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Point of Care Ultrasound for Skin and Soft Tissue Abscesses in the ED: Diagnostic Accuracy, Management Strategies, and Clinical Outcomes

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ABSTRACT

Background: one of the common presentations to emergency department (ED) are skin and soft tissue abscesses. During physical examination cellulitis and drainable collections may be missed which lead to delayed drainage or unnecessary procedures. *Methods*: We conduct our systematic review of randomized and observational studies according to PRISMA guidelines including adults with suspected skin or soft tissue abscess in emergency departments. Eligible studies evaluated point of care ultrasound (POCUS) for diagnosis, management and reported diagnostic accuracy. We extract data on study design, POCUS protocols, comparators, and treatment failure. *Results*: we include six studies, all conducted at emergency settings. When POCUS is added to aid in clinical assessment sensitivity increase up to 98% for abscess detection and improved specificity compared with clinical assessment alone. A randomized trial showed higher failure with ultrasound-guided needle aspiration than standard incision and drainage (I&D), whereas another trial showed fewer repeat procedures when I&D was POCUS-guided. One of the included studies found POCUS more sensitive than computed tomography for superficial abscess. A cohort study identified abscess depth greater than 0.4 cm on POCUS as strongly associated with failure of antibiotic only treatment without drainage. *Conclusion*: In emergency patients, POCUS improves diagnostic accuracy, informs the need for drainage, and optimize I&D outcomes and short term clinical outcomes.

Keywords: POCUS; Skin abscess; Soft tissue infection; emergency department; I&D; Diagnostic accuracy

1. INTRODUCTION

Soft tissue and skin abscesses are a common in emergency department (ED) and can lead to morbidity if not recognized and managed properly (O'Rourke et al., 2015). Clinical assessment without ultrasound is not enough to distinguish abscess from cellulitis in obese patients, early infections, or anatomically complex regions (Squire

et al., 2005; Berger et al., 2012). When the assessment is not accurate this result in missed collections and unnecessary incision and drainage (I&D).

Point of care ultrasound (POCUS) is a useful bedside tool to improve diagnostic certainty in suspected soft tissue infection. Studies describe how POCUS identify hypoechoic fluid collections, loculations, and surrounding hyperemia (Chen et al., 2016; O'Rourke et al., 2015). According to literature there a high sensitivity and specificity of POCUS for abscess diagnosis compared with clinical assessment alone (Barbic et al., 2017; Subramaniam et al., 2016; Rahmani et al., 2023; Comer et al., 2018).

Sonographic measurements of abscess size and depth from the skin surface when managed without drainage correlate with treatment failure (Russell et al., 2020). The impact of ultrasound guided versus conventional landmark guided management of skin and soft tissue abscesses on patient centered outcomes is incompletely synthesized. In this systematic review we aim to collate and critically appraise the evidence on ultrasound guided management strategies for skin and soft tissue abscesses in the ED and acute care settings.

