Retrospective on the Future: Brain Death and Evolving Legal Regimes for Tissue Replacement Technology

Derek J. Jones

In North America, the medico-legal definition of death has played an important role in facilitating organ transplantation. In the quarter century since the initial proposal of "brain death" criteria, acceptance of the criteria has helped standardize medical practice for the termination of life support, organ procurement and post-mortem donor patient management. In the author's view, it has provided a foundation for the reflection and judgments of North American courts in so-called "right to die" cases and even criminal trials. It has helped some families with loved ones who lie in a coma. Some would say that the new death standard has, in fact, advanced the societal value for human life. The author argues, however, that even with such benefits the new standard raises daunting "second generational questions" for law, medicine and bioethics. Seen in a broader perspective, brain death stands as one of the many fundamental pillars in the legal regime which North American society has erected to govern modern tissue replacement technology. The author demonstrates how this currently evolving regime parallels previous and foresees emerging legal regimes for the therapeutic transfer of human tissue, bodily parts and substances.

In Amérique du Nord, la définition médicale et juridique de la mort joue un rôle important dans les transplantations d'organes. Depuis vingt-cinq ans, l'adoption du concept de "mort cérébrale" a aidé la médecine dans plusieurs domaines. Comme la cessation de traitement, l'obtention et le don d'organes. L'auteur nous dit que ce concept a guidé la réflexion et les jugements des tribunaux nord-américains dans des causes dites "droit de mourir" et même dans des procès criminels. Il a également aidé des familles dont un des membres était dans le coma. Certains seraient tentés de dire que l'adoption du critère de la mort cérébrale a eu pour effet de protéger davantage la vie. L'auteur prétend cependant que cette définition de la mort n'est pas sans poser d'importants problèmes en droit, en médecine et en bioéthique. Dans une perspective plus large, la mort cérébrale constitue un élément fondamental du régime juridique nord-américain régnant la technologie moderne de remplacement des tissus. L'auteur termine en examinant les liens entre le régime actuel et les régimes précédents et futurs en matière de transplantation thérapeutique de tissus, parties et substances du corps humain.

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Brain death, it would seem, is a generally accepted concept in the medical and legal communities in North America. Evidence of the acceptance comes from the fact that hospitals, neurologists and transplant specialists now routinely rely on brain death protocols for the determination and timing of death. Moreover, the concept has been adopted by provincial and model uniform legislation and the Law Reform Commission in Canada, some forty-nine states and the

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5New Jersey Commission on Legal and Ethical Problems in the Delivery of Health Care, Problems and Approaches in Health Care Decisionmaking: The New Jersey Experience (New Jersey: The Commission, 1990) at 11 [hereinafter New Jersey Experience]. Over half of the U.S. jurisdictions have enacted laws based on a model law of the National Conference of Commissioners on
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President’s Commission in the United States and several judicial decisions and bioethical commissions.7

But if brain death protocols and laws today enjoy general support and help facilitate the life-saving process of transplanting organs from the deceased into the living, it has not always been so in North America. If we cast our minds back to national and international events of more than a quarter of a century ago, what lessons may be drawn from the development of medico-legal reforms of the definition of death? What, if anything, does this story counsel in terms of the reform of laws and policies on modern tissue transplant and tissue replacement technologies?

In the discussion that follows, these and like questions are examined. Part I explores the origins, cultural rationales and current limits of brain death in North America. Part II suggests a broader perspective on these reforms by comparing them with prior and more recent legal initiatives to facilitate medical uses of the human body.

I. Brain Death: Humankind and Its Machines

Science is committed to the universal. A sign of this is that the more successful a science becomes the broader the agreement about its basic concepts ... As the corollary of science, technology also exhibits the universalizing tendency ... If humans create machines, machines in turn shape their creators.9

May it accurately be said of modern medicine that humankind is in the process of disappearing into the machines we have created? The origins of, need for and consequences of the brain death standard portray something of a modern effort to live outside of and harmoniously with our technological creations.

A. Origins

The origin of the brain death criteria in Canada is a story that probably parallels those experienced by many countries in the 1960s. Then, a series of rather dramatic international events cumulatively forced the medical and legal communities to question, rethink and then propose modifying the traditional standard of death — irreversible heart-lung cessation.

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logical response to the treatment of disabling or paralytic forms of respiratory failure like polio:

Prolonged mechanical ventilation first became a reality in the midst of the worldwide epidemics of poliomyelitis during the first half of this century. In Europe and the United States, thousands of victims who suffered respiratory paralysis were sustained for months or years with “iron lungs” and other early types of ventilators.10

How much suffering was alleviated, how many lives were saved by these medical devices, we may never know. By the 1950s, when the advent of safe and effective vaccines helped eliminate polio as a major public health problem, more sophisticated and efficient respirators had made their way into critical care areas such as the emergency units, operating theatres and anaesthesia departments of hospitals. Thus, artificial respiration technology was becoming a modern standard of care when Boston doctors first successfully transplanted a human organ — a kidney — from one twin to his ailing brother in 1954.11

The therapeutic benefits imparted by these machines, however, had already begun to impose clinical and even moral burdens. What, as an eminent theological authority of the day asked, were doctors to do when artificial respiration and mechanical life support seemed to be the true source of life in a severely brain-damaged individual who had been resuscitated?

If the lesion of the brain is so serious that the patient will very probably, and even most certainly, not survive, the anaesthesiologist is then led to ask himself the distressing question as to the value and meaning of the resuscitation process ... Out of this situation there arises a question that is fundamental ... When ... has death occurred in patients on whom modern methods of resuscitation have been used?12

Doctors turned to the moral authority of the Church for answers to such dilemmas. Pope Pius XII’s 1957 response framed the issue, its implications and challenge for decades:

The question of the fact of death and that of verifying the fact itself ... or its legal authenticity ... have ... in the field of morals and of religion, an even greater importance ... The importance of the question extends also to effects in matters of inheritance, marriage and matrimonial process ... and to many other questions of private and social life. It remains for the doctor ... to give a clear and precise definition of “death” and “the moment of death” of a patient ... 13

These words reverberated in the early legal controversies over the medical and legal definition of death. One of the first controversies in common law countries arose in 1963 out of a British inquest into the death of John D. Potter, a 32-year-old man who had received extensive brain damage during a fight.14

Uniform State Laws; see the Uniform Determination of Death Act, 12 U.L.A. 338 (1991 Supp.).
10See e.g. supra note 5 and infra notes 25-36.
12See ibid. at 247.
Fourteen hours after admission to a hospital, Potter stopped breathing. To preserve the possibility of transplanting his organs, doctors attached Potter to a respirator for a day, secured familial consent and removed a kidney. The doctors thereafter withdrew the respirator and Potter evidenced no signs of spontaneous respiration. Unfortunately, the transplant recipient died within a month, though this was the year in which Boston doctors were to perform one of the first successful kidney transplants between a deceased unrelated donor and a living recipient.\(^{15}\)

In the ensuing inquest, some of the reports adduced as evidence apparently set the time of Potter’s death as occurring before the transplant; other reports set the time of death afterwards. Despite such uncertainties, the neurological and pathological medical testimony presented led a coroner’s jury to conclude that transplantation had not contributed to death. The jury returned a verdict of manslaughter against Potter’s assailant. Thus was first presented what might be called the “Potter defense”: namely, an accused’s argument that death was caused not by the accused’s assault, but by the doctors who removed the victim’s kidneys for transplantation or by the doctors who turned off the respirator. Though in this instance the argument had unsuccessfully exploited the divergence between the traditional designation of death and modern medical practices, it still bluntly highlighted the criminal liability concerns for transplant surgeons, neurosurgeons and critical care medical personnel.

