

## Treatment of irreparable full-thickness teat laceration in goats by connecting gland cisterns

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*Blood supply of the teat was studied in six udder samples by radiography (3 samples) and latex (3 samples). Results revealed that the caudal mammary branch of the mammary artery terminates as cranial and caudal papillary arteries to supply the teat. Accordingly, seven goats with irreparable teat laceration were treated by teat excision and anastomosis of its gland cistern to the sound-half gland cistern, through an area of 3x4 cm free from major blood supply, on the medial aspect of the sound gland. Following surgery, four goats underwent udder atrophy as a result of mastitis (2 cases) or dehiscence of wound and mastitis (2 cases) and the remaining three goats showed satisfactory milking. This is a simple technique for treatment of selected cases of teat laceration in goats for preservation of milking during the season till weaning of kids and further studies are required to increase the success rate.*

**Key words:** Anastomosis, Cistern, Goat, Laceration, Teat.

Teats are prone to various degrees of injuries as a result of direct trauma or during suckling. These injuries reduce the ability of teats to function efficiently (Roberts and Fishwick, 2010), and predispose to teat fistulae, mastitis, gangrenous mastitis, or sloughing of the udder (Ducharme *et al.*, 1987; Ameh *et al.*, 1994; Steiner, 2004; Nichols, 2008). These complications may lead to premature culling of the affected animals with subsequent great economic losses (Beaudeau *et al.*, 1995; Nichols, 2008).

Surgical repair of teat wounds requires proper understanding of its blood supply. However, there are few literatures describing teat blood supply contrary to the well-studied blood supply of the udder, which is derived from external pudendal (mammary) artery, passing through the inguinal canal. On reaching the udder base it divides into cranial and caudal branches that partially or wholly embedded in the glandular tissue, then it further branches as it descends down into the gland (Garrett, 1988; Smith and Sherman, 1994).

Teat wounds are classified according to duration, localization and conformation, and although their surgical treatment is challenging and time-consuming, it is ultimately rewarding to maintain animals in long-term full milk production. Although partial thickness teat laceration does not require suturing (Grymer *et al.*, 1984; Nichols, 2008), full-thickness teat laceration should be sutured. Although, surgical treatment of teat laceration is associated with good short and long-term prognosis (Arighi *et al.*, 1987), complications like delay in healing process and fistula formation may be recorded (Azizi *et al.*, 2007).

Because of the difficulty of suturing of certain teat lacerations in goats due to small sized teats, the high rate of post-surgical complications, we designed this study to evaluate a new technique for treatment of recent irreparable full-thickness teat wounds. The technique aims at anastomosis of the two gland cistern following complete excision of the recently lacerated teat, and draining the milk of both glands via one teat.

### Materials and Methods

For determination of the teat blood supply, and detection of the ideal seat for anastomosis, six udder samples were collected from apparently healthy female goats. Three of them were injected through the mammary artery with mercury after ligation of the ventral perineal artery, and then radiographs were obtained for these samples (Fig. 1). The other three samples were injected with gum milk latex red in colour with carmine from the same artery and fixed in formalin (10%), and then they were dissected after three days.

On the basis of anatomy results, seven goats suffered from unilateral recent irreparable full-thickness teat laceration that could not be reconstructed surgically under field condition due to small sized teat, were the subject of the surgical

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study (Fig. 2). All of the operated goats were in lactating season and each one of them had 1-3 kids. Animals were subjected to anastomosis of the two gland cisterns after amputation of the lacerated teat.

Goats were prepared for aseptic surgery, and were sedated by intravenous diazepam 1 mg/kg, and subjected to epidural analgesia. They were secured in lateral position and the lacerated teat was grasped and crushed with haemostatic forceps for two min (Fig. 3). At the same time, the sound half of the udder was milked, then an elliptical skin incision (2x4 cm) was made on its medial aspect dorsal to the base of the teat (Fig. 4). The lacerated teat was excised and the haemostatic forceps was removed, and its gland cistern advanced and sutured to the created hole on the medial aspect of the sound half (Fig. 5). Following suturing of the two walls of udder cisterns, the skin was closed by non-absorbable suture material (Fig. 6).

