



# Low platelet count is a risk factor of postoperative pneumonia in patients with type A acute aortic dissection

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**Background:** Previous studies have already established that low platelet count is related to adverse outcomes in patients with type A acute aortic dissection (AAAD). However, there are yet limited studies investigating the association of platelet count and the risk of postoperative pneumonia in AAAD patients.

**Methods:** This retrospective cohort study was conducted in Xiangya Hospital of Central South University from January 2014 to May 2019. Clinical and laboratory data were collected. The correlation between platelet count and postoperative pneumonia was analyzed using multivariate logistic regression and the area under the receiver operating characteristic curve (AUC) was used to assess the predictive power of platelet count on pneumonia.

**Results:** A total of 268 patients with AAAD were enrolled. The overall incidence of pneumonia was 36.94% (n=99). Multivariate logistic regression revealed that platelet count was negatively associated with the risk of postoperative pneumonia (OR 0.93; 95% CI: 0.88–0.98) after adjusting for the confounders. Compared to the lowest platelet count tertile (T1), medium platelet count (T2) and highest platelet count (T3) had a lower risk of postoperative pneumonia after adjusting for the confounders (OR 0.80, 95% CI: 0.40–1.60; OR 0.30, 95% CI: 0.13–0.66; respectively). A similar trend was observed when the platelet count was handled as categorical variables (tertiles). The area under the ROC curve was 0.635 (95% CI: 0.565–0.707), with a sensitivity of 76.77%, a specificity of 50.89% and an accuracy of 60.45%.

**Conclusions:** Our findings indicate that low platelet count is an independent risk factor of postoperative pneumonia in patients with AAAD and has a specific predictive power on the risk of postoperative pneumonia.

**Keywords:** Platelet count; postoperative pneumonia; type A acute aortic dissection (AAAD); predictor

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## Introduction

According to previous studies, 50% of patients with type A acute aortic dissection (AAAD) die within 48 hours (1). While, a good operative strategy and precise emergency surgery for AAAD can increase the rate of survival,

also commonly results in postoperative morbidity (2). Postoperative pneumonia is a severe complication of cardiac surgery. Most commonly, it occurs during the first week after surgery, with an estimated mortality rate ranging from 20% to 50% (3). It poses a substantial risk to the morbidity and mortality by causing pulmonary dysfunction or multiple

organ failure (4).

Platelets are crucial components involved in the coagulation process. Additionally, platelet activation could lead to unstable hemodynamics and plays an essential role in the development of AAD, which reduces the platelet count in patients with AAD (5,6). However, the impact of reduced platelet count on the prognosis in patients with AAAD remains subtle yet. A study conducted by Chen *et al.* indicated that a low preoperative platelet count in patients with AAAD was independently associated with the occurrence of healthcare-associated infections (2). Also, Huang *et al.* reported that a low admission platelet count increased the in-hospital mortality rates in patients with AAAD (7). However, few studies have focused on the association between platelet count and postoperative pneumonia in patients with AAAD.

Therefore, the purpose of this study was to explore the association of platelet count with the risk of postoperative pneumonia and to assess the predictive value of platelet count for the risk of postoperative pneumonia in Chinese AAAD patients.

## Methods

### Patients selection

This was a retrospective cohort study based on the medical records of patients who underwent surgery for AAAD from January 1, 2014 to May 30, 2019 in Xiangya Hospital of Central South University. All patients underwent surgery within 48 hours from admission by the identical experienced surgical team. The diagnosis for AAAD was based on computed tomography scanning and echocardiography. Participants' inclusion criteria were: all surgical patients diagnosed with AAAD and age  $\geq 18$  years old. Exclusion criteria were: death during operation, death within 24 hours after operation, severe organ dysfunction before operation and suffering from pneumonia before operation. The study was conducted in accordance with the guidelines for good clinical practice and the principles of the Declaration of Helsinki. It was approved by the Medical Ethics Committee of Xiangya Hospital of Central South University (ethical number: 2019010038). Owing to the retrospective study, individual consent was waived.