Some of the broader issues surrounding the Potter defense were explored in an international multidisciplinary symposium on ethics and transplantation in 1966. Was modern society, in fact, working with two definitions of death, the traditional “legal” one and a new “medical” one? Some conference participants remarked that conventional death criteria created clinical and “moral” problems for the termination of mechanical support. Others saw the criteria as impeding transplantation, while still others debated whether five proposed criteria for irreversible brain damage, based on neurological and pathological studies dating from 1959, established “incontrovertible evidence of death.”\(^{16}\)

Neither the conference nor the Potter case was explicitly mentioned two years later, in the threshold summer of 1968, when an ad hoc committee of Harvard University proposed a new definition of death. The proposal spoke to the core concerns raised by the conference two years earlier, by the Potter case in 1963 and by the Pope in 1957:

Our primary purpose is to define irreversible comas as a new criterion for death. There are two reasons why there is a need for a definition: (1) Improvements in resuscitative and supportive measures have led to increased efforts to save those who are desperately injured. Sometimes these efforts have only partial success so that they result in an individual whose heart continues to beat but whose brain is irreversibly damaged. The burden is great on patients who suffer permanent loss in intellect, on their families, on the hospitals ... (2)Obsolete criteria for the

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\(^{15}\) L.P. Merrill \textit{et al.}, “Successful Transplantation of Kidney from a Human Cadaver” (1963) 185 J.A.M.A. 347.


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definition of death may lead to controversy in obtaining organs for transplantation ... More than medical problems are present. There are moral, ethical, religious and legal issues. Adequate definition here will prepare the way for better insight into all of these matters as well as for better law that is currently applicable. [emphasis added]\(^{17}\)

The historical import and meaning of the Harvard proposal may be seen in the fuller light of events that made 1968 a milestone year in transplant history. In January, South African surgeon Christian Barnard — who had recently startled the world by performing the first successful human heart transplantation — drew further international scrutiny to the transplant community by performing a second one less than two weeks after the death of the first recipient. The first recipient survived 18 days; the second survived over 18 months.\(^{18}\) In April, France became one of the first countries to give legal effect to a new definition of death by adopting brain death criteria in a ministerial decree.\(^{19}\) In June and August, two international medical assemblies issued declarations on the role of irreversible cessation of cerebral function(s) as criteria for death and in the selection of transplant donors.\(^{20}\) In November, the Canadian Medical Association endorsed the need for new death criteria based on “cerebral function.”\(^{21}\) Hence, while the Harvard criteria were not the first to proclaim a revised standard, nor the first to give brain death legal effect, the criteria proved of such telling effect, in part, because they were so timely; in part, because they spoke authoritatively and cogently for an emerging consensus of experience and thought in the international medical community.

Canada was not immune from the international events and reflection, as evidenced by the 1968 declaration of the Canadian Medical Association. The Canadian medical community performed kidney and then heart transplants through the 1960s. These modern practices and medical technologies eventually combined with man’s ancient combatant rituals to oblige the Canadian legal community to question, study and then reform the definition of death.

A criminal court room in the western province of Manitoba provided the initial forum for change in 1970. In facts similar to those that had arisen seven years earlier in Britain, a man named Page invoked the “Potter defense” to
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17Ad Hoc Committee of the Harvard Medical School to Examine the Definition of Brain Death, “A Definition of Irreversible Coma” (1968) 205 J.A.M.A. 337.
refute a charge that he had killed a man whom he had severely beaten. Page argued that the hospital treatment of the injured man — specifically, the removal of decedent’s kidneys for transplant and the subsequent withdrawal of the respirator — had caused death. The Page jury followed the initial Potter jury and rejected the first invocation of the “Potter defense” in Canada: it returned a conviction for manslaughter.

Due in part to Page, the Manitoba Law Reform Commission recommended in 1974 that Manitoba enact a legislative definition of death based on the irreversible cessation of brain function. The Manitoba Legislature heeded the advice in 1975. A year later, the highest court of Manitoba upheld a jury’s implicit reliance on brain death criteria after the jury rejected the Potter defense the second time when it was raised in a Canadian criminal trial. Influenced by the reforms in Manitoba and foreign jurisdictions, the Law Reform Commission of Canada studied the issues in 1979 and recommended the enactment of a federal statutory definition of death in 1981, the same year that the U.S. President’s Commission issued its influential report which drew similar conclusions.

## B. Cultural Needs and Consensus

Any narrative of the origins of brain death criteria in Canada and the United States seems unlikely to capture the full story if it fails to speak of the human impact that ambiguity and reform may have on cultural identity. For

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23Ibid.
24An Act to Amend the Vital Statistics Act, S.M. 1975, c. 5, s. 1: When death occurs:
2.1 For all purposes within the legislative competence of the Legislature of Manitoba the death of a person takes place at the time which irreversible cessation of all that person’s brain functions occurs.
27See Report 15, supra note 4 at 10.

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within the shared customs, beliefs, values and knowledge that help identify the culture of given peoples lie diverse communities and individuals. Even within particular cultures, communities will often subscribe to thinking, customs and attitudes that make them distinct. It is in this sense that the technological imperatives of modern respiratory therapy and transplantation bound diverse communities — patients and their families, nurses and neurologists, theologians and lawyers — in a new, ill-defined technological culture that needed norms, common language and beliefs and more clearly defined roles and expectations, to enable affected individuals and communities to interact more easily and meaningfully.

Indeed, we in the technologically-laden culture of North America still need some minimally common ways of viewing, thinking about and interacting with our neighbour who lies hospitalized and maintained by artificial respirators and circulators with no brain functions. Surely it matters that, under traditional criteria of respiring lungs, circulating blood and a normal body temperature, we would regard her as alive. Surely it also matters that the mechanical support she receives has obscured and eroded the utility of the traditional standards. The questions, suffering and uncertainty provoked by countless such scenarios in hospitals on different continents over the last three decades have helped forge at least four points of consensus on the substance and process of formulating a modern concept of death in the West.

