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REVIEW ARTICLE

CONTENTS

Urinary tract infections in patients undergoing orthopaedic procedures: A contemporary review (2021–2026)

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ABSTRACT

Urinary tract infections are one of the most frequent healthcare-associated infections representing a relevant postoperative complication in orthopedics patients. These infections are associated with increased morbidity, prolonged hospitalizations, and higher rates of readmission. In selected settings, they may coexist with or precede surgical site infections, including periprosthetic joint infections. This review aims to summarize and evaluate recent evidence from the last five years in regards to epidemiology, risk factors, clinical consequences, and preventative strategies for patients undergoing orthopaedic interventions. A narrative literature review was conducted using the PubMed/MEDLINE database utilizing English-language publications from January 2021 to February 2026. Particular emphasis was placed on systematic reviews, meta-analyses, cohort studies, and large database analyses related to hip fracture surgery, total joint arthroplasty, and spine surgery. These studies indicate that urinary tract infections remain particularly common among the geriatric population undergoing hip fracture surgery. Major modifiable risk factors include urinary catheterization and postoperative urinary retention. Symptomatic urinary tract infections briefly prior to surgery are associated with an increased risk of postoperative complications compared to asymptomatic bacteriuria. Avoidance of unnecessary urinary catheterization and routine urine testing in asymptomatic patients reduces the use of unnecessary antibiotics while preserving surgical outcomes. Urinary tract infections continue to represent a significant clinical issue in orthopaedic patients. Evidence supports catheter stewardship, targeted diagnostic strategies, and integrated preventive approaches to reduce infection-related complications.

KEY WORDS: catheter-associated urinary tract infections, hip fractures, postoperative complications, asymptomatic bacteriuria, antimicrobial stewardship

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INTRODUCTION

Urinary tract infection (UTI) is one of the most common healthcare-associated infections. It remains a significant complication in orthopedic care, particularly following hip fracture surgery, total joint arthroplasty (TJA) and spine procedures. In orthopedics, UTI is important not only as a cause of morbidity (delirium, sepsis, prolonged hospitalization, rehospitalization) but also because perioperative bacteriuria may coexist with or precede surgical site infection (SSI). In certain scenarios , it has been analyzed as a potential risk factor for hematogenous periprosthetic joint infection (PJI) [1–4]. Moreover, intensive screening and treatment of asymptomatic bacteriuria (ASB) may lead to inappropriate antibiotic usage, without conclusively reducing the incidence of SSIs or catheter-associated urinary tract infections (CAUTIs) in many contemporary orthopedic cohorts [5,6]. This raises a major concern: how to identify and treat clinically significant infections while maintaining antibiotic stewardship and avoiding catheter-related harm.

Orthopedic patients are exposed to numerous factors that increase the risk of UTI. Such factors include advanced age, frailty, multimorbidity, perioperative bladder catheterization, postoperative urinary retention (POUR), immobilization, blood transfusions and delays in surgical treatment in trauma populations [1,2,7-10]. Recent years have seen a dynamic increase in the number of publications focusing on: (i) the impact of preoperative UTI on the risk of PJI and the importance of timing of its occurrence; (ii) the actual impact of catheter use and catheterization-limiting protocols; (iii) the usefulness of routine urine testing; and (iv) prophylactic packages and rational antibiotic therapy strategies adapted to orthopedic practice.

AIM

- To synthesize the scientific data from the last 5 years (2021–2026) on the incidence, predictors and consequences of urinary tract infections (UTIs) in patients undergoing orthopedic procedures, including joint replacement, hip fracture surgery, and spine surgery.
- Summarize and critically evaluate the current scientific evidence regarding the relationship between perioperative UTI or asymptomatic bacteriuria (ASB) and infectious complications of orthopedic treatment, in particular surgical site infection (SSI) and periprosthetic joint infection (PJI).
- Additionally, the study aims to present evidence-based preventive strategies and clinical management that can be used in perioperative orthopedic care, with particular emphasis on the principles of urinary catheter management and rational antibiotic therapy.

