



CASE REPORT

THERAPEUTIC APPROACH TO MAMMARY FISTULA IN A GOAT – SURGICAL INTERVENTION: A CASE STUDY

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Ethical considerations: When reporting experiments on animals Observation of the ARRIVE guidelines 2.0: Updated guidelines for reporting animal research, published on July 14, 2020 (DOI: 10.1371/journal.pbio.3000410), is applied. The authors ensure that all procedures were performed in compliance with the guidelines for animal care of their institutions or with national/international guidelines.

ABSTRACT

In June 2023, a goat presenting with a mammary gland fistula was admitted to our facility. Upon clinical examination of the patient, apart from the fistula located on the left half of the mammary gland, no other pathological findings were detected. Following diagnosis, the owner consented to surgical intervention involving excision of the lesion. An elliptical excision encompassing all tissue layers down to the mammary cistern was performed. The defect was subsequently closed using a three-layer suture with absorbable suture material. During the postoperative period, systemic antibiotic therapy was administered for ten days. Intramammary antibiotics and a non-steroidal anti-inflammatory drug were applied for three days, in combination with lavage of the mammary cistern using warm physiological saline and local wound care. At the time of removing the tension-relieving sutures, on the eighth day after surgery, the surgical site exhibited no signs of inflammation, and healing was proceeding adequately. The animal was alert, in good clinical condition, and showed interest in feed. On the tenth day, the patient was returned to the owner and reintegrated into the herd. The presented case describes the successful surgical treatment of a mammary fistula in a goat, resulting in complete healing without postoperative complications.

Key words: fistula; goat; udder

INTRODUCTION

Mammary gland and teat fistula is defined as an abnormal tract connecting the internal environment of the mammary gland or teat with the external environment, clinically manifesting in lactating animals by milk discharge [1].

From an etiological perspective, the fistula is described as either congenital or acquired. The acquired form of mammary gland fistula most commonly results from trauma or represents a complication following surgical treatment [2]. Traumatic injuries that do not involve the mammary cistern or teat canal may be managed by removal of debris

and necrotic tissue in combination with local therapy. If the trauma precludes machine milking, the placement of a sterile teat cannula is indicated. Hygiene management is crucial during patient care, especially when using a teat cannula, due to the high risk of mastitis development [3]. Mastitis is defined as inflammation of the mammary gland resulting from infection [4]. The inflammatory process induces a series of changes dependent on the extent of parenchymal damage and the causative pathogen. These changes include decreased milk production in both clinical and subclinical forms, reduced lactose content, altered casein proportion, and decreased lipoid concentration [5]. Surgical treatment is indicated for any laceration involving the mammary cistern or teat canal; otherwise, a permanent fistula may develop. Therapy is often challenging due to secondary bacterial infection [3]. The initial step of therapy involves thorough cleaning and debridement of the laceration to remove pathologically altered tissue, especially in chronic cases. Excision of wound edges is also recommended, with careful consideration of subsequent tissue adaptation. Precise debridement is essential not only for removing necrotic and non-viable tissue, but also for achieving proper wound closure during suturing [6].

CASE PRESENTATION

Case description

In June 2023, at the owner's request, a goat (cross-breed, 3 years old, 55 kg) was admitted to the Ruminant Clinic of the University Hospital at the University of Veterinary Medicine and Pharmacy in Košice. The owner reported an issue affecting the left half of the udder as the reason for presentation.

MANAGEMENT AND OUTCOMES

Clinical examination

General parameters were within reference ranges during the clinical examination. Examination of organ systems revealed no pathological findings other than the owner-reported issue involving the mammary gland. Parasitological examination of the patient was included as part of the general clinical examination. On clinical palpation, the udder exhibited a firm elastic consistency without en-

largement, asymmetry, pain, or changes in temperature. On the left half of the udder, at the transition between the mammary cistern and the teat canal, a fistula was identified (Fig. 1).

