Anemia and Its Severity is Associated with Worse Postoperative Outcomes following Open Reduction Internal Fixation of Ankle Fractures

Carlos David Ortiz-Babilonia, Daniel Badin, Arjun Gupta, Ryan Guilbault[1], Nigel Hsu[2], Amiethab Aiyer
[1]Johns Hopkins, [2]Johns Hopkins, Ortho

INTRODUCTION:
Ankle fractures are often treated in a non-emergent fashion and therefore offer the chance for treatment of preoperative anemia. Although preoperative anemia has been associated with postoperative morbidity following certain types of orthopaedic procedures, its effect on postoperative outcomes following open reduction internal fixation (ORIF) of ankle fractures has not been evaluated. The purpose of this study was to determine the influence of preoperative anemia on 30-day postoperative outcomes following ankle fracture ORIF.
METHODS:
The American College of Surgeons National Surgical Quality Improvement Program (ASC-NSQIP) registry was queried from 2005 to 2019 for patients undergoing ankle fracture ORIF. Patients were stratified into non-anemic, mildly anemic, and moderately to severely anemic. Univariate analyses were utilized to assess differences in patient characteristics between cohorts. Multivariate logistic regressions adjusting for these differences were performed to assess the effect of preoperative anemia on 30-day postoperative outcomes. Both mild (P=0.004) and moderate to severe (P<0.001) anemia groups had significantly higher odds of requiring a blood transfusion.
RESULTS:
We obtained data for 21,211 patients, of whom 14,931 (70.39%) were not anemic, 3,982 (18.77%) were mildly anemic, and 2,298 (10.83%) were moderately to severely anemic. After adjustment, mild preoperative anemia was associated with higher odds of any adverse event (P<0.001), deep SSIs (P=0.013), sepsis (P=0.001), 30-day readmission (<0.001), and extended length of stay (LOS) (P<0.001). Similarly, moderate to severe anemia in these patients was also associated with increased odds of any adverse event (P<0.001), deep SSIs (P=0.003), sepsis (P=0.001), readmission (P<0.001), and extended LOS (P<0.001).
DISCUSSION AND CONCLUSION: Preoperative anemia is associated with an increased risk of adverse postoperative outcomes in patients undergoing ORIF for ankle fractures. Surgeons should carefully consider treating preoperative anemia based on the time available for hemoglobin optimization, the severity of anemia, and the presence other comorbidities increasing the risk of adverse events.

Figure 1. Multivariable Analysis of Postoperative Complications Following Open Reduction and Internal Fixation of Ankle Fractures: Mildly Anemic and Moderately/Severely Anemic vs Nonanemic Patients