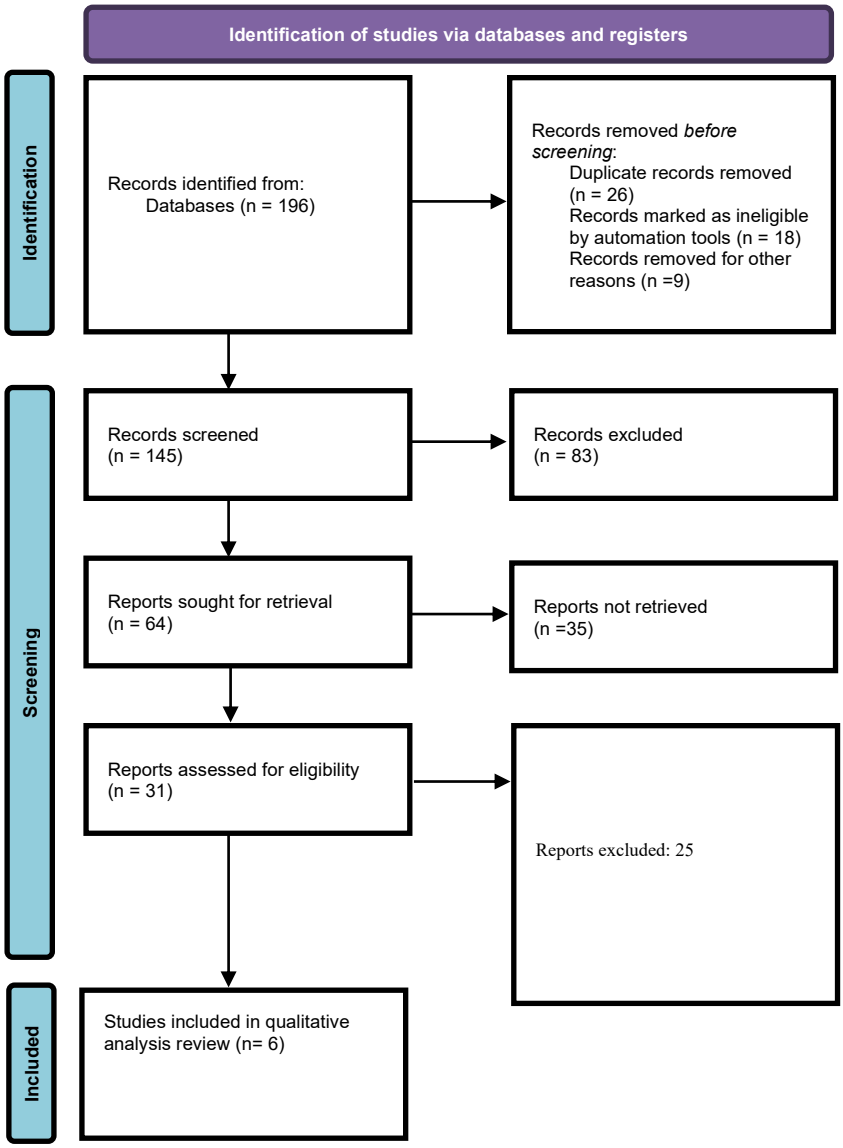

Fig. 1: PRISMA consort chart of selected studies

2. REVIEW METHODS

Our study was conducted according to PRISMA guidelines and we aimed to evaluate the impact of POCUS on the diagnosis and management of skin and soft tissue abscesses in ED patients.

Eligibility criteria

We included original studies with adults (≥18 years) presenting to the ED with skin or soft tissue abscess in which bedside ultrasound was used for diagnosis or to guide management. Our eligible designs include randomized controlled trials, cohort studies, and diagnostic accuracy studies. We excluded pediatric-only studies, case reports, case series with fewer than 10 patients, non-ED settings, non-ultrasound imaging studies, reviews, editorials, and non-English articles.

Information sources and study selection

We conduct a search on electronic databases (MEDLINE, EMBASE, Cochrane Library, and Google Scholar) from January 2005 to June 2025 using combinations of terms related to ultrasound, POCUS, skin abscess, soft tissue infection, and ED. We review the reference lists of included studies for additional articles. Two reviewers screened titles and abstracts, then assessed full texts for the eligibility criteria. Disagreements were solved by discussion with the supervisor. A PRISMA flow diagram summarizes the selection process (Fig. 1).

Data extraction

we extract data using a standardized form which include (country, setting, design, participant demographics, inclusion and exclusion criteria, ultrasound operators and training, ultrasound protocol, comparator, clinical exam, CT, or alternative procedure, and outcomes). Key outcomes included diagnostic accuracy, treatment failure, and complications.

Risk of bias and data synthesis

We used RoB 2 tool to assess risk of bias for randomized trials. Diagnostic accuracy and observational studies were assessed with QUADAS-2. Study characteristics were summarized in structured tables, and a qualitative synthesis was performed stratified by study design (Tables 1 & 2).

