How Does Alcohol Use Disorder Impact Outcomes and Costs Following Open Reduction and Internal Fixation for Bimalleolar Ankle Fractures?

Arie Monas[1], DERRICK CHATAD, Ariel Nicolas Rodriguez, Aaron Lam, Rushabh Vakharia[2], Amr Atef Abdelgawad, Afshin Razi[2]
[1]Department of Orthopaedic Surgery, SUNY Downstate, [2]Maimonides Medical Center

INTRODUCTION:

Alcohol use disorder (AUD) is one of the leading mental health disorders per *The Diagnostic and Statistical Manual for Mental Health Disorders, Fifth Edition.* (DSM-V). From a recent investigation, the weighted prevalence of AUD within the United States is roughly 7.8%. Studies evaluating the association of AUD on total joint arthroplasty and spine surgery have been thoroughly documented; however, its impact on outcomes following open reduction and internal fixation (ORIF) of bimalleolar ankle fractures has not been thoroughly analyzed. As such, the aims of this study were to compare: 1) annual trends; 2) baseline demographics; 3) medical complications; and 4) costs of care.

METHODS:

Using a large nationwide administrative claims database, a retrospective query from January 1st, 2010 to October 31st, 2020 was performed. Cohorts of interest were identified using International Classification of Disease, Ninth Revision (ICD-9), ICD-10, and Current Procedural Terminology (CPT) codes. The database was initially queried for all patients who sustained either an open or closed bimalleolar ankle fractures. Patients from this cohort who underwent ORIF were identified. Using Boolean command operators (“AND”, “OR”, “NOT”), the inclusion criteria for the study group consisted of all patients who underwent ORIF for bimalleolar ankle fractures with AUD; whereas patients without AUD served as the comparison cohort. The query yielded 64,563 patients within the study (n = 8,177) and comparison (n = 56,386) cohort. Primary aims of the study were to compare annual trends of AUD patients undergoing ORIF for bimalleolar ankle fractures and to compare baseline demographics, 90-day medical complications, in addition to day of surgery and total global 90-day episode of care costs. Ninety-day medical complications analyzed between the two cohorts included: acute kidney injuries, cerebrovascular accidents, deep vein thromboses, myocardial infarctions, pneumoniae, pulmonary emboli, respiratory failures, surgical site infections, transfusion of blood products, urinary tract infections, and venous thromboemboli. Reimbursements were used as a surrogate for costs as done in previously published investigations. Linear regression was used to determine annual trends of AUD patients undergoing ORIF for bimalleolar ankle fractures. A multivariate binomial logistic regression model was used to calculate the odds-ratios (OR) and 95% confidence intervals (95%CI) on the association of AUD on the aforementioned complications. The model was adjusted for age, sex, geographic region, and the Elixhauser-Comorbidity Index (ECI). ECI was used over the traditional Charlson-Comorbidity Index (CCI) as it is comprised of twice as many complications. Welch’s *t*-tests were used to compare costs between the two cohorts. An alpha value less than 0.001 was considered to be statistically significant.

RESULTS:

Linear regression demonstrated a statistically significant increase in AUD patients undergoing ORIF for bimalleolar ankle fractures during the study period from 2010 (n = 1,206) to 2020 (n = 2,232)(r^2 = 0.81; p<0.0001)(Figure 1). Study group patients were significantly different compared to the comparison cohort with respect to age (p<0.0001), sex (p<0.0001), and prevalence of certain comorbid conditions (Table 1). AUD patients were found to have significantly higher frequency and odds of developing complications within 90-days following ORIF of their bimalleolar ankle fractures (59.35 vs. 18.77%; OR: 2.30, 95%CI: 2.16 to 2.46, p<0.0001) (Table 2). Specifically, AUD was associated with higher rates and odds of cerebrovascular accidents (2.63 vs. 0.62%; OR: 3.60, 95%CI: 2.91 to 4.41, p<0.0001), respiratory failures (4.44 vs. 0.87%; OR: 3.19, 95%CI: 2.69 to 3.76, p<0.0001), pneumoniae (10.16 vs. 2.27%; OR: 2.67, 95%CI: 2.39 to 2.99, p<0.0001), transfusions of blood products (2.63 vs. 0.66%; OR: 2.46, 95%CI: 2.00 to 3.02, p<0.0001), in addition to other complications (Table 2). Additionally, the data demonstrated study group patients were found to have significantly higher day of surgery ($4,433.33 vs. $3,979.85, p<0.0001) and total global 90-day episode of care costs ($8,523.40 vs. $6,976.95, p<0.0001)(Figure 2).

DISCUSSION AND CONCLUSION:

This investigation demonstrates that there has been an increase in the prevalence of AUD patients undergoing ORIF for bimalleolar ankle fractures. AUD was found to be associated with significantly higher rates of medical complications and costs of care following ORIF for bimalleolar ankle fractures. The investigation is vital as it can allow orthopaedic surgeons and other healthcare professionals to adequately educate these patients on the potential complications following their surgery.

