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Review

The relationship between asymptomatic bacteriuria and surgical site infection in hip fracture patients: a systematic review and meta-analysis

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SUMMARY

Background: There is no consensus on whether asymptomatic bacteriuria (ASB) should be screened for and treated in hip fracture patients (HFPs). ***Aim:*** The aim of this study was to assess the relationship between the rate of peri-operative ASB and surgical site infection (SSI) in HFPs and explore the effect of treating ASB. ***Methods:*** PubMed, CINAHL and Cochrane Library were searched to identify studies that evaluated the relationship between peri-operative ASB and SSI. Meta-analysis was performed using a fixed- or random-effect model, as indicated. The study was prospectively registered with the International Prospective Register for Systematic Reviews (CRD42023431037). ***Results:*** A total of 2272 records were identified, with three studies included. The total sample size was 247 patients. Meta-analysis of all three studies reporting on ASB in HFPs (treated and not treated) showed an estimated SSI rate of 7.3% (95% confidence interval [CI]: 2.0–23.5%). The meta-analysis of two studies reporting on HFPs whose ASB was treated showed an overall estimated SSI rate of 13.0% (95% CI: 8.1–20.3%). However, in two studies in which ASB was not treated, the overall estimated SSI rate was 4.4% (95% CI: 1.7–11.2%). Due to the small number of studies, formal comparison between the two groups was not performed. ***Conclusion:*** There is a dearth of high-quality evidence to guide the management of ASB in HFPs. Hence, an approach involving risk stratification, local antimicrobial resistance patterns and rapid diagnostic tools may be considered in this vulnerable cohort. In addition, as SSIs can have devastating effects on HFPs, using the principle of caution, hospitals may consider screening and treating positive ASB. Furthermore, high-quality evidence is needed to determine the concrete relation between ASB and SSI rates in HFPs and determine the role of ASB treatment in reducing SSI rates.

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Introduction

Hip fractures are commonly encountered in elderly patients, a vulnerable cohort by virtue of their substantial underlying comorbidities. They are managed surgically in most cases. Surgical site infection (SSI) after surgery is detrimental to patients and confers substantial costs to healthcare services [1]. Globally, the incidence of hip fractures is expected to double in the next two to three decades [2]. With an estimated 76,000 hip fractures occurring each year in the UK, SSIs could affect a large number of patients [3].

The UK Health Security Agency SSI surveillance report of National Health Service hospitals in England (April 2023 to March 2024) showed that the combined SSI risk in elective and emergency hip replacement surgery was 0.5%. The SSI risk after hip replacement for hip fracture was reported as 0.2%, whereas the risk after surgical fixation was reported as 0.7% [4]. However, the estimated SSI risk of hip fracture patients (HFPs) from research articles has been reported as 2.1%, a rate higher than that suggested by the national surveillance report [1]. Early deep SSIs after hip fracture surgery are associated with a three-fold increase in 30-day mortality and a two-fold increase in one-year mortality [5,6].

Moreover, longer hospital stays, diminished quality of life and higher financial burden on the survivors of SSI have major clinical and cost implications on the healthcare system as a whole [5,7,8]. A study in Ireland found that the total cost associated with management of SSI post hip fracture surgery in a cohort of 16 patients was €712,898, corresponding to an average of €44,556 per patient [9]. Hence, there is a need for effective strategies to prevent SSI in this group of patients.

According to the 2023–2024 UK Health Security Agency surveillance report, Enterobacterales made up the highest proportion of causative organisms for superficial and deep SSI across surgical specialities. The most common Enterobacterales species was *Escherichia coli (E. coli)*. Enterobacterales SSIs accounted for 12.8% of superficial and 22.5% of deep infections following hip replacement surgery, and 24.7% of superficial and 20.9% of deep infections following repair of neck of femur fracture surgery [4]. Superficial SSI has been defined as one that occurs within 30 days of surgery and involves only the skin or subcutaneous tissue of the incision, whereas deep SSI is one which involves the deep tissues (fascial and muscle layers) within a year of implant placement [10]. As Enterobacterales are the most common causative organisms in urinary tract infection (UTI), there is increasing concern that symptomatic and asymptomatic colonisation of the urinary tract may be linked to SSI following hip fracture surgery [11].

