

Genitourinary Procedures as Risk Factors for Prosthetic Hip or Knee Infection: A Hospital-Based Prospective Case-Control Study

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Background. The purpose of this study was to determine the risk of prosthetic joint infection (PJI) as a complication of routine genitourinary (GU) procedures in patients with total hip arthroplasty (THA) or total knee arthroplasty (TKA) and to study the impact of antibiotic prophylaxis administered prior to these procedures.

Methods. We conducted a prospective, single-center, case-control study between December 1, 2001 and May 31, 2006. Case patients were hospitalized with total hip or knee PJI. Control subjects underwent a THA or TKA and were hospitalized during the same period on the same orthopedic floor without a PJI. Data regarding demographic features and potential risk factors were collected. The outcome measure was the odds ratio (OR) of PJI after GU procedures performed within 2 years of admission.

Results. A total of 339 case patients and 339 control subjects were enrolled in the study. Of these, 52 cases (15%) and 55 controls (16%) had undergone a GU procedure in the preceding 2 years. There was no increased risk of PJI for patients undergoing a GU procedure with or without antibiotic prophylaxis (adjusted OR [aOR] = 1.0, 95% confidence interval [CI] = 0.2–4.5, $P = .95$ and aOR = 1.0, 95% CI = 0.6–1.7, $P = .99$, respectively). Results were similar in a subset of patients with a joint age less than 6 months, less than 1 year, or greater than 1 year.

Conclusions. Genitourinary procedures were not risk factors for subsequent PJI. The use of antibiotic prophylaxis before GU procedures did not decrease the risk of subsequent PJI in our study.

Keywords. antibiotic prophylaxis; genitourinary procedures; prosthetic joint infection.

An estimated 4 million total hip arthroplasties (THA) or total knee arthroplasties (TKA) will be performed annually in the United States by 2030 [1]. Prosthetic joint infection (PJI) is a rare but well recognized complication of joint arthroplasty that causes significant morbidity and mortality [2, 3], and their annual financial burden in the United States is estimated to be \$250 million [4]. Prosthetic joint infection can occur early

from local bacterial invasion or late from joint seeding secondary to bacteremia [2].

An aging population faces increasing rates of lower urinary tract symptoms, resulting in an increased number of endoscopic genitourinary (GU) procedures to evaluate and manage those symptoms. Endoscopic urological procedures are considered to be “clean-contaminated” [5]. Mucosal manipulation during cystoscopy or other endoscopic GU procedures can introduce bacteria into the bloodstream, and this transient bacteremia can theoretically lead to hematogenous seeding of a prosthesis. Perioperative antimicrobial prophylaxis can potentially limit these bacteremias and hence prevent PJI. The risk of bacteremia after GU procedures is dependent on the presence of a urinary tract infection, invasiveness of the procedure, and the use of prophylactic antimicrobial therapy. Selected studies did not detect the presence of bacteremia after cystoscopy [6] and shock wave lithotripsy [7]. Other studies have shown a

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decrease in cystoscopy-associated bacteremia rate from 28% to 1% with the use of antimicrobial prophylaxis [8]. In 1 study, post-GU procedure bacteremia was detected in one fifth of patients who underwent cystoscopy without antibiotic prophylaxis. The majority of bacteremias detected post-GU procedures are due to Gram-negative bacilli and *Enterococcus* sp, organisms that are rarely implicated in PJI [9]. Whether procedure-related bacteremia is enough to cause PJI is unknown. A small number of case reports of PJI after GU procedures have been reported; the link is mostly based on circumstantial evidence [10, 11].

The American Urological Association (AUA) Best Practice statement, updated January 2014, recommended that (1) antibiotic prophylaxis for GU procedures not be administered routinely in patients with a prosthetic joint and that (2) it should be considered only in select patients with total joint arthroplasty who undergo high-risk procedures [5]. However, in 2009, the safety committee of the American Academy of Orthopaedic Surgeons (AAOS) posted an expert opinion-based informational statement on its Web site recommending that clinicians consider antibiotic prophylaxis for all patients with total joint replacement before any GU procedure associated with risk of bacteremia [12]. This is contrasted with the AAOS abstract in 1997 [13] stating that routine dental antibiotic prophylaxis is not needed after total joint replacement to prevent late PJI and, more recently, the ACC/AHA 2008 Guidelines' update on valvular heart disease, which states that "the administration of antibiotics solely to prevent endocarditis is not recommended for patients who undergo a GU or gastrointestinal tract procedure" [14]. The actual risk of developing infectious complications (such as PJI) after GU procedures is unknown.

