THE EFFECTS OF INTUBATION FEEDING OF THE NEWBORN CALF

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The newborn calf has three fore-stomachs (rumen, reticulum, omasum) plus an abomasum or true stomach. Compared to the adult ruminant, the fore-stomachs of the newborn are small, making up approximately 30 percent of the total stomach as compared to 93 percent of the total stomach area in the mature cow. Only the abomasum is physiologically functional in the newborn.[9] (Fig. 1).

The esophageal groove (reticular-omasal groove) which begins at the cardia (entrance of the esophagus into the reticulum) and extends to the reticulo-omasal opening forms a tube-like structure when the sensory area of the oral cavity is stimulated by the process of nursing or by the administration of specific chemicals. This aids indirecting fluids (colostrum) directly into the abomasum and bypasing the reticulum, the rumen, and the omasum.[1 22 23 24] Very little milk normally enters the calf rumen during nursing or drinking from a pail except when there is an overdistention of the abomasum followed by regurgitation into the rumen, when the esophageal groove is not properly stimulated or when the sensory area of the oral cavity is bypassed, as with intubation.[15]

If the esophageal groove is not functioning adequately, the milk is conducted into the reticulum or rumen.[23] Because neither the rumen nor the reticulum are physiologically functional in the newborn and through most of neonatal life, any milk that enters the undeveloped reticulum and rumen can undergo fermentation with the production of toxins (putrefaction) that can produce digestive disturbances. Enteritis frequently ensues.[2 12 25]

The esophageal groove closure and omasal-abomasal canal dilatation is initiated by the stimulation of the vagus nerve through contact with the sensory nerves in the oral cavity and pharyngeal area.[6 18] This stimulation is initiated by sodium chloride and sodium bicarbonate in the milk. Other stimulants can be water, eagerness to nurse, and the desire to consume milk.[5 14 17] The esophageal groove closure will not occur when milk or other fluids are fed through a tube as there is no contact of the milk with the sensory areas of the oral cavity, although the groove may close due to auditory, visual, and olafactory stimuli associated with colostral or milk

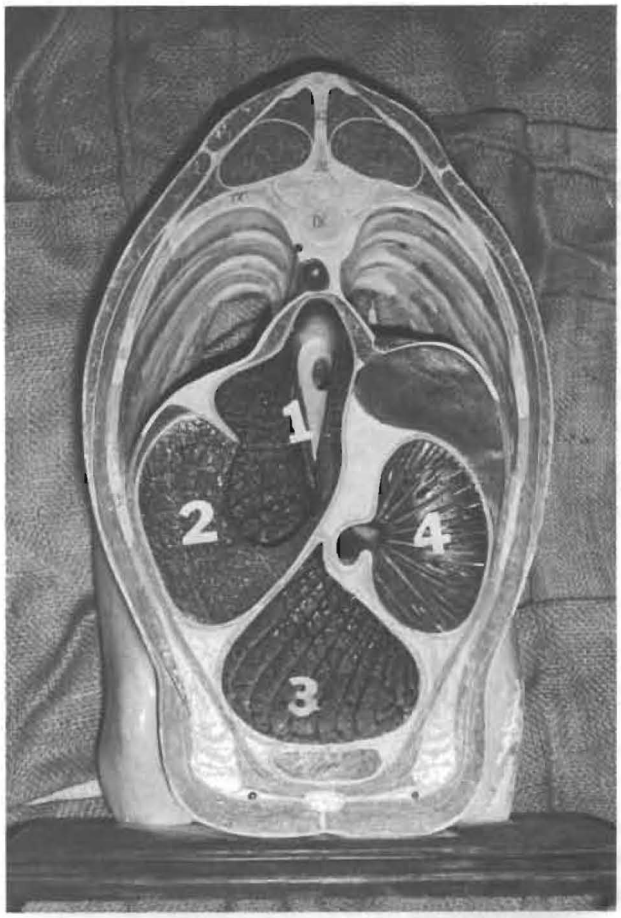

Figure 1. A rear to front view of a cross section of the body of calf at the 9th rib. The light area just to the right of number 1 is the esophageal groove. The area under the number 1 is the left fold of the esophageal groove. Other digestive organs include the rumen-reticulum wall (2), the abomasum (3), and the omasum (4).