Urinary bacteriuria may be symptomatic or asymptomatic. UTI refers to bacteriuria in the presence of focal urinary symptoms and signs, like urinary urgency, frequency, dysuria and loin tenderness [12]. Bacteriuria in the absence of clinical symptoms is referred to as asymptomatic bacteriuria (ASB), and its clinical significance is not well understood. Currently, the only indication for treatment of ASB with antibiotics is in pregnant women as it is a risk factor for pyelonephritis and premature delivery [13].

There is growing evidence of a positive correlation between ASB and SSI risk in elective orthopaedic joint replacement surgery [14]. However, its role in the emergency hip fracture setting remains unclear due to differences in patient characteristics, surgical urgency and peri-operative care pathways.

In a recent meta-analysis, our group showed that UTI was associated with a 2.4-fold increased risk of SSI in hip fracture surgery. Based on this result, we recommended considering the possibility of peri-operative UTI in HFPs, with treatment administered, as necessary, to reduce SSI rates [15]. However, there is limited evidence regarding the relation of ASB and SSI in hip fracture surgery to guide practice. Hence, this study was conducted with the primary objective of determining the rate of SSI in HFPs in the presence of pre-operative ASB. The secondary objective was to explore whether treatment of ASB could reduce SSI rates, through a systematic review and meta-analysis.

Methods

This systematic review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses updated guideline in 2020 [16]. The study was prospectively registered with the International Prospective Register for Systematic Reviews (CRD42023431037).

Search strategy

A literature search was performed by two researchers independently across PubMed, CINAHL and Cochrane Library databases from their respective inceptions to 6th November 2025. The search strategy involved the following keywords: urinary, hip, femur, femoral, fracture and bacteriuria. Studies which evaluated the relationships between ASB in the peri-operative period and SSI in HFPs were included with no language restriction. The exclusion criteria were systematic reviews/meta-analyses and case series reporting on less than 10 cases.

Study selection

Two researchers independently screened all the articles by titles and abstracts in order to identify potentially relevant articles. Full manuscripts of the chosen articles were then independently reviewed by the two researchers to select eligible articles. Disagreements over the selection of articles were settled by discussion between the two researchers and, if necessary, by arbitration by a senior researcher. Authors of relevant articles were contacted, as necessary, to provide more information or clarification about their respective studies, and two replies were obtained. The reference lists of all included studies were reviewed to identify any articles missed by the literature search.

Data extraction

A predesigned proforma was used to extract data items, including patient demographics, clinical outcomes and complications. The Cochrane Risk of Bias Tool [17] was used to