Therefore, we conducted this study to determine whether invasive dental, gastrointestinal, or GU procedures with or without antibiotic prophylaxis are risk factors for prosthetic hip or knee infection using a large, prospective, single-center, case-control study. The studies reporting on the association of dental or gastrointestinal procedures and the risk of PJI from our group have been published [15, 16]. An association, if demonstrated, may prompt reconsideration of the recommendation pertaining to the use of antibiotic prophylaxis before GU procedures.

MATERIALS AND METHODS

Study Setting and Participants

A description of the study setting and patients has been outlined in recent publications that assessed the risk of PJI associated with dental [15] and gastrointestinal endoscopic procedures [16]. The study was conducted at a single, tertiary-care referral center. Possible study participants were assessed from consecutive patients admitted to the inpatient orthopedic hospital service of the Mayo Clinic in Rochester, Minnesota from December 1, 2001 through May 31, 2006.

Case patients were patients with a diagnosis of prosthetic hip or knee infection (PJI). Control patients were those with a prosthetic hip or knee who were hospitalized by an orthopedic service for a noninfectious reason during the same time period. Frequency matching was used between case patients and control subjects on the location of joint arthroplasty. The study was approved by the Institutional Review Board (IRB) of the Mayo Clinic, Rochester (IRB no. 13-007355, January 15, 2014), and written informed consent was obtained from each patient.

Data Collection

Structured forms were used to interview patients and to abstract relevant clinical data from local and external medical records, including details of GU procedures performed within 2 years of entry into the study. Genitourinary endoscopic procedures included in the analysis were cystoscopy, urethral catheterization, lithotripsy, cystourethrogram, sterilization procedures (males and females), vaginal hysterectomy, vaginal delivery, cesarean section, therapeutic or spontaneous abortion, intrauterine device (IUD) insertion or removal and pap smears (only females), and prostate outlet procedures (only males).

A prosthetic hip or knee infection was defined as the same microorganism being isolated from 2 or more cultures from joint or periprosthetic fluid specimens, the presence of acute inflammation consistent with infection on pathological examination, the presence of a cutaneous sinus tract communicating with the prosthesis, or the presence of purulence in a joint space as determined by the surgeon [3]. The microbiological evaluation of PJIs was done according to Clinical and Laboratory Standards Institute techniques used in the clinical microbiological facilities of the Mayo Clinic.

The presence of previously defined risk factors associated with the development of PJI was assessed [2, 3]. The study date used for case patients and control subjects was the Mayo Clinic hospital admission date. Details of all GU procedures for both case patients and control subjects were abstracted from the study date and the previous 2 years (observation period). If the joint arthroplasty occurred less than 2 years before the study date, GU procedure records were abstracted backwards to the date of the joint arthroplasty.

Statistical Analysis

The primary risk factor of interest was whether study subjects had undergone any GU procedure up to 2 years before they entered the study. Other variables assessed for association with PJI are shown in Table 1. This study had 80% power for a 2-sided test of proportions for comparison of observed GU procedure rates of 16.2% in controls versus $\geq 24.9\%$ in the cases. Logistic regression was used to assess variables for association with the odds of PJI. Multivariable models included covariates with a univariate $P \leq .10$, including sex, age, joint age, immunosuppression, body mass index, presence of wound drain, prior arthroplasty, malignancy, American Society of Anaesthesiologists (ASA) score, and

Table 1. Clinical Features and Host-Related Factors of Patients in the 2 Study Populations

