Comparison between Colostomy and Coloanal Reconstruction Technique for Colonic Atresia in Calves

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Key words: Calves, Coloanal, Colonic atresia, Colostomy

ABSTRACT:

The aim of this study was to evaluate and compare the outcome of right flank colostomy technique and coloanal reconstruction technique in treating atresia coli in calves. All newly born calves (n= 39) with lack of feces were admitted to the Department of Surgery, Anesthesiology and Radiology, Kafrelsheikh University, between May 2011 and November 2015. After clinical and radiographic examinations, calves with atresia coli were subjected to either right flank colostomy or coloanal reconstruction technique, and outcome results after surgery were recorded. Of 39 calves with intestinal atresia, 16 male calves were confirmed atresia coli and treated surgically. Right flank colostomy was performed in 7 calves, two calves died within 24 hours after surgery. Two calves died after short period of surgery due to peritonitis and one was slaughtered after 1 month due to recurrent colonic prolapse. Two calves reached 2 months old with weight less than 60 kg. Coloanal reconstruction was performed in 9 calves; one calf died within 24 hours after surgery. Three calves died after short period of surgery due to peritonitis. One calf observed coloanal prolapse and treated with purse string suture. One calf was slaughtered at 50 days after recurrent diarrhea. Three cases reached 2-3 months old with weight up to 80 kg. The results of the current study suggested that the coloanal reconstruction technique seemingly has a beneficial effect on long-term for treatment of atresia coli in calves than right flank colostomy technique.

1. INTRODUCTION

Intestinal atresia has been reported as a congenital defect in humans and all species of domestic animals (Kilic and Sarierler, 2004, Nichol et al., 2011). Among the congenital malformations of the intestinal tract, stenosis and atresia is the most common (Constable et al., 1999, Nichol et al., 2011, Lombardero and Yllera, 2014). There are four types of intestinal atresia reported in humans and animals: Type 1 – mucosal atresia (mucosal blockage within the intestinal lumen), Type 2 – atretic ends separated by fibrous cord, Type 3a – atretic ends separated by a “V”-shaped mesenteric gap, Type 3b – distal atretic end is coiled like an “apple peel”, Type 4 – multiple sites of atresia (Ducharme et al., 1988, van der Gaag and Tibboel, 1980). The etiology of intestinal atresia is unclear and mostly like is multifactorial (Constable et al., 1989, Constable et al., 1999, Lombardero and Yllera, 2014). In calves, intestinal atresia is most common in the jejunum; the colon and the rectum (Sinowatz, 2010). The most frequent abnormality regarding intestinal segments is atresia coli. It is seen particularly in the spiral colon of calves, and in the large and small colon of foals (Johnson, 1986, Trent et al., 2004). Intestinal atresia in calves is fatal unless surgically corrected (Cecen et al., 2010). Interstinal atresia has been reported a most frequently encountered surgical affection in newly born calves (Azizi et al., 2010). Surgical treatment involves establishing a patent intestinal tract, either through bypass of the atretic intestinal segment by use of anastomosis or by establishment of a perineal opening in animals with atresia ani (Kilic and Sarierler 2004). Previous studies reported that, the prognosis for surgical repair of intestinal atresia in calves was poor except for calves with atresia ani was good (Constable et al., 1999, Azizi et al., 2010, Cecen et al., 2010). Calves with atresia ani et recti and/or colonic atresia were treated by typhlостomy (cecal fistula) and colostomy at right flank or by ventral colostomy (Cecen et al., 2010, Abdel-Hakiem and Aref, 2012). But, these techniques lead to fecal discharge which irritates the abdominal skin and overall, this outcome is not well tolerated by owners (Cecen et al., 2010).

In humans, following successful resection of the rectal cancer, bowel continuity can be restored by coloanal anastomosis (Ho, 2006). In which the coloanal reconstruction was done by a pull-through procedure of the colon to the anus (Hallet et al.,
2014). Therefore it was suggested that coloanal technique may be useful in case of atresia ani et rectai and/or colonic atresia in calves. The purpose of the present study is to report the outcome from a prospective study in calves by comparing the right flank colostomy and the coloanal reconstruction technique.