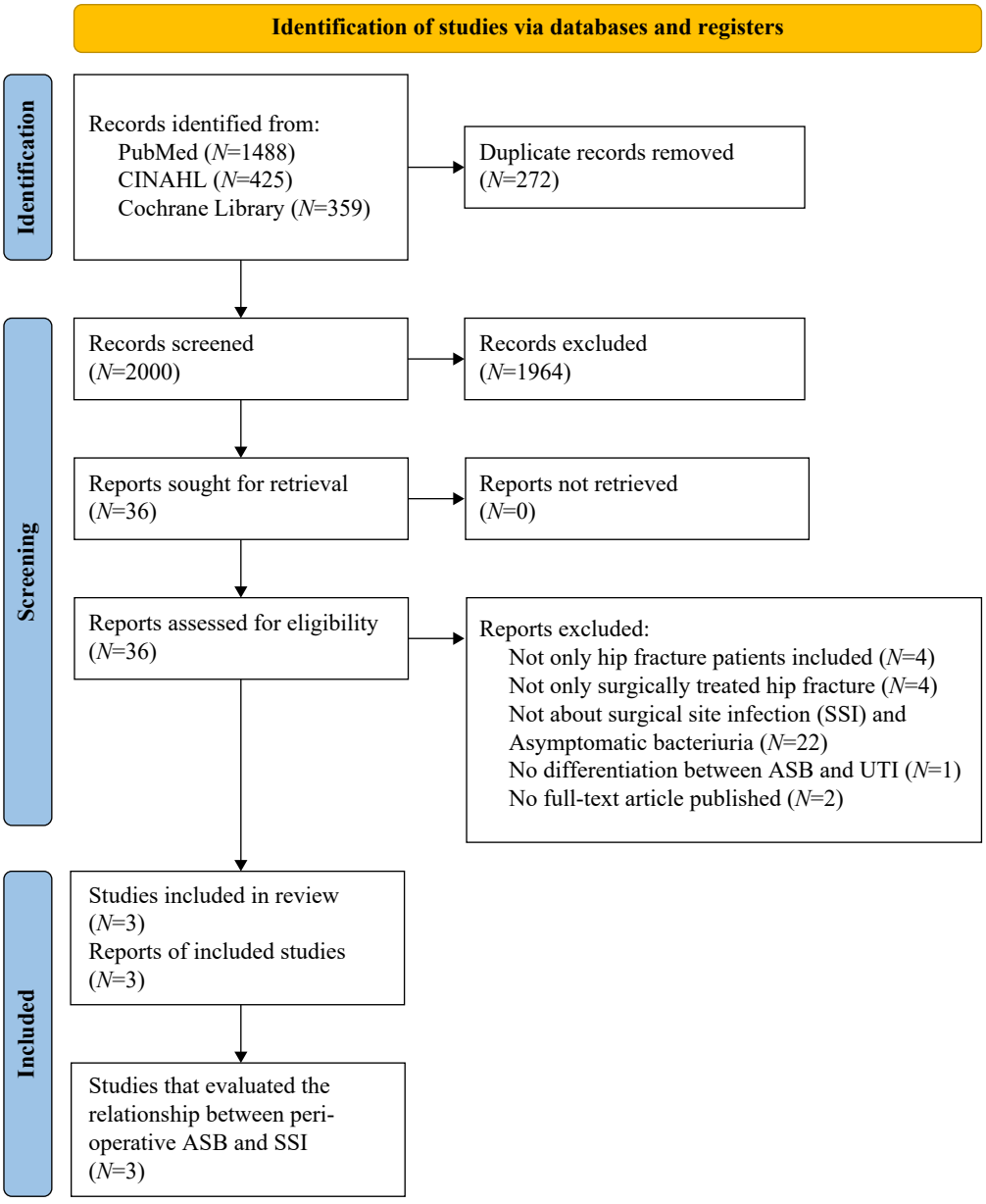
assess the risk of bias in included randomised controlled trials (RCTs) and the Methodological Index for Non-Randomized Studies tool [18] for assessment of bias in observational studies. Two researchers independently assessed the risk of bias with disagreements being resolved by the senior researcher. The Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach was used to assess the quality of evidence of the review [19].

Statistical analysis

A summary of patient demographics and study characteristics was constructed. A meta-analysis was performed on homogeneous studies using a fixed-effect model for analysis involving two studies and a random-effect model for analyses involving three or more studies. Estimated SSI rates and 95% confidence intervals (CIs) were calculated. Heterogeneity was to be assessed using I^2, τ^2 and Q values if five or more studies were included in the analysis. Statistical analysis was performed using Comprehensive Meta-analysis version 2 (Biostat, Englewood, NJ, USA) software.

Results

A total of 2272 records were identified on performing a literature search across PubMed, CINAHL and Cochrane Library databases. Three studies, with a total of 247 patients, which evaluated the relationship between peri-operative ASB and SSI, were included after removal of duplicate articles, screening of articles by title and abstract and full manuscript review (Figure 1). Table I shows demographics and characteristics of



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

Figure 1. PRISMA flow diagram 2020. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Table I