### Data collection

Demographic, laboratory, clinical, intra- and perioperative

data were collected by record review. Clinical and laboratory data were recorded throughout the hospitalization course by trained staff. Demographic data included age and gender. Laboratory data included neutrophil, lymphocyte, hemoglobin, platelet count, activated partial thromboplastin time (APTT), and prothrombin time (PT). Clinical data included history of smoking, drinking, Marfan syndrome, hypertension, diabetes mellitus, hemopericardium, chronic renal failure, cerebrovascular disease, coronary artery disease, and Penn class. Intraoperative data included autologous blood transfusion, ventilator time, operative time, cardiopulmonary bypass (CPB) time, and surgery type. Perioperative data included hospital stay length, intensive care unit (ICU) stay length, perioperative blood product transfusion and in-hospital mortality.

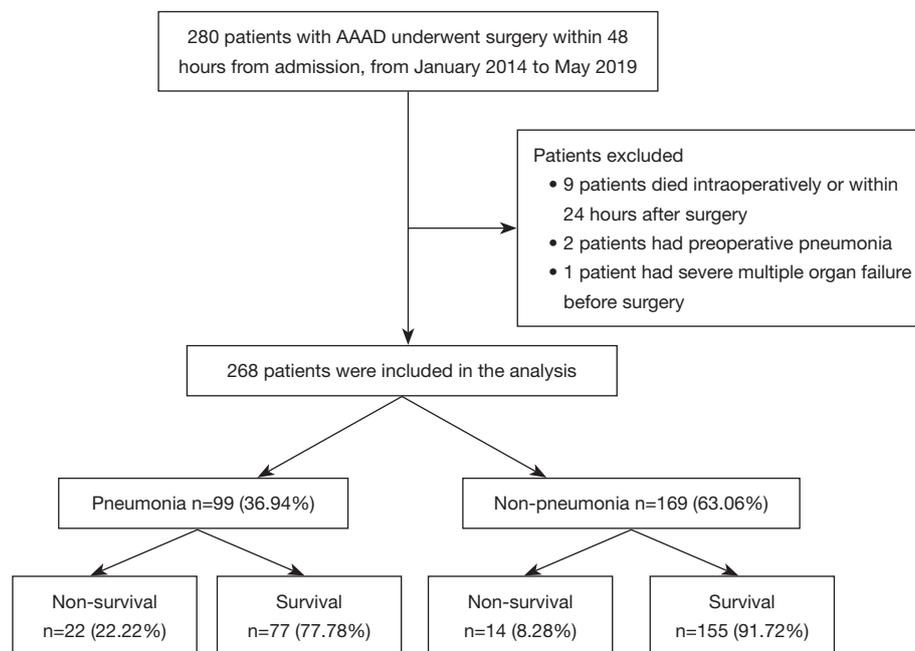
The platelet count referred to the lowest in-hospital values measured during 48 hours before the operation which was obtained by counting the whole blood cells.

### Outcomes

The outcome variable was the development of pneumonia after surgery. Pneumonia was diagnosed according to the Society of Thoracic Surgeons criteria, based on laboratory findings (e.g., positive sputum culture results from transtracheal fluid and/or bronchial washings) and/or radiological evidence (e.g., chest radiograph diagnostic of pulmonary infiltrates). Fever and white blood cell count were also considered as evidence of pneumonia (8).

### Statistical analysis

Quantitative parameters were expressed as means  $\pm$  standard deviation or medians with ranges, and qualitative parameters were expressed as frequencies and percentages. Continuous variables were compared using the *t*-test (for normal distribution) or Mann-Whitney's U test (for skewed distribution). The chi-squared test or Fisher's exact test was applied to compare the categorical variables. Missing values for autologous blood transfusion was 5.6%, ventilator time 2.24%. Missing data for these two continuous variables were handled via median imputation. There was no multicollinearity between the independent variables. Univariate logistic regression analysis was performed to evaluate the risk factors associated with postoperative pneumonia in patients with AAAD. Non-adjusted and adjusted multiple logistic regression model was applied to evaluate the effect of the platelet count on postoperative



**Figure 1** Flow chart of the study. AAAD, A acute aortic dissection.

pneumonia occurrence. Whether the covariances were adjusted determined by the principle that the variables added to this model, changed the matched odds ratio by at least 10% (9). The predictive capability of platelet count for postoperative pneumonia was assessed using the ROC analysis.

All analyses were performed with the statistical software packages R (<http://www.R-project.org>, The R Foundation) and EmpowerStats (<http://www.empowerstats.com>, X&Y Solutions, Inc, Boston, MA, USA). A two-tailed P value below 0.05 was considered as statistically significant.

