analgesia
   25.3.7.1  Blocks and neuraxial anesthesia
   25.3.7.2  Opiates
   25.3.7.3  Non-opiates
   25.3.7.4  Challenges in pain management

25.3.8  Oliguria/Polyuria
   25.3.8.1  Assessment of Volume Status
   25.3.8.2  Differential diagnosis

25.3.9  Post-Operative Mental Status Changes
   25.3.9.1  Delirium
   25.3.9.2  Differential diagnosis
   25.3.9.3  Delayed Emergence
25.3.9.4 Decreased level of consciousness, Acute cerebrovascular accident (CVA)

25.3.10 Fluid and Electrolyte Abnormalities
   25.3.10.1 Acid base
   25.3.10.2 Trans-urethral prostatectomy (TURP) Syndrome, Hysteroscopy syndrome
   25.3.10.3 Hypo- and Hyper-calcemia, kalemia, natremia, magnesemia, glycemia

25.3.11 Nausea and Vomiting
   25.3.11.1 Risk factors
   25.3.11.2 Pharmacology

25.3.12 Hyperthermia, Hypothermia & Shivering
   25.3.12.1 Postoperative fever
   25.3.12.2 Malignant Hyperthermia
   25.3.12.3 Hypothermia

25.3.13 Neurological
   25.3.13.1 Residual Neuromuscular Blockade
   25.3.13.2 Prolonged regional blocks and peripheral nerve blocks
   25.3.13.3 Peripheral Neuropathies
26  Preoperative Consultation

Upon completion of this training, the Anesthesiologist must demonstrate an ability to assess, evaluate, optimize and manage patients in the preoperative period with the following considerations regarding systemic illness

A) Cardiovascular

26.1  Hypertension

26.1.1  Identify significant hypertension and predict the impact on intraoperative risk and on long-term health

26.1.2  Recommend appropriate timing of surgery relative to severity of hypertension and urgency of surgical indication. Coordinate further investigation and consultations

26.1.3  Prescribe appropriate therapy to correct preoperative hypertension

26.1.4  Liaise with primary care provider to facilitate long-term management

26.2  Pulmonary Hypertension

26.2.1  Identify patients with pulmonary hypertension by history, physical exam and laboratory/imaging findings

26.2.2  Identify the impact of the proposed anesthesia and surgery on the underlying disease

26.2.3  Coordinate further investigations and consultations necessary to safely and expeditiously perform the necessary surgery

26.3  Cardiomyopathy

26.3.1  Identify right and left ventricular dysfunction by use of history, physical and laboratory findings/imaging

26.3.2  Identify appropriate preoperative management of ventricular dysfunction

26.3.3  Utilize consultants appropriate to optimize ventricular dysfunction

26.4  Valvular Disease

26.4.1  Utilize history and physical examination to identify cardiac murmurs

26.4.2  Identify patients that require a preoperative echocardiogram to evaluate the severity of stenotic and regurgitation lesions of aortic, mitral, pulmonic and tricuspid valves

26.4.3  Identify risk factors for bacterial endocarditis

26.4.4  Prescribe appropriate prophylaxis for endocarditis
26.5 Congenital Heart Disease

26.5.1 Obtain and utilize history, physical and laboratory findings to identify and grade the severity of congenital lesions, pulmonary hypertension, right-to-left and left-to-right shunts, partially corrected lesions

26.5.2 Describe the physiology and design appropriate management plans for R-L, L-R and bidirectional shunts

26.5.3 Prescribe appropriate prophylaxis for endocarditis

26.6 Pacemakers/Implantable Cardioverter/Defibrillator

26.6.1 Identify indications for preoperative pacemaker/ICD insertion or intraoperative pacing

26.6.2 Coordinate consultation for perioperative pacing

26.6.3 Identify the type of pacemaker/ICD and verify function

26.6.4 Coordinate appropriate perioperative assessment and programming of a pacemaker/ICD

26.7 Arrhythmia

26.7.1 Identify the presence, type and severity of abnormal rhythms, using history, physical and EKG

26.7.2 Identify rhythm abnormalities requiring preoperative therapeutic or prophylactic therapy

26.7.3 Prescribe appropriate therapeutic or suppressive therapy

26.7.4 Utilize consultants effectively to coordinate appropriate pharmacologic or electrophysiologic therapy

26.8 Conduction Abnormalities

26.8.1 Identify the presence, severity and type of abnormalities of conduction

26.8.2 Identify and manage reversible contributors to abnormal conduction

26.9 Peripheral Vascular Disease

26.9.1 Identify the presence, severity and physiologic impact of peripheral vascular disease

26.9.2 Predict the impact of carotid disease on intraoperative risk

26.9.3 Identify the important preoperative variables that affect outcome in major vascular surgery, and provide a plan to optimize them

26.10 Patient with heart transplantation

26.11 Cardiac tamponade and constrictive pericarditis
26.12 Superior vena cava syndrome

26.13 Cardiac risk assessment

26.13.1 Utilize history, physical examination and laboratory/imaging findings to identify patients with active cardiac conditions that require further evaluation and treatment prior to noncardiac surgery

26.13.2 Identify patients with clinical risk factors who would benefit from further preoperative testing, balancing the potential risks and the urgency of the surgical indication

26.14 Cardiac risk reduction

26.14.1 Utilize pharmacologic therapy to reduce perioperative cardiac risk

26.14.2 Describe the risks and benefits of beta-blockers, alpha-2 agonists, statins, and anti-platelet therapy for the reduction of perioperative cardiac risk

26.14.3 Identify indications for preoperative surgical or interventional management for cardiac risk reduction

26.14.4 Utilize appropriate consultation to coordinate preoperative cardiac risk reduction

26.14.5 Identify patients with Percutaneous Coronary Intervention (PCI) and develop a plan for the perioperative management of antiplatelet medications and timing of surgery based on the type of PCI and urgency of surgery

26.15 Cardiovascular testing

26.15.1 Interpret and use the results of the following to assess risk and appropriately modify perioperative management

26.15.1.1 ECG

26.15.2 Use the results of the following to assess risk and appropriately modify perioperative management

26.15.2.1 Echocardiography

26.15.2.2 Stress testing, dobutamine stress echocardiography

26.15.2.3 Perfusion imaging

26.15.2.4 Coronary angiography

26.15.2.5 Ventriculography

B) Respiratory

26.16 Airway assessment

26.16.1 Predict difficulty with laryngoscopy and intubation by use of history and physical findings
26.16.2 Predict difficulty with manual ventilation by use of history and physical findings

26.16.3 Use investigations including xray, computed tomography and pulmonary function studies to identify and/or quantify airway management concerns

26.16.4 Identify, grade the severity and list the implications of special airway situations including

  26.16.4.1 Airway obstruction – intra and extrathoracic
  26.16.4.2 Mediastinal mass
  26.16.4.3 Bronchopleural fistula
  26.16.4.4 Tracheo-esophageal fistula
  26.16.4.5 Tracheal stenosis
  26.16.4.6 Anatomic/structural abnormalities congenital and acquired
  26.16.4.7 Difficult airway and congnivity impairment
  26.16.4.8 Patient scheduled for tracheotomy

26.16.5 Prescribe appropriate preoperative therapy to facilitate difficult airway management

26.16.6 Coordinate the availability of special equipment, support and logistical preparation for special airway situations

26.16.7 Provide pertinent information to prepare the patient with awake intubation or possibility of dental damage

26.16.8 Manage side effects and complications of intubation e.g. Dental damage

26.17 Respiratory risk assessment

  26.17.1 Identify, grade the severity and estimate the impact on risk of perioperative complications of COPD, Asthma
  26.17.2 Restrictive defect
  26.17.3 Bullous lung disease/Bronchopleural fistula CO2 retention
  26.17.4 Obstructive +/- or central sleep apnea
  26.17.5 Recurrent aspiration
  26.17.6 ARDS
  26.17.7 CF/bronchiectasis
  26.17.8 Infection (pneumonia, upper respiratory tract infection, empyema)
  26.17.9 Pneumothorax/Chest tube
26.18 Reduction of respiratory risk

26.18.1 Identify patients with contagious pulmonary infection, coordinate special precautions for perioperative period

26.18.1.1 Identify and coordinate the availability of special intraoperative interventions to manage patients with any of the above problems

