Original Article

Utilization of Cross-Matched Blood for Elective Hysterectomy in a Tertiary Care Center: A Retrospective Review

Somkiat Aroonpruksakul MD[1], Nattaya Raykateeraroj MD[1], Kitikhun Phumkokrak MD[1], Parichart Permpikul MD[2]

[1] Department of Anesthesiology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand
[2] Department of Transfusion Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

Objective: To determine the incidence of perioperative blood transfusion in cross-matched patients undergoing elective hysterectomy at Siriraj Hospital, and to identify the associated risk factors.

Materials and Methods: This is a retrospective chart review of patients undergoing elective hysterectomy from 2013 to 2014. The details of each patient were recorded: demography, American Society of Anesthesiologists [ASA] physical status class, diagnosis, preoperative hematocrit, route of hysterectomy, and uterine or mass size. Independent sample's t-test was used to analyze continuous variables, and the risk factors for blood transfusion were analyzed by using univariate analysis and multiple logistic regression.

Results: A total of 3,219 patients had elective hysterectomy during study period; 644 cross-matched patients were enrolled in this study and 144 patients were blood transfused in their perioperative period; of which, the incidence was 22.4% (95% CI 19.3 to 25.7). From univariate analysis, the significant risk factors for perioperative blood using were the diagnosis (beyond myoma uteri and gynecologic carcinoma), size of mass (bigger than 5 centimeters), preoperative hematocrit (less than 35%), ASA class III-IV and vaginal hysterectomy. However, when calculated by using multivariate analysis, the vaginal hysterectomy was not a significant factor, contrary to the gynecologic carcinoma, which had a significant risk.

Conclusion: In elective hysterectomy cases, the medical team should order cross-matching blood when the patient has the risks: pre-operative anemia, larger than 5 centimeters mass, ASA class III-IV and diagnosis beyond myoma uteri.

Keywords: Cross-match, Blood utilization, Elective hysterectomy, Perioperative, Blood transfusion risk, ASA

J Med Assoc Thai 2018; 101 (Suppl. 9): S143-S147
Website: http://www.jmatonline.com

In the past, many health care institutes recommended keeping the patient's hemoglobin level at least 10 g/dL[1]. Because of blood-borne infectious diseases, both viral and bacterial, the threshold has been lowered. To date, the National Institute for Clinical Excellence and American Association of Blood Banks guidelines suggests that transfusion, for hemodynamically stable hospitalized adult patients, is not needed until the hemoglobin level is lower than 7 g/dL[2,3]. However, inappropriate cross-matchings are still found around the world, results in ineffective health care system and wasteful treatment expenses[4-7].

Hysterectomy is one of the most common major gynecologic operations. There were several studies about perioperative blood transfusion in these patients and the risk factors of transfusion were: pre-operative anemia, size or weight of the mass, and the surgical technique[8-10]. There are three surgical approaches: laparoscopy, vaginal approach, and explore laparotomy. Laparoscopic and a vaginal hysterectomy were associated with less intra-operative blood loss than abdominal approaches[11]. However, each route has its own place in the operative armamentarium of the gynecologist and the overall incidence of perioperative blood transfusion in these operations,

Correspondence to:
Aroonpruksakul S. Department of Anesthesiology, Faculty of Medicine Siriraj Hospital, Mahidol University, 2 Wanglang Road, Bangkoknoi, Bangkok 10700, Thailand.
Phone: +66-2-4197990, Fax: +66-2-4113256
E-mail: somkiat.aro@mahidol.ac.th

How to cite this article: Aroonpruksakul S, Raykateeraroj N, Phumkokrak K, Permpikul P. Utilization of Cross-Matched Blood for Elective Hysterectomy in a Tertiary Care Center: A Retrospective Review J Med Assoc Thai 2018;101;Suppl.9: S143-S147.

whether or not cross-matching, was less than 5%[12,13]. Although the real incidence of blood usage in this procedure is low, the medical teams often order the cross-match preoperatively which places unnecessary workload on blood bank officers and is not cost-effective. Nonetheless, the authors did not have the incidence of blood transfusion and its associated factors for this operation in our institute.

