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ANESTHESIA COMPLICATIONS RELATED TO SWINE EXPERIMENTAL INVASIVE SURGICAL PROCEDURES

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Abstract

The choice of anesthesia protocols for swine must take into account, besides specific characteristics*, the type of surgery and the experience of the anesthetist. The anesthesia protocol used for 64 cases ensured the premises of a good surgical performance in swine procedures, while adopting correct surgical and anesthetic techniques and a continuing monitorig of the patient. Main anesthetic complications related to anesthesia for swines, according to our research were: high sensibility regarding stress factors during contention,* difficult vascular access and intubation*, rapid installation of hypothermia, occurrence of malignant hyperthermia while using gaseous anesthetics, anaphylaxis, regurgitation and aspiration pneumonia. Complications occurred in 20.31% of cases, ranking this species in the category of patients with high anesthetic risk for invasive surgical procedure.*

Key words*: anesthesia, complications, surgery, swine.*

INTRODUCTION

The swine (*Sus scrofa domesticus*), is a domesticated omnivore, even-toed ungulate used for experimental procedures in various fields of surgery. In experimental invasive surgery, anesthesia protocols have to be safe, and should not influence the final results.

The aim of this study is to present the main anesthetic complications related to anesthesia in swines regarding the protocols of aneshtesia. These include the preoperative patient assessment and preparation for anesthesia including the main phases from premedication through induction and maintainence for experimental invasive surgical procedures.

MATERIALS AND METHODS

This study is based on our experience of anesthesia for 64 cases (male: female ratio 1: 6). The invasive surgical procedures included training sessions for laparoscopic surgery, urology, gynecology, traumatology, thoracic surgery and liver transplantation. All specimens admitted in the study were transported and housed in optimal hygiene conditions for this species minimum 48 hours prior to procedures in order to avoid stress related to transportation or accommodation. Pigs ranged in size from 11 to 32 kg, ideal to facilitate restrain and physical restraint. Large pigs may prove dangerous and difficult to handle.

To decrease the risk of regurgitation and aspiration pneumonia, patients required fasting for 6-12 hours, because stomach content is very acid (pH 1.5-2.5). A careful preanesthetic examination was performed. Premedication targed sedation in order to facilitate contention and venous access is necessary for the anesthetic protocol. Intravenous drug administration in adult swine is difficult to perform due to inaccessible superficial veins and thick subcutaneous fat layers (Pairis-Garcia, 2014).

After preanesthestetic examination in accordance to American Society of Anesthesiologists Classification (ASA Class) cases were assigned to score I and II.

Premedication using a combination of a dissociative anaesthetic- ketamine (20 mg/kg), a benzodiazepine-midazolam 0.2 mg/kg and an α_2 agonist-xylazine (2 mg/kg) was achieved, administered intramuscularly with 20 G needles. After 20 minutes vascular acces was possible and induction was achieved with Propofol (3.5 mg/kg) injected slowly intravenous (i.v.) and followed by endotracheal intubation. The anatomical particularities of the upper respiratory tract in pigs could represent a disadvantage when intubating a pig, comparing

to the other species and also comparing to human anatomy: the soft palate- *velum palatinum molle* is long and arrives to the bases of the epiglottis.
Swine intubation required experience due to anatomical features: shape of the head (dolichocephalic skull which is long and narrow), small larynx and undersized trachea are very sensible to excessive manipulation. A laryngoscope with a long, straight blade and a stilett were used to facilitate endotracheal tube passage (tube size 5, 5.5, 6, 6.5 F). The arytenoids were sprayed with 10% Lidocaine to decrease the risk of laryngeal spasm. Isoflurane in 100% oxygen was used to maintain anesthesia. The recommended minimum alveolar concentration (MAC) of 1.6-19.9 % (Malavasi et al.2008) was associated with a combination given by i.v. infusion in order to maintain anesthesia and to provide analgesia during the invasive surgical procedures: ketamine 0.5 mg/kg/h + fentanyl 3 µg/kg/h + lidocaine 0.5 mg/kg/h. Crystalloid fluids at a rate of 5-10 ml/kg/h were provided throughout the surgical procedures. Monitoring anesthesia included vital signs, evaluation of muscle relaxation, arterial blood pressure measurement, capnography, pulseoximetry, blood pH, gases and electrolytes, while swines were subject to complex interdisciplinary procedures.

RESULTS AND DISCUSSIONS

The anesthesia protocol used was the same for 64 cases of swine (*Sus scrofa domesticus*) during invasive surgical experiemental procedures: laparoscopic surgery (urology, gynecology, digestive procedures) - 52 cases (81.25%), conventional open techniques (classic surgery - traumatology, thoracic surgery, liver transplantation) - 12 cases (18.75%). The complications related to anesthesia, according to our study developed in 13 cases (20.31%), (laparoscopic or classic surgery) with no direct correlation with the type of the procedure (for the laparaoscopic procedures - 11 incidents related to anesthesia complications and 2 for the classic procedures). In the preanesthetic period all the specimens presented sensibility during contention for clinical examination and administration of the premedication, manifested by agitation and vocalization.
Vascular access, at the level of the auricular vein or external saphenous vein, was possible for all the cases except 2 cases for which a jugular catheter was inserted (Figure 1).

Figure 1. Vascular access: external jugular vein, auricular vein access, external saphenous access

During induction with propofol 1% lipid emulsion (3.5 mg/kg, slowly i.v.), we reported 1 case of anaphylaxis (Figure 2).

