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REVIEW ARTICLE

Abscess Formation in Dromedary Camels (*Camelus dromedarius*): A Review

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ABSTRACT. Abscess formation in dromedary camels (*Camelus dromedarius*) constitutes a major health and economic problem, leading to anemia, weight loss, reduced productivity, compromised reproductive performance, and carcass condemnation. This review synthesizes the current knowledge on the clinical and ultrasonographic evaluation of abscesses in dromedary camels, with an emphasis on etiology, classification, anatomical predilection sites, diagnostic approaches, and therapeutic management. Abscesses are defined as localized accumulations of purulent material resulting from tissue destruction and inflammatory expansion. In camels, they are predominantly associated with pyogenic bacterial infections, particularly *Corynebacterium pseudotuberculosis*, *Corynebacterium ulcerans*, *Corynebacterium pyogenes*, group B streptococci, *and* staphylococci, which frequently involve superficial lymph nodes and contribute to caseous lymphadenitis. Common sites include the parotid and submandibular regions, subconjunctival area, umbilicus, prescapular and thoracic regions, as well as abdominal, pelvic, thigh, and peri-mammary areas. Clinically, superficial abscesses typically present as well-circumscribed, firm, painful, and warm swellings, whereas deep-seated abscesses in the thoracic, abdominal, or pelvic cavities are often associated with systemic signs such as fever, anorexia, weight loss, pain, and restricted movement. Ultrasonographically, abscesses demonstrate stage-dependent echogenic patterns, ranging from homogeneous echogenic contents in acute stages to heterogeneous, hypoechoic or to hyperechoic areas with internal septations in chronic cases, usually enclosed by a distinct echogenic capsule. Therapeutic management primarily involves promoting abscess maturation, followed by surgical incision and thorough drainage. It is concluded that an integrated clinical and ultrasonographic approach is essential for accurate diagnosis, prognosis, and effective management, ultimately improving treatment outcomes.

Keywords: Animals, Ultrasonography, Caseous lymphadenitis, Pyogenic bacteria, Surgical drainage, Carcass condemnation.

INTRODUCTION

An abscess is a localized inflammatory lesion composed of a pocket of purulent exudate (pus) enclosed by a limiting pyogenic membrane. It may also be described as an accumulation of pus that forms a cavity by breaking down and enlarging the surrounding tissues (Sadan, 2019; El-Shafaey *et al*., 2020; Misk *et al*., 2020). Abscess formation is a common yet under-characterized health problem in dromedary camels, with important implications for animal welfare, productivity, and herd health management. Although recent studies (El-Gedawy *et al*., 2023; Gimenez *et al*., 2024; Tharwat, Elmoghazy *et al*., 2025; Sadan *et al*., 2026) have highlighted the occurrence and microbiological diversity of suppurative conditions in camels, the available evidence remains fragmented, with limited integration of clinical, ultrasonographic, pathological, and surgical perspectives. Moreover, inconsistencies in reported prevalence, morbidity, and economic impact indicate a lack of comprehensive understanding of the true burden of this condition. This gap is particularly critical given that chronic abscesses may progress to fibrotic or keloid-like lesions, complicating diagnosis and treatment, and increasing the risk of recurrence and production losses. Therefore, this review is necessary to consolidate current knowledge, clarify diagnostic criteria, and evaluate therapeutic approaches, with special emphasis on correlating clinical findings with advanced imaging and surgical outcomes. Such an integrated approach is essential for improving early diagnosis, optimizing treatment strategies, and ultimately reducing the economic and health impacts of abscess-related conditions in camels. From a pathohistological perspective, abscess formation represents a dynamic inflammatory process characterized by central liquefactive necrosis surrounded by degenerated neutrophils, cellular debris, and bacteria, encapsulated by a pyogenic membrane that may mature into dense fibrous connective tissue in chronic stages (Kumar, 2020; Sadan *et al*., 2026). This organized architecture reflects the host's defensive attempt to contain the infection and distinguishes abscesses from diffuse inflammatory processes, such as phlegmon (Ackermann, 2017).

Abscesses cause substantial economic losses in dromedary camels, largely due to mortality from bacterial toxins, reduced meat and hide yields, and their negative effects on overall health, including anemia, emaciation, carcass condemnation, and diminished reproductive and productive performance (Tharwat, Elmoghazy *et al*., 2025). Recent epidemiological evidence indicates that abscess-forming diseases, especially caseous lymphadenitis, remain relatively prevalent in camels. For instance, El-Gedawy *et al*. (2023)

reported an occurrence rate of approximately 10.35% in slaughtered camels, with lesions primarily presenting as superficial abscesses. Similarly, Gimenez *et al.* (2024) confirmed the role of *Corynebacterium pseudotuberculosis* as a major pathogen in camel abscess formation, emphasizing its clinical and economic importance. More recent investigations have further highlighted the diversity of bacterial pathogens involved. Elbir (2025) identified novel *Corynebacterium* species carrying virulence-associated genes in camels, suggesting an evolving epidemiological landscape of suppurative infections. In addition, Tharwat, Elmoghazy *et al.*, (2025) described internal abscessation (e.g., renal abscesses) in camels, indicating that abscesses are not limited to superficial tissues but may also affect internal organs, contributing to systemic diseases and production losses. Despite these advances, comprehensive epidemiological data on morbidity and mortality rates associated with abscesses in camels remain scarce and inconsistently reported, representing a critical knowledge gap in the current literature. Nevertheless, abscesses are widely associated with economic losses due to carcass condemnation, reduced productivity, and impaired performance, particularly in chronic conditions (El-Gedawy *et al.*, 2023).

The most frequently reported pathogens associated with abscess formation in camels are pyogenic bacteria, particularly *Corynebacterium pseudotuberculosis* and *Corynebacterium ulcerans*, followed by other bacterial agents, such as group B streptococci, staphylococci, and other *Corynebacterium* species. These microorganisms were detected within abscesses as well as in the dorsal and ventral superficial lymph nodes, where they contribute to the development of caseous lymphadenitis (Guo *et al.*, 2020; Osman & Alsidrani, 2021). Recent microbiological investigations, such as those by Youseef *et al.* (2024), have demonstrated the presence of diverse bacterial populations in camels, including strains harboring antimicrobial resistance genes, which complicate treatment outcomes. Invading microorganisms enter the animal's body through breaks in the skin or mucous membranes, or they may be passively introduced into deeper tissues along with contaminated foreign objects. Many infectious conditions lead to the development of superficial abscesses beneath the skin or deeper abscesses within the internal tissues and organs. Pus represents the final outcome of the battle between pyogenic pathogens and the host's tissues. It is composed of living and dead polymorphonuclear leukocytes, cellular debris, pyogenic bacteria, and fluid elements such as lymph and serum (Terab *et al.*, 2021). Comparable patterns of abscess formation have been documented in other animal species, particularly small ruminants and camelids, where chronic encapsulated abscesses caused by *Corynebacterium pseudotuberculosis* persist and act as reservoirs of infection within herds (Sting *et al.*, 2022). These similarities highlight the broader veterinary significance of suppurative diseases and reinforce the relevance of studying abscesses in camels.

A range of clinical signs has been associated with abscess formation. Acute superficial abscesses typically appear as well-defined, firm inflammatory swellings that are red, warm to the touch, and extremely painful when manipulated, with redness especially noticeable on non-pigmented skin. Deep abscesses, which may develop in the abdomen, pelvic cavity, or beneath thick tissue layers, are characterized by fever, localized pain, restricted movement or stiffness of the affected region, along with systemic signs such as anorexia, weight loss, and general fatigue (Konieczny & Pomorska-Mól, 2023).

Clinical examination combined with advanced noninvasive diagnostic tools, such as ultrasonography and hematological and biochemical analyses, can establish a definitive diagnosis of abscesses in camels. Surgical exploration may also be performed to confirm the diagnosis. Ultrasonographically, the echogenicity of the abscess contents varies with the stage of development, ranging from anechoic to hyperechoic material enclosed within a thick, well-defined hyperechoic wall. In the acute phase, abscesses typically show uniformly echogenic contents surrounded by a thick hyperechoic capsule that clearly separates the lesion from adjacent tissues. In contrast, chronic abscesses display heterogeneous fluid with hypoechoic to hyperechoic areas and thick internal septations, all enclosed within a prominent echogenic capsule. The standard management of uncomplicated cutaneous or soft-tissue abscesses involves allowing the lesion to mature, followed by incision and thorough evacuation of its contents (Tharwat, Sadan *et al.*, 2018; Sadan, 2019; El-Shafaey *et al.*, 2020). Chronic encapsulated abscesses in camels often require complete surgical excision due to poor antimicrobial penetration and a high risk of recurrence if inadequately treated, as emphasized by Tharwat, Elmoghazy *et al.*, (2025). In addition, previous clinical and surgical observations (Sadan, 2019; El-Shafaey *et al.*, 2020) have indicated that chronic abscesses in camels frequently undergo fibrotic transformation, forming keloid-like lesions that necessitate complete surgical excision rather than simple drainage. This underscores the importance of early diagnosis and appropriate intervention strategies to improve clinical outcomes.

