A Modified Sleeve and Plug Cannula for Esophageal Fistulated Cattle

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Abstract

An inexpensive esophageal fistula sleeve and plug cannula was constructed using 38-mm diameter PVC pipe with a 4-mm wall, a Babcock float rod, and laboratory rubber stoppers. The cannulae are easily made and have proven effective in reducing and correcting injury to the lining of the esophagus. Longer sleeves and larger plugs, plus use of 130- × 3-mm circles of rubberized belting material inside the esophagus and sometimes on the outside of the fistula, effectively reduced saliva and rumen content losses from animals with extra large fistulae.

Key Words: esophageal fistulated animals, cannulae

Use of esophageally fistulated animals to sample pasture forage was first introduced by Torrell (1954). Although this sampling method has proven to be a satisfactory technique, no completely acceptable cannula has been developed to maintain and close the fistula opening when animals are not sampling forage. The stainless steel sleeve type cannula with a plastic plug (Harris et al. 1967) may cause erosion of the lining of the esophagus and scar tissue accumulation (Forwood et al. 1985) due to the lightweight (20-gauge metal) sleeve with its relatively sharp edges. If the plastic plug fits snugly in the fistula, a portion of the delicate mucosal tissue can easily be pressed between the plug and the metal sleeve resulting in necrosis of that area. A plastic cannula developed in Australia (Breen and Hunter 1976) is difficult to keep tight enough to prevent its being pulled out, yet loose enough to avoid swelling and pressure necrosis. Taylor and Bryant (1977) developed a lightweight semipermanent plastic cannula which does not irritate the esophagus, but is very difficult to remove and replace if an animal's esophagus becomes plugged with forage. The outlet tube of the cannula can also become clogged with forage while animals are being used. More recently developed cannulae (Forwood et al. 1985, Walker et al. 1985) may alleviate some of the above problems, but they are still designed to fit a single-sized fistula and the internal plates are relatively short. In general, most types of cannulae do not fit and function well in all fistulated cattle because of slight anatomical differences between animals and/or differences in size and placement of the fistula.

The objective of this paper is to describe a sleeve and plug cannula that can be made in a variety of sizes, and to relate our experience using it and in dealing with some common problems encountered with fistulated animals.

Materials and Methods

The sleeve portion of the cannula (Fig. 1) is constructed from 38-mm diameter PVC pipe with 4-mm wall thickness. The sleeve width we use is 40 mm, the same as the stainless steel sleeve recommended by Harris et al. (1967). Sleeve lengths varying from 150 to 200 mm have been used successfully. After cutting a sleeve, the rough ends are rounded and all edges sanded smooth. A 5- × 75-mm threaded brass stem (Babcock-float-rod cut in half), which is mounted on the sleeve to hold the fistula plug in place, may be centered on the sleeve or offset as desired. The unthreaded end of the stem is rounded so that it will pivot easily when fastened to the PVC pipe. Two holes about 14 mm apart are drilled through the area where the stem is to be located. The inside of the pipe is then thoroughly roughened for about 40 mm in each direction from the 2 holes to maximize adhesion between the PVC pipe and the fiberglass which is applied later. A 2-mm hole is drilled through the stem about 2 mm from the unthreaded end and a 1.5- × 60-mm stainless steel welding rod is bent into an open-ended rectangle with a 14 mm long center portion. The welding rod is inserted into the hole in the stem. The ends of the welding rod are then put through the 2 holes on the top side of the PVC sleeve until only enough of the rod remains above the top of the PVC pipe to allow the stem to pivot easily from side to side. The PVC sleeve is turned over and the ends of the welding rod are bent in opposite directions parallel to the PVC sleeve. This prevents the stem from being separated from the sleeve. A fiberglass patch is placed over the bent ends of the stainless steel rod, then fiberglass resin is applied so that the patch and both ends of the rod are well covered; this completes the sleeve portion of the cannula.

