Original Article

Factors Associated with Transfusion of Uncross-matched Type-O Packed Red Cells for Acute Upper Gastrointestinal Hemorrhage

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Background: Acute upper gastrointestinal hemorrhage is a life-threatening condition that necessitates treatment within the first hour at the emergency department. Although prompt blood transfusion is one resuscitation procedure that can be implemented in these cases, its indications are not well understood.

Objective: To study factors that affect transfusion of uncross-matched type-O pack red cells (UOPRC) in acute upper gastrointestinal hemorrhage at the emergency department of a tertiary university hospital.

Materials and Methods: This was a cross-sectional analytical study. The population was acute upper gastrointestinal bleeding patients at the Srinagarind Hospital emergency department (Khon Kaen University Faculty of Medicine) from August 1, 2016 to August 31, 2019. Data were collected by reviewing Health Object program (Hospital data) and Medical charts. Multiple Logistic regression analysis was performed to determine which factors were associated with transfusion of UOPRC and to study the mortality rate in these patients.

Results: The three risk factors found in the UOPRC group were heart rate ≥100 bpm (OR 4.60, $p<0.05$, 95% CI 1.794, 12.126), shock index ≥0.8 (OR 3.78, $p<0.05$, 95% CI 1.464, 10.706), and history of blood transfusion (OR 2.96, $p<0.05$, 95% CI 1.126, 7.723). The mortality rate was 29% in the UOPRC group and 1.1% in the non-UOPRC group.

Conclusion: Heart rate ≥100 bpm was the main factor associated with transfusion of UOPRC in acute upper gastrointestinal hemorrhage patients at the Srinagarind Hospital emergency department. Further research should be conducted based on the results from the present study to establish emergency blood transfusion criteria.

Keywords: Blood transfusion, Gastrointestinal hemorrhage, Emergency department, Tertiary hospital

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Acute upper gastrointestinal bleeding (Acute UGIB) is a life-threatening emergency condition. It has an incidence ranging from 48 to 160 per 100,000 population and has been found to be the cause of 7 to 10% of deaths in the United States[1] and 10 to 15% of deaths in Thailand[2]. It is necessary to diagnose and treat the condition quickly, especially when blood transfusion is necessary for resuscitation. In 2004, Baradarian et al suggested that the time to initiate blood transfusion in Acute UGIB patients with hypotension is immediately blood transfusion resulting in stable blood pressure more quickly than non-specific blood transfusion time groups[3]. In 2013, Candid Villanueva et al found that acute UGIB patients who received blood transfusion when Hb was <7 g/dl (restrictive transfusion) had lower repeated bleeding rates, shorter periods of hospitalization, less balloon use to stop bleeding, fewer surgeries, and fewer side effects from receiving blood than patients who received blood when Hb was <9 to 10 g/dl (liberal transfusion)[4]. However, the total blood preparation time for patients requiring urgent blood transfusion at Srinagarind Hospital is at least 30 to 45 minutes including blood transportation time from the blood collection to the emergency department. From 2014 to the present, we have stored 3 packs of uncross-matched type-O packed red cells (UOPRC) per day at the emergency department (Figure 1) for use in critically ill patients. Nevertheless, the decision to use UOPRC depends on clinical decisions by the doctor. There have yet been no studies regarding factors associated with blood transfusion for resuscitation in acute UGIB in Thailand. The objective of this study was thus to identify factors associated UOPRC transfusion for acute

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Figure 1. Uncrossmatched type-O pack red cells at the emergency department.

upper gastrointestinal hemorrhage at the emergency department of a tertiary hospital.

Materials and Methods

This was a cross-sectional analytical study. The sample consisted of 125 patients over 18 years of age who had been diagnosed with acute UGIB at the Srinagarind Hospital emergency department from August 2016 to August 2019. The exclusion criterion was because of incomplete medical data from the electronic medical chart program. Ethics approval was provided by the Khon Kaen University Ethics Committee for Human Research (HE621375).

The sample size was calculated based on the hypothesis tests for two population means described in a study by Lopes[5]. In order to achieve a significance level of 5% and power of test of 0.8, we determined that a sample size of 125 would be required.

The primary outcome was factors associated with UOPRC transfusion in acute UGIB patients at the emergency department, and the secondary outcome was mortality rates in UOPRC and non-UOPRC patients.

Statistical analysis was performed using SPSS for Windows version 17.0 (SPSS Inc., Chicago, IL, USA). Categorical data were presented as percentages, and continuous data were presented using mean and standard deviation. Univariable analysis was performed using a two-sample t-test for numerical data and a Pearson's correlation and Fisher's Exact test for data relationships between the two groups.