MATERIALS AND METHODS

This review was conducted in accordance with the Scale for the Assessment of Narrative Review Articles (SANRA) proposed by Baethge *et al.* (2019), ensuring methodological transparency, structured synthesis, and scientific rigor. A comprehensive literature search was performed to identify relevant studies on abscess formation in dromedary camels (*Camelus dromedarius*) using the Scopus, PubMed, Web of Science, and Google Scholar electronic databases.

The search covered publications from January 2000 to April 2026. The literature search was performed using combinations of Boolean operators (AND, OR) and the following keywords: "camel abscess", "dromedary abscess",

"cutaneous abscess camel", "caseous lymphadenitis camel", "*Corynebacterium pseudotuberculosis* camel", "ultrasonography abscess camel", "camel surgery abscess", and "suppurative infections camel". For example, the search strings included ("camel abscess" OR "dromedary abscess" OR "cutaneous abscess camel") AND ("ultrasonography" OR "surgery" OR "*Corynebacterium pseudotuberculosis*"). Studies were then screened and selected according to predefined eligibility criteria. The inclusion criteria comprised peer-reviewed original research articles, clinical studies, and relevant review articles focusing on abscesses or suppurative conditions in camels and addressing at least one of the following aspects: etiology, anatomical distribution, clinical findings, ultrasonographic findings, diagnostic approaches, differential diagnoses, complications, treatment strategies, or outcomes, with publications restricted to the English language. This systematic selection process improved the comprehensiveness, reliability, and reproducibility of the review findings (Page *et al*., 2021; Haddaway *et al*., 2022).

The exclusion criteria were as follows: studies not involving camels (except for comparative purposes), reports lacking sufficient methodological or clinical detail, conference abstracts without full-text availability, and non-peer-reviewed sources. Relevant data were extracted and systematically categorized according to predefined thematic areas, including etiology, anatomical site, classification, clinical presentation, diagnostic methods, differential diagnoses, complications, and treatment outcomes. Particular emphasis was placed on ultrasonography as the primary imaging modality, as it represents the most widely applied and consistently reported diagnostic tool for camel abscess evaluation. The selection and synthesis of these parameters were based on both consistency across the literature and the authors' clinical expertise, allowing for a critical and balanced interpretation of the available evidence.

Treatment outcomes were evaluated qualitatively based on reported clinical resolution, recurrence rates, healing time, and postoperative complications, with priority given to studies including follow-up data to assess long-term outcomes. Where available, comparisons between different treatment approaches, including surgical excision, drainage, and medical management, were also considered. In this review, the discussion of diagnostic imaging is limited to ultrasonographic findings and their clinical relevance. Emphasis was placed on studies describing abscess etiology, anatomical distribution, classification, diagnostic methodologies, differential diagnosis, complications, and treatment outcomes (Tharwat, Sadan *et al*., 2018; Sadan, 2019; El-Shafaey *et al*., 2020; Misk *et al*., 2020; Tharwat, 2021; Sadan *et al*., 2023; Tharwat, Elmoghazy *et al*., 2025). Only investigations involving naturally occurring abscesses in camels were included to ensure species-specific relevance.

The diagnostic principles assessed in this review were based on a multimodal approach integrating clinical examination, laboratory testing, microbiological identification, and ultrasonography, as previously described in previous studies (Tharwat, Sadan *et al*., 2018; El-Shafaey *et al*., 2020; Tharwat, 2021). Clinical evaluation constituted the primary diagnostic step and involved careful inspection and palpation of swellings to determine their anatomical location, dimensions, consistency, degree of pain, local temperature, fluctuation, and evidence of capsule formation (Sadan, 2019; Misk *et al*., 2020). These parameters were essential for distinguishing abscesses from other soft-tissue lesions and for estimating lesion chronicity.

Hematological and biochemical findings were reviewed as supportive diagnostic indicators reflecting systemic inflammatory response and disease severity. Parameters such as total leukocyte count, differential leukogram, and selected serum biochemical values, including total protein and globulin concentrations, were considered useful markers of infection and chronic inflammatory processes (Tharwat, Sadan *et al*., 2018; Sadan *et al*., 2023).

Microbiological diagnosis relied primarily on aspiration of abscess contents followed by bacterial culture and antimicrobial susceptibility testing, as commonly applied in camel abscess investigations (Tharwat, Sadan *et al*., 2018; El-Shafaey *et al*., 2020; Guo *et al*., 2020; Nagati *et al*., 2021). This approach facilitated the identification of causative organisms and supported rational antimicrobial selection. In some studies, molecular diagnostic methods, including polymerase chain reaction, were used to enhance pathogen detection, particularly in chronic, recurrent, or deep-seated abscesses where conventional culture methods were inconclusive (Guo *et al*., 2020).

Ultrasonography was evaluated as the principal imaging technique for diagnosing and characterizing abscesses in camels (Sadan, 2019; El-Shafaey *et al*., 2020; Tharwat, 2021; Sadan *et al*., 2023). Sonographic examination focused on wall thickness, internal echogenicity, presence of septations or loculations, degree of mineralization, and involvement of surrounding tissues, all of which are critical for determining abscess maturity and guiding therapeutic decisions (Sadan, 2019; El-Shafaey *et al*., 2020; Tharwat, 2021). Ultrasound-guided aspiration was highlighted as a valuable method for sampling deep or anatomically sensitive lesions while minimizing procedural complications (Tharwat, 2021).

The therapeutic approaches reviewed included conservative measures to facilitate abscess maturation, surgical drainage techniques, postoperative wound care, and complete surgical excision of chronic or recurrent lesions, as reported in previous studies on camels (Tharwat, Sadan *et al*., 2018; Sadan, 2019; El-Shafaey *et al*., 2020; Tharwat, 2021; Sadan *et al*., 2023; Tharwat, Elmoghazy *et al*., 2025). The assessment of systemic antimicrobial and anti-inflammatory therapy was performed through a structured qualitative synthesis of the included studies, with particular emphasis on reports that provided microbiological confirmation and antimicrobial susceptibility testing. Specifically, studies were screened for identification of causative patho-

gens using culture and sensitivity testing, ii) type, dosage, and duration of antimicrobial agents administered, iii) the use of adjunct anti-inflammatory drugs. When available, outcomes such as clinical resolution, reduction in lesion size, recurrence rates, and healing time were extracted and compared across studies. Greater weight was given to studies in which antimicrobial selection was guided by susceptibility testing, allowing the evaluation of targeted therapy versus empirical treatment (El-Gedawy *et al*., 2023; Tharwat, Elmoghazy *et al*., 2025). In addition, the reported differences in outcomes between cases managed with combined medical–surgical approaches and those treated conservatively were considered. This approach enabled the assessment of how culture-guided antimicrobial therapy, together with anti-inflammatory management, contributed to improved clinical outcomes and reduced recurrence in abscess cases in *Camelus dromedarius* (El-Shafaey *et al*., 2020; Sadan *et al*., 2023; Youseef *et al*., 2024). Ultrasonography was also emphasized as a valuable tool for treatment planning and postoperative monitoring of healing and resolution (Sadan, 2019; Tharwat, 2021; Sadan *et al*., 2023; Tharwat, Elmoghazy *et al*., 2025).

RESULTS AND DISCUSSION

Among the 43 studies included in this review, superficial abscesses were the most commonly reported clinical presentation in dromedary camels, particularly in the parotid, submandibular, prescapular, and thigh regions. Approximately two-thirds of the studies focused on cutaneous or superficial lesions. In contrast, deep abscesses involving internal organs (e.g., the kidneys, liver, thoracic, and pelvic cavities) are reported less frequently but are consistently linked to more severe systemic involvement and poorer prognosis. Microbiological findings identified *Corynebacterium pseudotuberculosis* as the predominant pathogen, reported in over half of the bacteriological investigations, especially in cases of caseous lymphadenitis and lymph node abscessation. Other commonly isolated bacteria included *Staphylococcus spp*., *Streptococcus spp*., *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Corynebacterium ulcerans*. Recent studies have also highlighted mixed infections and the emergence of antimicrobial resistance, indicating an increase in the complexity of abscess pathogenesis. Ultrasonography was the most frequently used imaging modality and showed high diagnostic accuracy in differentiating abscesses from hematomas, cysts, hernias, and neoplasms. Overall, superficial pyogenic abscesses primarily associated with *Corynebacterium* species remain the dominant form in dromedary camels, whereas deep-seated abscesses, although less common, represent a significant cause of systemic disease and economic loss. Findings according to the reviewed literature are summarized in Table 1.

