Technical Note: Reversible Re-Entrant Cannulation of the Parotid Duct in Cattle Using a New Injection Anesthesia Regimen

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ABSTRACT: A new method for reversible re-entrant cannulation of the parotid duct in cattle by use of an injectable anesthetic regimen is described. Ruminal contents were removed before anesthesia instead of food deprivation. The parotid duct was dilated by means of a long hemostatic forceps: its jaws were encased in a piece of plastic tube, and the tip was extended by a piece of flexible wire. A polyethylene parotid catheter was inserted into the dilated duct and passed through the cheek. The saliva was re-directed back into the mouth via a silicone tube through another fistula in the cheek. The cannulations were maintained for 3 to 11 wk and two cows were re-cannulated three to five times in both parotid ducts without problems. No pathological changes of the mouth epithelium were found at slaughter. The rate of flow from the ducts during rest, ruminating, and eating were 5 to 20, 25 to 50, and 40 to 75 mL/min, respectively.

Key Words: Parotid Gland, Salivation, Cannulation, Injectable Anesthetics, Ruminants

Introduction

Salivation is important for regulation of the ruminal environment in cattle fed at a high plane of nutrition (Erdman, 1988). Simple cannulation of the parotid duct at the papilla results in a loss of saliva to the environment, sodium depletion, and metabolic acidosis (Kay, 1966). Kaufmann and Orth (1966) modified this technique by mechanical pumping of saliva to the rumen. Re-entrant cannulation of the duct involves a risk of damage to the nerves that stimulate the parotid gland (Stewart and Stewart, 1961; van Vuuren and van Beers, 1982). Carter and Grovum (1988) described a technique for reversible re-entrant cannulation of the parotid papilla in sheep. This technique includes insertion of a tube into the parotid duct at the papilla, passing the saliva via a tube through the cheek and returning it into the mouth via another tube. The technique is not readily applicable to cattle, because the parotid papilla in cattle are located about 30 cm from the mouth, on the inside surface of the cheek. The papilla are not immediately visible, and space for insertion of a catheter into the duct is narrow and nearly impossible when an oral endotracheal tube is in place. The aim of the experiment was to apply the method of Carter and Grovum (1988) in cattle.

Experimental Procedure

Experimental Animals

Two nonlactating Jersey cows equipped with a large ruminal cannula were used for cannulation of the parotid duct at the papilla. The cows were fed 2 kg of hay and 2 kg of concentrate two times daily in Exp. I, and .4 kg of straw and .4 kg of concentrate every 3 h in Exp. II, 1.5 times maintenance requirement according to NRC (1988). Experiment II was conducted 6 mo after Exp. I. Both experiments consisted of a Latin square design, with four periods and two concentrate/mineral treatments, LCA and HCA. The concentrate (LCA) consisted of 83% dried beet pulp, 5% fish meal, 8% molasses, 1.7% tallow, and 2.3% mineral and vitamin mixtures. Concentrate HCA was similar to LCA except that it was supplemented with NaHCO₃, Na₂CO₃, and KHCO₃. The cation-anion balances of the LCA and HCA concentrates were -100 and 1,200 mEq (Na⁺ + K⁺−Cl−−SO₄²−) /kg DM, respectively. Cows had free access to water.

The parotid ducts were cannulated three and four times in both cows in each of the two experiments. The
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Anesthesia Procedure

The cows were premedicated with a predose of .10 mg xylazine (Rompun Vet. Bayer®, Copenhagen) per kilogram BW intramuscularly. After 30 to 60 min they were given an intravenous (i.v.) dose of 2.2 mg ketamine (Ketelar®, vet Parke-Davis, Copenhagen) per kilogram BW and became recumbent in 60 to 90 s. A soft tube was placed through the nasal meatus just after recumbency, so that the tip was just above the larynx, and oxygen was delivered through the tube at a rate of .025 L O2/(kg BW · min). Anesthesia was supplemented 5 to 7 min later by injection of .01 mg of medetomidine (Domitor®, Vet Boehringer Ingelheim Agro Vet, Copenhagen) per kilogram BW i.v. This resulted in the development of bradycardia within 1 min, the pulse decreasing to 25 to 30 per min. When the cow showed signs of awakening or reaction to the surgery, anesthesia was supplemented with successive additional i.v. injections of .3 mg of ketamine/kg BW and .006 mg of medetomidine/kg BW. This was usually necessary after 45 to 65 min and could be repeated up to three times. When it became evident that the surgery was almost over, only medetomidine (.006 mg/kg BW i.v.) was supplemented.