Characteristic	Cases (n = 339)	Controls (n = 339)	OR (95% CI) ^a	P Value
THA/TKA	164 of 175	164 of 175	—	—
Female sex, no. (%)	168 (50)	180 (53)	0.9 (0.6–1.2)	.4
Median age (range), in years	69.5 (26–91)	71.4 (36–95)	0.94 per 5 years (0.88–1.0)	.09
Median joint age (range), in months	16 (1 day–296)	50 (1.2–414)	0.91 per 1 y (0.88–0.94)	<.001
	Number (%) of Cases	Number (%) of Controls		
BMI				<.001
<25	76 (22)	51 (15)	1.0, Reference	
25–30	89 (26)	124 (37)	0.5 (0.3–0.8)	
31–39	113 (33)	138 (41)	0.5 (0.4–0.8)	
>40	61 (18)	26 (8)	1.6 (0.9–2.8)	
Diabetes mellitus	69 (20)	42 (12)	1.8 (1.2–2.7)	.006
Prior operation on index joint	130 (38)	86 (25)	1.8 (1.3–2.5)	<.001
Prior arthroplasty on index joint	107 (32)	55 (16)	2.4 (1.6–3.4)	<.001
Immunocompromised ^b	208 (61)	149 (44)	2.0 (1.5–2.8)	<.001

Abbreviations: BMI, body mass index; CI, confidence interval; OR, odds ratio; THA, total hip arthroplasty; TKA, total knee arthroplasty.

^a Adjusted for sex and joint age.

^b Diagnosis of rheumatoid arthritis, diabetes mellitus, malignancy, chronic kidney disease, or current use of systemic steroids or immunosuppressive medications.

prothrombin time as potential confounders based on the clinician's judgment. A multivariate analysis was performed to control for possible confounding of other specifically known prior risk factors. All of the tests were 2-sided, and *P* values less than .05 were considered statistically significant. Statistical analysis was performed using SAS software version 9.0 (SAS Institute).

RESULTS

There were 339 case patients with prosthetic hip or knee infection, and 339 controls were enrolled. Cases and controls were similar regarding age, sex, and proportion of hip and knee arthroplasties. Cases were more likely than controls to be diabetic, immunocompromised, to have had a prior operation on the index joint, and to have had a prior arthroplasty on the index joint. Control subjects had older prostheses, compared with case patients (median joint age, 49.9 vs 15.5 months) (Table 1).

Of the 339 case patients, 259 (74%) had a diagnosis of PJI established within 10 days before or after study entry. Reasons for admission for the control subjects included need for an arthroplasty at a site distant from the index arthroplasty (57%), need for aseptic revision of the index arthroplasty (38%), and need for some other orthopedic procedure (5%).

The 339 cases and 339 controls had undergone 107 GU procedures within 2 years of enrollment in the study (Table 2). Of the case patients, 52 (15%) had undergone a GU procedure in the 2 years before admission, compared with 55 (16%) of the control patients. It is noteworthy that only 6 cases (1%) and 7 controls (2%) had received antimicrobial prophylaxis at the time of their GU procedures.

Individual procedures such as urethral catheterization, open prostatectomy, transurethral resection of the prostate (TURP), vaginal hysterectomy, and other urinary tract surgery were not associated with an increased risk of PJI (Table 2).

Patients who underwent cystoscopy in the preceding 2 years without antimicrobial prophylaxis had an adjusted odds ratio (aOR) of 2.5 (95% confidence interval [CI], 1.1–6.1; *P* = .04). On subgroup analysis of these patients, patients with joint age greater than 1 year had an aOR of 2.2 (95% CI, 0.8–5.6; *P* = .11), whereas patients with joint age less than 1 year had an aOR of 6.7 (95% CI, 0.5–94.1; *P* = .16) (Table 3). Of the 33 patients who underwent cystoscopy, only 6 were in patients with joint age <1 year. No patient with joint age <1 year undergoing cystoscopy received antibiotic prophylaxis.

Microbiology of PJI is presented in Table 4. The most common microorganisms obtained from PJI cases included coagulase-negative staphylococci (29%) and *Staphylococcus aureus* (28%). Microorganisms normally colonizing the GU tract, and associated with post procedural bacteremia in previous studies, including Gram-negative bacteria and enterococci, accounted for only 20 cases (6%) of PJI in our cohort. There were no statistically significant differences in the pathogens that caused PJI in patients who had undergone a GU procedure and in those who had not undergone a GU procedure (Table 4). The 2 case patients with prior TURP had infection with methicillin-resistant *Staphylococcus epidermidis* and methicillin-sensitive *Staphylococcus aureus* 5 months and 22 months after the procedure, respectively. The 2 case patients with prior open prostatectomy had infection with methicillin-sensitive *S aureus* and methicillin-resistant *S epidermidis* 4 months and 6 months after the procedure, respectively. No differences in

