ILEAL CANNULATION OF THE NEONATAL PIG WITH A SIMPLE T-CANNULA

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Story in Brief

A cannula and surgical procedure suitable for ileal cannulation of pre-weaned pigs were devised. Cannulas were installed in pigs at 18 days of age to study digestion immediately following weaning. The lightweight, durable T-cannula provided adequate ileal samples from pigs fed both semi-purified and practical diets. The screw cap and collar provided adjustment for growth and simplified maintenance and collection. Cannulas provided repeated ileal samples from pigs up to 135 lb at which time cannulas were nonsurgically removed from the conscious pig and replaced with larger cannulas for subsequent studies.

(Key Words: Swine, Neonatal Pig, Ileal Cannulation, T-Cannula)

Introduction

In order to maximize production efficiency, further understanding is needed concerning nutrient availability in pigs during all phases of production. Ileal sampling to estimate pre-ileal bioavailability is the method of choice for determining availability of nutrients in the pig since modifications of nitrogen and essential amino acids by microbial organisms in the cecum and small intestine of pigs makes availability calculation based on fecal samples questionable. Digestion and absorption of most nutrients is essentially complete in the small intestine and nitrogen and amino acids that disappear from the hindgut are of little or no value to the pig.

The neonatal pig at weaning is subjected to extreme changes in diet and digestive capacity is rapidly developing. Since these conditions limit the pigs ability to adapt to dietary changes and result in reduced gain and efficiency , the effect of diet on nutrient availability may be more critical in neonatal pigs than in older growing-finishing swine. Several ileal cannulation techniques have been described using T-cannulas for collecting intestinal samples in growing-finishing pigs, but no such techniques have been reported for the neonatal pig. The cannula for the young pig must be small enough to fit within the lumen of the small intestine yet have a large enough internal diameter to allow suitable digesta flow through the cannula. In addition, the cannula must be designed to minimize protrusion beyond the body wall since restraint, which is the typical means of protecting a cannula, is impractical in the neonatal pig.

This paper describes a lightweight, ileal T-cannula which allowed repeated sample collection in early weaned pigs.

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Materials and Methods

Cannula Design

The cannula for ileal cannulation of 18 day old pigs (figure 1) was constructed of a rigid lightweight yet extremely durable plastic (Delrin 600). The cannula was milled from a solid stock bar of Delrin. One end of this bar was machine cut to form the cannula body which was then threaded externally (25 threads/in). This body was machine cut on two opposite sides leaving an ovoid shaped body with two flat smooth sides and threaded ends. The bar was then centrally drilled through its entire length to provide an ovoid shaped barrel for digesta passage during collection. The large diameter end of the bar was hand tooled to provide the flanged end with a concave inner surface to conform to the shape of the small intestine.

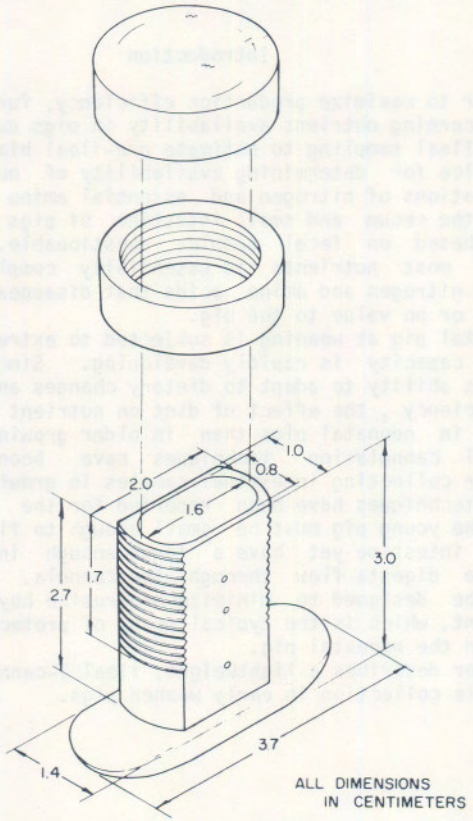

Figure 1. Design of the intestinal cannula for early weaned pigs.

To secure the cannula in place against the body of the pig, a lucite collar was constructed and threaded internally to match the threads on the body of the cannula. The collar secured the cannula in place and allowed adjustment to compensate for thickening or swelling of the body wall. A cap, also made of lucite, was designed in a similar fashion to fit the collar to prevent leakage during periods between sample collection.

Surgical Procedure

Yorkshire gilt pigs weighing 10 to 12 lb were removed from the litter approximately 1 hour prior to surgery. Halothane anesthesia was administered via face mask and maintained with an endotracheal tube. The pigs were placed on their left side on padded cotton towels provided for warmth. The right flank was shaved with surgical clippers and prepped with a surgical scrub.

An incision was made in the right abdominal wall through which the cecum was located and exteriorized and the ileo-cecal ligament identified. A section of ileum near the anterior attachment of the ileo-cecal ligament was isolated and packed off with saline saturated cotton gauze. A purse-string suture approximating the circumference of the body of the cannula was placed in the surface of the ileum and a longitudinal incision of minimal length to accommodate the flange of the cannula was made in the center of the purse-string. With gentle manipulation and the use of thumb forceps the cannula was inserted into the lumen of the ileum and the purse-string was tightened around the base of the cannula body. Two simple interrupted sutures were placed across the ileum at the anterior and posterior borders of the body of the cannula.