Demographics and characteristics of included studies

Study	Design, centre, duration, country	Population definition	Sample size (ASB)	Mean age in years (SD)	Sex	Definition of ASB	Definition of SSI	Antibiotics started pre-operatively for ASB	Antibiotics given peri-operatively for routine surgery	Antibiotics given postoperatively for UTI
Rodríguez-Pardo *et al.* (2021)	Randomised controlled trial, multi-centred, 27 months (September 2016—Nov 2018), Spain	Age ≥18 years undergoing hip fracture surgery Exclusion criteria: Concomitant infection requiring antibiotics, hip fractures treated with screws or THA	Total 152 77 ASB treated 75 ASB not treated	84.5 (7.9) Treated ASB = 84.6 (7.2) Untreated ASB = 84.2 (8.6)	Total: Males = 28 (18.4%) Females = 124 (81.6%) Treated ASB: Males = 12 (15.6%) Females = 65 (84.4%) Untreated ASB: Males = 16 (21.3%) Females = 59 (78.7%)	Urine C/S growing ≥10^5 cfu/mL of a bacteria species in a patient lacking symptoms of a UTI (symptoms not described)	PJIs occurring within 3 months after HHA (early-PJI). PJI diagnosed with the criteria established by the Infectious Diseases Society of America	77 patients treated with 3 g of fosfomycin-trometamol (oral route) between 24 and 6 h before surgery; 75 not treated	1st line — 2 g cefazolin IV at induction (one centre — combined with gentamicin) and 1—2 g IV 6—8 hourly for 24 h, but exact schedule varied	Not reported
Garcia-Nuño *et al.* (2017)	Prospective cohort study, multi-centred, unspecified duration, Spain	Patients with a femoral neck fracture Exclusion criteria: patients who received antibiotics within 2 weeks before the fracture, received postoperative antibiotics or had been diagnosed with UTI (symptomatic bacteriuria) during the hospital stay	No dementia — 11	Not specified	Not specified	Positive urine culture was defined as >10^5 cfu/mL Patients diagnosed with UTI were excluded. Difference between UTI and ASB is only based on expression of symptoms by patients. However, as patients with dementia have difficulties in explaining UTI symptoms, some UTI may be underdiagnosed.	Acute PJI, according to Tsukayama criteria — local inflammatory signs, purulent drainage through the wound and elevated C-reactive protein during the first 4 weeks after joint arthroplasty	No	One dose of first-generation cephalosporin during anaesthesia induction and second dose in case of high volume of bleeding or duration of surgery >2 h	No
Ashraf *et al.* (2014)	Prospective cohort study, single-centred, 6 months (October 2012 —April 2013), Pakistan	Postmenopausal women with pre-operative 'asymptomatic UTI' undergoing hip fracture surgery Exclusion criteria: other sources of active infection like sore throat, chest infection, diarrhoea etc.	84	63.57 (10.34)	84 females (100%)	Termed 'asymptomatic UTI' — defined as having no dysuria, no fever, no suprapubic tenderness, no costovertebral pain, no frequency, no urgency, urine showing >6 leucocytes or nitrite positivity and confirmed with positive urine culture (positive urine culture was not further described)	Presence of any one or more of the following: purulent discharge from the wound; pain or tenderness over the wound; swelling over the wound; abscess in the wound, within 30 days of the procedure, confirmed by swab culture and sensitivity	Yes (IV ceftriaxone + amikacin [for patients with normal creatinine])	Yes, same as pre-operatively for 5—7 days, stopped early if urine culture was clear	

ASB, asymptomatic bacteriuria; SD, standard deviation; SSI, surgical site infection; UTI, urinary tract infection; THA, total hip arthroplasty; C/S, culture and sensitivity; cfu, colony-forming units; PJI, prosthetic joint infection; HHA, hip hemi-arthroplasty; g, grams; IV, intravenous.

all the studies included. The definition of ASB and SSI varied among the included studies. A detailed summary of antibiotic prophylaxis in the three studies included is also provided in Table I. Table II provides an overall summary of the SSI rates in each of the selected studies. The organism identified in the ASB and SSI cases in the included studies is summarised in Table III. There was minimal crossover of organisms between the ASB urine sample and SSI sample, with only one case showing the same organism (*Pseudomonas aeruginosa* [*P. aeruginosa*]). Antimicrobial resistance or changes in SSI microbiology was not reported in the included studies.

One study reported the SSI rate in HFPs with ASB and in those with no ASB [20]. Two studies reported on cohorts of HFPs who underwent hip fracture surgery without treatment of their ASB [20,21], and two studies reported on cohorts who had treatment for their ASB commenced before undergoing hip fracture surgery [20,22].

The meta-analysis of all three studies reporting on ASB in HFPs (treated and not treated) showed an estimated SSI rate of 7.3% (95% CI: 2.0–23.5%) (Figure 2). The meta-analysis of the two studies reporting on HFPs whose ASB was treated showed an overall estimated SSI rate of 13.0% (95% CI: 8.1–20.3%) (Figure 3). In the two studies in which ASB was not treated, the overall estimated SSI rate was 4.4% (95% CI: 1.7–11.2%) (Figure 4).

