

Avoiding Urinary Catheterization in Patients Undergoing Atrial Fibrillation Catheter Ablation

Andrew B. Lehman¹, Asim S. Ahmed², Parin J. Patel².

¹Marian University College of Osteopathic Medicine, Indianapolis, IN.

²St Vincent Medical Group, Clinical Cardiac Electrophysiology, Indianapolis, IN.

Abstract

Purpose: Indwelling urinary catheters are commonly inserted when administering general anesthesia. However, there are significant risks to routine IUC insertion. We compared urinary and other outcomes in a population of patients undergoing atrial fibrillation (AF) ablation with or without IUC.

Methods: This was a single center, retrospective review of patients undergoing AF ablation. Patients were identified by procedure codes and patient health characteristics and outcome data were manually extracted from electronic health records. The primary composite endpoint was 7-day periprocedural urinary outcomes including cystitis, dysuria, hematuria, urethral damage, or urinary retention.

Results: 404 patients were included in the study, 297 with IUC and 107 without IUC. Uncatheterized patients were less likely to have congestive heart failure (CHF) (31.8% vs 43.4%; $P = 0.039$) and had a shorter procedure length (4.2 vs 4.9 hours; $P < 0.001$) with less fluid administered (1485 vs 2040 mL; $P < 0.001$). No urinary complications occurred in the uncatheterized group versus 14 in the catheterized group ($P = 0.026$). 3 patients in the uncatheterized group developed serious infections versus none in the catheterized group ($P = 0.018$). There was no incidence of death and no statistically significant difference in readmission in the 30 days after procedure.

Conclusions: There were no urinary complications in 107 patients who received no IUC during AF ablation. Avoiding bladder catheters during AF ablation procedures may lower incidence of adverse urinary complications without adding substantial risk of urinary retention.

Introduction

Atrial fibrillation (AF) ablation is an invasive but highly effective treatment for AF that is superior to medical treatment alone.^[1] Standard of care is to place patients under general anesthesia to improve catheter stability and outcomes.^[3,4] Especially during longer cases, large amounts of IV fluid may be administered. To better assess hemodynamic stability and to reduce the risk of urine retention developing during anesthesia, anesthetized patients often undergo indwelling urinary catheterization(IUC).

IUC is a commonly performed procedure in the inpatient setting, but is not risk-free.^[5] Common side effects of IUC include cystitis and subsequent complications^[6], and mechanical trauma to the genitourinary system, especially in men with Benign Prostatic Hyperplasia (BPH).^[5,7] Risk management strategies include minimizing the time a patient spends catheterized and avoiding IUC in the absence of a clear indication.^[8,9] During medical and surgical procedures that require general anesthesia and IUC, patients often have the urinary catheter removed immediately after the procedure is completed. This has successfully reduced the rates of UTI associated with these procedures. However, it has also resulted in an increase in the rate of acute urinary retention.^[10-13] Acute urinary retention

may require placement of a urinary catheter and can increase post-procedural length of stay.^[14]

At our institution, operators have recently begun to forego IUC in some patients undergoing AF ablation. We hypothesize that avoiding IUC during AF ablation may reduce the overall risk of postoperative urinary complications. This study is a nonrandomized observational study investigating the rates of urinary and other complications in patients who underwent AF ablation with or without IUC.

Methods and Materials

This was a single center, retrospective cohort study of patients undergoing ablation for atrial fibrillation. This study was approved by the Institutional Review Board. Patients were identified by billing code Current Procedural Terminology 93656 (Electrophysiology study and Atrial Fibrillation Ablation) at St. Vincent Hospital in Indianapolis, IN. Patients who underwent the procedure between 3/1/17 and 9/30/18 were eligible for inclusion. All procedures were performed by one of five primary operators, using a wide area, antral, circumferential approach to pulmonary vein isolation. Radiofrequency energy was used for ablation with force sensing ablation catheters with either the NavX Ensite (Abbott, St. Paul, MN) or Carto (Biosense Webster, Diamond Bar, CA) mapping platforms. General anesthesia was used for each ablation.