In the present study, we focused on the utilization of blood in cross-matched patients and the risk associated with the usage. The primary objective was to find the incidence of intraoperative and 24-hour postoperative blood transfusion in elective hysterectomy, cross-matched patients at a large, tertiary-care, government hospital. The secondary objective was to find the factors associated with transfusion in these patients. From the outcome of this study, it would help to create a hospital guideline for cross-matching in elective hysterectomy patients.

Materials and Methods

After approval by Siriraj Institutional Review Board (Faculty of Medicine Siriraj Hospital, Mahidol University, Thailand) (Si. 300/2015), the cross-matched patients undergoing elective hysterectomy at Siriraj Hospital from 1 January 2013 to 31 December 2014 were included in this retrospective descriptive study.

In every patient, demographic data was recorded, including age, body mass index [BMI], and American Society of Anesthesiologists physical status [ASA]. The number of patients who received blood during operation and/or 24-hour postoperative period was recorded as the incidence of blood utilization. From the previous studies, pre-operative anemia and the bigger uterine size affected the blood transfusion[8-10], and also with abdominal hysterectomy[11]. In this study, we recorded the potential factors (pre-operative hematocrit, mass or uterine size, and surgical approach), for finding the significant factors. We also collected the diagnosis, divided into 4 groups: myoma uteri, gynecologic cancer, others (e.g. adenomyosis, endometriotic cyst, ureterovaginal prolapse, etc.), and mixed (more than one condition).

From the study of Belayneh et al the surgical patients, who were prescribed cross-matching, were transfused only 29%[14]. However, they included the emergency cases that may cause the incidence higher than elective surgery. For sample size calculation, we estimated the incidence of intraoperative and postoperative blood transfusion in elective hysterectomy, equals to 25% and 95% confidence interval (CI) equals to 25%$\pm$3.5%. Calculated sample size was about 600.

The patients' data were divided into two groups, transfusion group (patients received the blood in intra-operative and/or within 24 hours postoperative period) and non-transfusion group. Data analysis was performed using PASW Statistics [SPSS] 18.0 software (SPSS Inc., Chicago, IL, United States). The demographic data were analyzed by independent sample t-test. Univariate and multivariate logistic regression were used for analyzing potential risk factors of blood transfusion (diagnosis, route of hysterectomy, pre-operative hematocrit, ASA physical status, and mass or uterine size) which were presented in number, percentage, odd ratio and 95% confidence interval. The *p*-value of less than 0.05 was considered statistically significant.

Results

In 2013 to 2014, there were 3,219 patients undergoing hysterectomy at Siriraj Hospital and 644 elective hysterectomy patients with pre-operative blood cross-matching were enrolled in the present study. There were 144 cases in transfusion group and 500 cases in non-transfusion group. The incidence of blood transfusion was 22.4% (95% CI 19.3 to 25.7). In transfusion group, 131 patients were transfused intra-operatively, 22 patients in 24 hours postoperative period, and 9 patients in both periods. For demographic data, age was not significantly different between groups (Table 1). In transfusion group, BMI was a little lower than non-transfusion group (23.4$\pm$4.6 vs. 24.9$\pm$5.4, p = 0.003). The number of ASA I-II and ASA III-IV was also significantly different between these two groups (p<0.001).

From the Table 2, using univariate analysis, there were potential risks for the need of blood transfusion. The diagnosis of myoma uteri and gynecologic carcinoma were not a significant factor affecting blood transfusion. In contrast, the patients with other gynecologic disease or having more than one diagnosis were the risk (crude OR 2.79, 95% CI 1.10 to 7.03, p = 0.03 and crude OR 4.69, 95% CI 1.73 to 12.72, p = 0.002, respectively). We added more than one gynecologic disease to the diagnosis category because some of patients were diagnosed both benign and malignancy e.g. myoma uteri and ovarian tumor, etc. Pre-operative anemia in any severity, hematocrit less than 35%, was the risk factor too. Concerning the route of hysterectomy, vaginal hysterectomy was only the risk factor (crude OR 10.5, 95% CI, 1.41-78.06 p = 0.022).

