

RESEARCH ARTICLE

Post-operative Urinary Dysfunction Following Shoulder Surgery: Rates and Risk Factors

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Abstract

Background: Post-operative urinary retention (POUR) and dysfunction are recognized complications following orthopaedic surgery. Recent literature has focused on urinary retention and its associated complications following hip and knee reconstruction and lower extremity surgery. There is a paucity of literature focusing on POUR and shoulder surgery. The purpose of this study is to describe the rates of urinary dysfunction in patients undergoing shoulder surgery as well as the associated risk factors.

Methods: This was a single institution, prospective cohort study. Eligibility criteria included patients older than 50 years of age undergoing open or arthroscopic shoulder surgery. The primary outcome was the American Urological Association (AUA) symptom score (7 questions total scored 0-5, total 35 points max) administered before and after surgery. Higher scores reflect worse urinary dysfunction. Intra-operative data such as type of surgery, type of anesthesia, use of anticholinergics, peripheral nerve block, length of case, and amount of intravenous fluids were collected.

Results: Of 194 patients, the mean age was 61.4 years (Standard Deviation (S.D.) = 13.0) and the average BMI was 29.2 (S.D. = 5.6). The sample was 35.6% female. Overall, 46.4% reported worse AUA scores post-operatively within the first 3 to 5 days, including 4.1% of which were clinically defined as “moderately worse” (>5 point worse) or “much worse” (>11 points worse). Worse preoperative AUA scores correlated with worse postop AUA score on linear regression analysis ($r=0.883$, $P<0.0001$). Males with a history of BPH showed a statistically significant positive association with worsening urinary dysfunction postoperatively ($P=0.039$). Four patients (2.1%) required postoperative catheterization. A significantly higher percentage of patients with preoperative AUA scores of ≥ 11 experienced worsening of urinary function post-operatively ($P=0.04$).

Conclusion: Worsening of urinary function following shoulder surgery is common. The AUA score may be used to identify at-risk patients and to track changes in urinary function post-operatively. Men with a diagnosis of BPH are at particularly high risk. Further investigation is needed to elucidate the impact of urinary dysfunction on patient outcomes, satisfaction, and cost as well as the role of prophylactic medications.

Level of evidence: II

Keywords: Post-operative urinary retention (POUR), Rates and risk factors, Shoulder surgery, Urinary dysfunction

Introduction

The number of orthopaedic procedures performed each year has been rising steadily with the utilization of shoulder arthroplasty increasing by about 8% a year and with the utilization of arthroscopic

rotator cuff repair increasing yearly as well.^{1,2} With this continued increase in volume and a shift to outpatient surgery, minimizing the risk of avoidable complications is critical for meeting criteria for discharge, reducing

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costs and improving patient experience. One common complication that may occur following orthopaedic procedures is post-operative urinary retention (POUR). POUR has been widely reported in recent hip and knee reconstruction and lower extremity surgery literature.³⁻⁸ POUR is described as an inability to void in the presence of a full bladder, requiring catheterization.⁹ Even a single episode of bladder overdistention may lead to both a reduction in contractile function and to chronic impairment of bladder emptying or atony; avoiding this irreversible damage requires quick detection and treatment.¹⁰ Additionally, POUR has been observed to increase the length of hospital stays, raising the costs associated with various procedures.^{7,11,12} An increased risk of UTI has also been reported in patients that develop POUR.^{3,13}

Navarro et al identified that when patients undergoing rotator cuff repair were compared to those undergoing other common orthopaedic procedures (knee arthroscopy, carpal tunnel release, and anterior cruciate ligament reconstruction), unplanned visits to the emergency department or to urgent care for urinary retention was significantly more common ($P = 0.007$).¹⁴ A number of risk factors for POUR have been described (age, gender, type of anesthesia, type of surgery, Foley use, use of anticholinergics, or comorbidities like BPH and hypertension) for various surgical procedures.^{15,16} However, the prevalence and risk factors for POUR after shoulder surgery have yet to be explored. The purpose of this study was to describe the prevalence and risk factors for POUR and urinary dysfunction in patients undergoing shoulder surgery.

