Outcomes of Unicompartmental Knee Arthroplasty in Patients Receiving Chronic Anticoagulation Therapy: A Matched Cohort Study

Janice M. Bonsu[1], Andrew Fuqua[1], Kevin Heo[1], Jacob Worden[2], Rahul K. Goel[1], George N. Guild III[1], Ajay Premkumar[1]
[1] Emory University School of Medicine, Atlanta, GA, [2] Medical College of Georgia, Augusta, GA
Jbonsu2@emory.edu

Disclosures: Janice Bonsu (AAOS Now, RJOS), Andrew Fuqua (N), Kevin Heo (N), Jacob Worden (N), Rahul Goel (N), George N. Guild III (Smith & Nephew), Ajay Premkumar (N)

INTRODUCTION: Osteoarthritis (OA) of the knee is a common pathology that is often treated surgically for definitive treatment for severe symptoms. Though total knee arthroplasty (TKA) has long been considered the gold-standard of treatment, unicompartmental knee arthroplasty (UKA) is fast becoming a technique of choice for OA that is isolated to a single compartment of the knee. The current evidence demonstrates that patients who receive UKA experience fewer complications compared to those after TKA. This makes UKA a potentially superior option for surgically high risk patients, with one subset of these patients being those who receive chronic anticoagulation therapy. However, there is a paucity of data related to the outcomes in these patients face after UKA. Therefore, the purpose of this study was to investigate the complications related to UKA in patients on chronic anticoagulation therapy.

METHODS: The IBM Commercial Claims and Encounters and Medicare Supplemental and Coordination of Benefit Databases were searched between 2009-2019 using the Current Procedural Terminology (CPT) code 27446 to identify patients who underwent UKA. Patients without a minimum of continuous enrollment 6 months before and after their UKA procedure and patients less than 18 years of age were excluded from analysis. National drug codes were used to identify patients who were prescribed warfarin, low molecular weight heparin (LMWH), and direct oral anticoagulants (DOACs). Patients with at least one prescription for these anticoagulant drugs filled within 6 months of surgery were placed into the chronic anticoagulation (CA) cohort and all others were placed into the non-anticoagulated cohort (NAC). Overall comorbidity burden among the CA and NAC cohorts was obtained by calculating the Charlson Comorbidity Index. Both 90-day and two-year complications were identified via International Classification of Disease (ICD) 9 and 10 codes. Chi-square and independent t-tests were utilized to analyze differences in patient demographics and comorbidities. Following univariate analysis, multivariate regression was utilized to assess for differences in 90-day and two-year complications between cohorts while controlling for age, sex, and relevant comorbidities. All statistical analysis was performed using R studio and SPSS.

RESULTS SECTION: We identified 45,749 patients that received UKA between 2009-2019. Of these, there were 12,267 (26.8%) patients that received chronic preoperative anticoagulation. The CA cohort was older (60.7 vs. 59.6; P<0.001), more likely to be male (50% vs. 48%; P<0.001), and had a significantly greater comorbidity burden compared to the non-anticoagulated cohort, including a higher Charlson Comorbidity Index (3.15 vs 2.84; P<0.001). Higher rates of anxiety (11% vs. 9.5%; P<0.001) and obesity (32% vs. 31%; P=0.002) were found in the NAC group (Table 1**)**. Multivariate analysis showed significant differences at 90 days in SSI (OR 1.14; P=0.021), sepsis (OR 1.93; P<0.001), MUA (OR 1.54; P<0.001), periprosthetic fracture (OR 2.27; P=0.017), extended length of stay (OR 1.45; P<0.001), DVT (OR 2.48; P<0.001), PE (OR 4.74; P<0.001), PNA (OR 1.28; P=0.020), and readmission (OR 1.27; P=0.006) (Table 2). The CA group also experienced significantly higher odds of PJI (OR 1.49;P<0.001), sepsis (OR 1.84; P<0.001), mechanical complications (OR 1.59; P<0.001), peri-prosthetic fracture (OR 2.51, P<0.001), and conversion to TKA (OR 1.75, P<0.001) at 2 year follow-up. Subgroup analysis investigating the influence of individual anticoagulant classes found patients receiving warfarin to be at increased risk of SSI, sepsis, mechanical complications, and MUA at 90 days. DOAC patients were at elevated risk of SSI, sepsis, and periprosthetic fracture at 90 days. Patients receiving LMWH were only at significant risk of MUA and hematoma at 90 days. For all anticoagulation subgroups, there was a significantly increased risk of PJI, sepsis, mechanical complications, periprosthetic fracture, and conversion to TKA at two years (Table 3).

