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Preprocedural Platelet Transfusion for Thrombocytopenic Patients Undergoing Interventional Radiology Procedures is Not Associated with Reduced Bleeding Complications

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Abstract

Background—Platelet transfusion prior to interventional radiology procedures is commonly performed in patients with thrombocytopenia. However, it is unclear if platelet transfusion is associated with reduced bleeding complications.

Study Design and Methods—This is a retrospective cohort study of adults undergoing interventional radiology procedures between January 1st, 2009 and December 31st, 2013. Baseline characteristics, coagulation parameters, transfusion requirements, and procedural details were evaluated. Propensity-matched analyses were used to assess relationships between platelet transfusions and the outcomes of interest, including a primary outcome of periprocedural red blood cell (RBC) transfusion during the procedure or within the first 24 hours post-procedurally.

Results—A total of 18,204 participants met inclusion criteria, and 2,060 (11.3%) had a platelet count $100 \times 10^9/L$ prior to their procedure. Of these, 203 patients (9.9%) received preprocedural platelets. There was no significant difference in RBC requirements between those receiving or not receiving preprocedural platelets in propensity-matched analysis [OR (95% CI) = 1.45 (0.95 – 2.21), $p = 0.085$]. Platelet transfusion was associated with increased rates of ICU admission [OR (95% CI) = 1.57 (1.07 – 2.32), $p = 0.022$].

Conclusion—In thrombocytopenic patients undergoing interventional radiology procedures, preprocedural platelet transfusion was not associated with reduced periprocedural RBC requirements. These findings suggest that prophylactic platelet transfusions are not warranted in non-bleeding patients with preprocedural platelet counts exceeding $50 \times 10^9/L$. Future clinical

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trials are needed to further define relationships between prophylactic platelet administration and bleeding complications, especially at more severe levels of thrombocytopenia or in the presence of platelet dysfunction.

Introduction

Patients undergoing percutaneous interventional radiology procedures often present with thrombocytopenia or other laboratory markers of impaired hemostasis. Unfortunately, there is little evidence to guide the decision to correct coagulation abnormalities preprocedurally, proceed without correction of coagulation derangements, or postpone or cancel a scheduled procedure.⁽¹⁾ Each of these management strategies has unique and important considerations, including transfusion-related risks as well as the financial implications associated with procedural delays or potentially unnecessary transfusion therapies in patients transfused preprocedurally. Alternatively, concerns frequently arise over the withholding of potentially life-sustaining therapies associated with procedural cancellation or increased risk of procedural bleeding in those without preoperative platelet transfusion.

In the case of thrombocytopenia, platelet transfusion is commonly employed prior to invasive procedures.(2) While the Society of Interventional Radiology's *Consensus Guidelines for Periprocedural Management of Coagulation Status and Hemostasis Risk in Percutaneous Image-Guided Interventions* recommend routine preprocedural platelet count measurement only for patients undergoing procedures of high-bleeding risk, transfusion of platelets is recommended for all percutaneous image-guided interventions regardless of procedure-related bleeding risk when platelet count is less than $50 \times 10^9/\text{L}$.(1) While these expert guidelines were formalized with consensus approval after thorough review of available clinical and laboratory evidence, there is markedly little data available to either support or refute this intervention, and the efficacy of preprocedural platelet transfusion for the reduction of periprocedural bleeding complications remains speculative.

The purpose of this investigation was to assess the relationships between preprocedural platelet transfusions and periprocedural bleeding complications in patients with abnormal preoperative platelet counts undergoing interventional radiology procedures, with a primary outcome of periprocedural RBC transfusion requirements.

Materials and Methods

This is a retrospective study conducted at the Mayo Clinic in Rochester, Minnesota under approval of the Institutional Review Board. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were used in the design and conduct of this study.(3)

Study Population

Inclusion criteria for this investigation consisted of patients 18 years of age undergoing percutaneous invasive image-guided interventions (i.e. procedures performed by the Division of Vascular/Interventional Radiology) at a single tertiary care center between January 1st 2009 and December 31st 2013 and the presence of a platelet count in the 30-day

interval preceding the procedure. Exclusion criteria included lack of valid research authorization and prior inclusion in the study (no patient was included twice). For those with multiple interventional procedures during the study time frame, only the first procedure with a valid platelet count was included.