- First, death is a religious, moral and legal concept, even if the early calls for revised norms were sounded initially by the medical community. An emerging consensus on the clinical need for and scientific basis of revised death criteria made the medical community a leading proponent of change. But Pope Pius the XII’s 1957 discourse and the Harvard Committee’s 1968 proposal illustrate the early consciousness that these matters transcend the confines of medicine and must include reflection from the theological, ethical and legal communities.

- Secondly, the removal of legal ambiguity over the modern life-death line proved to be a major catalyst for law reform. The confusion and challenge raised by the “Potter defense” in Britain in the early 1960s prodded legislatures to enact and courts to adopt or affirm brain death criteria in numerous jurisdictions, including Manitoba and Kansas in the 1970s, New York in 1984 and most recently in Minnesota in 1989. Beyond the criminal liability concerns, legal reform was needed because the timing and determination of death affects individuals’ rights and duties in inheritance, wrongful death, civil liability, fami-
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ily law matters, and medical examiner and coroner cases. Such considerations have persuaded the Law Reform Commission of Canada, the U.S. President’s Commission and other public analysts to premise reform on a “unitary concept” of death, which is to say that the revised criteria shall apply uniformly in diverse legal contexts.

Thirdly, and as something of a corollary to the unitary concept of death, many analysts agreed on the need for fair and neutral principles and procedures in defining and applying the criteria for determining death. One professor critiqued the first brain death statute in North America, for example, as being unduly biased towards transplantation, because it might lend the public perception that the law was “being re-written in favour of the potential recipient and against the interests of the moribund donor.” The concern raises basic issues of bioethical justice and the role of the law in distributing benefits and burdens in the process of reform. These neutrality principles have helped to structure the new routine procedural requirement that doctors involved in determining brain death not be involved with transplant procedures. They have also persuaded some legal analysts that while legal reforms might facilitate organ transplantation, transplant concerns alone did not justify modifying the legal definition of death. Such concerns have more recently persuaded North American analysts to reject amending the definition of death solely to facilitate organ procurement from moribund anencephalic newborns.

35See Working Paper 23, supra note 26 at 18-22. See also text accompanying note 13.
36See e.g. Report 15, supra note 4 at 12; Defining Death, supra note 6 at 60. But see the New Jersey Declaration of Death Act, 1991 N.J. Laws 90, §5 (exemption for religious purposes), enacted following the recommendations of the New Jersey Experience, supra note 5 at 34, 35.
37See supra note 32.
40See Determination of Death, supra note 29 at 6. See also Report 15, supra note 4 at 12; Defining Death, supra note 6 at 1.
41Proponents of designating moribund anencephalic newborns as legally “dead” tend to ground their proposal on the primacy of saving life and on a view that the mental and medical status of anencephalic newborns disqualifies them from being moral or legal “persons.” See M. Harrison, “The Anencephalic Newborn as Organ Donor” (1986) 16:2 Hastings Centre Rep. 21. Opponents of designating moribund anencephalic newborns as legally “dead” also place high value on saving life. However, they reject the proposition on the basis of the general unitary and neutrality principles outlined in the text accompanying notes 37-41 above and on the specific grounds of (a) medical uncertainty in the diagnosis of brain death and anencephaly; (b) violating deontological humanitarian ethical injunctions against treating patients as mere means to an end; (c) slippery slope concerns, or precedent momentum, about designating other severely disabled humans as dead simply to expand the organ donor pool; (d) concerns about discriminating against severely disabled persons; and (e) the alternative of donating non-vital organs or tissues after the infant has, in fact, died. See Working Paper 66, supra note 25 at 95-106, 176; New Jersey Experience, supra note 5 at 21-22. For the most recent North American case, see In re T.A.C.P., 609 S.2d 588 (Fla. 1992) (declining to declare live-born anencephalic infant dead for purposes of vital organ donation). For contrasting perspectives on the transplantation of anencephalic organs from a Canadian donor to a Californian recipient, see G. Anns, “From Canada with Love: Anencephalic Newborns as Organ Donors?” (1987) 17:6 Hastings Centre Rep. 36; T. Frewan et al., “Anencephalic Infants and Organ Donation: The Children’s Hospital of Western Ontario Experience” (1990) 22 Transpl.
42See supra notes 12, 13.
43See supra note 20.
44See supra notes 14, 19, 22.
45See supra notes 17, 21.
ily law matters, and medical examiner and coroner cases. Such considerations have persuaded the Law Reform Commission of Canada, the U.S. President's Commission and other public analysts to premise reform on a "unitary concept" of death, which is to say that the revised criteria shall apply uniformly in diverse legal contexts.

Thirdly, and as something of a corollary to the unitary concept of death, many analysts agreed on the need for fair and neutral principles and procedures in defining and applying the criteria for determining death. One professor criticized the first brain death statute in North America, for example, as being unduly biased towards transplantation, because it might lead the public perception that the law was "being re-written in favour of the potential recipient and against the interests of the moribund donor." The concern raises basic issues of bioethical justice and the role of the law in distributing benefits and burdens in the process of reform. These neutrality principles have helped to structure the now routine procedural requirement that doctors involved in determining brain death not be involved with transplant procedures. They have also persuaded some legal analysts that while legal reforms might facilitate organ transplantation, transplant concerns alone did not justify modifying the legal definition of death. Such concerns have more recently persuaded North American analysts to reject amending the definition of death solely to facilitate organ procurement from moribund anencephalic newborns.

