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Surgical Management of Traumatic Teat Fistulas in Crossbred Goats with Polyester Sutures

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Abstract: A total of six goats presented to University Veterinary Hospital (UVH), at Omar Al-Mukhtar University, with traumatic teat fistulas were selected for the present study. Upon preoperative evaluation, the mucosal and muscular layers were sutured separately by a simple continuous suture pattern using polyglactin 910. The skin edges were opposed by using braided and polybutilate-coated polyester sutures. Postoperative evaluation of the reconstructed teat was carried out by morphological evaluation. The quality of milk and milk ability reflected the effectiveness of the technique in regaining the functional capacity of the teat postoperatively. The surgical technique employed for the management of teat wounds with fistula was found to be less effective due to the encountered complications which could be due to the management practices, postoperative care, and the suture material.

Keywords: Goats, Traumatic teat fistula, Polyglactin 910, Braided Polybutilate Coated polyester sutures.

INTRODUCTION

Udder and teat health is becoming increasingly crucial for dairy farmers, as illness conditions affecting them have a negative impact on productivity, resulting in significant financial loss.(Abd-El-Hady, 2015). Mucosa, submucosa, highly vascularized connective tissue, muscular, and skin are the five layers of the goat's teat (Hendrickson, 2007). The occurrence of teat injuries in goats can be categorized as stenosis (31.5%), laceration without perforation (22.2%), skin wound (21%), rupture or splitting (20%), and perforating injury (4.9%). Teat lacerations are rarely neat, straight, and incised wounds; instead, they are often flap wounds with variable forms and penetration depths (Molaei & Ebrahimi, 2014). External or "uncovered" lesions and internal or "covered" lesions are the two categories of teat injury (Nichols, 2009). Based on the different layers involved, they can also be classed as superficial and deep (Ashraf. Abdel-Hamed. Hegazi & Khaled. M. A. Hussin, 2008; Nouh et al., 2014; Rafi. Mustafa. Elkaseh. Abdulla et al., 2008). External injuries include all forms of lacerations involving different layers of the teat wall. While internal injuries include those to the teat cistern and papillary duct (Sreenu et al., 2014). The majority of teat injuries occur when cattle are housed (78%) rather than when they are kept in

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a pasture (21%) (Molaei et al., 2002). They are often self-inflicted when the goat stands and can occur in tie stall or free-stall barns (Nichols et al., 2016). Teat wounds are prevalent after parturition as a result of the goat's increased udder size and awkward movement, and they are more common in animals aged five or six years, i.e., during early lactation (Molaei & Ebrahimi, 2014). The majority of the teat injuries occur within one month following calving, when goats are in high production, according to the authors. Better outcomes can be achieved using the correct suture material and stitch design on a goat's teat (Couture & Mulon, 2005).

Polyester sutures were the strongest non-absorbable synthetic suture material available at the time. They outperform nylon, polypropylene, and polybuster sutures, and are only surpassed by stainless steel sutures (Banks. Alan S et al., 2001). They are a non-absorbable synthetic braided multifilament made of polyethylene terephthalate with qualities such as low tissue reactivity, high tensile strength, easy handling, and long life, usually supplied plain or with a polybutilate, Teflon, or silicone coating. (Kudur et al., 2009).

MATERIALS AND METHODS

Six goats presented to University Veterinary Hospital (UVH) at Omar Al-Mukhtar University were diagnosed to have deep lacerated wounds with exposed teat cistern (Figure. 1) and were selected for the present study.

Figure: (1). Showing deep lacerated wounds with exposed teat cistern

The animal particulars viz; breed, age, body weight, feeding pattern- grazing/ stall feeding, stage of lactation, and calving history were documented. A complete history was obtained from the farmer regarding the time of occurrence of the wound, its duration, and its etiology. Clinical examination of the affected teat was performed and the parameters included udder morphology, teat which was affected, the shape of the affected teat, and teat length (Table 1).

