From the Southern Association for Vascular Surgery

Severe platelet transfusion refractoriness after thoracoabdominal aneurysm repair

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ABSTRACT

Severe thrombocytopenia after thoracoabdominal aortic aneurysm repair poses a significant clinical risk in the immediate postoperative period. Understanding the mechanisms of refractoriness to platelet transfusion is relevant to supporting thrombocytopenic patients postoperatively. We present the case of a 76-year-old woman with refractory thrombocytopenia secondary to alloimmunization following open repair of a Crawford extent IV thoracoabdominal aneurysm. The patient provided written informed consent for the report of her case details and imaging studies. (J Vasc Surg Cases Innov Tech 2024;10:101526.)

Keywords: Crawford extent; Spinal cord ischemia; Thoracoabdominal aortic aneurysm; Thrombocytopenia

Severe thrombocytopenia after thoracoabdominal aortic aneurysm repair poses a significant clinical risk in the immediate postoperative period, with the standard risks of postoperative bleeding compounded by the risk of spinal cord ischemia in the setting of extensive aortic coverage. Because platelets mediate primary hemostasis, ensuring adequate platelet counts postoperatively is synonymous with preventing hemorrhagic complications. Understanding the mechanisms of refractoriness to transfusion is relevant to supporting thrombocytopenic patients postoperatively. We present the case of a 76-year-old woman with refractory thrombocytopenia following open repair of a Crawford extent IV thoracoabdominal aneurysm, secondary to alloimmunization, with resolution by administration of cross-matched platelets. The patient provided written informed consent for the report of the following case details and images.

CASE REPORT

A 76-year-old woman with a history of hypertension, chronic kidney disease (baseline creatinine, 2.4 mg/dL), coronary artery disease, heart failure with a left ventricular ejection fraction of 45%, and ongoing 0.5 pack per day tobacco use, initially presented as an outpatient with a 47 mm extent IV thoracoabdominal aneurysm. The aneurysm had increased in size to 60 mm 9 months later. She was not a candidate for complex endovascular repair due to heavily diseased bilateral iliac arteries, heavily diseased bilateral renal arteries (compressed by the severe angulation of her aneurysmal aorta, contributing to her renovascular hypertension), and chronic thoracic aortic thrombus (Fig 1).

She underwent open thoracoabdominal aortic repair via a left eighth interspace retroperitoneal approach, with a proximal clamp site in the mid-descending thoracic aorta, a Carrell patch for the celiac artery and superior mesenteric artery, bilateral renal endarterectomy with bilateral aortorenal bypasses, and distal anastomosis to the infrarenal aorta. She tolerated the procedure well, and postoperatively was placed on modified spinal cord ischemia prevention protocol (no lumbar drain), with transfusion parameters of a goal of hemoglobin >9 g/dL, platelet count >100 $\times$ 10^9/L, and international normalized ratio <1.5.

Her preoperative platelet count was 170 $\times$ 10^9/L. Her initial postoperative platelet count was 89 $\times$ 10^9/L, which steadily declined to a nadir of 55 $\times$ 10^9/L despite transfusion of 7 units of platelets overthe following 28 hours (Fig 2). While the cause of her initial thrombocytopenia was platelet consumption related to her procedure, the cause of her refractoriness to the platelet transfusions was unclear, and we consulted hematology for assistance. There was no evidence of postoperative bleeding, and her hemoglobin counts remained stable. An enzyme-linked immunosorbent assay for heparin-induced thrombocytopenia was negative. Her platelet count increased in response to units 8 and 9 on the evening of postoperative day 1 but again failed to respond to unit 10. A post-transfusion platelet count obtained 30 minutes after administration of unit 10 showed no increase, consistent with immune-mediated refractoriness.

Platelet crossmatch demonstrated compatibility with only 2 of 14 random donor platelets, supporting the diagnosis of transfusion refractoriness due to alloimmunization, which was formally diagnosed by the hematology team. The patient then received

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Fig 1. Image showing a 60-mm Crawford extent IV thoracoabdominal aneurysm, with chronic thoracic aortic thrombus and heavily diseased bilateral renal and iliac arteries.

three cross-matched platelet units (units 11, 12, and 13), which consistently resulted in an increase in her platelet count. We attributed the transient response to transfusion of platelet units 8 and 9 to coincidental human leukocyte antigen (HLA) matching in those units. Her transfusion parameters were relaxed 5 days postoperatively, and her platelets had recovered to normal levels before hospital discharge.

