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Haemoglobin levels predicts length of hospital stay after hip fracture surgery in older patients

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Abstract

Introduction Treating anaemia in older patients who have undergone hip fracture surgery is to enhance functional recovery. The relationship between peri-operative haemoglobin levels and outcome after hip fracture surgery are controversial. We assessed whether higher haemoglobin levels predict length of hospital stay after hip fracture surgery in elderly subjects.

Methods A follow-up study in a historical cohort was performed in 317 patients aged 65 years old undergoing hip fracture surgery over the period 2004-2006 at the Leiden University Medical Centre. Linear regression analysis was used to assess the association between pre- and post-operative haemoglobin level and length of hospital stay after controlling for age and sex.

Results Anaemia after hip fracture surgery was present among 86% of the patients. Length of hospital stay after hip fracture surgery in elderly subjects with post-operative anaemia (10.7 days) was significant longer than in elderly subjects without post-operative anaemia (7.5 days, $p = 0.007$). Post-operative haemoglobin levels and length of hospital stay were inversely related ($p = 0.013$). The length of hospital stay was not related with pre-operative haemoglobin level.

Conclusion Higher postoperative haemoglobin levels predicts shorter length of hospital stay after hip fracture surgery in the elderly. A definitive randomized clinical trial has to demonstrate whether this association is causal.

Introduction

Hip fracture is a main cause of disability and death in older people, and numbers are expected to increase sharply in the near future. (1, 2) Poor functional recovery after hip surgery is related to loss of independence and long-term mortality. (3) Because hip fracture surgery is associated with considerable blood loss, some have reported that low peri-operative haemoglobin levels in older patients are associated with increased morbidity and mortality after hip surgery. (4-6) Functional recovery can be facilitated when treating anaemia. Moreover, Foss *et al* concluded that anaemia after hip fracture surgery in older patients impedes functional mobility in the early post-operative phase. (7)

Nowadays most hospitals in the Netherlands have a restricted transfusion policy after surgery due to associated risks with allogenic red blood cell transfusions, like infectious complications or acute lung injury. (8-11) A guideline that is frequently used in the Netherlands, advises red blood cell transfusion for patients over 60 years, if the haemoglobin level drops below 8g/dL or if anaemia is symptomatic. (12) This guideline is based on outcomes of studies that included patients younger than 60 years. (13) The haemoglobin threshold at which postoperative red-cell transfusion is warranted is controversial (14) and data of the benefits of red-cell transfusion after hip surgery in older subjects are scarce.

We assessed in older patients whether peri-operative higher haemoglobin level increases functional recovery and therefore shortens the length of hospital stay after hip fracture surgery. Therefore we performed a follow-up study in a historical cohort of older patients with hip surgery to determine whether pre- and post-operative haemoglobin levels predict length of hospital stay, which may provide provisionally evidence that a restricted transfusion policy has a (physical) cost.

Methods

Study population

Patients 65 years of age or older who were undergoing primary surgical repair of a hip fracture between 2004-2006 at the Leiden University Medical Centre by either trauma surgeons or orthopaedic surgeons were reviewed (n= 344). Patients with a re-operation within 1 month because of complications were excluded (n= 27). The total cohort included 317 subjects aged 65 years and over.

Peri-operative haemoglobin levels and length of hospital stay were retrieved from the hospital's patient information system. Length of hospital stay, the outcome measure for functional recovery, was defined as the difference between the day of admission and the day of discharge. The pre- and postoperative haemoglobin measurements reflected daily practice. The pre-operative haemoglobin value was measured. Furthermore, for

the postoperative haemoglobin level, the value measured one the day after surgery was used. If this was not available, the postoperative haemoglobin level measured in the recovery room was used. Anaemia was defined by the criteria of the World Health Organization.⁽¹⁵⁾ The reference interval for haemoglobin concentration was set at 12-16 g/dL for women and at 13-18 g/dL for men. Anaemia was defined as a haemoglobin level of ≤ 12 g/dL for women and ≤ 13 g/dL for men. No in- or exclusion criteria were used, except an age of 65 years and over.

There was no permission required of the Leiden Medical Ethical Committee, because the research was done with historical data of patients receiving usual clinical care. No additional blood samples or questionnaires were needed.