35See Working Paper 23, supra note 26 at 18-22. See also text accompanying note 13.
36See e.g. Report 15, supra note 4 at 12; Defining Death, supra note 6 at 60. But see the New Jersey Declaration of Death Act, 1991 N.J. Laws 90, §5 (exemption for religious purposes), enacted following the recommendations of the New Jersey Experience, supra note 5 at 34, 35.
37See supra note 32.
39See e.g. Donation Act, supra note 3, s. 11(2). See also World Health Organization, "Guiding Principles on Human Organ Transplantation" (1991) 337 Lancet 1470, Principle 2.
40See Determination of Death, supra note 29 at 6. See also Report 15, supra note 4 at 12; Defining Death, supra note 6 at 1.
41Proponents of designating moribund anencephalic newborns as legally "dead" tend to ground their proposal on the primacy of saving life and on a view that the mental and medical status of anencephalic newborns disqualifies them from being moral or legal "persons." See M. Harrison, "The Anencephalic Newborn as Organ Donor" (1986) 16:2 Hastings Centre Rep. 21. Opponents of designating moribund anencephalic newborns as legally "dead" also place high value on saving life. However, they reject the proposition on the basis of the general unitary and neutrality principles outlined in the text accompanying notes 37-41 above and on the specific grounds of (a) medical uncertainty in the diagnosis of brain death and anencephaly; (b) violating deontological humanitarian ethical injunctions against treating patients as a mere means to an end; (c) slippery slope concerns, or precedential momentum, about designating other severely disabled humans as dead simply to expand the organ donor pool; (d) concerns about discriminating against severely disabled persons; and (e) the alternative of donating non-vital organs or tissues after the infant has, in fact, died. See Working Paper 66, supra note 25 at 95-106, 176; New Jersey Experience, supra note 5 at 21-22. For the most recent North American case, see In re T.A.C.P., 609 S.2d 588 (Fla. 1992) (declining to declare live-born anencephalic infant dead for purposes of vital organ donation). For contrasting perspectives on the transplantation of anencephalic organs from a Canadian donor to a Californian recipient, see G. Anns, "From Canada with Love: Anencephalic Newborns as Organ Donors?" (1987) 17-6 Hastings Centre Rep. 36; T. Frewan et al., "Anencephalic Infants and Organ Donation: The Children's Hospital of Western Ontario Experience" (1990) 22 Transpl.
42See supra notes 12, 13.
43See supra note 20.
44See supra notes 14, 19, 22.
45See supra notes 17, 21.
Finally, brain death criteria have helped to create a new class of mechanically-sustained dead patients, who would seem to require new ethical and legal rules for when they are pregnant, when they are considered for gamete donation, when they are used in non-consensual medical research and when they become the object of dispute between hospitals and families unwilling to consent to donation of the patients’ organs. Such are some of the second generation legal issues presented in North America after decades of reform on the legal definition of death.

II. A Broadened Perspective on Brain Death and Tissue Transfer Regimes: Three Waves of Legal Reform

In many respects the process, merits and principles that guided the development of brain death criteria in North America illustrate many of the dynamics that compel modern medico-legal reforms. It is no longer true that brain death is determined by a single act of parliamentary fiat. The brain death issue is a case study of the complex interplay between the technical and legal aspects of brain death and the political and social factors that shape the course of medicine.

A. Anatomy Age

The first wave began three centuries after the Italian medical professor Andreas Vesalius published his 1543 treatise De Humani Corporis Fabrica, which ushered in the modern anatomical age.

In the autumn of 1843, some two decades after McGill University established the first medical school in Canada, the Medical Board of Montreal petitioned the Legislative Assembly of the Province of Canada to pass an Anatomy Act. The petition was submitted after numerous episodes in which the securing, by medical school students, of dead bodies from Montreal graveyards had provoked public outcry and political reaction. D. Walther, “Taming a Phoenix: The Year-and-Day Rule in Federal Prosecutions for Murder” (1992) 59 U. Chi. L. Rev. 1337.


60For a chronology of these ages, see the Appendix, below.
commentators have suggested that such PVS patients — who have been estimated at some 5,000-10,000 in Canadian and U.S. hospitals — ought to be considered legally dead. North American public analysts have consistently rejected the proposition. These circumstances helped to provoke the famous Quinlan case over the withdrawal of a respirator in 1976 in the United States. They have more recently provoked major "right to die" sequels from the U.S. Supreme Court and the British House of Lords, as well as some confusion in Canada over whether criminal assault that causes PVS constitutes homicide.

52See P. Taylor, "MDs Ponder What to Do with up to 10,000 'Living Dead':" The (Toronto) Globe and Mail (23 August 1989) A1.
53See e.g. D.R. Smith, "Legal Recognition of Noncortical Death" (1986) 71 Cornell L. Rev. 850.
54See Report 15, supra note 4 at 15-16; New Jersey Experience, supra note 5 at 13; Determination of Death, supra note 29 at 10; Defining Death, supra note 6 at 1, 38-40.
57See Lundy, supra note 25. The decision in Lundy to change the initial charge from homicide to assault seems correct on the facts presented. Variants on the case might initially seem more vexing for the law, however. Should courts, for example, grant an injunction to prevent the termination of life-supporting medical technology for those who lie in PVS, based on an assailant's fear that termination of life support would result in death and thereby subject the assailant to homicide charges? Compare D. Brahmas, "Delayed Disconnection of Dead Baby from Ventilator" (1992) 340 Lancet 1154. The logic behind the consent rejection by the courts of the "Poter defense" indicates that a motion for such an injunction should be denied. See Porter, supra note 14; Kitching, supra note 25; Esso, supra note 33. Such cases stand for the proposition that but for the assailant's assault one would not have suffered injury that "substantially causes" death; see E. Calvin, Principles of Criminal Law, 2d ed. (Toronto: Carswell, 1991) at 84-90; D. Stuart, Canadian Criminal Law, 2d ed. (Toronto: Carswell, 1987) at 112-13. For purposes of criminal law responsibility, medical (non) treatment of an injury does not generally constitute a supervening cause that breaks the chain of causation flowing from assault to death. In Canada, see Criminal Code, R.S.C. 1985, c. C-46, ss. 224-25 [hereinafter Criminal Code]; in the United Kingdom, see R. v. Chesnare, [1991] 3 All E.R. 670 (C.A.). To grant an injunction, moreover, might authorize non-consensual invasion of the patient's person, bodily integrity and autonomy, which are protected by civil law, common law, and Charter rights to decline life-supporting medical intervention (see the Canadian Charter of Rights and Freedoms, Part I of the Constitution Act, 1982, being Schedule B to the Canada Act 1982 (U.K.), 1982, c. 11). See Nancy B. v. L'Hôtel-Dieu de Québec, [1992] R.Q.J. 361, 86 D.L.R. (4th) 385 (Sup. Ct.); Malette v. Shulman (1990), 67 D.L.R. (4th) 321, 2 C.C.L.T. (2d) 1 (Ont. C.A.); Fleming v. Reid (1991), 4 O.R. (3d) 74, 82 D.L.R. (4th) 298 (Ont. C.A.). Such non-consensual intervention exacts the greatest injustice when the evidence indicates no likelihood of recovery and withdrawal is either what the patient would have wanted or is in the patient's best interests. For many of the same reasons, nor should life-supporting medical technology necessarily immunize criminal assailants from homicide charges, when life support is withdrawn from victims in PVS and results in death more than a year after the initial assault. Criminal defendants might then seek to apply the "year and a day rule," which traditionally requires death within a year and a day of the instigating event for culpable homicide; in Canada, see Criminal Code, s. 227. Modern forensic sciences and life-supporting medical technology have made this 13th century rule an anachronism that warrants abrogation or legislative reform. Some U.S. jurisdictions have in fact abrogated the rule; see State v. Vance, 403 S.E. 2d 495 (N.C. 1991). In the meantime, purposed and functional application of the rule should help to avoid miscarriages of justice. See generally, D. Wither, "Taming a Phoenix: The Year-and-Day Rule in Federal Prosecutions for Murder" (1992) 59 U. Chi. L. Rev. 1337.

For a chronological overview of these ages, see the Appendix, below.