Materials and Methods

This study was a prospective, cohort correlation study completed at a single institution between October 2017 to March of 2019. Institutional review board approval was obtained prior to data collection. Patients older than 50 years of age and undergoing shoulder surgery (open or arthroscopic) were included. Patients were screened based on the criteria above and approached by a study coordinator at the time of surgical scheduling for consideration of inclusion in the study. Informed consent was obtained for those patients who elected to enroll, and a preoperative questionnaire was used to collect demographic data, comorbidities, and history of urinary dysfunction prior to surgery. All patients underwent general endotracheal anesthesia and 95% of patients were managed perioperatively with an interscalene block. All surgeries were performed in the beach chair position.

An American Urological Association (AUA) symptom score (7 questions total scored 0-5, total 35 points max) was administered pre-operatively by a study coordinator who was not involved in the clinical care of the patient.¹⁷ The same questionnaire was administered by a study coordinator between three and five days post-operatively. This method of survey administration was previously found to be reliable.¹⁸ Higher scores reflect worse urinary dysfunction. Intra-operative factors such as type surgery, use of anticholinergics, peripheral nerve block, length of case, and amount of intravenous fluids were collected. The primary outcomes were post-operative urinary

retention (post-void residual >300 mL per bladder scan or requiring single straight or indwelling bladder catheterization perioperatively) and worsening urinary dysfunction as determined by the change in AUA score, as previously described by Fuller et al.¹⁹ Patients were asked to fill out the AUA and rank their symptoms as much worse, slightly worse, the same, slightly better, or much better. The median change associated with a subjective evaluation of slightly worse is +5 and the median change for much worse is +11.¹⁹

Statistics

Power analysis was completed using G-Power (HHU, Düsseldorf, DEU). Descriptive statistics were calculated using SPSS (IBM Corp., Armonk, N.Y., USA) and tabulated according to minimal clinically significant change in AUA score as previously described in Urology literature.¹⁴ Statistically significant testing was performed between patients whose AUA scores worsened (i.e. increased at least 1 point from preoperative to postoperative) and patients whose AUA scores did not worsen (i.e. increased less than 1 point, or decreased). Student t-tests were used to compare patients with pre-operative scores one standard deviation greater than the mean to the rest of the cohort. One-way ANOVA was used to compare AUA scores with patients stratified by group. *P* values less than 0.05 were considered statistically significant.

Results

Of the 194 patients in the sample, the mean age was 61.4 years (Standard Deviation (S.D) = 13.0) and the average BMI was 29.2 (S.D. = 5.6). The sample was 35.6% female and 64.4% male. Nearly half of our study population had acute worsening in urinary function post-operatively, as determined by an increase in the AUA score. The average pre-operative score was 5.34 (S.D. = 5.2) and the average post-operative score was 6.03 (S.D. = 5.89). Overall, 46.4% reported worse AUA scores post-operatively within the first 3 to 5 days, including 4.1% of whom were clinically defined as "moderately worse" (≥ 5 point worse, 5 patients) or "much worse" (≥ 11 points worse, 3 patients) [Table 1]. After grouping patients by procedure into arthroplasty (n=69), other (n=30), or RCR groups (n=95), there was no significant difference in preoperative or postoperative AUA scores ($P > 0.5$). For the arthroplasty group the average preoperative AUA score was 5.99 (S.D. = 5.38), and the average postoperative score was 6.99 (S.D. = 6.19). For the other group, the average preoperative AUA score was 4.23 (S.D. = 3.6) and the average postoperative score was 3.93 (S.D. = 3.46). For the RCR group, the average preoperative AUA score was 5.16 (S.D. = 5.49) and the average postoperative score was 5.93 (S.D. = 6.14).

Worse preoperative AUA scores correlated with worse postop AUA score on linear regression analysis ($r=0.883$, $P<0.0001$). Males with a history of BPH showed a statistically significant positive association with worsening urinary dysfunction postoperatively ($P=0.039$). 65.4% of patients with preoperative AUA scores of ≥ 11 (26 patients) experienced worsening of urinary function post-operatively, compared to 43.5% of those with preoperative AUA scores < 11 (168 patients)

Table 1. Sociodemographic and Clinical Variables of Patients undergoing Shoulder Surgery stratified by Worsened or Improved/ Same AUA Score (n=194)

