MENTORS IN ORTHOPEDICS

PREVALENCE OF ORTHOPAEDIC SURGICAL SITE INFECTION IN EGYPT

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SUMMARY

Background: Surgical site infection (SSI) represents a significant complication in orthopedic surgery, contributing to increased morbidity, mortality, and healthcare costs. While global incidence rates are documented, the specific burden within Egyptian orthopedic departments remains poorly characterized despite the high volume of internal fixation and arthroplasty procedures.

Objective: This systematic review and meta-analysis aimed to estimate the prevalence of SSIs in orthopedic patients within Egyptian hospitals and identify associated risk factors.

Key Points: A systematic search of PubMed, Scopus, Web of Science, and Embase through June 2024 identified three eligible studies involving patients from Cairo, Tanta, and Assiut. The pooled analysis revealed a statistically significant SSI incidence ranging from 12.5% to 32.3% (RR = 0.224; 95% CI [0.125, 0.323]; $p < 0.05$). High heterogeneity ($I^2 = 81.09\%$) was observed, which resolved ($I^2 = 0\%$) upon sensitivity analysis. Identified risk factors included male gender, tobacco use, and preoperative soft tissue trauma. The reported incidence in Egypt is notably higher than global averages (2.5%) and pooled rates for other developing nations (5.6%). Methodological limitations included small sample sizes, limited geographic representation, and a lack of standardized post-discharge surveillance.

Conclusion: The prevalence of orthopedic SSI in Egypt is substantial, exceeding regional and global benchmarks. These findings underscore the necessity for standardized perioperative antibiotic protocols and multicenter surveillance programs to mitigate infection rates and improve clinical outcomes in Egyptian orthopedic practice.

KEYWORDS

Surgical Wound Infection; Orthopedic Procedures; Egypt; Prevalence; Risk Factors

INTRODUCTION

Surgical site infection (SSI) remains a significant and challenging complication following orthopedic surgeries, impacting patient outcomes and healthcare systems globally [1]. These infections, which occur at the site of surgery within 30 days postoperatively or within a year if an implant is placed, pose a serious threat due to the intricate nature of orthopedic procedures and the complex environments in which they are performed [2]. Orthopedic SSIs can lead to extended hospital stays, increased medical costs, additional surgical interventions, and, most critically, substantial morbidity and mortality among patients [3].

The prevalence of SSIs in orthopedic surgeries varies widely, influenced by factors such as the type of surgery, patient comorbidities, surgical techniques, and adherence to infection control protocols [4]. Common pathogens responsible for these infections include Staphylococcus aureus, including methicillin-resistant strains (MRSA), coagulase-negative staphylococci, and Gram-negative bacilli [5]. The advent of antibiotic-resistant organisms further complicates the management and prevention of SSIs in orthopedic settings [6].

Preventive measures are multifaceted, involving preoperative, intraoperative, and postoperative strategies [7]. Preoperative measures include optimizing patient health, controlling blood glucose levels, and appropriate antibiotic prophylaxis [8]. Intraoperatively, meticulous surgical technique, proper sterilization of instruments, and maintaining normothermia are crucial [4]. Postoperative care involves wound management, timely removal of drains and catheters, and vigilant monitoring for early signs of infection [9].

Despite advances in surgical techniques and infection control practices, the incidence of SSIs in orthopedic surgeries remains a pressing concern. Ongoing research and the development of innovative strategies are essential to reduce the burden of these infections and improve patient outcomes in orthopedic care.

METHODS

The procedural framework of this investigation adhered to the methodology outlined in the Cochrane Handbook for Systematic Reviews and Meta-analysis [10]. We followed the PRISMA statement guidelines in reporting this meta-analysis [11].

1. Literature search

We conducted a methodical search across the subsequent databases: PubMed, Scopus, Web of Science (WOS), and Embase, aiming to retrieve relevant published studies from their inception until June 2024. We used keywords to build our search strategy including (“Surgical Wound Infection”[Mesh] OR “Surgical Site Infection” OR “SSI” OR “Postoperative Infection”) AND (“Prevalence” OR “Epidemiology” OR “Incidence” OR “Rate”) AND (“Egypt” OR “Egyptian”). All duplicates were removed by Endnote software.

Rayyan software [12] was utilized during the selection process, with two reviewers independently and blindly assessing the retrieved references in a two-stage procedure. First, they screened the titles and abstracts of all extracted articles. In the second phase, they conducted a thorough full-text screening of all eligible abstracts. Any discrepancies were resolved with the assistance of a third reviewer.