Finally, brain death criteria have helped to create a new class of mechanically-sustained dead patients, who would seem to require new ethical and legal rules for when they are pregnant, when they are considered for gamete donation, when they are used in non-consensual medical research and when they become the object of dispute between hospitals and families unwilling to consent to donation of the patients' organs. Such are some of the second generation legal issues presented in North America after decades of reform on the legal definition of death.

II. A Broadened Perspective on Brain Death and Tissue Transfer Regimes: Three Waves of Legal Reform

In many respects the process, merits and principles that guided the development of brain death criteria in North America illustrate many of the dynamics that compel modern medicolegal reforms. A look beyond brain death towards the broader texture of Canadian laws that govern modern therapeutic transfers of human tissues reveals a legal regime largely structured by three waves of legal reform. The reforms began in the anatomy age, accelerated in the transplant age and have continued into the biotechnology age.

A. Anatomy Age

The first wave began three centuries after the Italian medical professor Andreas Vesalius published his 1543 treatise De Humani Corporis Fabrica, which ushered in the modern anatomical age:

In the autumn of 1843, some two decades after McGill University established the first medical school in Canada, the Medical Board of Montreal petitioned the Legislative Assembly of the Province of Canada to pass an Anatomy Act. The petition was submitted after nightly episodes in which the securing, by medical school students, of dead bodies from Montreal graveyards had provoked public outcry and
calls for solutions. Accordingly, the petitioners sought an Anatomy Act to establish a regulated, legal system for supplying cadaver bodies for dissection and anatomical study in the medical schools. The absence of an existing system, they argued, hampered medical education and the practice of the healing arts, to the public detriment. A regulated system of supply would rid the community of grave robbing, body-selling and like black market abuses. Opponents countered that a more appropriate source would be the bodies of criminals, that the proposed legislation would legalize "traffic in corpses," and make public property of cadavers. The debate resulted in passage of An Act to regulate and facilitate the study of Anatomy, in December 1843.61

This initiative bears striking resemblance to the dynamics and process of reform that led to the enactment of brain death legislation. First, the initiation came from the medical community whose needs and practices were seen as being impeded by existing law. In this instance, an 18th century British common law misdemeanour of indecencies involving dead bodies applied in Canada and subjected medical practitioners to legal liability.62

Secondly, local and international incidents helped dramatize the need for a public solution. The mid-19th century medical literature reported black market shipments of cadavers between Canada and the United States and between countries of the British Isles.64 So-called "grave robbing" incidents in Canada65 and the United States66 drew local attention to the problem. The conviction of William Burke, for murdering individuals whose bodies he intended to sell to anatomists, in a sensational criminal trial in 19th century Scotland67 intensified support for a solution in the United Kingdom.

Thirdly, some consensus on legal remedies began to emerge after study of the problem. In this instance, the model advanced in a British Parliamentary study influenced anatomy laws in Massachusetts in 1830, in Britain in 1832 and in Canada in 1843.68 Canada today may thus trace its anatomy acts to the 18th

61Working Paper 66, supra note 2 at 2-3 [citations omitted].
62R. v. Lynn (1788), 2 Term Rep. 733, 100 E.R. 394 [hereinafter Lynn] (establishing disinterment of the dead, to supply anatomy teachers, as a common law indecency offense); R. v. Davies (1828) (Lancaster Assizes) (convicting doctor of possessing, for dissection, cadaver known to have been unlawfully disinterred), described in U.K., H.C. Report of the Select Committee on Anatomy at 6, 148 (22 July 1828) [hereinafter Report of the Select Committee on Anatomy].
63See F.I. Sheppard, Reminiscences of Student Days and Dissecting Room (Montreal: 1919) at 25 [printed for private circulation, available at Oslor Library of McGill University Medical School] (fining anatomy professor for "indecencies" involving the receipt of disinterred bodies). This common law misdemeanour appears to have been codified in Criminal Code, s. 18(2)(o).
64See Ermens, "On the Expropriation of Dead Bodies from Ireland to England and Scotland" (1828-29) 1 Lancet 714. See also D.G. Lawrence, "Resurrection and Legislation, or Body Snatching in Relation to the Anatomy Act in the Province of Quebec" (1958) 32 Bull. Hist. Med. 406 at 414 ("[T]he ‘regular channel’ was from the United States where ‘plenty of negroes were obtained, packed in casks and passed over the border as provisions, or flour’...").
65See Lawrence, ibid.
67W. Roughhead, Burke and Hare (Edinburgh: William Hodge, 1921).
68For the reports and laws of the respective jurisdictions, see Report of the Select Committee of the House of Representatives on Legalizing the Study of Anatomy (Boston: Dutton & Wentworth, 19th century Paris model adopted in the British Parliamentary study. Fourthly, Canadian debates over whether to use executed criminals or abandoned dead immigrants as a source of anatomical supply, even after a general model of reform had been identified, again reveal the significant role which the law may play in allocating the benefits and burdens of medico-legal reforms.

B. Transplant Age

The technical ability of medical professionals to transfuse blood cells, transplant tissues and implant whole organs generated a second wave of legal reform in Canada beginning in the 1950s. The new transplant technology differed from and paralleled anatomical technology. Both created new medical demand for the human body. But while anatomical demand emanates from the need to study and practice interventions on the dead human body, transplant needs emanate from direct surgical therapy for the living.

The distinction translates into practical, safety, legal and moral consequences. Practically, since transplantation does not require the use of whole human bodies, both deceased or living individuals may provide the transplanted material. With regard to safety, the transfer of human tissues raises concerns both on transmitting disease through transplanted material and on protecting the health and bodily integrity of living donors and recipients.70 Legally, transplantation involves the law on dead bodies, on living recipients and on non-traditional patients: donors who undergo medical interventions not for personal illness or injury, but for the benefit of another.71 The life-saving and health-pro

See e.g. Cov v. Saks, 1942 2 D.L.R. 412, 1942 1 W.W.R. 717 (Sask. C.A.) (blood donor injury/infection). As in other areas of medicine involving competent patients, the informed consent doctrine functions partially to help protect the patient-donor from the involuntary assumption of risk. For children, the incompetent, or others who lack the capacity to understand the nature, risks, benefits and consequences of the intervention, rigorous substantive and procedural safeguards must be strictly adhered to. See (Mrs.) v. Eve, [1986] 2 S.C.R. 388, 31 D.L.R. (4th) 1, 61 Nfld. & P.E.I.R. 273 (rejecting substitute judgment doctrine); Cayouette et Mathieu, [1987] R.Q. 2230 (Sup. Ct.) (authorizing minor’s donation of bone marrow to brother); Saskatchewan (Minister of Social Services) v. P(F) (1990), 69 D.L.R. (4th) 134, 63 Sask. R. 161 (Prov. Ct.) (upholding parental authority not to consent to liver transplant); Crevier v. Bieze, 566 N.E.2d 1319 (Ill. 1990) (hereinafter Bieze) (finding parentally disputed bone marrow “donation” not in the best interests of 3½-year-old twins); Donation Act, supra note 3, ss. 4-8, Working Paper 66, supra note 25 at 174-75; World Health Organization, supra note 39, Principle 4.