Figure 2. Anaphylaxis, 5 minutes after administration slowly i.v. of Propofol 1% lipid solution

For humans, since the propofol formulation contains both egg lecithin and soybean oil, its use is contraindicated in patients with hypersensitivities to these components. Clinicians should consider the potential for adverse drug events in patients with select food allergies (Hofer, 2003). This imediate

anaphylactic reaction after propofol i.v. administration was associated with head edema, generalised erythema, lingual edema, laryngeal edema, bradycardia and hypotension. The major difficulty during orotracheal intubation is visualisation of the swine larynx due to anatomy particularities. Pigs have thick tongues and long, narrow oropharyngeal spaces (Malavasi 2015).

The successful endotracheal intubation of pigs using the standard orotracheal method is challenging and technically difficult, because of the pig's oral anatomy and the presence of excess in tissue in the oropharyngeal region (Janiszewski, 2014).

The anesthetist, requires a good practical training in order to perform endotracheal intubation in pigs.

Some techniques are described for guiding the tube in the trachea: using a vascular catheter (Janiszewski, 2014), urinary catheter or a rigid stilett through the tube (Malavasi 2015). We used a rigid semiflexible intubating stilett (10Fr, ϕ 3.3 mm), adapted manually to secure it in the endotracheal tube during intubation (Figure 3).

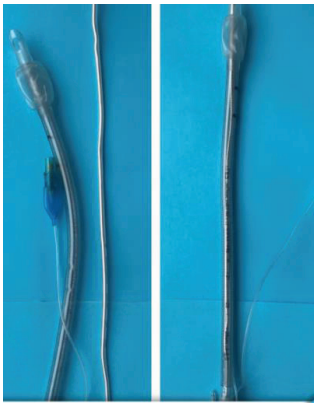

Figure 3. Rigid semiflexible intubating stilett, manually bent at one end

The laryngoscope should be introduced until the base of epiglottis, pressing the tongue. The soft palate should be lifted from the epiglottis usually with the tip of the tube or the tip of the stilett and the tube inserted under direct visualization of the larynx and vocal cords. The stilett can be first advanced in the trachea and the tube follow over it. If the tube stops at the entrance of the trachea, head and neck can be flexed and the tube rotated around its longitudinal axis. The use of this type of guiding stilett shortened the lenght of the procedure and reduced the risks associated with a prolonged manipulation in the area, without any injuries.

Difficult intubation was incountered in 9 cases (14.06%), for 4 (6.25%) of them emergency tracheotomy was performed (Figure 4).

Figure 4. Emergency tracheotomy

Malignant hyperthermia is a genetic hypermetabolic syndrome in humans and pigs, being also diagnosed in other species, including dogs, horses, cats, birds, deer, and other wild animals (Malavasi 2015). Malignant hyperthermia (MH) can be triggered in swine either by stress or by certain anesthetic agents. In humans, MH commonly occurs in patients previously exposed uneventfully to triggering anesthetics. This variability in expressivity of the MH syndrome is a combination of unknown genetic and environmental factors (Nelson, 1990).

All commonly used volatile inhalational anesthetics and depolarizing skeletal muscle relaxants will initiate the MH syndrome in genetically susceptible humans and swine, but hypothermia causes a graded reduction in the potential for triggering and reduces the incidence of MH (Iaizzo, 1996).

Considering this facts during maintenance of anesthesia with isoflurane, no additional warmer devices were used and we reported 1 single case of MH (incidence of MH in this

study 1.56%). While basic and advanced monitoring was used for all the swine experimental invasive surgical procedures there were no significant variations that we can catalog as specific swine anesthesia complications. All variations were consistent with the type of anesthesia, procedure, and clinical condition of the patients.

Table 1. Complications related to anesthesia

Complications	Number of cases	Procedure's type		(%)
		Laparoscopic 52	Classic 12	
Difficult vascular access	2	2	-	3.13%
Difficult intubation/ Emergency tracheostomy	9/4	7/4	2/0	14.06 %/ 6.25%
Anaphylaxis	1	-	1	1.56%
Malignant hyperthermia	1	1	-	1.56%
TOTAL	13/64	10/52	2/12	20.31 %

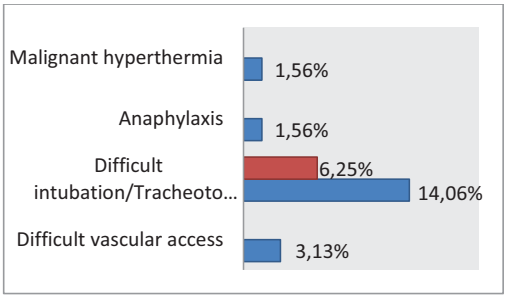

Figure 5. Distribution of complications

CONCLUSIONS

Complications occurred in 20.31% of cases, ranking this species in the category of patients with high anesthetic risk for invasive surgical procedure.

All the specific complications occurred during the anesthesia, we did not encounter any late complications following the implementation of this protocol.

Most of the anesthetic complications were related to intubation (14.06%) and determined the modification of the anesthetic technique by carrying out the emergency tracheotomy (6.25%) and maintaining the anesthesia via the endotracheal tube connected to this level.

Complications associated with anesthesia during swine experimental invasive surgical procedures are mainly life-threatening, requiring rapid stabilization measures.

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