



## RESEARCH ARTICLE

# The Impact of Post-Operative Drop in Haemoglobin and its Outcomes in Fracture Neck of Femurs

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## Abstract

**Objective:** This study is to analyse the fall in haemoglobin concentration following various commonly used surgical procedures to repair hip fractures, analysing its relationship with pre-existing co-morbidities, post-operative complications, length of stay and 30 day mortality.

**Material and methods:** A retrospective analysis of neck of femur fracture patients looking at their pre-operative and pre-discharge haemoglobin levels taking into consideration co-morbid conditions and possible adverse effects including 30 day mortality occurring during the perioperative period.

**Results:** Two hundred and thirty one patients (160 females 69.3%) with fracture neck of femur and anaemia were identified. The mean age was 84.2 years. Pre-operatively 31.6% had moderate/severe anaemia compared to 71% post-operatively. The drop in Hb was most significant in patients who had arthroplasty procedures. The 30 day mortality in pre and post-operative anaemia patients was 18.6% (43 patients), of which 21 patients (48.8%) and 22 patients (51.1%) were in the moderate/severe anaemia group respectively ( $p = 0.01$ ).

**Conclusion:** Identification of anaemia at the time of admission and discharge is important in improving patient outcomes and mortality in hip fracture patients with potential opportunities to proactively managing prior to surgery, as well as in the post-operative period.

## Keywords

Anaemia, Hip fractures, Post-operative, Mortality

## Introduction

The outcomes of proximal femoral fractures in the elderly generally are poor. The poor results are usually associated with pre-existing medical co-morbidities such as anaemia [1,2]. The post-operative drop in haemoglobin in this cohort of patients is often further exacerbated by oral anticoagulants, further loss of blood during surgery, malnutrition and general frailty [3,4]. Even though anaemia can be corrected with allogenic blood transfusion [5] and oral or parenteral iron supplementation [6], anaemia at the time of discharge is still a major risk factor for an increase in 30 day mortality.

Anaemia is defined by the World Health Organization (WHO) as a haemoglobin (Hb) level of  $< 13$  g/dL in men and  $< 12$  g/dL in women [7]. The causes of anaemia in elderly age group is multifactorial, commonly due to iron, folate, vitamin B12 deficiency [8], chronic liver or kidney disease [9] and inflammation [10]. However, in one third of the patients it can be idiopathic [11]. The drop in haemoglobin concentration in patients with hip fractures is attributed to pre-existing anaemia before sustaining the hip fracture [12] or due to bleeding before, during and after surgery [4]. Previous studies

has demonstrated that the haemoglobin level before and after surgery is an independent factor associated with increased 30 day mortality in elective general surgical and non-cardiac surgery [13,14].

We aimed to analyse the fall in haemoglobin concentration following various commonly used surgical procedures to repair hip fractures, analysing its relationship with pre-existing co-morbidities, post-operative complications, length of stay and 30 day mortality.

## Methods

A retrospective study of all the patients admitted with a neck of femur fracture between March 2019 to December 2019 was carried out. The data was obtained from NHFD (National Hip Fracture Database) and internal hospital computer systems (Medway, ICE, Clinic letters). After screening a total of 231 patients above the age of 65 admitted with fractured neck of femur were identified and included in analysis. Patients with bleeding disorders and pathological fractures were excluded from the study.

Patient demographics including age, sex, fracture pattern and pre-existing anaemia were recorded. The co-morbidities including oral anticoagulants at the time of admission were noted, along with the type of procedure which the patient underwent. All the patients received intra-operative tranexamic acid injections.

Female patients with haemoglobin (Hb) concentration  $\geq 12$  g/L were classified as normal, between 11 to 12 g/L as mild anaemia and those with Hb level  $\leq 11$  g/L as having severe anaemia. These Hb levels were based on WHO definitions of anaemia at sea level [7]. The drop in Hb at the time of discharge was calculated for individual sex, procedures done for hip fractures, those received post-operative blood transfusions, complications, readmissions, length of stay and 30 day mortality.

## Statistical Analysis

Demographic continuous data is presented as means, with standard deviations (SD). Categorical data is presented as the number of subjects in the category, along with proportional percentages. Chi-square test and Fisher's exact test were used for comparing groups of categorical data. Differences between the means of continuous data were compared using unpaired t-tests or one-way ANOVA. The strength of relationships between variables was estimated using Spearman's rank correlation. A P value  $< 0.05$  was taken as the threshold of statistical significance. The data were analyzed using IBM SPSS Statistics version 26.