70See e.g. Neson v. Tri Hawk, 1983 F.C. 208 (5th Cir. 1993) (internationally contaminated tissue used in reconstructive brain surgery); R. Simonds et al., "Transmission of Human Immunodeficiency Virus Type 1 from a Seronegative Organ and Tissue Donor" (1992) 326 New Eng. J. Med. 726 (3 transplant recipient deaths owing to AIDS).
71See L. R. Shaw et al., "Ethics of Lung Transplantation with Live Donors" (1991) 338 Lancet 677. In the legal context, Canadian society must reconcile the physician’s traditional legal responsibilities to ensure that patients reasonably “benefit” from surgical interventions, with the modern
calls for solutions. Accordingly, the petitioners sought an Anatomy Act to establish a regulated, legal system for supplying cadaver bodies for dissection and anatomical study in the medical schools. The absence of an existing system, they argued, hampered medical education and the practice of the healing arts, to the public detriment. A regulated system of supply would rid the community of grave robbing, body-selling and like black market abuses. Opponents countered that a more appropriate source would be the bodies of criminals, that the proposed legislation would legalize a "traffic in corpses," and make public property of cadavers. The debate resulted in passage of An Act to regulate and facilitate the study of Anatomy, in December 1843.\(^{61}\)

This initiative bears striking resemblance to the dynamics and process of reform that led to the enactment of brain death legislation. First, the initiative came from the medical community whose needs and practices were seen as being impeded by existing law. In this instance, an 18th century British common law misdemeanor of indecencies\(^{62}\) involving dead bodies applied in Canada and subjected medical practitioners to legal liability.\(^{63}\)

Secondly, local and international incidents helped dramatize the need for a public solution. The mid-19th century medical literature reported black market shipments of cadavers between Canada and the United States and between countries of the British Isles.\(^{64}\) So-called "grave robbing" incidents in Canada\(^{65}\) and the United States\(^{66}\) drew local attention to the problem. The conviction of William Burke, for murdering individuals whose bodies he intended to sell to anatomists, in a sensational criminal trial in 19th century Scotland\(^{67}\) intensified support for a solution in the United Kingdom.

Thirdly, some consensus on legal remedies began to emerge after study of the problem. In this instance, the model advanced in a British Parliamentary study influenced anatomy laws in Massachusetts in 1830, in Britain in 1832 and in Canada in 1843.\(^{68}\) Canada today may thus trace its anatomy acts to the 18th century Paris model adopted in the British Parliamentary study. Fourthly, Canadian debates over whether to use executed criminals or abandoned dead immigrants as a source of anatomical supply, even after a general model of reform had been identified,\(^{69}\) again reveal the significant role which the law may play in allocating the benefits and burdens of medico-legal reforms.

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moting goals of transplantation also tend to endow these interventions with particular moral force in societies that rank human life high in the hierarchy of public values. Could the added needs and dimensions of these new therapeutic practices be accommodated by the anatomy acts?

In Canada, the new needs inspired new law. As transplant successes moved from simple tissues to more complex organs, the law evolved. To facilitate the supply of cadaveric tissue, the Uniform Law Conference of Canada proposed model corneal grafting legislation in 1959, seven years after Britain did so. The law, inter alia, incorporated principles from the Anatomy Acts and proposed a modern tissue transfer principle whereby individuals might henceforth bequeath their eye tissue for transplant purposes. Six years later, by the time kidney transplants had joined corneal transplants as relatively routine therapies, the Uniform Law Conference of Canada proposed a model human tissue act. It expanded the bequeathal principle into the concept of giving tissue from either deceased or living donors, which has become the express consent model of donation. The 1971 revision of the Act further entrenched the "gift of life ethic" for tissue transfers by generally prohibiting the sale of tissue. The 1989 revision continues this ethic and expressly adopts the brain death concept.

C. Biotechnology Age

Advances in cell fusion, cell culture and genetic engineering technologies in the last 20 years have begun to prompt a third wave of legal reform aimed at accommodating the advent of biotechnology. Several features of these new tissue transfer and replacement technologies distinguish them from those of the transplant and anatomical ages: (1) they are typically derived, by dint of substantial research and development, from human tissues or bodily substances and genetic material; (2) they may often be preserved or "banked" indefinitely; (3) they may yield increased quantities of natural human substances like hormones, protein, tissue and other products.

While such technological advances may help meet the modern therapeutic demand for human tissues and bodily substances, they may also raise novel legal questions. Four contexts convey the flavour of novelty. First, for instance, who shall have predominant rights over banked human tissue? Prodded in part by advances in cell fusion, cell culture and genetic engineering, the new organ donation model provisions incorporate substantial public policy tools. These new provisions are designed to accommodate the third wave of legal reform. The conceptual and legal issues that the new provisions raise are critical to the development of a new law of organ donation.

These and other features of biotechnology have already begun to generate therapeutic advances, scrutiny and reform of the law. Consider the recent licensure in North America of genetically engineered human growth hormone (HGH), which is used to treat childhood growth disorders. Genetically engineered HGH yields purer and larger quantities of the hormone. Indeed, reports in the international literature that cadaveric HGH was contaminated with a lethal virus, prompted Canada and other nations to expedite the availability of genetically engineered HGH. Its availability tends to make obsolete those provisions in North American tissue transfer laws that have traditionally facilitated the procurement of cadaveric pituitaries for distilling HGH. The advance is not unique. Biotechnology companies have developed or are developing genetically engineered insulin for treating diabetes, blood factors for treating haemophilia, biosynthetic skin for burn therapy, genetically altered animals to produce human tissue constituents and cultivated human bone for therapeutic grafts and reconstructive surgery.


11See Biotechnology, supra note 77 at 77-78.


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23See Donation Act, supra note 3, s. 15.