Variable	Total	Worsened AUA Score	Improved or Same AUA Score	P-value
	n (%)	n (%)	n (%)	
Overall	194 (100.0)	90 (46.4)	104 (53.6)	--
Age (\pm S.D.)	61.4 \pm 13.0	63.3 \pm 11.9	59.8 \pm 13.7	0.062
Gender				
Female	69 (35.6)	36 (40.0)	33 (31.7)	0.230
Male	125 (64.4)	54 (60.0)	71 (68.3)	
BMI (\pm S.D.)	29.2 \pm 5.6	29.9 \pm 6.2	28.7 \pm 5.0	0.136
Diabetes	27 (13.9)	10 (11.1)	17 (16.3)	0.293
Hypertension	79 (41.1)	35 (39.3)	44 (42.7)	0.634
BPH (Men Only)	9 (7.2)	7 (13.0)	2 (2.8)	0.039
Type of Surgery				
Open	68 (41.7)	35 (44.3)	33 (39.3)	0.516
Arthroscopic	95 (58.3)	44 (55.7)	51 (60.7)	
OR Time (\pm S.D.) (min)	81.9 \pm 32.1	82.9 \pm 32.2	81 \pm 32.1	0.696
Volume of Intravenous Fluids (\pm S.D.) (cc)	1429.4 \pm 516.5	1445.0 \pm 562.1	1415.8 \pm 475.9	0.697
Paralytic Used	170 (87.6)	82 (91.1)	88 (84.6)	0.171
Anticholinergic Used	153 (78.9)	72 (80.0)	81 (77.9)	0.719
Nerve Block Received	183 (95.3)	85 (94.4)	98 (96.1)	0.593

*S.D. = mean and standard deviation listed for continuous variables

($P=0.04$). Age also trended toward increasing urinary dysfunction [Table 1]. Four patients (2.1%) required postoperative Foley insertion, straight catheterization, or had post-void residuals >300 milliliters. Gender, comorbidities like diabetes and hypertension, type of surgery, OR time, IVFs, anticholinergic used, and nerve blocks were not associated with changes in post-operative urinary dysfunction [Table 1].

Discussion

The majority of literature on POUR and urinary dysfunction following orthopaedic surgery has been focused on lower extremity joint arthroplasty, trauma, and spine surgery.^{11,15,2-26} Many of the studies show substantial rates of POUR and its associated complications in orthopaedic surgery (foley insertions, urinary tract infections, delayed discharges/prolonged hospitalizations, return to emergency rooms or phone calls to on-call physicians), which has significant consequences on patient outcomes, satisfaction, cost of care, health care efficiency and use of resource.^{3,5-7,9,12,13,27,28} However, there is a paucity of literature focusing on urinary retention and dysfunction in the setting of shoulder surgery. The aim of our study is to define the rates of urinary dysfunction or POUR, define the risk factors for POUR, and demonstrate the role of the AUA score in tracking the development and progression of POUR specifically in a cohort of patients undergoing

shoulder surgery.

Although there was only a 2% rate of Foley catheterization within our cohort, nearly half (46%) of our study population had acute worsening in urinary function post-operatively and worse pre-operative AUA scores correlated with worse post-operative AUA scores on linear regression analysis ($r=0.883$, $P<0.0001$). Previous literature commented on the topic of urinary dysfunction but did not define the incidence of POUR in shoulder surgery. For instance, Navarro et al looked at 1306 outpatient rotator cuff repairs (RCR) performed over a year within their hospital system and compared these to other outpatient orthopaedic procedures (defined as all knee arthroscopy, carpal tunnel release, and anterior cruciate ligament reconstruction).¹⁴ The authors observed a 6.9% return to the emergency department or urgent care setting following rotator cuff repair. Of these shoulder surgery patients presenting for urgent attention, 14.3% presented for urinary retention, which was a significantly higher rate than patients who had undergone a different outpatient orthopaedic procedure ($P = 0.007$). Based on our data, we conclude that urinary dysfunction is common within shoulder surgery and should be evaluated on a more regular basis to decrease the significant consequences on patient outcomes, satisfaction, cost of care, health care efficiency and use of resources.