Table: (1). Animal Particulars, Anamnesis, and Clinical examination (n = 6)

Animal No	Breed	Age (Years)	B.W (KGs)	Feeding Pattern	Stage of Lactation	Calving History (Days)	Duration (Days)	Etiology	Treatment adapted	Udder morphology	Affected Teat	Shape of affected teat	Length (cm)
1	Crossbred	3	36	Grazing	1	17	2	Barbed wire	Yes	Globular	LFT	Cylindrical	4
2	Crossbred	4	42	Grazing	1	23	5	Barbed wire	Yes	Globular	RHT	Funnel	6
3	Crossbred	5	45	Stall fed	1	11	3	Barbed wire	Yes	Pendulous	LHT	Cylindrical	3.7
4	Crossbred	4.3	39	Grazing	1	30	12	Barbed wire	Yes	Pendulous	RFT	Funnel	2.9
5	Crossbred	3.2	33	Stall fed	1	26	6	Barbed wire	Yes	Globular	RHT	Cylindrical	7
6	Crossbred	4	36	Grazing	1	32	8	Barbed wire	Yes	Globular	LHT	Cylindrical	5

LFT- Left Fore Teat; RFT – Right Fore Teat; RHT – Right Hind Teat; LHT – Left Hind Teat.

The milking ability of the affected teat was assessed on the day of presentation and after the suture removal using the following parameters viz; milk yield per quarter (kg), nature of milk flow, and milk flow rate of the affected quarter (kg/min) by hand milking. The milk quality was assessed by its colour, consistency, pH, California mastitis test, and somatic cell count (1x105cells/ml) on the day of presentation and suture removal. Following preoperative evaluation, Food and water were withheld for 12-18 hours prior to surgery in all the animals, and they were sedated with Xylazine at the dose concentration of 0.05mg/kg intramuscular, and ring block technique was employed with 0.5% Bupivacaine hydrochloride**.**

The wound was irrigated with 0.5% Povidone Iodine solution, and the margins were thoroughly debrided using No. 11scalpel blade. The suturing of the first layer of teat included an inner mucosal layer in a simple continuous pattern, and muscular and connective tissue in a simple continuous pattern were done with polyglactin 910 No. 3/0 in all the animals. Braided polybutilate coated polyester sutures of size 2/0 (Ethibond Excel – Ethicon, Johnson and Johnson private limited, India) were applied in a simple interrupted pattern for opposing skin wound edges (Figure. 2).

Figure: (2). Showing Braided polybutilate coated polyester sutures of size 2/0 which was applied in simple interrupted pattern on skin.

A sterile modified polyvinyl tube (Infant feeding tube No. 10, Romsons Scientific and Surgicals India) was placed in the teat to maintain the patency and fixed with stay sutures. A sterile disposable 2ml syringe was connected to the modified polyvinyl tube and closed. Postoperatively Inj. Meloxicam @ 0.5mg/kg and Inj. Streptomycin – Procaine penicillin (Dicrysticin- S- Zydus AHL) @ 10mg/kg body weight were administered intramuscularly for seven days. The surgically corrected teat was evaluated on the 7th and 10th day postoperatively by taking the parameters viz; Intactness of sutures, No. of sutures present, Nature of suture line (dry/ moist), Nature of the suture site (soiled/ contaminated), presence of discharge Wound dehiscence, if any.

RESULTS AND DISCUSSION

Among all the animals, four goats were allowed for grazing. Stall-fed animals were kept in a closed enclosure and were more prone to teat injuries due to stamping. Similar findings were reported (Khaled et al., 2016; Matzke et al., 1992; Molaei et al., 2002; Nichols et al., 2016; Nichols. S, 2008; Nouh SR et al., 2014).

The calving history ranged from 11 to 32 days as they were all in their first stage of lactation. The present findings were in agreement with (Bristol, 1989) as most teat injuries occurred within one month of calving when goats were in high production. The teat wounds were common around parturition as a result of udder size and movements of the goat (Molaei & Ebrahimi, 2014).

The duration of the wound was between 2-12 days, and the etiological factors of the wound were barbed wire in all cases. The overcrowding of animals with enlarged udders after calving in a tie-stall or free-stall barns puts the teat at risk of self-inflicted injury or by the other animals (Mulon, 2016; Nichols et al., 2016). The poor udder conformation, with low-hanging teats, predisposes the teat to be kicked

by the goat, causing injuries (Sreenu et al., 2014).

Udder morphology of the animal studied on the day of presentation revealed two animals had pendulous and globular-shaped udder in four. These findings were deferred (Tiwary et al., 2005) as the teat laceration was mostly observed in animals that have long teats and pendulous udders. The affected teats were right hind teat in two animals and one fore in right and left teat, and left hind teat in two animals. However, the hind teats are more frequently affected than the fore teats and vice versa (Molaei & Ebrahimi, 2014). The incidence of injury to the right and the left side is approximately equal (Kudur et al., 2009). The shape of the affected teats were cylindrical in four goats and funnel-shaped teat in two goats. The length of the affected teats ranged between 2.9-7 cm, which indicates longer teats were prone to injuries (Grommers et al., 1971).

