The use of an intestinal loop model in semi-ruminating and ruminating calves under complete anaesthesia: an in vivo model with intact neural and vascular systems

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Introduction

Intestinal loop models have been described in several species, including young calves and sheep, for studying the pathogenesis of several infections and inflammatory processes. The largest obstacle in ruminating animals is the long-lasting anesthesia with risk for ruminal tympany. In the present case an intestinal loop model was developed to test a collection of *Clostridium perfringens* strains for their ability to induce the typical haemorrhagic enteritis lesions in ruminating and semi-ruminating calves.

Methods

Animals

A series of 10 loop-experiments were performed in 3 ruminating conventional Holstein Friesian calves between 4 and 8 months and 7 semi-ruminating veal Holstein Friesian calves between 2,5 and 5 months of age.

Anesthesia

The animals were fasted for 12 hours before anesthesia. After premedication with fentanyl (2 µg kg-1 IV) and midazolam (0.1 mg kg-1 IV), anesthesia was induced with propofol (2-4 mg kg^{-1} IV). Subsequently, the calves were positioned in left lateral recumbency and the trachea was intubated. Anesthesia was maintained for 6 to 12 hours with isoflurane in oxygen/air (inspiratory O2 fraction 55%) and a fentanyl infusion (0.1 µg kg-1 min-1) (Figure 1).

Figure 1: Preparation of the calf: left lateral recumbency, generalised anaesthesia maintained by isoflurane and fentanyl

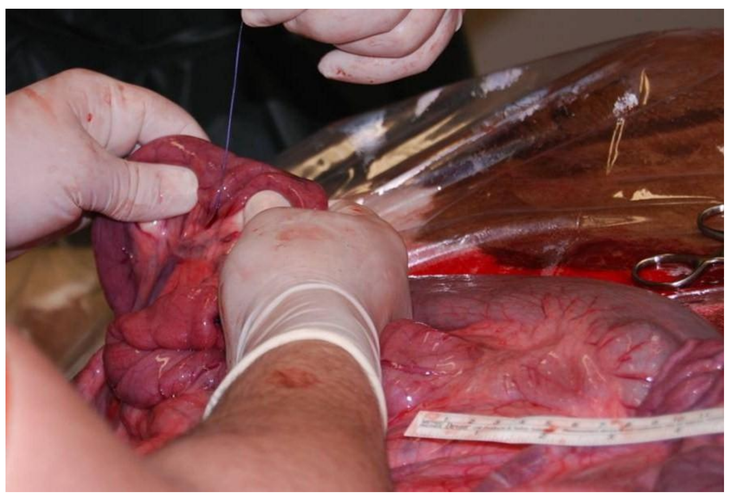

Figure 2: Ligation of the intestinal loops

Ligation of intestinal loops

After a right flank laparatomy the small intestines were exteriorized. Intestinal loops of approximately 10 cm in length were firmly ligated with Surgicryl PGA 0®, leaving 5 cm interspace (Figure 2). The first loops were placed 0.5 meters from the ileocecal transition, and placement of loops was continued in oral direction. The number of loops varied between 60 and 72.

Euthanasia

The calves were euthanized with pentobarbital overdose (200 mg kg^{-1} IV) after the experiment under continued generalized anesthesia.

Results

Tympany

Marked ruminal tympany was observed during anesthesia in all 3 the ruminating calves and in 1 semi-ruminating veal calf. Tympany could not be reduced by esophageal tubing only, but preoperative placement of an indwelling 12G catheter in the rumen connected to a vacuum pump by a sterile tube, completely reduced ruminal tympany in all cases (Figure 3).

Anesthesia

In all calves the planned anesthesia times could be fulfilled without any humane end points being reached. Cardiovascular parameters (heart rate, blood pressure, peripheral oxygen saturation, blood gasses) remained stable during the entire experiment in all animals.

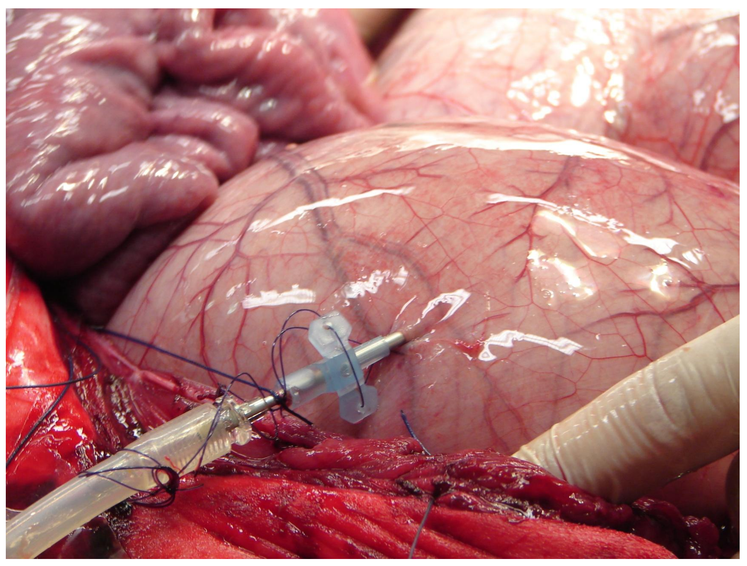

Figure 3: Ruminal catheter to reduce tympany

Discussion

This series illustrates the possibilities of the loop model in ruminating animals, during long periods of anesthesia. The model provides an in vivo intestinal environment with intact neural and vascular system. Large numbers of micro-environments can be studied in one animal, thus diminishing the number of experimental animals and providing excellent reference material for comparative studies of different strains of pathogens or conditions. Continuous anesthesia ensures reduction of stress and suffering for the animal and makes it possible to take in vivo samples and avoid post mortal artefacts. This model provides an excellent opportunity to study a variety of in vivo mechanisms in a considered manner with respect of the welfare of the experimental animals.

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