DISCUSSION: Overall, the CA cohort experienced worse medical and surgical outcomes at both 90-days and 2-years compared to the NAC group. Future research should include prospective studies confirming these findings and exploring the effect of perioperative protocols on outcomes in this population.

SIGNIFICANCE/CLINICAL RELEVANCE: The paucity of literature surrounding outcomes in chronic anticoagulation patients prevents clinicians from making evidence-based decisions when delivering care. As such, clinical practice is improved by providing the first published data that physicians can use to understand the risks associated with performing UKAs on patients on chronic anticoagulation therapy.

Table 1: Baseline Characteristics and Comorbidities

	Anticoagulation Status		
	No Chronic Anticoagulation	Chronic Anticoagulation	P-Value
Total, n (%)	33,482 (73.2)	12,267 (26.8)	
Age, mean (SD)	59.6 (9.7)	60.7 (10.3)	**<0.001**
Sex			**<0.001**
Male	15,918 (48.0)	6,098 (50.0)	
Female	17,564 (52.0)	6,169 (50.0)	
Comorbidities			
Charlson Comorbidity Index	2.84 (2.11)	3.15 (2.33)	**<0.001**
Peripheral Vascular Disease	1548 (4.6)	749 (6.1)	**<0.001**
Chronic Lung Diseases	7996 (24.0)	3,246 (26.0)	**<0.001**
Chronic Liver Disease	7667 (23.0)	3119 (25.0)	**<0.001**
Chronic Kidney Disease	1255 (3.7)	581 (4.7)	**<0.001**
Hyperlipidemia	21654 (65)	8013 (65)	0.2
Coronary Artery Disease	5139 (15)	2479 (20.0)	**<0.001**
Congestive Heart Failure	1354 (4.0)	831 (6.8)	**<0.001**
Diabetes	7561 (22.4)	3120 (25.0)	**<0.001**
Rheumatologic Disease	3222 (9.6)	831 (6.8)	0.2
Thrombophilia	1061 (3.2)	1132 (9.2)	**<0.001**
Anxiety	3636 (11.0)	1169 (9.5)	**<0.001**
Depression	6931 (21.0)	2499 (20.0)	0.4
Alcohol Abuse	738 (2.2)	292 (2.4)	0.3
Tobacco Use	4336 (13.0)	1550 (13.0%)	0.4
Obesity	10740 (32.0)	3751 (31.0)	**0.002**
Hypertension	22019 (65.0)	8451 (69.0)	**<0.001**
Atrial Fibrillation	900 (2.7)	1361 (11.0)	**<0.001**
Prior Myocardial Infarction	966 (2.9)	416 (3.4)	**0.005**

[1] *Independent 2 Sample T-test; Pearson's Chi squared Test*

Table 2. Multivariate Regression Analysis of Complications Between Cohorts – Controlled for Age, Sex, and Major Comorbidities

Complication	OR[1]	95% CI[2]	P-Value
90-Day Surgical Complications			
PJI*	1.10	0.895 – 1.36	0.356
SSI*	1.14	1.02-1.28	**0.021**
Mechanical Complications	1.10	0.91 – 1.32	0.377
MUA*	1.54	1.34 – 1.76	**<0.001**
Peri-prosthetic Fracture	2.27	1.16– 4.47	**0.017**
Hematoma	1.20	0.82 – 1.75	0.352
Seroma	1.19	0.81 – 1.73	0.376
Cellulitis	1.11	0.95 – 1.28	0.183
Transfusion	1.85	0.79 – 4.17	0.14
90-Day Medical Complications			
Extended Length of Stay	1.45	1.38-1.53	**<0.001**
DVT	2.48	2.18 – 2.83	**<0.001**
PE	4.74	3.57-6.29	**<0.001**
MI	1.33	0.92 – 1.92	0.135
PNA*	1.28	1.04 – 1.58	**0.020**
Sepsis	1.93	1.39 – 2.67	**<0.001**
Readmission	1.27	1.07-1.51	**0.006**
2-Year Complications			
PJI*	1.49	1.29 – 1.73	**<0.001**
Sepsis	1.84	1.54 – 2.19	**<0.001**
Mechanical Complications	1.59	1.45 – 1.74	**<0.001**
Peri-Prosthetic Fracture	2.51	1.51 – 4.18	**<0.001**
Conversion to TKA	1.75	1.56 – 1.97	**<0.001**