DISCUSSION

Postoperative thrombocytopenia after thoracoabdominal aneurysm repair is common and mediated primarily by platelet consumption and coagulopathy related to the index procedure. Risks of thrombocytopenia include bleeding, spinal cord ischemia because of hemodynamic changes or changes in oxygen delivery related to bleeding, and complications of spinal drains placed to mitigate the risks of extensive aortic coverage. In a recent study of 473 patients who underwent spinal drain placement for aortic procedures, lower platelet counts (median platelet count, 86 $\times$ 10^9/L vs 113 $\times$ 10^9/L) were associated with a higher incidence of subdural hematoma and intracranial hemorrhage.[1]

Refractoriness to platelet transfusion is defined as a suboptimal response to transfusion on more than one occasion, with a post-transfusion platelet increment of $<10 \times 10^9$/L. Most causes of platelet refractoriness are non-immune, such as sepsis or bleeding. In non-immune causes of refractoriness to platelet transfusion, platelet counts initially rise in response to transfusion and then decrease. In immune-mediated refractoriness, platelet counts do not rise in response to transfusion, as platelets are destroyed as they are administered due to antibodies in recipient plasma. In this patient, a post-transfusion platelet count drawn 30 minutes after completion of the platelet transfusion showed no rise, consistent with an immune-mediated cause of refractoriness.

Immune-mediated refractoriness can result from alloimmunization due to anti-HLA antibodies directed against transfused platelets (as in this case), or can be mediated by other pathologies such as immune thrombocytopenia or post-transfusion purpura. Platelet crossmatch, which demonstrated compatibility with only 2 of 14 random donor platelets, supported the diagnosis of transfusion refractoriness due to alloimmunization in this patient; testing for anti-HLA antibodies is not required. Making this diagnosis is complex, and consultation with Hematology is essential. We propose an algorithm to guide preoperative, intraoperative, and postoperative patient assessment with respect to concern for refractoriness to platelet transfusion and alloimmunization, as well as a workflow for involving expert Hematology consultation to guide in diagnosis and treatment (Fig 3).

With respect to preoperative considerations, a history of pregnancy is the most common risk factor for HLA alloimmunization; prior transfusions and hematopoietic stem cell transplant are also risk factors.[2] Our patient had a history of pregnancy and prior transfusions. While it is important to recognize risk factors for alloimmunization, we do not recommend preoperative evaluation for alloimmunization due to significant inter-individual variability in refractoriness to transfusion, even when alloimmunization has occurred.[2]

When immune-mediated refractoriness to transfusion due to alloimmunization is diagnosed, patients with platelet alloimmunization can be transfused with HLA-matched platelets (identical or similar HLA antigens to the patient), HLA antigen-exclusion platelets (lack the antigen implicated in platelet refractoriness), or crossmatch-compatible platelets (cross-matched with the patient's serum).[2] Cross-matched platelets were used for our patient and effectively increased her platelet count on each occasion. HLA-matched and HLA antigen-exclusion platelets are more costly and more difficult to obtain, so they are often reserved for patients with no compatible units on platelet crossmatch.

Given the association between prior transfusions and the development of alloimmunization, prevention of thrombocytopenia requiring platelet transfusion deserves consideration. Use of acute normovolemic hemodilution (ANH) may be one method. Patients undergoing repair of thoracic and thoracoabdominal aneurysms who receive ANH have been shown to have higher post-procedural platelet counts, receive fewer intraoperative platelet