2. Selection and Eligibility criteria

In selecting relevant studies, we followed a specific set of criteria. This investigation focused on patients undergoing any type of orthopedic surgery without interventions or comparators, with the primary outcome being the incidence of surgical site infections (SSIs). We excluded non-English studies, case reports, animal studies, reviews, editorials, studies with only an abstract or unavailable full text, or overlapping data.

3. Data Extraction

Data from eligible studies was gathered on a standardized sheet for data extraction form by two independent reviewers. Then a cross-verification was conducted, and any discrepancies were addressed through discussion. The uniform data extraction sheet encompasses two domains, from which details related to the included studies are derived, first domain was: characteristics of included studies such as (study ID, Study design, Country, Number of centers, inclusion criteria, number of patients, follow-up duration and conclusion). The second domain included the outcomes that we highlighted on them previously.

4. Quality assessment

Two authors independently evaluated the Risk of bias using the Joanna Briggs Institute (JBI) critical appraisal tools [34]. The suitable checklist was selected based on the observational study type. Each checklist included various questions that could be answered with "yes," "unclear," "no," or "not applicable." Discrepancies were resolved through consensus. Studies were categorized as having a low, medium, or high risk of bias according to the relevant questions. [13]

5. Statistical analysis

For comprehensive analysis of extracted data, we used OpenMeta[Analyst] software tool for analysis and construction of forest blots; For dichotomous outcomes, we pooled them as Risk ratio (RR) and their corresponding 95% confidence interval (CI) using the Mantel-Haenszel method, we also performed sensitivity analysis to solve the heterogeneity.

Additionally, to assess statistical heterogeneity among the included studies, a visual inspection of the forest plots was conducted. The Chi-square test (Cochrane Q test) and the Higgins and Thompson I^2 statistic were also used to quantify heterogeneity, with the formula $I^2 = ((Q - df) / Q) \times 100\%$. If the I^2 value exceeded 50% and the Chi-square test's p-value was less than 0.1, significant statistical heterogeneity was considered present between the studies. In such cases, DerSimonian and Laird random effects models were applied to address the heterogeneity effectively.

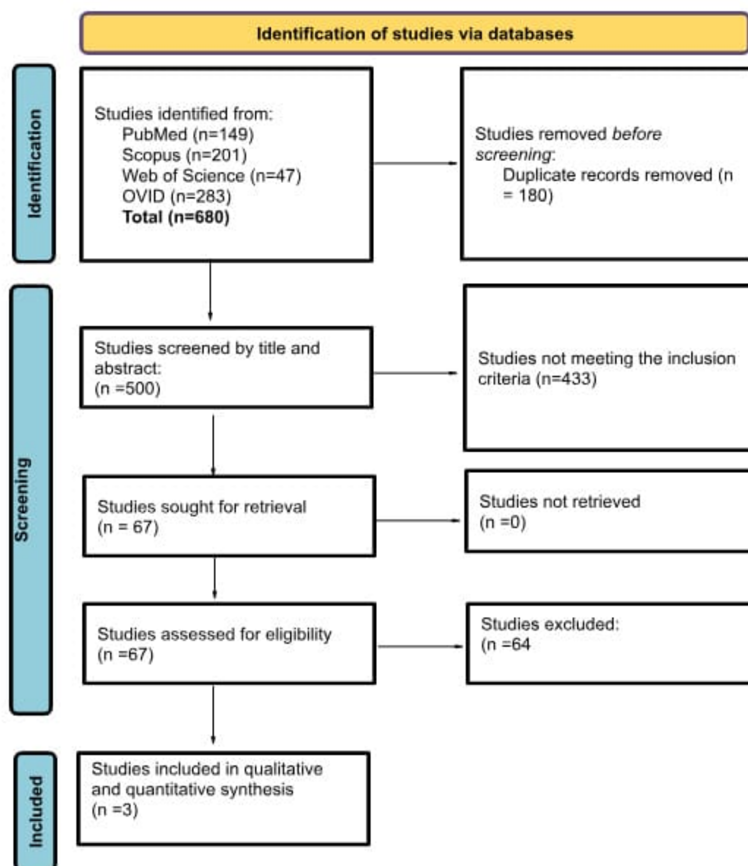
On the other hand, heterogeneity would be fluctuated as low, moderate, and high whether I2 valued as < 25%, from 25-75%, or > 75%, respectively [14].