26.18.1.2 Provide appropriate preoperative therapy to reduce the severity of the above problems

26.18.1.3 Smoking cessation

26.18.1.4 Utilize consultants effectively to assist in assessing perioperative respiratory problems and reducing risk

26.18.1.5 Recommend appropriate timing for surgical intervention balancing the inherent risk of the procedure, the incremental risk imposed by the respiratory problem, and the negative consequences of delay

26.18.1.6 Identify patients that would benefit from postoperative monitoring in an enhanced or intensive care unit

26.19 Assessment for lung resection

26.19.1 Estimate the impact of the proposed procedure on perioperative outcome using history, physical and laboratory information

26.19.2 Estimate the extent of resection that an individual patient is expected to tolerate utilizing PFTs, ABG, and VO2 max testing

26.20 Pulmonary testing

26.20.1 Order appropriate lung function testing to assist with perioperative decision making

26.20.2 Interpret and use the results of the following to assess risk and appropriately modify perioperative management

26.20.2.1 Flow and volume studies

26.20.2.2 Diffusion measurement

26.20.2.3 Arterial blood gases

26.20.2.4 XRays of chest, neck, airway

26.20.2.5 CT of airway/lungs

26.20.3 Integrate the results of the following to assess risk and appropriately modify perioperative management

26.20.3.1 Sleep studies

26.20.3.2 Exercise studies

26.20.3.3 Ventilation/perfusion scan
26.20.3.4 CT chest

C) Neurological

26.21 Intracranial mass
   26.21.1 Assess the implications for perioperative outcome and anesthetic management of intracranial mass lesions based on location, size, and proposed procedure
   26.21.2 Manage reversible contributions to increase ICP
   26.21.3 Identify and assess the severity of increased ICP

26.22 Seizure disorder
   26.22.1 Utilize consultation appropriately to identify, diagnose and treat seizure disorders
   26.22.2 Utilize the information from that consultation to anticipate appropriate modifications to perioperative management
   26.22.3 Coordinate the availability of required special resources
   26.22.4 Predict the impact of and appropriately manage anticonvulsant therapy

26.23 Cognitive impairment
   26.23.1 Assess the ability of the patient to participate in informed consent and cooperate with perioperative interventions
   26.23.2 Obtain appropriate surrogate consent in the event of incapacity
   26.23.3 Assess the need for, impediments to, and optimal methods to reduce perioperative anxiety, including sedation
   26.23.4 Coordinate the availability of required special perioperative resources, including environmental and management modifications to enhance cooperation and pain management
   26.23.5 Discuss the effects of general anesthesia on cognitive disorders

26.24 Neurovascular
   26.24.1 Categorize and grade the severity of intracranial hemorrhage
   26.24.2 Estimate the risk of bleeding and/or vasospasm perioperatively
   26.24.3 Assess the implications for perioperative outcome and anesthetic management of intracranial vascular lesions based on location, size, and proposed procedure

26.25 Peripheral Neuropathy
   26.25.1 Identify common causes of perioperative neuropathy
26.25.2 Utilize appropriate consultation to diagnose peripheral neuropathy
26.25.3 Discuss the relevance of peripheral neuropathy to choice of anesthetic

26.26 Spinal cord
26.26.1 Assess the severity and anesthetic implications of spinal cord impingement and threats to spinal cord perfusion
26.26.2 Assess the physiologic effects and anesthetic implications of pre-existing spinal cord injury. Assess the risk and anesthetic implication of autonomic hyperreflexia
26.26.3 Movement disorders
26.26.4 Identify movement disorders significant for anesthetic management
26.26.5 Utilize appropriate consultation to diagnose and stabilize movement disorders preoperatively
26.26.6 Identify anesthetic implications of movement disorders, including drug interactions
26.26.7 Identify anesthetic implications of pharmacotherapy for movement disorders and its withdrawal

26.27 Myopathies
26.27.1 Utilize appropriate consultation to assess the severity and systemic effects of muscular dystrophies
26.27.2 Identify risk factors for intra- and postoperative complications in patients with muscular dystrophies

26.28 Neuromuscular
26.28.1 Identify the anesthetic considerations for myasthenia gravis and develop a perioperative plan including the use of anticholinesterase medication
26.28.2 Identify patients at risk for Eaton-Lambert syndrome

26.29 Psychiatric
26.29.1 Identify patients taking antidepressant medication and be aware of the anesthetic considerations and potential drug interactions especially with monoamine oxidase inhibitors/SSRIs
26.29.2 Assess patient suitability for ECT and identify patient at increased risk for morbidity from ECT
26.30 Neurologic investigations

    26.30.1 Interpret and use the results of the following to assess risk and appropriately modify perioperative management

    - 26.30.1.1 CT head, spine
    - 26.30.1.2 Xray c-spine
    - 26.30.1.3 MRI Transcranial Doppler Imaging, Carotid Doppler, Angiography
    - 26.30.1.4 EEG
    - 26.30.1.5 EMG

D) Gastrointestinal

    26.31 Identify risk factors for preoperative reflux and provide appropriate prophylaxis
    26.32 Use information from consultants to characterize, grade the severity and assess the physiologic and anesthetic implications of hepatic dysfunction
    26.33 Identify the presence and type of infectious hepatitis and assess the infectious risk
    26.34 Identify the physiologic effects, comorbidities, metastatic spread, and anesthetic implications of GI malignancies, Carcinoid syndrome, paraneoplastic syndrome, thrombosis
    26.35 Assess the anesthetic implications of chemotherapy used and coordinate laboratory/investigation for their systemic effects
    26.36 Use the results of the following to assess risk and appropriately modify perioperative management

        - 26.36.1 Abdominal imaging
        - 26.36.2 Liver function testing

E) Musculoskeletal

    26.37 Grade the severity, mechanical and anesthetic implications and other system involvement of:

        - 26.37.1 Rheumatoid arthritis
        - 26.37.2 Osteoarthritis
        - 26.37.3 Ankylosing spondylitis
        - 26.37.4 Osteogenesis imperfecta
        - 26.37.5 Osteoporosis bone metastasis, dermatomyosites

    26.38 Assess the anesthetic implications of pharmacology for the above and recommend appropriate perioperative management
26.39 Interpret and use the results of the following to assess risk and appropriately modify perioperative management

26.39.1 CT C-spine
26.39.2 X-ray C T and L-spine

F) Dermatologic

26.40 Grade the severity, mechanical and anesthetic implications and other system involvement of:

26.40.1 Bullous diseases
26.40.2 Psoriasis
26.40.3 Scleroderma
26.40.4 Assess the anesthetic implications of burn injury

26.41 Assess the anesthetic implications of pharmacotherapy for the above and recommend appropriate perioperative management

G) Hematologic

26.42 Identify abnormalities of hemostasis on preoperative history
26.43 Specify hematologic disease (von Willebrand, hemophilia etc.)
26.44 Interpret results of screening tests for hemostasis
26.45 Utilize laboratory testing to characterize hypercoagulable disorders including:

26.45.1 Protein C, S, antithrombin III deficiencies
26.45.2 Homocysteinuria
26.45.3 Heparin induced thrombocytopenia
26.45.4 DIC V Leiden Factor

26.46 Utilize appropriate consultation to characterize the type and severity of other abnormalities of hemostasis, and provide preoperative optimization
26.47 Identify indications for thromboprophylaxis
26.48 Modify pre-existing anticoagulant/antiplatelet therapy to balance risks of intraoperative bleeding and thrombotic complications
26.49 Identify, diagnose and treat preoperative anemia using history physical and laboratory information
26.50 Utilize consultation appropriately to evaluate and treat uncommon causes of anemia bone marrow transplantation, patent with hematologic cancer hemoglobin disorders (thalassemia, IgA deficit, sickle cell disease, porphyria, etc.)
26.51 Identify and utilize consultation to characterize and treat thrombocytopenia
26.52 Quantify expected blood loss and coordinate a plan to reduce the likelihood of allogeneic transfusion

26.53 Explain to patients the indications, risks and benefits of methods of optimizing preoperative haemoglobin and preoperative autologous donation

26.54 Interpret and use the results of the following to assess risk and appropriately modify perioperative management

   26.54.1 CBC
   26.54.2 Anemia investigations excluding bone marrow
   26.54.3 Hemoglobin electrophoresis

26.55 Use the results of the following to assess risk and appropriately modify perioperative management

   26.55.1 Bone marrow biopsy
   26.55.2 Platelet function testing
   26.55.3 Coagulation testing and factor levels
   26.55.4 Thromboelastography

**H) Endocrine/Metabolic - See Endocrinology 8**

**I) Transplanted Organ - See Transplantion 33**
27 Regional Anesthesia

Upon completion of this training, the Anesthesiologist shall demonstrate knowledge of the anatomy and physiology of, and an approach to, regional anesthesia.

