Right Flank Celiotomy for Bovine Fetal Remnants : A Case Series

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SUMMARY

Fetal mummification and maceration are significant gestational pathologies in cattle, characterized by fetal death and subsequent intrauterine retention of fetal tissues, often beyond the expected term. These conditions arise due to various etiologies including umbilical cord torsion, hormonal imbalances, infectious agents, and failure of cervical dilation or luteolysis. The current study documents five cases of fetal mummification and maceration in Jersey crossbred cows, each exhibiting unique clinical presentations and diagnostic features. All animals had previously received prostaglandin $F_2\alpha$ ($PGF_2\alpha$) treatment from local para-veterinarians, yet failed to expel the retained fetus, necessitating referral for further evaluation. Thorough obstetrical examinations-including per-vaginal and transrectal assessments were instrumental in confirming intrauterine fetal death and characterizing the extent of pathology. Ultrasonographic examination using a 7.5 MHz linear rectal transducer provided definitive visualization of intrauterine contents, differentiating mummified fetuses from macerated remains. Sonographic findings ranged from compact, echogenic fetal masses without fluid in mummification cases to hyperechoic bony fragments within heterogeneous, fluid-filled uteri in maceration. Due to failure of medical management, all five cows underwent right flank celiotomy. Surgical intervention involved exteriorization of the uterus, manual evacuation of retained fetal contents, uterine lavage, and layered closure using standard surgical techniques. The intraoperative findings corroborated the diagnosis, with maceration cases showing extensive necrotic debris and purulent exudate, while mummification cases presented dry, leathery fetuses within contracted uteri. Postoperative care included NSAIDs, antibiotics, fluid therapy, and daily monitoring. All cows recovered uneventfully and were discharged on the fifth postoperative day with recommendations for 60 days of sexual rest. During a three-month follow-up, no surgical complications or systemic illnesses were observed. Estrus returned in all animals within 2.5-3 months post-surgery, and three cows successfully conceived following artificial insemination in the fourth month. The remaining two cows were not re-bred due to owner preference. This study highlights the diagnostic challenges and therapeutic considerations in managing fetal mummification and maceration. While $PGF_2\alpha$ remains the first-line therapy, surgical intervention is warranted in refractory cases. Celiotomy, when executed with proper technique and post-operative care, offers a viable and fertility-preserving solution. The use of transrectal ultrasonography was pivotal in case differentiation, guiding both diagnosis and treatment strategy. These findings emphasize the importance of early, accurate diagnosis and timely intervention for favorable reproductive outcomes. With appropriate management, even severe cases of fetal remnants can resolve with restoration of reproductive function, as demonstrated in this case series.

KEY WORDS

Celiotomy, Fetal maceration, Fetal Remnants, Fetal mummification.

INTRODUCTION

Fetal mummification is a pathological condition observed during gestation in domestic animals, characterized by fetal demise followed by the prolonged intrauterine retention of dehydrated fetal tissues, without expulsion, beyond the expected term of pregnancy (1,2,3,4,5). This condition arises when fetal death occurs without the regression of the corpus luteum or sufficient cervical dilation (6). Gradually, resorption of placental and fetal fluids leads to progressive dehydration and reduction in size of the uterus and fetal structures, culminating in the formation of a sterile, desiccated fetal mass. The cervix remains tightly closed throughout this process, thereby inhibiting fetal expulsion (7).Fetal mummification occurs sporadically in domestic animals (8). It can affect cattle of any age and is most commonly observed between 4-8 months of gestation across various indigenous and exotic breeds (9,10,11). Fetal mummification is broadly categorized into two types: papyraceous and hematic. In the papyraceous form, absorption of placental fluids results in desiccation of the fetus, with the fetal membranes closely enveloping the dried fetal body. The resulting mass is typically dark, leathery in appearance and lacks any putrid odor (1,4,5). In contrast, cows are more frequently affected by the hematic type, in which the fetus is coated with a thick, dark

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substance resulting from degraded blood products (8,12). Fetal maceration often following mummification, occurs when fetal bones have already developed and the corpus luteum regresses without successful expulsion of the fetus (13). In such cases, incomplete abortion after the third month leads to the retention of bony fetal remains in the uterus, particularly in cattle and buffaloes (14).