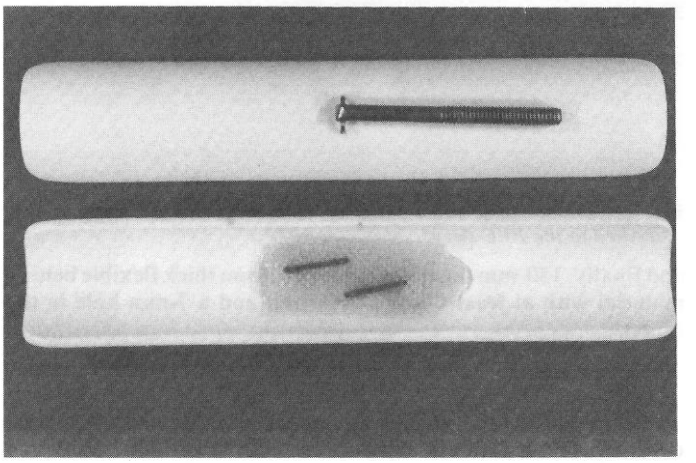

Fig. 1. *Top and bottom view of the PVC sleeve and threaded stem.*

Laboratory rubber stoppers are used for the plug portion of the cannula (Fig. 2). Generally, combinations of number 10 and 11, 11 and 12, or 11 and 13 are used with the 2 stoppers placed together to form a continuous taper. The surfaces that are to be glued together are roughened and glued with "Fastack Trim Adhesive" by 3M, or a similar product. After the glue has dried, the tapered side of the plug may need to be ground off slightly to provide a continuous smooth taper. Finally a 7-mm hole is drilled through the center of the plug so that it will easily slip over the stem.

In addition to the two basic parts of the cannula, we have found some other items (Fig. 3) useful in preventing saliva and rumen content loss when the fistula is excessively large. These include small plexiglass spacers (circles 50-mm diameter × 6-mm thick with a 7-mm hole in the center), large plexiglass plates (circles 130-mm diameter × 6-mm thick with a 7-mm hole in the center),

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Mention of a trade name is solely to identify materials used and does not constitute endorsement by the U.S. Department of Agriculture.

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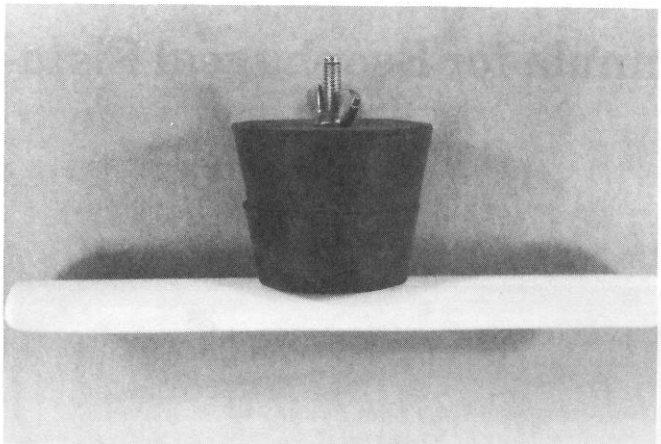

Fig. 2. *Cannula plug constructed of laboratory rubber stoppers and secured to the PVC sleeve.*

and finally, 130-mm diameter circles of 3-mm thick flexible belting material with at least 1 side rubberized and a 7-mm hole in the center[1].

Results and Discussion

Two problems causing us the most difficulty with fistulated cattle are: (1) the formation of pockets (Harris et al. 1967, Forwood et al. 1985) in the lining of the esophagus, and (2) the fistula being too large, causing loss of saliva and rumen contents. The thicker-walled PVC-plastic sleeve we use has substantially reduced the problems encountered with stainless steel sleeves. If pockets do occur as a result of forage buildup under one end of the sleeve, the problem can be corrected by using a sleeve that extends 10–15 mm beyond the damaged area. Using only a slightly longer or shorter sleeve may only extend the eroded area.

Forwood et al. (1985) alluded to pocketing causing nerve damage to the esophagus of fistulated animals, which affected their ability to swallow and resulted in starvation. Although we have had severe and repeated damage to the lining of the esophagus when using stainless steel and various other cannulae, we have had only 1 instance when an animal temporarily lost its ability to swallow. This occurred when a steer gradually became unable to swallow over a period of 2–3 weeks following a severe pocketing incident. This temporary problem apparently resulted from erosion of the mucosal tissue of the esophagus, repeated plugging of the esophagus with forage, dehydration due to loss of saliva, and excessive fatiguing of the muscles of the esophagus from continued dilation. This condition was complicated by the animal's general weakness from lack of feed. The problem was originally caused by a different type of cannula, but became worse while using the PVC sleeve because we were using a 180-mm sleeve with an offset stem and merely rotating ends to correct the problem. This steer had an excessively large fistula and simply rotating the sleeve did not work. The pocketing was corrected by using a 200-mm PVC sleeve with the stem centrally located so that the damaged tissue on both sides of the fistula was covered by the sleeve at the same time.

The animal finally regained the ability to swallow after dosing it with electrolytes (225 g sodium chloride, 225 g of a combination of potassium and magnesium sulfates, plus 50 g of dicalcium phosphate) and keeping it off feed for 12 hours. Two separate electrolyte doses, each followed by a 12-h period off feed, were required before the steer could eat without further plugging; dosing with electrolytes alone was not effective. This treatment apparently

[1]Nationwide Belting Manufacturing Co., P.O. Box 441 - 3309 South Avenue, Toledo, Ohio 43692.