A) Pharmacology

27.1 Demonstrate knowledge of the pharmacology of the local anesthetic with respect to:

27.1.1 Mechanism of Action
   27.1.1.1 Explain the effects of sodium channel blockade on the action potential
   27.1.1.2 Explain how local anesthetic blocks the sodium channel
   27.1.1.3 Explain the mechanism of factors facilitating and hindering local anesthetic effect at the sodium channel

27.1.2 Toxicity
   27.1.2.1 Identify the manifestations of systemic toxicity
   27.1.2.2 Demonstrate knowledge of the different forms of local anesthetic (LA) toxicity – cardiac toxicity, direct neurotoxicity; methaemoglobinemia; allergy
   27.1.2.3 Identify and provide appropriate management of local anesthetic toxicity
   27.1.2.4 Describe the mechanisms of LA neurologic and cardiac toxicity
   27.1.2.5 Demonstrate knowledge of factors influencing the development of CNS & CVS toxicity (e.g. speed of injection; site of injection; maximal doses; LA potency; hypercarbia; use of vasoconstrictors; cardiac/liver disease)

27.1.3 Kinetics
   27.1.3.1 Describe drug, patient and technical factors contributing to speed of onset of local anesthetics
   27.1.3.2 Describe the drug, patient and technical factors contributing to recovery from LA
   27.1.3.3 Describe the determinants of serum LA concentration, its measurement, and the role of protein binding

27.1.4 Structure Activity Relationships
   27.1.4.1 Describe the molecular structure of LA, and the resultant effects on kinetics and dynamics
   27.1.4.2 Describe the differences between amide & ester local anesthetics
with examples of each. Understand the physicochemical properties of potency; protein binding; pKa & pH

27.1.4.3 Describe the relationship between LA & differential blockade

27.1.5 Adjuvants

27.1.5.1 The Anesthesiologist must be able to explain the rationale for & against adding different adjuvants to LA’s for both peripheral and neuraxial blocks, and be able to describe the mechanism, dose, clinical effects and adverse effects of:

27.1.5.1.1 Epinephrine

27.1.5.1.1.1 List the clinical indications for and advantages of inclusion of epinephrine in local anesthetic for spinal epidural, regional and local infiltration

27.1.5.1.1.2 Describe the dose and effect of epinephrine on blockade characteristics when added to local anesthetic in spinal, epidural, regional and local infiltration

27.1.5.1.1.3 Describe the potential detrimental effects of inclusion of epinephrine in local anesthetic in spinal, epidural, regional and local infiltration

27.1.5.1.1.4 Describe the mechanisms of the above effects

27.1.5.1.2 Bicarbonate

27.1.5.1.2.1 Give the arguments for and against the addition of bicarbonate to local anesthetics

27.1.5.1.2.2 Describe the mechanism of action of potentiation of local anesthetic blockade by bicarbonate

27.1.5.1.3 Opioids

27.1.5.1.3.1 Discuss the rationale for and against, and clinical effects and adverse effects of opioids to local anesthetics for peripheral regional blockade

27.1.5.1.3.2 Describe the mechanisms, doses, clinical effects and adverse effects of opioids in neuraxial blockade

27.1.5.1.4 Alpha-agonists

27.1.5.1.4.1 Discuss the rationale for and against and clinical utility of addition of alpha-agonists to local anesthetics for peripheral regional blockade

27.1.5.1.4.2 Describe the mechanisms, doses, clinical effects and adverse effects of alpha-agonists in neuraxial blockade
27.1.5.1.5  NMDA Antagonists

27.1.5.1.5.1  Discuss the rationale for and against and clinical utility of addition of NMDA antagonists to local anesthetics for peripheral regional blockage

27.1.5.1.5.2  Describe the mechanisms, doses, clinical effects and adverse effects of NMDA antagonists in neuraxial blockade

B) Physiology

27.2  Describe the following physiologic principles relevant to regional anesthesia

27.2.1  Nerve Conduction

27.2.1.1  Describe the structural classification of nerve types and the relevance to local anesthetic action

27.2.1.2  Explain the generation of nerve action potential, refractory period and recovery

27.2.1.3  Describe the structure of nerves

27.2.2  Effects of Neuraxial Blockade

27.2.2.1  Describe the cardiorespiratory effects of neuraxial blockade

27.2.2.2  Describe the differences and similarities between spinal and epidural blockade with respect to mechanism of action, effects of adjuvants and cardiorespiratory physiology

27.2.2.3  Describe the effects of neuraxial blockade on coagulation

27.2.2.4  Describe the effects of neuraxial blockade on the neurohumoral stress response

27.2.2.5  Describe the effects of neuraxial blockade on postoperative respiratory effects of surgery

27.2.2.6  Describe the effects of neuraxial blockade on intraoperative blood loss (controlled hypotension)

27.2.2.7  Identify factors influencing spread of spinal/epidural anesthesia

27.2.3  The Neuroendocrine Stress Response

27.2.3.1  Describe the systems affected by the stress response, and the overall impact on each of those systems

27.2.3.2  Describe the specific changes within each of the affected systems that leads to the overall functional impact on those systems

27.2.3.3  Describe the extent to which the stress response is modified by anesthesia, the theoretical effect of such modification on surgical outcomes, and the extent to which the modification of stress response has been shown to affect outcomes
C) Technology

27.3 Demonstrate an understanding of the technology available for identification of nerves for the performance of plexus and peripheral nerve blocks

27.3.1 Nerve Stimulation
27.3.1.1 Describe the rationale for the use of stimulations for locating nerves
27.3.1.2 Discuss the advantages, disadvantages and limitations of nerve stimulation as a means of locating nerves
27.3.1.3 List and explain the characteristics of the ideal nerve stimulator
27.3.1.4 Describe the response characteristics of different nerve fibers to stimulation
27.3.1.5 Use stimulation to safely and effectively perform regional blocks
27.3.1.6 Different types of needles – insulated vs. non-insulated needles

27.3.2 Ultrasound
27.3.2.1 Describe the relative advantages, disadvantages and limitations of ultrasound as a method of locating nerves
27.3.2.2 Describe the basic physics principles of ultrasound and their clinical relevance in identifying different anatomic structures
27.3.2.3 Choose the appropriate ultrasound probe and machine settings to properly identify the desired structure
27.3.2.4 List and explain the characteristics of the ideal ultrasound machine
27.3.2.5 Identify the ultrasonographic anatomy relevant to nerve localization
27.3.2.6 Use ultrasound to safely and effectively perform regional blocks
27.3.2.7 Static vs. dynamic use of ultrasound
27.3.2.8 In-plane vs. Out-of-plane techniques

D) Clinical Application of Regional Anesthesia

27.4 Perform the following specific objectives for all regional anesthetic techniques relevant to the anesthesiologist’s level of training as indicated below, and in the context of anesthetic care situations within the anesthesiologist’s sphere of practice:

27.4.1 Anesthetic Planning
27.4.1.1 Generate and implement an anesthetic plan including appropriate options, contingency plans and expectations
27.4.1.2 Select an appropriate regional anesthetic technique(s) for anesthetic care
27.4.1.3 Discuss completely the relative advantage, disadvantage and physiologic implications of regional vs. general anesthesia, including specific risks and outcome in the context of anesthetic care situations within his/her sphere of practice

27.4.1.4 Discuss regional PLUS GA vs. GA vs. regional

27.4.1.5 Discuss the use of regional techniques pre vs. post induction of general anesthesia

27.4.1.6 Regional techniques in pediatric anesthesia

27.4.2 Nerve Localization

27.4.2.1 Describe anatomic landmarks for performance of blocks

27.4.2.2 Utilize nerve stimulation for identification of plexuses and peripheral nerves for regional anesthetic techniques within his/her scope of practice