Table 2. Genitourinary Procedures Performed in the 2 Study Populations in the Observation Period of 2 Years

Procedure, as Number (%)	Cases (n = 339)	Controls (n = 339)	OR (95% CI) ^{a,b}	P Value
Any GU procedure	52 (15)	55 (16)		1.00 (overall)
No prophylaxis	46 (13.6)	48 (14.2)	1.0 (0.6–1.7)	.99
With prophylaxis	6 (1.8)	7 (2.1)	1.0 (0.2–4.5)	.95
Cystoscopy	20 (6)	13 (4)		.11 (overall)
No prophylaxis	17 (5.0)	11 (3.2)	2.5 (1.1–6.1)	.04
With prophylaxis	3 (0.9)	2 (0.6)	1.3 (0.1–14.6)	.85
Urethral Catherization	30 (9)	27 (8)		1.00 (overall)
No prophylaxis	27 (8.0)	23 (6.8)	1.0 (0.5–2.0)	.99
With prophylaxis	3 (0.9)	4 (1.2)	1.1 (0.2–6.4)	.94
Other Urinary tract surgery	5 (1)	3 (0.9)		.96 (overall)
No prophylaxis	3 (0.9)	2 (0.6)	1.4 (0.2–11.8)	.77
With prophylaxis	2 (0.6)	1 (0.3)	2.0 (0.2–22.3)	.57
	Female Cases (n = 168) ^c	Female Controls (n = 180) ^c		
Pap smear ^d	8 (4.8)	15 (8.3)		
No prophylaxis	8 (4.8)	15 (8.3)	0.6 (0.2–1.9)	.39
With prophylaxis	0 (0)	0 (0)	—	
Vaginal hysterectomy	0 (0)	1 (0.6)		
No prophylaxis	0 (0)	1 (0.6)	0.0 (0.0–3.7)	.98
With prophylaxis	0 (0)	0 (0)	—	
	Male Cases (n = 171)	Male Controls (n = 159)		
TURP	2 (1.2)	2 (1.3)		
No prophylaxis	2 (1.2)	2 (1.3)	2.5 (0.3–19.8)	.37
With prophylaxis	0 (0)	0 (0)	—	
Open prostatectomy	2 (1.2)	0 (0)		1.0 (overall)
No prophylaxis	1 (0.6)	0 (0)	∞ (0.5–∞)	.96
With prophylaxis	1 (0.6)	0 (0)	∞ (0.5–∞)	.89

Abbreviations: CI, confidence interval; GU, genitourinary; IUD, intrauterine device; OR, odds ratio; TURP, transurethral resection of prostate.

^a The model includes the covariates of sex, joint age, dental propensity score, body mass index >140, procedure time >14 hours, immunocompromised host, American Society of Anesthesiologists score, wound healing complications, prior arthroplasty or surgery on the index joint, use of antibiotic surgical prophylaxis, postoperative urinary tract infection, and distant organ infection, with or without antibiotic prophylaxis as indicated.

^b Some patients had >1 procedure performed.

^c No females had vaginal delivery or cesarean section, therapeutic or spontaneous abortion, IUD insertion or removal in the observation period.

^d None of the patients undergoing Pap smear or vaginal hysterectomy received antibiotic prophylaxis; therefore, all values are for 'No Prophylaxis' and model does not include prophylactic antibiotics.

OR's were observed in the subset of patients with joint age less than 6 months, less than 1 year, or greater than 1 year (data not shown).

DISCUSSION

In this hospital-based, case-control study of prosthetic hip or knee infection, case patients were no more likely than control subjects to have undergone a GU procedure. Moreover, there was no apparent benefit to administering antibiotic prophylaxis in the setting of a GU procedure with the goal of reducing the likelihood of PJI. Currently, there is a lack of high-level evidence regarding the clinical effectiveness of protocols related to antimicrobial prophylaxis before GU procedures in patients with joint arthroplasties [17].

Our study did show a statistically increased risk of PJI in patients undergoing cystoscopy without antimicrobial prophylaxis (Table 2). However, on subgroup analysis after dividing patients based on joint age less than or greater than 1 year, both groups had statistically insignificant risk (Table 3). A majority of these cystoscopy's occurred in patients with joint age >1 year. Very few procedures (5 in cases, 1 in controls) were documented in the subgroup with joint age less than 1 year (Table 3). It is likely that the very wide CI in the subgroup with joint age <1 year is pulling the overall OR for the cystoscopy without antimicrobials group to greater than 1.