After completion of the surgery, anesthesia was reversed by i.v. injection of 1.2 to 1.6 mg of tolazoline per kg BW i.v. The cows were on their feet within 2 to 5 min and were able to walk 200 m to the stable within 10 min. The cows were given 2 mg of flunixin meglumine (Finadyne®, Scan Vet, Copenhagen) per kg BW i.v. for pain control. In addition, .004 mg of buprenorphine (Temgesic®, Reckitt and Colman, Copenhagen) per kg BW was given i.v. as a long-acting analgesic. Ruminal contents were returned to the rumen together with 5 to 9 L of lukewarm water, and the cows started to eat almost immediately.

Operative Surgery

The cow was placed in lateral recumbency on the side opposite to cannulation. The corner of the mouth was lifted by means of a laryngoscope equipped with a light source for localization of the parotid duct at the papilla at the back of the mouth. The papilla was dilated with a special dilator made by a 30-cm long hemostatic forceps extended with a 2-cm flexible wire (Seldinger wire) in the tip and encased in a piece of plastic tubing. A pointed and rigid plastic rod, 3 mm thick, was inserted into the parotid catheter to guide it into the parotid duct. The inside of the tube and the plastic rod were sprayed with silicone to reduce the resistance and facilitate withdrawal of the plastic rod. The parotid catheter was a 15-cm metal spiral catheter (Polystan 16 FR, DK 3500 Værløse), which was glued to a 21-cm clear polyethylene tube, o.d. 7 mm and i.d. 5 mm. A bouton made of a 2-cm silicone tube, o.d. 9 mm and i.d. 7 mm, was glued to the parotid catheter, 9 to 11 cm from the tip of the spiral end. The spiral end of the catheter was inserted 6 to 8 cm into the duct until met by the stopper (Figure 1). The bouton was pressed against the inside of the cheek, thereby keeping the parotid catheter in position in the duct. A mark was made on the skin 2 cm in front of the papilla and a scalpel was inserted through the cheek at an angle of 45° toward the papilla. A small hemostatic forceps was then inserted alongside the scalpel, and the scalpel was withdrawn. The output end of the parotid catheter was picked up and guided through the cheek by means of the hemostatic forceps.

A 12-cm-long silicone tube, o.d. 7 and i.d. 5 mm, redirecting saliva into mouth through the cheek (ReTu), was placed 3 to 5 cm anterior to the papilla dorsally and opposite to the first molar (Figure 1). This location is necessary to prevent saliva from escaping the mouth and to prevent feed particles from entering and blocking the ReTu cannula. The ReTu was fixed inside (Figure 1) and outside the cheek by two cylindrical silicone tubes 3 to 4 mm wide, o.d. 9 mm
and i.d. 5 mm. They were glued (Silastic®, Q7-2947, Dow Corning, Midland, MI) to the ReTu and kept the ReTu in place on the cheek without any need of sutures. Both catheters were passed through the cheek from the inside of the mouth in the area of the skin pleat above the upper molar (Figure 1) to prevent the cow from chewing on the tubes. A threedirection plastic T-tube was inserted between the parotid catheter and ReTu to check the saliva flow daily and to collect saliva when required, depending on the placement of a simple clamp. The parotid catheter and ReTu were sutured to the cheek in 2 to 3 places with a monofilament nylon suture (Dermalon 1, Dawis and Geck). The cannulas were protected by a bandage of cavalry twill wound around the head of the cow and a halter for added protection.