Table 1. Demographic and clinical data

Characteristics	Transfusion group (n = 144)	Non-Transfusion group (n = 500)	*p*-value
Age (year)	53.8±13.1	52.8±12.8	0.385
Body mass index (kg/m^2)	23.4±4.6	24.9±5.4	0.003*
Pre-operative hematocrit	32.7±5.3	36.2±4.7	0.001*
ASA			<0.001*
I/II	17 (11.8)/77 (53.3)	107 (21.4)/304 (60.8)	
III/IV	48 (33.3)/2 (1.4)	87 (17.4)/2 (0.4)	
Estimated blood loss (mL)	1,000 (613, 1,600)	250 (100, 400)	<0.001*

The data are presented as mean ± standard deviation or n (%) or median (P25, P75)
* $p<0.05$ indicates statistical significance
ASA = American Society of Anesthesiologists physical status class

Table 2. Potential factors associated with blood transfusion in hysterectomy patient using univariate and multivariate analysis

	Transfusion (n = 144)	Non-transfusion (n = 500)	Univariate analysis		Multivariate analysis	
			Crude OR (95% CI)	*p*-value	Adjusted OR (95%CI)	*p*-value
Diagnosis						<0.001*
Myoma uteri	8 (11.9)	59 (88.1)	1	-	1	-
Cancer	105 (21.9)	374 (78.1)	2.07 (0.96, 4.47)	0.064	3.79 (1.56, 9.22)	0.003*
Others	17 (27.4)	45 (72.6)	2.79 (1.10, 7.03)	0.030*	3.79 (1.57, 11.28)	0.017*
>1 diagnosis	14 (38.9)	22 (61.1)	4.69 (1.73, 12.72)	0.002*	11.98 (3.77, 38.02)	<0.001*
Pre-operative Hct						<0.001*
≤25	13 (68.4)	6 (31.6)	17.04 (6.12, 47.49)	<0.001*	24.77 (7.76, 78.92)	<0.001*
25.1 to 30	38 (40.9)	55 (59.1)	5.43 (3.18, 9.27)	<0.001*	5.56 (3.04, 10.18)	<0.001*
30.1 to 35	55 (28.2)	140 (71.8)	3.09 (1.95, 4.89)	<0.001*	3.06 (1.87, 5.03)	<0.001*
>35	38 (11.3)	299 (88.7)	1	-	1	-
Operation						0.375
TAH	138 (22.5)	475 (77.5)	3.05 (0.71, 13.19)	0.135	4.33 (0.39, 48.00)	0.233
V-Hyst	4 (50.0)	4 (50.0)	10.50 (1.41, 78.06)	0.022*	1.22 (0.23, 6.39)	0.815
LH	2 (8.7)	21 (91.3)	1	-	1	-
Size of mass (cm)						<0.001*
≤5	29 (11.3)	231 (88.8)	1	-	1	-
5.1 to 10	35 (19.8)	142 (80.2)	1.96 (1.15, 3.35)	0.013*	1.83 (1.00, 3.32)	0.049*
10.1 to 20	62 (37.1)	105 (62.9)	4.70 (2.86, 7.74)	<0.001*	5.61 (3.20, 9.85)	<0.001*
>20	18 (45)	22 (55.0)	6.52 (3.13, 13.56)	<0.001*	9.02 (3.92, 20.73)	<0.001*
ASA						0.002*
I-II	94 (18.6)	411 (81.4)	1	-	1	
III-IV	50 (36.0)	89 (64.0)	2.46 (1.63, 3.71)	<0.001*	2.16 (1.33, 3.51)	

The data are presented as n (%)
* $p<0.05$ indicates statistical significance
Hct = Hematocrit; TAH = Trans-abdominal hysterectomy; V-Hyst = Vaginal hysterectomy; LH = Laparoscopic hysterectomy, ASA = American Society of Anesthesiologists physical status class

The other significant risk factor was the size of mass or uterus. The patients, who had uterine or mass size bigger than 5 cm, increased the potential of blood transfusion. The last factor from this study was ASA

physical status, of which ASA III-IV was the significant risk ($p<0.001$).

