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Research Article

ULTRASONOGRAPHIC EVALUATION OF HEALING OF TEAT FISTULA USING POLYGLACTIN 910 SUTURE AND ISO – BUTYL CYANOACRYLATE TISSUE ADHESIVE IN BOVINES

SUKHDEV SINGH, R.S. BISLA*, ASHOK KUMAR, NEERAJ ARORA and MOHIT JAMDAGNI
Department of Veterinary Surgery and Radiology, College of Veterinary Sciences,
LalaLajpat Rai University of Veterinary and Animal Sciences, Hisar-125004, India

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ABSTRACT

The study was conducted on 18 clinical cases of teat fistula in bovines with the objective of assessing teat fistula severity in terms of tissue damage and evaluating process of healing through ultrasonographic examination. The animals were randomly divided into three groups based on the combinations of different suture material used. Mucosal layer in all the animals and muscular layer in group A and B were sutured with 3-0 Polyglactin 910. Skin was sutured with 2-0 silk in group A and adhered with Iso- butyl cyanoacrylate in B. However, in group C muscular and skin layer were adhered using Iso-butyl cyanoacrylate. Preoperatively on day 0, the teat fistula severity and tissue damage was evaluated by ultrasonography examination (change in echogenicity pattern). The findings of our study revealed that group B protocol was found to be better in the treatment of teat fistula in terms of healing and aesthetic value of teat.

Keywords: Bovines, Iso- butyl cyanoacrylate, Polyglactin 910, Teat fistula, Ultrasonography

Teat fistula is one of the most common causes of mastitis in domestic animals (Nichols *et al.*, 2016) and it needs a timely diagnosis and treatment not only to prevent milk loss but also keep the udder health in optimum condition. Repair of teat fistula is a challenging factor due to continuous milk flow in teat canal and prevalence of leakage of milk in teat muscle through suture line which further develops the condition of non union and infection. Tissue adhesive (iso- butyl cyanoacrylate) having the nature of sealing the suture line improves healing by preventing the leakage of milk in suture line. The present study was conducted to compare the healing process of teat fistula using different suture materials and tissue adhesive and the healing process was evaluated using ultrasonography.

MATERIALS AND METHODS

The study was conducted on 18 clinical cases of teat fistula in bovines presented to Veterinary Clinical Complex, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar with the history of leaking milk from right hind teat in eight cases, left hind teat in seven case and rest of the cases were of right and left fore-teat fistula. All the cases were divided into three groups having six animals in each group, irrespective of the age and breed to evaluate the severity of injury to the teat and also the ultrasonographic evaluation of healing process on day 0, 7 and 15 postoperatively. In group A (n=6), the two inner layers (mucosal layer and muscular layer) were sutured using 3-0 Polyglactin 910 and the skin was sutured using 2-0silk. In group B (n=6), the two inner layers were sutured using 3-0 Polyglactin 910 and skin was adhered using iso-butyl cyanoacrylate. In the group C (n=6), only the inner most layer was sutured using 3-0 Polyglactin 910 and other tissues including skin were adhered using iso-butyl cyanoacrylate. The operation was performed in lateral recumbency with the affected teat upward side. The surgical site was prepared for aseptic surgery. Sedation was achieved with xylazine, 0.03 mg/kg intravenously followed by local analgesia through 2% lignocaine hydrochloride infiltration in a ring pattern at the base of affected teat. Reconstruction of teat fistula was done by three different protocols. The present investigation was conducted in vertical and horizontal plane with Siemens ACUSON X300 ultrasound machine with 6.2 to 10 MHz linear probe. The normal bovine udder and teat in four buffaloes and four cows were subjected to ultrasonographic examination for standardizing the technique and machine settings. The direct contact and water bath techniques were used for ultrasonographic examination of teat for evaluation of healing process postoperatively (Franz *et al.*, 2009).

Corresponding author: ranbir_bisla@yahoo.com

RESULTS AND DISCUSSION

The ultrasonography of healthy animal's teat was done by linear probe with 6.2 to 8 MHz frequency for standardization. The echogenicity pattern observed was as follow; skin revealed as hyperechoic, muscular layer– longitudinal and circular and conjunctive tissue layers- hypoechoic, blood vessel- hyperechoic, sub-mucosa and mucosal layer- hypoechoic, Furstenberg rosette- slightly hyperechoic and teat canal revealed hyperechoic as thin, bright white line delineated on each side by parallel thick, dark, grey blank band (Fig. 1). The transition between teat cistern and gland cistern was done by annular fold and venous ring of Furstenberg which revealed by anechoic pattern near to annular fold (Fig. 2).

