



Factors for Blood Transfusions Following Hemi Hip Arthroplasty for Patients With Femoral Neck Fracture

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Aris Luangwaranyoo, MD¹, Methasit Suksintharanon, MD¹,
Pasin Tangadulrat, MD¹, Khanin Iamthanaporn, MD¹,
Theerawit Hongnarak, MD¹, and Varah Yuenyongviwat, MD¹ 

Abstract

Background: Hemi hip arthroplasty is one treatment option for femoral neck fractures; however, there has been limited evidence on factors associated with blood transfusions following hemi hip arthroplasty. Hence, the aim of this study was to identify the predictors of blood transfusion after hemi hip arthroplasty, which could lead to the establishment of proper guidelines for management protocols. **Materials and Methods:** This study was a retrospective cohort study, conducted in a single center of 323 femoral neck fracture patients having undergone hemi hip arthroplasty. Peri-operative factors and demographic data were extracted from the electronic medical records, from 2007 to 2019. A predictive model was developed by logistic regression (LR), and adjusted by multivariate logistic regression. **Result:** One hundred and twenty-six (39%) patients received blood transfusions. On multivariate analysis, those of a female gender (odds ratio (OR) 2.00, $p = 0.037$), having a body mass index lower than 18.5 kg/m² (OR 2.40, $p = 0.028$), lower preoperative hemoglobin levels (OR 0.52, $p < 0.001$) and given general anesthesia (OR 2.07, $p = 0.028$) were shown to be significantly associated with a higher risk of requiring a blood transfusion. **Conclusion:** The authors recommend that preparation of blood components coupled with the utilization of blood conserving methods for high risk patients, as studies have stated, in addition to the consideration of spinal anesthesia; if patients have no contraindication, should be implemented.

Keywords

blood transfusion, hemi hip arthroplasty, femoral neck fracture, risk factor, hip replacement

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Introduction

Hemi hip arthroplasty is an option for treatment of a femoral neck fracture. Although, there have been improvements in surgical techniques as well as patient care protocols for decreasing blood loss in the last decade, there are still a number of patients that require post-operative blood transfusions. Femoral neck fracture patients, whom require blood transfusions, usually require an allogenic blood transfusion, which increases the rate of infection.¹ Other problems occurring from blood transfusions are: acute transfusion reactions, transfusion-associated circulatory overload and transfusion-related acute lung injury.²

There are methods which apply for reducing blood loss and blood transfusions in hemi hip arthroplasty. Intraoperative cell saver blood replacement is an option, but this method increases the cost of patient care. There has been a study stating that: cell saver blood replacement is not a cost effective option, and not

recommended for application in all cases of femoral neck fractures.³ There was also a study demonstrating that intra-articular tranexamic acid injection during the hip hemi-arthroplasty is effective in reducing blood transfusions, without increasing the risk of thrombosis.⁴

Additionally, there are many studies reporting on the risk factors of post-operative blood transfusions after total hip arthroplasty (THA). Female gender, high American Society

¹ Department of Orthopedics, Faculty of Medicine, Prince of Songkla University, Songkhla, Thailand

Corresponding Author:

Varah Yuenyongviwat, Department of Orthopedics, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.
Email: varahortho@gmail.com



Table I. Patient Demographics.

Factors	Total (n = 323)	Transfusion (n = 126)	Nontransfusion (n = 197)	p value
Gender*				0.011 ^ψ
Male	91 (100)	25 (27.5)	66 (72.5)	
Female	232 (100)	101 (43.5)	131 (56.5)	
Age† (y)	79 (70.5,85)	78 (69.5,83.8)	79 (71,85)	0.449
BMI‡	21.8 (3.8)	21 (3.8)	22.3 (3.7)	0.006 ^ψ
ASA*				0.013 ^ψ
I	15 (100)	4 (26.7)	11 (73.3)	
II	219 (100)	76 (34.7)	143 (65.3)	
III	89 (100)	46 (51.7)	43 (48.3)	
Co-morbidity*				
DM	60 (100)	28 (46.7)	32 (53.3)	0.23
MI	24 (100)	6 (25)	18 (75)	0.213
CVA	49 (100)	19 (38.8)	30 (61.2)	1
Hb‡ (g/dL)	11.3 (1.8)	10.3 (1.6)	11.9 (1.6)	< 0.001 ^ψ
Hct‡ (%)	34.2 (4.9)	31.6 (4.4)	35.9 (4.4)	< 0.001 ^ψ
Garden classification ^a				0.70
I	21 (100)	7 (33.3)	14 (66.67)	
II	9 (100)	5 (55.56)	4 (44.44)	
III	57 (100)	24 (42.11)	33 (57.89)	
IV	236 (100)	93 (39.41)	143 (60.59)	
Duration† (days)	9 (5,21)	9 (5,24)	10 (6,20)	0.988
Preoperative anticoagulant*	24 (100)	11 (45.8)	13 (54.2)	0.621