When calculated by multivariate analysis, in addition to diagnosis category, gynecologic carcinoma was the one of significant risk factors (adjusted OR 3.79, 95% CI 1.56 to 9.22, $p = 0.003$). For pre-operative anemia, ASA physical status and mass or uterine size factors, result of multivariate analysis was similar to the univariate calculation. In addition, pre-operative hematocrit less than 35%, ASA III-IV and mass bigger than 5 cm were the significant risks. Nevertheless, for hysterectomy route, trans-vagina had no significant effect (adjusted OR 1.22, 95% CI 0.23 to 6.39, $p = 0.815$). This showed that the route of hysterectomy had no effect for the need of blood transfusion.

Discussion

There were 3,219 patients coming for elective hysterectomy at Siriraj Hospital during the period of study. However, the surgical team prescribed either type-screen or cross-matching blood order. Because the limited availability of blood pooling at our institute, we aimed this study to the cross-matched patients. From the result, the incidence of blood transfusion in cross-matched patients who going to elective hysterectomy was 22.4%. This incidence was higher than some previous studies[12,15]. Generally, in elective hysterectomy cases, gynecologists order blood cross-matching for 1 or 2 units, but we did not record amount of them in this study. However, if booking and using one unit each patient, the crossmatch-to-transfusion ratios [C/T] was equal to 4.47, which was still higher than 2 that was recommended[16,17]. This meant that there was still some waste from inappropriate blood order which resulted in unnecessary health care expenses and increased workload of blood bank workforce. The studies by Ransom et al about the usage and cost-effectiveness in routine preoperative type-and-screen blood test, without medical indication, for vaginal hysterectomy and elective laparoscopic surgery concluded that cross-matching were not worth doing and did not improve patient care. They suggested that the routine type-and-screen should be eliminated[12,15]. Multivariate logistic regression analysis showed four factors influencing blood utilization. The myoma uteri was only the diagnosis that had no effect when compared to others. Pre-operative anemia or lower hematocrit was a significant risk factor when the level was lower than 35%. This potential risk factor was similar to previous studies[9,10]. The authors predicted that the larger mass would cause more intraoperative blood loss and need blood transfusion for the patient[8-10]. The result of this study confirmed this opinion that the uterine or mass size larger than 5 centimeters was the risk. Other studies showed that the method or route of hysterectomy affected intraoperative blood loss[11]. Laparoscopic surgery and vaginal hysterectomy had lower amount of blood loss than transabdominal techniques. However, in this study, the surgical approach had no significant effect in blood usage. Finally, the high-risk patient [ASA III-IV] had potential to blood transfusion in elective hysterectomy.

Comparing the types of blood booking, type-and-screen with cross-match, the former is simple and less costly. Normally, processing time for type-and-screen is shorter than cross-matching at least 15 minutes. The other concern is the shortage of common blood pool if many medical teams prescribe cross-matching at the same period. At Siriraj Hospital, type-and-screen and cross-match booking cost 420 and 570 baht per unit respectively. Because of low incidence of blood transfusion for this kind of operation, it would be more cost effective, ordering type-and-screen instead. Even though bill reduction is not huge, it decreases the laboratory technician's workload. In addition, the institute should have the hospital guideline for blood booking in elective hysterectomy patients.

Limitation

The authors interested in the incidence of blood utilization in the cross-match patients. Due to no data on the amount of blood units, so we could not calculate crossmatch-to-transfusion [C/T] ratios exactly. The C/T ratio is a widely acceptable recommendation that will show whether the usage of blood is appropriate to demand. In addition, there are some factors, may influence the blood utilization, which we did not mention in this study; for example, gynecologist's experience, hematocrit level before giving the blood, operation time, etc.

Conclusion

The usage of blood transfusion for elective hysterectomy cross-matched patient at Siriraj Hospital was only 22.4%. Medical personnel should concern about the worthiness of blood order by considering of the risk factors: diagnosis beyond myoma uteri, uterine or mass size larger than 5 centimeters, high-risk ASA physical status and preoperative hematocrit less than 35%. Additionally, each medical institute should have

blood ordering guidance for elective surgery.

What is already known on this topic?

The incidence of peri-operative blood transfusion is low. Routinely blood ordering for hysterectomy wastes the healthcare budgeting and increases the blood bank technician workload. Pre-operative anemia and large uterine or mass size are the risk factors affecting the blood usage.