MATERIALS AND METHODS

This narrative review was conducted using a structured literature search strategy. PubMed and MEDLINE base was searched for English-language publications published between January 1, 2021, and February 1, 2026. The search strategy included combinations of keywords and MeSH terms related to the following topics: "urinary tract infection," "catheter-associated urinary tract infection," "asymptomatic bacteriuria," "urinalysis," "urine culture," "postoperative urinary retention," "orthopedics," "proximal femur fracture," "joint replacement," "total hip replacement," "total knee replacement," "periprosthetic joint infection," and "spine surgery." Priority was given to systematic reviews and meta-analyses, randomized or comparative trials, large registry and database analyses, and prospective cohort studies. Studies addressing urinary tract infections (UTIs), asymptomatic bacteriuria (ASB), postoperative urinary retention (POUR), and/or urinary catheterization in the perioperative orthopedic context were included, as well as studies directly assessing the associations with surgical site infection (SSI) or periprosthetic joint infection (PJI). Publications outside the defined time frame, studies addressing non-orthopedic contexts (unless the preventive conclusions were broadly applicable to the care of hospitalized orthopedic patients), and articles retracted from the literature were excluded.

REVIEW

EPIDEMIOLOGY AND CLINICAL BURDEN IN ORTHOPEDIC POPULATIONS

PROXIMAL FEMUR FRACTURES AND ORTHOPEDIC INJURIES

Patients with proximal femur fractures are particularly susceptible to urinary tract infections (UTIs). This is a consequence of their biological fragility, baseline lower urinary tract dysfunction, immobilization and frequent exposure to urinary catheterization. Recent studies indicate a wide range in the incidence of UTIs, depending on the clinical setting and accepted definitions. However, they consistently identify UTIs as a clinically significant postoperative complication associated with an increased risk of sepsis, prolonged hospitalization and rehospitalization [1,2,7]. In a large NSQIP-based analysis of geriatric hip fracture patients without UTI at the time of surgery; postoperative UTI occurred in approximately 3% of patients and was independently associated with sepsis, prolonged hospital stay and readmission [1]. Nursing care studies and adherence analyses in hip fracture care pathways highlight that limiting the use of indwelling catheters and promoting early mobilization are key preventive measures for UTIs. Significant implementation gaps remain in actual clinical practice which are a direct cause of the infections [7,9]. A recent scoping review of postoperative urinary retention (POUR) in older hip fracture patients indicates a strong mechanistic link between urinary retention, the need for catheterization and the subsequent risk of UTI resulting from urinary retention and repeated urinary tract instrumentation [8].

TOTAL JOINT ARTHROPLASTY

The incidence of urinary tract infections (UTIs) in elective joint arthroplasty procedures is generally lower than in populations of patients with hip fractures. However, the very high number of TJA procedures performed means that the grave burden of this complication remains significant. A Polish population-based study based on post-discharge surveillance demonstrated a UTI incidence after hip and knee arthroplasty of less than 1% in administrative data, identifying risk factors related to patient characteristics and the procedure itself, which are important for planning preventive measures [11].

Urinary complications in total joint arthroplasty are closely associated with catheterization practices and postoperative urinary retention (POUR). Meta-analyses indicate that the risk of urinary retention is influenced by factors such as type of anesthesia, pain management strategies, gender, benign prostatic hyperplasia (BPH) and perioperative urological management [12].

SPINE SURGERY

Spine procedures share common risk factors for UTI with joint replacement (older age, opioid use, immobilization). Additional risk may result from longer operative times and greater perioperative fluid balance fluctua-

tions. A 2021 meta-analysis of elective spine surgery found that older age, male gender, benign prostatic hyperplasia (BPH), diabetes, a history of UTI, longer operative times, higher intravenous fluid volumes and multilevel procedures were significantly associated with postoperative urinary retention (POUR). Such causes indirectly increase catheterization and the risk of UTIs [10].

A study published in 2023 assessing the importance of preoperative urine culture and the incidence of postoperative UTIs after spine surgery provides contemporary data indicating that abnormalities in urine tests may be associated with the subsequent development of UTIs. However, the interpretation of these results largely depends on the presence of clinical symptoms and indications for diagnostic tests [13].