Outcome variables

The primary outcome for this study was the presence of a periprocedural RBC transfusion, defined as an RBC transfusion episode with initiation time occurring during the procedural encounter or within 24 hours following discharge from the procedural environment. RBC transfusions initiated prior to entering the procedure suite were not included in the outcome evaluation. Additional secondary outcomes included unanticipated return to the procedural suite or transfer to an operating room within 24 hours of the index procedure, postprocedural ICU admission and length of stay, postprocedural mechanical ventilation and duration, hospital length of stay, and all-cause hospital mortality. As a post-hoc analysis, we also included the presence of a periprocedural platelet transfusion, defined as platelets administered during the procedural encounter or in the first 24 hours after discharge from the procedural environment.

Predictor variables

The primary predictor variable for this investigation was the presence or absence of preprocedural platelet transfusion, which was defined as platelets administered after the qualifying preprocedural platelet count and within 7 days of the procedure. For patients with multiple preprocedural platelet counts, the value closest to the time of the procedure was utilized as the qualifying platelet count. Platelet transfusions preceding measurement of the qualifying platelet count were not included. Moreover, intraoperative and postprocedural platelet transfusions were not considered as predictor variables as our aim was to specifically investigate the impact of preprocedural platelet administration. Additionally, this exclusion of platelet administration after the start of the procedure avoids the potential for cause-effect inversion with the outcomes of interest. To further ensure against cause-effect inversion, the timing of platelet transfusion was defined as the actual transfusion initiation time as documented in the electronic health record rather than the time of issue from the blood bank. The presence and timing of all periprocedural transfusion episodes were extracted from the electronic health record. Patient demographics, baseline clinical characteristics, and procedural and anesthesia-related details were also extracted from the electronic medical record. Procedures were classified based upon bleeding risk as identified by the Consensus Guidelines for Periprocedural Management of Coagulation Status and Hemostasis Risk in Percutaneous Image-guided Interventions into low, moderate, or high risk categories (Table 1).(1)

Data Sources

Assuming a periprocedural RBC transfusion event rate of 15% in the target study population (preprocedural platelet count $< 100 \times 10^9/L$, based on historical data from the participating institution) and a prophylactic platelet transfusion rate of 10% in those with a preprocedural platelet count $< 100 \times 10^9/L$ (estimated to be 10% of the total population with qualifying platelet values), the sample size required to identify an odds ratio of 0.5 in those who receive

a preprocedural platelet transfusion compared to those who do not was estimated to be 1998 total study participants (two-sided alpha of 0.05, beta = 0.20). Furthermore, assuming that 80% of patients would have a qualifying platelet count within 30 days of the procedure, we estimated the need to evaluate approximately 24,000 unique participants having undergone the procedures of interest.

Screening for potential study participants was performed using the OR Datamart, an institutional resource that captures clinical and procedural data for all patients who are admitted to an acute care environment including procedural suites, operating rooms, intensive care units, and progressive care units at the study's participating institution.(4) This robust data warehouse also contains information on baseline demographics and clinical characteristics, fluid and transfusion therapies, periprocedural medications and laboratory values, postprocedural outcomes, and lengths of stay. Additional baseline characteristics pertinent were obtained from a second validated database, the Mayo Clinic Life Sciences System (MCLSS).(5) Both databases have undergone extensive validation with accuracy superior to manual data collection alone.(6)