2. MATERIALS AND METHODS

Between May 2011 and November 2015, 39 newly born calves admitted to the department of Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine, Kafrelsheikh University with history of lack of meconium and distended abdomen.

2.1. Clinical examination

All calves were admitted with absence of anus and distended abdomen. Calves with pronounced protrusion of the perineal region with deep palpation of abdomen were diagnosed as atresia ani (20 calves). If abdominal palpation failed to protrude the perineal region, diagnosis was confirmed by performing lateral plain radiography of the abdominal and pelvic regions (Fig. 1). 16 calves had a diagnosis of atresia ani et recti and/or coli were selected for comparative study between colostomy and coloanal reconstruction technique. Severely dehydrated, toxemic, recumbent, and hypothermic calves (where surgery was not considered useful) were slaughtered and intestinal abnormalities were diagnosed at necropsy (3 calves).

2.2. Surgical techniques

2.2.a. Colostomy technique (right flank colostomy)

Calves were sedated with intramuscular xylazine HCl (0.22 mg/kg), and then they were placed in left lateral recumbency. After aseptic preparation of right paralumbar fossa, an inverted L-block in the right flank was performed with infiltration of 2% lidocaine. Skin incision (10–12 cm) was made in the right midflank and the external abdominal oblique muscle incised. The internal abdominal oblique and transverse muscles were bluntly dissected in the direction of their fibers and the peritoneum incised. Exploratory laparotomy was performed to confirm the anomalies and colonic atresia in all calves (Fig. 2, 3). The proximal blind end of the colon was exteriorized and fixed to peritoneum and abdominal muscles in the ventral commissar of the laparotomy incision (Fig. 4,5), in a circular fashion using seromuscular simple continues suture pattern (USP 0 chromic catgut). Then, the upper parts of the abdominal wall incision were closed in layers. The blind end of the colon was incised and after evacuation of meconium and irrigation of the region with normal saline (0.9% NaCl) solution, the colon wall was anchored to the skin using simple interrupted suture pattern (USP 1 silk) (Fig. 4,5).

2.2.b. Coloanal reconstruction technique

A standard right paralumbar fossa laparotomy was performed under sedation and an inverted L local block as previously described. After exploration of the abdominal viscera (Fig. 3), the cecum and the blind end of colon were decompressed by enterotomy to empty the bowels of meconium. A double layer suture of Cushing suture pattern (USP 2/0 chromic catgut) was performed to closure of enetromy sites. Blunt dissection around the colon to maximize its length to be capable to reach anus through the pelvic cavity. The perineum was infiltrated with 5-6 ml 2% lidocaine after routine aseptic preparation. A circular incision (~ 2 cm) was made through the skin and subcutaneous tissue at the site where the anus must normally be located. Careful blunt dissections were made through the pelvic cavity to allow bypass of colon. The blind end of the colon was withdrawn to the circular skin opening by holding the blind end of the colon with a long artery forceps which introduced through the circular opening to reach the abdominal cavity. The blind end of the colon was stitched at the circular skin opening by four stitches (dorsal, ventral and on both sides). The tip of the blind end of the colon was incised and sutured to the skin opening with simple interrupted suture pattern (USP 1 Silk) (Fig.4, 5).

2.3. Postoperative care

Antibiotic like procaine penicillin and dihydrostreptomycin (Pen & Strep) 1 ml / 25kg bodyweight was administrated once daily by deep intramuscular injection for successive 5 days. The surgical wound was cleaned and irrigated using povidine iodine (0.7 % solution) 3 times daily for 5 days and skin sutures were removed after 10-12 days.

2.4. Outcome

Follow-up information was obtained to determine immediate surgical complications (e.g., wound dehiscence, suture abscess, local infection), whether the calf was alive or dead. Long term follow-up information was weight gain, prolapse of colon through colostomy opening or anal opening, narrowing, obstruction, slaughter age and weight.
3. RESULTS

From May 2011 to November 2015, 39 calves referred with a history of lack feces, depression, anorexia and abdominal distension. Calves age at admission, ranged from 1 to 5 days old (Median 2 days) (Table 1). All calves were reported to have nursed normally immediately after birth.