27.4.2.3 Contrast the relative advantages and disadvantages of all applicable techniques of nerve localization including anatomic, stimulation, paresthesia, and image-guided approaches

E) Contraindications and Complications

27.5 Demonstrate knowledge of the limitations of regional anesthesia including contraindications and complications

27.5.1 Contraindications to Regional Anesthesia

27.5.1.1 Identify and, where appropriate, manage relative and absolute contraindications to regional anesthetics

27.5.2 Anticoagulation and Regional Anesthesia

27.5.2.1 Develop an approach to regional anesthesia in the patient with abnormal coagulation parameters

27.5.2.2 Plan regional anesthesia with reference to the current published guidelines from anesthetic associations and regulatory bodies pertaining to the conduct of regional anesthesia in the context of anticoagulation

27.5.2.3 Assess the appropriate timing of regional anesthetic procedures relative to anticoagulation therapy

27.5.2.4 Modify the anticoagulation, anesthetic plan or both appropriately in order to minimize overall risk and improve outcome

27.5.2.5 Interact with surgeons and administrators to create policies governing the interaction of anticoagulation and anesthetic/analgesic management
27.5.3 Complications of Regional Anesthesia

27.5.3.1 Describe the complications of regional anesthesia and the risk factor, presentation, diagnosis and treatment of:

- 27.5.3.1.1 Failed block
- 27.5.3.1.2 Intravascular injection of local anesthetic
- 27.5.3.1.3 Overdose
- 27.5.3.1.4 Epidural hematoma & abscess
- 27.5.3.1.5 Anterior spinal artery syndrome
- 27.5.3.1.6 Post Dural Puncture Headache (PDPH)
- 27.5.3.1.7 Post-operative neuropathy
- 27.5.3.1.8 Inadvertent spinal/subdural block

F) Spectrum of Anesthesia Techniques

27.6 Demonstrate knowledge of the spectrum of regional anesthetic techniques and perform those relevant to the anesthesiologist's level of training

27.7 Demonstrate knowledge of basic surface anatomy & palpable landmarks and the dermatomal & peripheral nerve distribution as applicable to each specific block

27.8 Describe site-specific equipment; indications; contraindications & drug selection for each block

27.8.1 Neuraxial Blocks

- 27.8.1.1 Spinal – single shot midline and paramedian
- 27.8.1.2 Epidural
  - 27.8.1.2.1 T1-4
  - 27.8.1.2.2 T4-8
  - 27.8.1.2.3 T8-L-5
  - 27.8.1.2.4 Caudal

27.8.2 Upper Extremity Blocks

- 27.8.2.1 Interscalene
- 27.8.2.2 Supraclavicular
- 27.8.2.3 Infraclavicular
- 27.8.2.4 Axillary
- 27.8.2.5 At the elbow
  - 27.8.2.5.1 Median nerve
  - 27.8.2.5.2 Musculocutaneous nerve
27.8.2.5.3  Radial nerve

27.8.2.6  At the wrist and hand
  27.8.2.6.1  Ulnar nerve
  27.8.2.6.2  Median nerve

27.8.3  Radial Nerve
  27.8.3.1  Digital nerves

27.8.4  Lower Extremity Blocks
  27.8.4.1  Lumbar plexus
  27.8.4.2  Femoral nerve block/3 – in – 1 block

27.8.5  Sciatic block
  27.8.5.1  Popliteal
  27.8.5.2  Ankle block

27.8.6  All Limbs – IVRA (Bier block)

27.8.7  Trunk Blocks
  27.8.7.1  Parvertebral block
  27.8.7.2  Intercostal nerve block
  27.8.7.3  Ilioinguinal/iliohypogastric
  27.8.7.4  Penile block

27.8.8  Head and Neck Blocks
  27.8.8.1  Supraorbital nerve block
  27.8.8.2  Mental nerve block
  27.8.8.3  Mandibular never block
  27.8.8.4  Occipital nerve block
  27.8.8.5  Superficial cervical plexus
  27.8.8.6  Retrobulbar & peribulbar blocks

27.8.9  Airway Blocks
27.8.10 Topicalization

27.8.10.1 Superior laryngeal
27.8.10.2 Lingual nerve
27.8.10.3 Transtracheal block
28 Remote Locations

Upon completion of this training, the competent Anesthesiologist must demonstrate an understanding of the considerations related to providing anesthetic care in non-traditional locations such as MRI suites, Cardiac Catheterization Laboratories, Image Guided therapy suites and endoscopy suites

A) Physical Requirements

28.1 Demonstrate an understanding of the physical requirements for provision of anesthesia in remote locations:

28.1.1 The anesthetizing location must conform to electrical code and excess anesthetic gas scavenging
28.1.2 Medical gas pipelines must meet the same standards as a regular operating room
28.1.3 The anesthetic machine must conform to CAS standards
28.1.4 Standard CAS monitors are required
28.1.5 Standard emergency drugs and equipment must be readily available
28.1.6 Anesthetic machines, monitoring and scavenging are the same as would be expected in a regular operating room, including resuscitation equipment etc.

B) Personnel

28.2 Demonstrate an understanding of the personnel required to provide safe anesthesia

28.2.1 Appropriate ancillary help must be available to the anesthesiologist

C) The Nature of the Remote Locations

28.3 Demonstrate an understanding of the unique considerations for each location, including the fact that these are frequently distant from the main operating room

28.3.1 Interventional Radiology

28.3.1.1 Radiation exposure: Patients and staff
28.3.1.2 Anesthetic considerations

28.3.1.2.1 Limited access to patient
28.3.1.2.2 Movement of radiological equipment
28.3.1.2.3 Temperature management

28.3.1.3 Contract media complications

28.3.1.3.1 Anaphylaxis
28.3.1.3.2 Interaction with Metformin
28.3.1.3.3 Renal failure

28.3.1.4 Temperature regulation
28.3.1.5 Variety of procedures and their implications
  28.3.1.5.1 Biopsies
  28.3.1.5.2 Angiography
  28.3.1.5.3 AAA stent graft
  28.3.1.5.4 Carotid artery stent
  28.3.1.5.5 Kyphoplasty/vertebroplasty
  28.3.1.5.6 TIPS (transjugular intrahepatic portosystemic shunt)
  28.3.1.5.7 Cerebral Aneurysm / AV malformation coiling
  28.3.1.5.8 Radiofrequency ablation
  28.3.1.5.9 E.G. vascular access procedures, biopsies, drain insertion angiography

28.3.2 MRI
  28.3.2.1 Implications of magnetic field
  28.3.2.2 Patient selection
  28.3.2.3 MRI compatible anesthesia equipment and monitors
  28.3.2.4 Management of resuscitation
  28.3.2.5 Noise
  28.3.2.6 Management of patient claustrophobia

28.3.3 Cardiac Catheterization Laboratory
  28.3.3.1 Considerations as per Interventional Radiology
  28.3.3.2 Specific considerations for cardiac patients
    28.3.3.2.1 Pediatric congenital heart disease
    28.3.3.2.2 Adult valvular heart disease
    28.3.3.2.3 Coronary artery disease
    28.3.3.2.4 Cardiomyopathies
    28.3.3.2.5 Dysrhythmias – pacemakers and ICD’s

  28.3.3.3 Type of procedure: diagnostic vs. therapeutic
    28.3.3.3.1 AICD
28.3.3.3.2 Electrophysiologic Studies

28.3.4 Endoscopy Suites
   28.3.4.1 Implications of bowel preparation on hydration and electrolytes
   28.3.4.2 Shared airway e.g. upper endoscopy

D) Electroconvulsive Therapy

28.4 Indications
28.5 Contraindications
28.6 Complications and management
   28.6.1 Bradycardia
   28.6.2 Tachycardia
   28.6.3 Hypertension
   28.6.4 Failure of seizure

E) Post Procedure Disposition

28.7 Demonstrate knowledge with respect to postanesthetic care of these patients
   28.7.1 Location
      28.7.1.1 Local vs. OR PACU
   28.7.2 Discharge planning
   28.7.3 Anticipation of complications
   28.7.4 Lack of Anesthesiology personnel available to deal with emergencies
29 Renal / Urologic

Prevention of perioperative morbidity and mortality depends in part upon an understanding of renal physiology and pharmacology and the effects of alterations in renal function on the excretion of drugs administered during and after surgery. Therefore, the anesthesiologist must demonstrate knowledge and understanding of Anesthesiology and the renal system.