Fetal mummification has been reported with an incidence of up to 2% in cattle and 0.01% in buffaloes (15,16,17). In mares, it is exceedingly rare, with only two cases (0.007%) noted in an extensive abortion study (18). The causes include chromosomal anomalies, placental insufficiencies, hormonal imbalances, use of certain medications and infectious agents such as *Campylobacter fetus*, *Leptospira* spp., BVD-MD virus, and fungal pathogens (1,3,19). Umbilical cord torsion is considered one of the principal etiological factors of fetal mummification in cattle; however, it is not a consistent finding in cases of haematic mummification (19). Furthermore, endocrine imbalances particularly those induced by exogenous administration of estradiol and trenbolone acetate have been implicated in disrupting the hormonal milieu necessary for normal gestational progression, thereby predisposing to fetal mummification (20).

CASE DESCRIPTION

Five Jersey crossbred cows of varying parity and reproductive history were presented to a referral Veterinary hospital with suspected cases of fetal mummification or maceration. All had previously received $PGF_2\alpha$ from local para-veterinarians without successful expulsion of remnants in-utero. Clinical evaluation revealed distinct signs in each case, necessitating thorough differential diagnosis and targeted management. A detailed obstetrical examination was performed, beginning with a gentle trans-vaginal assessment to evaluate cervical patency and detect abnormal discharge, ensuring minimal discomfort. This was followed by transrectal palpation to assess uterine tone, size, and the presence of retained fetal or placental structures. The combined findings supported the diagnosis of intrauterine fetal death, detailed case description is depicted in Table 1. A detailed transrectal ultrasonographic examination was conducted in all five Jersey crossbred cows using a Mindray Z5 portable ultrasound system equipped with a 7.5 MHz linear rectal transducer. The probe was carefully inserted into the rectum and oriented parallel to the reproductive tract to enable a comprehensive evaluation of intrauterine contents. This diagnostic modality was crucial in confirming the presence and stage of fetal death, as well as identifying secondary pathological changes within the uterus. In the first cow, ultrasonography revealed a compact, immobile fetal mass occupying the uterine lumen. Hypoechoic to hyperechoic contents in the uterine lumen without placental fluids and placentomes were appreciable. The fetus exhibited uniform echogenicity without any visible skeletal segmentation, consistent with early-to-mid-term mummification. The second case presented with a heterogeneous uterine echotexture containing multiple small, highly hyperechoic characteristic of bones. In the third cow, ultrasonographic imaging demonstrated scattered hyperechoic fetal bones embedded within a hypoechoic fluid matrix. Float-