Results

One hundred twenty-five subjects were examined. The number of patients who did and did not receive UOPRC (UOPRC and non-UOPRC groups) were 31 and 94, respectively. The mean age was 53.45±11.48 years in the UOPRC group and 55.24±17.8 years in the non-UOPRC group. The majority of patients were male in both groups. A higher percentage of patients in the UOPRC group had heart rate ≥100 bpm (41.9%) than in the non-UOPRC group (20.2%). Systolic blood pressure less than 100 mmHg in 35.5% of UOPRC patients and 17% of non-UOPRC patients. Most of the patients in the UOPRC group (69.6%) had a shock index ≥0.8. Seven out of eight patients with cardiac arrest underwent UOPRC transfusion. In terms of medical history, we found that cirrhosis (38.4%), recurrent UGIB (43.2%), history of blood transfusion (18.4%), history of alcohol dependency, (29.6%) and history of NSAID use (16%) were medical illness in UGIB patients. The UOPRC group also had lower hemoglobin (Hb) and hematocrit (Hct) levels than the non-UOPRC group. Patient characteristics are shown in Table 1.

The authors found that three of the 15 factors analyzed were related to UOPRC transfusion according to univariable analysis: heart rate ≥100 bpm (OR 4.60, $p<0.05$, 95% CI 1.794, 12.126), shock index ≥0.8 (OR 3.78, $p<0.05$, 95% CI 1.464, 10.706), and previous blood transfusion (OR 2.96, $p<0.05$, 95% CI 1.126, 7.723). However, after multivariable analysis, only heart rate ≥100 bpm (OR 3.61, $p<0.05$, 95% CI 1.181, 11.428; Table 2) was associated with UOPRC transfusion.

There were 9 deaths from acute gastrointestinal bleeding in the UOPRC group (29%) and 1 in the non-UOPRC group (1.1%).

Discussion

The present study found that heart rate ≥100 bpm was the most significant factor related to UOPRC transfusion in acute UGIB patients, which is consistent with the results of studies by the Joint United Kingdom Blood Transfusion and Tissue Transplantation Services Professional Advisory Committee[6] and the Committee on Trauma[7], which found that blood transfusion for resuscitation should be implemented immediately when patients have low blood pressure or heart rate of 105 to 110 bpm. However; those studies were in traumatic and hemorrhagic shock patients. A study by Harris CT et al[8] found that 3.8% of acute UGIB underwent UOPRC transfusion. Furthermore, the UOPRC group in that study had a higher mean heart rate than the non-UOPRC group (105 bpm).

Another associated factor was the shock index, which is calculated as HR/SBP. We found that shock index greater than 0.8 was related to UOPRC transfusion (3.78 times). This contrasts with the results of a study by Eliana

Table 1. Characteristics of the subjects

Patient characteristic at baseline	UOPRC group (n = 31)	Non-UOPRC group (n = 94)	*p*-value
Age years (mean ± SD)	53.45±11.48	55.24±17.80	0.118
Male, n (%)	27 (87)	71 (75.5)	0.260
Female, n (%)	4 (12.9)	23 (24.5)	
Heart rate, n (%)			
<100 bpm	11 (35.5)	74 (78.7)	0.003*
≥100 bpm	13 (41.9)	19 (20.2)	
No heart rate	7 (22.6)	1 (1.1)	
Systolic blood pressure, n (%)			
<100 mmHg	11 (35.5)	16 (17)	0.005*
≥100 mmHg	12 (38.7)	77 (81.9)	
No systolic blood pressure	8 (25.8)	1 (1.1)	
Diastolic blood pressure, n (%)			
<60 mmHg	10 (32.3)	21 (22.3)	0.077
≥60 mmHg	13 (41.9)	72 (76.6)	
No diastolic blood pressure	8 (25.8)	1 (1.1)	
Body temperature, n (%)			
<35°C	2 (6.5)	1 (1.1)	>0.099
≥35°C	29 (93.5)	93 (98.9)	
Respiratory rate, n (%)			
<20 tpm	4 (12.9)	22 (23.4)	0.714
≥20 tpm	19 (61.3)	71 (75.5)	
Apnea	8 (25.8)	1 (1.1)	
Shock index, n (%)			
<0.8	7 (30.4)	58 (62.4)	0.011*
≥0.8	16 (69.6)	35 (37.6)	
Glasgow coma scale, n (%)			
<15	11 (35.5)	6 (6.4)	0.002*
15	20 (64.5)	88 (93.6)	
Cirrhosis	17 (54.8)	31 (33)	0.050
Recurrent UGIB	13 (41.9)	41 (43.6)	>0.099
Previous blood transfusion	10 (32.2)	13 (32.3)	0.042*
Alcohol use, n (%)	13 (41.9)	24 (25.5)	0.131
NSAID use, n (%)	3 (9.7)	17 (18.1)	0.409
Hemoglobin, n (%)			
<7 g/dL	10 (32.3)	8 (8.5)	0.005*
7 to 10 g/dL	12 (38.7)	39 (41.5)	
>10 g/dL	9 (29)	47 (50)	
Hematocrit, n (%)			
<24 vol%	17 (54.8)	19 (20.2)	<0.001*
24 to 30 vol%	8 (25.8)	25 (26.6)	
>30 vol%	6 (19.4)	50 (53.2)	