Table 1.
Comparative summary of abscesses in dromedary camels (*Camelus dromedarius*) based on the reviewed studies: etiology, clinical features, ultrasonographic findings, differential diagnosis, and outcomes.

Parameter	Acute Superficial Abscess	Acute Deep Abscess	Chronic (Cold) Abscess	Tooth Root Abscess	Sole Abscess
Etiology	Pyogenic infection via trauma or injections (Tharwat, Elmoghazy *et al*., 2025)	Hematogenous/lymphatic spread (Tharwat & Elmoghazy, 2026)	Persistent low-grade infection (El-Shafaey *et al*., 2020; Tharwat, Elmoghazy *et al*., 2025)	Dental disease, feed impaction (Ibrahim *et al*., 2023)	Trauma, unhygienic conditions (Sadan, 2019; Tharwat, Elmoghazy *et al*., 2025)
Location	Subcutaneous tissues (neck, shoulder, thigh) (Sadan, 2019)	Internal organs (liver, lung, kidney) (Tharwat, Elmoghazy *et al*., 2025)	Variable, often lymph nodes (Misk *et al*., 2020)	Maxilla/mandible (Ibrahim *et al*., 2023)	Hoof/solar surface (Sadan, 2019)
Clinical signs	Pain, heat, fluctuation (El-Shafaey *et al*., 2020)	Fever, anorexia, weight loss (Tharwat, Elmoghazy *et al*., 2025)	Firm, non-painful swelling (Sadan *et al*., 2023)	Facial swelling, sinus tract (Ibrahim *et al*., 2023)	Lameness, pain (Sadan, 2019)
Systemic effects	Mild or absent (El-Shafaey *et al*., 2020)	Marked systemic response (Tharwat, Elmoghazy *et al*., 2025)	Minimal (Sadan *et al*., 2023)	Variable (Ibrahim *et al*., 2023)	Minimal (Sadan, 2019)
Laboratory findings	Mild leukocytosis (Terab *et al*., 2021)	Leukocytosis, ↑ acute-phase proteins (Tharwat, Elmoghazy & Haridy, 2025)	Hyperglobulinemia (Tharwat, Elmoghazy *et al*., 2025)	Inflammatory markers (Ibrahim *et al*., 2023)	Usually normal (Sadan, 2019)
Ultrasonography	Homogeneous echogenic content (El-Shafaey *et al*., 2020)	Variable echogenicity (Tharwat, Elmoghazy *et al*., 2025)	Heterogeneous with septa (Sadan *et al*., 2023)	Local hypoechoic lesion (Ibrahim *et al*., 2023)	Limited due to hoof (Sadan, 2019)
Probe/Frequency	Linear probe (5–10 MHz) (El-Shafaey *et al*., 2020)	Convex probe (3.5–5 MHz) (Tharwat & Elmoghazy, 2026)	Depends on depth (Tharwat, Elmoghazy *et al*., 2025)	Linear probe (Ibrahim *et al*., 2023)	Not applicable (Sadan, 2019)

CONT

Parameter	Acute Superficial Abscess	Acute Deep Abscess	Chronic (Cold) Abscess	Tooth Root Abscess	Sole Abscess
Differential diagnosis	Hematoma, cyst, phlegmon (Sadan, 2019; El-Shafaey *et al*., 2020)	Tumor, cyst (Sadan *et al*., 2024; Tharwat, Elmoghazy *et al*., 2025)	Neoplasia, granuloma (Misk *et al*., 2020)	Tumors, sinusitis (Ibrahim *et al*., 2023)	Laminitis, bruising (Sadan, 2019)
Prognosis	Excellent (El-Shafaey *et al*., 2020)	Guarded (Tharwat, Elmoghazy *et al*., 2025)	Variable (Sadan *et al*., 2023)	Good if early (Ibrahim *et al*., 2023)	Good (Sadan, 2019)
Treatment	Drainage + antibiotics (Misk *et al*., 2020)	Imaging-guided drainage (Tharwat, Elmoghazy *et al*., 2025)	Surgical Excision (Sadan *et al*., 2023)	Dental extraction (Ibrahim *et al*., 2023)	Drainage + hoof care (Sadan, 2019)

Etiology

Various causes of abscess formation in dromedary camels have been identified, with bacterial infections being the most common. The reported pathogens included *Corynebacterium pseudotuberculosis*, *Corynebacterium ulcerans*, *Klebsiella pneumoniae*, *Corynebacterium pyogenes*, group B streptococci, *various* staphylococci, *Escherichia coli*, *Pseudomonas aeruginosa*, Micrococcus species, Proteus vulgaris, Citrobacter species, *Staphylococcus epidermidis*, *Staphylococcus sciuri*, and *Rhodococcus* species. These microorganisms have been detected within abscess lesions and in the dorsal and ventral superficial lymph nodes (Tharwat, Sadan *et al*., 2018; Fouad *et al*., 2019; Guo *et al*., 2020; Nagati *et al*., 2021). Infected foreign bodies migrating from the oral cavity frequently led to abscess formation in the parotid and mandibular regions after penetrating the oral mucosa and adjacent soft tissues. Subconjunctival and third-eyelid abscesses typically developed when an infected foreign object became lodged in the conjunctival cul-de-sac and subsequently perforated the conjunctiva (Misk *et al*., 2020). Ultrasonography revealed abscess formation following filler injections, with eight cases occurring in the upper lip and four in the lower lip (Tharwat, 2021). Renal abscesses and chronic active pyelonephritis in dromedary camels have been attributed to *Escherichia coli* infections (Tharwat, Sadan *et al*., 2018).

The relationship between the etiology of abscess formation and anatomical predilection sites in dromedary camels was clinically significant. Traumatic injuries, contaminated injections, and skin breaches were frequently associated with superficial abscesses in accessible regions such as the neck, shoulder, and thigh. In contrast, hematogenous or lymphatic spread of infection was more commonly associated with deep abscess formation in internal organs, including the liver, lungs, and kidneys. Additionally, specific etiologies showed clear anatomical associations; for example, oral mucosal injuries and penetrating foreign bodies predisposed animals to abscess formation in the mandibular and parotid regions, whereas umbilical infections in young camels often led to umbilical abscessation. This anatomical–etiological correlation was essential for improving diagnostic suspicion and guiding clinical examination (Tharwat, Sadan *et al*., 2018; Misk *et al*., 2020; Tharwat, 2021).

Furthermore, other clinically relevant but underreported anatomical sites of abscess formation included the soft palate (dulla) (Figure 1; Sadan *et al*., 2026), dental (tooth root) abscesses and sole abscesses. Tooth root abscesses were typically associated with periodontal disease, dental trauma, or feed impaction and often manifested as facial swelling, sinus tract formation, or nasal discharge. Sole abscesses, although less frequently described in camels than in other livestock, occurred due to penetrating injuries, poor hygiene, or prolonged exposure to wet or contaminated environments, resulting in localized lameness and pain. The inclusion of these sites broadened the clinical understanding of abscess distribution in camels and highlighted the importance of comprehensive physical and orthopedic examinations (Eibl *et al*., 2023; Sparnon *et al*., 2024).

Numerous common sites of abscess formation have been identified in dromedary camels, including the parotid (Figure 2) and submandibular regions, subconjunctival area, umbilicus, pelvic and thigh regions (Figure 3), areas anterior and posterior to the udder, cranial or caudal to the shoulder joint, and within the abdominal and thoracic cavities (Tharwat, Sadan *et al*., 2018; Sadan, 2019; Misk *et al*., 2020; Tharwat, 2021).

