

Incidence of Postoperative Urosepsis Following Urological Surgeries in Developing Countries: A Systematic Literature Review

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Abstract: Postoperative urosepsis is a significant contributor to morbidity and mortality following urological procedures, particularly in developing countries, despite advancements in prophylactic measures. This systematic review evaluates the incidence, risk factors, and outcomes of postoperative urosepsis by analysing literature from 2010 to 2023, with data sourced from PubMed. Studies were included if they reported on postoperative urosepsis as a complication of urological surgeries in developing countries, while those lacking incidence rates, full-text access, or conducted outside these regions were excluded. Findings reveal an average incidence rate of 8.73%, with significant variability influenced by factors such as the type of surgical procedure, patient comorbidities, and healthcare resource availability. Despite the use of prophylactic antibiotics and supportive perioperative measures, the persistence of high incidence rates highlights the critical impact of limited healthcare infrastructure and resource constraints. This review underscores the need for improved infection prevention strategies and optimized perioperative care to address the specific challenges in resource-limited settings. Enhanced surgical practices and targeted interventions are essential to reduce the burden of postoperative urosepsis and improve patient outcomes in developing countries, emphasizing the importance of further research to guide such efforts.

Keywords: Incidence Rate, Postoperative Urosepsis, Urological Procedures, Developing Countries

1. Introduction

Around 1.2% of elective surgery patients in developed countries like the United States develop sepsis postoperatively. ⁽¹⁾ The mortality rate for severe sepsis and septic shock is still around 30% to 40% today. ⁽²⁾ There are 40% of cases of sepsis secondary to nosocomial infections attributed to urinary tract infections. ⁽³⁾ There was a postoperative SIRS rate of nearly 27.12% after urological procedures, and a postoperative urosepsis rate of 7.20% among patients after urological procedures in developing countries. ⁽⁴⁾ Research shows that the incidence rate in the developing world is extremely high. We are interested to determine out the incidence rate of post-operative urosepsis in developing countries.

In the United States, sepsis, severe sepsis, and septic shock were accompanied with 6%, 15%, and 34% mortality rates and budgets of approximately \$16,000, \$25,000, and \$38,000, respectively, in a large retrospective database analysis. ⁽⁵⁾ In the United Kingdom, each year, sepsis claims around 31,000 lives and costs the NHS in England about £2 billion. ⁽⁶⁾ In developed countries, Urosepsis is a huge burden on health care. As a developing country, in order to find out the incidence rate, we can find out the health care burden caused by post-operative urosepsis. We can reduce the burden on the healthcare system if we are able to control the contributing factors.

Urogenital tract infections can lead to urosepsis, a potentially life-threatening condition often caused by urinary tract obstructions such as urolithiasis, tumors, and stenosis, or urinary tract manipulations like ureteroscopy. The infection spreads from a localized site to a systemic condition as uropathogenic bacteria disseminate into the bloodstream. ⁽⁷⁾ Patients with renal stones,

immunocompromised states, or long-term catheterization are at increased risk. ⁽⁸⁾

A UTI and suspicion of sepsis are necessary for diagnosing urosepsis. Recognizing signs of a complicated UTI in the context of SIRS is crucial; these include dysuria, flank pain, costovertebral angle tenderness, urinary retention, bacteriuria, and leucocytosis. Severe sepsis may involve organ dysfunction, evidenced by decreased urine output, encephalopathy, mental state changes, or a low platelet count. ⁽⁹⁾

The laboratory workup for suspected urosepsis should include a full blood count, complete metabolic panel, blood cultures, serum lactate level, and urinalysis with a urine culture. Ultrasound can identify causes in about 93% of cases but depends on the sonographer's experience and availability. Non-contrast computed tomography (NCCT) is preferred for its accessibility and reproducibility. ⁽⁸⁾

Early diagnosis and effective treatment can reduce the severity and mortality rate of urosepsis. ⁽¹⁰⁾ Early goal-directed therapy (EGDT) for sepsis includes empiric antibiotics within one hour of diagnosis, supportive care, and other adjunctive therapies. Delays in antibiotic administration after the initial six hours decrease survival rates by 8% per hour. ⁽⁸⁾ Early diagnosis and effective therapy can minimize postoperative urosepsis complications.