Statistical Considerations

Baseline demographics, clinical characteristics and procedure-related information were summarized and presented as median (25% – 75% interquartile range) for continuous data elements and frequencies (%) for categorical data, respectively. A platelet count $100 \times 10^9/L$ was used as a threshold for thrombocytopenia in this study for two reasons: 1) recent evidence from surgical populations has shown increased rates of bleeding complications with preoperative platelet counts $100 \times 10^9/L$,(7, 8) and 2) the decision to transfuse prior to invasive procedures is commonly based on threshold values, with a platelet count $100 \times 10^9/L$ a commonly used trigger in local practice prior to procedures of high-bleeding risk. Recognizing that the 2011 *Consensus Guidelines for Periprocedural Management of Coagulation Status and Hemostasis Risk in Percutaneous Image-guided Interventions* specifically identify a platelet count $50 \times 10^9/L$ as a transfusion trigger for platelet therapy and that transfusion strategies may vary significantly by practice location, sensitivity analyses using platelet counts $75 \times 10^9/L$ and $50 \times 10^9/L$ were planned a priori.(1, 9)

The relationships between prophylactic preprocedural platelet transfusion and bleeding complications were explored with both univariate and multivariable analyses. As observational studies risk unequal distributions of key confounding variables due to the lack of subject randomization, propensity-matched analyses were performed. Logistic regression was used to calculate propensity scores utilizing all hypothesized confounding variables (variables included in the propensity score estimation are included in Figure 2). Each patient who received preprocedural platelet transfusion was matched with up to two patients who did not receive preprocedural platelet transfusion, using exact matching on procedure bleeding risk (low, moderate, high) and optimal matching on propensity score (± 0.10). (10) Standardized mean differences after matching adjustment as well as p-values from conditional logistic regression analysis using matched sets as strata were obtained for each covariate to assess the effectiveness of the matching to control for confounding of the observed variables. Logistic regression was then used to assess whether the likelihood of

receiving periprocedural RBC transfusion is associated with preprocedural exposure to prophylactic platelet transfusion. Similar procedures were carried out for the secondary outcomes as well.

Multiple additional sensitivity analyses were planned a priori: 1) restriction to study participants undergoing low, moderate, or high-risk procedure, respectively; 2) restriction to patients undergoing emergency procedures; and 3) restriction to patients with platelet counts $75 \times 10^9/L$ and $50 \times 10^9/L$. In addition, recognizing that some preprocedural platelet transfusions may occur in the setting of ongoing resuscitation from hemorrhage, patients receiving RBC transfusion within 24 hours of the procedure were excluded. All statistical analyses were performed using JMP statistical software base version 9.0.1 and SAS 9.1.4 (SAS Institute Inc, Cary, NC).

Results

A total of 42,952 invasive image-guided interventions were performed on 24,626 unique patients aged 18 years or greater. Among the 21,394 patients with a qualifying preprocedural platelet count, 2,060 (9.6%) had a platelet count $100 \times 10^9/L$ at the time of needle placement (Figure 1). Of these, 203 patients (9.9%) were administered platelets for the correction of preprocedural thrombocytopenia prior to entry into the procedural suite. The median (interquartile range) time between platelet count measurement and procedure onset was 8.5 (4.1 – 22.1) hours. In those who received a preprocedural platelet transfusion as defined by the study protocol, the median time from initiation of the last qualifying platelet component to the onset of the procedure was 1.8 (0.9 – 3.6) hours. Comparison of baseline clinical, demographic, and procedural characteristics for those with a platelet count $100 \times 10^9/L$ are displayed in Table 2, with key differences including a higher rate of hematologic malignancies, lower baseline platelet counts and hemoglobin values, an increased incidence of emergency procedures, and a higher rate of procedures performed under general anesthesia in those receiving platelet transfusions. Conversely, those receiving platelets were less likely to be receiving aspirin, NSAIDs, or warfarin in the perioperative period. In addition, the incidence of diabetes, congestive heart failure, and chronic renal failure were lower in the platelet-transfused group.

Results of unadjusted analyses evaluating the associations between preprocedural platelet transfusions with patient outcomes are displayed in Table 3. The frequency of periprocedural RBC transfusion among those who received preprocedural platelet transfusion versus those who did not was 28% versus 12% ($p < 0.001$). In addition, those receiving platelets had a higher rate of ICU admission (36% versus 24%, $p < 0.001$), longer hospital lengths of stay [13.2 (5.3 – 31.9) days versus 10.9 (4.0 – 24.1) days, $p = 0.024$], increased mortality (22% versus 10%, $p < 0.001$), and increased rates of periprocedural platelet transfusion (23% versus 7%, $p < 0.001$).