On admission most calves were mildly dehydrated, depressed, absence of anus and abdominal distension varied from mild to severe. In simultaneous percussion and auscultation of the abdomen “ping and splashing” sound were usually heard. Calves (n=20) with atresia ani were diagnosed based on absence of anus, tenesmus and subsequent protrusion of the perianal region by pressure to abdomen. No other visible external congenital anomalies were detected except one case had no tail.

3.1. Diagnostic radiographic findings

Multiple intestinal loops distended with gas and ingesta were observed on radiographs in the abdomen and did not reach to the pelvic cavity in all selected calves (Fig.1).

3.2. Necropsy findings

Three calves (4-5 day old age) were euthanized prior to surgery as a result of severe depression, severe abdominal distension and subnormal temperature. The necropsy findings of these calves with colonic atresia including: there was extensive intestinal gas and fluid accumulation, necrosis of the cecum and proximal blind end of colon, adhesions and diffuse peritonitis (Fig. 3).

Table 1. Surgical Outcome and clinical outcome in 16 Calves with Atresia Coli

<table>
<thead>
<tr>
<th>Technique</th>
<th>Calf No.</th>
<th>Age at admission (Day)</th>
<th>Calf breed</th>
<th>Early per rectal pregnancy diagnosis (before 42 day)</th>
<th>Surgical outcome, clinical outcome,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colostomy technique</td>
<td>1</td>
<td>2</td>
<td>NB</td>
<td>+</td>
<td>Died 3 days after surgery, septicemia (peritonitis)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>4</td>
<td>HF</td>
<td>+</td>
<td>Died within 24 hr after surgery</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
<td>CB</td>
<td>-</td>
<td>Slaughtered after 2 months</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1</td>
<td>CB</td>
<td>ND</td>
<td>Died 10 days after surgery, peritonitis</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
<td>NB</td>
<td>ND</td>
<td>Slaughtered at 1 month old, repeated colonic prolapse</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>5</td>
<td>HF</td>
<td>+</td>
<td>Died within 24 h after surgery</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>3</td>
<td>NB</td>
<td>+</td>
<td>Slaughtered after 2 months</td>
</tr>
<tr>
<td>Colonal reconstruction technique</td>
<td>8</td>
<td>2</td>
<td>CB</td>
<td>-</td>
<td>Slaughtered after 3 months</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>3</td>
<td>NB</td>
<td>-</td>
<td>Died 7 days after surgery, peritonitis</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>4</td>
<td>CB</td>
<td>+</td>
<td>Died within 24 hr after surgery</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>3</td>
<td>CB</td>
<td>ND</td>
<td>Slaughtered after 2 months</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>3</td>
<td>NB</td>
<td>ND</td>
<td>Died 2 days after surgery, peritonitis</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>2</td>
<td>HF</td>
<td>+</td>
<td>Colonal prolapse, slaughter after 36 days</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>2</td>
<td>CB</td>
<td>+</td>
<td>Slaughtered after 3 months</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>1</td>
<td>CB</td>
<td>-</td>
<td>Recurrent diarrhea, slaughter after 50 days</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>3</td>
<td>CB</td>
<td>-</td>
<td>Died 12 days after surgery, peritonitis</td>
</tr>
</tbody>
</table>

NB (native breed), HF (Holstein Friesian), CB (cross breed), + (Early per rectal pregnancy diagnosis before 42 day has done), - (Early per rectal pregnancy diagnosis before 42 day did not done), ND (no data).
After systematic abdominal exploration, no visible congenital anomalies other than colonic atresia were recognized in the calves. Colonic atresia was located in varying levels of colon from the centripetal loop of the ascending colon and extended to varying levels of the descending colon. The blind end was highly dilated; its diameter was ranged from 5-10 cm. The blind ends were completely detached, with no fibrous or muscular cord between them. Cases of colonic atresia in the ascending colon with short length that can’t reach to the anal opening through the pelvis cavity were selected to colostomy technique.