* Statistical significance

Saffouri et al[9] which found that Glasgow-Blatchford score (GBS), AIMS65 score, admission Rockall score (ARS), and international bleeding risk score were better able to predict the need for major transfusion (>4 units of pack red cells) than shock index. However, previous studies in trauma patients have found that shock index can be used as an indication for blood transfusion. For example, studies by Campos-Serra et al[10] and El-Menyar et al[11] found that shock index greater than 0.8 in trauma patients was able to predict ongoing bleeding as an indication to initiate a massive transfusion protocol and the outcomes of patients.

The authors also found history of blood transfusion to be associated with UOPRC transfusion, especially in cirrhotic patients. This is consistent with the results of a study of Erwin Biecker[12], which found that patients with cirrhosis have a 60% incidence of esophageal varice and 5 to 10% chance of new varice incidence each year. Patients with cirrhosis also have a higher chance of repeated bleeding.

The mortality rate in this study was 29% in the UOPRC group and 1.1% in the non-UOPRC group, which is consistent with a study by Taha et al[13] which found that the overall mortality rate in non-variceal UGIB patients was 5.3% at 30 days and 25.8% at 2 years regardless of whether or not transfusion was performed. Mortality was higher in the transfused versus non-transfused patients (p<0.001, log

Table 2. Logistic regression analysis (UOPRC group vs. non-UOPRC group) of all patients

Factor	Crude OR	*p*-value	95% CI
Age		0.118	
<60	0.46		0.275, 0.744
60 to 80	0.41		0.149, 1.018
>80	0.31		0.016, 1.891
Heart rate (bpm)		<0.001*	
<100	0.14		0.074, 0.268
≥100	4.60		1.794, 12.126
Systolic blood pressure (mmHg)		0.005*	
<100	0.68		0.310, 1.468
≥100	0.22		0.083, 0.604
Diastolic blood pressure (mmHg)		0.077	
<60	0.47		0.214, 0.986
≥60	0.37		0.145, 1.001
Body temperature (°C)		>0.099	
<35	1.73		NA
≥35	1.79		NA
Respiratory rate (tpm)			
<20	0.18	0.714	0.053, 0.474
≥20	1.47		0.489, 5.479
Shock index			
<0.8	0.12	0.011*	0.050, 0.245
≥0.8	3.78		1.464, 10.706
Cirrhosis			
No	0.22	0.050	0.119, 0.384
Yes	2.46		1.082, 7.724
Recurrent UGIB			
No	0.33	>0.099	0.193, 0.568
Yes	0.93		0.404, 2.114
History of blood transfusion			
No	0.25	0.042*	0.156, 0.410
Yes	2.96		1.126, 7.723
Alcohol use			
No	0.25	0.131	0.148, 0.421
Yes	2.10		0.890, 4.935
NSAID use			
No	0.36	0.409	0.232, 0.553
Yes	0.48		0.107, 1.584
Glasgow coma scale			
<15	1.83	<0.001*	0.697, 5.322
15	0.12		0.038, 0.364
Hemoglobin (g/dL)			
<7	1.25	0.005*	0.493, 3.274
7 to 10	0.24		0.076, 0.754
>10	0.15		0.045, 0.484
Hematocrit (vol%)			
<24	0.89	<0.001*	0.460, 1.724
24 to 30	0.35		0.122, 0.979
>30	0.13		0.042, 0.373

* Statistical significance

rank test). Due to abnormal vital signs, history of cirrhosis and lower level of hemoglobin and hematocrit in the UOPRC group, the severity of disease was greater than in the non-UOPRC group.

