Simplified Procedure for Abomasal Cannulation in Rumen Fistulated Goats and Sheep\textsuperscript{1,2}

E. C. PRIGGE, W. H. HOOVER, G. A. VARGA, and D. SCOTT LOUGH
West Virginia University
Morgantown 26506

ABSTRACT
To facilitate the infusion of nutrients into the abomasum of small ruminants, an abomasal cannulation technique was developed that would allow placement through a rumen fistula. Location of the cannula was confirmed by slaughter of two wether lambs. A retaining device was developed that resisted the tendency of movement of digesta in the rumen to twist the infusion line and pull the cannula through the reticulo-omasal orifice into the reticulo-rumen. The abomasal cannula was tested for 45 days in lactating dairy goats, and all cannulae remained functional and in proper position.

INTRODUCTION
Nutrients such as protein, carbohydrates, and simple sugars have been infused into abomasums of ruminants. In many studies the use of both rumen and abomasally fistulated animals is required. Most procedures for placement of an abomasal cannula involve exteriorizing a cannula between the last rib and the lumbar transverse processes. Although this cannulation procedure is relatively simple in concept, it can result often in extensive losses of animals as well as long recovery times and limited longevity. Although newer methods \textsuperscript{2} have reduced some of the problems, they still involve delicate surgical procedures. A method has been developed \textsuperscript{1} for the infusion of casein into the abomasum of dairy cows by placing a cannula through a rumen fistula past the reticulo-ruminal fold and manipulating it by hand through the reticulo-omasal orifice and past the sulcus omasi into the abomasum. This procedure eliminated the need for additional surgery and allowed the cows to be placed on experiment immediately after cannulation. Although this methodology worked well in dairy cows and beef steers (Clark, personal communication), the relative bulk of the device necessary to retain the cannula (a 60-ml polypropylene bottle) was too large to be effective in smaller ruminants. Thus, development of a simple and effective cannula for long term infusion into small ruminants such as goats and sheep was the major objective of this study.

MATERIALS AND METHODS
Two wether lambs and four lactating dairy goats were fistulated ruminally and fitted with a flexible rumen cannula\textsuperscript{3} with a 3.5 cm i.d. opening. Wethers were used to confirm placement of the abomasal cannula, and four goats were used to evaluate the retention of the device in the abomasum. The first infusion cannula tested was simply a polypropylene tube tightly fitted through the center of a No. 1 neoprene stopper. The second device was a toilet flange (Figure 1) that can be purchased in any plumbing supply or hardware store. It was modified by removal of all but a small portion of the outer lip with a scalpel blade. The flange then was buffed smooth with emery cloth. Two holes were drilled through the flange, one toward the remaining portion of the outer lip with a drill bit small enough to allow the infusion tubing to fit snugly. A second larger hole was drilled opposite this to allow the infusion line to move freely through it. Silastic tubing\textsuperscript{4} (1.57 mm and 3.175 mm) was used as the infusion line and placed through the holes in the toilet flange with about 1 cm of tubing protruding through the smaller hole.

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\textsuperscript{3}Division of Animal and Veterinary Science.
\textsuperscript{4}Bar Diamond, Inc., Route 2, Box 308, Parma, ID.
\textsuperscript{5}Dow Corning Corp., Midland, MI.
Figure 1. Toilet flange prior to modification for a retaining device for the abomasal cannula. Outer lip exclusive of area enclosed by the dotted line is removed.

This then was glued to the remaining portion of the outer lip with a silicone glue. The completed device can be seen in Figure 2. The theory behind this device is illustrated in Figure 3. Any pressure by the digesta in the rumen on the infusion line will cause the device to expand and prevent its removal from the abomasum.

For insertion of the abomasal cannula, removal of the rumen cannula was necessary. Once this was accomplished, the infusion line with the retaining device was placed in the rumen. As the rumen fistula is of limited size, it is strongly recommended that the person selected to do this placement have a small hand. Once the hand was in the rumen and the retaining device located, the individual moved his hand toward the anterior portion of the reticulo-ruminal fold and felt for the reticulo-omasal orifice. The orifice then was dilated with the fingers and the retaining device moved through the orifice. The abomasum could be distinguished from the omasum by the smooth texture of the tissue, and the retaining device then was manipulated into position in the abomasum.

After insertion of the abomasal cannula the silastic infusion line in the rumen was surrounded with Tygon tubing (4.763 mm and 7.938 mm) for all but the final 3 to 6 cm of tubing in proximity of the reticulo-omasal orifice. The majority of slack was removed from the infusion line with about 15 to 20 cm excess left to allow for some movement. The infusion line surrounded by the Tygon tubing was exited around the edge of the rumen cannula. The same insertion procedure was used regardless of cannula type.

RESULTS

Initially two wethers were fitted with a polypropylene infusion line placed through the cen-
ter of a #1 neoprene stopper. The stopper served to retain the infusion line in the abomasum. One wether was slaughtered the following day and the other 1 wk after placement to confirm the position of the cannula in the anterior portion of the abomasum. In both wethers the cannula was in proper position. Four goats then were fitted with the abomasal cannula and after 14 days, the location of the device was assessed by feeling its position in the abomasum through the reticulo-ruminal orifice. In two of the goats, the neoprene stopper was in the rumen whereas the other two had the cannula correctly located in the abomasum. However, the cannulas that remained in the abomasum did not remain always patent. Thus, failure of this cannulae could be attributed to: 1) withdrawal from the abomasum by rumen ingesta movement and 2) twisting of the polypropylene infusion line, thus cutting off flow of the infusate.

The cannula with the modified toilet flange retaining device then was placed into the abomasum of four lactating goats and checked after 30 days and again after 45 days. All cannulae remained in the abomasum, and no problems occurred from clogged or twisted infusion line. We are using this device routinely with lactating goats with excellent results. Although this device has not been tested thoroughly in sheep and not at all in cattle, it may prove to be effective in these species as personal observation indicates that the reticulo- omasal orifice is approximately the same size.

REFERENCES
