



## Brief communication

## Low rates of renal injury in total joint arthroplasty patients without pre-existing renal disease

Jessica M. Hooper, MD<sup>\*</sup>, Benjamin S. Kester, MD, Ran Schwarzkopf, MD, MSc

New York University Langone Health Orthopaedic Hospital, New York, NY, USA

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## ABSTRACT

Acute kidney injury is a reported complication of total joint arthroplasty (TJA), with potentially severe long-term complications. Our study aimed to identify the rate of perioperative renal injury in patients without pre-existing renal dysfunction who undergo TJA. Using the American College of Surgeons National Surgical Quality Improvement Program database, we identified a mean annual rate of perioperative renal injury of 0.172% between 2009 and 2015. Factors most strongly associated with perioperative renal injury are age of 70 years or older, current smoking, history of diabetes mellitus, history of hypertension, and American Society of Anesthesiologists class of 3 or greater. There was no significant increase in the rate of renal injury from year to year. In patients without pre-existing renal disease, perioperative rates of acute kidney injury remain low in patients undergoing TJA.

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## Introduction

The popularity and success of total joint arthroplasty (TJA) is strongly related to improved postoperative quality of life and independence [1], which begins with an expeditious and uncomplicated recovery period [2]. Perioperative complications, such as acute kidney injury (AKI), can prolong hospital stay, increase early and long-term mortality, and increase costs [3]. Until the recent adoption of a unifying definition of AKI by Kidney Disease Improving Global Outcomes [4], the rate of perioperative AKI associated with TJA was not well defined. With improved recognition of the condition, a growing body of evidence suggests that even transient kidney injury is associated with the development of chronic kidney disease [5]. We sought to identify the rate of perioperative AKI in patients without prior history of renal disease undergoing primary elective TJA and to identify any associated modifiable risk factors.

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<sup>\*</sup> Corresponding author. 301 E 17th Street, Suite 1402, New York, NY 10003, USA. Tel.: +1 212 598 6000.

E-mail address: [jessica.hooper@nyumc.org](mailto:jessica.hooper@nyumc.org)

## Material and methods

The American College of Surgeons National Surgical Quality Improvement Program (NSQIP) was used to identify patients who underwent primary total knee or hip arthroplasty, identified using Current Procedural Terminology codes, from January 1, 2009 to December 31, 2015. Exclusion criteria included hip arthroplasty for femoral neck fracture, a documented history of renal failure, and dialysis within 2 weeks of the index operation. Patients classified within the NSQIP database as either having renal insufficiency (>2 mg/dL from preoperative baseline) or renal failure (worsening renal dysfunction from baseline requiring hemodialysis, peritoneal dialysis, ultrafiltration, or hemofiltration) were included in the analysis. We specifically looked at patient age, sex, body mass index, smoking status, diabetes mellitus, severe chronic obstructive pulmonary disease, congestive heart failure, ascites, preoperative transfusions, anesthesia type, disseminated cancer, chronic steroid use, >10% weight loss 6 months before surgery, bleeding disorders, hypertension requiring medications, and American Society of Anesthesiologists physical status classification to assess risk factors. Postoperative variables included length of stay  $\geq 4$  days (1 standard deviation above the mean) and unplanned readmission.

SPSS Statistics, version 22, (IBM, Armonk, NY) was used to perform statistical analyses. In all cases, a *P* value of .05 was deemed statistically significant. Univariate analysis with Fisher's exact test was used to compare categorical preoperative variables. Multivariate regression was used to assess independent association of

preoperative variables with higher risk of renal injury and to determine if postoperative renal injury was independently associated with a risk of unplanned readmission or increased length of hospital stay. Candidate preoperative variables for each regression were screened from those with  $P < .2$  and at least 5 incidences in each of the cohorts from our previous univariate analysis.

## Results

A total of 271,659 patients underwent TJA during the study period, 543 of whom experienced perioperative renal injury, corresponding to a mean annual rate of renal injury equal to 0.172%. Factors found to be most strongly associated with perioperative renal injury in multivariate analyses were age of 70 years or older, current smoking, history of diabetes mellitus, history of hypertension, and American Society of Anesthesiologists class of 3 or greater (all  $P < .01$ ). Patients who did experience perioperative renal injury were more likely to have a length of stay of 4 days or more ( $P < .001$ ) and were more likely to have an unplanned readmission ( $P < .001$ ) during the 30-day postoperative period. Yearly rates of renal injury remained constant within this patient population between 2009 and 2015. The ratio of rates of renal insufficiency to renal failure was also calculated, and remained constant, indicating that the severity of renal insult did not change during the study period.

## Discussion

In most high-volume arthroplasty practices and hospitals, protocols have been established to help improve and expedite patient recovery, such as the use of nonsteroidal antiinflammatory drug-based multimodal analgesia [6], hypotensive epidural anesthesia [7], and perioperative IV vancomycin for methicillin-resistant *Staphylococcus aureus*-colonized patients [8]. During the period of our study, 2009–2015, there has been a marked increase in the establishment of such protocols, likely related to the passage of the Centers for Medicare and Medicaid Services Bundled Payment for Care Improvement Initiative in 2011. As many of these interventions have the potential to cause nephrotoxicity [7,9], it is important to be aware of the risk of renal injury in patients undergoing TJA in the current practice climate.

The mean annual rate of perioperative renal injury identified in this study is lower than what has been previously published in the literature [10]. This finding is likely related to the exclusion of patients with pre-existing renal disease from our cohort, and the inclusion of only patients undergoing elective primary TJA, who are less likely to experience major blood loss or hemodynamic instability during surgery than patients undergoing a revision procedure or hip arthroplasty for femoral neck fracture. We felt it was important to define the risk for the healthy patient undergoing TJA, in whom perioperative AKI could have long-term deleterious

consequences. The patient factors we found to be most strongly associated with perioperative AKI after TJA are similar to what has been reported in previous studies [10].

The strengths of this study lie in its large numbers and heterogeneous patient population. In addition, we focus only on patients without kidney disease, which allows generalizability to the average community arthroplasty practice. However, the designations of renal insufficiency and renal failure were defined by NSQIP, which limits our ability to draw conclusions on the severity of renal injury per Kidney Disease Improving Global Outcomes staging. Also, the information within the database regarding the use of NSAIDs, enoxaparin, vancomycin, gentamycin, and other nephrotoxic drugs during the perioperative period was incomplete, and thus, we cannot comment on the specific effect of each individual medication on the rate of perioperative AKI.

## Conclusions

Our findings indicate that the rate of perioperative renal injury is low in this low-risk elective primary TJA patient population, for whom the routine use of NSAIDs, hypotensive anesthesia, and other nephrotoxic medications would be used routinely. However, surgeons and internists should be aware that there are several factors that substantially increase the risk of perioperative renal injury. Further study is needed to define the risks associated with specific common medications during TJA for this patient population.

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