Milk ability detection on the day of presentation was found to be difficult as the milk was dribbling from the affected teat and was difficult to assess. Whereas on the 10th postoperative day, the milk yield per quarter (kg), nature of milk flow, and milk flow rate of the affected quarter (kg/min) by hand milking were observed as the Mean ± S.E. was 0.09 ± 0.01. In all the cases, deep laceration from the skin to the mucosa communicating with the cistern, caused dribbling of milk from the injured site. So it was difficult to assess the milk ability on the day of presentation. A similar statement was reported by (Mulon, 2016; Nichols. S, 2008).

The milk was apparently normal, without any change in colour, consistency, and pH on the day of presentation and the 10^{th} postoperative day (Table 2). California mastitis test was negative and somatic cell count (1x105cells/ml) on the day of presentation was (Mean ± S.E.) 27812≠12724.1 and on the 10^{th} postoperative day, it was 37452±19754.6, which were found to be within normal range, since all the animals were treated with antibiotic therapy and the wound was protected with Dynafix without any contamination. Similar findings were recorded by (Arul jothi N & Balagopalan. T.P, 2012; Khaled. M. A. Hussin & Ashraf. abdel-hamed. Hegazi, 2008; Khaled. M. A et al., 2014; Khan & Khan, 2006; Tiwary et al., 2006).

Table: 2. Qualitative examination of milk on the day of presentation and on 10th Postoperative day (n=6)

Animal NO	Milkability		Colour of milk		Consistency of milk		pH		California mastitis test		Somatic cell count (1.00.000cell/mi)	
	Day of Presentation	10^{h} Postoperative Day	Day of presentation	10^{h} Postoperative Day	Day of presentation	10^{h} Postoperative Day	Day of presentation	10^{h} Postoperative Day	Day of presentation	10^{h} Postoperative Day	Day of presentation	10^{h} Postoperative Day
1	0	0.134	White	White	Normal	Normal	6.5	7	Negative	Negative	249893	294876
2	0	0.122	White	White	Normal	Normal	7	7.5	Negative	Negative	273524	334972
3	0	0.080	White	White	Normal	Normal	7	7.5	Negative	Negative	308953	390328
4	0	0.093	White	White	Normal	Normal	6.5	7	Negative	Negative	258986	294765
5	0	0.071	White	White	Normal	Normal	6.5	7	Negative	Negative	230472	289745
6	0	0.102	White	White	Normal	Normal	7	7.5	Negative	Negative	300467	359870
Mean ± SE		0.096± 0.013									27812≠12724.1	37452±19754.6

Irrigating with 0.5% Povidone Iodine solution and thorough debriding the wound margins were found to be very effective to prepare the surgical site (Arul jothi N & Balagopalan. T.P, 2012; Khaled. M. A. Hussin et al., 2021; Khaled. M. A.Hussin et al., 2018; Mulon, 2016; Nichols. S, 2008). The mucosal and the muscular layers were sutured separately in a

simple continuous pattern with polyglactin 910 No. 3/0. A three-layer suture pattern was adopted in the present study and found to be very effective in the complete closure of the teat cistern (Arul jothi N & Balagopalan. T.P, 2012; Arul Jothi et al., 2006; Balagopalan & Aruljothi, 2016; Ghamsari et al., 1995).
Braided and polybutilate-coated polyester sutures were used to close the skin. The number of sutures applied ranged from 5 to 12, which depended on the length, direction, and wound size, they are synthetic braided sutures that last indefinitely in tissues. They are used primarily in humans for tendon lacerations in which the sutures remain within the tissues for extended periods (Singer et al., 2010). The suture pattern employed was a simple interrupted pattern (Nichols et al., 2016).

Table: (3). Morphological evaluation in animals group II (n=6)

Animal no	Intactness of sutures	No. of sutures present		Nature of suture line	Nature of the suture site	Discharge	Wound dehiscence
	7^{th} day	0^{th} day	7^{th} day	7^{th} day	7^{th} day	7^{th} day	7^{th} day
1	Not Intact	8	3	Moist	Contaminated	Yes	Yes
2	Not Intact	5	3	Moist	Contaminated	Yes	Yes
3	Intact	6	6	Dry	Not Soiled	No	No
4	Intact	8	8	Moist	Not Soiled	No	No
5	Not Intact	7	4	Moist	Contaminated	Yes	Yes
6	Not Intact	10	6	Dry	Contaminated	Yes	Yes
Mean ± **S.E.**		7.4±1.4	5±0.5				

Figure (3): Showing wound dehiscence, fistula formation and gaping of wound edges on day 7 postoperatively in gout.