## Results

### *The selection of participants*

Among the 280 patients whose records were reviewed, nine patients died intraoperatively or within 24 hours after surgery, two had preoperative pneumonia and one had severe multiple organ failure before surgery. The remaining 268 patients with AAAD were enrolled in the present study (Figure 1); 99 (36.94%) of the 268 patients developed postoperative pneumonia and the in-hospital mortality rate was 22.22% among these patients.

### *Patients' baseline characteristics*

The baseline characteristics are presented by platelet count tertiles in Table 1. Of all these total participants, the highest incidence (48.28%) of postoperative pneumonia was in patients with the lowest platelet count tertiles ( $P<0.001$ ). Compared with high level (T3) of platelet count group, patients in other groups (T1 and T2) had a significantly lower lymphocyte ( $P<0.001$ ), higher APTT ( $P=0.020$ ), PT ( $P=0.009$ ), operative time ( $P=0.023$ ), plasma transfusion ( $P=0.008$ ), platelet transfusion ( $P=0.047$ ) and ICU stay length ( $P=0.003$ ). The remaining variables showed no statistically significant differences among the groups.

### *Univariate analysis risk factors associated with postoperative pneumonia*

Table 2 shows the results of the univariate analyses. Using the univariate binary logistic regression analysis, we found that the platelet count was negatively associated with the risk of postoperative pneumonia. In contrast, age, ventilator time, ICU and hospital stay length, RBCs, plasma, platelet and cryoprecipitate transfusion were positively correlated with the risk of postoperative pneumonia. Other variables

**Table 1** Baseline clinical characteristics of all patients with AAAD

Variable	Platelet count tertiles ( $\times 10^9/L$ )			P value
	T1 (<136) (n=87)	T2 (136 to 184) (n=91)	T3 (>184) (n=90)	
Age (year)	51.21 $\pm$ 9.71	50.46 $\pm$ 11.16	48.21 $\pm$ 12.25	0.174
Gender (male)	69 (79.31)	62 (68.13)	58 (64.44)	0.079
Laboratory examination pre-operation				
Neutrophil ( $\times 10^9/L$ )	9.64 $\pm$ 3.44	9.04 $\pm$ 3.62	9.09 $\pm$ 4.29	0.510
Lymphocyte ( $\times 10^9/L$ )	1.08 $\pm$ 0.57	1.18 $\pm$ 0.54	1.44 $\pm$ 0.60	<0.001*
Hemoglobin (g/L)	124.40 $\pm$ 20.59	121.88 $\pm$ 18.80	119.37 $\pm$ 22.69	0.273
APTT (sec)	36.83 $\pm$ 7.02	34.53 $\pm$ 5.74	34.44 $\pm$ 6.37	0.020*
PT (sec)	14.83 $\pm$ 1.93	14.17 $\pm$ 2.07	14.03 $\pm$ 1.46	0.009*
Complications				
Smoking	41 (47.13)	42 (46.15)	40 (44.44)	0.936
Drinking	31 (35.63)	35 (38.46)	29 (32.22)	0.680
Marfan syndrome	3 (3.45)	7 (7.69)	7 (7.78)	0.403
Hypertension	66 (75.86)	60 (65.93)	59 (65.56)	0.245
Diabetes mellitus	6 (6.90)	5 (5.49)	2 (2.22)	0.330
Hemopericardium	9 (10.34)	12 (13.19)	4 (4.44)	0.120
Chronic renal failure	6 (6.90)	5 (5.49)	1 (1.11)	0.150
Cerebrovascular disease	6 (6.90)	2 (2.20)	6 (6.67)	0.279
Coronary artery disease	7 (8.05)	7 (7.69)	9 (10.00)	0.838
Penn class				0.600
Class Aa	52 (59.77)	51 (56.04)	47 (52.22)	
Non class Aa	35 (40.23)	40 (43.96)	43 (47.78)	
Intra-operative variables				
Autologous blood transfusion (unit)	0 (0 to 45)	0 (0 to 30)	0 (0 to 30)	0.448
Ventilator time (hour)	6 (0 to 192)	10 (0 to 960)	8 (0 to 1,176)	0.165
Operative time (hour)	11.07 $\pm$ 3.35	11.40 $\pm$ 4.31	10.18 $\pm$ 3.41	0.023*
CPB time (min)	173.86 $\pm$ 74.77	167.42 $\pm$ 70.16	147.08 $\pm$ 86.45	0.057
Surgery type				0.174
AAR + TAR (TAVR) + FET	44 (50.57)	49 (53.85)	39 (43.33)	
Bentall + TAR (TAVR) + FET	14 (16.09)	25 (27.47)	19 (21.11)	
David + TAVR + FET	4 (4.60)	2 (2.20)	4 (4.44)	
Combine others	25 (28.74)	15 (16.48)	28 (31.11)	
Perioperative blood transfusion				
RBCs (unit)	10.14 $\pm$ 7.76	9.00 $\pm$ 7.47	8.29 $\pm$ 8.04	0.071
Plasma (unit)	15.01 $\pm$ 10.31	12.06 $\pm$ 9.28	10.45 $\pm$ 9.71	0.008*