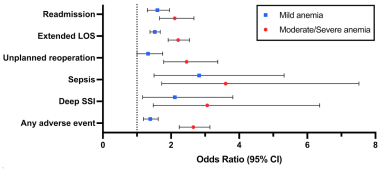

Table 1. Anemic vs Nonanemic Patient and Procedure Characteristics

	Nonanemic (N=14,931)	Mildly Anemic (N=3,982)	P-value	Moderately to Severely Anemic (N=2,298)	P-value
Age, mean [SD]	52.24 [17.23]	58.17 [17.24]	**<0.001**	64.22 [16.25]	**<0.001**
Female, n (%)	9,229 (61.81%)	2,442 (61.33%)	0.746	1,820 (79.20%)	**<0.001**
White, n (%)	9,780 (65.50%)	2,544 (63.89%)	0.058	1,590 (69.19%)	**0.001**
BMI, mean [SD]	31.27 [7.18]	31.27 [7.70]	0.492	31.80 [8.21]	**0.002**
Smoker, n (%)	3,763 (25.20%)	831 (20.87%)	**<0.001**	367 (16.41%)	**<0.001**
HTN, n (%)	5,205 (34.86%)	2,047 (51.41%)	**<0.001**	1,543 (67.15%)	**<0.001**
CHF, n (%)	70 (0.47%)	37 (0.93%)	**0.001**	82 (3.57%)	**<0.001**
COPD, n (%)	446 (2.99%)	208 (5.22%)	**<0.001**	201 (8.75%)	**<0.001**
ESRD, n (%)	34 (0.23%)	52 (1.31%)	**<0.001**	137 (5.96%)	**<0.001**
Bleeding disorder, n (%)	509 (3.41%)	242 (6.08%)	**<0.001**	255 (11.10%)	**<0.001**
Disseminated cancer, n (%)	33 (0.22%)	22 (0.55%)	**0.001**	28 (1.22%)	**<0.001**
Diabetes, n (%)	1,774 (11.88%)	899 (22.58%)	**<0.001**	802 (34.90%)	**<0.001**
Transfused preoperatively, n (%)	6 (0.04%)	7 (0.18%)	**0.004**	7 (4.22%)	**<0.001**
Steroid/immunosuppressant use, n (%)	276 (1.85%)	52 (2.99%)	**<0.001**	133 (5.79%)	**<0.001**
Dependency, n (%)			**<0.001**		**<0.001**
Independent	14,244 (96.62%)	3,684 (93.48%)		1,989 (87.78%)	
Partially Dependent	457 (3.44%)	239 (3.07%)		252 (11.12%)	
Totally Dependent	42 (0.16%)	18 (0.46%)		25 (1.10%)	
ASA Class, n (%)			**<0.001**		**<0.001**
1	2,280 (15.27%)	370 (9.29%)		73 (3.18%)	
2	7,989 (53.51%)	1,610 (40.43%)		596 (25.94%)	
3	4,356 (29.17%)	1,788 (44.90%)		1,302 (56.66%)	
4	306 (2.05%)	214 (5.37%)		327 (14.23%)	
Outpatient procedure, n (%)	8,177 (54.77%)	1,568 (39.38%)	**<0.001**	628 (27.33%)	**<0.001**

Table 2. Multivariate Logistic Regression Models

	Mildly Anemic vs Nonanemic			Moderately to Severely Anemic vs Nonanemic		
	OR	95% CI	P-value	OR	95% CI	P-value
Any adverse event	1.390	[1.189-1.624]	**<0.001**	2.654	[2.241-3.143]	**<0.001**
Major adverse event	1.418	[1.157-1.739]	**0.001**	1.980	[1.561-2.511]	**<0.001**
Deep SSI	2.111	[1.169-3.815]	**0.013**	3.064	[1.476-6.362]	**0.003**
Dehiscence	1.519	[0.870-2.652]	0.141	1.757	[0.906-3.408]	0.095
Reintubation	1.264	[0.688-2.321]	0.450	0.951	[0.451-2.006]	0.895
Pulmonary embolism	1.360	[0.747-2.478]	0.315	0.945	[0.380-2.345]	0.902
DVT/thrombophlebitis	1.089	[0.615-1.928]	0.769	1.778	[0.860-3.677]	0.121
Failure to extubate	2.316	[0.993-5.404]	0.052	1.658	[0.588-4.672]	0.339
Stroke/CVA	0.185	[0.019-1.797]	0.146	0.424	[0.095-1.883]	0.259
Arrest	1.390	[0.517-3.737]	0.513	0.421	[0.077-2.312]	0.341
Myocardial infarction	1.852	[0.833-4.116]	0.131	1.240	[0.497-3.092]	0.552
Sepsis	2.825	[1.500-5.319]	**0.001**	3.694	[1.728-7.517]	**0.001**
Perioperative transfusion	2.971	[1.420-6.214]	**0.004**	30.304	[16.514-55.610]	**<0.001**
Acute kidney injury	3.282	[0.784-13.744]	0.104	4.045	[0.999-16.384]	0.050
30-day mortality	1.319	[0.687-2.532]	0.405	1.004	[0.487-2.069]	0.991
Unplanned reoperation	1.326	[1.000-1.757]	0.050	2.455	[1.788-3.371]	**<0.001**
Minor adverse event	1.306	[1.044-1.635]	**0.020**	1.533	[1.176-1.996]	**0.002**
Superficial SSI	1.334	[0.936-1.902]	0.111	1.516	[0.915-2.514]	0.106
Pneumonia	1.623	[0.992-2.656]	0.054	1.158	[0.660-2.031]	0.609
Urinary tract infection	1.125	[0.797-1.589]	0.504	1.367	[0.942-1.986]	0.100
Extended length of stay	1.525	[1.381-1.683]	**<0.001**	2.208	[1.915-2.545]	**<0.001**
Unplanned 30-day readmission	1.599	[1.307-1.957]	**<0.001**	2.107	[1.661-2.672]	**<0.001**