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**1. PURPOSE**

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The intent of this Standard Operating Procedure (SOP) is to describe methods of assessing pain in swine and mitigating pain by administration of analgesic medications.

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**2. RESPONSIBILITY**

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Principal investigators (PI) and their research staff, veterinary care staff.

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**3. GENERAL CONSIDERATIONS**

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- 3.1. A procedure which would be expected to be painful if it were done on humans must be considered painful to the animal.
- 3.2. When there is a question of whether or not a procedure is painful, the animal should receive the benefit of analgesia.
- 3.3. Analgesia should be provided at an appropriate dose and frequency to control pain.
- 3.4. Any deviation from this procedure must be justified by the investigator and approved by the appropriate Facility Animal Care Committee (FACC).

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**4. PAIN RECOGNITION AND ASSESSMENT**

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- 4.1. Adapt the frequency of observation to the invasiveness of the procedure (minimum once a day).
- 4.2. Start by observing the animal from a distance so the animal's behavior is not altered by the presence of the observer. Then proceed to observe the animal more closely.
- 4.3. Look for any changes in behavior. Report animals which appear to be in pain to the veterinary care staff.
- 4.4. Common clinical signs indicative of pain or distress include:
  - 4.4.1. Social isolation
  - 4.4.2. Lying down more frequently, immobile
  - 4.4.3. Aggressive vocalization
  - 4.4.4. Altered gait
  - 4.4.5. Hunched posture
  - 4.4.6. Head down
  - 4.4.7. Arched back or abdomen, appears tucked in upward
  - 4.4.8. Increased muscle tension around the eye (orbital tightening)
  - 4.4.9. Eyes partially closed
  - 4.4.10. Cheek tightening/nose bulge
  - 4.4.11. Ear positioning
  - 4.4.12. Less reactive to external stimuli
  - 4.4.13. Reduced appetite (sometimes)

**Note:** The most reliable signs of pain and distress are the changes in behavior. This implies a good knowledge of species and individual normal behavior by the observer.

4.5. The Piglet Grimace Scale (Turner et al. 2017):

The piglet grimace scale is a standardized behavioral coding system that demonstrates facial expressions which can be used to assess pain in the pig.

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### Ear Position

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Absent (0)



Moderately present (1)



Obviously present (2)

When the animal is in pain, the ears are drawn back from forward (baseline) position

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### Cheek Tightening/Nose Bulge

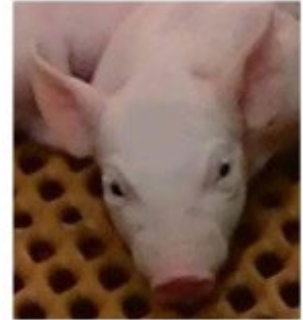
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Absent (0)



Moderately present (1)



Obviously present (2)

When the animal is in pain, a bulge of skin is apparent on the snout in response to cheek tightening

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### Orbital Tightening

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Absent (0)



Present (1)

When the animal is in pain, the orbital area is narrowed as the eyelids are squeezed together (scored on a two-point scale)

## 5. ANALGESIA PLAN

- 5.1. When possible, provide analgesia before the painful stimulus, as it is more effective in preventing pain (e.g. give analgesic before surgery).
- 5.2. Use a combination of analgesics, which is often more effective than using a single agent. For example, a combination of opioid, non-steroidal anti-inflammatory drug (NSAID), and infiltration of a local analgesic.
- 5.3. For surgical procedures, extend analgesia from pre-op to 72 hours post-op, unless specified otherwise in the Animal Use Protocol (AUP) and approved by the FACC.

## 6. LOCAL ANALGESIA

- 6.1. Infiltrate or apply local analgesic to areas where a painful stimulus may be induced. Repeat application of local agent at specified intervals to maintain analgesia. In some cases, a sedative is recommended when using local analgesia (when not using anesthesia).