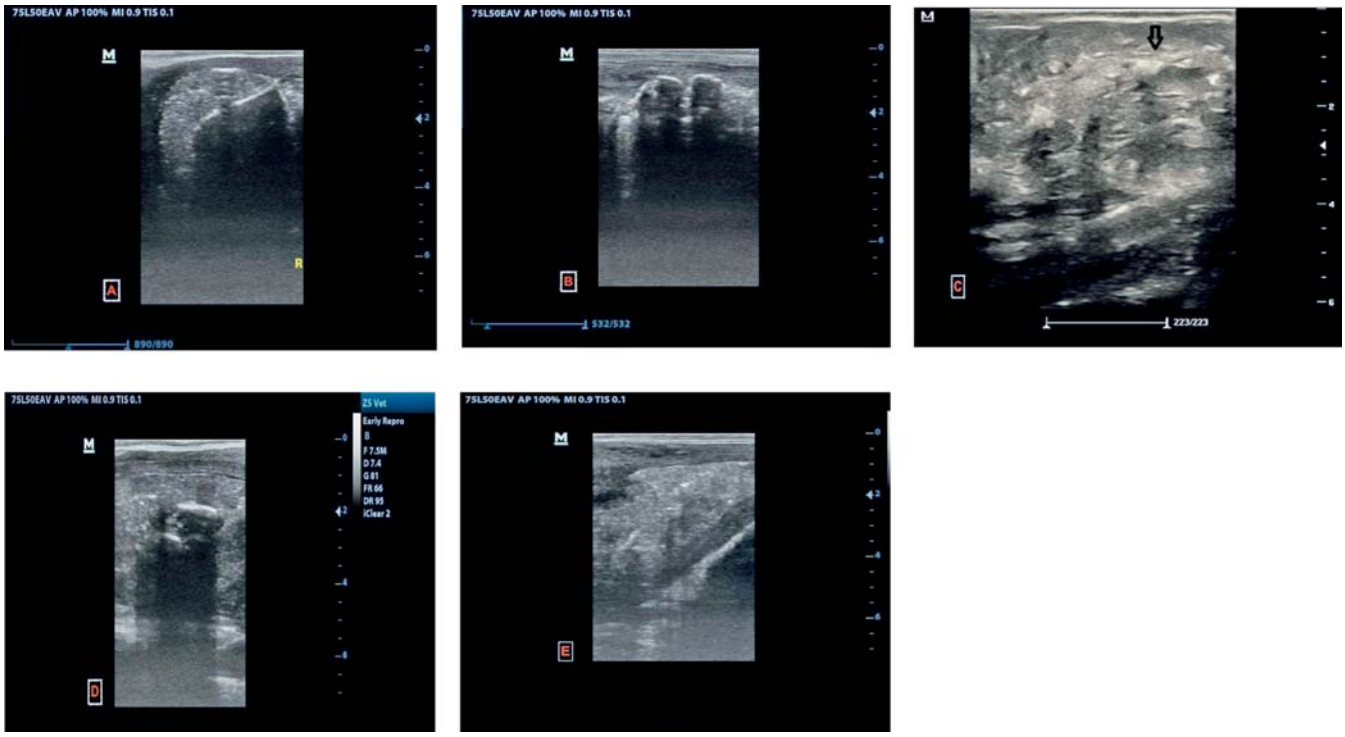

Figure 1 - Trans-rectal ultrasonographic images of the fetal remnants. A: Compact uniform echogenic fetal remnant with absence of placental fluids, indicative of early-to-mid-term fetal mummification (Case 1); B: Hyperechoic debris inside the uterine lumen along with heterogeneous uterine echotexture suggestive of advanced fetal maceration and tissue disintegration (Case 2); C: Scattered hyperechoic fetal remnants within a hypo-hyperechoic matrix and floating echogenic debris, consistent with fetal decomposition and purulent exudate (Case 3); D: Highly reflective fetal remnants with strong acoustic shadows and thickened, irregular uterine wall indicating chronic degenerative uterine changes (Case 4); E: Uterus containing intensely hyperechoic, calcified fetal bones with marked acoustic shadowing, suggestive of prolonged intrauterine retention and chronic fibrotic changes (Case 5).

Table 1 - Detailed case description.

Case	Anamnesis	Clinical Signs	Per-vaginal Examination	Transrectal Examination	Diagnosis
1	Primiparous, Presented at 9 months post artificial insemination	Mucopurulent discharge, failure to calve, no systemic illness	Partially dilated cervix (2 fingers)	Shrunken uterus, fetus 2.5-3 months, no fetal fluids and placentomes	Mummification
2	Primiparous, Presented at 10 months post mating	Mucopurulent discharge, failure to calve, no systemic illness	Partially dilated cervix (2 fingers), blood tinged mucopurulent discharge	Doughy uterus, crepitus	Mummification
3	Pluriparous, Presented at 11 months post mating	Foul sanguineous discharge, Fever 103° F, anorexia, dystocia and retention of placenta during previous calving	Partially dilated cervix (2 fingers), fetid odour purulent discharge	Contracted uterus, firm mass, no fetal fluids and placentomes	Maceration
4	Pluriparous, Presented at 10 months post artificial insemination	No vaginal discharge, failure to calve, no systemic illness, no illness during previous calving	Cervix closed, no discharge	Fragmented bones, crepitus, atonic uterus	Mummification
5	Pluriparous, Presented at 11 months post artificial insemination	Anorexia, tail elevation, inappetence, retention of placenta during previous calving	Partially dilated cervix (3 fingers), foul brown discharge	Small irregular uterus, movable bones with no fetal fluid	Maceration