A stab incision was made through the right body wall above and behind the original incision. The length of the stab incision was sufficient to barely accommodate the body of the cannula thus avoiding the necessity of skin sutures in this incision. The cannula was then brought up through the stab incision. It is essential that the cannula not be rotated and that the proximal end of the ileum remain ventral and the posterior end remain dorsal to allow gravity to facilitate sample collection.

The original incision site was closed with a continuous interlocking pattern of sutures in the muscle layers and an interrupted pattern in the skin. After closing, a topical antibiotic spray was applied to the two incisions sites. The cannula collar was placed on the body of the cannula and tightened until the internal flange and ileum were pulled snugly against the internal peritoneal surface of the body wall. Care should be taken to avoid getting the collar so tight as to cause restriction of peripheral circulation in the area surrounding the cannula. The cap was then screwed tightly on the top of the cannula to prevent leakage of intestinal contents. In the final step, cotton gauze was placed over the cannula and surgical area and an adhesive bandage wrapped over the gauze and around the abdomen of the pig. This wrap provided protection of the incision site and cannula from trauma or foreign material and from other pigs in the litter during the recovery period. Care should be taken with male pigs to avoid enclosing the prepuce in the adhesive wrap.

Post Surgical Care

Immediately following surgery the pigs were returned to the litter and remained with the dam for a 7 day recovery period. To avoid injury,

from the sow or other pigs in the litter, the cannulated pigs were closely observed for 2 to 3 hours after surgery or until the effects of the anesthesia were no longer evident. Following surgery, procaine penicillin was administered twice daily for 5 days at a dose of 9,000 IU/lb body weight.

In addition to the milk provided by the dam, the pigs were allowed continuous access to an 18% crude protein starter diet in creep feeders and water was available at all times from nipple waters. The adhesive wrap was changed when necessary. In general, this was necessary only when the wrap was loosened by other pigs in the litter. The recovery period was generally uneventful and skin sutures were removed approximately 10 days postsurgery. Pigs were weaned and moved to individual metabolism crates 7 days postsurgery and digestibility studies began following a 2 day adjustment period.

Results and Discussion

This cannula has been installed in 6 pigs at 18 days of age weighing between 10 and 12 lb. All pigs completely recovered within 7 to 10 days postsurgery as evidenced by a lack of inflammation around the surgical area and normal appetite and growth. Following weaning at 25 days of age, the adhesive wrap was removed and the cannula was left unprotected. Pigs were housed in smooth sided metabolism crates to minimize trauma caused by catching the cannulas on the sides of the crate. Crates were located in an environmentally controlled feeding room. Five of the 6 pigs were used in a 5 week digestion study starting when pigs were 27 days of age. During this time all pigs were fed semi-purified cornstarch based diets. Samples were collected from the cannulas by removing the cap and unscrewing the collar until the outside edge was flush with the end of the body of the cannula. A small plastic bag was then attached over the collar and around the body of the cannula to collect digesta. This procedure could be performed within the metabolism crate with the unrestrained pig. After the 5 week trial, all 6 pigs were fed an 18% crude protein corn-soybean meal starter diet until they reached about 55 lb at which time the diet was switched to a 16% crude protein growing diet until the cannulas were removed. Samples were collected from all pigs periodically during this time to insure that function of the cannula was maintained. When pigs reached approximately 75 lb live weight, the cannulas were removed from 3 of the pigs in the unanesthetized state by hand manipulation of the cannula until the cannula was dislodged. A larger, flexible cannula was inserted into the fistula immediately following removal of the small rigid cannula. The larger T-cannula were maintained for subsequent trials as the pigs grew larger. The remaining 3 pigs with rigid cannulas as well as the 3 with flexible cannulas were maintained with periodic collections until they reached a weight of about 135 lb at which time all cannulas were nonsurgically removed.

Other cannula designs were also tested in this age and weight of pig. Cannulas made of flexible tubing large enough for sample collection resulted in intestinal blockage, frequent loss of cannula or were too large to fit within the lumen of the small intestine. Thin walled stainless steel cannulas could not be threaded and therefore provided no practical means of securing the cannula in place or of adjusting the cannula for changes in body wall thickness. Stainless steel cannulas thick walled enough to be threaded were too heavy and difficult to maintain in the pig. Initial cannulas were designed with

two circular openings, one for intestinal blockage with an inflatable catheter and the other for digesta collection, but the diameter of the openings with this system proved to be too small to allow suitable cannula flow in pigs fed semi-purified diets.

The cannula described in this paper was small, lightweight but sturdy enough to use in digestion studies with neonatal pigs. This cannula does not protrude excessively from the body of the pig and avoided certain problems encountered such as cannula loss and intestinal blockage previously encountered with other types of cannulas in neonatal pigs. Collections can be accomplished by one person on unrestrained pigs. The cannula was large enough to provide sufficient sample flow for routine analysis from pigs fed either semi-purified or practical diets. The screw on cap and collar allowed adjustment for changes in body wall thickness that accompanies pig growth and provided a method to easily attach bags to collect digesta.