Conclusion

The present study found that heart rate ≥100 bpm was associated with UOPRC transfusion in acute UGIB patients at the emergency department. The mortality rate in the UOPRC group was higher than in the non-UOPRC group, as has been found in previous studies.

What is already known on this topic?

Acute UGIB is a life-threatening condition that

requires blood transfusion for resuscitation. Recent studies have found various factors that can predict the initiation of massive blood transfusion protocol for trauma patients. However, the standard indication for UOPRC transfusion in Acute UGIB patients is unclear.

What this study adds?

Heart rate ≥100 bpm is associated with UOPRC transfusion in acute UGIB patients. In addition, we should consider using heart rate in addition to other factors to establish transfusion protocol in these patients for further study.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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ปัจจัยที่มีความสัมพันธ์กับการให้เลือดชนิด uncrossmatched type-O packed red cell ในผู้ป่วยเลือดออกทางเดินอาหารส่วนต้นเฉียบพลัน

กมลวรรณ เอี้ยงฮง, ภาณุพงศ์ ศรีคำภา, กรกฎ อภิรัตน์วรากุล, ปริวัฒน์ ภู่เงิน, ดนุ เกษรศิริ, วัชรพงศ์ พุทธิสวัสดิ์

ภูมิหลัง: ภาวะเลือดออกในทางเดินอาหารส่วนต้นเฉียบพลันเป็นภาวะที่ทำให้เกิดอันตรายถึงชีวิตมีความจำเป็นต้องรีบทำการรักษาภายใน 1 ชั่วโมงแรกในแผนกฉุกเฉิน การรักษาโดยการให้เลือดทันทีเป็นหนึ่งในหัตถการช่วยชีวิตในผู้ป่วยเหล่านี้ อย่างไรก็ตามข้อบ่งชี้ยังไม่ชัดเจน

วัตถุประสงค์: เพื่อศึกษาปัจจัยที่มีผลต่อการให้เลือด uncrossmatched type-O pack red cells ในผู้ป่วยเลือดออกทางเดินอาหารส่วนต้นเฉียบพลันที่แผนกฉุกเฉิน โรงพยาบาลมหาวิทยาลัยระดับตติยภูมิ

วัสดุและวิธีการ: การศึกษาเชิงวิเคราะห์ตัดขวาง ประชากรศึกษาคือผู้ป่วยที่มีเลือดออกทางเดินอาหารส่วนต้นเฉียบพลันที่แผนกฉุกเฉิน โรงพยาบาลศรีนครินทร์ คณะแพทยศาสตร์ มหาวิทยาลัยขอนแก่น ตั้งแต่วันที่ 1 สิงหาคม พ.ศ. 2559 ถึง วันที่ 31 สิงหาคม พ.ศ. 2562 ข้อมูลที่ศึกษารวบรวมจากระบบฐานข้อมูลโรงพยาบาลและเวชระเบียนทางการแพทย์ การวิเคราะห์สถิติใช้วิธีการวิเคราะห์แบบถดถอยพหุโลจิสติกส์ เพื่อศึกษาปัจจัยที่สัมพันธ์กับการให้เลือด และศึกษาอัตราการเสียชีวิตในผู้ป่วยกลุ่มนี้

ผลการศึกษา: ปัจจัยที่มีผลต่อการให้เลือดในผู้ป่วยเลือดออกในทางเดินอาหารส่วนต้นเฉียบพลันที่แผนกฉุกเฉินมากที่สุดสามอันดับ ได้แก่ อัตราการเต้นของหัวใจมากกว่าหรือเท่ากับ 100 ครั้งต่อนาที, shock index มากกว่าหรือเท่ากับ 0.8 และผู้ป่วยเลือดออกในทางเดินอาหารที่เคยได้รับเลือด มีอัตราเสียชีวิตจากภาวะเลือดออกในทางเดินอาหารส่วนต้นเฉียบพลันในกลุ่ม UOPRC ร้อยละ 29 และกลุ่ม non-UOPRC ร้อยละ 1.1

สรุป: อัตราการเต้นของหัวใจที่มากกว่า 100 ครั้งต่อนาที เป็นปัจจัยหลักที่สัมพันธ์ในการให้เลือด UOPRC ในผู้ป่วยเลือดออกในทางเดินอาหารส่วนต้นเฉียบพลันที่แผนกฉุกเฉิน โรงพยาบาลศรีนครินทร์ การศึกษาเพิ่มเติมควรดำเนินการตามผลการศึกษานี้เพื่อสร้างเกณฑ์การให้เลือดฉุกเฉิน