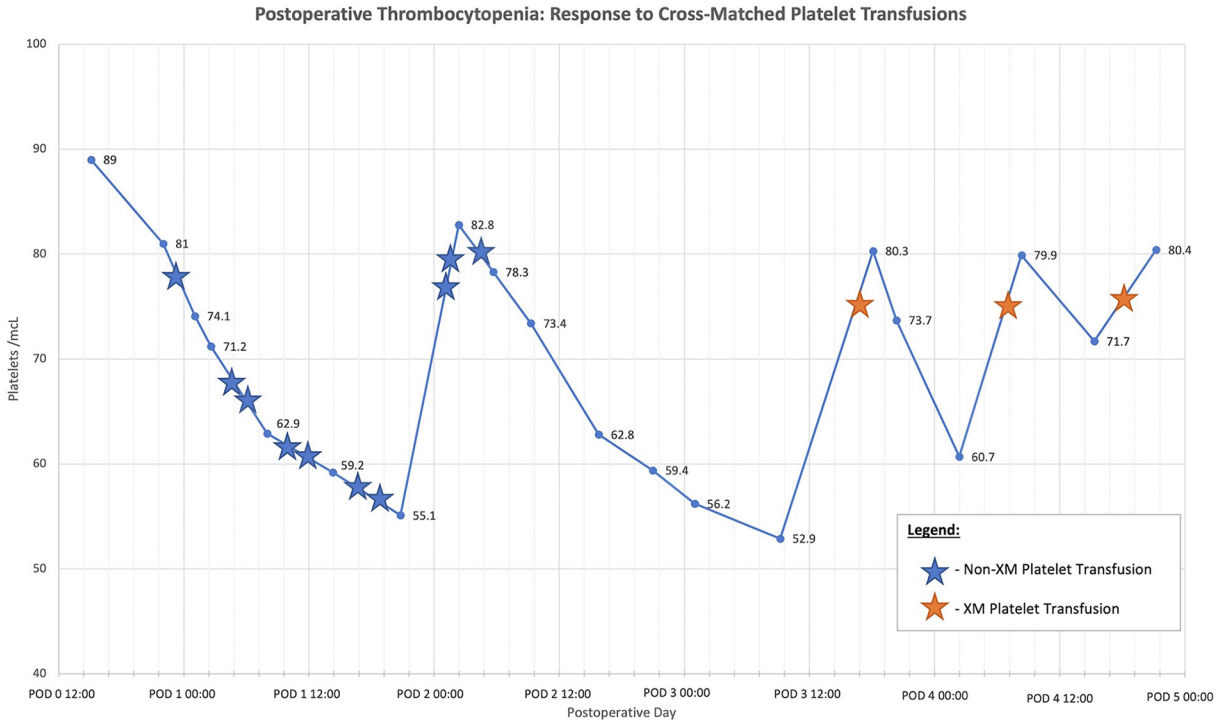

Fig 2. Graph showing postoperative thrombocytopenia and response to cross-matched platelet transfusions.

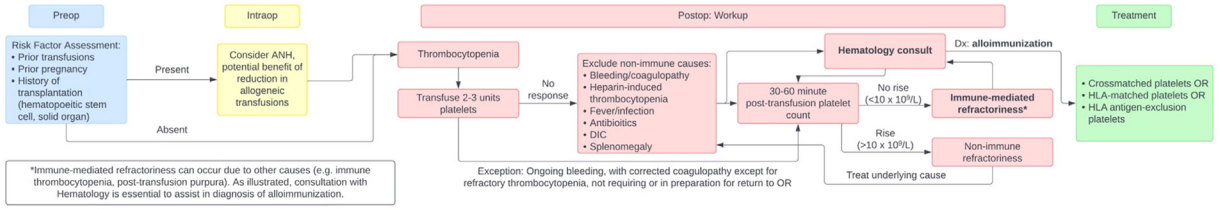

Fig 3. Refractory thrombocytopenia patient management algorithm. *ANH,* Acute normovolemic hemodilution; *DIC,* disseminated intravascular coagulation; *Dx,* diagnosis; *HLA,* human leukocyte antigen; *Intraop,* intraoperative; *OR,* operating room; *Preop,* preoperative.

transfusions, and be exposed to fewer donors, relative to patients undergoing these procedures who do not receive ANH.[3] More recent data have re-demonstrated the relationship between use of ANH and reduced number of transfused allogeneic platelets in cardiothoracic aortic procedures.[4] In the setting of open abdominal aortic aneurysm repair, utilization of ANH has been shown to result in greater platelet counts at 48 hours postoperatively.[5] While we did not use ANH for the patient in this case report (it was our experience with a rare diagnosis of immune-mediated refractoriness in this patient that spurred our interest in preventing future alloimmunization), we will consider using ANH in future open thoracoabdominal aneurysm repairs, especially for patients with risk factors for alloimmunization.

CONCLUSIONS

Alloimmunization is a rare but important cause of refractoriness to platelet transfusion after thoracoabdominal aortic repair and should be considered when a suboptimal response to platelet transfusions is observed.

DISCLOSURES

None.

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