**Table 1** (continued)

Table 1 (continued)

Variable	Platelet count tertiles ( $\times 10^9/L$ )			P value
	T1 (<136) (n=87)	T2 (136 to 184) (n=91)	T3 (>184) (n=90)	
Platelet (therapeutic dose)	1.57 $\pm$ 1.17	1.35 $\pm$ 1.18	1.31 $\pm$ 1.45	0.047*
Cryoprecipitate (therapeutic dose)	1.55 $\pm$ 1.18	1.41 $\pm$ 1.27	1.28 $\pm$ 1.35	0.359
Hospital stay length (day)	17.52 $\pm$ 8.35	16.46 $\pm$ 8.38	17.57 $\pm$ 8.84	0.617
ICU stay length (day)	7.82 $\pm$ 6.02	7.74 $\pm$ 5.97	7.01 $\pm$ 9.24	0.003*
Pneumonia	42 (48.28)	38 (41.76)	19 (21.11)	<0.001*
In-hospital mortality	14 (16.09)	14 (15.38)	8 (8.89)	0.297

Results are expressed as n (%) or mean  $\pm$  SD or median (min to max). \*,  $P < 0.05$ . APTT, activated partial thromboplastin time; PT, prothrombin time; CPB, cardiopulmonary bypass; AAR, ascending aorta replacement; TAR, total arch replacement; TAVR, total aortic vascular replacement; FET, frozen elephant trunk; RBC, red blood cell; ICU, intensive care unit.

were not found to be significantly associated with the risk of postoperative pneumonia.

#### Association of the platelet count with the risk of postoperative pneumonia

In this study, we constructed four models to analyze the independent effects of the platelet count on the risk of postoperative pneumonia (Table 3). In non-adjusted model II, the platelet count showed a negative correlation with postoperative pneumonia (OR 0.92, 95% CI: 0.88–0.96). Furthermore, a rise of  $10 \times 10^9/L$  in the platelet count was associated with an 8% decrease in the risk of pneumonia. In model II (adjusted for age and gender), the result remained significant (OR 0.92, 95% CI: 0.88–0.97). Multiple variables, including blood component transfusion, length of hospital and ICU stay, and postoperative pneumonia may affect each other. In order to eliminate the interference of these factors, we applied model III and model IV to evaluate the relationship between platelet count and postoperative pneumonia. In model III (adjusted for age, gender, autologous blood transfusion, neutrophil, lymphocyte, PT, ventilator time and surgery type), the result did not have obvious changes (OR 0.91, 95% CI: 0.87–0.96) and a rise of  $10 \times 10^9/L$  in the platelet count was associated with a 9% decrease in the risk of pneumonia. In model IV (adjusted covariates in model III plus the length of hospital and ICU stay, RBCs, plasma, cryoprecipitate and platelet transfusion), the result did not change obviously (OR 0.93, 95% CI: 0.88–0.98). For the purpose of sensitivity analysis, we handled the continuous variable (platelet count) as three equal categorical variables, and the P value for the trend

of platelet count was consistent with the result when the platelet count was considered as a continuous variable.

#### ROC analysis

Table 4 shows the results of the ROC analyses of the platelet count used to identify postoperative pneumonia in patients with AAAD. The AUC of the ROC curve was 0.635 (95% CI: 0.565–0.707), with the optional cut-off value  $173.5 \times 10^9$  as well as 76.77% for sensitivity, 50.89% for specificity and 60.45% for accuracy.