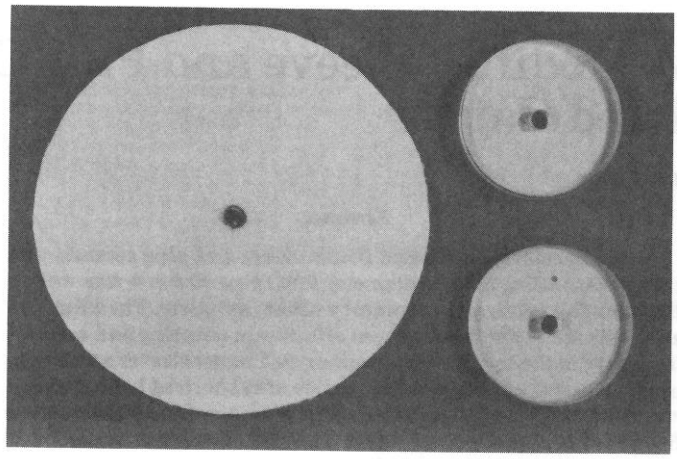

Fig. 3. *Large 130 mm circle of rubberized belting and 50 mm plexiglass spacers used to close enlarged fistulae.*

resulted in renewed production of copious amounts of saliva and facilitated an improvement in the muscle tone of the esophagus. The esophagus was almost completely healed and the animal had regained its ability to swallow within 2 weeks.

The other problem that we have had with fistulated cattle resulted from fistulae that were too large for standard fixed-dimension cannulae to adequately close. Cannulae such as the Australian type (Breen and Hunter 1976) can be installed so loosely that they often are pulled out or partially swallowed, or they may be fastened so tightly that swelling and necrosis of the mucosal tissue occurs. A sleeve and plug cannula that is too small may stay in place, but allow continued loss of saliva and rumen contents causing dehydration and gradual loss of condition. We have not found a fixed-size cannula that works adequately in all fistulae. When animals have a large fistula, we use the larger-sized rubber stoppers plus belting material (Fig. 4). A circle of belting with the

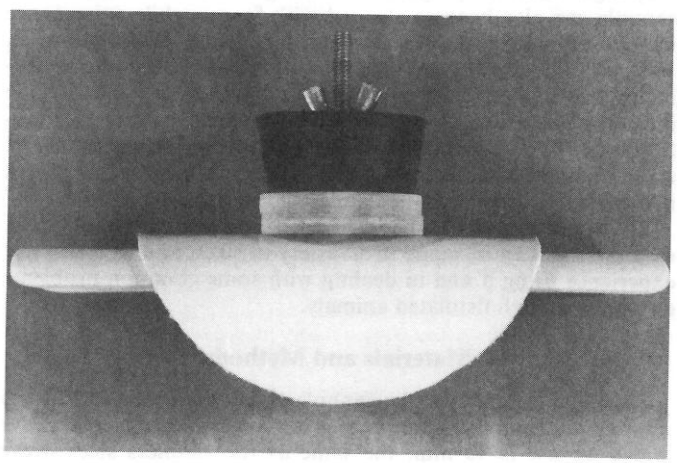

Fig. 4. *Photograph depicting use of cannula and rubberized belting material for cattle with extra large fistulae.*

rubberized surface facing outward is placed over the sleeve before it is inserted into the esophagus. If necessary a circle of belting is also used on the exterior surface of the animal next to the skin. If there is still excessive loss of rumen contents or concern that the cannula may be swallowed, we use a 130- × 6-mm plexiglass plate on the exterior surface of the fistula. The belting and plexiglass effectively act as barriers to fluid loss.

In younger animals, the thickness of the tissue between the interior of the esophagus and the exterior surface of the animal may not be adequate to support a heavy rubber plug without causing irritation and erosion of tissue around the fistula. Thus, a single rubber stopper and 50- × 6-mm plexiglass spacers may be used, with or without the belting and large plexiglass plate, to close the fistula. Generally as the animal grows, the tissue between the esophagus and the animal's exterior surface increases in thickness so that normal length rubber plugs can eventually be used. As tissue gradually fills in around excessively large fistulae they may tighten enough so that circles of belting and plexiglass can be eliminated, especially on the exterior side of the cannula.

The fiberglass joint holding the stem to the PVC sleeve is the weakest portion of the PVC pipe cannula; however, we have had little problem with this joint if the pipe was properly roughened before the fiberglass was applied.

The cannula and accompanying parts may seem crude and cumbersome since several pieces may be necessary to close an excessively large fistula. However, the cannula is effective, inexpensive, easy to make, and offers the flexibility of accommodating animals with large fistulae. The cannula also provides a means of preventing and correcting problems of pocketing and mucosal tissue erosion.

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