A total of 2,012 of the study subjects were assigned a propensity score; 48 (2.3%) were not assigned a score as a result of missing data, of which 5 had received a preprocedural platelet transfusion. The standardized differences of propensity scores in the cohort of patients who did and who did not received preprocedural platelets are shown in Figure 2. From those with

available propensity scores, 179 study subjects receiving preprocedural platelet transfusion were propensity matched to 342 study subjects who did not. Sixteen subjects who received platelets were matched to a single non-transfused subject and 163 subjects were matched to 2 non-transfused subjects. A total of 19 subjects who had received platelets were removed from the propensity matched analyses due the lack of a suitable non-transfused propensity matched study subject. Propensity matching was effective in reducing baseline covariate imbalances between platelet exposure groups (Table 2, Figure 2).

In the propensity matched cohort, 48 (27%) of the platelet transfused subjects received a periprocedural RBC transfusion compared with 69 (20%) of those who did not receive preprocedural platelets. This difference was not statistically significant [OR (95% CI) = 1.45 (0.95 – 2.21), $p = 0.085$]. Preoperative platelet transfusion was associated with increased ICU admission rates [36% versus 27%; OR (95% CI) = 1.57 (1.07 – 2.32), $p = 0.022$]. There were no significant differences in hospital length of stay, postprocedural mechanical ventilation rates, periprocedural platelet transfusion requirements, or mortality between platelet transfused and non-transfused groups. The results of sensitivity analyses assigned *a priori* are displayed in Table 5. Notably, there was no difference in RBC transfusion rates using lower platelet count thresholds of $50 \times 10^9/L$ and $75 \times 10^9/L$.

Discussion

This investigation was performed to assess the relationships between preprocedural platelet transfusion and periprocedural bleeding complications in thrombocytopenic patients undergoing interventional radiology procedures. To that end, there was no evidence for decreased periprocedural RBC requirements or improved clinical outcomes with preprocedural platelet transfusion.

The frequency of platelet transfusions has increased in recent years, with the majority of transfusions being given prophylactically for the prevention of bleeding.(2, 11, 12) However, the appropriate platelet count threshold for prophylactic transfusion and the utility of such transfusions to mitigate bleeding complications remains unclear. This is particularly relevant for patients undergoing interventional procedures in which there is limited data available to make evidence-based decisions. In a prospective cohort study of 105 thrombocytopenic patients undergoing central venous catheter placement, there was no significant differences in bleeding, infection, thrombosis, or mortality between those receiving or not receiving prophylactic platelet transfusion.(13) In 55 patients with thrombocytopenic thrombotic purpura undergoing central venous catheter placement for plasma exchange, bleeding and mortality rates were increased in those receiving preprocedural platelet transfusions, though transfused patients were more acutely ill.(14) An additional observational study of nearly 400 patients with platelet counts between $50 \times 10^9/L$ and $99 \times 10^9/L$ and mild coagulopathy undergoing paracentesis or thoracentesis without prophylactic transfusion of platelets found no bleeding complications, suggesting that these procedures are likely safe even in the presence of abnormal laboratory markers of hemostasis. Moreover, in patients undergoing percutaneous liver biopsy, periprocedural bleeding complications do not correlate with preprocedural platelet count,(15, 16) and procedures such as bone marrow biopsy and lumbar puncture are routinely performed with platelet counts well below $50 \times 10^9/L$ with a

very low incidence of hemorrhagic complications.(17–19) Hence, though guidelines continue to focus on preprocedural platelet counts for the assessment of bleeding risk, there is little evidence to support a relationship between platelet quantity and bleeding complications.