*chi-square, † Ranksum, ‡ independent t-test, ^aFisher exact test.

^ψp value < 0.05.

of Anesthesiologists (ASA) and lower preoperative hemoglobin (Hb) were associated with a high rate of blood transfusions.^{5,6} However, there has been no report on the predictors of blood transfusions in hemi hip arthroplasty that have less intraoperative bleeding compared with THA. Moreover, patients who have had hemi hip arthroplasty were usually older and less active than patients who had THA. This present study was conducted to evaluate the risk factors for post-operative blood transfusion after hemi hip arthroplasty in a single center that utilized the same surgical techniques and patient care protocols.

Material and Methods

This study was a retrospective study conducted at a tertiary hospital; from January, 2007 to May, 2019. The primary outcome was the requirement of post-operative allogenic blood transfusion. A total of 323 femoral neck patients having undergone hemi hip arthroplasty were recruited. The exclusion criteria were: patients who had pathological fractures from tumor or infection, patients who had multiple fractures and patients with incomplete data. This study was approved by the local Ethics Committee and Institutional Review Board.

The posterior approach was used for all patients; wherein: the hip capsule and short external rotator were sutured back through the bone, with a suction drain being placed prior to wound closure. The drain was then removed on day 2 after the operation; however, patients were able to ambulate on the day after their operation. In cases of DVT prophylaxis, aspirin was used for venous thromboembolism (VTE) prophylaxis.

Cefazolin was used for prophylaxis of surgical site infection. In cases of a cefazolin or penicillin allergy, patients were administered clindamycin instead.

Criteria for allogenic blood transfusion were postoperative hematocrit below 30 percent, or when the patient had anemic symptoms. The following factors were evaluated as potential factors that might affect allogenic blood transfusion requirements.

Patient demographic data; gender, age, body mass index (BMI), ASA, co-morbidity, pre-operative hemoglobin, pre-operative hematocrit, Garden classification, preoperative anticoagulation.

Perioperative and postoperative data; type of anesthesia, operative time, intraoperative blood loss, type of prosthesis, deep venous thrombosis (DVT) prophylaxis, length of stay, tranexamic and post-operative NSAIDs, was collected and reviewed.

All data were obtained from electronic medical records. The Garden classification was evaluated with picture archiving and communication system (PACS), from both hip antero-posterior view and lateral cross table views.

Statistical Analysis

Patient demographic data; such as: gender, ASA classifications, co-morbidity, preoperative anticoagulant, type of anesthesia, type of prosthesis, postoperative anticoagulant, was compared between the allogenic blood transfused group and non-blood transfused group, using chi-square. Rank sum test was used to compare age. BMI, preoperative hematocrit and

Table 2. Perioperative Factors.

Factors	Total (n = 323)	Transfusion (n = 126)	Nontransfusion (n = 197)	p value
Type of anesthesia*				0.002 [‡]
General anesthesia	79 (100)	43 (54.4)	36 (45.6)	
Spinal anesthesia	244 (100)	83 (34)	161 (66)	
Operative time [†] (min)	130 (89.5,160)	135 (105,160)	123 (85,155)	0.068
Intraoperative blood loss [†] (mL)	250 (150,400)	300 (200,500)	200 (150,350)	0.01 [‡]
Type of prosthesis*				0.546
Cemented	231 (100)	93 (40.3)	138 (59.7)	
Cementless	92 (100)	33 (35.9)	59 (64.1)	
Postoperative anticoagulant*	206 (100)	79 (38.3)	127 (61.7)	0.838
Length of stays [†] (days)	5 (4,7)	6 (4,9)	5 (4,7)	< 0.001 [‡]
Tranexamic used*	42 (100)	18 (42.9)	24 (57.1)	0.718
Postoperative NSAIDs*	145 (100)	52 (35.9)	93 (64.1)	0.351

*chi-square, † Ranksum, [‡]Fisher exact test.