Analgesic	Dose	Route	Duration	Note
Lidocaine	< 2 mg/kg	SC, Infiltration of surgical wounds	30–60 min.	Use lidocaine HCl 2% (20mg/ml) injectable solution. Because this drug is acidic, it is recommended to dilute it 3:1 with sodium bicarbonate injectable solution (at 5 or 8.4%).  Dilution must be prepared immediately before use and should not be stored. Diluted solution is as effective but induction of analgesia is slightly prolonged.  *Dilution with sodium bicarbonate is not necessary if lidocaine is to be administered to an anesthetized animal.
Bupivacaine	< 2 mg/kg	SC, Infiltration of surgical wounds	3–4 hr.	Use bupivacaine HCl 0.50% (5mg/ml) injectable solution.  Same comment as for lidocaine.
* Lidocaine-bupivacaine mixture	< 2 mg/kg	SC, Infiltration of surgical wounds	30 min. to 4 hrs.	Same comment as for lidocaine.  Combining both drugs allows for rapid induction and prolonged effect.  Use a 1:1 mixture of lidocaine HCl 2% (20mg/ml) injectable solution and bupivacaine HCl 0.50% (5mg/ml) injectable solution.  Discard mixture after 3 months.
EMLA cream	Thick spread	Topical	30–60 min.	Shave fur and apply a thick layer of cream ideally 10 minutes before the painful procedure.  Apply only to intact skin.

\*most commonly used

## 7. GENERAL ANALGESIA

### Swine

Analgesic	Dose	Route	Frequency	Note
*Buprenorphine	0.05–0.1 mg/kg	SC, IM	6-8 hr.	Controlled drug.
Butorphanol	0.1- 0.03 mg/kg	IM	4-6 hr	Controlled drug.
Fentanyl	50µg-100µg (17-25 kg)	Transdermal patch	Every 3 days, starting 24h prior to surgery	Patch placed behind ear. Controlled drug.
Morphine-Lidocaine-Ketamine Combination	2 ml/kg/hr	IV	Constant rate infusion	To a 500ml bag of fluids: add morphine 60mg, lidocaine 750mg and ketamine 150mg. Controlled drugs.
Ketamine	0.1-1.0 mg/kg	SC, IM, IV	-	After initial bolus, constant rate infusion of 0.1-0.3 mg/kg/hr. Controlled drug.
*Ketoprofen	1–2 mg/kg	IM	12–24 hr.	
Carprofen	2-4mg/kg	IM, PO	24hr.	
Meloxicam	0.2-0.4mg/kg	IM, PO	24hr.	

\* most commonly used

#### 7.1. Administration of non-steroidal anti-inflammatory drugs (NSAIDs):

- 7.1.1. NSAIDs include carprofen, ketoprofen, and meloxicam.
- 7.1.2. Ensure good water intake and monitor hydration status during the treatment period.
- 7.1.3. To minimize chances for adverse drug interactions, a washout period of 5-7 days is recommended before switching between NSAIDs.

## 8. REFERENCES

- 8.1. Viscardi, A. V., Hunniford, M., Lawlis, P., Leach, M., & Turner, P. V. (2017). Development of a Piglet Grimace Scale to Evaluate Piglet Pain Using Facial Expressions Following Castration and Tail Docking: A Pilot Study. *Frontiers in veterinary science*, 4, 51. <https://doi.org/10.3389/fvets.2017.00051>

