

Surgical site infections in veterinary obstetrical procedures— a short communication

Abstract

Surgical site infections (SSIs) following veterinary obstetrical and gynecologic procedures present substantial clinical and economic burdens across species. This narrative review synthesizes published literature on SSI epidemiology, clinical manifestations, and prevention strategies in companion and large animals. Documented SSI incidence ranges from 3–6% for all surgical procedures, 1.7% for minimally invasive procedures, and 15.8% for orthopedic surgeries. In bovine abdominal surgeries, incidence ranges from 4.4–10.5%, with infected dairy cows facing a 4.8-fold higher culling risk. Pathogens commonly associated with SSIs include *Staphylococcus aureus*, *Staphylococcus pseudintermedius*, and *Escherichia coli*, along with other Gram-negative aerobes and anaerobes. Clinical manifestations range from localized inflammation to systemic infection with species-specific presentations. Effective prevention requires multimodal approach: incorporating preoperative skin preparation, timely antibiotic administration, and evidence-based surgical techniques. This review highlights critical knowledge gaps in SSI prevention for veterinary reproductive surgery and summarizes current evidence that may inform clinical decision-making.

Keywords: obstetrics, perioperative, surgical site infections, wound complication

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Key recommendations

- i Surgical site infection (SSI) incidence varies by species and procedure: 3–6% for general surgeries in small animals, 4.4–10.5% for bovine abdominal surgeries.
- ii Infected dairy cows face a 4.8-fold higher risk of culling, and obstetrical procedures account for 70% of veterinary litigation in one French study.
- iii Common pathogens associated with SSIs: *Staphylococcus pseudintermedius* and *S. aureus* in small animals versus Gram-negative aerobes, anaerobes, and *Trueperella pyogenes* in ruminants.
- iv Critical preventive measures include preoperative hair clipping (<4 hours), chlorhexidine-alcohol skin preparation, and antimicrobial administration 30–60 minutes before incision in companion animals.
- v For bovine cesarean sections, lateral recumbency, uterine exteriorization, and Utrecht suture pattern are strongly recommended to reduce infection and improve fertility.
- vi Evidence for antimicrobial-coated sutures and silver-impregnated dressings in veterinary obstetrics remains limited; these should be considered emerging therapies, not standard of care.

Introduction

Surgical site infections represent a significant complication in veterinary gynecological and obstetrical procedures, with incidence rates and consequences varying across species. In small animals, SSI incidence varies by procedure type: 3–6% for all surgical procedures, 1.7% for minimally invasive procedures, and 15.8% for orthopedic surgeries, with risk stratification dependent on procedural factors and patient comorbidities.^{1,2} In contrast, bovine abdominal surgeries report higher SSI rates (4.4–10.5%),³ with profound economic implications

due to associated culling risks.^{4,5} For instance, cows developing SSIs post-cesarean section face a 4.8-fold increase in culling odds,⁶ compounded by reduced fertility and longevity compared to uncomplicated normal parturition.⁷

Emergency field interventions in large animals, such as ruminant cesarean sections performed under non-sterile conditions, further elevate SSI risks,⁵ directly impacting herd productivity and welfare.⁸ Beyond clinical outcomes, SSIs carry medicolegal consequences; a French retrospective analysis identified obstetrical procedures as the basis for 70% of veterinary litigations, with uterine suture failure (40%), hemorrhage (20%), and peritonitis (10%) as predominant complications.⁹ Strict adherence to aseptic techniques and evidence-based surgical protocols remains critical to mitigating SSI-related sequelae, including wound dehiscence, abscessation, and systemic infections.¹⁰

The objective of this narrative review is to synthesize available evidence on the incidence, clinical manifestations, pathogen profiles, and species-specific prevention strategies for SSIs in veterinary obstetrical and gynecologic procedures, with the aim of informing clinical practice and identifying priorities for future research.

Methods (Narrative review process)

This manuscript is a narrative review of peer reviewed literature published between 1985 and 2024. A structured literature search was conducted using PubMed, Web of Science, and CAB Abstracts with the following keyword combinations: “surgical site infection,” “veterinary obstetrics,” “cesarean section complications,” “ovariohysterectomy infection,” “bovine SSI,” “canine SSI,” “MRSP,” “chlorhexidine antiseptics,” “antimicrobial prophylaxis veterinary,” and “uterine suture pattern.” Studies were included if they reported original data on SSI incidence, risk factors, microbiological profiles, or preventive interventions in companion or food animal obstetrical/gynecologic procedures. Reference lists of retrieved articles were hand searched for additional relevant studies. Given the narrative review format, no formal quality assessment or meta-analysis was performed; instead,

findings were synthesized thematically to highlight species specific patterns, evidence gaps, and practical recommendations for clinicians.