*PJI = Periprosthetic Joint Infection, SSI = Surgical Site Infection, MUA = Manipulation under Anesthesia, PNA = Pneumonia
[1] *Odds Ratio);* [2] *95% Confidence Interval;*

Table 3. Regression Analysis of Complications by Anticoagulation Type – Controlled for Age, Sex, and Major Comorbidities

	Warfarin			DOAC			LMWH		
Complication	OR[1]	95% CI[2]	P value	OR[1]	95% CI[2]	P value	OR[1]	95% CI[2]	P value
90-Day Surgical Complications									
PJI*	1.23	0.95-1.58	0.10	0.97	0.72-1.28	0.8	0.62	0.04 2.79	0.6
SSI*	1.20	1.04 – 1.39	**0.011**	1.03	0.88–1.20	0.7	1.53	0.69-2.93	0.2
Mechanical Complications	1.26	1.00-1.57	**0.047**	0.94	0.72-1.22	0.7	1.87	0.57-4.45	0.2
MUA*	1.56	1.31 – 1.85	**<0.001**	1.55	1.30-1.85	**0.001**	2.55	1.20-4.76	**0.007**
Peri-prosthetic Fracture	1.70	0.61-4.08	0.3	3.50	1.54-7.48	**0.002**	-	-	-
Hematoma	1.30	0.81-2.01	0.3	0.94	0.51-1.62	0.8	7.25	1.76-19.8	**<0.001**
Seroma	1.19	0.81 – 1.73	0.376	1.23	0.51-2.62	0.6	-	-	-
Cellulitis	1.11	0.95 –1.28	0.183	0.99	0.34-2.36	>0.9	-	-	-
Transfusion	1.98	0.69-5.03	0.2	1.68	0.47-4.73	0.4	-	-	-
90-Day Medical Complications									
Extended LOS	1.63	1.49 -1.77	**<0.001**	1.46	1.04-2.04	**0.027**	-	-	-
DVT	3.05	2.63 – 3.53	**<0.001**	1.74	1.44-2.10	**<0.001**	1.62	0.49-3.90	0.3
PE	5.38	3.96-7.36	**<0.001**	3.86	2.69-5.51	**<0.001**	-	-	-
MI	1.25	0.77 – 1.98	0.3	1.23	0.72-2.01	0.4	-	-	-
PNA*	1.34	1.02-1.73	**0.029**	1.17	0.87-1.54	0.3	5.27	2.05-11.1	**<0.001**
Sepsis	1.81	1.18 -2.72	**0.005**	1.97	1.29-2.94	**0.001**	-	-	-
Readmission	1.47	1.32-1.64	**<0.001**	1.15	**1.01-1.30**	**0.028**	1.88	1.06-3.09	**0.021**
2-Year Complications									
PJI*	1.47	1.23– 1.64	**<0.001**	1.15	1.01-1.30	**0.033**	1.85	1.04-3.05	**0.023**
Sepsis	1.50	1.24 –1.67	**<0.001**	1.14	1.01-1.29	**0.038**	1.92	1.08-3.15	**0.017**
Mechanical Complications	1.77	1.58 –1.97	**<0.001**	1.41	1.25-1.59	**<0.001**	1.99	1.12-3.28	**0.011**
Peri-prosthetic Fracture	1.79	1.61– 1.99	**<0.001**	1.44	1.27-1.62	**<0.001**	2.01	1.13-3.31	**0.010**
Conversion to TKA	1.91	1.65 –2.20	**<0.001**	1.61	1.37-1.88	**<0.001**	3.14	1.64-5.45	**<0.001**

*PJI = Periprosthetic Joint Infection, SSI = surgical site infection, MUA = Manipulation under Anesthesia, PNA = Pneumonia
[1] *Odds Ratio;* [2] *95% Confidence Interval;*