#### Discussion

In this study, we found a significant association between platelet count and postoperative pneumonia after adjustment for potential confounders. A  $10 \times 10^9/L$  decrease of platelet count was associated with a 7% increase in the risk of pneumonia. Previously, few studies investigated the association between platelet count and postoperative pneumonia in patients with AAAD. However, the association between platelet count and postoperative pneumonia has been evaluated in the context of other diseases and procedures. In a study of 212 cases liver transplantation, the researchers found that preoperative low platelet count was related to postoperative pneumonia (10), which is consistent with our result. The findings in other studies also supported our results. Chen *et al.* reported a low preoperative platelet count would significantly increase the risk of healthcare-associated infections (including pneumonia) after surgical arch replacement in a sample of 210 participants (2). Kelly *et al.* found that low platelet count was associated with

**Table 2** Univariate analysis of risk factors associated with pneumonia in patients with AAA

Variable	No pneumonia (n=169)	Pneumonia (n=99)	OR (95% CI)	P value
Age (year)	48.91±11.36	51.72±10.55	1.02 (1.00, 1.05)	0.048*
Gender (male)	117 (69.23)	72 (72.73)	1.19 (0.68, 2.05)	0.545
Neutrophil ( $\times 10^9/L$ )	8.95±3.91	9.77±3.56	1.06 (0.99, 1.13)	0.091
Lymphocyte ( $\times 10^9/L$ )	1.28±0.60	1.15±0.56	0.68 (0.43, 1.05)	0.083
Hemoglobin (g/L)	120.54±19.45	124.10±22.79	1.01 (1.00, 1.02)	0.176
Platelet count ( $\times 10^9/L$ )	184.60±76.72	150.32±55.98	0.99 (0.98, 0.99)	<0.001*
APTT (sec)	35.44±6.94	34.92±5.55	0.99 (0.95, 1.03)	0.518
PT (sec)	14.19±1.86	14.60±1.86	1.13 (0.98, 1.29)	0.090
Smoking	81 (47.93)	42 (42.42)	0.80 (0.49, 1.32)	0.383
Drinking	60 (35.50)	35 (35.35)	0.99 (0.59, 1.67)	0.980
Marfan syndrome	14 (8.28)	3 (3.03)	0.35 (0.10, 1.24)	0.102
Hypertension	114 (67.46)	71 (71.72)	1.22 (0.71, 2.11)	0.467
Diabetes mellitus	8 (4.73)	5 (5.05)	1.07 (0.34, 3.37)	0.907
Hemopericardium	15 (8.88)	10 (10.10)	1.15 (0.50, 2.68)	0.739
Chronic renal failure	5 (2.96)	7 (7.07)	2.50 (0.77, 8.09)	0.127
Cerebrovascular disease	6 (3.55)	8 (8.08)	2.39 (0.80, 7.10)	0.117
Coronary artery disease	16 (9.47)	7 (7.07)	0.73 (0.29, 1.84)	0.500
Penn class				
Class Aa	91 (53.85)	59 (59.60)	Ref	
Non class Aa	78 (46.15)	40 (40.40)	0.79 (0.48, 1.31)	0.361
Autologous blood transfusion (unit)	0 (0 to 30)	0 (0 to 45)	1.04 (1.00, 1.08)	0.059
Ventilator time (hour)	8 (0 to 192)	14 (0 to 1,176)	1.01 (1.00, 1.01)	0.009*
Operative time (hour)	10.61±3.58	11.34±4.00	1.05 (0.99, 1.12)	0.128
CPB time (min)	160.96±80.76	165.61±73.32	1.00 (1.00, 1.00)	0.638
Surgery type				
AAR + TAR (TAVR) + FET	79 (46.75)	53 (53.54)	Ref	
Bentall + TAR (TAVR) + FET	43 (25.44)	15 (15.15)	0.52 (0.26, 1.03)	0.061
David + TAVR + FET	7 (4.14)	3 (3.03)	0.64 (0.16, 2.58)	0.529
Others	40 (23.67)	28 (28.28)	1.04 (0.58, 1.89)	0.889
RBCs (unit)	8.14±7.09	10.82±8.58	1.04 (1.01, 1.08)	0.008*
Plasma (unit)	11.18±9.19	14.69±10.72	1.04 (1.01, 1.06)	0.007*
Platelet (therapeutic dose)	1.27±1.12	1.65±1.47	1.26 (1.03, 1.54)	0.023*
Cryoprecipitate (therapeutic dose)	1.26±1.14	1.67±1.44	1.29 (1.05, 1.57)	0.014*
Hospital stay length (day)	15.57±6.17	19.91±10.97	1.06 (1.03, 1.10)	<0.001*
ICU stay length (day)	5.46±3.19	11.03±10.26	1.22 (1.14, 1.32)	<0.001*

