

Preoperative Anemia as a Risk Factor for Postoperative Complications Following Open Reduction Internal Fixation of Distal Radius Fractures

Alexander R. Garcia, BS¹, Kenny Ling, MD², Samer Al-Humadi, MD², David Komatsu, PhD², Edward D. Wang, MD²

¹Renaissance School of Medicine at Stony Brook University, Stony Brook, NY, USA, ²Department of Orthopaedics and Rehabilitation, Stony Brook University, Stony Brook, NY, USA.
Alexander.garcia@stonybrookmedicine.edu

Disclosures: Alexander R. Garcia (N), Kenny Ling (N), Samer Al-Humadi (N), David Komatsu (N), Edward D. Wang (N)

INTRODUCTION: The incidence of distal radius fractures (DRF) in the United States is over 640,000 cases per year and is projected to increase. The overall prevalence of anemia in the United States increased from 5.71% in 2005 to 6.86% in 2018. Therefore, preoperative anemia may be an important risk factor to consider prior to surgical fixation of a distal radius fracture. The purpose of this study was to investigate preoperative anemia and its association with short-term complications following surgical treatment of distal radius fractures.

METHODS: The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database was queried for all patients who underwent open reduction internal fixation (ORIF) of DRF between 2015 and 2020. The initial pool of patients was divided into cohorts based on preoperative hematocrit. Multivariate logistic regression, adjusted for all significantly associated patient demographics and comorbidities, was used to identify associations between preoperative anemia and postoperative complications following ORIF of DRF.

RESULTS SECTION: A total of 22,923 patients who underwent ORIF of DRF were identified in NSQIP from 2015 to 2020. Of the 12,068 patients remaining after exclusion criteria, 9,616 (79.7%) patients were included in the normal cohort, 2,238 (18.5%) patients were included in the mild anemia cohort, and 214 (1.8%) patients were included in the severe anemia cohort. Compared to the reference cohort, patients with any anemia were independently associated with higher rates of reintubation (OR 6.51, 95% CI 1.29-32.80; $p = 0.023$), blood transfusion (OR 11.83, 95% CI 3.95-35.45; $p < 0.001$), septic shock (OR 10.76, 95% CI 1.19-97.02; $p = 0.034$), readmission (OR 2.10, 95% CI 1.60-2.76, $p < 0.001$), non-home discharge (OR 2.22, 95% CI 1.84-2.68; $p < 0.001$), and mortality (OR 2.70, 1.03-7.07; $p = 0.043$).

DISCUSSION: We hypothesized that preoperative anemia is associated with non-home discharge. Preoperative anemia, both mild and severe, were clinically significant predictors for postoperative complications within 30-days following ORIF of DRF. Severe anemia was associated with higher rates of blood transfusion, non-home discharge, and mortality compared to mild anemia. A major limitation is that NSQIP inherently excludes cases performed for trauma, which likely excludes cases of DRF ORIF in poly-trauma patients. While this does not allow us to investigate a certain portion of DRF cases, it may be beneficial to our analysis, as anemia is much more difficult to control in a poly-trauma setting. The NSQIP database only allows us to investigate postoperative complications within 30 days of the procedure only.

SIGNIFICANCE/CLINICAL RELEVANCE: Distal Radius fractures occur largely in elderly populations that may be at higher risk for preoperative anemia. By analyzing complications with preoperative anemia surgeons can better determine patients at increased risk of complications.

Level of Evidence: Level III; Retrospective Cohort Comparison; Prognosis Study

Keywords: distal radius fracture, open reduction internal fixation, preoperative anemia, postoperative complication

Table 1. Patient demographics/comorbidities in patients with and without anemia who underwent surgical treatment of distal radius fractures. Bold p-values indicate statistical significance with $p < 0.05$.