In group A, five cases of teat fistula healed properly but in one case reoccurrence was observed due to infection at suture line area. Preoperatively on day 0, the teat fistula severity and tissue damage (Fig. 3) was easily diagnosed by ultrasonographic image (change in echogenicity pattern) (Fig. 4). On 7th day, hypoechoic image pattern was formed in the region of suture line area as depicted in ultrasonographic observation (Fig. 5). Gross examination on seventh day revealed that the fistula gap was completely filled up and suture was removed on seventh day. 15th day of ultrasonographic observation revealed that the pattern of healing area was changed from hypoechoic to slightly hyperechoic (Fig. 7). Gross examination on 15th day revealed that complete healing with large scar and suturemarks (Fig. 6). In group B, five cases of fistulae healed properly but in one case recurrence were reported due to early sloughing off tissue adhesive scab. On 7th day, at the region of suture line hypoechoic and small dot pattern of hyperechoic image was observed (Fig. 8). Gross examination on seventh day revealed that the fistulae gap was completely filled up and a hard scab of tissue adhesive was formed over suture line. On 15th day of ultrasonographic observation, the healing area was changed from hypoechoic to more hyperechoic (Fig. 10). The complete healing of teat fistula occurred on 15th day (Fig. 9) and scab was sloughed off on 18th day. In group C, reoccurrence occurred in all cases due to early sloughing of tissue adhesive scab and leakage of milk through teat fistula. On 7th day, at the tract of fistulae region, interrupted pattern of small irregular hypoechoic and anechoic pattern was present in ultrasonographic observation (Fig. 12). Gross examination on seventh day confirmed that the fistulae gap was not completely filled up (Fig. 11) and no healing was recorded in this protocol.

The change in echogenicity pattern of teat wall was recorded to examine the severity of tissue damage in affected teat preoperatively, on day 0. The proportion of hypoechoic appearance, discontinuity of the hyperechoic outer teat wall and hypoechoic and anechoic irregular tubular appearance of fistulous tract denoted tissue damage. Similar observations have also been reported by earlier workers (Mulon, 2016; Geishauser *et al.*, 2005). On 7th day in group A and B, at the region of healing in teat wall, hypoechoic pattern with small hyperechoic dots were formed but in group C due to early sloughing of tissue adhesive scab, no healing occurred and irregular hypoechoic tubular appearance was observed. The hypoechoic pattern was formed due to newly formed immature granulation tissue and small hyperechoic dot was formed due to starting of maturation of granulation tissue by deposition of collagen fiber. Similar observations have been reported by Mohafez *et al.* (2018) that in B-mode images, the newly formed granulation tissue appear as hypoechoic and this region becomes hyperechoic when wound strength increases by deposition of collagen fiber. As compared to group A, more hyperechoic dots were present in group B which depicts the early maturation of granulation tissue and early wound healing. On the basis of this finding, tissue adhesive applied over the skin did not interfere between the skin edges, preserving the original structure leading to quicker reunion (Bresnahan *et al.*, 1995). In group C, healing of muscular layer was not observed as good as in group A and B ultrasonographically because iso-butyl cyanoacrylate fail to seal the muscular layers and leakage of milk in muscular layers was observed, secondly iso-butyl cyanoacrylate acts as barrier between muscular layers in presence of moisture and delayed healing process (Pope and Knowles, 2013). Singer *et al.* (2008) stated that frequent exposure to moisture may result in adhesive failure. The cyanoacrylate topical skin adhesives should not be used in proximity to mucous membranes such as the mouth. Singer *et al.* (2008) hypothesized that topical skin adhesives are not as strong as 3/0 and some 4/0 sutures. Therefore, when used alone, there is an increased risk of wound dehiscence at high-tension site. On 15th day observation in group A and B, complete healing was observed and ultrasonographic images of healing area revealed more hyperechoic pattern in group B as compared to group A indicating more maturation of granulation tissue and increased wound strength by deposition of collagen fibers. This was found in consistent with findings of Mohafez *et al.* (2018).

In group B where Iso amyl 2- cyanoacrylate was used for skin union, better cosmesis of skin was observed as compare to group A. Similarly findings were reported when skin was closed using Iso amyl 2- cyanoacrylate (Pope and Knowles, 2013). It was also observed that incisions closed with tissue adhesive were aesthetically pleasing and a single linear scar was produced. The use of the topical cyanoacrylate adhesives also reduces the risks of needle sticks (Gordon, 2001) and prevents the formation of suture marks on either side of the wound. Deolekar *et al.* (2017) also found that use of tissue adhesive has an advantage of cosmetically better scar when compared to conventional suturing.