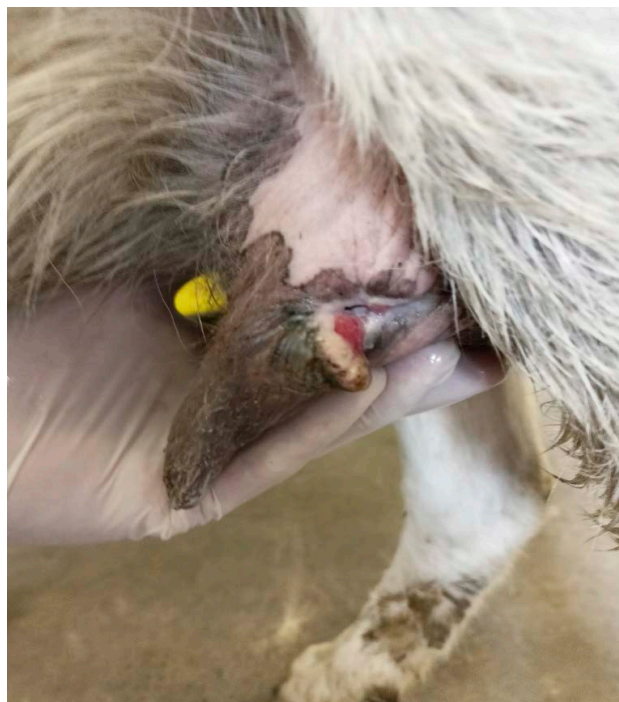


Fig. 1. Fistula of the mammary gland identified during clinical examination

It was characterized by skin adherent to the underlying parenchyma and a small amount of secretion. Scar tissue was evident in the surrounding area. The owner had attempted to dry off the udder, which was successful on the right side; however, the affected left half continued to produce a small amount of secretion, which discharged through the fistula. For hematological and biochemical evaluation, blood samples were collected from the jugular vein (*v. jugularis*). Biochemical analysis revealed no abnormalities, with all parameters within reference ranges. Hematological analysis, however, confirmed leukocytosis. Based on the clinical findings, a diagnosis of fistula of the left half of the mammary gland was established. The owner was informed of the diagnosis, clinical status, and therapeutic options and consented to surgical treatment.

Surgical treatment

As part of the surgical procedure, patient preparation included a 24-hour preoperative fasting period with free access to water. For general anesthesia, xylazine (0.2 mg/kg) was administered in combination with ketamine

(11 mg/kg). Anesthesia was subsequently maintained with the administration of half the initial dose. Prior to standard surgical field preparation, the mammary fistula was flushed with warm physiological saline. An elliptical incision was made around the fistula, approximately 1 cm from its margins, encompassing all tissue layers down to the mammary cistern (Fig. 2).



Fig. 2. Surgical excision of mammary fistula

Following excision of the fistula, the mammary cistern was flushed again, and an intramammary antibiotic was administered. Wound edge adaptation and three-layer closure of the surgical site were then performed. The first layer – the mucosa was closed using a mattress suture pattern with absorbable polydioxane suture material. The second layer, the submucosa, was closed with a simple continuous suture, also using absorbable material (PDX 3). The final layer, the skin, was closed intradermally with absorbable suture material (Fig. 3) and reinforced with three



Fig. 3. Intradermal closure of the mammary gland after fistula excision

tension-relieving sutures. Finally, the surgical site was cleaned and treated with an antiseptic aluminum spray.

Postoperative care

The patient was housed in an individual pen during recovery from general anaesthesia and for the subsequent 10 days following surgery. Pharmacological treatment includes systemic antibiotic administration for 10 days (amoxicillin at a dose of 15 mg/kg), as well as intramammary antibiotics and non-steroidal anti-inflammatory drugs (flunixin meglumine at 2.2 mg/kg) for three days postoperatively. For the first three days following surgery, the mammary gland was irrigated with warm physiological saline, which was subsequently milked out to remove blood clots formed after the procedure. Each lavage was followed by intramammary antibiotic administration. By the fourth postoperative day, the mammary gland secretion was free of blood clots and fibrin flakes. On the eighth day, the three tension-relieving sutures were removed, and local wound care was performed. By the tenth day, the patient's condition was stable, the surgical site showed no pathological signs, and the patient was returned to the herd (Fig. 4).

