

Red Blood Cell Transfusions and Postoperative Venous Thromboembolism in Surgical Patients

Rowan Melville*

Department of Transfusion and Vascular Medicine, East Crest University, Melbourne, Australia

DESCRIPTION

Red Blood Cell (RBC) transfusion is a cornerstone intervention in modern surgical practice, particularly during major operations where blood loss, tissue hypoxia and hemodynamic instability pose significant risks. While transfusions help restore oxygen-carrying capacity and stabilize critical patients, emerging evidence has linked perioperative RBC transfusion to an increased risk of postoperative Venous Thromboembolism (VTE). This includes both Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE), conditions that can markedly elevate morbidity and mortality in surgical patients. The pathophysiological mechanisms driving this association are multifactorial.

Stored RBCs undergo progressive structural and biochemical changes-known as storage lesions-characterized by reduced deformability, membrane damage, increased microparticle formation and accumulation of pro-inflammatory substances. When transfused, these altered cells can induce endothelial activation, promote platelet adhesion and stimulate coagulation cascade activation, thereby fostering a prothrombotic state during the critical postoperative recovery period.

Inflammation plays a central role in bridging transfusion and thrombotic risk. Stored RBCs contain cytokines, oxidative byproducts and bioactive lipids that amplify systemic inflammation once transfused. This heightened inflammatory response can injure the vascular endothelium, upregulate tissue factor expression and increase leukocyte-endothelial interactions. Additionally, free hemoglobin released during hemolysis binds nitric oxide, impairing vasodilation and promoting vascular constriction-another factor facilitating thrombogenesis.

Surgery itself is a strong pro-inflammatory stimulus and when combined with transfusion-induced immune activation, the cumulative effect significantly raises VTE susceptibility. Postoperative immobility, sedation and increased blood viscosity following transfusion further exacerbate venous stasis, completing Virchow's triad and creating an ideal environment for clot formation.

Clinical studies highlight that the risk of VTE increases in a dose-dependent manner with the number of RBC units transfused. Patients undergoing orthopedic, abdominal, cardiac and oncologic surgeries are particularly vulnerable due to longer operative times and higher transfusion requirements. This concern has prompted a shift toward restrictive transfusion practices, in which clinicians intervene only when hemoglobin levels fall below defined thresholds or the patient exhibits clear signs of tissue hypoxia. Such strategies reduce unnecessary exposure to stored blood products and have been shown to lower postoperative complications without compromising oxygen delivery.

A tailored, risk-based approach allows clinicians to identify patients who may require more aggressive prevention, such as those with a history of thrombosis, malignancy, obesity, or prolonged immobilization. As perioperative medicine continues to evolve, understanding the complex interplay between RBC transfusion, inflammation and coagulation will be important in refining transfusion protocols and improving surgical outcomes.

CONCLUSION

The growing awareness of transfusion-related risks underscores the importance of multidisciplinary decision-making in perioperative care. Surgeons, anesthesiologists, hematologists, and critical care specialists must collaborate to evaluate each patient's individual risk profile, ensuring transfusions are administered only when clinically justified. Enhanced recovery protocols, patient blood management programs, and evidence-based guidelines continue to strengthen safe transfusion practices. As research advances, a deeper understanding of molecular pathways linking transfusion to thrombogenesis may pave the way for targeted therapies that further reduce complications.

REFERENCES

1. Goel R, Patel EU, Cushing MM, Frank SM, Ness PM, Takemoto CM, et al. Association of perioperative red blood cell transfusions with venous thromboembolism in a North American registry. *JAMA surgery*. 2018;153(9):826-833.

Correspondence to: Rowan Melville, Department of Transfusion and Vascular Medicine, East Crest University, Melbourne, Australia, E-mail: rowan.melville@ecu-au.edu

Received: 20-May-2025, Manuscript No. JHTD-25-39235; **Editor assigned:** 22-May-2025, PreQC No. JHTD-25-39235 (PQ); **Reviewed:** 05-Jun-2025, QC No. JHTD-25-39235; **Revised:** 12-Jun-2025, Manuscript No. JHTD-25-39235 (R); **Published:** 19-Jun-2025, DOI: 10.35248/2329-8790.25.13.674

Citation: Melville R (2025). Red Blood Cell Transfusions and Postoperative Venous Thromboembolism in Surgical Patients. *J Hematol Thrombo Dis*.13:674.

Copyright: © 2025 Melville R. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

2. Sheth BK, Yakkanti R, Ravipati K, Arif B, Castro G, Hernandez V, et al. Red blood cell transfusions and risk of postoperative venous thromboembolism. *JAAOS*. 2022;30(13):e919-e928.
3. Raphael J, Feng X, Shotwell MS, Mazzeffi MA, Bollen BA, Shah AS, et al. Association of intraoperative red blood cell transfusions with venous thromboembolism and adverse outcomes after cardiac surgery. *Ann Surg*. 2023;278(3):e650-e660.
4. Mo M, Lian Z, Xiang Y, Du X, Liu H, Sun J, et al. Association between perioperative red blood cell transfusions and postoperative venous thromboembolism. *Ann.Surg*. 2024;237:163-170.
5. Jackson A, Goswami K, Yayac M, Tan TL, Clarkson S, Xu C, et al. Association of perioperative red blood cell transfusion with symptomatic venous thromboembolism following total hip and knee arthroplasty. *J Arthroplasty*. 2021;36(1):325-330.
6. Choi UE, Nicholson RC, Frank SM, Cha S, Aziz H, Lester LC, et al. Perioperative plasma in addition to red blood cell transfusions is associated with increased venous thromboembolism risk postoperatively. *A&A*. 2024;139(2):254-261.
7. Rothstein DH, Cairo SB, Schaefer BA, Lautz TB. Association of perioperative red blood cell transfusion with postoperative venous thromboembolism in pediatric patients: A propensity score matched analysis. *PBC*. 2019;66(10):e27919.
8. Rylvlin J, Javed K, De la Garza Ramos R, Hamad M, Essibayi MA, Gelfand Y, et al. Is perioperative blood transfusion associated with postoperative thromboembolism or infection after metastatic spinal tumor surgery?. *Clinical Neurology and Neurosurgery*. 2023;235:108052.
9. Goel R, Patel EU, Cushing MM, Frank SM, Ness PM, Takemoto CM, et al. Association of perioperative red blood cell transfusions with venous thromboembolism in a North American registry. *JAMA surgery*. 2018;153(9):826-833.
10. Sheth BK, Yakkanti R, Ravipati K, Arif B, Castro G, Hernandez V, et al. Red blood cell transfusions and risk of postoperative venous thromboembolism. *JAAOS*. 2022;30(13):e919-e928.