Classification of abscesses

Superficial and deep abscesses were reported across the reviewed studies; however, detailed descriptions of pus formation and classification were not consistently emphasized. Pus was described as consisting of leukocytes, cellular debris, bacteria, and tissue fluids, reflecting the host–pathogen interaction (Misk *et al*., 2020; Tharwat, 2021). Abscesses in camels were classified according to duration, location, etiology, and internal characteristics. Acute abscesses were described as rapidly developing and inflamed, whereas chronic abscesses were persistent, less inflamed, and often contained thick or caseous material. Lesions were identified as superficial or deep, with deep abscesses frequently associated with systemic manifestations. Bacterial infections, particularly those involving *Corynebacterium pseudotuberculosis*, *Staphylococcus epidermidis*, and

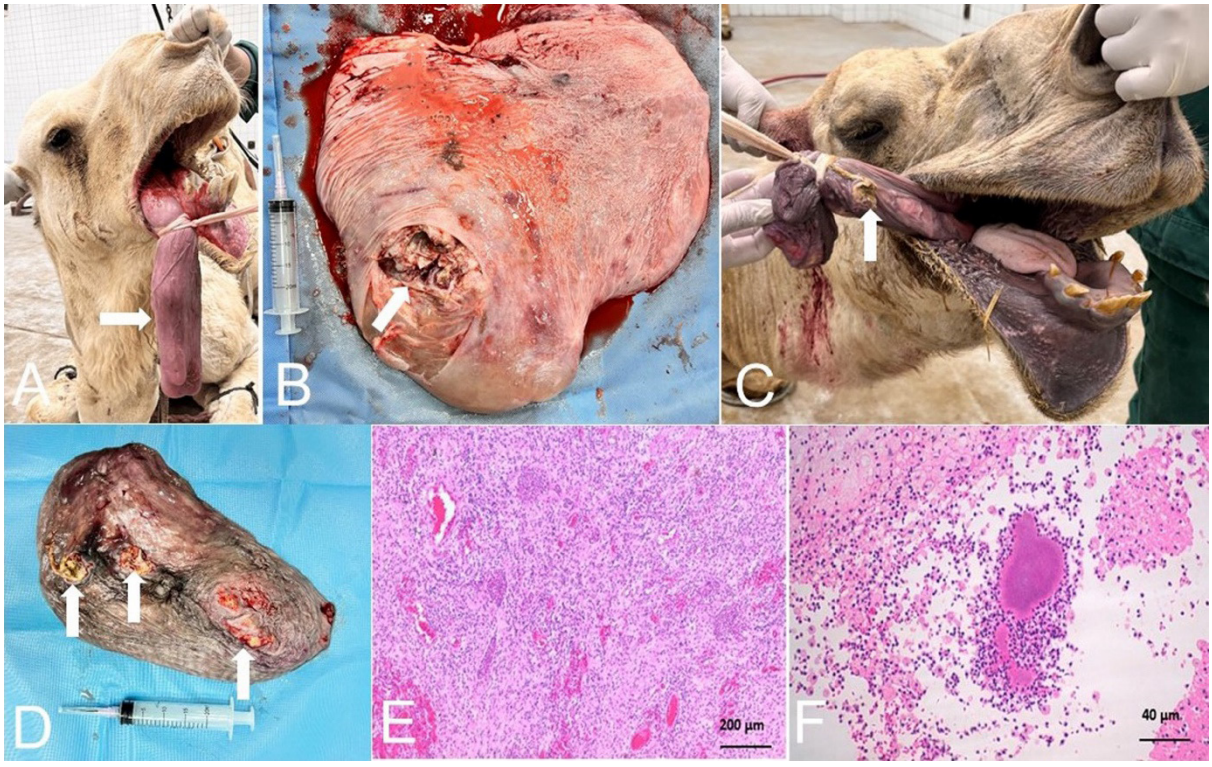

Figure 1.
Soft palate lesions and surgical management in camels. A: Abscessated soft palate (arrow). B: Surgical excision of the Abscessated soft palate (arrow). C: Old lacerating wound of the soft palate associated with abscess formation (arrow). D: Resected soft palate demonstrating multiple small abscess (arrows). E: Abscesses and diffuse suppurative inflammation associated with venal thrombosis with pyogenic emboli. F: Colonies of actinomyces were observed related to abscesses. Images are derived from the author's clinical cases.

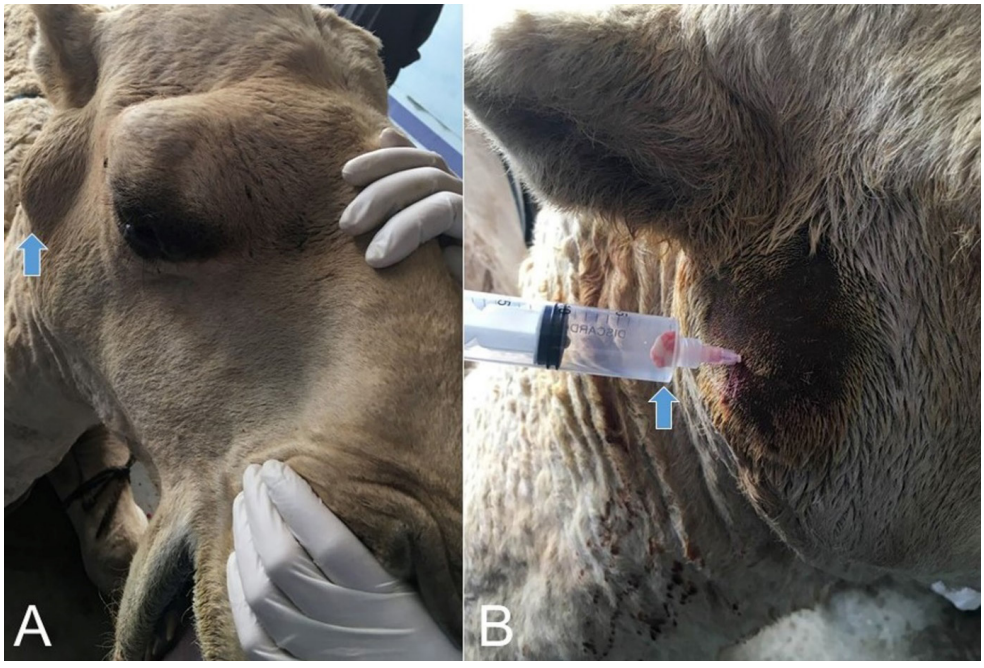

Figure 2.
A: Chronic abscess at the parotid region in a camel (arrow). B: Aspiration of little amount of pus from the abscess (arrow). Images are derived from the author's clinical cases.

Figure 3.
A: Chronic abscess at the posterior aspect of the thigh region in a camel (arrow). B: Ultrasonographic image of the chronic abscess showing heterogeneous and hypoechoic to anechoic contents (blue arrow) with thick internal septa enveloped (red arrow) in a thick echogenic capsule (white arrow). C: Operative image of resection of the abscess at the posterior aspect of the thigh region (arrow) two days post ultrasonographic evaluation. D: Post-operative image of the resected abscess. Images are derived from the author's clinical cases.

Escherichia coli, as well as penetrating foreign bodies, were reported as common causes. Ultrasonographically, acute abscesses appeared more homogeneous, whereas chronic lesions showed heterogeneous contents with septations and a thick capsule (El-Shafaey *et al*., 2020).

Diagnosis

Across the reviewed studies, diagnostic methodologies demonstrated a clear predominance of ultrasonography as the principal imaging modality for abscess evaluation in dromedary camels. Analysis of the included literature indicates that most studies incorporated ultrasonographic examination as a core diagnostic tool, often in combination with clinical assessment and, less consistently, with laboratory or microbiological investigations. Ultrasonography has been repeatedly reported as the primary method for differentiating abscesses from other soft tissue swellings and for characterizing lesion structure, maturity, and extent. In contrast, hematological, biochemical, and microbiological techniques have been used as complementary approaches rather than standalone diagnostics. Molecular methods have been applied in only a limited number of studies, mainly in complex or chronic infections. This distribution highlights a strong methodological trend toward imaging-based diagnosis, particularly ultrasound, reflecting its accessibility, diagnostic accuracy, and practical applicability in both field and clinical settings (Tharwat, 2021; Sadan *et al*., 2023).

Diagnosing abscesses in dromedary camels requires a systematic, integrative approach that combines a detailed clinical evaluation with complementary laboratory and imaging modalities. While physical examination remains the initial cornerstone of assessment, allowing detection of classical features such as localized heat, fluctuance, pain on palpation, and, in more chronic cases, a mature fibrous capsule, these clinical signs alone may be insufficient for a definitive diagnosis due to overlapping presentations with other soft-tissue swellings (El-Shafaey *et al*., 2020). Therefore, additional diagnostic strategies are often essential for accurate lesion characterization, identification of causative pathogens, and evidence-based therapeutic planning (Osman & Alsidrani, 2021; Terab *et al*., 2021).