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consumption.[10 11 25] Solutions of sensory stimulants such as sodium bicarbonte or copper sulfate may be placed in the oral cavity to artificially stimulate closure of the esophageal groove.[5 9 26]

Nursing or sucking an artificial nipple to obtain milk results in closure of the esophageal groove and opening of the omasal-abomasal canal within two seconds with little or no milk spilled into the non-functioning reticulum and rumen.[7 23] Drinking directly from a bucket results in a longer period before closure of the esophageal groove with greater quantities of milk deposited into the reticulum and rumen. When milk is directed normally through the omasal-abomasal canal it is metabolized more rapidly and the incidence of diarrhea is decreased.[1 19 29]

One of the devices made available to force colostrum or electrolytes into the newborn calf is a plastic tube with a ball on the end (Fig. 2). The ball and rod supposedly provide an easy method of depositing fluids into the digestive tract of the newborn calf with little chance of depositing the fluid into the lungs.

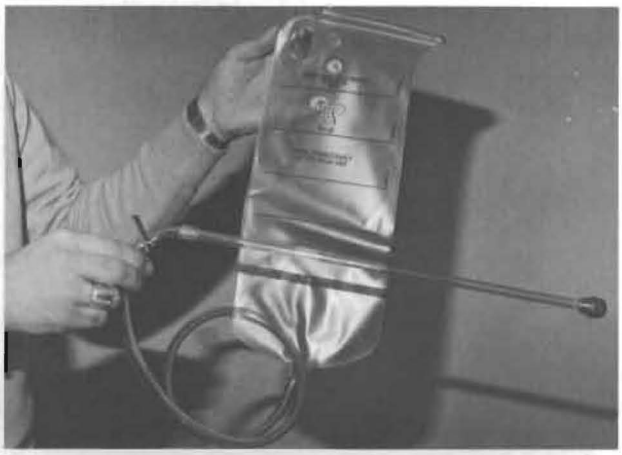

Figure 2. A calf feeder for feeding calves by intubation.

Investigations have demonstrated that there is some rumen-reticulum movement in the newborn calf but that neither of the fore-stomachs are truly physiologically functional as they normally are in an older more mature animal.[1 19]

A number of investigators have indicated that when milk bypasses the fore-stomachs and enters the abomasum directly there will be better weight gains, fewer digestive disturbances, more rapid and higher blood glucose level, and lower mortality of the involved calves.[1 2 3 4 11 17 20 21 23 29 30] It has been suggested that the formation of a casein clot is necessary for optimum digestion of colostrum and that the clot formation is a result of enzyme production which is maxium when the esophageal groove stimulation is at a maximum.[8 16 27 28]

More recent investigations have demonstrated that the immunoglobulin in the small intestine will be absorbed into the circulatory system regardless of the method of administration. It has also been demonstrated that when all events of nursing or milk consumption are eliminated (sight, smell, previous feeding experiences) and the esophogeal groove sensory area is bypassed by intubation or by administration of non-stimulatory substances (e.g. barium sulfate), closing of the esophageal groove is eliminated; however, when the same animals drink milk from a trough the esophageal groove closes and milk is passed directly into the abomasum only.[10 13 14]

The objective of this investigation was to determine the area of final deposition of milk in the digestive tract of the neonatal calf following administration by the nipple or by intubation.

INVESTIGATIONAL PROCEDURE

Experimental Animals

Calves used in this investigation were of dairy breeding, clinically healthy, and under one week of age. No food was made available to the calves for 12 hours before experimental feeding to induce a vigorous appetite.

Feeding Procedure

All calves received an identical milk-barium sulfate (MBS) mixture (30% W-W) at 50 ml of barium per 100 ml of milk. One pint of the mixture was utilized for each individual experimental animal.