As only one study reported the SSI rate in HFPs with ASB versus no ASB, a formal comparison between these two groups was not performed. Similarly, heterogeneity assessment, sensitivity analysis and small study effect assessment were not performed due to the small number of studies included.

Bias assessment

Critical appraisal of the included studies is summarised in Table IV. Of the studies included, both the non-RCTs had a score above 10. A score of 9–12 is considered indicative of moderate quality. A clearly stated aim was observed with adequate statistical analysis in all studies.

Quality of evidence

The GRADE approach was used to assess the overall quality of evidence, which was determined to be 'low' [19]. The review consisted of one RCT and two non-randomised studies. There was inconsistency with methodological and clinical heterogeneity, and variability in the results was reported.

Discussion

This meta-analysis showed an overall estimated SSI rate of 7.3% is associated with ASB in HFPs. The estimated SSI rates for treated and untreated ASB were 13% and 4.4%, respectively. The overall estimated SSI rates in patients with ASB are on the higher end of those reported in literature for HFPs. However, this is based only on 3 studies, with corresponding very broad CIs. The only study which compared SSI rates in both ASB and non-ASB groups showed these to be similar (2.63 vs 2.5%) [20]. Due to the small number of studies examined, the role of ASB treatment in HFPs could not be assessed. Our findings show that there is sparse evidence to robustly guide appropriate management of ASB to prevent SSI in HFPs. However, the lack of evidence does not equate to an absent relation between ASB and SSI or that treatment of ASB is not essential. Further high-quality evidence is needed to determine the concrete relation between ASB and SSI rates and also to determine the role of ASB treatment in reducing SSI rates in this patient population.

There has been a gradual increase in the prevalence of Gram-negative organisms in SSIs. According to the 2023–2024 UK Health Security Agency SSI surveillance report,

Table II
Results

Study	Sample size	SSIs
Rodríguez-Pardo *et al.* (2021)	Total ASB = 152	4/152 (2.63%)
	77 treated ASB	2/77 (2.6%)
	75 not treated ASB	2/75 (2.7%)
	No ASB = 442	11/442 (2.5%)
Garcia-Nuño *et al.* (2017)	11 (no dementia)- not treated	0/11 (0%)
Ashraf *et al.* (2014)	84 treated	14/84 (16.7%)

SSI, surgical site infection; ASB, asymptomatic bacteriuria.

Table III
Aetiology of ASB and SSI

Study	Aetiology of ASB	Aetiology of SSI
Rodríguez-Pardo *et al.* (2021)	*Escherichia coli*	*Staphylococcus epidermidis*
	Klebsiella pneumoniae	*Corynebacterium striatum*
	Escherichia coli ESBL producer	MRSA
	Escherichia coli	*Staphylococcus epidermidis*
Garcia-Nuño *et al.* (2017)	*Escherichia coli*	MSSA, *Proteus* subspecies
	Pseudomonas aeruginosa	*Pseudomonas aeruginosa*
Ashraf *et al.* (2014)	Not specified	Not specified

ASB, asymptomatic bacteriuria; SSI, surgical site infection; ESBL, extended-spectrum beta-lactamase; MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-sensitive *Staphylococcus aureus*.

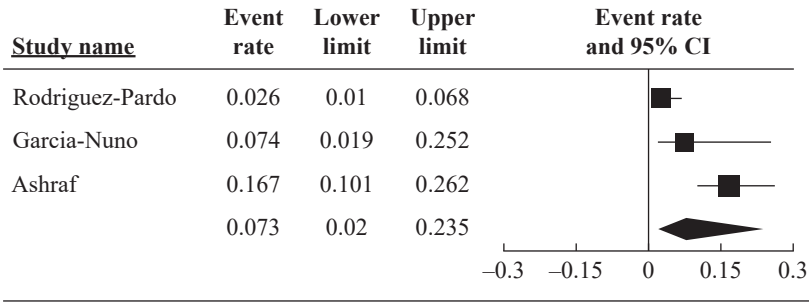


Figure 2. Estimated surgical site infection rate with asymptomatic bacteriuria. CI, confidence interval.