A) Basic Science

29.1 Demonstrate knowledge of the anatomy and physiology of the renal excretory system

29.1.1 Functional Anatomy of the Kidneys, Ureters, and Bladder
   29.1.1.1 Description of the nephron
   29.1.1.2 Description of the renal circulation and its regulation

29.1.2 Physiology of Urine Formation
   29.1.2.1 Sodium filtration and reabsorption
   29.1.2.2 Water filtration and reabsorption
   29.1.2.3 Physiologic control of glomerular filtration and solute reabsorption

29.1.3 Neurohumoral Regulation of Renal Function
   29.1.3.1 Aldosterone
   29.1.3.2 Antidiuretic hormone
   29.1.3.3 Atrial natriuretic peptide
   29.1.3.4 Prostaglandins

29.1.4 Neuroendocrine Response to Stress of Trauma and Surgery

29.1.5 Effects of Anesthesia on Renal Function

29.1.6 Evaluation and Interpretation of Renal Function Tests
   29.1.6.1 BUN, creatinine, ratio, clearance
   29.1.6.2 Urinalysis: Na, osmolarity, proteinuria, hematuria, urine sediment

29.1.7 Pharmacology of the Renal System
   29.1.7.1 Potential nephrotoxic agents
   29.1.7.2 Renal excretion of anesthetic drugs
   29.1.7.3 Pharmacology and classification of diuretics
B) Renal Protection

29.2 Demonstrate an understanding of different renal protection strategies and the evidence in their use. The anesthesiologist must be able to describe an approach for renal protection.

C) Pathology

29.3 Demonstrate knowledge of pathologies related to the renal system:

29.3.1 Chronic Renal Failure
   29.3.1.1 Clinical characteristics / the uremic syndrome
   29.3.1.2 Dialysis treatment: indications, types, physiologic effects and complications
   29.3.1.3 Anesthetic management of the patient with chronic renal failure:
      29.3.1.3.1 Preoperative evaluation / optimization
      29.3.1.3.2 Monitoring
      29.3.1.3.3 Selection of anesthetic agents

29.3.2 Acute Renal Failure
   29.3.2.1 Pathophysiology of oliguria
      29.3.2.1.1 Types
      29.3.2.1.2 Diagnostic tests
      29.3.2.1.3 Management

29.3.3 Hepatorenal Syndrome
   29.3.3.1 Pathophysiology
   29.3.3.2 Treatment
   29.3.3.3 Response to liver transplant

D) Anesthesia for Urologic Procedures

29.4 Demonstrate an appreciation of the pathology that can alter normal renal physiology and the non physiologic insults to which patients might be subjected during urological procedures will help the anesthesiologist optimize preoperative preparation, intraoperative anesthetic management and postanesthetic care of these patients.

29.5 Demonstrate understanding of the considerations of, and to independently provide anesthetic care for patients presenting for the following procedures:

29.5.1 Transurethral Resection of the Prostate
   29.5.1.1 List the complications of TURP
29.5.1.2 Describe the TURP syndrome and its treatment

29.5.2 Prostatectomy: Open and Laparoscopic Lithotripsy
   29.5.2.1 Percutaneous ultrasonic lithotripsy
   29.5.2.2 Extracorporeal shock wave lithotripsy (ESWL)

29.5.3 Endourologic Procedures
   29.5.3.1 Urethral
   29.5.3.2 Bladder
   29.5.3.3 Ureteral

29.5.4 Nephrectomy
29.5.5 Renal Transplant
30 Respiratory Physiology and Thoracic Anesthesia

Upon completion of this training, the Anesthesiologist must demonstrate an in depth knowledge with respect to anatomy and physiology of the respiratory system.

A) Respiratory anatomy and physiology

30.1 Anatomy of respiratory tract
   30.1.1 Anatomy of the airway and upper airway muscles
   30.1.2 Anatomy of the Tracheobronchial tree
   30.1.3 Functional histology and anatomy of the alveolus
   30.1.4 Pulmonary and bronchial circulation
   30.1.5 Pulmonary lymphatics

30.2 Pulmonary physiology
   30.2.1 Pulmonary mechanics: Elastic forces and lung volumes
      30.2.1.1 Elastic recoil of the lungs and chest wall
      30.2.1.2 Surface tension, surfactant, and its effects on lung mechanics
      30.2.1.3 Alveolar, intrapleural and transmural pressures and their relationship
      30.2.1.4 Hysteresis
      30.2.1.5 Lung and chest wall compliance and elastance
      30.2.1.6 Static compliance versus dynamic compliance
      30.2.1.7 Lung volumes, Functional Residual Capacity (FRC)
      30.2.1.8 Physiologic changes with aging
      30.2.1.9 Principles of measurement of lung volumes, lung compliance

   30.2.2 Pulmonary mechanics: Respiratory system resistance
      30.2.2.1 Principles of gas flow and resistance: laminar flow, turbulent flow, flow through and orifice, Reynolds number
      30.2.2.2 Respiratory system resistance
      30.2.2.3 Gas trapping
      30.2.2.4 Airway closure, closing capacity and closing volumes
      30.2.2.5 Flow-related airway collapse
      30.2.2.6 Neuromuscular control of airway diameter
      30.2.2.7 Pharmacology affecting airway resistance
      30.2.2.8 Measurement of airway resistance and closing capacity
30.2.3 Control of breathing
   30.2.3.1 Central nervous system control of respiratory drive
   30.2.3.2 Peripheral receptors and respiratory drive
   30.2.3.3 Lung reflexes
   30.2.3.4 Carbon dioxide and respiratory control
   30.2.3.5 Oxygen, respiratory control and the response to hypoxia
   30.2.3.6 Effects of drugs on respiratory drive
   30.2.3.7 Methods of assessing control of breathing and sensitivity to hypoxia

30.2.4 Pulmonary ventilation
   30.2.4.1 Functional anatomy of the muscles of respiration
   30.2.4.2 Postural effects on respiratory muscle function
   30.2.4.3 Work of breathing
   30.2.4.4 Work against resistance
   30.2.4.5 Work against elastic recoil
   30.2.4.6 Measurement of ventilation
   30.2.4.7 Neuronal control of respiratory muscle function
   30.2.4.8 Respiratory muscle fatigue

30.2.5 Pulmonary circulation
   30.2.5.1 Pulmonary blood flow and blood volume
   30.2.5.2 Pulmonary vascular pressures
   30.2.5.3 Pulmonary vascular resistance
   30.2.5.4 Control of vascular tone – cellular mechanisms and neural control
   30.2.5.5 Control of vascular tone – pharmacology
   30.2.5.6 Effects of hypoxia and hypoxic pulmonary vasoconstriction
   30.2.5.7 Effects of lung volume
   30.2.5.8 Effect of lung inflation on pulmonary blood flow, pulmonary vascular resistance, and cardiac output
   30.2.5.9 Principles of measurement of pulmonary flow, cardiac output and pulmonary vascular resistance

30.2.6 Distribution of pulmonary blood flow and ventilation
   30.2.6.1 Distribution of ventilation
30.2.6.2 Anatomical distribution of ventilation
30.2.6.3 Gravitational effects on compliance and ventilation distribution
30.2.6.4 Gravitational effects on pleural pressure
30.2.6.5 Distribution related to rate of alveolar filling – time constants
30.2.6.6 Distribution of perfusion
30.2.6.7 Gravitational effects on perfusion distribution
30.2.6.8 Gravity independent determinants of regional blood flow, (cardiac output, lung volume)
30.2.6.9 West’s four zones of the lung
30.2.6.10 Ventilation: perfusion matching – V/Q ratio
30.2.6.11 Alveolar gas tensions
30.2.6.12 Dead space – anatomical and physiological
30.2.6.13 Quantification of dead space
30.2.6.14 Bohr, (dead space), equation
30.2.6.15 Venous admixture or shunt
30.2.6.16 Effect of V/Q ratio on arterial PO2
30.2.6.17 Measurement of ventilation / perfusion matching
30.2.6.18 Alveolar air equation
30.2.6.19 Measurement of dead space