One group of calves received the MBS mixture through nipple feeding using a conventional rubber nipple-pail calf feeder. Five calves were used in this phase of the investigation. Each calf received one pint of the MBS mixture. Radiographs were made from lateral abdominal right or left sides with the calf in a standing position. Radiographs were made before feeding when approximately half of the MBS mixture had been consumed immediately following feeding, five and three minutes post feeding, and one, two, and six hours post feeding.

One group of five calves received the MBS mixture by intubation employing a commercially available calf feeder (Fig. 2). Other than intubation, all procedures and materials were identical to those described for the nipple feeding.

Results

When the calves consumed the MBS mixture from a nipple pail, the mixture passed directly into the abomasum, indicating that the esophageal groove was closed and the omasal-abomasal canal open (Figs. 3 and 6).

When the MBS mixture was passed directly into the calf with the plastic "tube-ball" apparatus, the mixture was deposited into the reticulum and rumen area (Figs. 4 and 5).

Discussion

Radiographs obtained in this study demonstrated that the MBS mixture passed directly into the abomasum when calves nursed from the nipple. The presence of sodium salt in the milk mixture resulted in the closure of the esophageal groove and opening of the omasal-abomasal canal. This resulted in the rapid deposition of the MBS mixture in the abomasum or true stomach, making it readily available to the upper small intestine (duodenum).

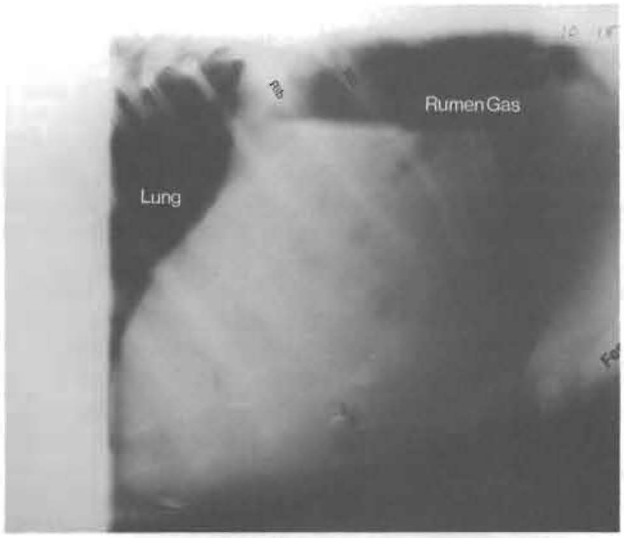

Figure 3. Radiograph of the stomach area taken from the left side prior to feeding.

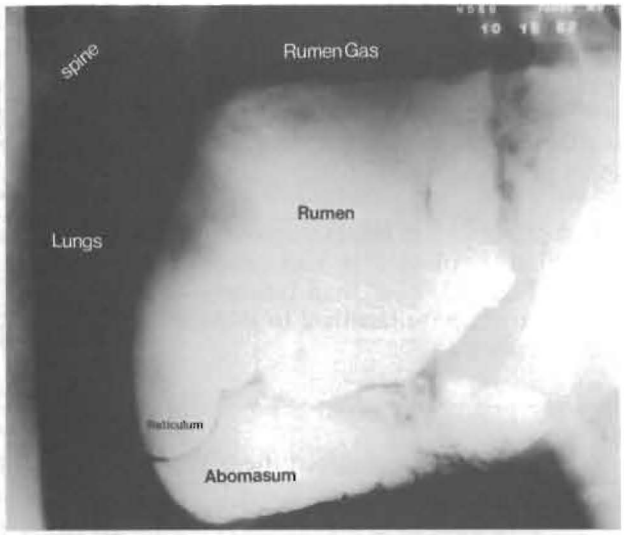

Figure 4. Radiograph of the stomach area of a calf taken immediately following full feeding by nipple nursing. The abomasum is full of milk.