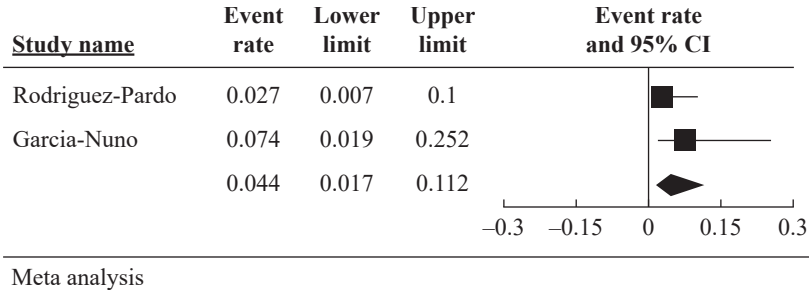


Figure 3. Estimated surgical site infection rate with untreated asymptomatic bacteriuria. CI, confidence interval.

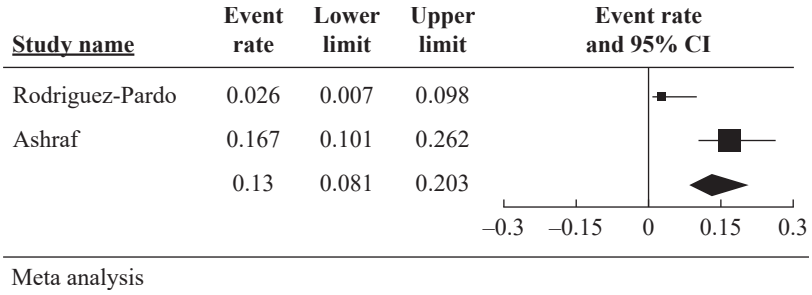


Figure 4. Estimated surgical site infection rate with treated asymptomatic bacteriuria. CI, confidence interval.

Enterobacterales made up the highest proportion of causative organisms for superficial and deep SSI across surgical specialities, accounting for 12.8% of superficial and 22.5% of deep infections following hip replacement surgery and 24.7% of superficial and 20.9% of deep infections following repair of neck of femur fracture surgery [4]. A study assessing deep infection after hemi-arthroplasty found that concurrent UTI was an independent predictor of developing SSI and that the presence of Gram-negative organisms reduced the effectiveness of implant retention surgery [23]. The national action plan for antimicrobial resistance in the UK from 2024 to 2029 aims to prevent any increase in Gram-negative bloodstream infections in humans from the 2019-to-2020 baseline rate [24]. As Enterobacterales are commonly encountered in ASB and UTI, there is increasing concern that colonisation of the urinary tract may be linked to SSI following hip fracture surgery.

UTI is defined as bacteriuria with a colony count of at least 10^5 colony-forming units (cfu)/mL and at least 1 urinary sign or symptom. ASB refers to the presence of one or more species of bacteria growing in the urine at specified quantitative counts ($\geq 10^5$ cfu/mL), irrespective of the occurrence of pyuria, in the absence of signs or symptoms attributable to UTI [12].

The aetiology of ASB is multi-factorial, some proven and others debatable. A shorter urethra predisposes women to have bacteriuria as it makes it easier for bacteria to travel from the urethral meatus and perineum to the bladder [25]. Elderly individuals above 80 years of age and those living in nursing homes are more likely to have ASB [26]. Incomplete bladder emptying in the elderly population is also a factor that makes them more prone to develop ASB [27].

Several mechanisms have been postulated to explain the relationship between UTI and SSI. Some of these may also be used to explain any potential relation between ASB and SSI risk. Direct contamination of the wound by infected urine may occur, especially in the presence of cognitive impairment, which is commonly encountered among HFPs [15,28,29]. Wound infection may also occur via the bloodstream, and it has been shown that the haematoma at the site of a hip fracture commonly contains bacteria even before surgery. Haematogenous spread may be related to bacterial translocation, whereby

Table IV
Bias assessment

Non-RCTs-MINORS tool (the items are scored 0 [not reported], 1 [reported but inadequate] or 2 [reported and adequate]). Maximum possible score being 16.