Aftercare included injection of systemic antibiotic, non-steroidal anti-inflammatory drug, protection of the wound by hand made cover, regular dressing of the wound, guarded suckling and wound protection during suckling for a week, and removal of suture materials after 8-10 days (Fig. 7). Complications were recorded and treated conservatively.

## Results and Discussion

Suturing of the teat wounds of goats may not be the ideal treatment in certain circumstances like when an extensive transverse laceration involves the teat, and then alternative more invasive techniques like mastectomy would be preferred. Although mastectomy was well tolerated, made the animals more comfortable, and potentially prolonged their lives as pets (Cable *et al.*, 2004), the high incidence of intra- and post-surgical complications of mastectomy or hemi-mastectomy (Niehaus, 2011) may make mastectomy unsuitable for treatment of such lacerations. Even remodelling of the technique via vascular ligation of the external pudendal blood vessels and milk veins (Makady *et al.*, 1990; El-Maghraby, 2001) could only lower trauma and stress on patient, but it could not resolve the problem of permanently decreased milk production as a result of loss of the gland.

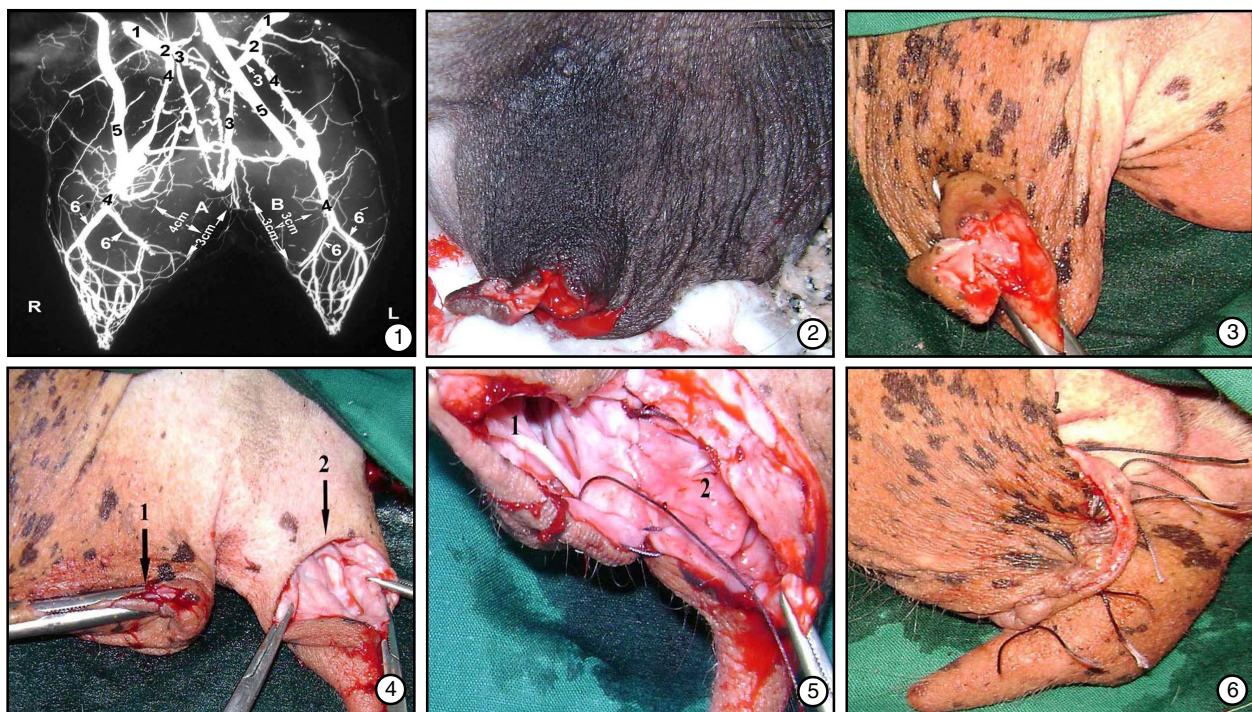
Proper treatment of teat laceration requires both gentle debridement of the laceration to remove infected necrotic tissue and proper understanding of teat blood supply. However, the luxury of debridement is not an option in small sized goats with small teats. At the same time, longitudinal orientation of teat blood supply predisposes to more

vascular damage, avascular necrosis of the teat, and postoperative dehiscence of the sutured wound with transverse lacerations than longitudinal ones (Nichols, 2008; Roberts and Fishwick, 2010).