Clinical manifestations and impact

Clinical presentation

Surgical site infections demonstrate a spectrum of clinical presentations ranging from superficial infections to deep organ-space involvement. Characteristic manifestations include localized erythema, swelling, delayed wound healing, abscess formation, and systemic signs such as pyrexia.¹¹ In canine patients, retroperitoneal abscesses following ovariectomy typically present with fever and marked abdominal pain.^{12,13} Bovine cases exhibit distinct clinical profiles, with retroperitoneal abscesses secondary to paralumbar fossa laparotomy most commonly manifesting as rumen hypomotility, anorexia, and systemic inflammatory responses.⁸

Risk factors

Procedural duration significantly impacts SSI risk across species. For instance, extended surgical time (>2 hours) in equine celiotomy procedures correlates with increased infection rates,¹⁴ while bovine cesarean sections demonstrate higher calf mortality with prolonged operative periods.⁶ These complications not only intensify patient morbidity but also impose substantial economic burdens through increased treatment costs and potential loss of productive animals.^{2,15}

Microbiological profiles and implication of empiric therapy

Microbiological investigations reveal distinct pathogen profiles among species. Canine SSIs predominantly yield *Staphylococcus pseudintermedius* and *S. aureus* isolates, with biofilm-producing strains demonstrating enhanced virulence.¹⁶ The emergence of methicillin-resistant *S. pseudintermedius* (MRSP) presents particular therapeutic challenges due to its multidrug resistance patterns.¹⁷ Consequently, for canine reproductive surgeries, empiric antibiotics should provide coverage against Gram-positive cocci, with vancomycin or linezolid reserved for confirmed MRSP cases based on culture and susceptibility testing.¹⁸

Ruminant infections frequently involve Gram-negative aerobes (*Escherichia coli*) and anaerobic organisms, with *Trueperella pyogenes* - a commensal of bovine skin and mucosal surfaces - representing a significant opportunistic pathogen.^{5,19} Polymicrobial isolates typically indicate environmental contamination of surgical sites or instrumentation,⁷ while canine uterine surgeries commonly yield *S. aureus* and *E. coli*, supporting the use of combination therapy (e.g., amoxicillin-clavulanate or a first-generation cephalosporin with an aminoglycoside) while awaiting culture and susceptibility results.^{12,20}

Prevention strategies

General Principles

Emergency surgical procedures are associated with significantly higher rates of SSIs compared to elective operations, necessitating the implementation of rigorous preoperative protocols. The primary objective of preoperative skin asepsis is to reduce the microbial burden in the surgical field to the lowest possible level and maintain this reduction throughout the procedure, thereby supporting SSI prevention.²¹ Hair removal via clipping should be performed less than four hours before surgery to minimize bacterial colonization

while avoiding premature skin irritation that could increase infection risk.^{22,23}

Optimal skin antisepsis is achieved using either 4% chlorhexidine gluconate or 0.5% chlorhexidine in 70% ethanol, which have demonstrated superior antimicrobial persistence and prolonged residual antibacterial activity compared to aqueous chlorhexidine or alcohol-based solutions alone.^{24,25} The recommended scrubbing technique involves concentric circular motions, alternating between clockwise and counterclockwise directions, with fresh gauze used for each successive pass to prevent bacterial reintroduction.²⁶ In cats, a 2024 study demonstrated that 2% chlorhexidine combined with either 70% ethyl or 70% isopropyl alcohol effectively reduces skin bacterial load, with no significant difference between circular and linear scrub techniques.²⁷

Preoperative measures

In companion animals, intravenous antibiotics should be administered 30 to 60 minutes prior to surgical incision to ensure adequate tissue concentrations during the procedure.²⁸ However, a 2024 scoping review for the European Network for Optimization of Veterinary Antimicrobial Therapy (ENOVAT) guidelines found that evidence for surgical antimicrobial prophylaxis in companion animals is limited, with available studies skewed towards orthopedic stifle surgeries and showing wide variation in protocols and SSI definitions.²⁹

For ruminant cesarean sections, comprehensive preoperative measures including surgical site disinfection and appropriate antibiotic prophylaxis are strongly recommended.⁵ Lateral recumbency is the preferred positioning for bovine cesarean sections involving heavily contaminated uterine fluids or emphysematous fetuses to minimize abdominal contamination.³⁰ Uterine exteriorization during the procedure further reduces infection risk, particularly in cases involving emphysematous fetuses.^{31,32} The use of a Utrecht suture pattern for uterine closure has been associated with improved subsequent fertility in dams, while shorter surgical duration and cases of maternal-fetal disproportion have been correlated with higher perinatal calf survival rates.⁶