RESULTS

1. Search Results and Study Selection

680 publications were found by scanning the various electronic databases (PubMed, Web of Science, Scopus, and Ovid). 180 articles were discovered to be duplicates and deleted. Through the application of the above-described inclusion and exclusion criteria, 677 studies were deemed irrelevant and subsequently eliminated throughout the

screening process. Ultimately, it was determined that three studies [15],[16],[17] qualified and were included in the analysis. (Figure 1)



2. Characteristics of Included Studies

All the included studies were carried out in Egypt including one prospective analytical study, one single institution study, and one cross-sectional study (Table 1). The follow up duration was different among these studies ranging from three to nine months.

Study ID	Country	Study design	Inclusion criteria	Number of centers	Number of patients	Follow-up duration	Conclusion
Afifi 2010	Egypt	Prospective Cohort	All patients undergoing surgical operations at orthopedic department, . Emergency cases were excluded.	1	121	90	The SSI incidence rate was 8.264%, with significant associations found for age >50 years, diabetes mellitus, ASA score >2, surgery duration >2 hours, and use of drains. The use of drains was the only independent risk factor. Common isolated organisms were *Staphylococcus aureus*, *Pseudomonas spp.*, and *E. coli* (20% each).
Abdel-Halim 2010	Egypt	Prospective Cohort	all patients undergoing surgical operations at orthopaedic department.	1	93	30	Incidence of SSIs in orthopedic patients in Egypt is higher than that reported in some developing countries. *S. aureus* is the most common pathogens associated with orthopedic SSIs
Kotb 2019	Egypt	Cross-sectional	Adult patients their age range between (18-65) years old from both sexes	1	200	-	Prevalence of orthopedic wound infection over three months was (28.5%). There was a positive correlation between dressing technique and wound infection

Table.1 Summary of the included studies. SSI : Surgical site infectionSSI : Surgical site infection

3. Quality assessment of the included studies

Two studies were classified as having medium concerns regarding the methodological quality and one study, Kotb et al 2019, demonstrated a weak adherence to methodological guidelines and high risk of bias, which decreased the validity of its findings. (Table 2 and 3)

Study ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Category
Abdel-Halim 2010	Y	Y	Y	N	N	Y	Y	N	U	U	Y	Medium
Afifi 2010	Y	Y	Y	Y	N	Y	Y	N	U	U	Y	Medium

Table : 2 Quality assessment of cohort studies

Study ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Category
Afifi 2010	Y	Y	Y	Y	N	N	N	Y	High

Table : 3 Quality assessment of the cross-sectional study

4. Prevalence of surgical site infection in orthopedic patients

The analysis of SSI revealed that its incidence is statistically significant (P value < 0.05) with a risk ratio (RR) = 0.224 and 95% confidence interval (CI) [0.125; - 0.323. with significant heterogeneity I^2=81.09. (Figure 2)

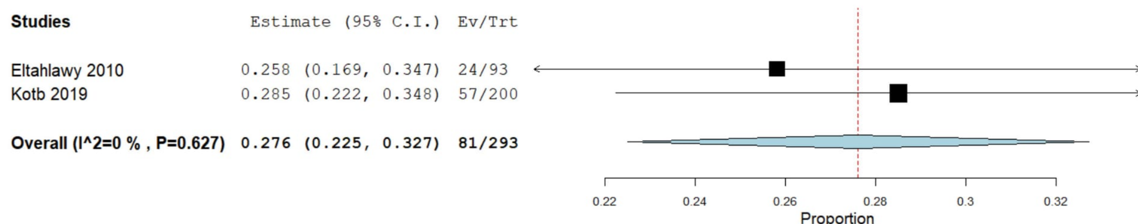


Figure 2. Forest plot showing prevalence of surgical site infection in orthopedic patients

5. Sensitivity analysis on prevalence of surgical site infection in orthopedic patients

After removal of the study Afifi 2010 [15] the heterogeneity was resolved I^2 = 0%. (Figure 3)

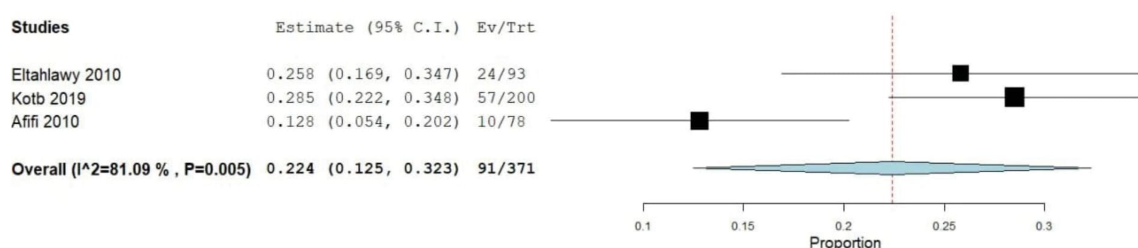


Figure 3. Forest plot after sensitivity analysis of prevalence of surgical site infection in orthopedic patients