Patient health characteristics and outcomes data were manually

Key Words

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Corresponding Author

Parin J. Patel,
Naab Rd, Suite 400, Indianapolis, IN, 46260

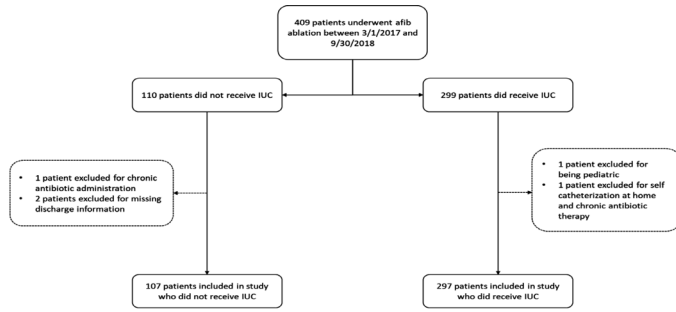


Figure 1: Patients included and excluded from study.

extracted from electronic health records (Athena, Athenahealth, Inc., Watertown, MA; and Sunrise, Allscripts Healthcare Solutions, Inc., Chicago, IL). A random sample of 10% of the charts were manually re-reviewed by a second extractor to ensure high degree of ascertainment. Serum creatinine, height, and weight were input using the measurements closest to the date of procedure +/- 30 days. Chronic Kidney Disease was evaluated as any stage of chronic kidney disease. No patients in this study were on dialysis. Other diagnoses were evaluated by presence of appropriate ICD-10 codes in the patient's health records. Recent malignancy/chemo was diagnosed as diagnosis with malignancy and/or ongoing treatment for a malignancy within the 6 months before the procedure. Remote history of malignancy without ongoing treatment was not included. Case duration was reported as room time in and out of the electrophysiology laboratory.

The primary outcome was a composite of the following: urine retention, need for recatheterization, hematuria, dysuria, UTI or other genitourinary (GU) trauma. Urine retention, UTI, hematuria, and penile or urethral pain were considered procedure-related if they occurred in the 7 days after the procedure. Urinary recatheterization was defined as placement of any additional urinary catheter after the initial IUC due to a urinary complication (as opposed to for another procedure or due to rehospitalization). Patients were censored if they were recatheterized for any reason unrelated to the procedure. Other GU trauma was defined as any specific trauma to the genitourinary system secondary to IUC. Outcomes were assessed from the index discharge summary, subsequent call records, appointments notes, and any discharge notes after readmission in the 30 days after the procedure. Secondary outcomes included serious infection, readmission, death, incontinence, incident congestive heart failure, and post-procedural groin complication. Secondary outcomes occurring within 30 days of the procedure were reported. Serious infection was defined as any infection that resulted in readmission. Incident congestive heart failure and post-procedural groin complication were collected separately from 391 of the patients included in the original analysis.

Statistical Analysis

All analyses were conducted using Stata Statistical Software Release 14 (Stacorp, College Station, TX). Data is presented using frequency and mean and standard deviation. Categorical variables were assessed using Fisher's exact test. Continuous variables were assessed using Student's t test. Results were considered significant if

they had a $P < 0.05$ on two tailed analysis.^[10]

Results

409 patients were included in the study, 299 of whom received IUC and 110 of whom received no IUC. 5 patients were excluded as detailed in [Figure 1] and 404 patients were included in final analysis. One patient was censored early due to catheterization unrelated to urinary complications.

Descriptive statistics of the included patient population are described in [Table 1]. Patients who were uncatheterized were less likely to have CHF (31.8% vs 43.4%; $P=0.039$) and had a higher average BMI (31.7 vs 30.4, $P=0.035$). Patients who were uncatheterized were also less likely to be on aspirin (12.2% vs 19.3%) and more likely to be on clopidogrel (3.7% vs 1.0%), with an overall P of this association of 0.050. There was no statistically significant difference in proportion of patients with persistent AF in the two groups (30.8% uncatheterized and 39.1% catheterized; $P = 0.16$).