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which naturally occur in small quantities, and (4) as a result of the potential therapeutic supply and initial research and development, they may prove financially lucrative and more closely associated with commerce.27

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While such technological advances may help meet the modern therapeutic demand for human tissues and bodily substances, they may also raise novel legal questions. Four contexts convey the flavour of novelty. First, for instance, who shall have predominant rights over banked human tissue? Prodded in part


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by lawsuits in the United States\textsuperscript{65} and France\textsuperscript{66} over the control and transfer of banked reproductive tissues, some tissue banks have begun to specify more rights and duties under different eventualities in their informed consent forms for tissue donors and depositors.\textsuperscript{67}

Secondly, what legal standards shall govern physician and patient rights and duties in an era when physicians may cultivate the therapeutically excised tissue or cells of their patients into patented "biotech" drugs or similarly commercial therapeutic agents?\textsuperscript{68} If reform activists tend to agree on the need for consent\textsuperscript{69} to protect a patient's bodily integrity, autonomy and dignity in this context, they tend to disagree over whether express\textsuperscript{70} or implied\textsuperscript{71} consent standards should govern. Thirdly, is processed human eye tissue — procured from a cadaver, purified, frozen and cut for implantation into needy recipients as a "living contact lens" — to be considered natural tissue or an implantable medical device?\textsuperscript{69} for purposes of national safety standards? The same may be asked about some 250 cadaveric human heart valves, which were procured in Canada between 1988-1992, processed and frozen in the United States and then shipped back to Canada for use in reconstructive heart surgery.\textsuperscript{72} Such questions recently prompted proposed reforms in Canada\textsuperscript{73} and regulations in the United States.\textsuperscript{74} Finally, what of a $500,000 fee charged by a company that specializes in processing such tissue? Does the fee constitute a "sale" of human tissue in violation of Canadian\textsuperscript{75} and U.S.\textsuperscript{76} law, or are we satisfied that the monetary exchange is a legitimate fee for medical services? The State of Minnesota recently attempted to reconcile such new technological developments with existing tissue transfer law by exempting the sale of cell lines from its tissue sales prohibition.\textsuperscript{77} Such examples indicate that biotechnological advances may generate legal uncertainty, potential for conflict and eventual reform by blurring the definitions and standards of existing legal regimes that govern tissue transfer and replacement technologies.

Conclusion

From the broadened perspective of laws adopted in the anatomy, transplant and biotechnology ages, brain death laws and criteria stand as a fundamental pillar that North America has erected in a legal regime that governs the therapeutic transfer of human tissues and tissue replacement technology. This regime is, perforce, structured with pillars and imbued with lessons from the three ages. Indeed, the recent biotechnology case of Moore\textsuperscript{78} the decades old brain death case of Potter\textsuperscript{79} and the centuries old grave robbing case of Lynn\textsuperscript{80} collectively indicate that societal tensions and uncertainties associated with medical advances in a particular age may erupt into legal controversies that tellingly symbolize the need for clarity and reforms in that age. In this way, advances in medicine regularly prod the legal regime to evolve. Changes in societal thought and attitudes help restructure and refine the regime.

It is, thus, not surprising that nearly a quarter of a century after some of the first jurisdictions in the West gave legal effect to a new definition of death, proposals and reforms again are under way to clarify the ethico-legal status of the human body in medicine. Much of the current activity to regulate modern tissue transfer and replacement technologies centres, \textit{inter alia}, on refining familiar notions of consent, defining the precise role of the family in the transplant process and addressing bodily property issues, commerce and safety, human rights and biotechnological implications.\textsuperscript{81}

As medicine continues its creative therapeutic use of the human body, what legal rules and public policies shall structure the natural, artificial and bioprosthetic tissue replacement technologies of the future? While a precise answer obviously cannot be known, the lessons and broader context of the brain death reforms suggest at least three insights about emerging and future regimes.

\textsuperscript{57} Uniform Human Tissue Gift Act, supra note 75 at s. 10 (adopted in most Canadian provinces), as revised by s. 15 of the \textit{Donation Act}, supra note 3.


\textsuperscript{60} supra note 39.

\textsuperscript{61} supra note 14.

\textsuperscript{62} supra note 62.

by lawsuits in the United States[^6] and France[^7] over the control and transfer of banked reproductive tissues, some tissue banks have begun to specify more rights and duties under different eventualities in their informed consent forms for tissue donors and depositors.[^8] Secondly, what legal standards should govern physician and patient rights and duties in an era when physicians may cultivate the therapeutically excised tissue or cells of their patients into patented "bio-tech" drugs or similarly commercial therapeutic agents?[^9] If reform analysts tend to agree on the need for consent[^10] to protect a patient's bodily integrity, autonomy and dignity in this context, they tend to disagree over whether express[^11] or implied[^12] consent standards should govern. Thirdly, is processed human eye tissue — procured from a cadaver, purified, frozen and cut for implantation into needy recipients as a "living contact lens" — to be considered natural tissue or an implantable medical device[^13] for purposes of national safety standards? The same may be asked about some 250 cadaveric human heart valves, which were procured in Canada between 1988-1992, processed and frozen in the United States and then shipped back to Canada for use in reconstructive heart surgery.[^4] Such questions recently prompted proposed reforms in Canada[^15] and regulations in the United States.[^16] Finally, what of a $500,000 fee charged by a company that specializes in processing such tissue? Does the fee constitute a "sale" of human tissue in violation of Canadian[^17] and U.S.[^18] law, or are we satisfied that the monetary exchange is a legitimate fee for medical services? The State of Minnesota recently attempted to reconcile such new technological developments with existing tissue transfer law by exempting the sale of cell lines from its tissue sales prohibition.[^19] Such examples indicate that biotechnological advances may generate legal uncertainty, potential for conflict and eventual reform by blurring the definitions and standards of existing legal regimes that govern tissue transfer and replacement technologies.

Conclusion

From the broadened perspective of laws adopted in the anatomy, transplant and biotechnology ages, brain death laws and criteria stand as a fundamental pillar that North America has erected in a legal regime that governs the therapeutic transfer of human tissues and tissue replacement technology. This regime is, perforce, structured with pillars and imbued with lessons from the three ages. Indeed, the recent biotechnology case of Moore[^100] the decades old brain death case of Potter[^15] and the centuries old grave robbing case of Lynn[^110] collectively indicate that societal tensions and uncertainties associated with medical advances in a particular age may erupt into legal controversies that tellingly symbolize the need for clarity and reforms in that age. In this way, advances in medicine regularly prod the legal regime to evolve. Changes in societal thought and attitudes help restructure and refine the regime.

It is, thus, not surprising that nearly a quarter of a century after some of the first jurisdictions in the West gave legal effect to a new definition of death, proposals and reforms again are under way to clarify the ethical/legal status of the human body in medicine. Much of the current activity to regulate modern tissue transfer and replacement technologies is an attempt to refine and address bodily property issues, commerce and safety, human rights, and biotechnological implications.[^20]

As medicine continues its creative therapeutic use of the human body, what legal rules and public policies shall structure the natural, artificial and bioprosthetic tissue replacement technologies of the future? While a precise answer obviously cannot be known, the lessons and broader context of the brain death reforms suggest at least three insights about emerging and future regimes.