Criteria	Garcia-Nuño *et al.*	Ashraf *et al.*
A clearly stated aim	2	2
Inclusion of consecutive patients	2	2
Prospective collection of data	2	2
Endpoints appropriate to the aim of study	2	2
Unbiased assessment of study end point	1	1
Follow-up appropriate to the aim of study	2	1
Loss to follow-up <5%	0	2
Prospective calculation of study size	0	2
Total	11	14

RCT — Cochrane Collaboration's tool for assessing risk of bias (adapted from Higgins and Altman)

Bias domain	Source of bias	Author's judgement	Support for judgement
Selection bias	Random sequence generation	Low risk	Random assignment of participants with ASB in a 1:1 ratio to receive treatment or not. Establishment of a parallel follow-up cohort of hip hemi-arthroplasty patients without ASB.
	Allocation concealment	Unclear risk	The randomisation list was centralised and stratified by centre, but further description of allocation is not included
Performance bias	Blinding of participants and personnel	High risk	Open label
Detection bias	Blinding of outcome assessment	High risk	Open label
Attrition bias	Incomplete outcome data	High risk	Losses to follow-up and death were disclosed. Twenty-two patients with ASB, who were considered at risk for fosfomycin resistance, were not randomised. As an interim analysis showed that it was not possible to test the hypothesis, the study was discontinued midway. Hence, adequate sample size of 1394 patients (697 per group) could not be achieved.
Reporting bias	Selective reporting	Low risk	All prespecified outcomes were reported
Other bias	Anything else, ideally prespecified	-	-

RCT, randomised controlled trial; MINORS, Methodological Index for Non-Randomized Studies; ASB, asymptomatic bacteriuria.

bacteria in the urine may pass through the uroepithelium into the renal interstitium and subsequently into the bloodstream [30]. In an animal study, uropathogenic *Escherichia coli* (UPEC) cultured from five humans with ASB formed intracellular bacterial communities (IBCs) and caused cystitis in a mouse model. In fact, the ASB strains produced more IBCs within the bladder, which were also greater in size than acute UTI strains. Understanding the basis of the IBCs formed by UPEC will throw more light on the need for evaluation and treatment of ASB [31].

We previously showed in a meta-analysis that UTI is associated with a 2.4-fold increased risk of SSI in hip fracture surgery. Based on those findings, we recommended that perioperative UTI has to be considered in HFPs and treatment has to be administered, as necessary, to reduce SSI rates [15]. The current study has gone a step further, looking at ASB and SSI in HFPs.

Evaluating HFPs for ASB may be undertaken with clinical history-taking (to determine the absence of UTI symptoms) and clinical examination. Routine urine testing could be performed with point-of-care tests, like semi-automated urine analysers based on the level of cfu/mL and culture-based devices [32,33]. There are point-of-care culturing techniques with high negative predictive values, which could give results within 8 h. Similarly, there are assays evaluating up to 20 bacterial targets in less than 3 h. [34]. If point-of-care tests show positive results, then antibiotic treatment

may be considered until standard urine culture results become available or until a negative culture result is obtained. Another revolutionary option would be to use molecular assays like multiplex polymerase chain reaction (PCR) for ultra-rapid diagnosis of bacteriuria [34]. Such techniques have already made a breakthrough in the diagnosis of gastrointestinal infection, with higher detection rates reported than culture-based techniques [35]. PCR-based technologies are better at identifying not only common organisms, like *E. coli*, but also fastidious organisms associated with ASB if they are included in the panel targets [36,37]. Rapid semi-automated culture techniques and ultra-rapid screening using molecular techniques, where possible, would ensure that ASB in HFPs is detected promptly and management carried out appropriately. Our institution is already considering this strategy.

In the presence of ASB identified prior to hip surgery, there are three management options: 1) ignore the ASB and proceed with surgery, 2) start antibiotic treatment for ASB and proceed with hip fracture surgery and 3) treat the ASB with antibiotics and wait until a negative urine culture prior to proceeding with surgery. Among the studies which were analysed, two studies reported on cohorts of hip fractures who underwent hip fracture surgery without treatment of their ASB [20,21] and two studies reported on cohorts who were commenced on antibiotic treatment for ASB prior to proceeding with hip fracture surgery [20,22]. As delays in hip fracture surgery are associated with increased postoperative morbidity and mortality, the preferred option would be to avoid any delays and proceed with surgery [38,39].