In the present investigation, patients transfused prophylactically with platelets had no significant reduction in subsequent RBC transfusion requirements. In fact, there was a trend towards increased RBC requirements after platelet administration, which may be related in part to unique provider transfusion practices. For example, a provider inclined to transfuse platelets prior to needle placement may also be more inclined to transfuse RBCs in the periprocedural period. Additionally, it is possible that platelet transfusion was indicative of a sicker patient population, despite our efforts at careful propensity-adjustment. Though not a high-volume product, platelet transfusion may also contribute to hemodilution, which may decrease hemoglobin concentration beyond transfusion thresholds. Interestingly, platelet administration was associated with increased ICU admission rates, which may also be a reflection of provider preference for higher levels of postoperative care in transfused patients or residual unmeasured confounding. Nevertheless, clinical outcomes were not superior in any of the analyzed categories for those receiving preprocedural platelets, suggesting that at a minimum, prophylactic platelet transfusion does little to improve patient outcomes. Similar results have recently been shown in thrombocytopenic patients undergoing non-cardiac surgery.(8)

There are several important limitations for the present investigation, most notably being the retrospective design of this investigation with potential for residual confounding and bias. Propensity-matching was effective in reducing between group differences, though several variables remained with absolute standardized differences greater than 0.1 including the rate of general anesthesia which was slightly higher in those receiving platelets and the rates of low molecular weight heparin and warfarin use which were marginally greater in those not receiving platelet therapy. Hence, despite careful statistical adjustments with propensity-matching, it is possible that the lack of perceived benefit following platelet transfusion may be confounded by a sicker patient population in those receiving platelets. In addition, it should be noted that the precise clinical circumstances affecting the decision to transfuse or withhold transfusion in the periprocedural period was unable to be directly assessed. RBC transfusion was used as a surrogate for clinical bleeding; however transfusion may have occurred for other causes (e.g. anemia of chronic disease). In addition, some clinically significant bleeding complications (e.g. spinal hematoma, pseudoaneurysm formation) may not have been captured by the primary outcome measure if they were not severe enough to warrant RBC transfusion. As mentioned previously, platelet transfusions occurring after entry into the procedural suite were excluded as predictor variables in an attempt to minimize the probability for cause-effect inversion with the primary outcome (e.g. platelets given to prevent bleeding versus platelets given in response to ongoing hemorrhage). This may have excluded some prophylactic transfusions from analysis. As a post-hoc analysis however, we did include periprocedural platelet transfusions as a surrogate marker for bleeding complications. There were no differences between propensity-matched groups. Furthermore, it must be noted that any observed relationships between prophylactic transfusion and the outcomes of interest represent associations without any inference of

causality. Finally, this investigation represents the experience of a single tertiary care medical center. Study results will ultimately require external validation in a multicenter prospective investigation or randomized clinical trial.

Conclusion

Thrombocytopenia is commonly encountered in patients undergoing percutaneous interventional procedures. In this investigation, there was no improvement in bleeding complications or clinical outcomes when preprocedural platelet transfusions were provided for platelet counts exceeding $50 \times 10^9/L$. Preprocedural platelet transfusions may be best reserved for those with active bleeding or more critical levels of thrombocytopenia. However, future clinical trials are necessary to further assess the relationships between prophylactic platelet transfusions and bleeding complications, especially at these more severe levels of thrombocytopenia or in the presence of platelet dysfunction.

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Figure 1.
Study population flow diagram.

Figure 2.

Standardized mean differences between groups for matched (●) and unmatched (◇) samples. Points to the right of the vertical reference line represent a standardized difference greater than 0.1 between those who received prophylactic preoperative platelet transfusion versus those who did not.

* Standardized mean difference of platelet count between groups in the unmatched sample was 1.67. Value was truncated to 1.0 in this figure for visual clarity.