The AUA and the AAOS first published consensus-based and expert opinion-based guidelines in 2003 for patients with total joint replacement who were undergoing urologic procedures

Table 3. Cystoscopy Performed in the 2 Study Populations Divided by Joint Age Less Than and Greater Than 1 Year in the Observation Period of 2 Years

Joint Age <1 Year	Cases (n = 151)	Controls (n = 75)	OR (95% CI) ^a	P Value	Overall P Value
Cystoscopy					
Yes, with prophylaxis	0 (0)	0 (0)	—		
Yes, no prophylaxis	5 (3.3)	1 (1.3)	6.7 (0.5–94.1)	.16	
No	146 (96.7)	74 (98.7)	1.0 (Reference)		
Joint Age >1 Year	Cases (n = 188)	Controls (n = 264)	OR (95% CI) ^a	P Value	Overall P Value
Cystoscopy					
Yes, with prophylaxis	3 (1.6)	2 (0.8)	1.1 (0.1–12.4)	.95	
Yes, no prophylaxis	12 (6.4)	10 (3.8)	2.2 (0.8–5.6)	.11	
No	173 (92.0)	252 (95.4)	1.0 (Reference)		.28

Abbreviations: CI, confidence interval; OR, odds ratio.

^a The model includes the covariates of sex, joint age, dental propensity score, body mass index >140, procedure time >14 hours, immunocompromised host, American Society of Anesthesiologists score, wound healing complications, prior arthroplasty or surgery on the index joint, use of antibiotic surgical prophylaxis, postoperative urinary tract infection, and distant organ infection, with or without antibiotic prophylaxis as indicated.

[18]. Based upon lack of supporting data, the AUA guidelines published in 2008 do not recommend routine antimicrobial prophylaxis before GU procedures to prevent PJI; prophylaxis is recommended for patients at increased risk of hematogenous PJI who undergo urologic procedures associated with an increased risk of bacteremia [5]. In contrast, the safety committee of the AAOS posted a new information statement on its Web site recently recommending that clinicians consider antibiotic prophylaxis for all patients with total joint replacement before any GU procedure [12].

The continued use of inappropriate antibiotics carries considerable risk regardless of benefit. Whether antimicrobial prophylaxis can protect against PJI is unproven by high-level evidence,

but it is a commonly held professional opinion. The large number of patients with prosthetic joint undergoing GU procedures and the relative rarity of PJI ensure a very high “number needed to treat” to prevent even a single PJI, even if efficacy is proven [19]. The “cost” functions to be considered include the financial burden of medication, the promotion of antimicrobial resistance, the individual’s risks of antimicrobial-induced adverse effects, including anaphylaxis, and the individual and public health effects of increased *Clostridium difficile* infections.

The role, if any, of antimicrobial prophylaxis for GU procedures in prosthetic joint patients has never been addressed in prospective, comparative trials. A prospective study (1) observed 1000 patients after total joint arthroplasty for 6 years and (2) evaluated the risk of hematogenous seeding in PJI after procedures of the GU tract including the prostate, among others [20]. Only 24 of these 1000 patients underwent such a procedure, and none developed PJI. A case of *Enterococcus faecalis* TKA infection immediately after TURP occurred despite sterile preoperative urine and appropriate antibiotic prophylaxis, raising the question of the ability of prophylaxis to protect against these rare infections [10]. The 4 cases in our study that had undergone a procedure on the prostate in the last 2 years had infection with either *S aureus* or *S epidermidis*; organisms not associated with the GU tract of humans.

The presence of bacteremia is a recognized risk factor for hematogenous PJI, and a study found risk as high as 34% after documented *S aureus* bacteremia [21]. In a multicenter, prospective study involving 284 patients after prostatectomy, 22% of the patients with a sterile urine culture preoperatively developed bacteriuria postoperatively. Bacteremia secondary to bacteriuria occurred in 1 patient, whereas another had an episode of primary bacteremia [22]. Bacteremia risk is dramatically increased in the presence of bacteriuria; the advisory statement