	Normal	Any Anemia	Mild Anemia	Severe Anemia	Any vs no anemia	Mild vs no anemia	Severe vs mild anemia	
Characteristic	Number	%	Number	%	p-value	p-value	p-value	
Total	9,616	100.0%	2,432	100.0%	2,238	100.0%	214	100.0%
Age								
18-39	1,179	12.3%	204	8.3%	192	8.6%	12	5.6%
40-44	4,542	47.2%	859	35.1%	869	38.8%	90	42.1%
45-74	2,403	25.0%	640	26.4%	590	26.7%	50	23.4%
≥75	1,490	15.5%	641	26.3%	579	25.9%	62	29.0%
Body mass index (kg/m ²)								
<18.5	211	2.2%	94	3.8%	79	3.5%	15	7.0%
18.5-24.9	6,048	62.8%	1,567	63.9%	1,444	64.5%	123	57.5%
25.0-29.9	1,800	18.6%	447	18.2%	403	18.0%	44	20.6%
30.0-34.9	842	8.8%	191	7.8%	179	8.0%	12	5.6%
≥35.0	633	6.6%	133	5.5%	133	5.9%	20	9.3%
Gender								
Male	7,304	76.0%	1,802	73.2%	1,712	76.5%	180	84.1%
Female	2,312	24.0%	500	20.8%	526	23.5%	34	15.9%
Functional status								
Independent	9,443	98.2%	2,344	95.6%	2,150	96.1%	194	90.7%
Dependent	173	1.8%	108	4.4%	88	3.9%	20	9.3%
ASA classification								
1-2	6,482	67.4%	1,124	47.1%	1,084	48.4%	79	37.2%
≥3	3,134	32.6%	1,288	52.9%	1,154	51.6%	144	67.3%
Dyslipidemia								
No	8,678	90.3%	2,022	82.5%	1,846	82.5%	176	82.2%
Yes	628	6.3%	210	8.4%	214	9.6%	16	7.5%
Current smoker								
No	7,871	81.9%	2,035	83.0%	1,867	83.4%	168	78.5%
Yes	1,745	18.1%	417	17.0%	371	16.6%	46	21.5%
COPD								
No	9,228	96.0%	2,238	92.1%	2,072	92.6%	168	78.6%
Yes	388	4.0%	194	7.9%	166	7.4%	28	13.1%
Congestive heart failure								
No	9,585	99.7%	2,420	98.7%	2,213	98.9%	207	96.7%
Yes	31	0.3%	12	0.5%	25	1.1%	7	3.3%
Hypertension								
No	6,002	62.4%	1,162	47.4%	1,064	47.5%	98	45.8%
Yes	3,614	37.6%	1,280	52.6%	1,174	52.5%	116	54.2%
Disseminated cancer								
No	9,508	98.9%	2,400	99.1%	2,218	99.1%	212	99.1%
Yes	108	1.1%	32	1.3%	20	0.9%	2	0.9%
Open wound/wound infection								
No	9,410	97.9%	2,348	95.8%	2,147	95.9%	201	93.9%
Yes	206	2.1%	104	4.2%	91	4.1%	13	6.1%
Chronic steroid use								
No	9,377	97.3%	2,338	95.4%	2,132	95.3%	206	96.3%
Yes	239	2.7%	114	4.6%	106	4.7%	8	3.7%
Bleeding disorders								
No	9,380	97.3%	2,300	93.9%	2,105	94.1%	195	91.1%
Yes	236	2.5%	122	5.0%	133	5.9%	19	8.9%
Transfusion prior to surgery								
No	9,615	100.0%	2,432	99.2%	2,234	98.9%	198	92.7%
Yes	1	0.0%	20	0.8%	4	0.2%	16	7.5%
Operative duration (minutes)								
0-49	2,347	24.4%	600	24.5%	542	24.2%	58	27.1%
50-49	4,951	51.3%	1,195	48.7%	1,109	49.6%	86	40.2%
≥50	2,302	23.9%	637	26.3%	587	26.2%	70	32.7%

ASA, American Society of Anesthesiologists; COPD, chronic obstructive pulmonary disease.

Table 4. Days from preoperative hematocrit value to procedure.

Time before surgery	No anemia	Mild anemia	Severe anemia
Same day	2,155	748	109
1 day to 2 weeks	6,213	1,256	83
>2 weeks	1,248	234	22

Table 2. Bivariate analysis of 30-day postoperative complications in patients with no anemia, mild anemia, and severe anemia. Bold p-values indicate statistical significance with $p < 0.05$.