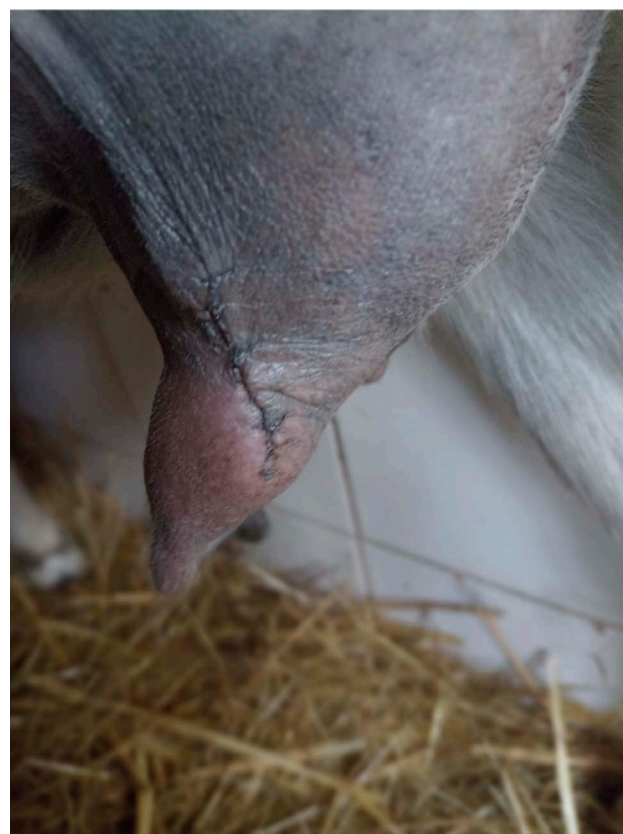


Fig. 4. Healing wound on the 10th day after surgery

DISCUSSION

The mammary gland is an exceptionally sensitive organ, highly susceptible to injury. Even minor trauma can lead to significant health complications and negatively affect milk production. Minimal dysfunction of the physiological barrier may result in chronic inflammation or infection of the gland, which in severe cases can lead to culling of the animal from the herd [7]. Postpartum enlargement of the mammary gland increases the risk of trauma. Injuries may occur due to other animals in the herd, foreign objects such as metal sheeting or wire, or even milking equipment. Both the mammary gland and the teats are at risk, as they are directly exposed to environmental factors. A fistula of the mammary gland or teat is considered an acute condition, especially in lactating animals, due to the increased risk of mastitis and the associated economic losses. Immediate intervention and closure of the fistula within 12 hours of injury (optimally within 3 hours) significantly improve prognosis [8]. After 12 hours, massive edema of the wound margins typically occurs. In such cases, it is advisable to delay repair for 2–3 days until the swelling subsides [9]. If the injury is left untreated, the wound heals secondarily, resulting in the formation of a fistula. Fistula formation is generally complete approximately four weeks post-injury [10].

In the present case, we performed surgical treatment of a mammary gland fistula most likely caused by trauma, as suggested by visible scar tissue. The chronic nature of the lesion was also indicated by the adherence of skin to the gland's mucosa and submucosa. The absence of clinical signs of inflammation in the mammary gland improved the prognosis. Surgically, an elliptical incision approximately 1 cm from the fistula margins was made, extending through all tissue layers down to the mammary cistern. Roberts et al. [11] emphasize that incisions in this region should be performed cautiously to avoid excessive tissue removal, which can complicate adaptation of wound edges. In our case, tissue was excised conservatively to ensure healthy tissue alignment. No issues with adaptation were observed due to the adequate amount of free tissue and the anatomical location of the defect, situated at the transitional zone between the mammary cistern and teat canal. Following tissue excision, the cistern was flushed with sterile saline, intramammary antibiotics were applied, and the wound was sutured. Although the most widely rec-