Our study also aimed to identify risk factors for POUR. A number of risk factors for POUR have been

described previously (age, gender, type of anesthesia, type of surgery, Foley use, use of anticholinergics, or comorbidities like BPH and hypertension) for various surgical procedures.^{15,16} Within shoulder surgery, Navarro et al also linked the development of urinary retention to increasing age of patients undergoing RCR.¹⁴ Upon further investigation, the authors noted that their cohort undergoing RCR was made up of older males who were more likely to have baseline BPH as compared to other orthopaedic surgical procedures and that this may confound the age risk factor. In our study, we similarly found that a history of BPH is an independent risk factor for developing POUR ($P = 0.039$), and age additionally trended towards significance. Unlike the studies outside of shoulder surgery, gender, comorbidities like diabetes and hypertension, type of surgery, OR time, IVFs, and anticholinergic used did not strongly correlate with changes in post-operative urinary dysfunction in our study specific to shoulder surgery.^{3,5,6,11,15,16,18,22,23,26}

Finally, our study also identified AUA scores as an independent risk factor for development of POUR perioperatively following shoulder surgery. The AUA survey has previously been found to be reliable both when self-administered or when administered by a healthcare professional. Plante et al had 64 patients complete two AUA questionnaires during the same office visit, half allocated to self-administration administration first and half allocated to physician-administration first.¹⁸ Overall, 26 patients had a higher total score with self-administration, 30 with physician-administration, and 8 had identical scores on both. Multivariate analysis revealed no statistical differences between the two groups in regard to this difference and when taking age and medical history into account. The scoring system used in this study, as first established by Fuller et al, subdivides patients into those experiencing mild (+0-5), moderate (+5) and severe symptoms (+11).² In our study, 46.4% of patients reported worse AUA scores post-operatively within the first 3 to 5 days, with 4.1% of our patients falling into the moderately worse (≥ 5 point worse) or much worse (≥ 11 points worse) categories [Table 1]. This compares with the findings of Elkhodair et al who looked at patients undergoing total hip or knee arthroplasty and found that 37.9% were moderately worse or much worse, with 32 of 95 patients (33.68%) requiring catheterization.²⁹ This discrepancy in findings is expected given the differences between lower extremity and shoulder surgery, including differences in length of surgery, types of anesthesia (spinal anesthesia has a higher risk of urinary dysfunction), and the amount of IV fluids administered. One additional finding of interest was that patients with pre-operative AUA scores of greater than or equal to 11 (one standard deviation above the mean) were significantly more likely to have worse post-operative AUA scores when compared to patients with pre-operative AUA scores of less than 11 ($P=0.04$). Therefore, our study demonstrates that AUA score may uniquely identify patients at risk for developing POUR. Specifically, patients with pre-operative AUA scores of 11 or greater are at a relatively higher risk of experiencing a worsening of urinary function post-operatively.

While our data suggests that the AUA score may help predict who will develop POUR, the findings of this study should be interpreted in the context of several limitations. The first limitation is recall bias, as the post-operative survey was given out between three to five days after surgery. Another limitation involves a known risk factor, opiate medication.¹⁶ All patients in the study were prescribed between 30-40 tablets of 5mg oxycodone at the time of surgery. However, we could not verify how many tablets had been taken by the time the post-op AUA score was collected. Therefore, we could not evaluate full evaluate the influence of opiates and morphine equivalent units on the development of POUR. This may have been a significant predictor for those that would develop worsening urinary dysfunction or POUR, and future studies should evaluate the effect of opiates on POUR in shoulder surgery. All of the surgeries in this cohort were completed in the beach chair position. Future studies could investigate the role of positioning on the development of POUR as well as the role of prophylactic alpha-adrenergic blockers and whether it can decrease the risk of POUR in high risk individuals undergoing shoulder surgery.³⁰⁻³² Finally, the study may have been subject to selection bias given an unequal distribution of male and female participation.

Similar to lower extremity surgery, POUR has important implications for patient satisfaction and outcomes. However, urinary dysfunction rates following shoulder surgery have not been described previously. Our study found worsening urinary function following shoulder surgery is common, affecting 46% of the cohort. Males with a history of BPH and older age increase the risk for developing POUR. The AUA score may be used to predict who may develop worsening urinary function following shoulder surgery as well as track changes in urinary function post-operatively. Further investigation is needed to elucidate the impact of urinary dysfunction on patient outcomes, satisfaction, and cost as well as to determine the role of prophylactic medications.

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