Anesthesia in Swine

1. **Purpose**
The purpose of this standard operating procedure (SOP) is to describe methods used for swine anesthetic regimes.

2. **Scope**
This SOP applies to Principal Investigators (PI's), research staff, and the animal/veterinary care staff.

3. **Prerequisites**
The following are special perioperative considerations for swine receiving anesthesia.
   3.1 Swine should be acclimatized for 5-7 days in the facility prior to undergoing survival surgery as they tend to dehydrate and lose weight during shipping. If being housed in groups, it is also important to allow pigs to re-establish the social hierarchy between members of a group (minor fighting between pigs is not uncommon within the first few days).
   3.2 Swine have a rapid intestinal transport time and hence require only a short period of fasting to empty the stomach. A fast of solid food for 6-8 hours preoperatively is hence sufficient for most surgical procedures. Water may be provided up until the time of surgery.
   3.3 Please note that swine will readily consume most liquid diets (ensure) and hence may be provided these preoperatively in case of specialized procedures where prolonged fasts may be indicated (ex. colonic procedures).

4. **Responsibilities**
The anesthetic regime chosen is dependent upon the experimental protocol and needs to be defined by the PI prior to initiating the procedure. The selected regime must also be included in an approved Animal Research and Ethics Board (AREB) Animal Use Protocol (AUP).

5. **Procedure**

**SEDATION/PRE-ANESTHETIC**

5.1 Swine normally require a pre-anaesthetic agent prior to mask or intravenous (IV) anaesthetic induction. The purpose of the pre-anaesthetic:
   5.1.1 To reduce the stress associated with handling and anaesthetic induction.
   5.1.2 To reduce anaesthetic related changes in physiological parameters.
   5.1.3 To decrease the overall amount of maintenance anaesthetic required.
5. Procedure

SEDATION/PRE-ANESTHETIC

5.2 Anticholinergic agents (Atropine or Glycopyrrolate) are used preoperatively to dry upper respiratory tract and oral secretions as well as to counteract the bradycardia (slow heart rate) that is associated with many anaesthetic agents. The anticholinergic agent may be combined with the sedative pre-anaesthetic agents, or given immediately post sedative to reduce the pain associated with a large volume IM (intramuscular) injection.

5.3 There are many combinations of sedative agents that may be used preoperatively in swine. Below are the most common combinations used:

5.3.1 Ketamine/Acepromazine 10 mg/kg IM/0.2 mg/kg IM (in same syringe)
5.3.2 Ketamine/Xylazine 15-20 mg/kg IM/1.1-2.2 mg/kg IM (in same syringe)
5.3.3 PLUS Anticholinergic: Atropine 0.05 mg/kg IM, SQ or 0.02 mg/kg IV or Glycopyrrolate 0.004-0.01 mg/kg IM, SQ

See SOP GEN 551 “Intramuscular Injection in Swine”

5.4 Following pre-anaesthetic administration, remove the pig from the housing area and transport via the hydraulic (scissor lift) transport cart to the surgical suite once the pig is suitably sedated (in lateral recumbency).

5.5 NOTE: Hearing protection is required when handling pigs, and should be used when administering the pre-anaesthetic injection (McMaster Health and Safety).

ANESTHETIC INDUCTION AND MAINTENANCE

5.6 Following sedation, pigs may be moved to the OR room and placed on isoflurane anaesthesia delivered by face mask until a depth of anaesthesia is reached to allow endotracheal intubation.

5.7 Should injectable anaesthetic induction be required, several agents may be administered intravenously. The most common of these agents include:

5.7.1 Sodium Pentobarbital (Nembutal) administered at 20-30 mg/kg IV to effect. Supplemental doses are required if prolonged anaesthesia is expected.

(This option is recommended for terminal or acute procedures only.)
5.7.2 Propofol 16-22 mg/kg IV. Please note that propofol has a relatively narrow therapeutic margin in swine and can produce severe hypotension and apnea.
ANESTHETIC INDUCTION AND MAINTENANCE

5.9 Inhalation anaesthesia using Isoflurane.

5.9.1 Mask induction generally takes place following sedation/pre-anaesthetic. Intubation of the swine requires a skilled technician. Use of a laryngoscope is necessary and the vocal folds should be sprayed with Lidocaine prior to intubation.