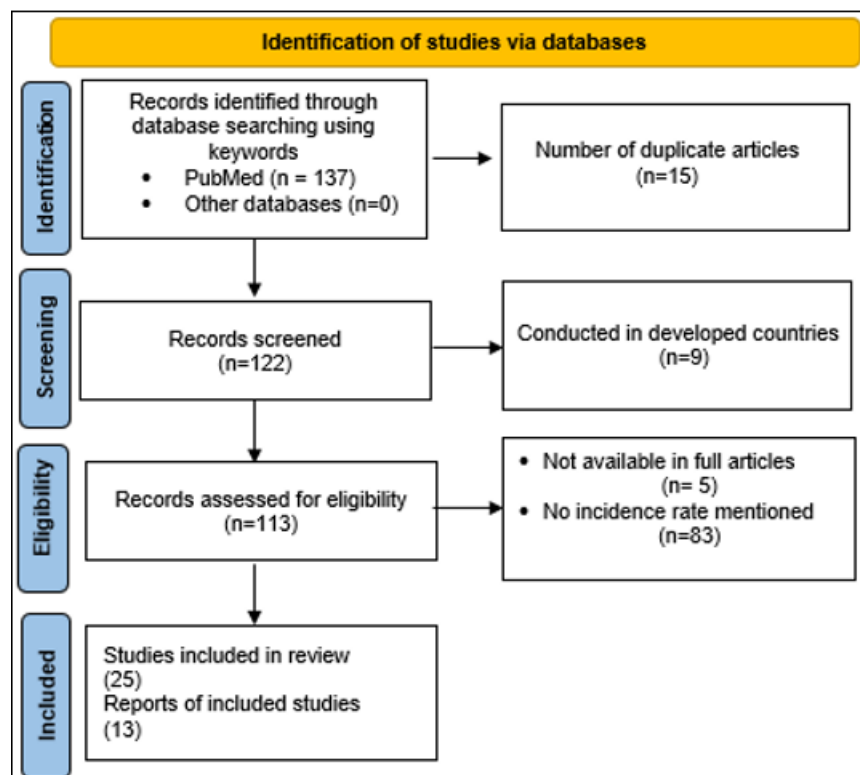
Postsurgical urosepsis is a surgical complication and recognise the importance of appropriate treatment to prevent further complications and improve the quality of life for patients. Additionally, the focus on reducing the incidence rate not only benefits individual patients but also addresses the broader impact on healthcare costs, which is crucial for healthcare systems, particularly in developing countries. The need for studies in developing countries is essential, as these

regions often face unique challenges in healthcare infrastructure, access to resources, and patient demographics. Investigating the incidence rate of post-operative urosepsis in these settings is a valuable step toward understanding the specific challenges and tailoring interventions accordingly. The emphasis on pre-surgical optimization is a key aspect of approach, highlighting the importance of thoroughly evaluating and preparing patients before surgery to minimize the risk of complications. This proactive approach aligns with the principles of preventive medicine and patient-centered care. Furthermore, to identify contributing factors leading to serious complications is crucial for improving patient outcomes. Pinpointing these factors can guide strategies to mitigate risks, enhance patient safety, and ultimately improve the overall success of surgical procedures. In summary, this study aims to address a significant medical issue, especially in developing countries, by focusing on the incidence rate of post-operative urosepsis and understanding contributing factors. This research has the potential to contribute valuable insights that can inform preventive measures, optimize patient care, and reduce the healthcare burden associated with this complication.

2. Methodology

A systematic literature search and review will be conducted using PubMed to determine the incidence rate of postoperative urosepsis in developing countries. The search will use the keywords "incidence rate," "postoperative urosepsis," "urological procedures" and "developing countries.". The inclusion criteria are articles reporting the incidence rate of postoperative urosepsis, studies conducted in developing countries, and articles available in English. The exclusion criteria are; studies conducted in developed countries; studies not mentioning about incidence rate and articles not available in full text. For each selected study, extract the following data: Title and authors, Year of publication, Study design, sample size, incidence rate of postoperative urosepsis, Geographic location of the study, and Key findings and conclusions. After full-text review, 13 articles meet the inclusion criteria. Based on the synthesized data, conclude the incidence rate of postoperative urosepsis in developing countries. Provide recommendations for future research, policy, and clinical practice.