30.2.7 Gas diffusion
30.2.7.1 Diffusion of oxygen from alveolus to the red blood cell (RBC)
30.2.7.2 Diffusion of oxygen within the RBC and uptake by hemoglobin
30.2.7.3 Diffusion of carbon monoxide by hemoglobin and measurement of diffusing capacity
30.2.7.4 Factors affecting diffusing capacity

30.2.8 Oxygen
30.2.8.1 The oxygen cascade
30.2.8.2 Factors affecting alveolar oxygen tension
30.2.8.3 The shunt equation
30.2.8.4 Oxygen carriage in the blood
30.2.8.5 Oxygen delivery and oxygen consumption and its measurement
30.2.8.6 Physical solution
30.2.8.7 Hemoglobin
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30.3 Non-respiratory functions of the lung

30.3.1 Filtration
30.3.2 Biological hazards
30.3.3 Metabolism of endogenous compounds
30.3.4 Pulmonary interstitial fluid mechanics
30.3.5 Starling equation

B) Physics of gas delivery - See Monitoring and Equipment 15.2

C) Inhaled Anesthetics - See Volatiles 34

D) Thoracic Anesthesia

30.4 Demonstrate the knowledge and ability to provide care for patients presenting for thoracic surgery, including but not limited to:

30.4.1 Preoperative assessment and optimization of the patient for thoracic surgery
30.4.2 Chest radiology
30.4.3 Fiberoptic bronchoscopy
30.4.4 Physiology of the lateral decubitus position, the open chest and one lung ventilation
30.4.5 Indications for one lung ventilation
30.4.6 Regional anesthesia for thoracic surgery
30.4.7 Anesthetic management for thoractomy and pulmonary resection
30.4.8 Anesthesia for esophageal and mediastinal surgery, including management of patients with a mediastinal mass
30.4.9 Management of thoracic trauma
30.4.10 Lung isolation for management of hemoptysis and bronchopleural fistula

E) Thoracic Surgical Procedures

30.5 Independently provide anesthetic management for:

30.5.1 Tracheostomy
30.5.2 Rigid and fiberoptic bronchoscopy
30.5.3 Bronchoscopy and Mediastinoscopy
30.5.4 One-lung ventilation
30.5.5 Lobectomy/Pneumonectomy
30.5.6 Esophageal resection
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31 Statistics

A) Definition of terms

31.1 Define the following statistical terms and state their differences where appropriate:

31.1.1 Mean; median; mode
31.1.2 Standard deviation (SD); standard error of the mean (SEM); 95% confidence interval (95% CI)
31.1.3 Type of data: continuous (ordinal/interval/ratio) vs. categorical (nominal)
31.1.4 Distribution of data: normal (Gaussian) vs. non-normal
31.1.5 $a$ and $P$ value (level of statistical significance) vs. $\beta$ and statistical power $(1-\beta)$
31.1.6 Type I error vs. type II error
31.1.7 One vs. two sample tests; multiple sample tests
31.1.8 One-tailed vs. two-tailed tests and when to use them
31.1.9 Linear regression vs. correlation
31.1.10 Bias

31.2 Define the following statistical terms and concepts, and independently compute corresponding values:

31.2.1 Sensitivity
31.2.2 Specificity
31.2.3 Positive predictive value
31.2.4 Negative predictive value
31.2.5 Incidence
31.2.6 Prevalence
31.2.7 Odds ratio
31.2.8 Relative risk
31.2.9 Absolute risk
31.2.10 Number needed to treat (NNT)
31.2.11 Number needed to harm (NNH)
31.2.12 Intention-to-treat analysis
B) Statistical tests

31.3 Demonstrate knowledge of when the following statistical tests should be used for the following data types:

31.3.1 Comparisons of two groups
   31.3.1.1 Continuous Gaussian data: Student’s $t$ test (parametric testing)
   31.3.1.2 Continuous non-Gaussian data: Mann-Whitney $U$ test/Wilcoxon rank-sum test (non-parametric testing)
   31.3.1.3 Categorical data: Fisher’s exact test or chi-square test (contingency tables)

C) Study Characteristics

31.4 Perform the following:

31.4.1 State the variables required for an a priori power analysis/sample size projection:
   31.4.1.1 Desired level of statistical significance ($\alpha$)
   31.4.1.2 Desired power ($1 - \beta$)
   31.4.1.3 Minimum clinically important difference to be detected

31.4.2 Evaluate statistical and clinical significance of the findings
   31.4.2.1 Correctly interpret P values
   31.4.2.2 Correctly interpret measures of data scatter/dispersion/variance (e.g. standard deviation)
   31.4.2.3 State the difference between primary and secondary outcome variables
   31.4.2.4 Define and state the differences between the following types of experimental design

31.4.3 Systematic reviews of the literature and meta-analyses
   31.4.3.1 Experimental studies
   31.4.3.2 Non-randomized and quasi-randomized controlled trials
   31.4.3.3 Randomized controlled clinical trials (RCTs)
      31.4.3.3.1 Double-blinded
      31.4.3.3.2 Single-blinded
      31.4.3.3.3 Non-blinded
   31.4.3.4 Observational analytic studies (retrospective or prospective)
      31.4.3.4.1 Cross-sectional studies
31.4.3.4.2  Case-control studies
31.4.3.4.3  Cohort studies

31.4.3.5  Descriptive studies
31.4.3.5.1  Surveys

31.4.4  Demonstrate awareness of the following methods/tools and be able to explain their purpose, but is not expected to manage by themselves
31.4.4.1  Univariate and multivariate statistics
31.4.4.2  Kaplan-Meyer analysis and comparison of survival curves (logrank test)
32 Thermoregulation

Upon completion of this training, the Anesthesiologist must demonstrate knowledge of the physiology and pathophysiology of thermoregulation and its’ relevance in Anesthesiology.

A) Basic Science

32.1 Define mild, moderate and deep hypothermia

32.2 Demonstrate knowledge of the mechanisms of heat loss during anesthesia

32.2.1 Convection

32.2.2 Conduction

32.2.3 Radiation

32.2.4 Evaporation

32.2.5 Decreased heat production/metabolism

32.2.6 Prepping, draping/exposure

32.2.7 IV fluid & blood products

32.2.8 Vasodilation/Central neural blockade

B) Principles of temperature measurement

32.3 Sites

32.4 Accuracy

C) Thermoregulation

32.5 Body Temperature Regulation

32.5.1 Neonate

32.5.2 Child

32.5.3 Adult

32.5.4 Elderly patient

32.6 Physiological changes with hypothermia

32.6.1 Cardiovascular

32.6.2 Respiratory

32.6.3 CNS

32.6.4 Metabolic/endocrine/trauma

32.6.5 Musculoskeletal

32.6.6 Renal
32.6.7 Haematological
32.6.8 GI

32.7 Effect of temperature on gases
32.7.1 Solubilities
32.7.2 Temperature compensation of arterial blood gases (ABGs)

D) Intraoperative heat loss

32.8 Demonstrate competence and knowledge of the description, mechanism, effectiveness, and complications of the following techniques:

32.8.1 Methods of prevention of heat loss and raise of body temperature under anesthesia
32.8.1.1 Ambient temperature
32.8.1.2 Humidification and circle systems
32.8.1.3 Fluid and blood warmers
32.8.1.4 Warming blankets
32.8.1.5 Reflection blankets
32.8.1.6 Core re-warming including CPB, bladder, peritoneal and other forms of dialysis
32.8.1.7 Body thermal gradients & complications of re-warming

32.8.2 Adverse consequences of hypothermia including the following:
32.8.2.1 Delayed awakening
32.8.2.2 Delayed drug metabolism
32.8.2.3 Shivering including increased oxygen consumption
32.8.2.4 Hypotension during re-warming
32.8.2.5 Impaired wound healing and infection
32.8.2.6 Cardiac complications (arrhythmias, ischemia, hypertension, poor peripheral perfusion)
32.8.2.7 Bleeding
32.8.2.8 Augmented hormonal and metabolic “Stress response”
32.8.2.9 Decreased patient comfort

E) Deliberate or therapeutic hypothermia

32.9 Cardiac surgery
32.10 Neurosurgery
32.11 Vascular surgery
32.12 Critically ill patient
32.13 Following cardiac arrest

F) Resuscitation Medicine

32.14 Implications of accidental hypothermia in non-anesthetized patients: Emergency Room or Intensive Care Unit
32.15 Alterations in ACLS protocols in severe hypothermia
32.16 Management of re-warming patients with severe hypothermia
33 Transplantation