Hence, there is great need for a new less-invasive technique that can deal with extensive teat lacerations in goats, overcome disadvantages of hemi-mastectomy or wound suturing and preserve continued milk production to fulfil the needs of the high number of kids. This new technique involves anastomosis of the two gland cisterns for milking the two glands via one teat but it requires an area free from major blood vessels to avoid post-surgical necrosis of operated teat and its skin.

From anatomical point of view, our results revealed that the goat teats were wide at their base and protruded like a funnel from the udder. Each mammary gland had six to nine large milk ducts joined to form the gland cistern, which ended at a single streak canal and a single teat opening. The external pudendal artery (Fig. 1/1) gave the mammary artery (Fig. 1/2) which passed through the inguinal canal and on reaching the base of the udder it divides into cranial and caudal mammary branches (Fig. 1/3 & 4) that were partially or wholly embedded in the glandular tissue. The cranial mammary branch supplies the mammary lymph nodes while the caudal mammary branch anastomosed with another division of the ventral perineal artery (Fig. 1/5), to supply the upper rear portion of gland, then it passed downward to terminate cranially and caudally as two main papillary arteries (Fig. 1/6 & 6), each giving fine distributed branches to supply the teat (Garrett, 1988; Frandson *et al.*, 2009; Dyce *et al.*, 2010). This longitudinal distribution of teat blood supply (Nichols, 2008), cranial and caudal to the teat created an area of about 3X3 to 3X4 cm (Fig. 1/A&B) on the medial aspect of the gland, dorsal to the teat, free from major blood vessels. This area proved to be satisfactory for performing anastomosis of udder cistern of injured teat to the gland cistern of the sound gland, predisposed to no severe haemorrhages during surgery and produced no avascular necrosis of the teat and its surrounding skin after surgery.

From surgical point of view, the technique of anastomosis of the two cisterns was complicated, associated with minimal bleeding and fewer complications than hemi-mastectomy, had less extensive wound size than alternative hemi-mastectomy techniques and preserved milk production of both glands. Moreover, the technique is advantageous over suturing of the lacerated teat



**Figs.** (1) Radiographic image of the udder of the goat showing its arterial distribution. 1: External pudendal artery, 2: Mammary artery, 3: Cranial branch of 2, 4: Caudal branch of 2, 5: Ventral perineal artery, 6 and 6': Papillary arteries, and A & B: Proper areas for surgical interference to the udder without involvement of blood supply; (2) Recent irreparable full-thickness lacerated teat in a goat; (3) Grasping and crushing of the base of lacerated teat with haemostatic forceps; (4) Elliptical surgical excision at the medial aspect of the sound udder [2] for anastomosis to the gland cistern of lacerated teat [1]; (5) Apposition of the udder cistern of lacerated teat [1] to the udder cistern of sound one [2]; (6) Immediately after anastomosis of the two udder cisterns and excision of lacerated teat.



**Fig. 7:** Suture line after removal of silk.

under field condition, as it requires no highly expensive small-sized suture materials, no source of magnification or impractical frequent draining of the gland of sutured teat, moreover, treatment of these lacerations by suturing could not protect the animal against complications like teat necrosis, teat fistulae, mastitis, gangrenous mastitis, or sloughing



**Fig. 8:** Atrophy of the udder after mastitis, artery forceps passes through the created tunnel following anastomosis of the two cisterns.

of the udder (Ducharme *et al.*, 1987; Ameh *et al.*, 1994; Steiner, 2004; Nichols, 2008). Therefore, the anastomosis of the gland cisterns can be considered as an alternative technique for treatment of recent extensive full-thickness teat laceration in small sized goats.

Unfortunately, out of the operated seven goats, two goats suffered from acute bilateral mastitis that did not respond to conservative treatment and ended with fibrosis of the udder (Fig. 8), and two goats suffered from dehiscence of the wound and milk leakage with subsequent mastitis and udder fibrosis. Moreover, one goat suffered from slight wound infection with formation of cutaneous micro-abscesses that responded to conservative treatment, and this goat and the remaining two goats continued normal milking till weaning of the kids, then they were used for meat production. However, none of the operated goats suffered from avascular necrosis of the teat or the skin around the site of surgery and this proved absence of major blood supply of the teat on the medial aspect of the gland and coincided with radiology results.