DISCUSSION

Surgical site infections (SSI) are the most common complications in surgical patients and the second most common complications in orthopedic patients leading to prolonged hospital stay, readmissions to the hospital, and increased morbidity and mortality [18],[19]. One of the most common challenges that orthopedic surgeons face is the use of implants for open reduction and internal fixation which are foreign objects to the body increasing the risk of SSI. [20]

The aim of this analysis is to estimate the incidence of SSI in orthopedic surgeries in Egyptian hospitals. The orthopedic procedures in the included studies were mainly internal fixation of fractures and arthroplasty.

Our findings estimated the incidence of SSI to range from 12.5% to 32.3%, with statistically significant results (RR = 0.224, 95% CI [0.125 to 0.323], $p < 0.05$].

In 2002, SSI was the second leading cause of healthcare-associated infections (HAI) in both the USA and Europe. In the USA, there were nearly 270,000 episodes per year, accounting for 20% of HAIs, while in Europe, there were approximately 900,000 episodes annually, representing 19.6% of HAIs [21]. A recent meta-analysis with a total of 43 studies from 29 countries no including Egypt aimed to estimate the global incidence of SSI [22]. The study found a worldwide SSI incidence rate of 2.5%, which is notably lower than the 5.6% reported by Allegranzi et al [23]. Moreover, according to Mengistu et al [22], the highest incidence of SSI worldwide was found in studies conducted in Africa, accounting for 7.2% [22]. This finding aligns closely with Allegranzi et al [23], which reported

a pooled SSI incidence of 5.6% among patients in developing countries. Also, Ngaroua et al, which aimed to estimate the incidence of SSI in sub-Saharan Africa reported a pooled SSI incidence of 14.8% [24]. All these outcomes are lower than those reported in Egypt ranging from 12.5% to 32.3%.

Multiple risk factors could be attributed to this high-risk SSI. Male gender may be associated with high risk of SSI as proven by Al-Qurayshi et al and Utsumi et al [25],[26] this could be related to the fact that hormones may play a role in defining proper immune response where females have eminent cell-mediated immune responses compared with males owing to their low testosterone levels [27], also older patients between 17 and 65 years demonstrated higher risk for SSI, while patients aged 65 and above showed low risk of SSI by 1.2% for every year based on Kaye et al [28] which is inconsistent with Hegazy et al and Al-Mulhim et al that reported higher risk of SSI in younger patients [29],[30], but it could be due to the majority of patients in Al-Mulhim et al were reported to have traumatic injury and it has been shown that preoperative injury to soft tissues is a major risk factor for SSI. [30],[31]

Additionally, smoking significantly increases the risk of SSI as it is known for its negative effect on immunity causing impaired wound healing, wound dehiscence, and incisional hernia [32]. Sheet et al. highlights a growing concern about smoking in developing nations, where almost 80% of the world's 1.1 billion smokers live. Furthermore, additional risk factors such as obesity, duration of surgery, pre-existing infections, blood transfusions, low serum albumin levels, and inadequate sterilization practices may contribute to the high rate of SSIs in Egypt and other developing countries. [33],[34]

This is the first meta-analysis conducted to evaluate the prevalence of orthopedic SSI in Egyptian hospitals. A comprehensive search strategy was formulated and used to search different electronic databases to retrieve all relevant studies. This meta-analysis strictly followed the Cochrane Handbook guidelines, including only RCTs and having at least two authors involved in each step. This meticulous methodology enhanced the reliability of our findings and provided important insights into the prevalence of orthopedic SSI in Egypt. Nonetheless, our study encountered several challenges. The limited number of included studies and the small sample sizes hindered our ability to gather comprehensive data on the prevalence of SSIs in Egypt. Moreover, the three studies we included only covered patients from three hospitals in Egypt: Assiut, Tanta, and Cairo. There are several gaps in the surveillance of SSI including the lack of surveillance methodologies post-discharge (patients encountered some difficulty to assess their own wounds for infection), no data from many hospitals, and the absence or limited written guidelines on proper perioperative antibiotic policies.

A multicenter surveillance study, on many homogeneous Orthopedic cases with larger sample size and longer duration, is needed to allow for meaningful comparisons between different Orthopedic conditions and hospitals.

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