Intraoperative characteristics are described in [Table 2]. Procedure duration was significantly shorter in uncatheterized patients (4.2 vs 4.9 hours; $p < 0.001$). Total fluid administration was significantly less in uncatheterized patients (1485 vs 2040 mL; $p < 0.001$), and there was only a small amount of urine recorded in either population (overall average 417 mL).

Table 1: Patient population characteristics.

Patient Characteristic	No IUC	IUC	P-value
Age (mean)	63.9	62.6	0.214
Male (%)	66.4	64.3	0.725
BMI (mean)	31.7	30.4	0.035
Persistent Afib (%)	30.8	39.1	0.161
Congestive Heart Failure (%)	31.8	43.4	0.039
Coronary Artery Disease (%)	29.0	28.6	1.000
Chronic Kidney Disease (%)	11.2	6.4	0.137
Benign Prostatic Hyperplasia (%)	11.9	12.5	1.000
Prostate Cancer (%)	5.6	4.7	0.752
Diabetes (%)	29.0	19.6	0.056
Chronic UTI (%)	0.9	2.7	0.455
History of Kidney Cancer (%)	0.0	0.3	1.000
Cockcroft-Gault (mean)	107	106	0.743
History of Malignancy/Chemo (%)	0.9	1.0	1.000
Preop Antiplatelet			0.050
Aspirin (%)	12.2	19.3	
Clopidogrel (%)	3.7	1.0	
Preop Anticoagulant			0.079
Warfarin (%)	17.8	12.2	
Apixiban (%)	62.6	63.5	
Rivaroxiban (%)	13.1	15.9	
Dabigatran (%)	4.7	8.5	

Table 2: Intraoperative patient characteristics.

Intraoperative Characteristic	No IUC	IUC	P-value
Fluid In Procedure (mL)	1485	2040	<0.001
Fluid Out Procedure (mL)	326	431	0.080
Case Duration (hours)	4.2	4.9	<0.001
Intraop Complication (%)	2.8	5.1	0.422

Table 3: Results. Urinary outcomes were assessed up to 7 days after AF ablation, secondary outcomes were assessed up to 30 days after AF ablation.

Postop Complications	No IUC (N=107)	IUC (N=297)	P-value
Composite Outcome	0	14	0.026
Urine Retention	0	1	
Urinary Recatheterization	0	4	
UTI	0	5	
Hematuria	0	8	
Penile or Urethral Pain	0	2	
Other GU Trauma	0	3	
Secondary outcomes			
Serious Infection	3	0	0.018
Readmission	7	23	0.831
Death	0	0	
Incontinence	0	0	

Primary and secondary outcomes are described in [Table 3]. No urinary complications occurred in the uncatheterized group versus 14 in the catheterized group ($P = 0.026$). The most common complications observed were UTI (5 patients) and hematuria (8 patients). 3 patients suffered intraurethral injury during urinary catheter placement, 2 patients reported penile or urethral pain, and 1 patient developed acute urinary retention. 4 patients were recatheterized for urinary complications. Of these, one was the patient who developed acute urinary retention, and the other three were patients with intraurethral injury.

Of the secondary outcomes assessed, 3 patients developed a serious infection requiring hospitalization in the uncatheterized group, versus 0 in the IUC group ($P=0.018$). There was no statistically significant difference in readmission in the 30 days after procedure. Of readmissions, 3 were those who developed serious infections, 19 were for arrhythmia-related issues, 4 for pericarditis or cardiac injury syndrome, 2 issues with anticoagulant use, 1 patient had another cardiac ablation, 1 patient experienced respiratory failure, and one patient had a newly diagnosed brain tumor. The three patients who developed infections suffered from a pneumonia leading to sepsis, acute cholecystitis leading to acute pneumonia, and one patient developed septic shock of unknown origin. There was no observed incidence of death in the 30 days after the procedure in our population. Only 12 out of 391 (3%) patients experienced incident heart failure in the 30 days post procedure; there was no difference in incident HF between the two groups (2.7% v 5.6%, $p = 0.10$). Only

1 patient required rehospitalization for a groin complication in the bladder catheter group.

