DOI: https://doi.org/10.61841/rxykwd94 Publication URL: https://nnpub.org/index.php/MHS/article/view/2069

ANTIBIOTIC PROPHYLAXIS IN UROLOGIC PROCEDURE : A COMPREHENSIVE SYSTEMATIC REVIEW

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ABSTRACT

Background: *Antibiotics are synthetic molecules that can destroy or inhibit the growth of microorganisms without harming the host. They can be used for prophylactic purposes to reduce the incidence of postoperative infection of which duration should not exceed 24hrs in many procedures given one hour prior to incision. Also antibiotics for treatment purposes are given when an established infection has been identified. Urologists commonly prescribe antimicrobial agents before, during, and after urologic procedures.*

The aim: *This study aims to show about antibiotic prophylaxis in urologic procedure.*

Methods: *By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2014 and 2024 were taken into account. Several different online reference sources, like Pubmed and SagePub, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.*

Result: *In the PubMed database, the results of our search brought up 34 articles, whereas the results of our search on SagePub brought up 77 articles. The results of the search conducted for the last year of 2014 yielded a total 26 articles for PubMed and 55 articles for SagePub. The result from title screening, a total 16 articles for PubMed and 25 articles for SagePub. In the end, we compiled a total of 10 papers. We included five research that met the criteria.*

Conclusion: *Antibiotic therapy should be considered only for procedures in which studies have shown a clinical benefit in the prevention of infection. It is important to establish the duration and type of treatment for antimicrobial therapy for surgical prophylaxis in patients with AB who are going to receive urological invasive procedures.*

Keyword: *Antibiotic prophylaxis, urologic procedure, preoperative, postoperative.*

INTRODUCTION

The main aim of surgical antimicrobial prophylaxis (SAP) in urologic procedures is to prevent bacteraemia, surgical site infections (SSIs), and postoperative urinary tract infections (ppUTIs). Studies carried out in adults have tried to identify the most relevant risk factors for the development of urologic surgery-related infections, the clinical conditions in which antibiotics could be recommended, and finally, which antibiotics are appropriate for each clinical condition and when and how they should be prescribed. Unfortunately, mainly due to the relatively low number of appropriately conducted randomized controlled clinical trials, national guidelines developed by local experts have frequently differed. For several urological procedures, different conclusions have been drawn, making it very difficult to decide which could be the most effective and safe antibiotic prescription. This explains why most of the studies carried out to evaluate how antibiotics are used to prevent infections in patients undergoing urological procedures have shown substantial variations in practice patterns among surveyed urologists.[1]

Guidelines are available for the use of antimicrobial prophylaxis in open operative procedures to prevent postoperative wound infections. However, the field of urology uses unique surgical approaches to treat various urologic conditions. Quite often, our approach does not require incisions; instead we use transluminal (endoscopy and catheter manipulation), transrectal (biopsy of the prostate) and/or completely non-invasive (extracorporeal shock wave lithotripsy [ESWL]) techniques. In urologic procedures, infections may arise not only from skin or rectal flora, but also from organisms in the vicinity of the operative site (i.e., struvite stones, subclinical prostatitis, pre-existing Foley catheters and stents). The sequelae of these infections can have devastating consequences, including significant morbidity and even death.[2]

Asymptomatic bacteriuria (AB) or urinary tract colonisation is defined as the isolation of bacteria in a urine sample collected properly from a person who has no signs or symptoms of a UTI. This colonisation of the urinary tract is common in diabetic women, with a prevalence of 8–14%, in pregnant women (2–7%) , in men aged >60 years (6–15%), and in patients with spinal cord injury, with a prevalence rate of >50%.[3,4]

There is clinical evidence that AB should be treated in pregnant women because it decreases the risk of pyelonephritis by between 4% and 20%, and reduces the risk of premature birth. Antibiotic therapy should be used for patients with AB who are going to undergo urological surgery due to a 60% risk of presenting with infectious complications such as bacteraemia and a 10% risk of sepsis. For this condition, some clinical trials have shown that antibiotic prophylaxis in patients with AB decreases the risk of bacteraemia and sepsis in the postoperative period; but there is no consensus on the treatment type or when to start antibiotic therapy. Studies have started prophylaxis from 1 to 7 days before the procedure, without determining the differences in the results for each intervention.[3,5]

METHODS

Protocol

By following the rules provided by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

Criteria for Eligibility

For the purpose of this literature review, we compare and contrast antibiotic prophylaxis in urologic procedure. It is possible to accomplish this by researching or investigating antibiotic prophylaxis in urologic procedure. As the primary purpose of this piece of writing, demonstrating the relevance of the difficulties that have been identified will take place throughout its entirety.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English, and it needs to determine about antibiotic prophylaxis in urologic procedure. In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2014, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

Search Strategy

We used "antibiotic prophylaxis in urologic procedure." as keywords. The search for studies to be included in the systematic review was carried out using the PubMed and SagePub databases by inputting the words: *((*"Antibiotic*"[MeSH Subheading] OR* "Antibiotic prophylaxis*"[All Fields] OR* "Urologic procedure*" [All Fields]) AND (*"Mechanism of antibiotic*"[All Fields] OR* " effects of antibiotic prophylaxis *"[All Fields]) AND (*"Mechanism of urologic procedure*"[All Fields]) OR (*"Kind of urologic procedure" *[All Fields]))* used in searching the literature.

Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and can't have been seen anywhere else.

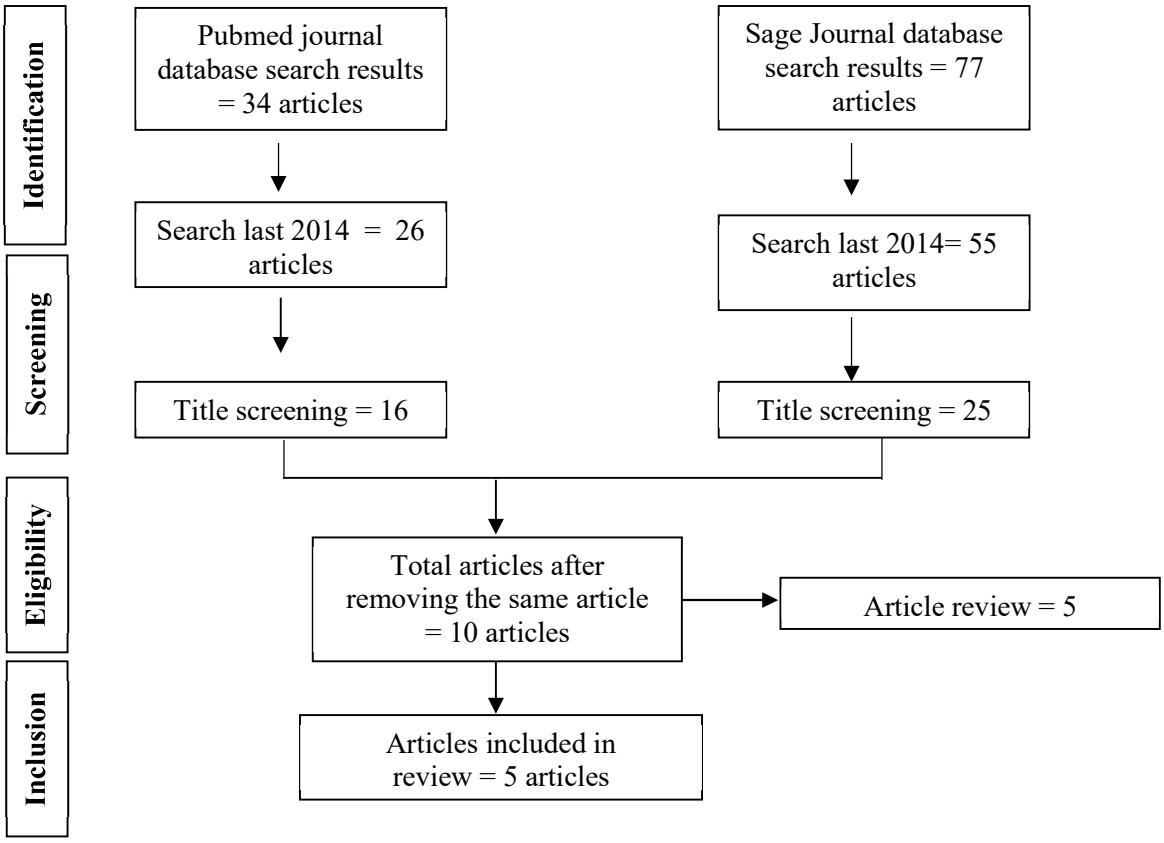

Figure 1. Article search flowchart

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. in order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

RESULT

In the PubMed database, the results of our search brought up 34 articles, whereas the results of our search on SagePub brought up 77 articles. The results of the search conducted for the last year of 2014 yielded a total 26 articles for PubMed and 55 articles for SagePub. The result from title screening, a total 16 articles for PubMed and 25 articles for SagePub. In the end, we compiled a total of 10 papers. We included five research that met the criteria.

Asmarawati, TP *et al* (2023)[6] showed Third-generation (ceftriaxone) is the antibiotic most often used as prophylaxis in urological procedures in a teaching hospital in Indonesia. However, the culture results of urine specimens mainly are gram-negative bacterial bacilli that are highly resistant to this class of antibiotics. Aminoglycosides have an excellent sensitivity against Gram-negative bacteria. It can be used as an option for Antimicrobial prophylaxis.