Figure 1. Trends in Alcohol Use Disorder and Comparison Cohort Undergoing Open Reduction and Internal Fixation for Bimalleolar Ankle Fractures

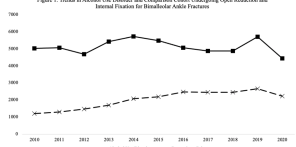
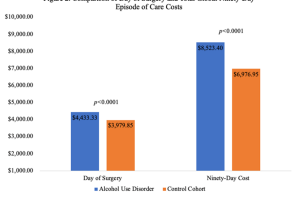


Figure 2. Comparison of Day of Surgery and Total Global Ninety-Day Episode of Care Costs



Demographics	Alcohol Use Disorder		Comparison Cohort		*p*-value
Age (Years)	n	%	n	%	<0.0001
15 to 19	238	2.91	2,211	3.92	
20 to 24	391	4.78	1,932	3.43	
25 to 29	504	6.16	2,133	3.78	
30 to 34	526	6.43	2,349	4.17	
35 to 39	583	7.13	2,665	4.73	
40 to 44	639	7.81	2,970	5.27	
45 to 49	893	10.92	3,616	6.41	
50 to 54	1,172	14.33	4,822	8.55	
55 to 59	1,155	14.12	6,028	10.69	
60 to 64	847	10.36	6,367	11.29	
65 to 69	557	6.81	6,073	10.77	
70 to 74	441	5.39	7,633	13.54	
75 to 79	184	2.25	5,480	9.72	
80<	23	0.28	1,328	2.36	
Sex					<0.0001
Female	4,322	52.86	40,757	72.28	
Male	3,855	47.14	15,629	27.72	
Comorbidities					
Asthma	1,531	18.72	7,892	14.00	<0.0001
Coronary Artery Disease	1,873	22.91	13,563	24.05	0.023
Cardiac Arrhythmia	2,347	28.70	13,571	24.07	<0.0001
Cerebrovascular Disease	1,850	22.62	12,661	22.45	<0.0001
Congestive Heart Failure	747	9.14	5,972	10.59	<0.0001
COPD	3,420	41.82	18,145	32.18	<0.0001
Depressive Disorder	1,751	21.41	9,520	16.88	<0.0001
Diabetes Mellitus	2,823	34.52	21,464	38.07	<0.0001
HIV	151	1.85	286	0.51	<0.0001
Hypertension	5,917	72.36	37,147	65.88	<0.0001
Hypothyroidism	1,769	21.63	15,502	27.49	<0.0001
Iron Deficiency Anemia	1,751	21.41	9,520	16.88	<0.0001
Liver Disease	2,842	34.76	7,373	13.08	<0.0001
Obesity	3,064	37.47	22,255	39.47	<0.0001
Peripheral Vascular Disease	1,591	19.46	10,859	19.26	0.681
Rheumatoid Arthritis	285	3.49	2,218	3.93	0.054
Tobacco Use	5,993	73.29	20,187	35.80	<0.0001
Valvular Disease	1,389	16.99	10,499	18.62	0.0003
Pathologic Weight Loss	1,462	17.88	6,156	10.92	<0.0001

Table 1. Comparison of Baseline Demographic Profiles of Alcohol Use Disorder and Comparison Cohort Undergoing Open Reduction and Internal Fixation for Bimalleolar Ankle Fractures. COPD = Chronic Obstructive Pulmonary Disease; HIV = Human Immunodeficiency Virus

Medical Complications Assessed	AUD (%)	Control (%)	OR	95%CI	*p*-value*
Cerebrovascular Accidents	2.63	0.62	3.60	2.91 – 4.41	<0.0001
Respiratory Failures	4.44	0.87	3.19	2.69 – 3.76	<0.0001
Pneumoniae	10.16	2.27	2.67	2.39 – 2.99	<0.0001
Transfusions of Blood Products	2.63	0.66	2.46	2.00 – 3.02	<0.0001
Urinary Tract Infections	12.14	4.69	2.37	2.16 – 2.61	<0.0001
Acute Kidney Injuries	11.51	2.90	2.16	1.95 – 2.41	<0.0001
Myocardial Infarctions	4.63	1.19	2.07	1.77 – 2.43	<0.0001
Surgical Site Infections	6.79	3.32	1.63	1.45 – 1.83	<0.0001
Deep Vein Thromboses	1.50	0.52	1.51	1.17 – 1.94	0.0001
Venous Thromboemboli	2.10	1.08	1.25	1.02 – 1.51	0.026
Pulmonary Emboli	0.81	0.63	1.01	0.74 – 1.35	0.923
Total Medical Complications	59.35	18.77	2.30	2.16 – 2.46	<0.0001

Table 2. Comparison of Ninety-Day Medical Complications Among Alcohol Use Disorder Patients and Comparison Cohort.
OR = Odds-Ratio; 95%CI = 95% Confidence Interval
* = Adjusted for Age, Sex, Geographic Region, and Elixhauser-Comorbidity Index