## Results

A total of 231 patients with neck of femur fractures and anaemia were identified. The mean age was 84.2 years (range 60-100). The male female ratio was 71:160.

**Table 1:** Baseline patient demographics.

Variables	Values	Percentage
Age (mean)	84.2 years	
Sex		
Male	71	43.5
Female	160	56.5
Fracture pattern		
Intra-capsular	138	60
Extracapsular	93	40
Co-morbidities		
Cardiac diseases	53	23
COPD	55	24
Kidney diseases	42	18
Malignancy	28	12
Oral Anticoagulants	63	27.4
Procedure done		
Hemiarthroplasty	119	52.5
DHS	52	21.6
IM nail	41	17.7
THR	19	8.2
Post op blood transfusion	32	13.9

**Table 2:** No significant difference for drop in haemoglobin for gender.

Gender	No.	Mean	Std. Deviation	Std. Error Mean
Male	71	2.1111	1.25455	0.15806
Female	160	1.9921	1.27314	0.11297

The pre-operative co-morbidities recorded included cardiac diseases (53.23%), COPD (55.24%), kidney disease (42.18%) and malignancies (28.12%). 63(27.4%) patients were taking oral anticoagulants on admission. There were 138 (60%) patients with intracapsular fractures and 93(40%) with extracapsular fractures.

The procedures performed were hemiarthroplasty 119, Dynamic hip screw fixation (DHS) 52, Intramedullary nail (IM) 41 and Total hip replacements (THR) 19 patients. Post op blood transfusions were given to 32(13.9%) patients, [Table 1](#).

There was no significant difference in drop of Hb between males and females, [Table 2](#). There were 57 (24.7%) patients had borderline anaemia and 73 (31.6%) patients had severe pre-operative anaemia respectively. But in the post-operative group there was a significant rise in the number of patients with severe anaemia 164 (71%), [Table 3](#). The fall in Hb was assessed against the surgical procedure performed using one way ANOVA tests which showed a significant mean fall in Hb in patients who had arthroplasty (THR-2.94 g/L and hemiarthroplasty-2.07 g/L), [Table 4](#). Multiple comparisons using Bonferroni correction test showed

**Table 3:** Pre and post-op anaemia details.

	Pre-operative anaemia			Post-operative anaemia		
	Frequency	Percentage	Cumulative percentage	Frequency	Percentage	Cumulative Percentage
No Anaemia	101	43.4	43.7	32	13.8	13.8
Borderline Anaemia	57	24.7	68.4	35	15.2	29.0
Severe Anaemia	73	31.6	100.0	164	71.0	100.0
Total	231	100		231	100	

**Table 4:** One way ANOVA test to calculate mean drop in Hb for individual procedures for hip fracture treatment.

Procedure	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Hemiarthroplasty	119	2.0688	1.20920	0.12539	1.8198	2.3178
DHS	52	1.6512	1.12586	0.17583	1.2959	2.0066
IM nail	41	1.9472	1.39417	0.23236	1.4755	2.4189
THR	19	2.9444	1.17984	0.27809	2.3577	3.5312
Total	231	2.0383	1.26285	0.09210	1.8566	2.2200

**Table 5:** The THR group has significant drop in Hb than Hemiarthroplasty, DHS and IM nail (p value < 0.05).

(I) Operation performed	(J) Operation performed	Mean Difference (I-J)	Std. Error	95% Confidence Interval		P value (< 0.05)
				Lower Bound	Upper Bound	
Hemiarthroplasty	DHS	0.41760	0.22998	-0.1958	1.0310	0.426
	IM nail	0.12159	0.24081	-0.5207	0.7638	1.000
	THR	-0.87563*	0.31590	-1.7182	-0.0331	0.037
DHS	Hemiarthroplasty	-0.41760	0.22998	-1.0310	0.1958	0.426
	IM nail	-0.29600	0.28020	-1.0433	0.4513	1.000
	THR	-1.29322*	0.34687	-2.2183	-0.3681	0.002
IM nail	Hemiarthroplasty	-0.12159	0.24081	-0.7638	0.5207	1.000
	DHS	0.29600	0.28020	-0.4513	1.0433	1.000
	THR	-0.99722*	0.35414	-1.9417	-0.0527	0.032
THR	Hemiarthroplasty	0.87563*	0.31590	0.0331	1.7182	0.037
	DHS	1.29322*	0.34687	0.3681	2.2183	0.002
	IM nail	0.99722*	0.35414	0.0527	1.9417	0.032