The high ESBL rate in the urine culture is also essential for determining antibiotic prophylaxis. It is necessary to review local guidelines in antibiotic prophylaxis that specifically consider the incision site, type of procedure, local bacterial mapping in the hospital, and monitoring of the surgical site infection.

Nyongole, O *et al* (2015)[7] showed Antibiotic use is still a challenge at our hospital. Prolonged use of prophylactic antibiotics beyond five days was the main finding. Ceftriaxone was the most given antibiotic regardless of the urological surgery done and its level of contamination. Antibiotic stewardship needs to be addressed by adhering to antibiotics use guidelines and this will increase the quality of care and at the same time reduce both costs and the development of microbial resistance. Further research is needed because of lack of evidence that those patients with increased risk for infectious complications should receive antibiotic prophylaxis and why do clinicians give antibiotics empirically.

Table 1. The litelature include in this study

Author	Origin	Method	Sample Size	Result
Asmarawati, TP *et al*., 2023[6]	Indonesia	A retrospective study	179	One hundred seventy-nine urological procedures were assessed. Antibiotic prophylaxis was administered in the clean-contaminated and clean procedures (93.2% and 6.8%, respectively). Ceftriaxone was commonly used (69.3%), single-dose, one day before the surgery. Gram-negative bacteria were widely found in the urinary culture of patients (75.2%). E. coli, K. pneumoniae, and P. aeruginosawere dominating with low susceptibility to cephalosporins. ESBL-producing bacteria were E. coli (64%) and K. pneumoniae (89%).
Nyongole, O *et al*., 2015[7]	Tanzania	A retrospective study	726	Male patients were the majority at 62% (450). The age range was 0 - 90 years, with a mean of 30 ± 22.09. Among the urological surgeries done at MNH 86.5% (628) received prophylactic antibiotics regardless of the type surgery done. Majority 63.7% (463) received antibiotics during induction. Ceftriaxone was the commonly given antibiotic regardless of the type of urological surgery done. Most of patients (86.4%) were given antibiotics for five days regardless whether it was for prophylactic or treatment intention.
Khaw, C *et al*., 2018[8]	USA	Multicenter cohort study	375	Among the 375 patients, 366 (97.6%) were male and 9 (2.4%) were female, with a mean (SD) age of 64.2 (10.9) years and a predominantly white race/ethnicity (289 [77.1%]). In addition, 29 530 patient records in the national administrative database were assessed. Among the patient records, 28 938 (98.0%) were male and 592 (2.0%) were female with a mean (SD) age

				of 69.1 (10.2) years and a predominantly white race/ethnicity (23 297 [78.9%]). Among the manually reviewed medical records, periprocedural or postprocedural antimicrobial prescribing was guideline discordant in 217 patients (57.9%). Postprocedural antimicrobial agents were continued beyond 24 hours in 211 patients (56.3%) and were guideline discordant in 177 patients (83.9%), with a median (interquartile range) duration of 3 (3-5) days of unnecessary antimicrobial therapy.
Alnajjar, LI *et al*., 2023[9]	Saudi Arabia	A single-group, quasi-experiment study	233	In total, 233 patients were included in each of the pre- and post-ASP implantation groups. There was a significant reduction in antibiotic use among patients who received a pre-procedure antimicrobial prophylaxis in the post- compared to the pre-implementation group (45.9% vs. 24.46%, $p < 0.0001$), and there was a highly significant reduction in the post- compared to the pre-implementation group in the number who received a post-procedure prophylaxis (16.7% vs. 1.2%, $p < 0.0001$).
Guerrero, DMM *et al*., 2023[10]	Colombia	A retrospective, observational, analytical cohort study	723	Overall, 10.3% of patients had complications, 7.2% of patients had postoperative urinary infection, 1.8% had upper urinary tract infection (UTI) and 1.4% had urinary sepsis. Lower UTI were significantly more likely in the extended prophylaxis group with 6.8% versus 2.7% (RR = 2.8; 95% CI: 1.10–7.37, $p = 0.030$). The risk of upper UTI and sepsis did not show significant differences. A total of 69% patients with postoperative infection had isolated multidrug-resistant bacteria (MDRB) in the UC, with a higher risk in patients with extended prophylaxis (RR = 3.1; 95% CI: 1.33–7.59, $p = 0.009$).

Khaw, C *et al* (2018)[8] showed in patients undergoing common urologic procedures, the rate of guideline-discordant antimicrobial use was high, mostly because of overprescribing of postprocedural antimicrobial prophylaxis. Future antimicrobial stewardship interventions should target the postprocedural period with the goal of reducing unnecessary antimicrobial use.