ing echogenic material, presumed to be purulent exudate, was observed. The findings indicated fetal decomposition within a partially fluid-filled uterine environment. The fourth cow exhibited highly reflective fetal remnants interspersed within an anechoic to hypoechoic intrauterine environment. Strong acoustic shadowing was observed beneath the denser fragments. The uterine wall appeared moderately thickened and irregular, with poor differentiation between the myometrial and endometrial layers, suggesting chronic degenerative changes. In the fifth case, the uterus appeared contracted and was filled with irregular, intensely hyperechoic structures producing marked acoustic shadows, consistent with calcified fetal bones. The uterine lumen lacked normal fetal fluids and placentomes. Additionally, a significant increase in the echogenicity of the endometrial lining was noted, indicating chronic inflammatory or fibrotic changes (Figure 1). Overall, transrectal ultrasonography served as a valuable diagnostic tool in assessing the status of the retained fetus, the integrity of the uterine wall, and the nature of the intrauterine environment. These findings were instrumental in differentiating between fetal mummification and maceration and guided the appropriate therapeutic interventions for each case.

These five cases underscore the clinical variability and diagnostic challenges associated with gestational pathologies in cattle, particularly fetal mummification and maceration. Each animal exhibited differing combinations of reproductive history, systemic involvement, and peripartum abnormalities, necessitating tailored diagnostic and therapeutic approaches. Comprehensive examination, including transrectal palpation and obstetrical examination, played a vital role in the diagnosis, while previous obstetrical history proved critical in understanding predisposing factors and guiding management strategies. Across all five cases, the combination of per-vaginal and transrectal evaluations revealed varying stages of fetal degeneration ranging from mid-term mummification to advanced maceration with differing degrees of cervical dilation and uterine tone. These findings underscore the importance of detailed obstetrical examination in diagnosing gestational pathologies and guiding appropriate therapeutic interventions. Use of both examination modalities proved essential for assessing the stage of fetal retention and determining the extent of reproductive tract involvement.

Differential Diagnosis

Fetal mummification must be differentiated from conditions with overlapping clinical signs. Fetal emphysema involves a gas-filled, malodorous fetus with crepitus, unlike the dry, odorless fetus in mummification. Pyometra presents with uterine distension and purulent discharge but lacks a fetus and occurs in non-pregnant animals. Early fetal resorption leaves no remnants, whereas mummification retains a dehydrated, intact fetus. Accurate diagnosis requires integrating clinical, ultrasonographic, and obstetrical findings to distinguish these conditions effectively.

Comparative Synthesis

The five cases demonstrated the diverse clinical and diagnostic spectrum of intrauterine fetal death in Jersey crossbred cows, with ultrasonographic findings strengthening the differentiation between fetal mummification and maceration. Clinically, mummification (Cases 1, 2 and 4) was largely subclinical, with animals remaining systemically stable but failing to