The following PRISMA flowchart summarises the identification of studies using PubMed database searching:



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71

3. Results

The following table 1 summarizes the incidence rates, associated procedures, risk factors and key findings for postoperative urosepsis from the above-mentioned studies:

| Serial Number | Author (year) | Procedure | Incidence of urosepsis | Risk factors | Key findings |
|---------------|--|--|---|---|---|
| 1 | Junkai Huang et al. (2023) [11] | Flexible Ureteroscopy Lithotripsy | 6.3% | Hypoalbuminemia within one hour after surgery | Early recognition of hypoalbuminemia can help reduce risk of postoperative urosepsis |
| 2 | Can Wang et al. (2022) [12] | Uroscopic Minimally Invasive Lithotripsy | 7.20% | Post procedure | Nomogram used to predict SIRS and urosepsis |
| 3 | Jie Gu et al. (2022) [13] | Percutaneous Nephrolithotomy (PCNL) | 19.4% | Diabetes | High risk of urosepsis in diabetic patients |
| 4 | Yirixiatjiang Amier et al. (2022) [14] | Mini-Percutaneous Nephrolithotomy (Mini-PCNL) | 17% | Large kidney stones | High risk of postoperative urosepsis in patients with large stones |
| 5 | E Jarry et al. (2022) [15] | Flexible Ureteroscopy | 9.8% | Post procedure | Lower risk compared to Mini-PCNL, still significant |
| 6 | Amelia Pietropaolo et al. (2021) [16] | Ureteroscopy | 8.1% | Post procedure | Machine learning predictive model for post-procedural urosepsis requiring ICU admission |
| 7 | Shreya Chugh et al. (2020) [17] | Ureteroscopy | Although reported rates of urosepsis were minimal, nearly half of all post-URS problems are attributable to infectious complications. | High Charlson comorbidity index, elderly age, female gender, neurogenic bladder, high BMI | Risk factors for urosepsis and urinary infections identified |
| 8 | Xia Liang et al. 2019) [18] | Surgical intervention for calculous pyonephrosis | 14.3% | Urgent surgery, hypotension during surgery | Prolonged hospital stay, need for intensive care, higher mortality rates for patients developing urosepsis |
| 9 | Jordan B Southern (2019) [19] | Ureteroscopy for stone disease | 6.9% | Female gender, prolonged surgical procedure, preoperative positive urine culture | High risk of postoperative fever and SIRS; pre-op positive urine culture increases infection risk |
| 10 | Y Q Liu et al. (2018) [20] | One-Phase PCNL | 7.9% | Diabetes, high stone burden, prolonged surgery, higher irrigation rates, infectious stone composition | Significant independent risk factors for urosepsis identified |
| 11 | Mohammed Shahait et al. (2016) [21] | TRUS Prostate Biopsy | 9.4% | Hypertension, age | High prevalence of urosepsis following TRUS, especially in patients with hypertension |
| 12 | Sultan S AlKhateeb et al. (2016) [22] | TRUS Prostate Biopsy | 5% | Antibiotics resistance | Ciprofloxacin resistance in 90.9% of patients without sepsis, highlighting need for improved prophylactic strategies |
| 13 | Alexey Martov et al. (2015) [23] | Ureteroscopic Stone Removal (URS) | ≤2.2% | Female gender, high ASA score, | Preoperative antibiotic prophylaxis did not reduce postoperative infections in patients with negative baseline urine culture. |

4. Discussion

Urosepsis remains a significant postoperative complication in developing countries. The literature consistently identified several preoperative risk factors that contribute to the development of urosepsis. Analysis of Preoperative Risk Factors for Postoperative Urosepsis After Mini-Percutaneous Nephrolithotomy (Mini-PCNL) in Patients with Large Kidney Stones showed 17% of patients developed postoperative urosepsis. ⁽¹⁴⁾ This suggests a considerable risk of urosepsis following Mini-PCNL in patients with large kidney stones. The factors contributing to this risk should be explored for better patient management and outcomes. Another study of predictive factors for postoperative septic complications after flexible ureteroscopy for urinary stones showed 9.8% of urosepsis cases were identified. ⁽¹⁵⁾ This study indicates a lower but still significant risk of urosepsis

after flexible ureteroscopy. Both studies highlight the risk of postoperative urosepsis, albeit with different procedural approaches. The varying incidence rates may be attributed to the differences in the procedures themselves, patient populations, or healthcare settings.