Hematological profiling offers valuable insights into the systemic inflammatory status and host immune response. Alterations, such as leukocytosis with neutrophilia and elevated acute-phase reactants, have been documented in camels with infectious conditions, reflecting the severity of the infection and systemic response (Terab *et al*., 2021). Complementary biochemical analyses may reveal hyperglobulinemia, altered liver enzyme activity, or electrolyte disturbances, suggesting ongoing inflammation, tissue damage, or chronic disease states. Microbiological assessment remains central to definitive diagnosis and rational antimicrobial therapy. Aspiration, culture, and antimicrobial sensitivity testing of purulent material or tissue samples from abscesses in dromedary camels commonly reveal pathogens such as *Corynebacterium pseudotuberculosis*, *Staphylococcus spp*., or *Streptococcus spp*., which are frequently associated with superficial and internal abscessation (Osman & Alsidrani, 2021; Terab *et al*., 2021).

Given the rising concerns regarding antimicrobial resistance in camel-rearing regions, these data are critical for tailoring effective treatment regimens (Almutairi *et al*., 2025). Moreover, molecular diagnostic methods (e.g., PCR and sequencing) can improve detection sensitivity in chronic, deep-seated, or previously treated abscesses, where traditional culture may fail (Terab *et al*., 2021). Ultrasonography has emerged as an indispensable imaging modality for the evaluation of camel abscesses. In a cohort of 123 dromedary camels with various superficial swellings, ultrasonography (US) demonstrated high sensitivity (91–100%) and specificity (97–100%) in differentiating abscesses from hernias, cysts, tumors, hematomas, and other swellings, outperforming clinical examinations (Tharwat,

El-Shafaey *et al*., 2018; El-Shafaey *et al*., 2020; Silva *et al*., 2021; Shoulah *et al*., 2023). Ultrasound features, including wall (capsule) thickness, internal echogenicity, presence of septations or loculations, fluid-echo characteristics, and involvement of surrounding tissues, provide critical information on abscess maturity, chronicity, and potential complications, thereby guiding management choices such as drainage, surgical excision, or conservative therapy (El-Shafaey *et al*., 2020; Terab *et al*., 2021). In deep-seated or anatomically sensitive lesions, US-guided needle aspiration improves sampling accuracy and reduces the risk compared with blind puncture. The integration of clinical evaluation, hematologic and biochemical profiling, microbiological and molecular diagnostics, and ultrasonographic imaging constitutes a robust, evidence-based framework for diagnosing abscesses in dromedary camels. Such a multidisciplinary approach enhances diagnostic precision, informs prognosis, guides targeted therapy, and supports better clinical outcomes and animal welfare (El-Shafaey *et al*., 2020; Misk *et al*., 2020; Osman & Alsidrani, 2021; Terab *et al*., 2021; Tharwat, 2021; Almutairi *et al*., 2025).

A clear association exists between clinical presentation and abscess type (superficial versus deep; acute versus chronic), which should be integrated with laboratory findings to enhance diagnostic accuracy. Superficial acute abscesses are typically characterized by localized inflammatory signs and may show mild systemic hematological changes, whereas deep abscesses are more frequently associated with pronounced systemic responses, including leukocytosis, neutrophilia, and elevated acute-phase protein levels. Chronic abscesses, particularly those with thick fibrous capsules (antibiomas), may exhibit minimal systemic changes but can be associated with persistent hyperglobulinemia. Therefore, combining clinical classification with laboratory data provides a more comprehensive diagnostic framework and improves the differentiation from other pathological conditions (Osman & Alsidrani, 2021; Terab *et al*., 2021).

A strong correlation exists between the clinical presentation, ultrasonographic appearance, and pathological evolution of abscesses in dromedary camels. Acute abscesses are generally associated with marked inflammatory signs and homogeneous echogenic or hypoechoic fluid accumulation surrounded by a relatively thin, echogenic capsule. In contrast, chronic abscesses frequently exhibit heterogeneous echotexture, thick fibrous capsules, internal septations, mineralized foci, and inspissated purulent material. Deep abscesses are often accompanied by systemic hematological and biochemical alterations, including leukocytosis, neutrophilia, hyperglobulinemia, and elevated acute-phase proteins, whereas superficial uncomplicated abscesses may produce minimal systemic changes. Therefore, the integration of clinical findings, laboratory investigations, and ultrasonographic evaluation provides a comprehensive diagnostic framework that improves lesion characterization, prognostic assessment, and therapeutic decision-making (Terab *et al*., 2021; Almutairi *et al*., 2025; Tharwat, Elmoghazy *et al*., 2025; Tharwat & Elmoghazy, 2026).

Clinical signs

Across the reviewed studies, consistent clinical patterns were identified, with clear differences between superficial and deep abscesses in dromedary camels. Superficial lesions have been most commonly described as localized swellings accompanied by heat, pain, and detectable fluctuation or capsule formation, representing the predominant presentation in most reports. In contrast, deep abscesses were reported less frequently but were consistently linked to systemic manifestations, including fever, anorexia, weight loss, and impaired mobility, indicating a more severe disease. Chronic abscesses were typically characterized by firm, nonpainful swellings with minimal inflammatory response, especially in encapsulated or antibioma cases. Overall, the evidence demonstrates a strong relationship between lesion depth, chronicity, and the predominance of local versus systemic clinical signs, supporting the need to integrate clinical findings with diagnostic evaluation (Tharwat, 2019; El-Shafaey *et al*., 2020; Sadan *et al*., 2023).

Acute superficial abscess

An acute superficial abscess presents as a well-defined, firm, and compressible inflammatory swelling that is red, warm, and extremely painful when handled, with redness being more noticeable on non-pigmented skin (Figures 4 and 5). As the lesion progresses, the central area becomes softer, while the edges remain firm, and fluctuation can be felt when gentle pressure is applied. Pointing typically develops at the center of the abscess, and this condition may impair the normal function of the affected region (Sadan, 2019; El-Shafaey *et al*., 2020).

Acute deep abscess

Deep abscesses in camels develop within the abdomen, pelvic cavity, or beneath thick layers of tissue. They are typically associated with systemic and local signs, including fever, localized pain, and stiffness or impaired movement of the affected area. Affected animals often exhibit anorexia, weight loss, general fatigue, dullness, and depression, reflecting the impact of the infection on overall health and productivity (Tharwat, 2019; El-Shafaey *et al*., 2020; Sadan *et al*., 2023).

Chronic or cold Abscess

This type of abscess is characterized by firm consistency and contains only a small amount of pus (Figure 6), with no evident signs of inflammation. It develops slowly and may occur in any region of the body. Pain is usually minimal, and when present, it results from pressure exerted on adjacent tissues; tenderness is generally absent. These abscesses typically possess a thick fibrous capsule enclos-

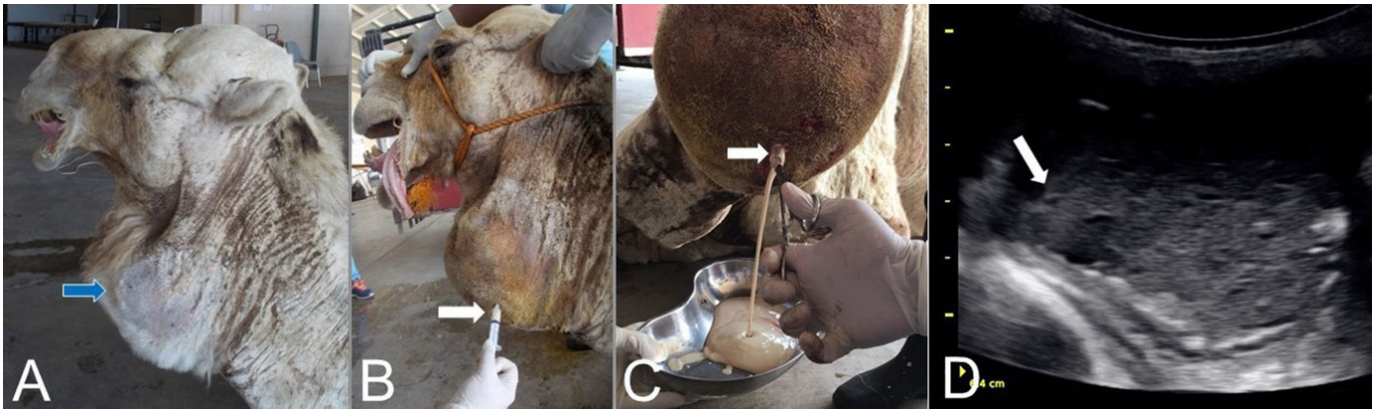

Figure 4.
A: acute abscess at the anterior aspect of the upper part of the neck in a camel (arrow). B: Aspiration of pus from the abscess (arrow). C: Incision of the abscess and evacuation of pus (arrow). D. Ultrasonographic image showing that, the content appeared as homogenous and hypoechoic to echogenic (white arrow) with a thick capsule. Images are derived from the author's clinical cases.