The average number of sutures present was only 5.3. This number could be due to its multifilament nature, and poor knot security, causing more tissue reaction and increasing the inflammatory response. The application of polyester sutures might have caused persistent local infection and exaggerated tissue reaction (Boothe, 2003). The nature of the suture line was dry only in 33% of the animals, whereas moist in 67%, which could be due to the inflammatory response at the suture line and the multifilament nature of the suture material favouring infection. Similar findings were reported (Boothe, 2003; Premsairam et al., 2020). The multifilament nature favoured the retrograde infection causing postoperative wound infection (Modi, 2009). The moist nature of the suture line could be due to the presence of discharge at the suture site in 67% of animals, which resulted in a contaminated suture site. Discharge was noticed at the suture site in four animals (67%), and was absent in only 33%, which indicated the persistence of local infection at the suture site and exaggerated tissue reaction to the polyester suture favoured the postoperative wound infection and resulted in discharge from the suture site (Banks. Alan S et al., 2001; Boothe, 2003). The braided nature of the polyester sutures potentiated suture site contamination and further led to infection (Al-Mubarak & Al-Haddab, 2013).

There was no evidence of wound dehiscence in 33% of cases but 67% of the animals had dehiscence due to the contaminated suture site which resulted in increased inflammatory response due to the shredding of the outer coated layer (Boothe, 2003).

The skin sutures were removed on the 10th postoperative day in all the animals (Nichols et al., 2016), in which wound dehiscence, fistula formation, and gaping of edges were observed. The moist nature of the suture line, contaminated suture site with discharge, postoperative surgical complications like tissue flap necrosis, wound dehiscence, and fistula formation with the gaping of wounds exposing the inner lying structures might have caused wound dehiscence, and complete wound healing was not achieved in four animals (Azizi S et al., 2007; Mulon, 2016). Polyester sutures were not intact in 67% of animals and caused more tissue reaction and increased inflammatory response, contamination of the suture site, persistent local infection, and exaggerated tissue reaction, as explained (Boothe, 2003; Chellamani et al., 2013). Whereas 33% of the cases showed uncomplicated wound healing without any dehiscence (Figure. 4).

Figure (4): Showing uncomplicated wound healing without any dehiscence on day 10 after removal of sutures.

The in-situ fixing of a sterile prosthetic tube made up of modified polyvinyl chloride number 10 was very useful in retaining the teat patency and remove the milk from the affected quarter. The application of an adhesive bandage (Dynafix) was found to be effective in protecting the surgical site. The attachment of a 2ml syringe to the tube was useful to complete the circuit.

CONCLUSION

The quality of milk and milk ability reflected the technique's effectiveness in regaining the functional capacity of the teat postoperatively. The surgical technique employed for the management of teat wounds with fistula was found to be less effective due to the encountered complications, which could be due to the management practices, postoperative care, and the suture material.

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المعالجة الجراحية لنواسير الحلمة الرضحية في الماعز الهجين بخيوط البوليستر

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المستخلص: تم اختيار ما مجموعه 6 ماعز، تم تقديمها إلى المستشفى البيطري الجامعي (UVH) بجامعة عمر المختار، مصابة بناسور الحلمة الرضحية في هذه الدراسة. بعد التقييم قبل الجراحة ، تمت خياطة الطبقات المخاطية، والعضلية بشكل منفصل عن طريق نمط خياطة بسيط مستمر باستخدام بولي جلاكتين 910. تمت مواجهة حواف الجلد باستخدام خيوط بوليستر مضفرة ومغلفة بالبوليبوتيلات. تم إجراء تقييم ما بعد الجراحة للحلمة التي أعيد بناؤها من خلال التقييم المورفولوجي، والتقييم فوق الصوتي. عكست جودة الحليب، وقابليته فعالية التقنية في استعادة القدرة الوظيفية للحلمة بعد الجراحة. تم العثور على التقنية الجراحية المستخدمة لإدارة جروح الحلمة مع الناسور لتكون أقل فعالية بسبب المضاعفات المصادفة، والتي يمكن أن تكون بسبب ممارسات الإدارة، والرعاية بعد الجراحة، ومواد الخياطة.

الكلمات المفتاحية: ماعز، ناسور حلمة رضحي، بولي جلاكتين 910، خيوط بوليستر مضفرة مغلفة بالبوليبوتيلات.

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