A quick and simple method for establishing permanent ruminal fistulae is described. A frozen cannula is forced into the rumen in a manner similar to the use of a trocar. Minimal equipment is required, and the entire operation can be performed in 15 to 20 min in sheep or 30 min in cattle. The technique has been used successfully to fistulate seven sheep and two cows.

INTRODUCTION

Fistulated ruminants are valuable in research concerning ruminant nutrition and physiology. Several types of cannulae, as well as surgical methods for their installation, have been described (1, 2, 3). In general, the main problem in using fistulated animals involves establishment of the fistula and installation of the cannula. The technique described here greatly simplifies procedures (1, 2, 3). The principle is similar to that used in relieving bloat with a trocar and cannula.

PROCEDURE

Except for dimensions, cannulae are similar to those described by Dougherty (1). They are molded of a liquid plastic material (Quelcor 1075-Red) which cures when heated for 15 to 30 min at 185°C. The cannulae for sheep have the following dimensions. The flange is 7.5 cm in diameter and 3.5 mm thick. The neck is 17.5 cm long with an inside diameter of 1.9 cm and an outside diameter of 2.54 cm (Fig. 1). The external flange is 8 μm in diameter and .9 cm thick. The hole is 2.54 cm in diameter. Those used in cattle are larger. The flange is 10.2 cm in diameter and 5 mm thick. The neck is 30 cm long with an inside diameter of 3.8 cm and an outside diameter of 4.5 cm. The external flange is 10.5 cm in diameter and 1 cm thick. The hole is 4.5 cm in diameter.

A cone shaped mold is necessary to prepare the cannula for installation. This can be made by rolling a piece of polyethylene (such as the side of a polyethylene bottle) into a cone and cementing it in this position.

Prior to installation, the flange is tucked into the lumen of the cannula as far as possible leaving only a small lip outside. A sharp steel rod (.64 cm × 30 cm in sheep or 1 cm x 40 cm for cattle) is passed through the lumen of the cannula with the pointed end extending from the flange end of the cannula (Fig. 2). The cannula then is fitted into the polyethylene cone with the sharp end of the rod extending to the bottom (apex) of the cone. The rest of the cannula is pushed down into the cone making sure that the rod remains extended to the bottom. Water is poured into the cone until just covers the flange portion of the cannula, and it is frozen in this position.

After the cone is held in the hands for a few seconds, the frozen cannula can be removed with the icicle intact (Fig. 3). It then is placed in a container of dry ice and kept frozen until installed.
The animal is prepared by closely shearing a liberal area of the left paralumbar fossa, scrubbing the area, and applying a topical antiseptic. The animal should be maintained in a standing position of restraint. The area is desensitized by intradermal and subdermal injection of a suitable anesthetic (e.g., procaine hydrochloride). The rumen is inflated tightly with air via a stomach tube (1.27 cm or 2.54 cm outside diameter for sheep or cattle, respectively) attached to the outlet of a vacuum pump. When the desired degree of tympany is reached, a vertical incision (2 cm for sheep or approximately 8 cm for cattle) is made quickly in the skin, and the frozen cannula is forced through the incision and into the rumen (Fig. 4). Once the cannula has penetrated into the rumen, the stomach tube can be removed. Only a small amount of the cannula neck should be left protruding to ensure that when opened, the flange will be inside the rumen. The neck of the cannula, along with some skin, can be grasped with hemostats to prevent its slipping completely into the rumen (Fig. 5). The cannula is left in this position until the ice has melted, at which time the sharp rod is withdrawn. The cannula then is pulled out slightly (2 cm) and grasped firmly with hemostats or pliers. A blunt rod (1.27 cm in diameter) is inserted into the neck of the cannula and used to push the flange into its normal (unfolded) position. It may be necessary to wait a few minutes for the flange to become warm and flexible (Fig. 6). The excess length is cut from the neck and a rigid plastic pipe connection (with an external diameter the same as the internal diameter of the cannula neck) is inserted into the lumen. Antibiotic (pen strep) is applied topically to the exposed tissues around the neck of the cannula. The exterior flange then is positioned and secured with a hose clamp. The cannula is closed with a rubber stopper (Fig. 7).

The entire operation requires 15 to 20 min for sheep, slightly longer for cattle. The animals are given daily antibiotic injections for 3 or 4 days after fistulation. The exterior flange should be removed and the area inspected and
cleaned periodically. Sulfa urea powder can be applied to the area to help prevent infection until healing is complete.

**DISCUSSION**

The technique has been used successfully to fistulate seven sheep and two cows. There was little bleeding and no evidence of peritonitis. There may be some danger of perforating the left longitudinal groove of the rumen; however, this problem has not been encountered. Chances are minimized by selecting the incision site where protrusion is most prominent when the rumen is inflated.

These precautions are necessary for success. The rumen must be inflated tightly at the time of perforation. The left side of the animal should be distended well with some distention apparent on the right side. Inflation need not be maintained after perforation of the rumen. The neck of the cannula must be of sufficient length to ensure penetration of the rumen and that the flange end remains within the rumen as the distention subsides.

The pointed rod must be sharp, and the icicle must taper evenly to the point. The frozen cannula should be inspected for blunt edges or large bubbles in the icicle when it is removed from the cone. Blunt edges toward the point can be smoothed and sharpened by shaving off some of the ice with a scalpel. If there are large bubbles in the ice, it should be thawed and refrozen.

Considerable force is required to push the frozen cannula through the abdominal and ruminal walls. With sheep, the incision in the skin can be slightly smaller than the frozen cannula and still allow penetration. With cattle, due to the toughness of the skin, the incision must be large enough to allow the frozen cannula to pass through without stretching the incision.

In some of the animals, there was a little necrosis around the neck of the cannula and a small amount of tissue sloughed. After the tissue sloughed, however, the muscles tightened around the cannula neck giving a reasonably tight seal. Leakage has been similar to or less than that generally observed in conventionally fistulated animals.

In one sheep, the cannula accidentally was pulled out 2 wk after installation. The adhesion between the rumen and abdominal wall was in excellent condition, and another folded cannula was easily installed. The tone of the muscles around the cannula in this animal seemed unusually poor, and this apparently contributed to the loss of the cannula. This condition has not been observed in any of the other animals.

A Murphy purse string suture was sewn in the skin around the cannula neck on the first two animals. This was unnecessary and discontinued.

**REFERENCES**