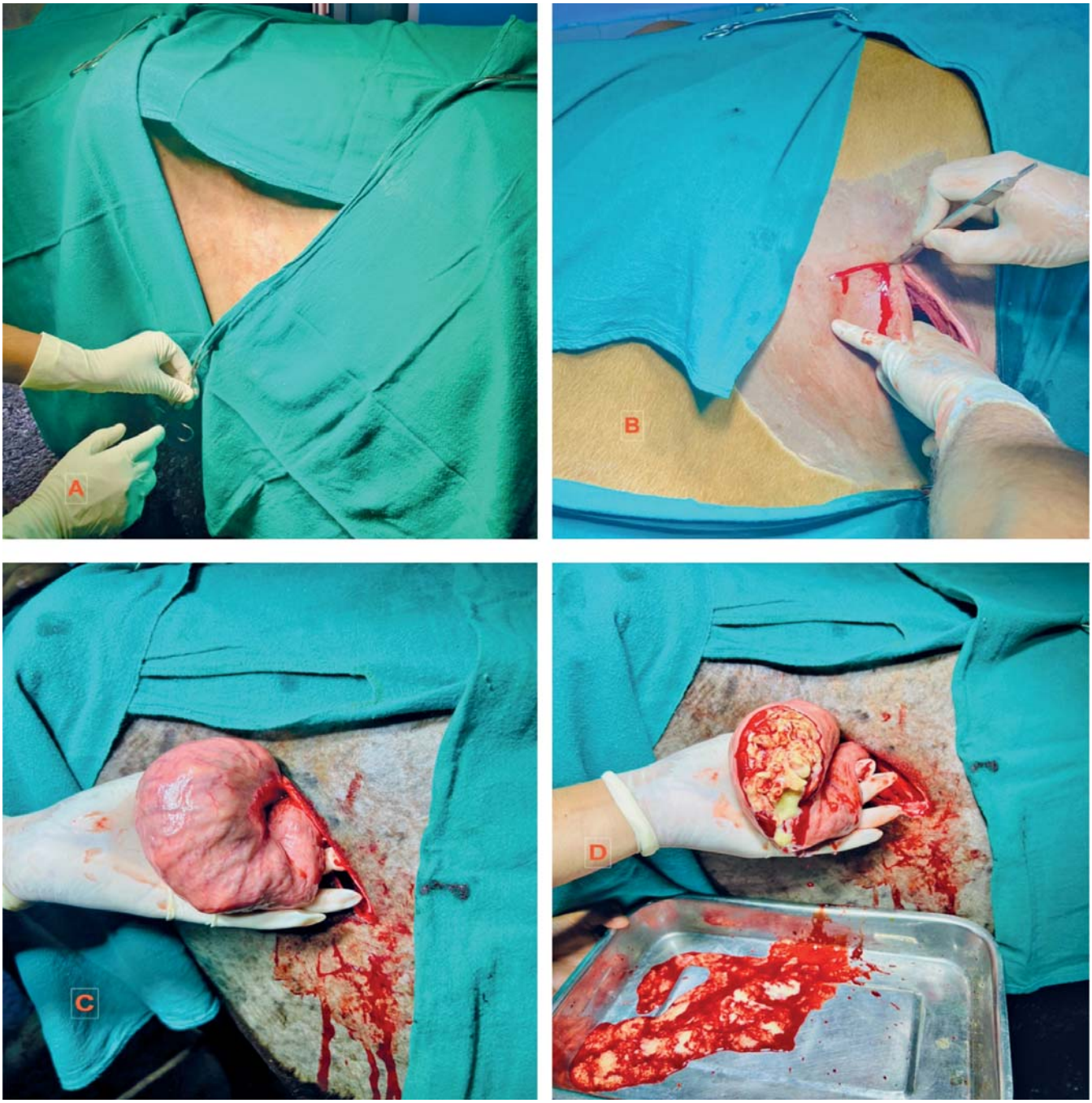

Figure 2 - Right flank approach for celiotomy. A: Right flank approach for the celiotomy; B: Site of incision for the right flank celiotomy; C: Exteriorisation of the uterus outside the abdominal cavity to prevent the contamination; D: Removal of the macerated fetal remnants.

calve at term, whereas maceration (Cases 3 and 5) was frequently accompanied by systemic illness, foul-smelling discharge, and progressive uterine degeneration. Rectal palpation and per-vaginal examinations provided essential clues, but ultrasonography allowed a more definitive characterization of intrauterine pathology. Mummification cases typically revealed compact, uniformly echogenic fetal remnants without placentomes or fluid, often accompanied by acoustic shadowing and chronic uterine wall changes, while maceration was characterized by heterogeneous echotexture, freely floating echogenic fragments, purulent material, and irregular calcified remnants producing strong acoustic shadows. These ultrasonographic contrasts not only confirmed the stage of fetal degeneration but also helped explain the observed clinical differences, with infection and systemic compromise being more pronounced in maceration cases. Taken together, the combination of clinical and ultrasonographic findings underscored the heterogeneity of presentations, the diagnostic value of multimodal examination, and the importance of timely detection in preventing advanced degenerative sequelae.