Table 4. Microbiological Findings for the 339 Case Patients^a

Microorganism, n (%)	Cases With GU Procedure (n = 52)	Cases Without GU Procedure (n = 287)
Coagulase-negative <i>Staphylococcus</i>	19 (37)	82 (29)
<i>Staphylococcus aureus</i>	17 (33)	78 (27)
Beta-hemolytic streptococci	2 (4)	11 (4)
Viridans group streptococci	1 (2)	10 (3)
Polymicrobial	5 (10)	33 (11)
Culture negative	2 (4)	31 (11)
<i>Enterococcus</i> species	2 (4)	8 (3)
<i>Enterobacteriaceae</i>	0 (0)	10 (3)
Anaerobic bacteria	1 (2)	11 (4)
Others	3 (6)	13 (5)

Abbreviation: GU, genitourinary.

^a No statistically significant differences in prevalence of individual organisms were found between cases and controls.

recommends preoperative treatment of bacteriuria before manipulation of the urinary tract [5].

High-grade bacteremia is needed to cause implant seeding in animal models [23]. Although occasional bacteremia can occur after procedures, they are usually transient and low grade. Whether these reported transient bacteremias actually cause PJI remains unknown. The microbiology of transient bacteremias post-GU procedures differ from that of the offending organism causing PJI; a majority of prosthetic hip or knee infections are due to staphylococci [3]. Transient bacteremias are also commonly associated with several activities of daily living as well [24], and, by the same logic, every patient with an arthroplasty must take routine antibiotics to prevent PJI to offset the daily multiple transient bacteremias.

Efforts should be made to modify identifiable risk factors when possible to decrease the risk of prosthetic hip or knee infection in patients undergoing joint arthroplasty. Of note, GU procedures were not associated with increased risk of PJI in this study. No difference in ratios was observed in patients with joint age less than 6 months, less than 1 year, and greater than 1 year. The early subgroup of patients is of particular interest because of (1) the heightened alertness towards the risk of PJI in clinician and patients and (2) the increased consideration of the need of antibiotic prophylaxis in these early time periods.

The present study had several possible limitations. First, not all GU endoscopic procedures were included in our evaluation. Given the nonreproductive age group of a majority of the cohort, vaginal delivery or caesarian section, abortion, and IUD insertion or removal were underrepresented. Likewise, prostate outlet procedures and endoscopic procedure associated with urolithiasis were underrepresented in our dataset, and the study may not have been powered to detect associations with PJI with these more invasive procedures, associated with a presumed higher risk of transient bacteremia. Furthermore, the urologic standard for any of these more invasive procedures is consistent with the nationwide surgical quality measures for appropriate antimicrobial prophylaxis within 1 hour before the procedure. Second, the sample size was initially chosen for power to detect an association between dental procedures and PJI. The prevalence of GU procedures was lower in the patient cohort than was occurrence of a dental procedure; therefore, power for assessment was lower in this study. Third, patients with prosthetic joints at sites other than the hip and knee were not included; therefore, findings from our study may not be applicable to patients with shoulder arthroplasties, for example. In addition, only a small number of patients reportedly received antimicrobial prophylaxis at the time of the GU procedure; hence, our ability to assess the efficacy of prophylaxis in preventing PJI was limited. Fourth, due to the retrospective nature of this study, we were unable to capture preprocedural bacteriuria and the indication for antibiotic prophylaxis in the few patients that did receive it.

Our study was performed at a single referral center, although referral bias was minimized by choosing hospitalized control subjects from the same institution on the same orthopedic service. The potential for differential recall bias between case patients and control subjects was minimized by obtaining records of the individual procedures. This study was not designed to necessarily prove causality. The study date used for case patients and control subjects was the Mayo Clinic hospital admission date. In a majority of cases, the PJI diagnosis date was very close to the hospital admission date. Because PJI usually starts insidiously, the symptom onset date was not clear in a bulk of patients, and we used the diagnosis date as the study date for cases.

CONCLUSIONS

This large prospective, single-center, case-control study did not demonstrate an increased risk of prosthetic hip or knee infection after GU procedures. Antibiotic prophylaxis was not associated with a statistically significant reduction of the risk for prosthetic hip or knee infection. We cannot definitely exclude the utility of antibiotic prophylaxis before GU procedures in patients with prosthetic joints. Current opinion-based policies for administering antibiotic prophylaxis to patients with prosthetic hip or knee arthroplasty who undergo GU procedures should be reconsidered [5, 12].

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