Patient Blood Management in Totally Endoscopic Mitral Valve Surgery within an ERAS Pathway

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Introduction: Patient Blood Management (PBM) is an important perioperative strategy in cardiac surgery, aiming to optimize hematologic status, reduce blood loss, and minimize unnecessary allogeneic transfusion. Totally endoscopic mitral valve surgery (TEMVS) may provide a favorable setting for PBM because of reduced surgical trauma and enhanced recovery. However, real-world data on structured PBM pathways in TEMVS remain limited. This study evaluated transfusion outcomes and early clinical results in consecutive patients undergoing TEMVS within a standardized institutional PBM program.

Methods: This retrospective, single-center observational study included 214 consecutive adult patients who underwent elective TEMVS between January 2021 and December 2025. The PBM pathway was structured around three major components, as detailed in Figure 1.

The primary outcome was perioperative red blood cell (RBC) transfusion exposure. Secondary outcomes are transfusion rates, intensive care unit stay, hospital stay, major postoperative complications, and mortality. As an exploratory analysis, factors associated with clinically relevant RBC transfusion burden were evaluated using univariate analyses and multivariate logistic regression.

Results: A total of 214 consecutive patients undergoing PBM-integrated TEMVS were included. The median age was 58 years, 45.8% were male, and median preoperative hemoglobin was 13.2 g/dL. Preoperative anemia was present in 60 patients (28.0%), atrial fibrillation in 29.0%, and NYHA class III–IV symptoms in 16.3% of the cohort. Among anemic patients, 48 patients (80.0%) received intravenous iron therapy. Following treatment, hematologic and iron profile parameters presented in Table 1.

Figure 1. Three Stages of Patient Blood Management Program in TEMVS

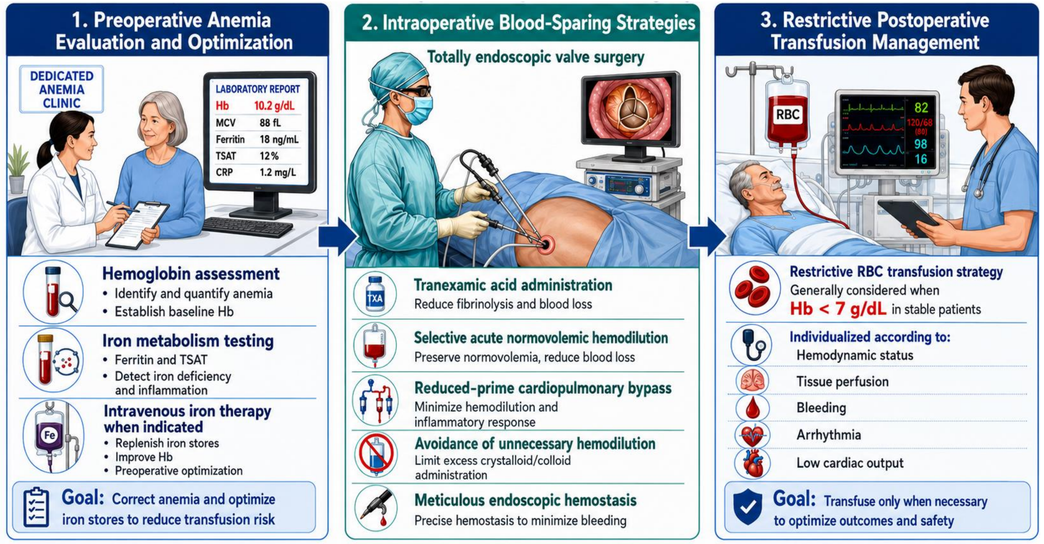

Table 1. Changes in hematologic parameters following preoperative iron therapy (n:48)

Variable	Pre-treatment (Median [IQR])	Post-treatment (Median [IQR])	p-value
Hemoglobin (g/dL)	11,8 (11-12,8)	12,8 (12-13,3)	**< 0.001**
Ferritin (ng/mL)	35 (19-54)	284 (209-458)	**< 0.001**
Transferrin saturation (%)	15 (12-21)	31 (23-34)	**< 0.001**
Serum iron (µg/dL)	59 (44-75)	93 (78-102)	**0.004**
TIBC (µg/dL)	360 (324-406)	301 (272-327)	**< 0.001**

Acute normovolemic hemodilution was performed in 82 patients (38.3%), tranexamic acid was administered at the start of surgery in 167 patients (78.0%), and a low-prime cardiopulmonary bypass strategy was used in 40 patients (18.7%). Postoperative blood product utilization was markedly limited, and detailed transfusion outcomes are presented in Table 2.

Early postoperative outcomes were favorable. Detailed intraoperative and early postoperative outcomes presented in Table 3. In exploratory analysis, lower preoperative hemoglobin, longer cardiopulmonary bypass time, male sex, higher body mass index, increased postoperative drainage, and re-exploration for bleeding were associated with the requirement for ≥2 RBC units in univariate analyses.

Table 2. Postoperative Transfusion Outcomes

Variable	Value (Median [IQR] or n [%])
No RBC transfusion	157 (73,4)
1-unit RBC transfusion	28 (13,1)
≥2-unit RBC transfusion	29 (13,5)
Total RBC units	0 (0-1)
Fresh frozen plasma (FFP) transfusion	21 (9,8)
Platelet transfusion	5 (2,3)

Table 3. Intraoperative and Early Postoperative Outcomes

Variable	Value (Median [IQR] or n [%])
Mitral valve repair	122 (57)
Concomitant tricuspid repair	15 (7)
Cryoablation	60 (28)
Cardiopulmonary-Bypass time (min)	142 (123,5-166)
Cross-clamp time (min)	92 (77-105)
Peak postoperative lactate (mmol/L)	3,8 (2,7-5,5)
Postoperative drainage (mL)	350 (150-450)
Re-exploration for bleeding	8 (3,7)
Mechanical ventilation time (hour)	6 (5-8,5)
Prolonged ventilation (>24 hours)	4 (1,9)
New-onset arrhythmia	26 (12,1)
Stroke	0 (0)
Renal failure	3 (1,4)
Sepsis	3 (1,4)
Multiple organ dysfunction syndrome	1 (0,5)
Intensive care unit stay (day)	1 (1-1)
Hospital stay (day)	5 (3-7)
Mortality	2 (0,9)

In multivariate logistic regression, only lower preoperative hemoglobin remained independently associated with increased RBC requirement (**OR 0.398, 95% CI 0.284–0.557; p<0.001**), while cardiopulmonary bypass time, male sex and higher body mass index were not independently significant.

Conclusion: In a contemporary TEMVS program, integration of a structured PBM pathway was associated with minimal perioperative blood product utilization, short ICU and hospital stay, and low early morbidity and mortality. Most patients avoided RBC transfusion entirely, while FFP and platelet use remained limited.