## SOP REVISION HISTORY

DATE	NEW VERSION
2015.04.22	6.1 Use lidocaine HCl 2% (20mg/ml) injectable solution.
2015.04.22	6.1 Use bupivacaine HCl 0.50% (5mg/ml) injectable solution.
2015.04.22	6.1 Lidocaine-bupivacaine mixture: <b>Discard mixture after 3 months.</b>
2016.09.02	7. Ketoprofen: <b>Ensure good water intake and monitor hydration status. Suspend water restriction prior to administration.</b>
2016.09.06	5.2 For example, administer a combination of buprenorphine, ketoprofen, and local infiltration of <del>lidocaine</del> <b>a local analgesic.</b>
2020.04.20	4.1. Adapt the frequency of observation to the <del>protocol</del> <b>invasiveness of the procedure</b> (minimum once a day).
2020.04.20	6.1 <b>(Added routes for local analgesics)</b>
2020.04.20	6.1 Lidocaine-bupivacaine mixture: <b>Use a 1:1 mixture of lidocaine HCl 2% (20mg/ml) injectable solution and bupivacaine HCl 0.50% (5mg/ml) injectable solution.</b>
2020.04.20	6.1 EMLA cream: <b>Apply only to intact skin.</b>
2020.05.08	<p>4.4.1. <del>Tolerate manipulations</del></p> <p>4.4.1. <b>Social isolation</b></p> <p>4.4.2. Lying down more frequently, immobile</p> <p>4.4.3. Aggressive vocalization</p> <p>4.4.4. Altered gait</p> <p>4.4.5. <b>Hunched posture</b></p> <p>4.4.6. <b>Head down</b></p> <p>4.4.7. <b>Arched back or abdomen, appears tucked in upward</b></p> <p>4.4.8. Increased muscle tension around the eye <b>(orbital tightening)</b></p> <p>4.4.9. <del>Piloerection</del></p> <p>4.4.9. <b>Eyes partially closed</b></p> <p>4.4.10. <b>Cheek tightening/nose bulge</b></p> <p>4.4.11. <b>Ear positioning</b></p> <p>4.4.12. <b>Less reactive to external stimuli</b></p> <p>4.4.13. Reduced appetite (sometimes)</p>
2020.05.08	<p>4.5. <b>The Piglet Grimace Scale (Turner et al. 2017):</b></p> <p><b>The piglet grimace scale is a standardized behavioral coding system that demonstrates facial expressions which can be used to assess pain in the pig.</b></p>
2020.05.08	<b>Butorphanol: 0.1-0.3 mg/kg, IM, 4-6hr., Controlled drug.</b>
2020.05.08	Fentanyl: 50µg-100µg (17-25 kg), <b>Transdermal patch</b> , Every 3 days, starting 24h prior to surgery, <b>Placed behind ear.</b> Controlled drug.
2020.05.08	<b>Carprofen: 2-4mg/kg, IM, PO, 24hr., Ensure good water intake and monitor hydration status.</b>
2020.05.08	<b>Meloxicam: 0.2-0.4mg/kg, IM, PO, 24hr., Ensure good water intake and monitor hydration status.</b>
2020.05.08	<b>8.1. Viscardi, A. V., Hunniford, M., Lawlis, P., Leach, M., &amp; Turner, P. V. (2017). Development of a Piglet Grimace Scale to Evaluate Piglet Pain Using Facial Expressions Following Castration and Tail Docking: A Pilot Study. Frontiers in veterinary science, 4, 51. <a href="https://doi.org/10.3389/fvets.2017.00051">https://doi.org/10.3389/fvets.2017.00051</a></b>
2021.11.03	5.2. <del>Try to</del> Use a combination of analgesics, which is often more effective than using a single agent. For example, a combination of <del>buprenorphine opioid, carprofen</del> <b>non-steroidal anti-inflammatory drug (NSAID)</b> , and local infiltration of <del>lidocaine/bupivacaine</del> <b>a local analgesic.</b>
2022.01.13	<del>Ketoprofen: Ensure good water intake and monitor hydration status. Suspend water restriction prior to administration.</del>
2022.01.13	<del>Carprofen: 2-4mg/kg, IM, PO, 24hr., Ensure good water intake and monitor hydration status.</del>
2022.01.13	<del>Meloxicam: 0.2-0.4mg/kg, IM, PO, 24hr., Ensure good water intake and monitor hydration status.</del>
2022.01.13	<p><b>7.1. Administration of non-steroidal anti-inflammatory drugs (NSAIDs):</b></p> <p><b>7.1.1. NSAIDs include carprofen, ketoprofen, and meloxicam.</b></p> <p><b>7.1.2. Ensure good water intake and monitor hydration status during the treatment period.</b></p> <p><b>7.1.3. To minimize chances for adverse drug interactions, a washout period of 5-7 days is recommended before switching between NSAIDs.</b></p>