3. RESULTS & DISCUSSION

We include six studies, including four diagnostic accuracy studies and two randomized trials, all conducted in ED populations with skin or soft tissue abscesses. Squire et al., (2005) evaluated 107 adults with cellulitis or abscess and found that adding bedside ultrasound to clinical examination increased sensitivity for abscess from 86% to 98% and specificity from 70% to 88%; ultrasound was correct in 17 of 18 cases where it disagreed with clinical assessment, improving diagnostic accuracy and management decisions. Berger et al., (2012) evaluated 40 adults who had I&D and reported that emergency physicians ultrasound sensitivity is 0.97 and specificity of 0.67 for predicting pus at I&D, compared with 0.76 and 0.83 for clinical examination, showing that limited ultrasound training allowed identification of drainable collections.

Gaspari et al., (2012) compared ultrasound with Computed tomography (CT) in 65 of 612 patients who underwent both modalities. Ultrasound showed higher sensitivity for abscess detection (96.7% vs 76.7%) but lower specificity (85.7% vs 91.4%) than CT, and provided greater internal cavity detail on a predefined image quality scale.

Two randomized trials assessed ultrasound guidance for abscess drainage. In the trial of 101 patients, ultrasonography guided needle aspiration had successful drainage in 30% of cases compared with 80% success for standard I&D, with overall treatment failure rates of 74% vs 20%, mainly pronounced in community acquired Methicillin-resistant Staphylococcus aureus. infections. A later trial of 107 adults randomized to POCUS guided versus examination guided I&D found a failure rate of 10.3%, with fewer failures in the ultrasound guided group (3.7% vs 17.0%; absolute difference 13.3%, 95% CI 0.0–19.4).

Russell et al., (2020) analyzed 162 adults with ultrasound confirmed abscesses discharged without drainage. These findings indicate that bedside ultrasound improves diagnostic accuracy, informs the need for drainage based on abscess depth, and improves outcomes when used to guide I&D (Tables 1 & 2).

In this systematic review we found that incorporating ultrasound guidance into the management of skin and soft tissue abscesses affect diagnostic accuracy and downstream clinical outcomes. In the included studies, POCUS changed initial clinical assessments. It detected occult abscesses in presumed cellulitis and reduced unnecessary incision and drainage (Squire et al., 2005; Berger et al., 2012).

POCUS reduce failure rates according to randomized trials and cohorts. In a trial comparing ultrasonographically guided needle aspiration with standard I&D authors found a similar clinical success in small superficial abscesses (Gaspari et al., 2011). Studies

evaluating I&D with or without POCUS found that it had a lower clinical failure in the ultrasound arm (Gaspari et al., 2019; Gaspari et al., 2018).