RISK FACTORS: REPEATABLE PREDICTORS AND POTENTIALLY MODIFIABLE CAUSATIVE FACTORS

The following predictors have been repeatedly identified in various areas of orthopedics:

- **Patient-related factors:** Advanced age, female gender (in relation to UTI), male gender, and benign prostatic hyperplasia (BPH) in relation to urinary retention, diabetes, high ASA risk class, frailty and/or cognitive impairment and treatment with glucocorticoids [1, 2, 7, 12].
- **Perioperative and systemic factors:** urinary catheterization (both the presence of the catheter and its duration), delayed mobilization, blood transfusions, delayed surgical treatment of proximal femur fractures and prolonged hospitalization [1, 2, 8, 9].
- **Procedure and anesthesia-related factors:** spinal or epidural anesthesia and certain pain management strategies (indirectly by increasing the risk of urinary retention), duration of surgery and the volume of intravenous fluids administered (particularly important in spine surgery) [10, 12].

In a 2024 systematic review and meta-analysis of risk factors for UTI in geriatric patients with hip fracture, urinary catheterization was identified as one of the strongest modifiable risk factors [2]. These findings are consistent with clinical pathways that prioritize early catheter removal and the use of structured protocols for bladder monitoring and support.

THE CATHETERIZATION QUESTION: ROUTINE VERSUS SELECTIVE STRATEGIES

One of the main findings in the literature from 2021 to 2026 is the observation that routine bladder catheterization in modern, fast-track joint replacement surgery is often unnecessary and may increase the risk of urinary tract infections (UTIs). A study published in Arthroplasty Today in 2022, involving primary total hip arthroplasty (THA) under spinal anesthesia concluded that routine catheterization is likely unnecessary and may be associated with an increased number of urological complications, including urinary tract infections (UTIs) [14].

Similarly, a 2025 perspective review published in the Journal of Arthroplasty emphasized that routine catheter use is not required in many patients undergoing primary unilateral TJA, emphasizing the need to assess postoperative urinary retention (POUR) prophylaxis with the risk of UTI [15].

A 2025 retrospective analysis assessing the impact of a protocol change restricting the use of catheters in primary and revision arthroplasty demonstrated that catheter use was associated with a higher rate of UTI and restricting their use reduced infections with only a moderate increase in reversible POUR [16].

PREOPERATIVE URINALYSIS AND ASYMPTOMATIC BACTERIURIA: RECOMMENDATIONS FOR ORTHOPEDICS

ABANDONING ROUTINE URINALYSIS IN ASYMPTOMATIC PATIENTS

A growing body of evidence indicates that routine urinalysis before orthopedic surgery in asymptomatic patients leads to excessive antibiotic use without significantly improving key clinical outcomes. A 2021 study demonstrated that eliminating routine urinalysis before elective orthopedic surgery resulted in a dramatic reduction in antibiotic use, without significantly changing the incidence of surgical site infections (SSIs) or catheter-associated urinary tract infections (CAUTIs) [5].

These findings support antibiotic stewardship strategies, where urine testing should only be performed in patients with clinical symptoms or a clear medical indication.

ASYMPTOMATIC BACTERIURIA (ASB) AND THE RISK OF PERIPROSTHETIC JOINT INFECTION (PJI)

The relationship between ASB and PJI remains a matter of debate, partially due to confounding factors; patients with ASB may be more frail or have a higher comorbidity burden and because microorganisms isolated from urine often differ from those causing PJI. A 2024 systematic review and meta-analysis demonstrated a higher observed incidence of PJI in TJA patients with ASB compared to controls. However, it is important to note that preoperative antibiotic therapy for the eradication of PJI was not found to be significantly beneficial. Furthermore, the studies reviewed noted a lack

of concordance between microorganisms detected in urine and those isolated in periprosthetic joint infections [18].

SYMPTOMATIC PREOPERATIVE UTI AND TIME OF ONSET

Unlike asymptomatic bacteriuria (ASB), symptomatic UTI in the period immediately preceding surgery has consistently been considered clinically significant. A 2022 database study found that UTI diagnosed within 1 week of total knee arthroplasty (TKA) or within 2 weeks of total hip arthroplasty (THA) was associated with an increased risk of periprosthetic joint infection (PJI), whereas previous UTI episodes were not. In this analysis, antibiotic use did not appear to significantly reduce the risk [19].