[^8]: Trib. gr. inst. Toulouse, 26 March 1991, Galton v. CECOS, J.C.P. 1992 II 21807 (Annexe P. Pédrot). In this sequo to Parpalais, ibid., the French sperm bank successfully argued that the informed consent form provisions instituted after Parpalais, and agreed to by the sperm depositor, precluded post-mortem restitution of the deceased depositor's sperm to his widow.
[^10]: See Civil Code of Quebec, supra note 72, arts. 11, 22.
[^15]: Working Paper 66, supra note 25 at 183-84
[^17]: Uniform Human Tissue Gift Act, supra note 75 at s. 10 (adopted in most Canadian provinces), as revised by s. 15 of the Donation Act, supra note 3.
[^20]: Supra note 39.
First, the merits of particular reforms shall depend on an ability to define, articulate and rank the public principles and values that shall guide reform. Secondly, public deliberations shall prove more effective if they are cultivated through a process that consciously attempts to identify the conflicts, ambiguities, language and cultural underpinnings of reform options. Such a process has facilitated multidisciplinary and transcultural understanding in the brain death reforms in North America. Indeed, the process has helped to structure problem-solving and consensus-building models relied on today for addressing other pressing bioethical issues before society. Finally, future reforms promise more success if they unfold with a sensitivity to the role of the law in establishing new medico-legal norms — its strengths and limits; its hand in clarifying and allocating rights and duties; its ability to regulate, facilitate or impede the healing arts.

Appendix

Corpus Humanum: Chronology

Anatomy Age (Circa 1540 – 1950)

1540  Act authorizing Barbers and Surgeons Guild of London to receive four executed felons annually for dissection and anatomical study.104

1543  De Humani Corporis Fabrica: The father of modern anatomy Andreas Vesalius’ anatomical treatise formed the basis of anatomical study in Europe for some two centuries. The treatise on which modern anatomy is founded.

1746  Dr. William Hunter establishes first British anatomical and dissecting school.

1752  Act authorizing bodies of all murderers executed in London and Middlesex to be given to Hall of Surgeons for dissection and anatomical study.105

1788  R. v. Lynn, established common law criminal misdemeanour for disinterring bodies for dissection; though exhumation for purposes of dissection is not explicitly forbidden by the felony prohibition on exhuming cadavers for witchcraft, such practice is still highly indecent, “contra bonos mores,” and an indictable offence.106

1815  Massachusetts Act to Protect Sepulchres of the Dead: $1000 fine or one year imprisonment for exhuming or knowingly and willfully receiving or concealing exhumed dead bodies.107

1824-29  Montreal Medical Institution integrates into McGill University to become first university medical school in Canada.

1828  R. v. Davies (Lancaster Assizes) involving common law criminal misdemeanour for receiving and possessing corpses known to have been illegally disinterred.108

1829  The conviction and execution of William Burke for murdering individuals for the sake of selling their bodies to Edinburgh anatomists (whence the verb “to burke,” to suffocate, to dispose of in a disguised manner).

1831  Massachusetts Anatomy Act, amending 1815 Act, to authorize cadavers to be used for medical study.109

1832  British Anatomy Act.110

1843  Province of Canada Anatomy Act.111

1867  Canadian Confederation.

1870s  McGill University Medical School Demonstrator of Anatomy fined $50 for receiving dead bodies, as “offenses against decency.” Bodies often obtained from Côte-des-Neiges Cemetery in exchange for $30-$50.

1882  Williams v. Williams, regarded as establishing no property in corpse rule.112

1892  Criminal Code of Canada enacted.113 Section 206 (currently s. 182) criminalizes misconduct respecting dead human bodies and remains.

Transplant Age (Circa 1950 – 2000+)

1950  Corneal transplant era begins.

1952  British Corneal Grafting Act.114

1954  First successful organ (kidney) transplant performed in Boston between twins, some seven years after the introduction of the artificial kidney.

1955  First Canadian Eye Bank established in Toronto.

1959  Uniform Law Conference of Canada proposes Uniform Cornea Transplant Act.115

104 For Barbers & Surgeons (U.K.), 32 Hen. 8, c. 42.
106 Supra note 62.
107 General Laws of the Commonwealth of Massachusetts, ch. 174 (1815).
108 An Act More Effectively to Protect the Sepulchres of the Dead and to Legalize the Study of Anatomy in Certain Cases, supra note 68.
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1967 First successful heart transplant performed in South Africa. Recipient survives 18 days.

1968 (1) Uniform Anatomical Gift Act proposed in U.S.
(2) Harvard University \textit{ad hoc} Committee proposes “brain death” criteria of death, which will facilitate organ donation.

1970 Kansas becomes first North American jurisdiction to enact brain death legislation, which the Kansas Supreme Court would uphold six years later.\textsuperscript{21}

1971 Revised Uniform Human Tissue Gift Act of Canada.\textsuperscript{122}

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1976 Multi-centre organ retrieval system established between Ontario hospitals.

1981 (1) First Canadian adult liver transplants undertaken. Heart transplant renaissance, following general worldwide moratorium in the 1970s.
(2) Law Reform Commission of Canada proposes brain death legislation for all federal laws in Canada.

1982 Cyclosporin, an anti-rejection drug, dramatically increases survival rates for transplants.

\textbf{Biotechnology Age (Circa 1980 – 2000+)}

1984 Six years after one of the first medical biotechnology companies is founded (Genentech), a California cancer patient institutes suit against the company and his doctor, alleging that they misappropriated his cells and patented derivative elements thereof (a cell line) without his knowledge or consent. The California Supreme Court would issue its landmark ruling in the case six years later, \textit{Moore v. University of California}.\textsuperscript{124}

\textsuperscript{16}\textit{Human Tissue Act}, 1961 (U.K.), 9 & 10 Eliz. 2, c. 54.
\textsuperscript{17} Supra note 73.
\textsuperscript{18} Supra note 116. See Castel, \textit{supra} note 73.
\textsuperscript{19} Supra note 74.
\textsuperscript{20} Supra note 73.
\textsuperscript{21} Supra note 32.
\textsuperscript{122} Supra note 75.
\textsuperscript{123} Supra note 24.
\textsuperscript{124} Supra note 89.

\textbf{1993} \textbf{BRAIN DEATH}

1985 (1) First Canadian paediatric liver transplant performed.
(2) Canadian patent office grants patent application for human cell lines.
(3) Genetically-engineered human growth hormone receives federal licensure, replacing human growth hormone derived from cadaver pituitaries.

1989 Uniform Law Conference of Canada revises Uniform Human Tissue Donation Act.\textsuperscript{125}

1990 (1) Biotechnology companies begin clinical trials on genetically engineered blood products, skin equivalents and cell growth factors.
(2) Following a major ruling of the Canadian Supreme Court,\textsuperscript{126} the Canadian Manual of Patent Office Practice is amended to recognize, officially, that cell lines and other new microbial life forms may be patentable subject. The amendment comes nearly 15 years after the Canadian Patent Office granted one of its first patents for human cell lines (999, 546 of 9 Nov. 1976).

(2) A U.S. biotechnology company successfully breeds a transgenic pig to produce human blood products, and applies for patient protection for the process.

\textsuperscript{125} Supra note 3.
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