What this study adds?

The incidence of perioperative (intra-operation and 24-hour post-operation) blood transfusion in cross-matched elective hysterectomy patient at Siriraj Hospital was 22.4%. The risk factors for blood transfusion are diagnosis beyond myoma uteri, mass bigger than 5 cm, pre-operative Hct less than 35% and ASA III-IV. Route of hysterectomy had no significant effect.

Acknowledgements

The authors thank Chulaluk Komoltri for statistical analytic assistance.

Potential conflicts of interest

The authors declare no conflict of interest.

References

1. Wang JK, Klein HG. Red blood cell transfusion in the treatment and management of anaemia: the search for the elusive transfusion trigger. Vox Sang 2010;98:2-11.
2. Padhi S, Kemmis-Betty S, Rajesh S, Hill J, Murphy MF. Blood transfusion: summary of NICE guidance. BMJ 2015;351:h5832.
3. Carson JL, Guyatt G, Heddle NM, Grossman BJ, Cohn CS, Fung MK, et al. Clinical practice guidelines from the aabb: red blood cell transfusion thresholds and storage. JAMA 2016;316:2025-35.
4. Lin JS, Chen YJ, Tzeng CH, Lyou JY, Lee CH. Revisiting of preoperative blood ordering policy—a single institute's experience in Taiwan. J Chin Med Assoc 2006;69:507-11.
5. Hall TC, Pattenden C, Hollobone C, Pollard C, Dennison AR. Blood transfusion policies in elective general surgery: How to optimise cross-match-to-transfusion ratios. Transfus Med Hemother 2013;40:27-31.
6. Alghamdi S, Gonzalez B, Howard L, Zeichner S, LaPietra A, Rosen G, et al. Reducing blood utilization by implementation of a type-and-screen transfusion policy a single-institution experience. Am J Clin Pathol 2014;141:892-5.
7. Kumari S. Blood transfusion practices in a tertiary care center in Northern India. J Lab Physicians 2017;9:71-5.
8. Matthews CA, Cohen S, Hull K, Ramakrishnan V, Reid N. Risk factors for blood transfusion in women undergoing hysterectomy for benign disease. J Gynecol Surg 2012;28:108-12.
9. Kane S, Collins S, Sproat LA, Mangel J. Predictors of transfusion requirement among patients who undergo hysterectomy for benign disease. J Gynecol Surg 2012;28:113-5.
10. Sordia-Hernandez LH, Rodriguez DS, Vidal-Gutierrez O, Morales-Martinez A, Sordia-Pineyro MO, Guerrero-Gonzalez G. Factors associated with the need for blood transfusion during hysterectomy. Int J Gynaecol Obstet 2012;118:239-41.
11. Nieboer TE, Johnson N, Lethaby A, Tavender E, Curr E, Garry R, et al. Surgical approach to hysterectomy for benign gynaecological disease. Cochrane Database Syst Rev 2009;(3):CD003677.
12. Ransom SB, McNeeley SG, Malone JM Jr. A cost-effectiveness evaluation of preoperative type-and-screen testing for vaginal hysterectomy. Am J Obstet Gynecol 1996;175:1201-3.
13. Ghirardo SF, Mohan I, Gomensoro A, Chorost MI. Routine preoperative typing and screening: a safeguard or a misuse of resources. JSLS 2010;14:395-8.
14. Belayneh T, Messele G, Abdissa Z, Tegene B. Blood requisition and utilization practice in surgical patients at university of gondar hospital, northwest ethiopia. J Blood Transfus 2013;2013:758910.
15. Ransom SB, McNeeley SG, Hosseini RB. Cost-effectiveness of routine blood type and screen testing before elective laparoscopy. Obstet Gynecol 1995;86:346-8.
16. Friedman BA. An analysis of surgical blood use in United States hospitals with application to the maximum surgical blood order schedule. Transfusion 1979;19:268-78.
17. Nuttall GA, Santrach PJ, Oliver WC Jr, Horlocker TT, Shaughnessy WJ, Cabanela ME, et al. The predictors of red cell transfusions in total hip arthroplasties. Transfusion 1996;36:144-9.