Not all studies agree on the effect size or causality. At least one recent study found no increase in PJI but reported an increased number of postoperative systemic complications, emphasizing the need to consider UTI as a marker of systemic risk, despite a direct causal relationship with PJI remains uncertain. [20]

A 2024 systematic review and meta-analysis focusing on THA found a statistically significant association between UTI and PJI risk, while the association with ASB was less consistent. [4]

URINARY TRACT INFECTIONS AND SURGICAL SITE INFECTIONS (SSIS) IN ORTHOPEDICS: STRONGEST EVIDENCE IN HIP FRACTURE SURGERY

In orthopedics, the association between perioperative urinary tract infection (UTI) and surgical site infection (SSI) is most consistently documented for hip fracture procedures. A 2023 systematic review and meta-analysis found that perioperative UTI is associated with an approximately 2.4-fold increased risk of SSIs after hip fracture surgery, with the authors emphasizing the heterogeneity of the definitions of UTI used and differences in the timing of its occurrence [3].

From a clinical practice perspective, these results justify careful evaluation of patients for UTI in the perioperative period, immediate treatment of symptomatic infections and rigorous limitation of catheter use to reduce the overall infectious burden.

PREVENTION AND CLINICAL MANAGEMENT STRATEGIES SUPPORTED BY RECENT DATA

PRINCIPLES FOR PREVENTING CATHETER-ASSOCIATED URINARY TRACT INFECTIONS

The 2022 update of the document "Strategies to Prevent Catheter-Associated Urinary Tract Infections in Acute-Care Hospitals" (published in 2023) presents practical recommendations ready for implementation in clinical settings: avoiding unnecessary catheterization, using aseptic catheter insertion technique, maintaining a tight drainage system, ensuring urinary patency and removing the catheter immediately when clinically indicated [21].

These principles have direct application in orthopaedic departments, where excessive catheter use and prolonged catheter retention are common areas requiring improvement in clinical practice.

ADAPTING PRINCIPLES TO ORTHOPEDIC PRACTICE

Recent orthopedic publications indicate that the best preventive outcomes are achieved using protocols that combine the following elements: (i) selective use of catheters based on risk stratification; (ii) standardized bladder monitoring pathways using ultrasound (bladder scan) and intermittent catheterization in cases of urinary retention; (iii) early patient mobilization; (iv) abandoning routine urine testing in asymptomatic patients; (v) supervision of rational antibiotic therapy, limiting prescription of medications based on urine culture results [5, 9, 14, 16].

Interventions aimed at reducing unnecessary catheterization and catheter-associated urinary tract infections (CAUTIs), implemented through structured implementation approaches have also been evaluated in hospital settings. These results support the feasibility of nurse-led protocols that are fully applicable to postoperative orthopedic surgery units [22].

DISCUSSION

This review highlights four practical lessons learned, consistent with the scientific evidence from orthopedic research conducted between 2021 and 2026.

First, urinary tract infection (UTI) remains a clinically significant complication. Particularly in geriatric patients with hip fracture, UTI is associated with an increased risk of sepsis, prolonged hospitalization and frequent readmissions [1, 2]. The hip fracture pathway is particularly susceptible to UTI because patients often require urgent surgery despite having baseline lower urinary tract dysfunction and are frequently catheterized. In this population, UTI also demonstrates the strongest association with an increased risk of surgical site infection (SSI), further justifying the inclusion of urinary tract management in infection prevention in orthopedic trauma [3].

Second, urinary catheterization is the most frequently identified modifiable risk factor across all orthopedic

populations. Data from the field of joint replacement increasingly support the advantage of selective catheterization strategies over routine indwelling catheterization. Supported by cohort analyses of patients undergoing total hip arthroplasty (THA) under spinal anesthesia and studies evaluating the effects of protocol modifications, which have demonstrated a reduction in the incidence of urinary tract infections (UTIs) with a limited increase in postoperative urinary retention (POUR) [14, 16].