[‡]p value < 0.05.

hemoglobin were assessed with independent t-test, while Garden classification was evaluated with Fisher exact test.

Multivariate logistic regression analysis was used to estimate the impact of potential predictors associated with allogenic blood transfusions. All statistical analyses were conducted in R, version 3.1.0 (R Foundation for statistical computing, Vienna, Austria). A P value < 0.05 was used to define a statistical significance.

Results

The demographic data of 323 femoral neck fracture patients is summarized in Table 1. Thirty-nine percent of patients had allogenic blood transfusions. The results revealed that: patients within the blood transfusion group had a higher proportion of female gender, lower BMI, higher ASA class, lower preoperative hemoglobin levels and hematocrit compared with the non-blood transfusion group (P < 0.05).

Intraoperative and post-operative data is summarized in Table 2. Patients who were given spinal anesthesia had a lower rate of blood transfusions compared with patients who had general anesthesia (P < 0.02). Patients in the blood transfusion group had higher intraoperative blood loss greater than those in the non-transfusion group (P < 0.01). The length of stay was shorter for patients who did not receive blood transfusions (P < 0.001).

Multivariate analysis revealed a significant relationship between patients who had allogenic-blood transfusions and the following factors (Table 3). Female patients had a lower incidence of blood transfusions compared with male patients (Female: OR 2; 95% CI, 1.04-3.83; P = 0.037). Patients with a BMI ≤ 18.5 were more likely to receive blood transfusions compared with patients with a BMI 18.5-22.9 (OR 2.40; 95% CI, 1.10-5.25; P = 0.028). Patients with high preoperative hemoglobin were less likely to receive a blood transfusion (OR 0.52; 95% CI, 0.42-0.63; P < 0.001). General anesthesia patients were more likely to receive blood transfusions in comparison to spinal anesthesia patients (OR 2.07; 95% CI, 1.08-3.96; P = 0.028). However, there were no significant

Table 3. Multivariate LR Analysis of Blood Transfusion in Related Factors.

Factors	OR	95% CI	p value
Gender			
Male	1.00		Ref
Female	2.00	1.04-3.83	0.037*
Age	0.98	0.96-1.01	0.145
BMI			
<18.5	2.40	1.10-5.25	0.028*
18.5-22.9	1.00		Ref
23.0-24.9	1.05	0.44-2.50	0.907
25.0-29.9	0.77	0.31-1.88	0.56
≥30.0	0.57	0.07-4.41	0.59
ASA			
I	1.00		Ref
II	0.79	0.19-3.23	0.741
III	1.4	0.30-6.40	0.668
Hb	0.52	0.42-0.63	<0.001*
Type of anesthesia			
General anesthesia	2.07	1.08-3.96	0.028*
Spinal anesthesia	1.00		Ref
Type of prosthesis			
Cemented	1.05	0.55-2.00	0.891
Cementless	1.00		Ref
Tranexamic used	0.86	0.38-1.93	0.719
Preoperative anticoagulant	1.22	0.44-3.36	0.700

*p value < 0.05.

relationships between patients who had allogenic-blood transfusions in concerns to: age, ASA classification, type of prosthesis, tranexamic acid use and preoperative anticoagulant.

Discussion

Allogenic blood transfusions after joint replacement is of increasing concern; due to the recent evidences demonstrating that: patients who received blood transfusions had a higher rate of complications, such as postoperative infection, fluid overload, increase duration of hospital stay and worse surgical and

medical outcomes.^{7,8} There have been many studies reporting on the risk factors of blood transfusions in total hip arthroplasty.⁹⁻¹² However, there is, to our knowledge, no report on the risk factors for blood transfusions in hemi hip arthroplasty in femoral neck fractures, which are less invasive and generally performed on older aged patients, compared with THA.