Intraoperative considerations

Maintaining strict aseptic technique throughout the surgical procedure is essential for infection prevention. Surgical duration should be minimized whenever possible, as prolonged procedures consistently correlate with increased infection rates across species. In equine obstetrics, celiotomy procedures exceeding two hours demonstrate elevated SSI risks.¹⁴ In bovine cesarean sections, shorter surgical duration correlates with higher perinatal calf survival rates.⁶

For bovine cesarean sections, specific intraoperative techniques are strongly recommended to minimize contamination and infection. Lateral recumbency is the preferred positioning for cases involving heavily contaminated uterine fluids or emphysematous fetuses.³⁰ Uterine exteriorization during the procedure further reduces infection risk, particularly in cases involving emphysematous fetuses.^{31,32} The use of a Utrecht suture pattern for uterine closure has been associated with improved subsequent fertility in dams.⁶

Regular glove changes, especially following contact with contaminated tissues or fluids, help maintain sterility. The use of antimicrobial-coated sutures provides an additional layer of protection against bacterial colonization at the surgical site. Regarding antimicrobial-coated sutures, a 2013 study evaluated triclosan-

impregnated suture for incisional closure following tibial plateau leveling osteotomy in dogs; while the study found no significant difference in overall SSI rates compared to standard suture, the authors noted that the low baseline infection rate (4.6%) may have limited the ability to detect a difference.^{33,34} No comparable studies have been published specifically for veterinary obstetrical or gynecologic procedures. Therefore, further investigation with larger studies is warranted before recommending antimicrobial-coated implants for routine use.

Regular glove changes, especially following contact with contaminated tissues or fluids, help maintain sterility, though specific studies quantifying this benefit in obstetrical procedures are not available.

Postoperative management

Early recognition and intervention are critical when managing potential SSIs. Broad-spectrum antibiotic therapy should be initiated promptly upon SSI diagnosis, with selection ideally guided by culture and susceptibility results. In small animal practice, silver-impregnated dressings have shown efficacy in disrupting bacterial biofilms and accelerating wound healing processes.³⁵ A 2024 study on nanocrystalline silver dressings in a rat burn wound model infected with *Candida albicans* found no significant difference in fungal or bacterial growth compared to controls, though the authors noted that silver dressings facilitate wound healing and have broad antimicrobial effects.³⁶ However, the evidence in veterinary practice remains limited and this should be characterized as an emerging therapy rather than standard of care. For bovine patients, postpartum intrauterine antiseptic lavage may help prevent metritis-associated SSIs, though additional studies are needed to confirm efficacy.⁵

Conclusion

Surgical site infections remain a critical complication in veterinary obstetrical and gynecologic procedures, with significant variations across species. In small animals, SSI incidence ranges from 1.7% for minimally invasive surgeries to 15.8% for orthopedic procedures, with *Staphylococcus pseudintermedius*, *S. aureus*, and *Escherichia coli* as predominant pathogens. In contrast, bovine abdominal surgeries carry substantially higher SSI rates (4.4–10.5%), with *Trueperella pyogenes*, Gram-negative aerobes, and anaerobes dominating the microbiological profile. Clinical manifestations range from localized inflammation to systemic infection.

Critical preventive measures include preoperative hair clipping, concentric circular scrub technique, and intravenous antimicrobial administration 30–60 minutes before incision in companion animals. For bovine cesarean sections, lateral recumbency, uterine exteriorization, and the Utrecht suture pattern are strongly recommended. Evidence for antimicrobial-coated sutures and silver-impregnated dressings in veterinary obstetrical patients remains limited to non-obstetric or experimental studies, requiring further investigation before routine adoption.

Specific priorities for future research include: (1) prospective randomized controlled trials evaluating silver-impregnated dressings versus standard wound care specifically in canine ovariohysterectomy and bovine cesarean section incisions; (2) multicenter studies comparing SSI rates with and without antimicrobial-coated sutures in contaminated obstetrical procedures such as cesarean sections with emphysematous fetuses; (3) validation of standardized SSI surveillance definitions adapted from human medicine for routine use

in veterinary obstetrical practice; and (4) prospective cohort studies identifying procedure-specific risk factors for SSI in equine and small ruminant obstetrical surgeries, for which current evidence is particularly sparse.

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None.

Conflict of interest

The authors declares that there are no conflicts of interest.

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