![Fig. 1. Lateral radiograph of the abdomen in calves with atresia coli. Multiple intestinal loops distended with gas and ingesta were observed in the abdomen and did not reach to the pelvic (A, B). Postoperative radiography in a calf treated with coloanal reconstruction technique (C) shown the colon in the pelvic cavity. Introducing a catheter in the colon (white arrow head) and catheter tip is identified by a rectangular metallic density (arrow) (D).](image)


![Fig. 3. After right flank laparotomy and exploration of the abdominal cavity and identification of the blind end of the colon. A. blind end in the ascending colon (black arrow head), B. and C. blind end of the descending colon (white arrow head). D. necropsy findings in one calf died during surgery shown spiral colon (s), small intestine (SI), and distended blind end of the descending colon (white arrow head).](image)

![Fig. 4. Diagrammatic illustration comparing between right flank colostomy technique (A,B) and coloanal reconstruction technique (C,D) in calves. A. After right flank laparotomy (x), the colon (y) was protruded from laparotomy incision, B. fixation of the colon in the ventral commissar of the laparotomy incision C. after right flank laparotomy (x) the colon (z) was withdrawn (arrow) toward the anal opening, D. after colon was fixed to anal opening, the laparotomy incision was sutured.](image)
While cases of colonic atresia either in the ascending colon with long length and in descending colon that can reach to the anal opening through the pelvic cavity were selected to coloanal reconstruction technique.

3.3. Right flank colostomy technique (7 calves). Two cases died within 24 hours after surgery. Two cases died between 3, 10 days after surgery with signs of fever, anorexia and severe depression from suspected septicemia due to peritonitis associated with leakage at colostomy site (one case has necropsy finding of diffuse intestinal adhesion). One case was slaughtered at 1 month age due to repeated colonic prolapse from the colostomy site. Two cases were slaughtered at age of 2 months with weight less than 60 kg. Owners reported that fecal discharge was continuous watery like and irritate the abdominal wall which required cleaning the calves several times per day.

3.4. Coloanal reconstruction technique (9 calves). One case died within 24 hours after surgery. Three cases died between 2-12 days after surgery from suspected peritonitis. One case after 2 weeks observed colonic prolapse from the anal opening that treated by purse string suture (USP 1, Silk) and slaughtered at age of 36 days after surgery. One calf was slaughtered at 50 days after recurrent diarrhea. Three calves were slaughtered at age between 2 and 3 months with a mean weight of 80 kg. Owners reported that fecal matter was watery to softy with intermittent to continuous release from the anal opening.

4. DISCUSSION

The exact etiology of atresia coli in calves is not well understood and represents a matter of scientific controversy (Constable et al., 1989). It is unclear whether it arises from some organ development disturbances or from hereditary defects (DuCharme et al., 1988; Lombardero and Yllera, 2014). As this atresia is more frequent in Holstein-Friesian calves than would be expected, a genetic origin has been proposed (Lombardero and Yllera, 2014). In the present study, the calves are Holstein-Friesian and cross breed and native breed. However, Johnson 1986 concluded nonhereditary cause of atresia coli and stated that atresia of colon in cattle is developed early in embryonic life and results from vascular insufficiency to the developing spiral colon. A number of studies have observed that pregnancy diagnosis in the first 42 days of gestation by per rectal amniotic vesicle palpation markedly increases the risk of atresia coli in the fetus. Strangulation or damage to the blood vessels supplying the developing embryonic or fetal colon may be followed by colonic ischemia, leading to missing atretic segments. (Johnson, 1986; Syed and Shanks, 1992; Brenner and Orgad, 2003; Azizi et al., 2010). In our study, the owners of some cases reported that early pregnancy diagnosis was done (7 calves) while others did not confirm that (5 calves). Therefore our study can’t confirm the relation between the early pregnancy diagnosis and the incidence of atresia coli in calves.

Affected calves with intestinal atresia are usually normal at birth, but develop clinical signs 24-48 hours after birth. Characteristic clinical findings include inappetence, tenesmus, abdominal pain and distention, and the absence of feces (Smith et al., 1991; Constable et al., 1989; Hyttel et al., 2010). Atresia ani in calves was an obvious clinical finding and easily diagnosed by plugging of the prenium region with pressure applied to the abdomen (Meylan 2008).