5.9.2 Isoflurane is delivered through a face mask on an anaesthetic machine with a precision vaporizer. Carrier gas(es); medical air, oxygen optionally combined with nitrous oxide must be provided in order to deliver the desired inhalant anaesthetic dose.

5.9.3 Carrier gas flow rates are dependent on the size of the animal and the anaesthetic circuit chosen; for example, a bain circuit or open circuit which supplies 150 ml/kg/min of oxygen/nitrous oxide or a re-breathing circuit which provides 50 ml/kg/min of oxygen/nitrous oxide. NOTE: Oxygen should never fall below 30% of total flow delivered.

5.9.4 To induce anaesthesia provide: Isoflurane @ 3-5% with the appropriate flow of oxygen or oxygen/nitrous oxide.

5.9.5 Maintenance: Isoflurane@ 1.5-2.5% with the appropriate flow of oxygen/oxygen and nitrous oxide.
NOTE: Maintenance doses are approximate values. Depth of anaesthesia needs to be assessed continually to determine appropriate dose rates.

5.10 Other considerations:

5.10.1 IV fluid administration at 5-10 ml/kg/hr

5.10.2 Thermal support: Rectal temperatures should be continuously monitored and not allowed to fall below 36°C (normal 38-39.5°C). The use of a Bair hugger warm air blanket system, and warmed IV fluids will help to prevent hypothermia and should be used in recovery cases.

ANESTHETIC EMERGENCIES

DEFIBRILLATION:

Internal: 10 joules
External: 200 joules
Lidocaine: 2-4 mg/kg (50 mg/kg/minute)
Atropine: 0.05 mg/kg

ANALGESICS:

Anafen: 1.0 - 3.0 mg/kg
Buprenorphine: 0.05 mg/kg
## ANESTHETIC EMERGENCIES

### EMERGENCY DRUG CHART: SWINE

<table>
<thead>
<tr>
<th>DRUG</th>
<th>USE</th>
<th>DOSE/ROUTE</th>
<th>30 kg</th>
<th>40 kg</th>
<th>60 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine</td>
<td>To increase HR AV-Block</td>
<td>0.02 mg/kg (0.5mg/ml) IV, IM, (SQ)</td>
<td>1.2 ml</td>
<td>1.6 ml</td>
<td>2.4 ml</td>
</tr>
<tr>
<td>Glucocort (SoluDeltaCortef)</td>
<td>Shock</td>
<td>10 mg/kg (125mg/ml) IV, (IM)</td>
<td>2.4 ml</td>
<td>3.2 ml</td>
<td>4.8 ml</td>
</tr>
<tr>
<td>Diazepam (Valium)</td>
<td>Anticonvulsant</td>
<td>1 mg/kg (5 mg/ml) IV</td>
<td>6 ml</td>
<td>8 ml</td>
<td>12 ml</td>
</tr>
<tr>
<td>Lidocaine Neat</td>
<td>Antiarrythmic VFib, VPC</td>
<td>2.0 mg/kg (2%=20mg/ml) Slow IV</td>
<td>3 ml</td>
<td>4 ml</td>
<td>6 ml</td>
</tr>
<tr>
<td>Epinephrine (Epiclor)</td>
<td>Cardiac Arrest Anaphylactic shk</td>
<td>0.1 ml/kg 1:1000 IV (2x dose IT)</td>
<td>3 ml</td>
<td>4 ml</td>
<td>6 ml</td>
</tr>
<tr>
<td>Sodium Bicarbonate</td>
<td>Acidosis pH&lt;7.2</td>
<td>For Cardiac arrest: Give 1ml/kg IV (1mEq/kg), then 0.5 ml/kg @10-15 minute intervals during CPR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dantrolene</td>
<td>MH: hyperthermia</td>
<td>1mg/kg IV 0.33 mg/ml</td>
<td>90 ml</td>
<td>120 ml</td>
<td>180 ml</td>
</tr>
</tbody>
</table>

### References