Results are expressed as n (%) or mean  $\pm$  SD or median (min to max). \*,  $P < 0.05$ . OR, odds ratio; CI, confidence interval; Ref, reference; APTT, activated partial thromboplastin time; PT, prothrombin time; CPB, cardiopulmonary bypass; AAR, ascending aorta replacement; TAR, total arch replacement; TAVR, total aortic vascular replacement; FET, frozen elephant trunk; RBC, red blood cell; ICU, intensive care unit.

**Table 3** Multivariable regressions analysis of association between platelet count (per  $10 \times 10^9/L$ ) and postoperative pneumonia

Variable	Model I (OR, 95% CI)	Model II (OR, 95% CI)	Model III (OR, 95% CI)	Model IV (OR, 95% CI)
Platelet count	0.92 (0.88, 0.96)*	0.92 (0.88, 0.97)*	0.91 (0.87, 0.96)*	0.93 (0.88, 0.98)*
Platelet count tertiles				
T1	Ref	Ref	Ref	Ref
T2	0.77 (0.43, 1.39)	0.79 (0.43, 1.44)	0.78 (0.41, 1.48)	0.80 (0.40, 1.60)
T3	0.29 (0.15, 0.55)*	0.31 (0.16, 0.60)*	0.25 (0.12, 0.53)*	0.30 (0.13, 0.66)*
P value for trend	<0.001	<0.001	<0.001	0.003

\*,  $P < 0.05$ . Model I, we adjusted none; Model II, we adjusted age and gender; Model III, we adjusted age, gender, autologous blood transfusion, neutrophil, lymphocyte, PT, ventilator time and surgery type; Model IV, we adjusted covariates in model III plus the length of hospital and ICU stay, RBCs, plasma, cryoprecipitate and platelet transfusion. OR, odds ratio; CI, confidence interval; Ref, reference.

**Table 4** Area under the ROC curves and sensitivity analysis of platelet count

Test	AU-ROC	95% CI	Cut off ( $\times 10^9/L$ )	Specificity	Sensitivity	Accuracy
Platelet count	0.635	0.565 to 0.707	173.5	0.5089	0.7677	0.6045

AU-ROC, area under the receiver operating characteristic; CI, confidence interval.

postoperative morbidity (including pneumonia) in patients who underwent distal pancreatectomy (11). Besides, when platelet count was divided into three tertiles in this study. Compared with the lowest platelet count tertile (T1), the risk of postoperative pneumonia decreased by 20% in medium platelet count tertile (T2) and by 70% in the highest platelet count tertile (T3). Similar trends were observed whether we handled platelet count as a categorical variable or a continuous variable. It further illustrates the robustness of our results and that low platelet count is a risk factor of postoperative pneumonia in AAAAD patients. Besides, other risk factors have also been reported to be related to postoperative pneumonia, such as hypertension, chronic renal failure (12), age  $>70$  years (13), perioperative transfusions (14), type of surgery, weight loss, chronic obstructive pulmonary disease, general anesthesia, smoking and alcohol use (15). Therefore, early intervention for these risk factors might be helpful to prevent postoperative pneumonia. Postoperative pneumonia is considered as a preventable complication (16) and is closely associated with prolonged length of hospital and ICU stay (17) and in-hospital mortality (18). Similarly, in this study, we found that the mortality rate was significantly higher in patients who suffered from postoperative pneumonia (22.22%) than in those without postoperative pneumonia (8.28%). Also, the length of hospital and ICU stay was significantly longer in patients with pneumonia than those without pneumonia.

Therefore, the low platelet count in AAAAD patients could become a predictor for early clinical intervention to prevent the occurrence of postoperative pneumonia. Also, it might aid to shorten the length of hospital and ICU stay effectively, further reduce the financial burden on patients and even reducing in-hospital mortality.