ommended suturing technique is a two-layer continuous suture, with first layer involving only the mucosa and the second the submucosa [12, 13] in this case, we performed a three-layer closure. The mucosal layer was closed with a continuous mattress suture, followed by a simple continuous suture of the submucosa. The skin was closed using an intradermal suture, reinforced with three tension-relieving sutures.

Experimental studies have shown that three-layer closure of mammary cistern and teat lacerations offers superior outcomes and minimizes the risk of postoperative fistula formation compared to two-layer techniques [14]. As for suture materials, synthetic absorbable options such as polyglactin, polyglycolic acid, or polydioxanone are recommended [12, 14]. These materials are particularly suitable for deep tissue repairs such as those involving the mammary cistern because they induce minimal inflammatory response and are degraded by hydrolysis [12, 15]. In contrast, chromic catgut is considered inappropriate for mammary surgery due to its intense inflammatory and phagocytic reaction and rapid loss of tensile strength, which adversely affects healing [16]. In this case, polydioxanone was used for suturing all three layers. No postoperative wound reactions suggestive of suture intolerance were observed. By day 4, postoperative edema had markedly subsided and wound edge adaptation had improved. Sutures should ideally be removed on day 9, depending on the healing progress. Prolonged presence of sutures may result in excessive fibrosis or localized infections [10]. On postoperative day 8, the surgical site showed no pathological signs, and wound edges were well adapted. Common complications associated with surgical repair of mammary gland or teat lacerations include suture dehiscence, fistula formation, abscess development, mammary cistern fibrosis, and mastitis [17].

Postoperative care should include systemic antibiotics, NSAIDs, and intramammary antibiotic therapy. Wound protection, particularly during summer months with increased fly activity, is also advised [18]. In our case, during the first three postoperative days, warm 0.9% saline lavage was performed to remove blood clots from the mammary cistern, followed by milking. By the fourth day, milk was clear and free of discoloration, clots, or fibrin flakes. Despite the owner's attempt to dry off the affected udder, complete involution occurred only on the right side. The left affected side continued to produce a small volume of

milk, which increased postoperatively. This residual milk production was beneficial for therapy, as it facilitated the removal of clots and fibrin from the cistern. California Mastitis Test (CMT) results on days 3 and 4 were positive; however, by day 8, the result was negative. Upon discharge, the owner was advised to continue milking the affected udder until postoperative day 15, followed by a gradual dry-off process.

CONCLUSION

This case report confirms that surgical management of a mammary gland fistula is an effective therapeutic approach, allowing for the restoration of both glandular morphology and milk production, thereby reducing economic losses in the herd. From a material and technical standpoint, the procedure is not demanding; however, postoperative care plays a crucial role and significantly influences the therapeutic outcome.

Data Availability Statement

The raw data of this article will be made available by the authors, without undue reservation.

Ethical Statement

All examinations and therapeutic procedures were performed in accordance with established standards and with due regard for the patient's welfare. The owner consented to the therapeutic process under the given conditions.

Conflict of Interest

The authors have no pertinent financial or non-financial conflicts of interest to declare.

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Generative AI Statement

The authors declare that no Gen AI was used in the creation of this manuscript.

Authors' Contributions

Marián Kadaši – article processing, clinical examination and diagnostics, surgery, article revision, Mekkóvá Simona – clinical examination and diagnostics, surgery, article revision, Hisira Vladimír – clinical examination, postoperative therapy, article revision, Glembová Veronika – clinical examination of patient, anesthesiology, article revision, Gomulec Pavel – surgery, article revision Dolník Michal – clinical examination, medical care, article revision.

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