Statistical analysis

The statistical analysis proceeded in various stages. First, descriptive statistics were performed using means and standard deviations (SDs) for continuous variables. Then, multivariate regression analysis was used to assess the association between pre- and post-operative haemoglobin level and length of hospital stay. Because length of hospital stay was not normally distributed, data were log transformed. Pre- and post-operative levels of haemoglobin were simultaneously entered in a linear regression model adjusted for age and sex. Then, results were transformed back to the original scale. All results on the association between haemoglobin and length of hospital stay are therefore presented as geometric means and corresponding 95% confidence intervals. All analyses were performed with SPSS for Windows (version 16.0, SPSS Inc, Chicago,III).

Results

The study population comprised of 223 women and 94 men, undergoing hip fracture surgery with a mean age of 80.4 years (range, 65-104). The clinical characteristics of the patients are shown in Table 1.

Table 1. Clinical characteristics of the study patients.

	All subjects
Age, years (range)	80.4 (65-104)
Male/female	94/223
Peri-operative transfusion, n (%)	136 (43)
Pre-operative haemoglobin (g/dL)	12.4 (1.7)
Pre-operative anaemia, n (%)	107 (33)
Pathologic/traumatic fracture	12/305

Data are presented as mean (SD), unless otherwise stated.

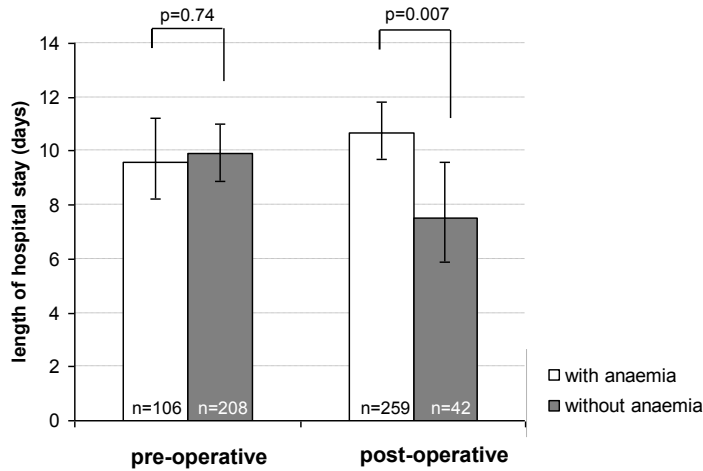


Figure 1. Pre- and post-operative anaemia of hip fracture surgery elderly patients in relation to length of hospital stay (mean and corresponding 95% confidence intervals), adjusted for age and sex.

The mean (SD) haemoglobin concentration before hip surgery was 12.6 (1.7) g/dL. After hip surgery the mean (SD) haemoglobin level was 10.4 (1.7) g/dL, the mean difference being 2.4 (1.4) g/dL. Before hip fracture repair anaemia was present in 33 % of the older patients. After surgery it was present in 86 %. At hospital discharge anaemia was still present in 68%. In-hospital mortality was less than 4 % (12/317 patients).

The mean length of hospital stay after hip fracture surgery in subjects with and without pre-operative anaemia was similar (9.6 vs 9.9 days, $p=0.741$) (Figure 1). In subjects with post-operative anaemia the mean duration of hospital stay was 10.7 days and in those