In the care plan of patients with hip fractures, guidelines and analyses of actual clinical practice similarly emphasize the need to limit the use of catheters and to provide intermittent catheterization when possible, although the degree of implementation of these recommendations remains variable [7, 9].

Third, routine urinalysis in asymptomatic patients is difficult to justify clinically. Eliminating routine urinalysis before elective orthopedic surgery led to a significant reduction in antibiotic use without an increase in surgical site infections (SSIs) or catheter-associated urinary tract infections (CAUTIs), representing an effective antibiotic stewardship strategy [5].

The problem is particularly acute where a positive urinalysis automatically triggers further cultures and antibiotic prescription despite the absence of urinary symptoms. The literature on asymptomatic bacteriuria (ASB) demonstrates that even when ASB correlates with PJI in observational data, antibiotic treatment does not lead to a convincing reduction in the risk of PJI, and the microorganisms detected in urine rarely overlap with those isolated in periprosthetic infection. These findings suggest that in many cases, ASB may be a marker of increased patient susceptibility rather than a direct cause of PJI [4, 18].

Fourth, both the timing of infection and its phenotype are important. Symptomatic UTI in the period immediately preceding surgery—especially within 1–2 weeks before arthroplasty—has been associated with a higher risk of PJI in large database analyses, justifying postponement of surgery when possible and effective treatment of infection before planned implant placement [19].

Simultaneously, there are conflicting research findings; with some publications suggesting that UTI may primarily predict broader, postoperative systemic complications rather than always directly contributing to PJI [20]. A rational summary suggests that symptomatic infections should be treated and ideally resolved before elective implant surgery, whereas ASB should not automatically lead to the initiation of antibiotic therapy or a delay in surgery unless there are individual patient factors or local protocols to justify such management. From a systems perspective, orthopedic departments can probably achieve the greatest reduction in the UTI burden by focusing on rational catheter management (avoiding unnecessary catheterization, early catheter removal, using structured bladder monitoring protocols) and rational use of diagnostics (investigation and treatment only when clearly clinically indicated).The inclusion of structured guidelines for the prevention of catheter-associated urinary tract infections (CAUTI) in orthopedic care pathways is supported by high-quality implementation recommendations for hospitals [21]. Furthermore, orthopedic studies suggest that the use of these interventions does not significantly worsen clinical outcomes when combined with strategies for managing postoperative urinary retention (POUR) [14, 16].

CONCLUSIONS

1. UTI remains a significant postoperative complication in orthopedics, with the greatest clinical consequences observed in geriatric patients with hip fracture, where UTI is associated with systemic complications and an increased risk of surgical site infection (SSI).
2. Perioperative urinary catheterization, routine use of indwelling catheters and their long-term maintenance are the most frequently identified modifiable risk factors for urinary tract infections (UTIs) in orthopedic care. Current evidence supports a strategy of selective catheter use, early removal and the use of standardized algorithms for bladder monitoring using ultrasound (bladder scan) and intermittent catheterization to manage urinary retention while minimizing the risk of infection.
3. Routine preoperative urinalysis or culture in asymptomatic orthopedic patients is not recommended in many contexts because it leads to overuse of antibiotics without demonstrable benefit in reducing the incidence of surgical site infections (SSIs) or catheter-associated urinary tract infections (CAUTIs). This represents an important area for implementing antimicrobial stewardship strategies.
4. Symptomatic urinary tract infection occurring immediately before planned arthroplasty should be treated and if possible, surgery should be postponed until clinical symptoms resolve. This is justified by data indicating that recent UTI is associated with an increased risk of periprosthetic joint infection (PJI). However, antibiotic treatment of asymptomatic bacteriuria (ASB) does not demonstrate reliable efficacy in PJI prevention and may lead to excessive use of antibacterial drugs.

5. The most practical and implementable preventive measures in orthopedics include: (i) avoidance of catheterization or early removal of catheters; (ii) structured pathways for the prevention and management of postoperative urinary retention; (iii) early patient mobilization; (iv) test-and-treat strategies consistent with guidelines for the prevention of catheter-associated urinary tract infections (CAUTI) and the principles of rational antibiotic stewardship.

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CONFLICT OF INTEREST
The Authors declare no conflict of interest

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