A) Multiple organ donation

33.1 Preoperative evaluation and intraoperative management of organ donors
33.2 Define brain death, criteria for certifying brain death and various tests performed to confirm the diagnosis
33.3 Describe organ dysfunction after brain death especially cardiopulmonary complications, coagulopathy, temperature changes and diabetes insipidus
33.4 Describe the intraoperative management of multi-organ donors
   33.4.1 Multi-organ brain dead donors
   33.4.2 Living related donors for kidney & liver
   33.4.3 Donation after cardiac death (DCD)

B) Organ recipients

33.5 Manage recipients for organ transplantation
33.6 Describe the basic principles of immunosuppression and graft rejection
33.7 Reperfusion injury
33.8 Management of Hyperkalemia
33.9 Demonstrate an understanding of post transplant complications including rejection, infection, and immunosuppression, and be able to conduct anesthesia for surgical procedures in patients after organ transplantation
33.10 Transfusion medicine and coagulation management [See Hematology 11 F]]

C) Heart Transplantation

33.11 Patient Care
   33.11.1 Demonstrate an ability to:
      33.11.1.1 Conduct a preoperative evaluation of the patient presenting for cardiac transplantation
      33.11.1.2 Demonstrate awareness of the effects of end stage cardiac failure on other organ functions
      33.11.1.3 Determine the cardiovascular and pulmonary monitoring requirements for optimal anesthesia care
      33.11.1.4 Transport critically ill patients to and from the O.R. safely
      33.11.1.5 Demonstrate an understanding of:
         33.11.1.5.1 The principles of myocardial preservation
         33.11.1.5.2 The principles of extracorporeal circulation including ECMO,
circulatory assist devices and circulatory arrest

33.11.1.5.3 Monitoring the patient during cardiopulmonary bypass, and be able to separate a patient from cardiopulmonary bypass

33.11.1.5.4 Management of coagulation issues and blood component therapy

33.11.1.5.5 Monitoring, diagnosis and treatment of perioperative myocardial ischemia, cardiac arrhythmias and, left & right ventricular dysfunction

33.11.1.5.6 Monitoring, diagnosis and treatment of acute pulmonary dysfunction and pulmonary hypertension in the peri-operative period

33.12 Medical Knowledge

33.12.1 Perform a preoperative cardiac evaluation: History, medications, physical and airway examination, laboratory evaluation, CXR, EKG, stress testing, Echocardiography, cardiac catheterization data

33.12.2 Describe cardiac physiology: Cardiac cycle, pressure volume loops, systolic and diastolic function, preload, afterload, contractility

33.12.3 Describe coronary anatomy and physiology: Description of coronary anatomy, determinants of coronary blood flow, pathogenesis of myocardial ischemia, determinants of myocardial oxygen supply/demand ratio, coronary steal, coronary reserve

33.12.4 Demonstrate an understanding of the effects of cardiac deafferentation and deafferentation (Denervation physiology)

33.12.5 Describe relevant cardiovascular pharmacology

33.12.5.1 Inotropes and vasopressors agents

33.12.5.2 Beta-blockers

33.12.5.3 Calcium channel antagonists

33.12.5.4 Angiotensin converting enzyme inhibitors

33.12.5.5 Peripheral vasodilators

33.12.5.6 Antihypertensives

33.12.5.7 Pulmonary vasodilators

33.12.5.8 Antiarrhythmic drugs

33.12.5.9 Diuretics

33.12.5.10 Thrombolytics: TPA, uro- or streptokinase

33.12.5.11 Anticoagulants: Heparin and substitutes, warfarin, anti-platelet drugs

33.12.5.12 Heparin reversal agents – Protamine, heparinase

33.12.5.13 Antifibrinolytics: Epsilon aminocaproic acid, tranexamic acid,
aprotinin

33.12.5.14 Miscellaneous: Magnesium, DDAVP, Potassium

33.12.6 Describe relevant anesthetic pharmacology in relation to cardiac function and preconditioning

33.12.7 Demonstrate an understanding of:

33.12.7.1 Extra corporeal membrane Oxygenation
33.12.7.2 CardioPulmonary Bypass (CPB)
33.12.7.3 Initiating and weaning from CPB
33.12.7.4 Myocardial protection during CPB
33.12.7.5 Problems during weaning from cardiopulmonary bypass
33.12.7.6 Mechanical support as a bridge to transplantation: Types, indications/contraindications, complications and limitations
33.12.7.7 Circulatory assist devices
33.12.7.8 Intra-aortic balloon pump counter pulsation (IABP): indications, contraindications, insertion techniques and complications
33.12.7.9 Management of right heart failure, specific pulmonary vasodilators
33.12.7.10 Independently manage anesthesia for surgical procedures after heart transplantation

D) Lung Transplantation

33.13 The consultant Anesthesiologist must demonstrate knowledge of:

33.13.1 Preoperative assessment of a patient before lung transplantation
33.13.2 Anesthetic management of lung transplant recipient
33.13.3 Monitoring during lung transplantation
33.13.4 Management of one lung ventilation, indications for cardiopulmonary bypass
33.13.5 Anesthesia for surgical procedures after lung transplantation
33.13.6 Outcomes

33.14 The subspecialist Anesthesiologist must demonstrate an ability to independently provide anesthetic care for the patient undergoing lung transplantation
E) Liver Transplantation

33.15 Manage a patient undergoing liver transplantation:

33.15.1 Medical Knowledge - Basic Science

33.15.1.1 Demonstrate knowledge of:

33.15.1.1.1 The pharmacology of various drugs in patients with end stage liver disease
33.15.1.1.2 Hepatic physiology
33.15.1.1.3 Antifibrinolytic agents
33.15.1.1.4 Interpret arterial blood gases and acid base balance
33.15.1.1.5 Interpret hemodynamic parameters
33.15.1.1.6 Physiology and monitoring of Coagulation system
33.15.1.1.7 Stages of liver transplantation
33.15.1.1.8 Transfusion medicine

33.15.2 Clinical Knowledge

33.15.2.1 Causes of liver dysfunction
33.15.2.2 Indications and contraindications for liver transplantation
33.15.2.3 Effect of liver failure on all organ systems
33.15.2.4 Scoring systems for severity of liver disease
33.15.2.5 Treatment of Hyperkalemia
33.15.2.6 Transfusion medicine

33.15.3 Patient Care

33.15.3.1 The subspecialist transplant Anesthesiologist must be able to provide anesthetic care for patients undergoing liver transplant surgery and are expected to demonstrate and ability to:

33.15.3.1.1 Perform preoperative evaluation of patients with end-stage liver disease

33.15.3.1.2 Manage recipients of cadaveric or living related liver transplant

33.15.3.1.2.1 Formulate anesthetic plan
33.15.3.1.2.2 Appropriate preparation
33.15.3.1.2.3 Manage patients during three phases of liver transplantation
33.15.3.1.2.4 Interpret different coagulation parameters and treat coagulopathies
33.15.3.1.2.5 Assess and manage blood volume status
33.15.3.1.2.6  Treat hyperkalemia and correct other electrolyte abnormalities
33.15.3.1.2.7  Treat reperfusion syndrome
33.15.3.1.2.8  Prevent and treat anemia
33.15.3.1.2.9  Prevent infection
33.15.3.1.2.10 Maintain normothermia
33.15.3.1.2.11 Transport and hand over the post transplant patient to the ICU staff
33.15.3.1.2.12 Management of patients for living donor hepatectomy and major liver resection
34 Volatile Agents

Upon completion of this training, the Anesthesiologist must demonstrate knowledge of the volatile anesthetics with regard to safety, and efficacy, toxicity, and inertness of halogenated gases currently in use. The anesthesiologist must be able to discuss the theories of the mechanism of action of inhaled anesthetics, including but not limited to:

- Nitrous Oxide
- Ether, chloroform, trichloroethylene, methoxyflurane, cyclopropane
- Halothane, enflurane, isoflurane, desflurane, sevoflurane