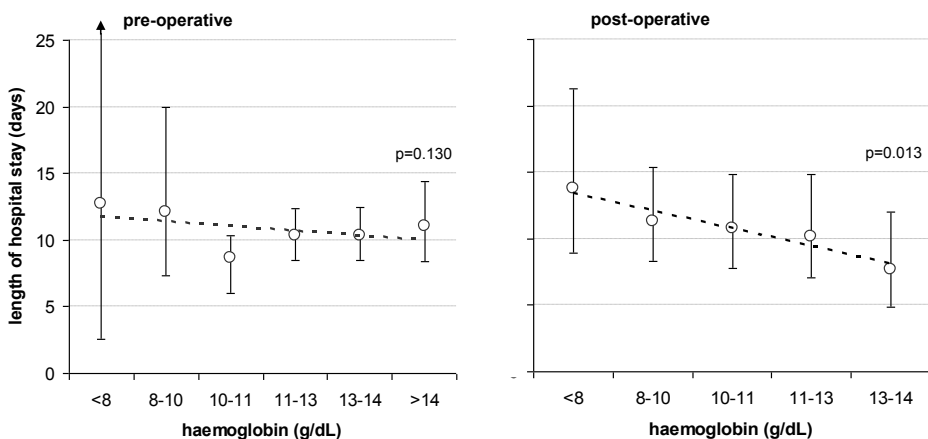


Figure 2. Categories of pre- and post-operative haemoglobin levels for hip fracture surgery in elderly subjects in relation to length of hospital stay, adjusted for age and sex.

without post-operative anaemia it was 7.5 days ($p=0.007$) (Figure 1). When pre- and post-operative haemoglobin levels were simultaneously entered into a linear regression model, adjusted for age and sex, pre-operative haemoglobin was not associated with length of hospital stay ($p=0.130$), while post-operative haemoglobin level was inversely correlated with a significant shorter hospital stay ($p=0.013$) (Figure 2). Moreover, subjects with no post-operative decrease in haemoglobin levels had a mean hospital stay of 9.2 days compared to 10.3 days for subjects with more than 3 g/dL decrease in haemoglobin ($p=0.03$).

Discussion

In this study we find that after hip fracture surgery, older patients with post-operative anaemia were significantly longer admitted postoperatively compared to those without anaemia after hip fracture repair.

The significant blood loss after hip fracture surgery in our study is in accordance with the literature. (16) This acute onset of post-operative anaemia in a large proportion of the patients has important clinical impact in older patients, not only on the cardiovascular system but also on the functional status of individuals, frequent in-hospital events, costs, resource utilization and even mortality. (4,6,17-19) Nevertheless, only few studies have evaluated the impact of acute anaemia on these outcomes in older subjects. (6,7,14,20) Since acute anaemia can cause such a wide spectrum of complications here we have chosen the length of hospital admittance as global outcome measure of this study, because it integrates all the relevant clinical events having an adverse effect on the functional recovery of the patient in a clinical setting.

The fact that older patients with post-operative anaemia stayed significantly longer in the hospital than patients without anaemia, may suggest that acute anaemia due to the blood loss has negative clinical impact on the post-operative functional recovery of these patients. The fact that 80% of all patients were anaemic after the surgical procedure results from the stringent blood management guidelines. (12) With incidence rates of less than 0.1 % for acute lung injury and of less than 0.01% for viral and bacterial infections due to red blood cell transfusions, the clinically important risks associated with these transfusions is low, and even lower when using leucocyte depleted red blood cell transfusions. (11,21,23) In contrast to the post-operative haemoglobin level, pre-operative haemoglobin was not associated with the length of hospital stay after hip fracture surgery.

Strength and limitations

This study has several limitations. First, we used a historical data collection, which did not permit measurement of haemoglobin levels at standardized time periods. Second, we could not control for differences in patient characteristics for example like co-morbid illnesses and institutionalization, which both influence hospital stay duration. However, the fact that we found no significant relation between pre-operative haemoglobin levels and hospital stay virtually rules out that pre-existing co-morbidity has influenced our results. Third, because of the permanent shortage of post-operative rehabilitation places outside the hospital after any type of surgery in our country, patients may have stayed longer in hospital than strict medical necessary, but this is likely to be randomly distributed over the study groups. Fourth, information about the timing of the given erythrocyte transfusions is lacking. Therefore we were not able to include the influence of transfusions on the length of hospital stay in our analysis. Furthermore, in our study population none of the patients received intravenous iron administration nor erythropoietin supplements.

Conclusion

In conclusion, this analysis generates the hypothesis that high post-operative haemoglobin values after hip fracture surgery in older patients is associated with shorter length of hospital stay. Length of hospital stay seems not related to pre-operative haemoglobin level. Our hypothesis requires testing in a randomized clinical trial. If a definitive prospective clinical trial demonstrates the same results and causality between higher post-operative haemoglobin levels and post-operative function and length of hospital stay after hip fracture surgery in older persons, current transfusion guidelines would have to be updated.

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