Fig. 5. Surgical management of calves with atresia coli. A. Right flank colostomy technique with feces released from the colostomy opening. B. Caudal view after fixation of the colon to the anal opening.
While, diagnosis of cases of atresia ani et recti and/or coli in calves was much more difficult and calves usually were referred with abdominal distention and inability to pass feces (Azizi et al., 2010; Kilic and Sarierler, 2004). In calves with these abnormalities, radiographic findings are necessary to confirm diagnosis. Definitive diagnosis of the congenital intestinal abnormalities is made by right flank exploratory laparotomy (Azizi et al., 2010; Cecen et al., 2010). Similarly, in our study all cases were diagnosed with plain radiography and confirmed with right flank laparotomy.

The primary goal of operations for atresia coli is restoring bowel continuity and safe animal life with more comfortable for both the animal and the owner. Colonic atresia in calves is fatal unless surgically corrected by surgical anastomosis of the discontinuous segments or by colostomy (Smith et al., 1991; Kilic and Sarierler, 2004; Cecen et al., 2010). Many procedures have been used to correct atresia coli (Kilic and Sarierler, 2004; Cecen et al., 2010; Abdel-Hakiem and Aref, 2012). Right flank colostomy if the entire colon and rectum are involved. Localization of the stoma dorsally in the flank results in severe fecal contamination of the abdominal wall, whereas a more ventral stoma has an increased risk for intestinal prolapse (Meylan, 2008; Cecen et al., 2010). Postoperative complications such as prolapse of the colon, peritonitis and unacceptable esthetic results limited the feasible application of the procedure (Kilic and Sarierler, 2004; Cecen et al., 2010; Azizi et al., 2010; Abdel-Hakiem and Aref, 2012). Steenhaut et al., (1976) reported that, 5 of 6 calves with an anus praeternaturalis in the flank died and Martens et al., (1995) reported that survival was not achieved in 7 calves with a flank stoma. While Abdel-Hakiem and Aref, (2012) reported that 3 of 5 cases of atresia ani et recti that were treated by right flank colostomy showed good results without major complication over 6-months period. In current study, 5 of 7 cases treated with right flank colostomy died within 1 month and only 2 cases were slaughtered at age of 2 months with weight less than 60 kg.

In humans, Coloanal anastomosis has been proposed in cases of low rectal carcinoma (Pocard et al., 2007) and improved patient quality of life in compare with abdominal colostomy (Hassan et al., 2008). The technique used in this study was modified to the coloanal anastomosis in humans. However, this study is the first to report coloanal reconstruction to treat calves with atresia ani et recti and/or coli. Some complications were reported after this technique as peritonitis (three cases), coloanal prolapse (one case), and diarrhea (one case). The survival time after both techniques was similar and long term complications were less in the coloanal reconstruction technique than colostomy technique. However the weight gain was increased after coloanal technique than colostomy technique but all of the operated calves had reduced growth rate than normal calves of the same age and it was the main complaint of the owners and this is consistent with Smith et al. (1991) and Kilic and Sarierler (2004). This reduced growth weight was presumably either due to failure in post-ruminal fermentation and reduced absorption of hind gut fermentation products, or decreased fluid absorption from the colon and utilization of nutrients because of the free flow of fecal matter from the stoma (Kilic and Sarierler, 2004). Moreover, straight coloanal anastomosis in humans has been historically associated with relatively poor postoperative bowel function because of loss of the rectal reservoir. (de la Fuente and Mantyh, 2007). Another limitation of the coloanal reconstruction technique is that it is depending on the length of formed colon.

Generally, the owners of the calves treated with coloanal reconstruction technique were more satisfied with outcome than owners of the calves treated with colostomy technique because earlier one looks similar to normal condition and saving of the animal life that could be used for meat as veal calves or yearling.

5. Conclusion
The results of the current study suggested that Calves undergoing coloanal reconstruction may expect not only better functional results but also an improved quality of life in the early months after surgery compared with calves undergoing right flank colostomy. Additionally, the owners were subjectively more satisfied with outcome, specially the site of operation. However further investigations are needed to get long-term outcome information to confirm better quality of life for calves treated by coloanal reconstruction technique.

6. REFERENCES