RESULTS

Following a detailed clinical assessment and confirmation of fetal mummification or maceration through transrectal palpation and ultrasonography, surgical intervention was deemed necessary in all five Jersey crossbred cows. A right flank celiotomy approach was selected for its practicality and accessibility in standing large ruminants. Prior to surgery, each animal received

supportive fluid therapy comprising intravenous administration of 2 liters of Dextrose Normal Saline (Aardex®; Aarna Healthcare), 1 liter of Normal Saline (Denis®; Deni Pulse), and 2 liters of Ringer's Lactate (Ringer Lactate Infusion BP®; Salius). Antimicrobial prophylaxis was achieved with intramuscular administration of strepto-penicillin (Dicrysticin-S®; Zenex AHL) at a dose of 10,000 IU and 10 mg/kg body weight. Non-steroidal anti-inflammatory therapy was provided with flunixin meglumine (Megludyne®; Virbac) at 2.2 mg/kg body weight to manage perioperative inflammation and pain. Cows were restrained in a standing position within a secure chute. The right upper flank was selected for the surgical approach. The site was clipped, shaved, and scrubbed with chlorhexidine solution, followed by final asepsis using surgical spirit and povidone-iodine (Betadine®). Local anesthesia was administered by linear infiltration of 70 mL of 2% lignocaine hydrochloride (Lox; Neon) along the planned line of incision. A vertical skin incision approximately 25-30 cm in length was made, extending caudally from just behind the last rib toward the tuber coxae. Sequential dissection through the subcutaneous tissue, external and internal abdominal oblique muscles, and transversus abdominis was performed to enter the peritoneal cavity with minimal trauma. Upon abdominal exploration, the gravid uterus was identified and carefully exteriorized. In cases diagnosed with fetal maceration, the uterus appeared flaccid and distended with purulent exudate, necrotic debris, and fragmented fetal bones. In contrast, cows with mummified fetuses exhibited a contracted uterus enclosing a desiccated, leathery fetus devoid of fluid or placental attachments. Celiotomy was performed via a small uterine incision, allowing manual evacuation of the uterine contents, including mummified fetuses or macerated fragments. The uterine lumen was copiously lavaged with warm sterile normal saline to remove residual debris and reduce microbial contamination. The uterine incision was closed using a modified Cushing pattern with No. 2 (5 metric) Polyglactin 910 (Vicryl®), ensuring a fluid-tight seal without penetrating the endometrial lining. The abdominal cavity was then irrigated with a 1% Betadine-saline solution to ensure decontamination and reduce the risk of peritonitis. Anatomical closure of the abdominal wall was performed in layers.

The peritoneum along with the transversus abdominis were sutured using an interlocking pattern with No. 2 Polyglactin 910. The internal and external oblique muscles were closed in a continuous suture pattern with No. 1 Polyglactin 910. Finally, the skin was approximated using No. 1 Silk in a simple interrupted suture pattern, allowing for optimal wound healing and drainage monitoring.

Outcome and Follow up

All five Jersey crossbred cows exhibited smooth and uneventful recovery following celiotomy. Postoperative management included intramuscular administration of meloxicam (Melonex®; Intas Pharmaceuticals) at 0.5 mg/kg body weight once daily for three days to control inflammation and pain. Antimicrobial therapy was continued using strepto-penicillin (Dicrysticin-S®; Zenex AHL) at 10,000 I.U and 10 mg/kg body weight, administered intramuscularly twice daily for five days to prevent secondary infections. Animals were closely monitored for appetite, demeanor, and wound healing. All cows were discharged on postoperative day five with a recommendation for a 60-day sexual rest period to ensure adequate uterine and systemic recovery. Follow-up assessments over three months revealed no signs of surgical site infection, systemic illness, or reproductive abnormalities. All animals exhibited estrus within 2.5 to 3 months post-surgery, indicating restoration of reproductive cyclicity. Three cows were bred via artificial insemination during the fourth month post-operatively and suc-

Figure 3 - Gross images of the mummified and macerated fetuses removed by right flank celiotomy. A: Mummified fetus removed from case 1,approximately 3 months in gestational age, characterized by desiccation and preservation of fetal contours; **B:** Mummified fetus along with fetal membrane retrieved from case 2; **C:** Fetal maceration from case 3; **D:** Mummified fetus along with fetal membrane retrieved from case 4 **E:** Severely macerated and calcified fetal bones recovered from case 5, suggestive of chronic intrauterine decomposition.

cessfully conceived. The remaining two cows were withheld from breeding upon owner request due to prior reproductive concerns. These outcomes affirm the efficacy of timely surgical intervention and comprehensive postoperative care in restoring reproductive potential in cases of fetal mummification and maceration.