Multivariable regression was considered but not performed for this study due to there being zero urinary events in the uncatheterized group and insufficient overall events to ensure statistical validity of a multivariable model.

Discussion

In patients undergoing AF ablation, we compared differences in the rates of urinary and non-urinary outcomes between patients who received IUC for the procedure and those who did not. There was a statistically significant increase in the overall risk of urinary complications in the 7 days postoperatively in patients who received IUC. Urinary catheters are a known means of introducing pathogens into the bladder and can cause mechanical trauma to the urethra during insertion,^[5-7] and this finding supports existing data. One of the main risks associated with forgoing IUC in other studies has been urine retention.^[15, 16] Urine retention is a urologic emergency, but is typically treated with intermittent urinary catheterization until the patient can successfully void.^[17] In the inpatient setting, urine retention can be detected before it becomes emergent, but it may prolong a patient's length of stay. Only one case of urine retention occurred in our study in a catheterized patient. This may be because AF ablation is relatively less traumatic than surgeries that involve manipulation of the viscera and nerve plexuses.

Patients who were catheterized had a significantly higher rate of CHF than patients who were not catheterized. This study was not randomized, and patients with CHF may have received IUC more often to better account for volume status. The higher rate of CHF in catheterized patients may also explain why preoperative aspirin use was higher in this population as well. There were no established criteria for avoiding bladder catheters, and so operator preference and experience, and baseline patient characteristics clearly influenced outcomes. Patients with persistent AF were also slightly more likely to be catheterized in this study, though not statistically significantly so. Because persistent AF ablation may involve ablation in addition to pulmonary vein targets, these procedures can be longer and may involve more fluid administration. This may help explain the difference in average procedure length and fluid administration. Finally, in a post-hoc study of secondary outcomes, incident heart failure and post-procedure groin complications were no different in the two groups.

Inadequate follow-up is a limitation for this study. Procedural complications were ascertained during the index hospitalization, but AF ablation patients are routinely discharged the same day or day after surgery at our institution. After discharge, a patient needed to present to a healthcare facility or lodge a patient call in our system for outcomes to be ascertained. Milder complications, such as dysuria and hematuria, were likely underreported. We found an extremely low rate of UTI after catheter ablation of AF (5/404 = 1%), compared to prior studies (2.9% in Cluckey et al 2019^[18]; 4.7% in Lewandowski et al 2018^[19]). Though the primary composite endpoint was significantly different between those who did or did not have IUC, our study was not powered to see a difference in UTI

alone. It is possible that with appropriate, prospective ascertainment of outcomes, a difference in UTI or readmission can drive significant health care cost savings and reduce patient morbidity.

To address these limitations, we have established a randomized, controlled trial of bladder catheterization during atrial fibrillation ablation (ABCD-AF trial; Avoiding Bladder Catheters During Atrial Fibrillation ablation; [clinicaltrials.gov #NCT03635034](https://clinicaltrials.gov/ct2/show/study/NCT03635034)). We await the results of this trial to better understand the true harm of routine use of bladder catheters during AF ablations.

Conclusion

Avoiding urinary catheterization during AF ablation procedures was associated with a lower incidence of adverse urinary complications in follow up, without adding substantial risk of urinary retention. However, results of this study are confounded by the higher incidence of CHF, persistent AF, longer procedure time, and higher volume of fluid administration intraoperatively in these patients.