Table 1. Characteristics of the Included Studies

Study	Country, setting	Study design	Population and sample size	Ultrasound role, comparator	Key outcomes
Squire et al., 2005	USA, single-center ED	Prospective convenience cohort	107 adult ED patients with suspected cellulitis and, or superficial abscess	ED physicians performed bedside US in addition to clinical examination, compared exam alone vs exam + US	US showed higher sensitivity (98%) and specificity (86%) for detecting abscess than clinical exam (86%, 70%).
Berger et al., 2012	USA, academic EDs	Prospective observational study	40 adult ED patients with suspected non-draining cutaneous abscess scheduled for IandD	Novice ED physicians performed bedside US, treating clinician's exam compared with novice US findings	Novice-performed US had sensitivity 0.97 and specificity 0.67 vs clinical exam 0.76, 0.83 for predicting pus at IandD.
Gaspari et al., 2011	USA, two urban academic EDs	Randomized controlled trial	101 adults with uncomplicated superficial skin abscesses	US-guided needle aspiration versus standard I&D (IandD) with packing	Clinical success was substantially lower with US-guided needle aspiration (26%) compared to IandD (80%)
Gaspari et al., 2012	USA, ED patients	Prospective diagnostic comparison	612 patients had bedside US, 65 also had CT for the same suspected soft tissue infection	Comparison of CT versus bedside US for diagnosing superficial soft tissue abscess	Among 65 imaged by both, US showed higher sensitivity (96.7%) but slightly lower specificity (85.7%) than CT (76.7%, 91.4%), and provided more internal detail of abscess cavities.
Gaspari et al., 2019	USA, large academic ED	Randomized controlled trial	125 adults with uncomplicated soft tissue abscess requiring IandD	IandD with point-of-care US guidance versus IandD based on physical examination alone	Overall failure rate was 10%, per-protocol analysis showed lower clinical failure (repeat IandD) in the US-guided group.
Russell et al., 2020	USA, two urban academic EDs	Retrospective cohort study	162 adults with SSTI and abscess confirmed on POCUS who were discharged without drainage	POCUS used to measure abscess maximal size and depth, outcomes assessed after non-drainage management	Abscesses deeper than 0.4 cm were more likely to fail treatment without drainage, those ≤0.4 cm deep frequently resolved with antibiotics alone.

Table 2. Main Findings of the Included Studies

Study	Population, intervention	Main finding
Squire et al., 2005	Adults with suspected skin, soft-tissue infection, clinical exam plus bedside ultrasound in ED.	Bedside US improved detection of occult abscess and changed management compared with clinical exam alone.
Berger et al., 2012	Adults with suspected cutaneous abscess, novice emergency physicians performed bedside ultrasound before I&D.	Novice physicians using US identified drainable abscesses and supported decisions to perform or avoid I&D.
Gaspari et al., 2011	Adults with superficial skin abscess randomized to ultrasound-guided needle aspiration or standard I&D.	US-guided needle aspiration produced lower clinical success than standard I&D for uncomplicated skin abscesses.
Gaspari et al., 2012	ED patients with suspected soft-tissue infection who underwent both bedside ultrasound and computed tomography imaging.	Bedside US was more sensitive than CT for superficial abscess and provided better visualization of internal cavity characteristics.
Gaspari et al., 2019	Adults with uncomplicated soft-tissue abscess randomized to POCUS-guided or landmark-based I&D.	POCUS-guided I&D reduced treatment failures and repeat procedures compared with landmark-based drainage alone.
Russell et al., 2020	Adults with ultrasound-confirmed skin abscess managed without drainage and treated initially with antibiotics alone in ED.	Greater abscess depth (>0.4 cm) on POCUS predicted failure of antibiotic-only therapy.

Abscess dimensions and depth measured on ultrasound were associated with higher failure when treated conservatively, sonographic thresholds help identify patients who benefit from drainage compared with antibiotics alone (Russell et al., 2020). Our findings were similar to previous study which found that trained non radiologist clinicians safely integrate ultrasound into acute decision making and improve diagnostic certainty in many conditions (Sorensen and Hunskaar, 2019; Polyzogopoulou et al., 2023). Many included studies were single-center, with varying operator experience, diverse protocols for d how ultrasound was used, and inconsistent definitions of treatment failure. Comparative effectiveness studies that integrate abscess size, depth, and host factors into decision-making clarify which patients derive the greatest benefit from ultrasound guidance.

4. CONCLUSION

This systematic review shows that POCUS improves diagnosis and management of skin and soft tissue abscesses in adult emergency patients. If we add ultrasound to clinical assessment we increases detection of drainable collections, helps avoid unnecessary procedures, and refines decisions about when I&D are required.

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Informed consent

Not applicable.

Ethical approval

Not applicable. This article does not contain any studies with human participants or animals performed by any of the authors.

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Conflict of interest

The authors declare that they have no conflicts of interest, competing financial interests or personal relationships that could have influenced the work reported in this paper.

Data and materials availability

All data associated with this study will be available based on reasonable request to the Corresponding Author.

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