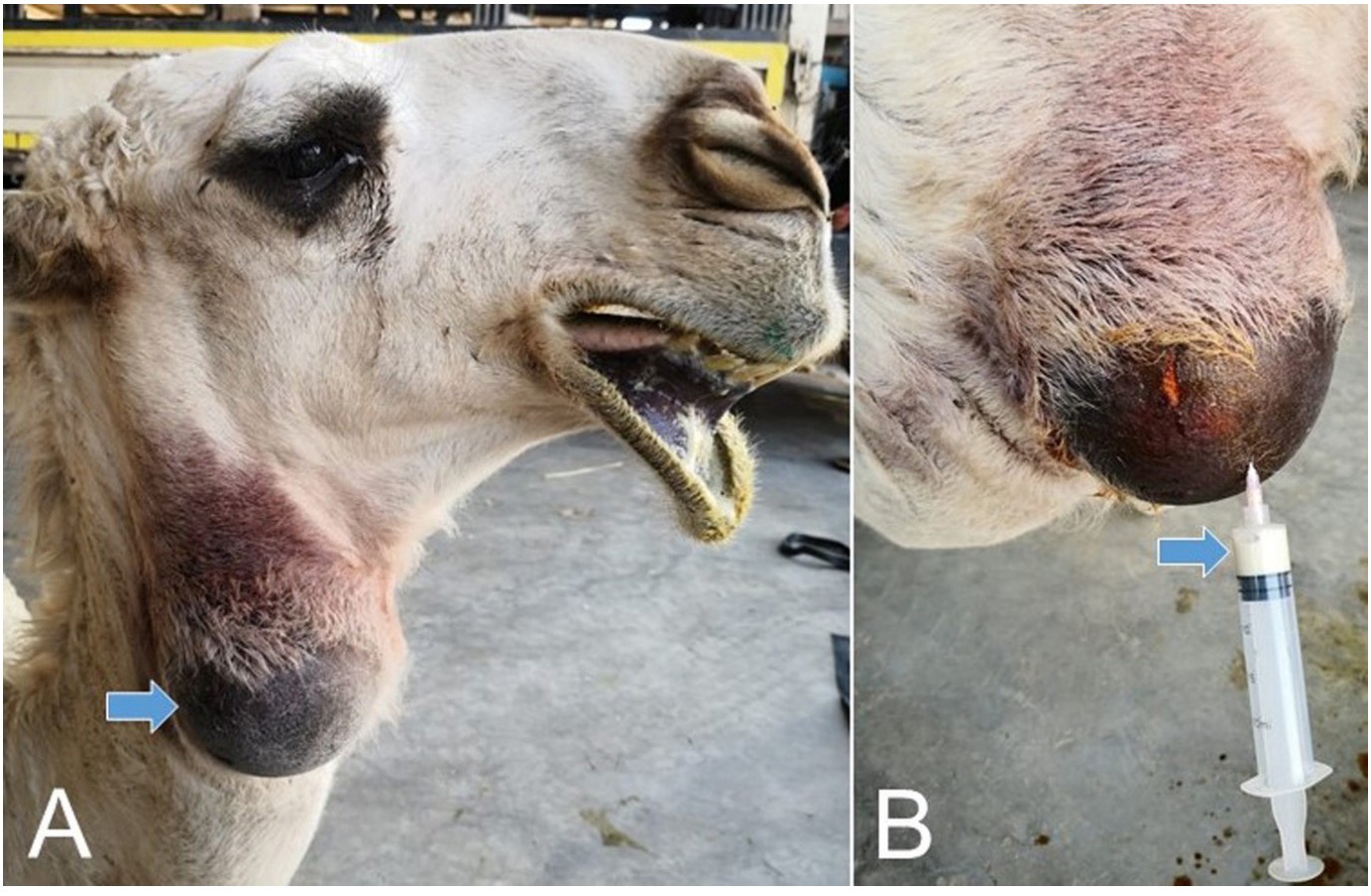

Figure 5.
A: acute abscess at the lateral aspect of the upper part of the neck in a camel (arrow). B: Aspiration of pus from the abscess (arrow). Images are derived from the author's clinical cases.

ing a small central pocket of pus. When the fibrous capsule is particularly well-developed and contains only a small amount of thickened or inspissated pus, the condition is referred to as an antibioma (El-Shafaey *et al.*, 2020; Sadan *et al.*, 2023).

mineralized foci. The capsule was generally thicker and more echogenic, reflecting fibrous encapsulation and long-standing inflammation. Increased echogenicity of the internal contents in advanced cases is frequently linked to fluid resorption and the accumulation of inspissated mate-

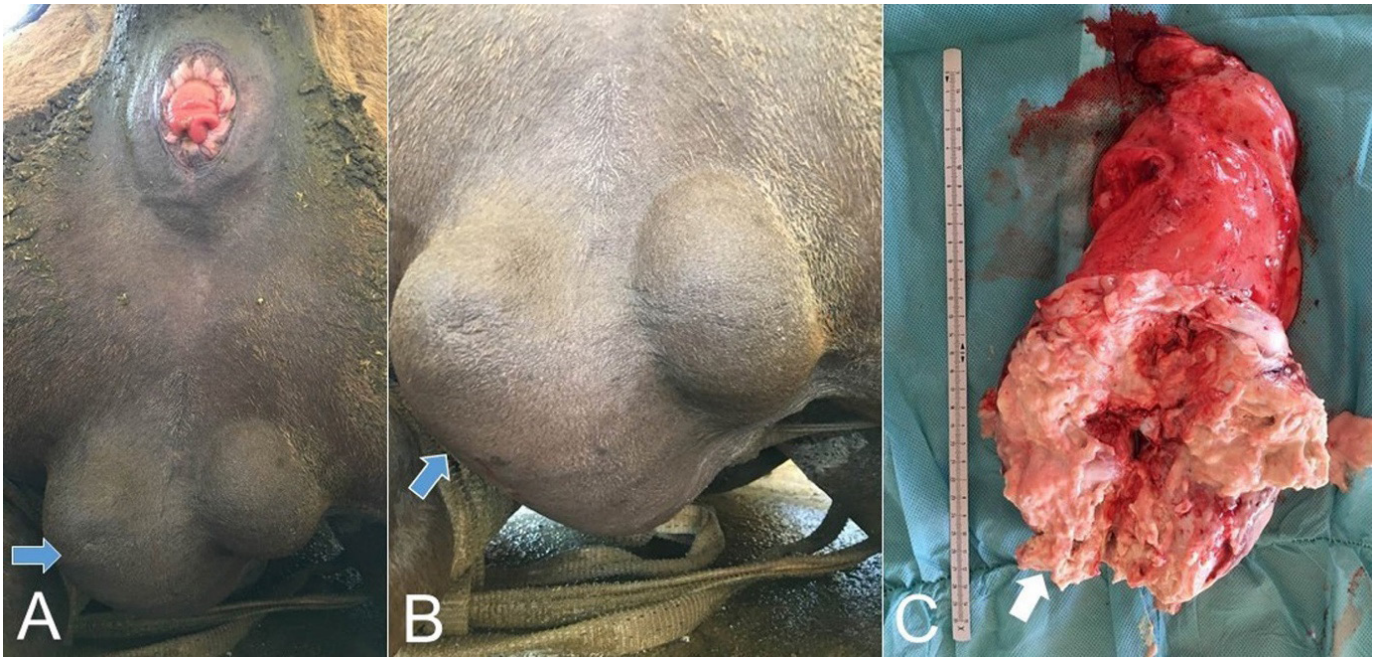

Figure 6.
A: Chronic testicular abscess in a camel (arrow). B: Close image of testicular abscess in a camel (arrow). C: Operative image of resection abscessated testicle (arrow). Images are derived from the author's clinical cases.

Ultrasonographic evaluation of abscess

The ultrasonographic findings reported in the reviewed studies demonstrated consistent patterns related to the abscess type and stage of development. Lesions were mainly characterized by capsule appearance, internal echogenicity, and structural complexity (Tharwat, Elmoghazy *et al.*, 2025).

Ultrasonography of acute abscess.