LMW heparin = low molecular weight heparin; ILD = interstitial lung disease; INR = international normalized ratio; ASA = American Society of Anesthesiologist's Physical Classification Score; RN = registered nurse; COPD = chronic obstructive pulmonary disease; MI = myocardial infarction; CT disease = connective tissue disease; NSAIDs = non-steroid anti-inflammatory drugs; CHF = congestive heart failure

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Table 1

Procedural bleeding risk categories for patients with platelet count $100 \times 10^9/L$ at time of needle placement *

Low (n=962)	Moderate (n=1005)	High (n=93)
<u>Vascular</u> Brachytherapy positioning (n=10) Central line removal (n=76) Central venous catheter (n=145) Dialysis access (n=35) IVC filter placement (n=158) IVC filter removal (n=7) Lytic recheck (n=15) PICC placement (n=102) Venography (n=62) Sclerotherapy (n=6) <u>Nonvascular</u> Drainage catheter exchange (n=5) Loopogram (n=4) Lymphangiogram (n=3) Paracentesis (n=16) Sinogram (n=41) Superficial biopsy (n=277)	<u>Vascular</u> Angiography (n=245) Angioplasty (n=) Arterial embolization, coiling (n=71) Chemoembolization (n=42) Subcutaneous port (n=44) Transjugular liver biopsy (n=2) Tunneled venous catheter (n=212) Venous interventions (n=14) <u>Nonvascular</u> Intraabdominal or retroperitoneal abscess drainage (n=199) Transabdominal liver biopsy (n=13) Percutaneous cholecystostomy (n=21) Percutaneous cholangiogram (n=119) Radiofrequency ablation (n=9) Spine procedures (n=5) Cryoablation (n=9)	<u>Vascular</u> TIPS (n=63) <u>Nonvascular</u> Renal biopsy (n=26) Biliary interventions (n=4)

* Adapted from Consensus Guidelines for Periprocedural Management of Coagulation Status and Hemostasis Risk in Percutaneous Image-guided Interventions.¹

IVC – inferior vena cava, PICC – peripherally inserted central catheter, TIPS – transjugular intrahepatic portosystemic shunt

Baseline demographic and clinical characteristics of patients with preprocedural platelet count $100 \times 10^9/L$ at time of needle placement*

Table 2

	No platelet therapy (N=1857)		Platelet therapy (N=203)		Full cohort P-value	Matched cohort P-value [†]
Demographics						
Age (y)	61	(52, 69)	59	(52, 69)	0.47	0.50
Gender					0.37	0.22
Female	709	(38%)	71	(35%)		
Male	1148	(62%)	132	(65%)		
Body mass index [§]	28.0	(24.3, 32.6)	27.7	(23.8, 32.7)	0.81	0.06
Comorbidities						
Cancer	379	(20%)	41	(20%)	0.94	0.79
Metastatic cancer	108	(6%)	11	(5%)	0.82	0.38
Cerebrovascular disease	144	(8%)	14	(7%)	0.66	0.89
CHF	239	(13%)	16	(8%)	0.040	0.96
Diabetes	420	(23%)	32	(16%)	0.025	0.43
Diabetes w/ organ damage	86	(5%)	6	(3%)	0.27	0.68
Dementia	15	(1%)	1	(0%)	0.63	0.64
Leukemia	121	(7%)	30	(15%)	<.001	0.53
Lymphoma	276	(15%)	44	(22%)	0.011	0.69
MI	192	(10%)	18	(9%)	0.51	0.61
COPD	180	(10%)	16	(8%)	0.40	0.63
Asthma	143	(8%)	13	(6%)	0.51	0.47
ILD	56	(3%)	8	(4%)	0.47	0.64
Pulmonary disease	331	(18%)	29	(14%)	0.21	0.42
Peripheral vascular disease	89	(5%)	8	(4%)	0.59	0.36
CT disease	84	(5%)	8	(4%)	0.70	0.28
Chronic renal failure	638	(34%)	56	(28%)	0.05	0.74
Hemiplegia	14	(1%)	0	(0%)	0.21	-
Liver disease					0.60	0.70