Hypoalbuminemia within One Hour After Surgery as a Predictor of Post-Operative Urosepsis in Patients Undergoing Flexible Ureteroscopy Lithotripsy: A Retrospective Study showed 6.3 % of patients developed postoperative urosepsis. Additionally, the study suggests that early recognition of hypoalbuminemia within one hour after surgery could be a predictor of postoperative urosepsis and may help in reducing the risk. ⁽¹¹⁾ Proper management of these risk factors, including thorough screening and adherence to infection prevention protocols, is critical for reducing the incidence of urosepsis.

Patients with pre-existing conditions, particularly those who are immunocompromised- such as individuals with diabetes- are at higher risk, underscoring the importance of targeted interventions during the preoperative period. According to nomograms for predicting SIRS and urosepsis after uroscopic minimally invasive lithotripsy, 7.20% of patients develop urosepsis after surgery. ⁽¹²⁾ A nomogram for predicting urosepsis risk factor in diabetic patients following percutaneous nephrolithotomy (PCNL) showed that 19.4% diabetic patients who underwent one-stage PCNL experienced urosepsis following surgery, and their hospitalization time was greater than that of those without urosepsis. ⁽¹³⁾ This study focusses on assessing the risk factors associated with urosepsis following these procedures and highlights the importance of predicting and managing such complications.

The studies also highlight the disproportionate impact of urosepsis on healthcare systems in developing countries. Limited resources, suboptimal infection control practices, and the additional burden of managing urosepsis contribute to higher morbidity and mortality rates. These findings stress the need for healthcare providers to be vigilant in identifying at-risk patients and implementing tailored preventive strategies, especially in resource-limited settings. A Case-Control YAU Endourology Study from Nine European Centres Using Machine Learning Predictive Model for Post-Ureteroscopy Urosepsis Needing Intensive Care Unit Admission revealed that 8.1% of post-procedural urosepsis cases required intensive care and ICU admissions. ⁽¹⁶⁾

Another study of predictors of Urinary Infections and Urosepsis After Ureteroscopy for Stone Disease: A Systematic Review from EAU Section of Urolithiasis (EULIS) showed the reported rates of urosepsis were minimal, nearly half of all post-URS (ureteroscopy) problems are attributable to infectious complications and the risk is higher in patients with high Charlson comorbidity index, elderly patients, female gender, long duration of pre-procedural indwelling ureteric stents and patients with a neurogenic bladder and with high BMI. ⁽¹⁷⁾ Understanding these risk factors allows healthcare providers to identify patients who may be at a higher risk of developing urinary infections and urosepsis following a procedure. This knowledge can help in implementing preventive measures and tailoring postoperative care to reduce the likelihood of complications.

Another study of risk factors and outcomes of urosepsis in patients with calculous pyonephrosis receiving surgical intervention: a single-center retrospective study reported that 14.3% of patients developed postoperative urosepsis after undergoing surgical intervention for calculous pyonephrosis. The identified risk factors associated with postoperative urosepsis in these patients were urgent surgery and hypotension during surgery. Urgent surgery may indicate a more critical or advanced stage of the condition, potentially increasing the risk of complications. The most common outcomes observed in patients who developed urosepsis were prolonged hospital stay, the need for intensive care, and higher mortality rates. Prolonged hospital stays and the requirement for intensive care suggest the severity of the condition, while the higher mortality rate indicates the

potential life-threatening nature of urosepsis in this patient population. ⁽¹⁸⁾

Risk Factors for Postoperative Fever and Systemic Inflammatory Response Syndrome After Ureteroscopy for Stone Disease showed that 6.9% of postoperative cases were identified. The study suggests that being female is associated with a higher risk of postoperative fever and SIRS after ureteroscopy for stone disease. Prolonged surgical procedures may increase the likelihood of postoperative complications. Patients with more complex medical conditions or comorbidities may be at an increased risk of developing postoperative complications. This finding underscores the importance of considering the overall health status of patients undergoing ureteroscopy. A positive result in the preoperative urine culture was identified as a significant risk factor. This suggests that the presence of bacteria or infection in the urine before the procedure may contribute to postoperative complications. ⁽¹⁹⁾