Daily Maintenance

Cannulas were checked twice daily to ensure normal circulation of saliva. The ReTu was flushed with chlorhexidine dissolved in water 1:50 to remove mucin deposits and small feed particles coming from the mouth.

Change of ReTu

The return tube was easily replaced under sedation. A dose of .04 mg of xylazine (Rompun®, vet Bayer, Copenhagen)/kg BW, .06 mg of acepromazine (Plegicil®, vet Pherrovet, Copenhagen)/kg BW, and 1.5 mg of pethidine/kg BW were administered i.v. and after a delay of 15 to 20 min, 5 to 10 mL of 2% lidocaine was injected around the hole for ReTu. A small hemostatic forceps was gently guided through the cheek, and the ReTu was picked up from the cavum oris. After finishing Exp. I, the parotid catheters were removed and replaced by tubes similar to the ReTu to maintain the fistula in the cheek. After finishing Exp. II, the cows were slaughtered and the oral cavity and the parotid ducts were examined.

Measuring Saliva Flow

Chewing activity was recorded and saliva flow was measured continuously for 8 to 9 h during daytime for 2 d within each period. Saliva flow was recorded by continuously redirecting saliva from the parotid catheter to a small reservoir connected to a pumping system that directed the saliva to the mouth via ReTu. Jaw movements and pumping activity were recorded continuously on a computer.

Results and Discussion

The cows walked to the stable and started eating after the ruminal contents had been returned to the rumen, and within 1 h after the anesthesia was reversed. In two cases, the cows fed LCA concentrate went off feed, whereas no cow fed HCA concentrate went off feed after total anesthesia. Later on, all the cows were fed HCA concentrate 1 d before and 1 d after anesthesia. The parotid catheters were dislodged after 2 to 4 d on three occasions, whereas four parotid catheters functioned for 10 to 20 d at the end of Exp. I and II. Seven parotid catheters remained functioning for an average of 3 to 4 wk, ranging from 2 to 11 wk. No signs of abnormalities were found after dissection of the oral cavity and the parotid ducts at the end of Exp. II. The procedure seems to be harmless to the cows, since the ducts were cannulated numerous times over a total period of 4 mo within 1 yr. In cases where the cannulas had been removed or rubbed out by the cows, the saliva flow from the parotid duct into the mouth was normal. The mouth epithelium apparently closed the fistula within 1 h. When the tubes remained in the duct longer than 1 wk, the middle part (about 2 cm) of the tubing turned a yellow-green color. Micropathological cultivation confirmed the growth of nonpathogenic bacteria.

The first re-entrant cannulations of the parotid ducts with a simple silicone tube, 5 mm o.d. and 3 mm i.d., sutured to the skin on the cheek, lasted 4 and 11 wk for the two cows. The present kinds of ReTu (Figure 1) have been retained for 2 to 12 wk continuously.

The cows ruminated on both the cannulated and the non-cannulated sides of the mouth. The cannulation method was used to measure parotid flow while recording eating and ruminating behavior. The rate of flow from the parotid ducts (milliliters/minute) varied considerably while the cow was resting (5 to 20), ruminating in the non-cannulated side of the mouth (10 to 20), ruminating in the cannulated side of the mouth (20 to 40), and eating straw or hay (20 to 50) and concentrate (30 to 75). The pH values, osmotic pressure, and sodium and potassium contents in saliva ranged from 8.1 to 8.5, 260 to 290 mosm/L, 140 to 160 mM, and 3 to 15 mM, respectively. The effect of eating and rumination on the rate of flow of saliva, pH, osmotic pressure, and sodium and potassium concentration agree with the small number of published values for the parotid glands (Kay, 1966; Nørgaard, 1995).

Implications

The cannulation technique is recommended because it is reversible and it provides reliable values of saliva flow during resting, eating, and ruminating. The main reason for a dearth of information on salivating in the species is probably attributed to unacceptable cannulation techniques. This technique works well and should promote research aimed at improving rumen function in high-producing cattle.
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