	No platelet therapy (N=1857)		Platelet therapy (N=203)		Full cohort P-value	Matched cohort P-value [†]
None	1341	(72%)	142	(70%)		
Mild	185	(10%)	19	(9%)		
Moderate to severe	331	(18%)	42	(21%)		
Peptic ulcer	141	(8%)	14	(7%)	0.72	0.64
Charlson score	3	(2, 6)	4	(2, 6)	0.91	0.72
Perioperative medications						
Aspirin	295	(16%)	15	(7%)	0.001	0.85
Clopidogrel	44	(2%)	2	(1%)	0.21	0.96
NSAIDS	72	(4%)	2	(1%)	0.036	0.44
Thrombin inhibitor	36	(2%)	2	(1%)	0.34	0.75
LMW heparin (within 24 hours)	73	(4%)	7	(3%)	0.74	0.12
Therapeutic heparin (within 24 hours)	89	(5%)	5	(2%)	0.13	0.66
Warfarin	142	(8%)	6	(3%)	0.014	0.12
Baseline laboratory values						
Platelet count	77	(60, 91)	39	(28, 48)	<001	0.07
INR [§]	1.2	(1.1, 1.4)	1.3	(1.1, 1.5)	0.003	0.64
Creatinine [§]	1.1	(0.8, 2.0)	1.1	(0.7, 1.8)	0.56	0.35
Albumin [§]	3.4	(2.9, 3.9)	3.0	(2.6, 3.6)	<001	0.23
Hemoglobin [§]	9.9	(8.8, 11.7)	9.2	(8.3, 10.5)	<001	0.34
aPTT [§]	33	(29, 39)	33	(29, 37)	0.99	0.82
Procedural characteristics						
ASA PS ^{§#}					0.10	0.42
1–2	309	(40%)	32	(31%)		
3–4	457	(59%)	66	(65%)		
5+	8	(1%)	4	(4%)		
Procedure bleed risk					0.38	0.83
Low	854	(46%)	83	(41%)		

	No platelet therapy (N=1857)		Platelet therapy (N=203)		Full cohort P-value	Matched cohort P-value [‡]
Moderate	920	(50%)	110	(54%)		
High	83	(4%)	10	(5%)		
Emergency procedure	65	(4%)	16	(8%)	0.002	0.98
Anesthesia type					0.003	0.24
General	243	(13%)	44	(22%)		
Monitored anesthesia care	127	(7%)	15	(7%)		
RN sedation	1487	(80%)	144	(71%)		
Procedure duration (min)	22	(12, 41)	25	(12, 44)	0.21	0.048

* Data are presented as number (percentage) or median (interquartile range).

To compare ASA PS between treatment groups, patients with values greater than 4 were included in the 3–4 category.

§ Some values are missing for body mass index (n=29), INR (n=167), creatinine (n=44), albumin (n=720), hemoglobin (n=48), aPTT (n=837), and ASA PS (n=1184).

[‡] P-values for continuous variables are from rank sum tests. P-values for categorical variables are from Chi-Square tests. Matched cohort p-values correspond to the comparison of the given characteristic for the propensity matched cohort.

ASA PS = American Society of Anesthesiologist's Physical Classification Score; NSAIDS = Non-steroidal anti-inflammatory drugs; INR = international normalized ratio; aPTT = activated partial thromboplastin time.

Table 3

Univariate analyses of primary and secondary outcomes by the presence or absence of preprocedural platelet transfusion in those with preprocedural platelet count $100 \times 10^9/L$

Outcome*	No platelet therapy (N=1857)	Platelet therapy (N=203)	OR (95% CI)	P Value [†]
Periprocedural RBC	231 (12%)	56 (28%)	2.68 (1.91 to 3.76)	<.001
Return to procedure suite within 24 hrs	46 (2%)	5 (2%)	0.99 (0.39 to 2.53)	0.99
ICU admission	450 (24%)	74 (36%)	1.79 (1.32 to 2.43)	<.001
ICU length of stay (days, n=524)	3.4 (1.3, 10.1)	5.0 (1.7, 11.3)		0.26
Postprocedural MV	107 (6%)	19 (9%)	1.69 (1.01 to 2.82)	0.044
Duration of MV (days, n=126)	1.4 (0.1, 6.8)	2.3 (0.1, 13.1)		0.51
Hospital LOS (days, n=1571)	10.9 (4.0, 24.1)	13.2 (5.3, 31.9)		0.024
Mortality	182 (10%)	44 (22%)	2.55 (1.76 to 3.68)	<.001
Periprocedural platelet transfusion	127 (7%)	46 (23%)	3.99 (2.74 to 5.81)	<.001

* Values are n (%) for categorical variables and median (IQR) for continuous variables.