Practical Implications and Recommendations

The integration of ultrasonography into the diagnostic workup provided a better understanding of intrauterine conditions and offered a reliable means of distinguishing between mummification and maceration. While mummification often presented without systemic illness, ultrasound confirmation of compact echogenic masses without fluid or placentomes emphasized the need for prompt intervention through pharmacological induction or manual removal before secondary complications developed. In contrast, the ultrasonographic identification of hyperechoic fragments, purulent fluid, and uterine wall thickening in maceration cases highlighted the more severe nature of the pathology, necessitating aggressive management strategies involving systemic antibiotics, uterine lavage, and, in refractory or recurrent cases, consideration of salvage culling to preserve herd health. These findings reinforce the necessity of routine reproductive monitoring, especially in cows that exceed expected gestation lengths, as ultrasonography allows earlier and more accurate detection than clinical examination alone. For herd-level management, preventive strategies such as closer supervision of breeding, careful monitoring of pregnancy progression, and targeted follow-up in animals with a history of reproductive disorders, including retained fetal membranes or repeat breeding are vital. Ultimately, combining trans-vaginal, rectal and ultrasonographic evaluations provides the most comprehensive diagnostic approach, enabling veterinarians to intervene effectively, minimize systemic complications, and optimize reproductive outcomes in dairy cattle.

DISCUSSION

In this series of five Jersey crossbred cows presenting with fetal mummification and maceration, the cases mirrored well documented etiopathogenesis in bovine reproduction. Fetal mummification typically arises between months 4 and 8 of gestation, often initiated by umbilical cord torsion or other mechanical disturbances that compromise fetal perfusion. This results in a dry, firm fetus retained within a progesterone-dominant uterus due to persistent corpus luteum activity and closed cervix (8,20,21). When cervical dilation is incomplete and uterine contractility fails, bacterial invasion may ensue, transforming sterile mummification into maceration. This is characterized by purulent exudate, autolysed fetal tissue, and liberated bone fragments findings consistent with our intraoperative observations (22,23).Ultrasonographic imaging in our cases demonstrated classic features such as compact, immobile fetal masses void of fluids or placentomes in pure mummification and hyperechoic bone fragments amidst heterogeneous fluid in maceration (8,21,24) Therapeutically, prostaglandin F α remains the first-line medical treatment, inducing luteolysis and facilitating fetal expulsion within 2-4 days (21,25,26).

Nonetheless, a subset of cows fails to respond to $PGF_2\alpha$ alone, particularly when uterine inertia or incomplete cervical dilation are present (21,23). Alternatively single or multiple administration of Diethyl Stilbesterol (50 80 mg) by I.M route has been advocated (21) and mummified fetus is expelled within 3 days (20). These cases may benefit from combined therapy with $PGF_2\alpha$ and estradiol or PGE_2, which enhances uterine contractility and cervical relaxation, though high doses have been linked to compromised fertility (20,21). In our cohort, all five cows failed to respond to medical management and subsequently underwent celiotomy with uterine evacuation. The celiotomy can be carried at upper flank (27), lower flank (13) on right side depending on the size of the fetus or can be removed by giving incision on left flank (28). Intra-operative findings included contracted, fibrotic uteri, thickened walls, purulent debris and bone fragments findings aligning with descriptions in similar surgical reports (8,17). Post-surgery, uterine lavage and layered suturing were performed, preserving uterine structure and function similar to (29).

Fertility outcomes following surgical or medical intervention are favorable when performed appropriately. Retrospective data show approximately 36% conception after hysterotomy for non-responsive mummified fetuses, compared to null rates with medical treatment alone (21,23,25). In our study, all five cows made full recoveries, with three conceiving via AI at four months post-surgery; the other two remained unbred by owner preference a finding that aligns with retained reproductive potential after appropriate management. Mummification and maceration predispose the uterus to inflammatory changes, adhesion formation, and wall thickening; however, with careful surgical removal and postoperative care, uterine integrity can be maintained (8,21).

CONCLUSION

In peroration right flank celiotomy proved effective in managing refractory cases of fetal mummification and maceration in cows unresponsive to $PGF_2\alpha$. Transrectal ultrasonography was vital for accurate diagnosis and case differentiation. Surgical intervention, combined with appropriate postoperative care, restored reproductive function in most cases, underscoring its value as a fertility preserving option in chronic fetal remnants retention.

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