A) Physical Characteristics

34.1 Explain and demonstrate knowledge of the following pharmacokinetic concepts:

34.1.1 Physical characteristics of gases
   34.1.1.1 Chemical potential (escaping tendency)
   34.1.1.2 Vapour pressure
   34.1.1.3 Boiling point
   34.1.1.4 Mixtures
   34.1.1.5 Gases in solutions
   34.1.1.6 Gas-liquid interface
   34.1.1.7 Tension or partial pressure
   34.1.1.8 Fractional volume
   34.1.1.9 Solubility

34.1.2 Properties of Inhaled Anesthetics
   34.1.2.1 Bidirectional transfer and equilibration
   34.1.2.2 Relative lack of absorption by tissues
   34.1.2.3 Metabolism

34.1.3 Uniqueness of Inhaled Anesthetics
   34.1.3.1 Route of administration
   34.1.3.2 Bidirectionality and equilibrium
   34.1.3.3 Adjustability
B) Uptake and Distribution

34.2 Demonstrate a thorough understanding of the concepts underlying uptake and distribution, and the factors which increase and decrease the rate of rise of alveolar fraction/inspired fraction \( (F_a/F_i) \)

34.2.1 Alveolar gas concentration/Inspired gas concentration \( (F_a/F_i) \)

34.2.1.1 Effect of fresh gas flow
34.2.1.2 Capacity of circuit
34.2.1.3 Effect of fractional concentration or pressure of gas
34.2.1.4 Effect of time and time constant
34.2.1.5 1st order kinetic
34.2.1.6 Effect of circuit absorbents
34.2.1.7 Theory with and without uptake
34.2.1.8 Effect of FRC
34.2.1.9 Effect of ventilation perfusion mismatching
34.2.1.10 Concentration effect
34.2.1.11 Overpressurization
34.2.1.12 Second Gas effect

34.2.2 Compartment model
34.2.3 Vessel Rich group/Muscle/Fat/Vessel – poor group
34.2.4 Gradient from machine to brain
34.2.5 Partition coefficients
  
34.2.5.1 Blood gas
34.2.5.2 Blood brain

34.2.6 Clinical differences between prolonged and short anesthesia
34.2.7 Elimination
34.2.8 Percutaneous and visceral
34.2.9 Diffusion between tissues
34.2.10 Metabolism
34.2.11 Exhalation
34.2.12 Diffusion hypoxia
C) Toxicity

34.3 Discuss and describe the metabolism and biotransformation of volatile agents

34.3.1 Desflurane and Carbon Monoxide

34.3.2 Effect of hepatic and renal disease on metabolism

34.3.3 Sevoflurane and compound A

34.3.4 Fluoride production

34.3.5 Clinical overview of agents

D) Occupational Exposure

34.4 Demonstrate knowledge of the occupational and environmental concerns in the use of volatile anesthetic agents

E) Pharmacology

34.5 Demonstrate knowledge with respect to the following issues related to use of the various agents:

34.5.1 Halothane

34.5.1.1 Solubility and metabolism

34.5.1.2 Controversy over its’ continued use

34.5.2 Enflurane and Isoflurane

34.5.2.1 Fluoride production

34.5.2.2 Seizure activity on EEG

34.5.2.3 Coronary Steal controversy

34.5.3 Desflurane

34.5.3.1 Blood gas solubility

34.5.3.2 Relative lack of Low potency, stability, pungency, high vapour pressure

34.5.3.3 Peculiarity of vaporizer

34.5.3.4 Tachycardia and hypertension

34.5.3.5 Low metabolism

34.5.3.6 Effect of dry carbon dioxide (CO₂) absorbent and carbon monoxide (CO) production

34.5.3.7 A role in outpatient surgery
34.5.4 Sevoflurane
   34.5.4.1 Acceptability as inhalational induction agent
   34.5.4.2 Solubility
   34.5.4.3 Coronary vasodilation and pre-conditioning
   34.5.4.4 Non-production of antibody formation
   34.5.4.5 CO production and heat
   34.5.4.6 Compound A during low flow anesthesia
   34.5.4.7 Nephrotoxicity controversy – Fluoride

34.5.5 Nitrous Oxide
   34.5.5.1 Characteristics
   34.5.5.2 Role as adjuvant
   34.5.5.3 Controversies
   34.5.5.4 Effect of PONV
   34.5.5.5 Inactivation of B12 metabolism
   34.5.5.6 Effect on closed, and potential air spaces
   34.5.5.7 Environmental considerations

F) Clinical Effects

34.6 Discuss and describe the following with respect to clinical utility of volatile agents:

   34.6.1 Minimum Alveolar Concentration (MAC)
      34.6.1.1 Definitions, types (MAC awake, MAC movement, MAC aware, MAC BAR)
      34.6.1.2 Describe the factors that increase and decrease MAC
      34.6.1.3 MAC for commonly used agents

   34.6.2 Induction
      34.6.2.1 Volatile induction
      34.6.2.2 Appropriate agents
      34.6.2.3 Risks and benefits

   34.6.3 Maintenance
      34.6.3.1 Safety
      34.6.3.2 Adjustability
34.6.3.3 Generalizability of use regardless of age, habitus
34.6.3.4 Cardiac and cerebral blood flow
34.6.3.5 Predictable recovery
34.6.3.6 Absence of analgesia
34.6.3.7 Post-operative nausea and vomiting (PONV)
34.6.3.8 CO and Hepatitis

34.6.4 Central Nervous System
34.6.4.1 Cerebral Metabolic Rate of oxygen (CMRO$_2$) – effect on EEG
34.6.4.2 Cerebral Blood Flow (CBF)
34.6.4.3 ICP
34.6.4.4 Autoregulation and Uncoupling
34.6.4.5 Role of individual agents
34.6.4.6 Role of nitrous oxide
34.6.4.7 Effect on CSF production
34.6.4.8 Effect on response to hyper and hypocarbia
34.6.4.9 Cerebral protection

34.6.5 Circulatory System
34.6.5.1 Hemodynamics
34.6.5.2 Cardiac Index
34.6.5.3 Central Venous Pressure (CVP)
34.6.5.4 Systemic vascular resistance, pulmonary vascular resistance
34.6.5.5 Contractility
34.6.5.6 Other effects
34.6.5.7 Distribution of blood flow
34.6.5.8 Halothane, sensitization of myocardium
34.6.5.9 Relation to adrenaline

34.6.6 Pulmonary System
34.6.6.1 Effects in spontaneously breathing patients
34.6.6.2 Resting Arterial pressure of carbon dioxide (PaCO$_2$)
34.6.6.3 Mechanics of ventilation
34.6.6.4 Response to Carbon Dioxide (CO$_2$)
34.6.6.5  Response to hypoxia
34.6.6.6  Smooth muscle tone and bronchodilations
34.6.6.7  Mucociliary function
34.6.6.8  Pulmonary vascular resistance and hypoxic pulmonary vasoconstriction (HPV) and relevance to one-lung ventilation (OLV)

34.6.7  Liver
34.6.7.1  Relevance of hepatic blood supply and architecture of the liver
34.6.7.2  Effects of volatile agents
   34.6.7.2.1  Mechanisms for Halothane Hepatitis
34.6.7.3  Antibody formation
34.6.7.4  Mechanism for
34.6.7.5  Epidemiology
34.6.7.6  Non-antibody mediated mild form

34.6.8  Neuromuscular System and Malignant Hyperthermia (MH)
34.6.8.1  Effect on skeletal muscle
34.6.8.2  Triggering of MH response; relative potency of different agents
34.6.8.3  Investigation for MH
34.6.8.4  Reproductive and genetic effects
34.6.8.5  Limitation of animal studies
34.6.8.6  Low grade long term exposure

34.6.9  Effects of Volatile Agents in Pregnant Patients
34.6.9.1  Effect of methionine synthetase and thymidylsynthetase by nitrous oxide
34.6.9.2  National Institute for Occupational Safety and Health (NIOSH) standards
34.6.9.3  Effect on Uterine Smooth Muscle
34.6.9.4  Effect on fetus
34.6.9.5  Effect on fetal loss
34.6.9.6  Toxicity

34.6.10  Nitrous Oxide
34.6.10.1  Effect on sympathetic nervous system (SNS)
34.6.10.2 Preconditioning and cardioprotection
34.6.10.3 Autonomic effects
34.6.10.4 Effect on baroreflexes
34.6.10.5 Effect on Sympathetic Outflow (Desflurane)
Appendix A: List of Contributors

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