Alnajjar, LI *et al* (2023)[9] showed An ASP for SCI/D patients in a rehabilitation hospital is an example of a highly needed setting, and utilizing related data will greatly improve the appropriate use of antimicrobial therapy, as well as promote prescribers' acceptance of the guideline, thus reducing related costs and antimicrobial consumption. Future studies should examine the generalizability of these findings to other patient population groups with similar conditions as neurogenic bladder (patients with stroke and non-traumatic SCI/D). Moreover, more studies are needed to assess the long-term clinical benefits for patients of all diseases (mortality benefits, symptomatic UTIs with resistant organisms, recurrent hospitalizations). These studies can ensure the allocation of further resources that are crucial to supporting the expansion of the ASP as it becomes increasingly accepted as a standard of care in many advanced hospital settings.

Guerrero, DMM *et al* (2023)[10] showed In patients with negative UC who underwent fURS in a fourth-level hospital, complications occurred in one out of 10 patients. Overall, 7.2% presented postoperative infection: 11.7% of patients with extended prophylaxis and 5.1% of patients with standard prophylaxis. The risk of UTI was 2.2 times higher in patients with extended prophylaxis, without demonstrating an impact on the incidence of upper UTI or sepsis. Variables such as age, use of ureteral access sheath, preoperative diversion and hydronephrosis did not affect the outcome. Overall, 1.4% of patients developed sepsis of urinary origin, without finding differences between the groups. The isolation of multidrug-resistant bacteria occurred in 69% of patients with postoperative infection, and the most frequent bacteria were ESBL-producing *E. coli*. The risk of multidrug-resistant bacteria is 3 times higher in the extended prophylaxis group. Therefore, standard prophylaxis 60 min before the surgical procedure offers a lower risk of UTI and reduces the risk of isolation of multidrug-resistant bacteria.

DISCUSSION

As per the global prevalence study on infections in urology 2003–2010, the incidence of multi-resistant hospital-acquired urinary tract infection (UTI) is 9.4% and the prevalence of carbapenemase-producing *Enterobacteriaceae* is rising. The data from European and other international governmental organizations have also reported on the emerging threat of multidrug-resistant strains, particularly for the primary uropathogen, *Escherichia coli*. A unique problem to our urological setup (tertiary care center in a developing country) is indwelling catheters and percutaneous nephrostomies which remain in-situ for long durations and get colonized by resistant bacteria and become a source of postoperative sepsis and cross infection.[11,12]

Systemic antimicrobial usage is the primary driver of antimicrobial resistance both in the index patient and the community. Limiting AP to cases when it is medically indicated will reduce the risks of antimicrobial overuse, which include patient-associated adverse events, the development of multidrug resistant (MDR) organisms, and the impact of MDR on recovery from common communityacquired infections. Cases that may safely be performed without AP should rely on good sterile techniques and best surgical practices rather than AP, such as bathing the skin with soap or an antiseptic agent prior to surgery; preparing nonmucosal skin surfaces with chlorhexidine and alcohol in the operating room; and removing hair prior to surgery, although data do not show that hair removal decreases the risk of infection. If hair removal is to be performed, clipping hair may be associated with lower infection compared to using razors.[13]

Recent guidelines recommend that in addition to using a single dose of preoperative AP, there should be no postoperative continuation of antimicrobials, without exception for surgical procedure type. There is no high-level evidence to support the use of multiple doses of antimicrobials in the absence of preoperative symptomatic infection. Furthermore, there is moderate-quality evidence from multiple randomized controlled trials that do not show a benefit of prolonging AP beyond the case completion; and the use of prolonged AP (>48 hours postincision) has been significantly associated with an increased risk of acquiring antibiotic-resistance, while conferring no decrease in SSI.[13]

In this way assessing the pre-intervention surgical wound class, an estimate can be made of the need for antibiotic prophylaxis during surgery. Clean surgery involves uninfected tissues without opening of the urinary tract and with primary closure of the wound. In clean contaminated surgery, the urinary tract is entered under controlled conditions, without the presence of infected tissues or bacteriuria. Surgery with use of bowel tissue is also classified as clean-contaminated. The presence of a non treated infection, including UTI, should be considered as contaminated urologic surgery. When pus is present, the surgery is labelled dirty. Implantation of prosthesis material is not classified as above. Since infectious complications are potentially serious when involving prosthesis material, antibiotic coverage is advocated irrespective of surgical class. Derived from the surgical literature and not supported by urologic evidence, there is no indication for antibiotic prophylaxis in clean surgery, whereas there is an indication in clean-contaminated and prosthetic surgery. Contaminated and dirty surgery should be covered by therapeutic antibiotics instead of prophylactic dosages.[7]

CONCLUSION

Antibiotic therapy should be considered only for procedures in which studies have shown a clinical benefit in the prevention of infection. It is important to establish the duration and type of treatment for antimicrobial therapy for surgical prophylaxis in patients with AB who are going to receive urological invasive procedures.

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