[†] p-values are from logistic regression for categorical variables and from rank-sum tests for continuous variables.

OR = odds ratio; CI = confidence interval; RBC = red blood cell transfusion; ICU = intensive care unit; MV = mechanical ventilation; LOS = length of stay; IQR = interquartile range

Table 4

Propensity-matched analyses of primary and secondary outcomes by the presence or absence of preprocedural platelet transfusion in those with preprocedural platelet count $100 \times 10^9/L$

Outcome *	No platelet therapy (N=342)	Platelet therapy (N=179)	OR (95% CI)	P Value [†]
Periprocedural RBC	69 (20%)	48 (27%)	1.45 (0.95 to 2.21)	0.085
Return to procedure suite within 24 hrs	12 (4%)	5 (3%)	0.79 (0.27 to 2.28)	0.66
ICU admission	91 (27%)	65 (36%)	1.57 (1.07 to 2.32)	0.022
ICU length of stay (days, n=156)	4.2 (1.3, 14.2)	5.0 (1.2, 9.8)		0.96
Postprocedural MV	31 (9%)	17 (9%)	1.05 (0.57 to 1.96)	0.87
Duration of MV (days, n=48)	0.8 (0.1, 3.7)	4.0 (0.3, 13.1)		0.07
Hospital LOS (days, n=463)	13.9 (5.6, 30.3)	12.7 (5.0, 29.1)		0.75
Mortality	53 (15%)	35 (20%)	1.33 (0.83 to 2.12)	0.24
Periprocedural platelet transfusion	66 (19%)	42 (23%)	1.28 (0.83 to 1.99)	0.27

* Values are n (%) for categorical variables and median (IQR) for continuous variables.

[†] p-values are from logistic regression for categorical variables and from rank-sum tests for continuous variables.

OR = odds ratio; CI = confidence interval; RBC = red blood cell transfusion; ICU = intensive care unit; MV = mechanical ventilation; LOS = length of stay; IQR = interquartile range

Table 5

Sensitivity analyses evaluating the associations between preoperative platelet administration and perioperative RBC transfusion.

Model*	Preoperative Platelets [†]		OR (95% CI) [§]	P-value
	No	Yes		
Low risk procedures	164	82	1.74 (0.93 – 3.25)	0.081
Moderate risk procedures	169	91	1.03 (0.56 – 1.90)	0.913
High risk procedures	9	6	**	0.089
All procedures, platelet 75 × 10 ⁹ /L	318	167	1.35 (0.87 – 2.10)	0.183
All procedures, platelet 50 × 10 ⁹ /L	253	140	1.05 (0.64 – 1.73)	0.853
Excluding procedures with RBCs 24 h pre-op	202	122	1.11 (0.60 – 2.02)	0.747

* Logistic regression modelling the probability of requiring perioperative RBC transfusions in the matched cohort. Due to the matched set design, some subjects were excluded within each sub-analysis because there was not at least one platelet-transfused subject and one non-platelet-transfused subject in the given strata.

** Given the small number of patients in the high risk category, groups were compared using Fisher's exact test. The frequency of RBC transfusion was 4/6 and 1/9 for those who did and did not receive preoperative platelets respectively.

[†] Values represent the number of patients included in the sensitivity analysis that either did or did not receive preoperative platelets.

[§] Odds ratios are for preoperative platelets. Odds ratios over 1.00 indicate increased likelihood of requiring perioperative RBC transfusion.

OR = odds ratio; CI = confidence interval.