



Effect of Intraoperative Red Blood Cell Transfusion on Postoperative Complications After Open Radical Cystectomy: Old Versus Fresh Stored Blood

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Abstract

Transfusion is associated with adverse clinical outcomes. The effect of intraoperative transfusion with fresh versus old blood on postoperative complications was compared in patients undergoing open radical cystectomy. Intraoperative transfusion was predictive of postoperative complications. However, there was no difference in the incidence of postoperative complications between transfusions with old blood and fresh blood. Intraoperative transfusion per se, not the storage duration of red blood cells, was associated with increased postoperative complications.

Introduction: Transfusion with red blood cells (RBCs) is associated with adverse clinical outcomes. We determined whether an intraoperative RBC transfusion is related to postoperative complications in patients undergoing open radical cystectomy. We also compared the effect of transfusion with fresh versus old blood on postoperative complications. **Patients and Methods:** A total of 261 patients undergoing open radical cystectomy were divided into no-transfusion or transfusion groups. Transfused patients were divided according to RBC storage duration (fresh, < 14 days; old, > 14 days). Postoperative complications, such as infection, paralytic ileus, urinary tract obstruction, and anastomotic leak, were noted. **Results:** Infection (26.5%) was the most common postoperative complication, followed by procedural (17.6%), gastrointestinal (16.7%), renal (13.7%), and vascular (10.5%) problems. Age (odds ratio [OR], 1.04; 95% confidence interval [CI], 1.00-1.07; $P = .029$), urinary diversion with a neobladder (OR, 2.30; 95% CI, 1.29-4.11; $P = .005$), and intraoperative RBC transfusion (OR, 1.77; 95% CI, 1.02-3.07; $P = .042$) were independent predictors of postoperative complications in a binary logistic analysis. Patients ($n = 172$; old blood, $n = 47$; fresh blood, $n = 116$; mixed blood, $n = 9$) who received an intraoperative RBC transfusion had a higher incidence of postoperative complications than those ($n = 89$) who did not undergo intraoperative transfusion (65.1% vs. 49.4%, $P < .05$). No difference in the incidence of postoperative complications between transfusions with old blood and fresh blood was observed (63.8% vs. 65.5%). **Conclusion:** Intraoperative RBC transfusion is associated with increased postoperative complications in patients undergoing open radical cystectomy. The RBC storage duration may not affect the incidence of postoperative complications in this study population.

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Keywords: Blood storage duration, Blood transfusion, Cystectomy, Postoperative complications

Introduction

Stored red blood cells (RBCs) undergo morphologic and biochemical changes, or stored lesions, such as loss of deformability,

morphologic alterations, and depletion of adenosine triphosphate and 2,3-diphosphoglycerate. These changes decrease the oxygen-transporting capacity of RBCs and impair their passage through

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Intraoperative Red Blood Cell Transfusion

capillaries.^{1,2} Previous studies have shown that transfusing old blood significantly increases mortality and postoperative complications, such as infection, multiorgan failure, and vascular thrombosis, in various patient populations.³⁻⁷

The intraoperative transfusion rate in patients undergoing radical cystectomy is relatively high, at 42% to 64%.^{8,9} Previous clinical reports demonstrated that increased blood loss and subsequent transfusion during radical cystectomy is closely associated with an increased number of postoperative complications.¹⁰⁻¹³ However, the effect of RBC storage duration on postoperative complications was not investigated in these studies; thus, it is unknown if these intraoperative transfusion results are the result of a transfusion of old blood. We hypothesized that transfusion with old RBC would increase the incidence of postoperative complications in patients undergoing radical cystectomy as a result of stored lesions.

In this study, we determined whether intraoperative RBC transfusion was associated with postoperative complications in patients undergoing open radical cystectomy. In addition, we compared the effect of fresh blood transfusion versus old blood transfusion on postoperative complications.

Materials and Methods

This retrospective observational study was approved by institutional review board of Seoul National University Hospital (study H1408-135-607), and obtaining informed consent was waived. A total of 261 consecutive patients who underwent open radical cystectomy under general anesthesia between January 2009 and December 2013 were enrolled.