It was concluded that the technique of anastomosis of the gland cisterns in goats is an alternative technique to hemimastectomy. Considering the low success rate of the technique, further studies are required to remodel the technique to increase its success rate.

## References

- Ameh, J.A., Addo, P.B., Adekeye, J.O., Gyanq, E.O., Teddek, L.B. and Abubakar, Y. 1994. Gangrenous caprine coliform mastitis. *Small Rum. Res.* **13**: 307-309.
- Arighi, M., Ducharme, N.G., Horney, F.D., Livsey, M.A. and Hurtig, M.H. 1987. Invasive teat surgery in dairy cattle: II- Long-term follow-up and complications. *Can. Vet. J.* **28**: 763-767.
- Azizi, S., Rezaei, F.S., Saifzadeh, S. and Dalir-Naghadeh, B. 2007. Associations between teat injuries and fistula formation in lactating dairy cows treated with surgery. *J. Am. Vet. Med. Assoc.* **231**: 1704-1708.
- Beaudeau, F., Ducrocq, V., Fourichon, C. and Seegers, H. 1995. Effect of disease on length of productive life of French Holstein dairy cows assessed by survival analysis. *J. Dairy Sci.* **78**: 103-117.
- Cable, C.S., Peery, K. and Fubini, S.L. 2004. Radical mastectomy in 20 ruminants. *Vet. Surg.* **33**: 263-266.
- Couture, Y. and Mulon, P.Y. 2005. Procedures and surgeries of the teat. *Vet. Clin. North Am. Food Anim. Pract.* **21**: 173-204.
- Ducharme, N.G., Arighi, M., Horney, F.D., Livsey, M.A., Hurtig, M.H. and Pennock, P. 1987. Invasive teat surgery in dairy cattle: Part I- surgical procedures and classification of lesions. *Can. Vet. J.* **28**: 757-762.
- Dyce, K.M., Sack, W.O. and Wensing, C.J.G. 2010. *Textbook of Veterinary Anatomy*, 4<sup>th</sup> edn. W.B. Saunders, Philadelphia, USA.
- El-Maghraby, H.M. 2001. Comparison of two surgical techniques for mastectomy of goats. *Small Rum. Res.* **40**: 215-221.
- Frandsen, R.D., Wilke, W.L. and Fails, A.D. 2009. Anatomy and physiology of the mammary glands. In: *Anatomy and Physiology of Farm Animals*, 7<sup>th</sup> edn. Wiley-Blackwell, Iowa, USA.
- Garrett, P.D. 1988. *Guide to Ruminant Anatomy Based on the Dissection of the Goat*, 1<sup>st</sup> edn. Iowa State University Press, USA.
- Grymer, J., Watson, G.L., Coy, C.H. and Prindle, L.V. 1984. Healing of experimentally induced wounds of mammary papilla (teat) of the cow: comparison of closure with tissue adhesive versus nonsutured wounds. *Am. J. Vet. Res.* **45**: 1979-1983.
- Makady, F.M., Saleh, A.S. and Seleim, S.M. 1990. External pudic artery ligation in goats. *Assiut Vet. Med. J.* **22**: 174-177.
- Nichols, S. 2008. Teat laceration repair in cattle. *Vet. Clin. North Am. Food Anim. Pract.* **24**: 295-305.
- Niehaus, A. 2011. Mastectomy in ruminants, farm animal proceedings. In: *ACVS Veterinary Symposium Proceedings, The Surgical Summit, 3-5 November 2011, The Ohio State University*. pp 679-681.
- Roberts, J. and Fishwick, J. 2010. Teat surgery in dairy cattle. In Practice **32**: 388-396.
- Smith, M.C. and Sherman, D.M. 1994. *Goat Medicine*. Williams and Wilkins, Baltimore, USA. pp 465-494.
- Steiner, A. 2004. Teat surgery. In: *Food Animals Surgery*. Fubini, S.L. and Ducharme, N.G. (Eds), 1<sup>st</sup> edn. W.B. Saunders, St. Louis. pp 414-418.