**Table 6:** Post-operative blood transfusion for the operations performed.

			Operation performed				Total
			Hemiarthroplasty	DHS	IM nail	THR	
Postoperative transfusion in hospital	No postoperative transfusion in hospital	Count	106	47	32	14	199
		% within Operation performed	89.1%	90.4%	78.0%	73.7%	86.1%
	Postoperative transfusion in hospital	Count	13	5	9	5	32
		% within Operation performed	10.9%	9.6%	22.0%	26.3%	13.9%
Total	Count	119	52	41	19	231	
	% within Operation performed	100.0%	100.0%	100.0%	100.0%	100.0%	

that total hip replacement procedure had significant fall in Hb levels compared to other procedures, [Table 5](#).

The correlations between the kind of operation and postoperative blood transfusion shows a significant correlation, most of the transfusion were in patients who had THR and IM nail, [Table 6](#).

No significant differences for fall in Hb and incidence of postoperative stroke, postoperative cardiac event, and respiratory infections, postoperative wound infections and anticoagulant therapy was demonstrated. The average length of stay was 17.14 days. Both regression and ANOVA analysis did not show any relation between length of stay and post-operative drop in Hb in all three groups ( $p = 0.469$ ), [Table 7](#).

The 30 day mortality in pre and post-operative anaemia patients was 18.6% (43 patients), of which 21 patients (48.8%) and 22 patients (51.1%) were in the severe anaemia group on admission and post-operatively respectively ( $p = 0.01$ ), [Table 8a](#) and [Table 8b](#). The 30 day mortality with 95% CI for all three groups

of pre and post-operative anaemia are shown in [Figure 1](#) and [Figure 2](#). The statistical analysis shows that the 30 day mortality in severe anaemia group is higher in patients with pre and post-operative anaemia.

## Discussion

In our study 56.3% of patients had pre-operative anaemia which is slightly higher than the other studies [15,16]. The advancing age in our group (mean = 84.2 years) of hip fracture patients may be a contributing factor for the high incidence of pre-operative anaemia [3]. In elderly patients there is abnormal regulation of proinflammatory cytokines, which inhibits haemopoiesis either by reducing erythropoietin production or impaired erythropoietin receptor function [17]. The prevalence of pre-operative anaemia was independent of gender and fracture pattern in our study.

The significant co-morbidities recorded in our study were COPD, cardiac diseases, chronic kidney diseases and malignancies. There were 27.4% of patients taking oral anticoagulants on admission. The factors

**Table 7:** The length of stay in all three anaemia groups.

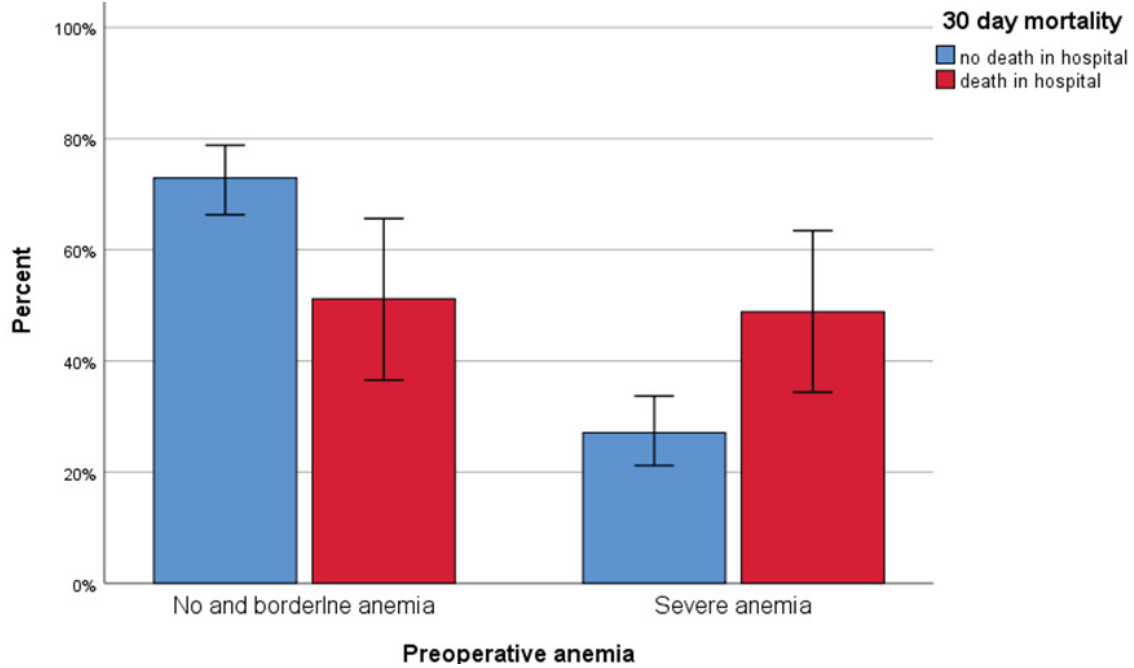
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
No anemia	32	19.57	16.611	3.033	13.36	25.77
Borderline anemia	35	17.03	10.211	1.726	13.52	20.54
Severe anemia	164	16.72	10.835	0.846	15.05	18.39
Total	231	17.14	11.640	0.769	15.62	18.66