Based on the observations of present study, we can conclude that combination of tissue adhesive and suture material was found to be superior in the correction of teat fistula as it promotes early healing and maintains aesthetic value of the teat.

For standardization of ultrasound machine four healthy cows and buffalo's teat were scan with water bath and direct contact technique and normal images of teat taken as follows:

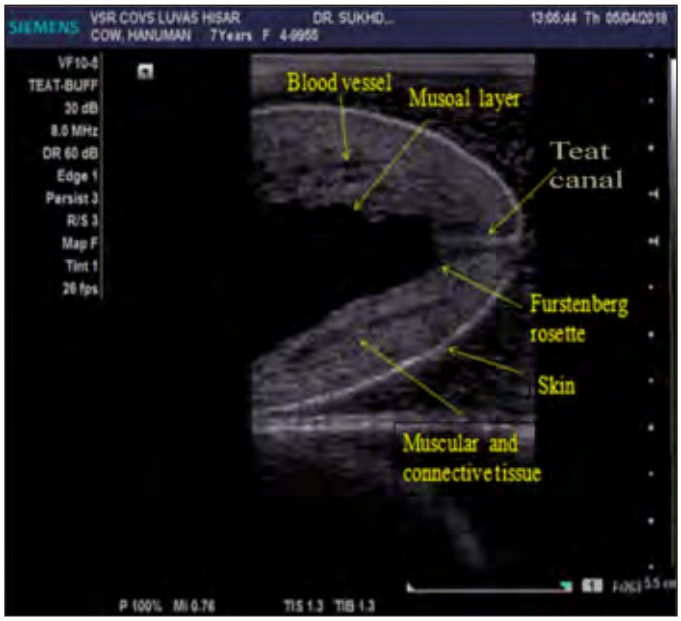

Fig. 1. Normal ultrasonographic image of cow teat showing teat canal, Furstenberg rosette, skin, muscular and connective tissue and mucosal layer (Water bath technique; vertical scan; 8 MHz linear probe)

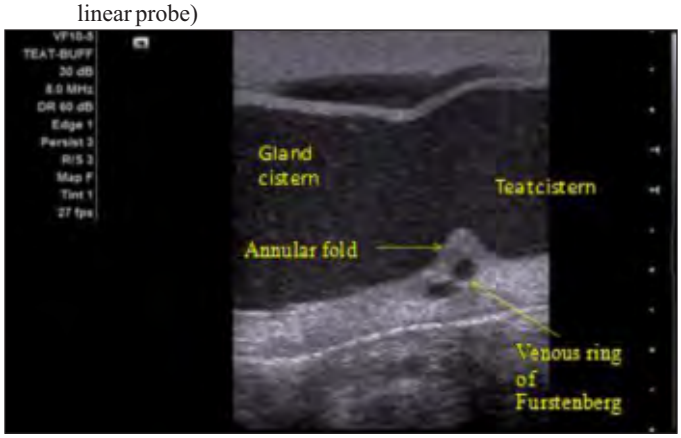

Fig. 2. Ultrasonographic of transition between teat and gland cistern of bovine showing annular fold and venous ring of Furstenberg (Direct contact technique; vertical scan; 8 MHz linear probe)

Comparative ultrasonographic evaluation of healing process of teat fistula

Fig. 3. Gross image of teat fistula on day zero preoperative (Group A)