The patients were divided into groups according to whether they had received an intraoperative RBC transfusion (at least 1 RBC unit intraoperatively) or not (no blood products received intraoperatively). The RBC transfusion group was further divided according to the duration of RBC storage. Fresh blood was defined as a storage duration of ≤ 14 days, and old blood was defined as a storage duration of > 14 days. These criteria were used in a previous study.³ The selection of transfused fresh or old blood was dependent on the decision of the clerk working in the hospital blood bank. No anesthesiologist participated in the selection of the blood to be transfused.

Nine patients who had a mixed transfusion (2 patients: 3 old RBC units, 2 fresh RBC units; 2 patients: 2 old RBC units, 1 fresh RBC unit; 2 patients: 1 old RBC unit, 2 fresh RBC units; 3 patients: 1 old RBC unit, 1 fresh RBC unit) were excluded from data analysis about the incidence of postoperative complications between the old blood group and the fresh blood group.

The decision to provide an intraoperative blood transfusion during radical cystectomy was made by an anesthesiologist and/or a urologic surgeon. No particular blood transfusion protocol was used. A blood transfusion was usually indicated when hemoglobin was < 8 g/dL; when the hemoglobin level dropped, suggesting ongoing blood loss; or when the patient manifested signs of acute anemia.

Data were categorized into 3 variable sets. Preoperative variables included demographic data, American Society of Anesthesiologists Physical Status (ASA PS) class, comorbidities, and preoperative laboratory findings. Intraoperative variables included estimated

Table 1 Comparison of Perioperative Variables Between Patients With Intraoperative Blood Transfusion and Those Without

Characteristic	Intraoperative RBC Transfusion		P
	No (n = 89)	Yes (n = 172)	
Male gender	82 (92.1%)	134 (77.9%)	.007
Age (years)	67.4 \pm 8.4	69.8 \pm 8.8	.034
Body mass index (kg/m ²)	22.1 \pm 2.9	22.3 \pm 3.3	.637
ASA PS class			.908
1-2	48 (53.9%)	90 (52.3%)	
3-4	41 (46.1%)	82 (47.7%)	
Comorbidity			
Diabetes	10 (11.2%)	37 (21.5%)	.060
Hypertension	34 (38.2%)	70 (4.7%)	.797
Neurologic	3 (3.4%)	10 (5.8%)	.552
Pulmonary	19 (21.3%)	28 (16.3%)	.401
Cardiac	6 (6.7%)	10 (5.8%)	.981
Hepatic	5 (5.6%)	8 (4.7%)	.768
Renal	14 (15.7%)	22 (12.8%)	.643
Other malignancy	1 (1.1%)	4 (2.3%)	.664
Other	1 (1.1%)	5 (2.9%)	.667
Duration of surgery (minutes)	371.6 \pm 97.0	394.4 \pm 101.3	.082
Urinary diversion type			.461
Ileal conduit	52 (58.4%)	110 (64.0%)	
Neobladder	37 (41.6%)	62 (36.0%)	
Estimated blood loss (mL)	608.4 \pm 377.6	115.3 \pm 78.0	<.001
Pathologic T stage			.057
T0, Tis, Ta, T1	56 (62.9%)	80 (46.5%)	
T2	10 (11.2%)	30 (17.4%)	
T3	15 (16.9%)	48 (27.9%)	
T4	8 (9.0%)	14 (8.1%)	
Pathologic node status			.098
N0	76 (85.4%)	133 (77.3%)	
N1	3 (3.4%)	17 (9.9%)	
N2	8 (9.0%)	11 (6.4%)	
N3	2 (2.2%)	11 (6.4%)	
Hemoglobin (g/dL)			
Preoperative	13.2 \pm 1.7	12.4 \pm 1.8	.001
Immediate postoperative	11.3 \pm 1.3	11.3 \pm 1.4	.699
Albumin (g/dL)			
Preoperative	4.1 \pm 0.5	4.0 \pm 0.4	.269
Immediate postoperative	2.8 \pm 0.4	2.5 \pm 0.4	<.001
Creatinine (mg/dL)			
Preoperative	1.1 \pm 0.6	1.2 \pm 0.8	.285
Immediate postoperative	1.2 \pm 0.5	1.3 \pm 0.7	.398
ICU admission	5 (5.6%)	17 (9.9%)	.347
Hospital stay (days)	22.7 \pm 12.1	25.5 \pm 18.8	.207

Data are presented as mean \pm standard deviation or n (%). Abbreviations: ASA PS = American Society of Anesthesiologists Physical Status; ICU = intensive care unit; RBC = red blood cell.

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