This study underlines that there were many factors associated with blood transfusions after hemi hip arthroplasty. There was 39 percent of patients who received an allogenic blood transfusion after surgery. Additionally, this study had comparable rates of transfusions compared with previous reports in THA, that have reported in their systematic reviews for THA patients using a standard drain without autologous re-transfusion. These showed the transfusion rate to be ranging from 19-48 percent.¹³ However, in this study the transfusion rate was quite high compared to previous studies. This may have been a result of the study being conducted in hemi hip arthroplasty, which usually involves patients of an older age and co-morbidity, compared to THA patients. An additional reason was that this study contained a low threshold for blood transfusion.

Logistic regression analysis, in our study, demonstrated many patient factors as well as other associated factors that were related with blood transfusions. In this study it was established that female patients had a higher rate of blood transfusions compared with male patients. However, prior studies in THA had various results regarding this aspect. There are many studies indicating that female patients are at risk for blood transfusions in THA.^{5,6,11,12,14} However, Grosflam reported higher blood transfusions in male patients.¹⁵ Contrary, Ogbemudia found that sex is not a predictor for blood transfusions.¹⁶ Lower BMI was a factor that increased the chances of a blood transfusion in our study. This study, which has also been supported by other studies in THA,^{17,18} discovered that: an underweight patient (BMI < 18.5) was a significant, related factor for blood transfusion. In contrast to our result, there were many studies stating that: BMI or weight were not predictive factors for blood transfusion.^{5,11,14,16}

Preoperative hemoglobin levels, or hematocrit, were stated to be strong predictors for blood transfusion. Our study had the same results as previous data, which reported that a lower preoperative hemoglobin level and hematocrit was associated with a higher risk of blood transfusion in THA.^{5,11,12,14,19,20} The intraoperative factor associated with blood transfusion was the type of anesthesia. Our study concluded that: patients who had spinal anesthesia had a lower chance of requiring a transfusion. The results in our hemi hip arthroplasty patients concurred with the results of previous meta-analysis in THA patients; which stated that: patients under spinal block were less likely to require a blood transfusion than patients under general anesthesia (OR = 0.26).²¹

In our study, the length of stay was shorter in patients who didn't receive a blood transfusion (P < 0.001). Smeets reported a study in hip fracture patients who were treated by hip arthroplasty or internal fixation. This study revealed that patients who received blood transfusions had a significantly longer hospital stay adjoined with more postoperative cardiac complications.²² Another study in THA patients, by Browne, also reported that:

THA patients who had blood transfusions had longer lengths of stay and higher mortality.²⁰

The limitation of this study was that our protocol used lower thresholds for blood transfusion than other studies. Our center was using 30 percent of hematocrit, which is a historical rule proposed for improving outcomes in surgical patients with poor anesthesia risk.²³ However, nowadays many surgeons consider the use of restrictive transfusion threshold of hemoglobin concentration 7g/dl, which is also as safe and as effective as a liberal transfusion strategy.²⁴ So, further studies evaluating factors for blood transfusions, by using a restrictive transfusion threshold would be of interest.

Conclusions

In conclusion, this study reveals that: female gender, lower BMI, a lower preoperative hemoglobin level and general anesthesia, were factors associated with the risk of a blood transfusion; in the context of hemi-hip arthroplasty in femoral neck fractures. Our study concluded that the factors that surgeons could modify, so as to decrease the risk of a blood transfusion in this group of patients, was the use of spinal anesthesia. The authors, therefore, recommend prior preparation of blood components, or consider blood conserving methods for high risk patients, as described, in addition to considering spinal anesthesia if the patient has no contraindication.

Authors' Note

This article does not contain any studies involving any human participants, or procedure's performed on participants by any of the authors. This study was approved by the Ethics Committee and Institutional Review Board of the Faculty of Medicine, Prince of Songkla University (EC 62-156-11-1). This study was a retrospective study. Consent was waived by the ethics committee. The hospital gave permission to extract information from the database. The datasets generated during the current study are available from the corresponding author upon reasonable request.

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Declaration of Conflicting Interests

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ORCID iD

Varah Yuenyongviwat, MD  <https://orcid.org/0000-0003-0338-7733>

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