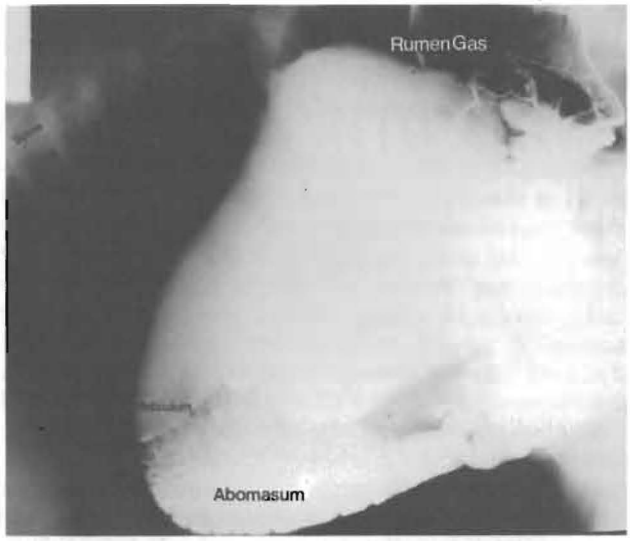

Figure 5. Radiograph taken from the left side of calf immediately following full feeding by intubation. The rumen and reticulum contain most milk.

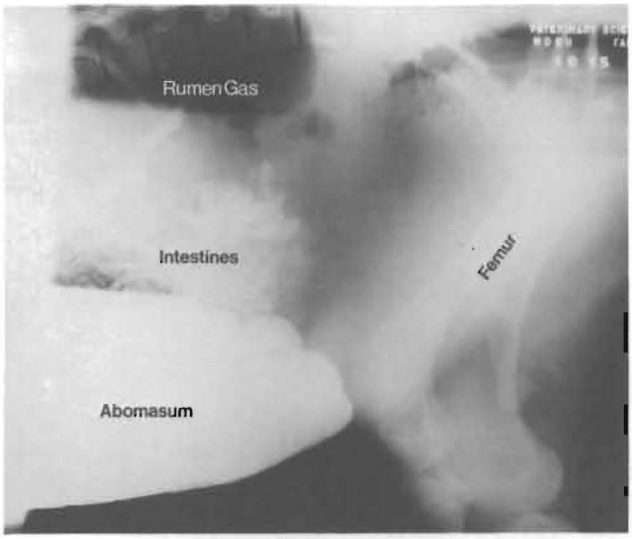

Figure 6. Radiograph of same calf described in Figure 5 six hours following full feeding by intubation. Milk is still present in the rumen and reticulum and has spilled over into the abomasum.

When calves obtained the MBS mixture directly through the plastic "tube-ball" apparatus, the mixture was deposited in the reticulum-rumen area which is relatively non-functional in the newborn calf (Figs. 4 and 5). The colosturm or fluid remaining in the non-functional rumen can provide an ideal condition for fermentation and the release of toxic substances that can initiate digestive disturbances.

The calf that is physiologically well enough to nurse can be given colostrum or electrolytes by nipple feeding and have the fluids pass directly into the abomasum and then into the small intestine where the components can be readily utilized. The closure of the esophageal groove

and dilation of the omasal-abomasal canal can be achieved in the weak calf by placing 5 to 10 milliliters of a 0.5 to 1.0 percent solution of sodium chloride directly into the mouth before attempting to have the calf nurse or force feeding colostrum or electrolytes. When colostrum enters the abomasum, it will pass into the anterior small intestine within five minutes in a calf of one week or less in age. These studies indicate that the opportune time to administer supplemental colostrum or electrolytes orally is before the calf has become so starved and/or dehydrated that it is too weak to nurse from a rubber nipple.

Fluids such as electrolytes can be safely administered by the intubation method particularly if they do not contain fermentable substances such as sugar. If sufficient fluid is administered by this route there will be a "spill-over" into the abomasum and then into the duodenum where the electrolytes can be utilized. Although non-fermentable fluids can be safely given by intubation they will be more quickly absorbed if given by nursing to the sick animal.

Summary

Studies utilizing radiographic techniques demonstrated that the forced feeding of a milk-barium mixture by intubation resulted in a deposition of fluids in the reticulum and rumen of the neo-natal bovine. Conversely, when the MBS mixture was administered via nursing, the mixture was deposited in the abomasum where digestive enzumes were present. If large quantities of electrolytes that contain no fermentable compounds were administered via intubation it is unlikely that adverse effects would result.

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