Acute abscesses were typically described as well-defined structures containing relatively homogeneous echogenic or hypoechoic material, surrounded by a distinct, moderately thick echogenic capsule. These features are consistent with early inflammatory changes and active pus accumulation (Figure 3D) (Sadan, 2019; Tharwat, 2019; El-Shafaey *et al.*, 2020; Sadan *et al.*, 2023).

Ultrasonography of chronic abscess

In contrast, chronic abscesses showed more complex ultrasonographic characteristics. They were commonly associated with heterogeneous internal echotexture, including mixed hypoechoic and hyperechoic areas, internal septations, and, in some cases, echogenic debris or rial (Figures 3B, 7C, and 8C). Deep-seated abscesses exhibited more variable echogenic patterns and less clearly defined margins, depending on their anatomical location and surrounding tissues. In several studies, ultrasound-guided aspiration was used to obtain diagnostic samples, particularly from deep or less accessible lesions (Sadan, 2019; Tharwat, 2019; El-Shafaey *et al.*, 2020; Sadan *et al.*, 2023).

Regarding technique, high-frequency linear transducers (5–10 MHz) were mainly applied for superficial lesions, whereas lower-frequency probes (3.5–5 MHz) were preferred for deeper structures to ensure adequate penetration (El-Shafaey *et al.*, 2020; Tharwat, 2021).

Although ultrasonography has proven reliable in most cases, certain limitations have been reported, including reduced sensitivity in early lesions before capsule formation, acoustic shadowing in heavily mineralized abscesses, and image interference caused by gas or dense tissues. Overall, the reviewed evidence indicates that ultrasonographic features change predictably with abscess maturation, allowing differentiation between acute and chronic lesions and supporting accurate clinical decision-making (El-Shafaey *et al.*, 2020; Terab *et al.*, 2021).

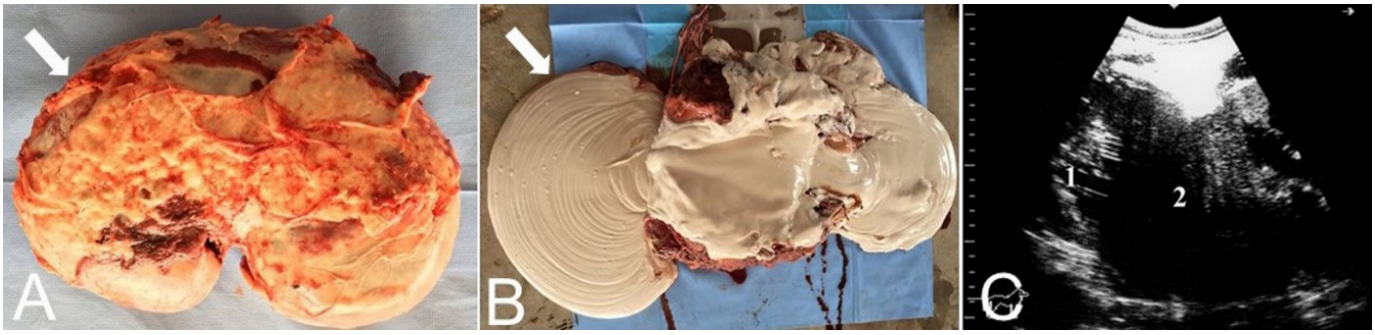

Figure 7.
A: Macroscopic appearance of the right kidney of a male dromedary camel showing a large perinephric abscess associated with chronic pyelonephritis. B: Thick creamy purulent exudate evacuated from the affected kidney. C: Transabdominal ultrasonographic examination of the same camel revealed a hyperechoic renal capsule with fibrin tags, while the renal cortex appeared markedly echogenic. A surrounding hypoechoic fluid accumulation consistent with perinephric abscessation was also observed. 1- Renal parenchyma; 2- Renal abscessation. Images are derived from the author's clinical cases.

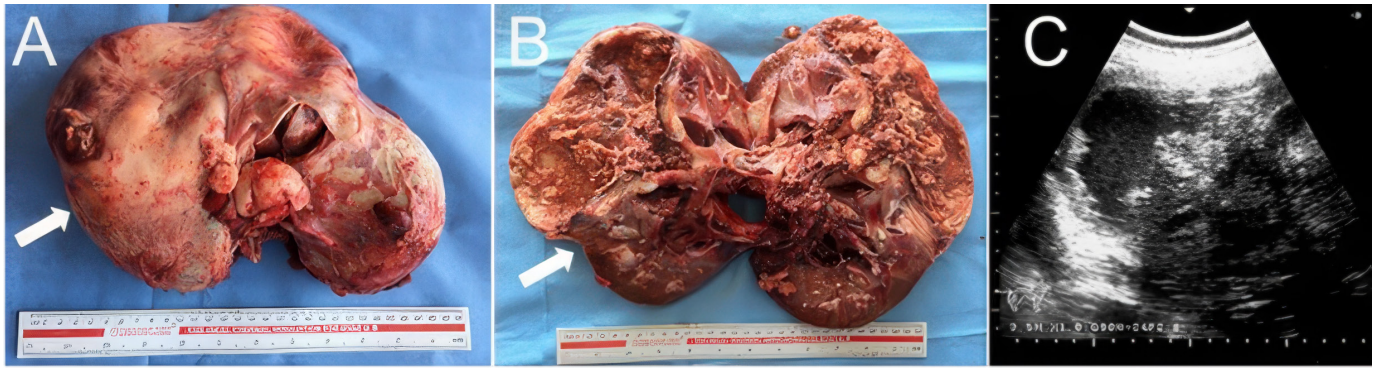

Figure 8.
A: Postoperative image of the right kidney in a female dromedary camel affected with renal abscessation, showing marked enlargement of the abscessed kidney. B: Longitudinal section of the affected kidney demonstrating a corticomedullary abscess (arrow). C: Ultrasonographic examination revealed heterogeneous echogenic contents with multiple internal chambers (loculations) within the abscess cavity. Images are derived from the author's clinical cases.

Differential Diagnosis of Abscesses

Several conditions reported in the reviewed studies were initially suspected to be abscesses but were ultimately diagnosed as nonsuppurative lesions. In these cases, ultrasonography combined with aspiration proved essential for accurate differentiation (Table 2). In the literature, abscesses have been consistently identified as encapsulated lesions with heterogeneous echogenic contents, often with internal septations. In contrast, hematomas were described as non-encapsulated accumulations of blood or clot material with changing echogenic patterns. Cystic lesions typically appeared as well-defined anechoic structures with thin, smooth walls, whereas hernias were recognized by the presence and movement of abdominal contents during real-time ultrasonographic examination (Sadan, 2019; El-Shafaey *et al*., 2020; Sadan *et al*., 2023).

The clinical differentiation of abscesses from other soft tissue swellings remains a fundamental component of surgical diagnosis in camels. Although abscessation is common and often straightforward to recognize once fully matured, early or atypical presentations may closely resemble other pathological swellings. Misclassification can lead to inappropriate treatments, such as unnecessary drainage of non-purulent lesions or delays in addressing conditions requiring surgical intervention. The following points synthesize the key features of several lesions that may mimic abscesses and highlight the diagnostic criteria that can assist clinicians in making accurate distinctions (Sadan, 2019; El-Shafaey *et al*., 2020).

Recent advances in camel diagnostic imaging have reinforced the fact that the combined use of ultrasonography and clinical examination is the most reliable approach for

Table 2.
Differential diagnosis of common soft-tissue swellings in dromedary camels (*Camelus dromedarius*) based on the reviewed studies.