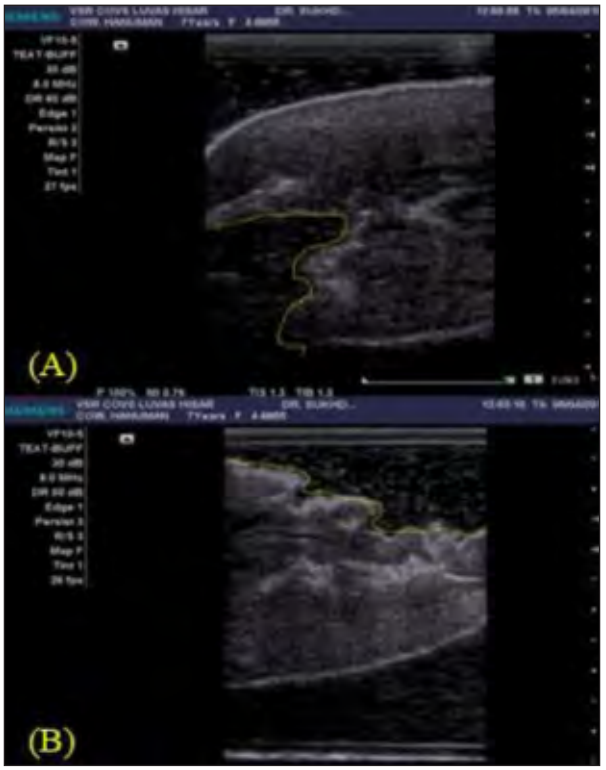

Fig. 4(A, B). Ultrasonographic image of damage and loss of tissue of teat shown due to teat fistula (Water bath technique; vertical scan; 8MHz linear probe)

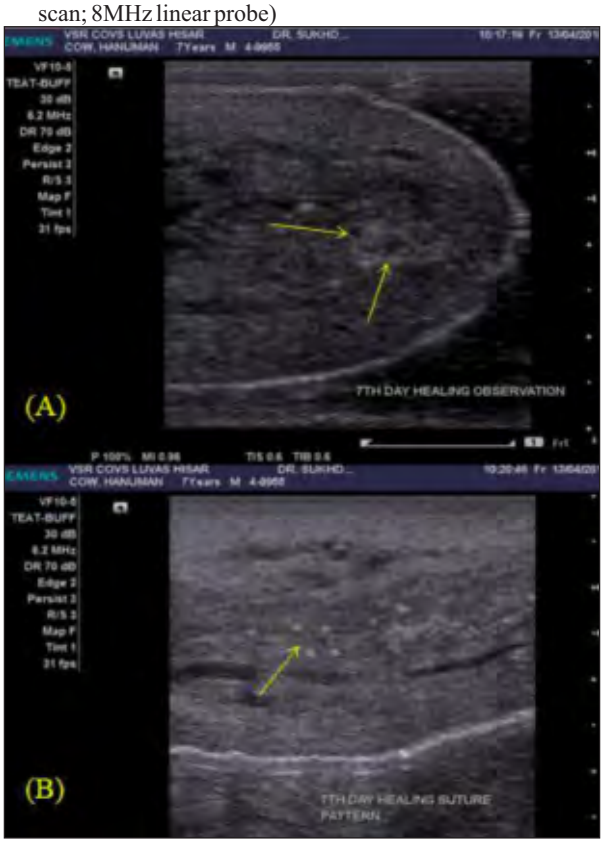

Fig. 5(A, B). Ultrasonographic image of teat fistula on seventh day observation show hypoechoic pattern at healing area marked by arrow (water bath technique; vertical scan; 6.2 MHz linear probe) group A

Fig. 6. Gross image of completely healed teat fistula case on day 15th group A

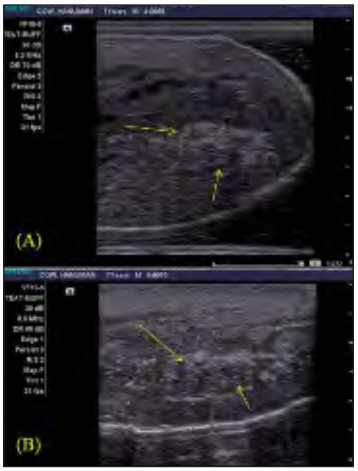

Fig. 7(A, B). Ultrasonographic image of healed region of teat fistula on 15th day observation show more hyperechoic pattern at healed region marked by arrow. (Water bath technique; vertical scan; 8MHz linear probe)

The gross and ultrasonographically images of teat fistula on day 7 and 15 group B

Fig. 8. Ultrasonographic image on seventh day observation show hypoechoic and hyperechoic pattern at healing area marked by arrows (water bath technique; vertical scan; 6.2 MHz linear probe)

Fig. 9. Gross image of healed teat fistula region on day 15th and 18th day group B

Fig. 10. Ultrasonographic image of healed region on 15th day observation show more hyperechoic pattern at healed region marked by arrows. (Water bath technique; vertical scan; 6.2 MHz linear probe)

Group C: The gross and ultrasonographically images of teat fistula on day 7

Fig. 11. Gross image of unhealed teat fistula on 7th day

Fig. 12. Ultrasonographic image of unhealed teat fistula tract marked by arrows on 7th day (Water bath technique; vertical scan; 8 MHz linear probe)

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