There is increasing evidence that ASB in elective orthopaedic joint replacement surgery is associated with a significant risk of SSI. However, a consensus in treating ASB has not yet been reached [14]. Sousa *et al.* found a significantly higher incidence of prosthetic joint infection in the ASB group vs the non-ASB group in elective hip and knee arthroplasty, with an odds ratio of 3.23 [40]. Gómez-Ochoa *et al.* observed that the incidence of SSI in the ASB group was higher than that in the non-ASB group in elective hip, knee and shoulder arthroplasty (2.3% vs 1.1%) [41]. A retrospective study on primary total hip arthroplasty patients by Peng *et al.* concluded that a positive pre-operative bacteriuria result on urinalysis significantly increased the risk of SSI, re-admission and length of stay, irrespective of the urine culture result [42].

Our findings show that there is insufficient evidence to formally compare HFPs whose ASB was treated with those whose ASB was untreated. However, lack of evidence does not mean that treatment of ASB is not essential. It is established that a positive relation exists between ASB and SSI in elective orthopaedic joint arthroplasty [14,40,41]. Moreover, SSI can have devastating consequences for the highly vulnerable hip fracture population [1], often requiring surgical wound debridement, implant removal or revision surgery, in addition to antibiotic treatment [43]. Faced with these facts, while high-quality evidence is awaited, it would be beneficial to develop an investigation and treatment algorithm, as a first step towards management of ASB in HFPs. Understanding the role of rapid and ultra-rapid screening techniques for ASB is of paramount importance to the formulation of such an algorithm. Until then, local hospitals could consider applying the principle of caution and screening for, as well as treating ASB in HFPs, while proceeding with surgery. Such treatment could be continued post surgery until a negative urine culture is obtained or until the surgical wound heals, thereby covering the high-risk period for SSI.

This study has certain limitations. A limited number of studies were analysed, which included a relatively small number of patients. There was heterogeneity in the included studies in relation to population demographics and definitions or diagnostic criteria for ASB and SSI. This could possibly explain the unusually high SSI rate in the group treated for ASB, as opposed to the untreated group. Only one randomised trial was available with the other two studies being observational. Moreover, the former study was discontinued midway as an interim analysis performed by the authors suggested that it would not be possible to test the hypothesis. The inability of this study to reach the target sample size could be considered a critical limitation with serious implications on the strength of evidence available. As only one study compared SSI rates in treated and untreated ASB groups, formal comparison was not conducted, limiting the ability to assess the effect of treatment.

Nonetheless, despite these limitations, our study is the first to analyse in a systematic way the available evidence of the relation between ASB and SSI rates in a highly vulnerable patient population and identify current evidence gaps.

In conclusion, we have shown that there is a dearth of high-quality evidence to support or refute routine treatment of ASB in HFPs. In the absence of high-quality evidence, an approach involving risk stratification, local antimicrobial resistance patterns and rapid diagnostic tools may be considered. As SSI can have devastating effects on these patients, it would be beneficial to develop an investigation and treatment algorithm incorporating rapid and ultra-rapid screening techniques as a first step towards management of ASB in HFPs. In addition, using the principle of caution, hospitals may consider screening and treating positive ASB. Further work is needed to determine the concrete relation between ASB and SSI rates and the role of ASB treatment in this highly vulnerable patient population.

CRediT authorship contribution statement

R.R. Nair: Writing — review & editing, Writing — original draft, Validation, Resources, Project administration, Methodology, Investigation, Data curation. **E.M.A. Ahmed:** Validation, Methodology, Investigation, Formal analysis, Data curation. **K.F.K. Suen:** Resources, Methodology, Investigation, Data curation, Conceptualization. **A. Gopinathannair:** Resources, Methodology, Investigation, Data curation. **V. Sivaprakasam:** Writing — review & editing, Writing — original draft, Validation, Supervision, Project administration, Methodology. **C.P. Charalambous:** Writing — review & editing, Writing — original draft, Validation, Supervision, Software, Project administration, Methodology, Formal analysis, Conceptualization.

Ethics statement

Not required.

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Conflict of interest statement

None declared.

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