Parameter	Abscess	Phlegmon	Hematoma	Cyst
Definition	Localized collection of pus within a well-defined capsule (El-Shafaey *et al*., 2020; Tharwat, 2021).	Diffuse, non-encapsulated inflammation spreading along tissue planes (Sadan, 2019; El-Shafaey *et al*., 2020).	Localized accumulation of blood due to trauma (Sadan, 2019).	Fluid-filled cavity lined by epithelium or fibrous tissue (Misk *et al*., 2020).
Etiology	Pyogenic bacterial infection (Tharwat, Elmoghazy *et al*., 2025)	Bacterial infection without encapsulation (El-Shafaey *et al*., 2020)	Trauma, vascular rupture (Sadan, 2019)	Congenital, developmental, or parasitic (Echinococcus) (Ahmed *et al*., 2021)
Onset	Gradual (acute to chronic)	Rapid and diffuse	Sudden	Slow
Pain	Marked (acute stage)	Severe, diffuse pain	Mild to moderate (early)	Usually, absent
Local heat	Present	Markedly increased	Mild (early)	Absent
Swelling characteristics	Well-circumscribed, fluctuant	Diffuse, poorly demarcated, firm	Fluctuant initially, then firm	Well-defined, soft
Capsule	Present (especially chronic)	Absent	Absent (may organize later)	Present
Fluctuation	Present (mature stage)	Absent	Present early	Often present
Skin changes	Redness, pointing	Diffuse redness	Bruising possible	Normal unless infected
Aspiration findings	Thick pus	Little or no pus	Blood or serosanguinous fluid	Clear, straw-colored, or keratinous fluid
Ultrasonography	Encapsulated lesion with echogenic contents (El-Shafaey *et al*., 2020)	Diffuse tissue edema, no capsule	Hypoechoic/anechoic fluid, may clot	Anechoic or hypoechoic fluid with clear wall
Response to antibiotics	Limited without drainage	Good response	Not required (unless infected)	Not required
Treatment	Drainage + antibiotics (Misk *et al*., 2020)	Medical therapy (antibiotics, anti-inflammatory)	Conservative or surgical evacuation	Surgical removal if indicated
Prognosis	Good (superficial), guarded (deep)	Good if treated early	Excellent	Excellent
Key distinguishing feature	Encapsulated pus	Diffuse inflammation without pus cavity	History of trauma + blood content	Non-inflammatory fluid-filled cavity

differentiating soft tissue swellings in dromedary camels, particularly between abscesses, hematomas, cysts, hernias, and neoplastic lesions. Contemporary studies by Tharwat, Elmoghazy *et al*., (2025) demonstrated that ultrasonography provides high diagnostic accuracy in field conditions by enabling real-time characterization of lesion architecture, internal echogenicity, and capsule formation. In these investigations, abscesses were consistently described as encapsulated lesions with heterogeneous echogenic content and possible internal septations, whereas hematomas were characterized by non-encapsulated fluid or clot formation with evolving echogenic patterns and the absence of a defined capsule. Cystic lesions were reported as well-circumscribed anechoic structures with thin or echogenic walls, whereas hernias were distinguished by identifiable displacement of abdominal contents with dynamic movement on real-time scanning. These imaging patterns have been confirmed in camel clinical studies by El-Shafaey *et al*. (2020), Sadan *et al*. (2023), Tina Roshini *et al*. (2023), and Torkaman *et al*. (2025).

Neoplastic masses were generally reported as solid, irregular structures with heterogeneous echotexture and no fluctuation, frequently requiring cytological or histopathological confirmation. Other conditions, including bursitis, distended synovial sheaths, and edema, were differentiated based on their anatomical location, fluid characteristics, and absence of purulent material upon aspiration (Sadan, 2019; Sadan *et al*., 2019; El-Shafaey *et al*., 2020; Mahla *et al*., 2024; Tharwat *et al*., 2024). Less frequently, conditions such as sialolithiasis and phlegmon mimic abscesses clinically; however, aspiration findings (e.g., saliva or non-purulent exudate) and the absence of a defined capsule aid in differentiation (Almansour *et al*., 2024; Hosny, 2024).

Overall, the reviewed studies indicate that misclassification is most likely in early or atypical presentations and that combining ultrasonographic findings with aspiration remains the most reliable approach for distinguishing abscesses from other soft-tissue swellings in dromedary camels (Gadallah *et al*., 2023; Hamoda *et al*., 2025).

Complications of abscesses

The complications reported in the reviewed studies varied according to abscess location, depth, and chronicity. Superficial abscesses were generally associated with fewer complications and favorable outcomes following appropriate drainage and antimicrobial therapy. In contrast, deep and chronic abscesses were more frequently associated with clinically significant adverse outcomes (Al-Mheiri *et al*., 2024). Among the documented complications, persistent sinus tract formation was one of the most commonly reported, particularly in chronic or inadequately treated cases. This condition was typically linked to retained necrotic tissue or incomplete drainage, resulting in delayed healing and ongoing infection. Recurrence has also been described in several studies, especially in lesions with thick fibrous capsules or when complete surgical excision was not achieved (Tharwat, Elmoghazy *et al*., 2025). Chronic inflammation can also erode nearby blood vessels, leading to hemorrhage and worsening the animal's condition (Wernery *et al*., 2025). Deep-seated abscesses were consistently associated with more severe complications. Internal abscesses, particularly renal lesions, have been reported to cause functional impairment, including dysuria, azotemia, and progressive organ dysfunction (Tharwat, Elmoghazy *et al*., 2025). Systemic involvement, such as bacteremia, was mainly observed in advanced or disseminated cases, indicating a poorer prognosis (Sadan, 2019; El-Shafaey *et al*., 2020; Sadan *et al*., 2023; Tharwat & Elmoghazy, 2025). Local extension of infection, including surrounding tissue involvement and cellulitis, has been reported in some cases, particularly following rupture or delayed intervention, often requiring more aggressive medical and surgical management (Tharwat, Sadan *et al*., 2018; Tharwat, 2019; Sadan *et al*., 2023). Overall, the reviewed evidence suggests that complications are more frequent and severe in deep and chronic abscesses compared with superficial lesions. Early diagnosis and appropriate treatment remain critical for reducing recurrence and limiting the progression of systemic or organ-related complications. However, consistent reporting of complication rates and long-term outcomes remains limited in the available literature (Tharwat, Sadan *et al*., 2018; Sadan, 2019; El-Shafaey *et al*., 2020; Tharwat, Elmoghazy *et al*., 2025).

Treatment of Abscesses

The reviewed studies consistently identified surgical intervention as the primary approach for managing abscesses in dromedary camels, with treatment selection largely depending on lesion type, location, and chronicity (Sadan, 2019; El-Shafaey *et al*., 2020). For superficial abscesses, the most frequently reported method was the promotion of abscess maturation, followed by incision and drainage, combined with appropriate wound management. This approach was generally associated with favorable clinical outcomes and low complication rates when adequate drainage and postoperative care were achieved (Tharwat, Sadan *et al*., 2018; Sadan, 2019; El-Shafaey *et al*., 2020; Misk *et al*., 2020). In contrast, chronic or recurrent abscesses particularly those with well-developed fibrous capsules or persistent sinus tracts were more commonly treated with complete surgical excision. This method has been reported to reduce recurrence, especially in encapsulated lesions, where drainage alone was insufficient (Sadan, 2019; El-Shafaey *et al*., 2020; Misk *et al*., 2020). The management of deep-seated abscesses required a more individualized approach. In these cases, ultrasonography was frequently used to guide aspiration, drainage, or surgical planning. Combined medical and surgical management, including systemic antimicrobial therapy guided by culture and sensitivity testing, has been commonly described in studies involving internal or complicated infections. Adjunctive antimicrobial and anti-inflammatory therapies were reported in most studies, particularly in cases with systemic involvement or deep lesions, to control infection and limit the inflammatory response (Tharwat, Sadan *et al*., 2018; Tharwat, Sadan, El-Shafaey, Al-Hawas *et al*., 2018; Sadan, 2019; El-Shafaey *et al*., 2020; Waziri *et al*., 2020; Tharwat, Elmoghazy *et al*., 2025). Ultrasonography has also been applied for treatment planning and postoperative monitoring, contributing to improved clinical outcomes and reduced recurrence rates (Tharwat, Sadan *et al*., 2018; Sadan, 2019; El-Shafaey *et al*., 2020; Tharwat, Elmoghazy *et al*., 2025). Overall, the evidence indicates that incision and drainage is the standard approach for uncomplicated superficial abscesses, whereas complete excision and combined medical–surgical management are more frequently employed in chronic, recurrent, or deep abscesses, with generally better outcomes when appropriately applied.

CONCLUSION

This review demonstrates that ultrasonography represents the central diagnostic modality for abscess evaluation in dromedary camels. Across the reviewed studies, it was consistently applied for abscess detection, characterization of lesion structure and maturity, and differentiation from other soft tissue swellings. In addition, ultrasound-guided aspiration and drainage are widely used, particularly for deep or inaccessible lesions.

When integrated with clinical examination, ultrasonography improves diagnostic accuracy, supports treatment planning, and facilitates the monitoring of therapeutic outcomes. Standard management includes incision and drainage for superficial abscesses, whereas chronic or deep lesions may require surgical excision or a combined medical-surgical approach.

Future studies should adopt standardized ultrasonographic protocols and include long-term outcome data. Strengthening preventive measures is essential to reduce the clinical and economic impacts of abscesses in camel populations.

DECLATATIONS

Declarations of competing interest

The author declares no conflict of interest.

Author Contributions

M.S: Conceptualization, data curation, resources, validation, writing – original draft, Writing – review & editing.

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