**Table 8a:** Significant 30 day mortality in patients with severe pre-operative anaemia ( $p = 0.01$ ).

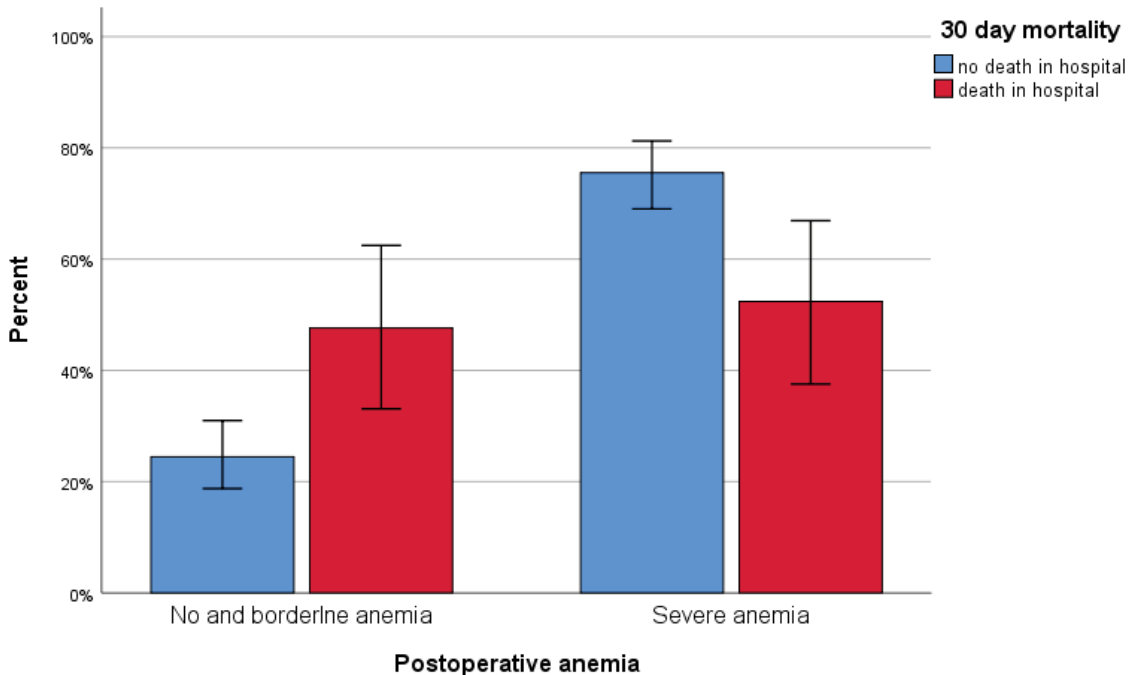
			30 day Mortality		
			Survived	Died	Total
Pre-operative anemia	No anemia	Count	86	15	101
		% within In hospital death	46.9%	34.9%	44.7%
	Borderline anemia	Count	50	7	57
		% within In hospital death	26.0%	16.3%	24.3%
	Severe anemia	Count	52	21	73
		% within In hospital death	27.1%	48.8%	31.1%
Total		Count	188	43	231
		% within In hospital death	100.0%	100.0%	100.0%

**Table 8b:** Significant 30 day mortality in patients with severe post-operative anaemia ( $p = 0.01$ ).

			30 day Mortality		
			Survived	Died	Total
Post-operative anemia	No anemia	Count	25	7	31
		% within 30 day mortality	13.3%	16.3%	13.5%
	Borderline anemia	Count	21	14	35
		% within 30 day mortality	11.2%	32.3%	15.2%
	Severe anemia	Count	142	22	164
		% within 30 day mortality	75.5%	51.1%	71.3%
Total		Count	188	43	231
		% within 30 day mortality	100.0%	100.0%	100.0%