Predicting the incidence of urosepsis after percutaneous nephrolithotomy based on risk factors was revealed to be 7.9% in the study. There are independent risk factors that affect the development of urosepsis after one-phase percutaneous nephrolithotomy for upper urinary tract calculi, including diabetes mellitus history, higher stone burden, longer operation times, increased intraoperative irrigation rates, and infectious stone composition. ⁽²⁰⁾ Therefore, careful evaluation of these risk factors is necessary to optimize outcomes after one-phase percutaneous nephrolithotomy and prevent the incidence of postoperative incidence.

A research study conducted at a tertiary-care medical centre in Lebanon evaluated the prevalence of sepsis following transrectal ultrasound guided prostate biopsy. According to the study, urosepsis is very common (9.4%) among patients who have undergone TRUS prostate biopsy, and hypertension and age were identified as significant risk factors. ⁽²¹⁾ These findings suggest that clinicians should be aware of the risk factors associated with this procedure and take the necessary precautions to reduce the incidence of urosepsis.

An analysis of the prevalence of urinary tract infections and patterns of susceptibility to fluoroquinolones following transrectal ultrasound-guided prostate biopsy in a subset of Saudis showed an increase in the incidence (5%) of infectious complications following TRUS prostate biopsy. 90.9% of patients without sepsis were resistant to ciprofloxacin. ⁽²²⁾ The results of a previous study in developed country like Canada entitled increasing risk of infectious complications after transrectal ultrasound-guided prostate biopsies: time to reassess antimicrobial prophylaxis concluded that there is an increasing risk of infectious complications following transrectal ultrasound-guided prostate biopsies. ⁽²³⁾ This increase indicates the need for improved prophylactic strategies to reduce infectious complications risk in this population.

Improving outcomes requires a multifaceted approach, including early detection, better preoperative management of comorbidities, and stringent postoperative monitoring. By

addressing the underlying risk factors and improving perioperative care, healthcare systems can alleviate the burden of urosepsis, enhance patient recovery, and ultimately improve long-term surgical outcomes. Postoperative infection rates in patients with a negative baseline urine culture undergoing ureteroscopic stone removal: a matched case-control analysis of antibiotic prophylaxis from the CROES URS global study showed preoperative antibiotic prophylaxis did not reduce the postoperative infections, which showed a rate of $\leq 2.2\%$ in both groups, regardless of whether or not they received antibiotic prophylaxis. This study identified female gender and a high ASA score as specific risk factors for postoperative infection.⁽²⁴⁾

5. Conclusion

The average incidence of postoperative urosepsis of 8.73% in developing countries poses a significant burden on healthcare resources and contributes to elevated mortality rates, necessitating a comprehensive, multifaceted approach to address this challenge. Early detection and timely diagnosis of urinary tract infections (UTIs) prior to surgery, especially in high-risk patients, are critical to preventing progression to urosepsis. The appropriate use of antibiotics, guided by culture and sensitivity testing, ensures effective treatment and helps mitigate the rise of antibiotic-resistant strains, while avoiding unnecessary or improper use. Stringent hygiene and infection control measures, including proper hand hygiene, sanitation, and aseptic techniques, are essential to reducing the risk of infections in healthcare settings. Empowering patients with knowledge about maintaining urinary tract health and recognizing early symptoms of infection can facilitate prompt medical intervention and reduce complication rates. Enhancing access to healthcare services in resource-limited areas is equally important, enabling early diagnosis and treatment of UTIs and preventing severe complications like urosepsis. Additionally, implementing surveillance systems to monitor UTI and urosepsis rates, along with antibiotic resistance trends, supports evidence-based clinical practices and optimal resource allocation. Investment in research and innovation is crucial to understanding local risk factors and developing context-specific solutions tailored to resource-constrained settings. By focusing on these strategies, healthcare systems in developing countries can reduce the burden of postoperative urosepsis, improve patient outcomes, and address systemic healthcare challenges, with continued efforts in prevention and research playing a pivotal role in achieving these objectives.

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