References

- Virk SA, Bennett RG, Chow C, Sanders P, Kalman JM, Thomas S, et al. Catheter Ablation Versus Medical Therapy for Atrial Fibrillation in Patients With Heart Failure: A Meta-Analysis of Randomised Controlled Trials. *Heart Lung Circ*. 2018.
- Wilber DJ, Pappone C, Neuzil P, De Paola A, Marchlinski F, Natale A, et al. Comparison of antiarrhythmic drug therapy and radiofrequency catheter ablation in patients with paroxysmal atrial fibrillation: a randomized controlled trial. *JAMA*. 2010;303(4):333-40.
- Calkins H, Hindricks G, Cappato R, Kim YH, Saad EB, Aguinaga L, et al. 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation. *Heart Rhythm*. 2017;14(10):e275-e444.
- Yamaguchi T, Shimakawa Y, Mitsumizo S, Fukui A, Kawano Y, Otsubo T, et al. Feasibility of total intravenous anesthesia by cardiologists with the support of anesthesiologists during catheter ablation of atrial fibrillation. *J Cardiol*. 2018;72(1):19-25.
- Feneley RC, Hopley IB, Wells PN. Urinary catheters: history, current status, adverse events and research agenda. *J Med Eng Technol*. 2015;39(8):459-70.
- Colli J, Tojuola B, Patterson AL, Ledbetter C, Wake RW. National trends in hospitalization from indwelling urinary catheter complications, 2001-2010. *Int Urol Nephrol*. 2014;46(2):303-8.
- Dave C, Faraj K, Vakharia P, Boura J, Hollander J. Quality Improvement Foley Project to Reduce Catheter-Related Trauma in a Large Community Hospital. *J Healthc Qual*. 2018;40(1):51-7.
- Araujo da Silva AR, Marques AF, Biscaia di Biase C, Zingg W, Dramowski A, Sharland M. Interventions to prevent urinary catheter-associated infections in children and neonates: a systematic review. *J Pediatr Urol*. 2018.
- Tambyah PA, Oon J. Catheter-associated urinary tract infection. *Curr Opin Infect Dis*. 2012;25(4):365-70.
- Hooton TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, et al. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. *Clin Infect Dis*. 2010;50(5):625-63.
- Patel DN, Felder SI, Luu M, Daskivich TJ, K NZ, Fleshner P. Early Urinary Catheter Removal Following Pelvic Colorectal Surgery: A Prospective, Randomized, Noninferiority Trial. *Dis Colon Rectum*. 2018;61(10):1180-6.
- Sadeghi M, Leis JA, Laflamme C, Sparkes D, Ditrani W, Watamaniuk A, et al. Standardisation of perioperative urinary catheter use to reduce postsurgical urinary tract infection: an interrupted time series study. *BMJ Qual Saf*. 2018.
- Young J, Geraci T, Milman S, Maslow A, Jones RN, Ng T. Risk factors for reinsertion of urinary catheter after early removal in thoracic surgical patients. *J Thorac Cardiovasc Surg*. 2018;156(1):430-5.
- Steggall M, Treacy C, Jones M. Post-operative urinary retention. *Nurs Stand*. 2013;28(5):43-8.
- Hata T, Noda T, Shimizu J, Hatano H, Dono K. Omitting perioperative urinary catheterization in laparoscopic cholecystectomy: a single-institution experience. *Surg Today*. 2017;47(8):928-33.
- Miller AG, McKenzie J, Greenky M, Shaw E, Gandhi K, Hozack WJ, et al. Spinal anesthesia: should everyone receive a urinary catheter?: a randomized, prospective study of patients undergoing total hip arthroplasty. *J Bone Joint Surg Am*. 2013;95(16):1498-503.
- Yoon PD, Chalasani V, Woo HH. Systematic review and meta-analysis on management of acute urinary retention. *Prostate Cancer Prostatic Dis*. 2015;18(4):297-302.
- Cluckey A, Perino AC, Fan J, Askari M, Nasir J, Marcus GM, et al. Urinary tract infection after catheter ablation of atrial fibrillation. *Pacing Clin Electrophysiol*. 2019.
- Lewandowski DE, Pierce D, Barnett A, Sampene E, Safdar N, Field ME, et al. Impact of antibiotic prophylaxis on catheter-associated urinary tract infections during atrial fibrillation ablation. *J Interv Card Electrophysiol*. 2018;51(2):183-7.