**Figure 1:** 30 day mortality for all three groups of pre-operative anaemia (Error bars 95% CI).



**Figure 2:** 30 day mortality for all three groups of post-operative anaemia (Error bars 95% CI).

contributing to pre-operative anaemia with existing comorbidities are multi-factorial mediated by cytokines such as interleukin-1 [IL-1], IL-6, tumour necrosis factor- $\alpha$  [TNF- $\alpha$ ] [18]. These factors regulate the secretion and action of erythropoietin and median red blood cell survival [9,10]. In patients with chronic kidney disease the cause of anaemia are due to decrease in erythropoietin and glomerular filtration rate [19].

The post-operative drop in Hb in our series was quite significant demonstrated in 86.2%. Our results are similar to the study by Halm, et al. who has found that the incidence of post-operative drop in Hb was 84.6% [3].

Those patients who underwent arthroplasty procedures such as total hip replacement and hemiarthroplasty had the substantial drop in Hb levels (THR-mean drop of 2.94 g/L and hemiarthroplasty-mean drop of 2.07 g/L). This is in full agreement with previous studies on drop in Hb levels after lower limb arthroplasty [20]. The causes for the drop of post-operative Hb can be due to several factors such as duration of surgery and the type of the procedure [1]. Arthroplasty procedures take longer surgical time hence more blood loss.

In our study patients who had most post-operative blood transfusion were those who underwent total

hip replacement (26.3%) and intramedullary nailing procedures (22%). Morris, et al. [21] in their study on allogenic blood transfusions for fracture neck of femur surgery concluded that the incidence of post-operative blood transfusion is 20.8% for those patients who underwent total hip replacement and 67.4% who had intramedullary nailing. But various authors have described decreased blood loss [22], increased blood loss [23] and no difference [24] in patients who had intramedullary nailing for hip fractures. In an already co-morbid population, an allogenic blood transfusion is not without significant risk and can contribute towards morbidity and mortality.

Choi, et al. [25] in their study found that a post-operative haemoglobin level between 8 g/dl and 10 g/dL did not affect the length of stay in the hospital. But Willems, et al. [26] have reported that higher postoperative haemoglobin levels predict shorter length of hospital stay after hip fracture surgery in the elderly. In our study the length of stay in the hospital did not show any statistically significant association was found between patients who had normal and low Hb levels post-operatively.

There are several studies which have also shown an association between pre admission Hb and the mortality following fracture neck of femur. Gruson, et al. [12] reported an increased mortality in patients, who were anaemic on admission. Similarly, Halm, et al. [3] showed Hb to be an important predictor of mortality and re-admissions within 60 days. Greatorex and colleagues [27] also found low Hb on admission to be predictive of mortality at 6 months. Bhaskar, et al. reported comparable lower mortality in males and females with normal Hb (21.1% and 20.0%, respectively with  $p$ -value 0.873) compared with higher mortality rates between anaemic males and females (43.6% and 36.2%, respectively with  $p$ -value 0.258) [28]. In our study, we found that the overall 30 day mortality was 18.6%, but in severe anaemia group the mortality was 48.8% in pre-op and 51.1% in post-operative groups respectively ( $p = 0.01$ ) which is highly significant.

The limitation of this study is that it is a retrospective analysis. The sample size is small and the results are calculated for 30 day mortality. However we looked at all the confounding variables that can affect the haemoglobin level both pre and post-operatively. The significance of our results has made a foundation for future studies with large sample size, one year mortality and correction of reversible factors affecting the pre and post-operative anaemia in hip fracture patients. Although there are several guidelines regarding the management of anaemia during the pre-operative assessment of elective orthopaedic surgery, in elderly hip fracture patients the guidelines are unclear regarding the treatment of pre and post-operative anaemia. Future randomised trials should be done

looking at the results of treatment of pre admission and post-operative anaemia and its effects on perioperative and one year mortality in hip fracture patients as we feel this may present with potential opportunities to proactively manage anaemia prior to surgery, as well as in the post-operative period with a view to reducing the mortality risk.

## Conclusion

Our analysis has shown a significant number of patients were discharged from the hospital with moderate/severe anaemia. The 30 day mortality in this group of patients is above 50%. We also found that there was significant drop of Hb in the post-operative period in patients undergoing arthroplasty procedures for hip fractures. We recommend that in patients undergoing hip fracture surgery both pre and post-operative anaemia should be corrected with adequate and appropriate interventions to decrease morbidity and mortality.

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