	Normal (n=9,616)	Any Anemia (n=5,487)	Mild Anemia (n=2,738)	Severe Anemia (n=214)	Any vs no anemia	Mild vs no anemia	Severe vs mild anemia
Complication	Number	%	Number	%	p-value	p-value	p-value
Pneumonia	5	0.05%	3	0.12%	0.006	0.212	0.006
Superficial incisional SSI	28	0.29%	11	0.45%	1	0.47%	0.224
Deep incisional SSI	5	0.05%	3	0.12%	1	0.47%	0.241
Organ/Space SSI	5	0.05%	2	0.08%	0	0.00%	0.590
Wound dehiscence	5	0.05%	0	0.00%	0	0.00%	0.999
Reintubation	2	0.02%	7	0.29%	5	0.22%	0.001
Pulmonary embolism	7	0.07%	3	0.12%	0	0.00%	0.608
Ventilator >48 hours	0	0.00%	4	0.16%	3	0.13%	0.275
Urinary tract infection	36	0.37%	21	0.86%	16	0.71%	0.006
Stroke	5	0.05%	1	0.04%	0	0.00%	0.824
Cardiac arrest	0	0.00%	5	0.20%	3	0.13%	0.93%
Myocardial infarction	9	0.09%	3	0.12%	0	0.00%	0.688
Blood transfusions	4	0.04%	26	1.06%	11	0.49%	0.001
Deep vein thrombosis	8	0.08%	3	0.12%	2	0.09%	0.568
Sepsis	5	0.05%	6	0.24%	5	0.22%	0.010
Septic shock	1	0.01%	5	0.20%	4	0.18%	0.007
Readmission	137	1.42%	104	4.24%	91	4.07%	<0.001
Reoperation	99	1.03%	30	1.22%	27	1.21%	0.463
Non-home discharge	265	2.76%	244	9.95%	199	8.89%	<0.001
Mortality	7	0.07%	11	0.45%	6	0.27%	<0.001

Table 3. Multivariate analysis of 30-day postoperative complications in patients with preoperative anemia, adjusted for significantly associated patient demographics and comorbidities. Bold p-values indicate statistical significance with $p < 0.05$.

Complication	Any vs no anemia			Mild vs no anemia			Severe vs mild anemia		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Pneumonia	1.35	0.60-3.03	0.463	—	—	—	—	—	—
Reintubation	6.51	1.29-32.80	0.023	5.71	1.05-31.07	0.044	—	—	—
Urinary tract infection	1.48	0.85-2.57	0.168	—	—	—	2.02	0.73-5.62	0.177
Cardiac arrest	—	—	—	—	—	—	4.12	0.66-25.68	0.130
Blood transfusions	11.83	3.95-35.45	<0.001	7.03	2.16-22.90	0.001	7.91	3.29-19.03	<0.001
Sepsis	2.63	0.72-9.69	0.145	3.06	0.83-11.27	0.093	—	—	—
Septic shock	10.76	1.19-97.02	0.034	9.57	1.01-90.93	0.049	—	—	—
Readmission	2.10	1.60-2.76	<0.001	2.05	1.55-2.73	<0.001	—	—	—
Non-home discharge	2.22	1.84-2.68	<0.001	2.04	1.67-2.49	<0.001	2.04	1.40-2.97	<0.001
Mortality	2.70	1.03-7.07	0.043	1.72	0.57-5.17	0.335	7.02	2.05-24.08	0.002

OR, odds ratio; CI, confidence interval.

Table 5. Multivariate analysis of 30-day postoperative complications in patients with preoperative anemia, stratified by the time between hematocrit value was determined prior to surgery. Bold p-values indicate statistical significance with $p < 0.05$.

Complication	Any anemia (ab same day)			Any anemia (ab 1 day-2 weeks)			Any anemia (ab > 2 weeks)		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Reintubation	—	—	—	3.71	0.58-23.82	0.167	—	—	—
Blood transfusions	22.05	2.84-171.40	0.003	5.00	1.14-21.83	0.033	—	—	—
Septic shock	—	—	—	5.52	0.45-67.11	0.180	—	—	—
Readmission	2.35	1.44-3.84	<0.001	1.86	1.29-2.68	0.001	1.77	0.74-4.20	0.109
Non-home discharge	2.95	2.21-3.95	<0.001	1.36	1.01-1.82	0.040	2.31	0.97-5.04	0.060
Mortality	—	—	—	1.42	0.31-6.57	0.655	—	—	—