Moreover, we evaluated the predictive value of platelet count on postoperative pneumonia in patients with AAAAD in this study. The ROC curve demonstrated that platelet count might be a predictor of postoperative pneumonia (AUC: 0.635). The sensitivity and specificity were 76.77% and 50.89%, respectively. The result shows the platelet count has a specific predictive power as a single predictor of postoperative pneumonia. To enhance the predictive value, a prediction model based on a combination of parameters should be developed, for it is unlikely that a single parameter can faithfully represent all possible patient conditions. The concept of combining multiple parameters is considered to be the best alternative to overcome the limitations of a single parameter and is likely to maximize their clinical usefulness. In Nomura *et al.*'s study, single predictor such as preoperative white blood cells, C-reactive protein or angiotensin-converting enzyme 2, had limited ability to predict postoperative pneumonia in patients with esophagostomy. The AUC of each predictor was 0.567, 0.571 and 0.652, respectively (19). Strobel *et al.* combined 17 preoperative variables to predict postoperative

pneumonia in patients after coronary artery bypass grafting, and the AUC reached 0.74 (20). Takesue *et al.* used an 18-parameters model to predict postoperative pneumonia in patients after gastroenterological surgery, and the AUC reached as high as 0.822 (21). In addition, through the ROC curve analysis, we found the optimal cut-off value of the admission platelet count was  $173.5 \times 10^9 /L$ , which was rather close to that reported by Chen *et al.* ( $171 \times 10^9 /L$ ) (2). This result could hopefully be useful for future clinical prediction models of postoperative pneumonia.

The underlying mechanism of the association between a low admission platelet count and postoperative pneumonia in patients with AAAD is not well understood so far. One possible explanation could be the platelet activation. Platelet consumption (low platelet count) possibly due to platelet activation, which is associated with arterial dissection occurrence (5,22). Activated platelets may secrete proinflammatory cytokines to initiate inflammatory responses (23). These pro-inflammatory molecules could exacerbate neutrophil rolling, adhesion and recruitment, thereby promoting the formation of platelet-neutrophil complexes. Both complexes and proinflammatory molecules could promote lung inflammation and increase the severity of lung infection (24). Another possible explanation is bleeding, which consumes massive platelets, later leads to low platelet count. Low platelet count was associated with transfusion (25,26) and we also found that patients with lower platelet count received more blood product transfusion in this study. However, transfusion itself has been linked with a variety of postoperative adverse outcomes such as bacteremia, pneumonia and mortality (27,28). Transfusions increase the suppressor T cell activity and inhibit B cell differentiation and natural killer cell activity indirectly (29), which could further lead to a greater likelihood of infection in transfused patients. Also, fragments of banked blood deposited in the lung interstitial activating inflammation that could worsen lung damage may account for the development of pneumonia (2).

There were some limitations. First, this study was a retrospective study of a small sample. Owing to a retrospective cohort study, it cannot avoid a certain bias. However, we adjusted the potential confounding factors as much as possible in the data analysis to reduce the potential bias. Considering the power of the statistics was 95%, although the sample size was small, the results of this article had a certain credibility. Second, we hadn't reviewed the results of thromboelastography, which might help us to explain the relationship between low platelet count and

postoperative pneumonia. We will expect to expand the sample in the future study or conduct a prospective cohort study and incorporate thromboelastography into our indicators to prove that low platelet count is a risk factor for postoperative pneumonia in AAAD patients. Third, a lot of AAAD patients may also suffer from fever and elevated white blood cell count perioperatively because of stress response. Also, other factors like infection from other system or absorption of pleural effusion might present with similar symptoms and signs. They can be hardly classified as pneumonia.

## Conclusions

In conclusion, a low platelet count is an independent risk factor of postoperative pneumonia in patients with AAAD. Platelet count has a specific predictive power as one of the predictors to predict high-risk populations. Early intervention might prevent postoperative pneumonia, thereby shorten the length of ICU and hospital stays and reduce in-hospital mortality.

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## Footnote

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/jtd.2020.03.84>). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was approved by the Medical Ethics Committee of Xiangya Hospital of Central South University (ethical number: 2019010038). Owing to the retrospective study, individual consent was waived.

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