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ORIGINAL ARTICLE

Factors that increase the risk of blood transfusion in patients with hip fractures☆

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KEYWORDS
Hip fractures;
Blood transfusion;
Risk factor

Abstract
Objective: To determine the risk factors associated with blood transfusion in patients with hip fractures.
Material and methods: We prospectively reviewed 188 consecutive patients -over 64 years old- admitted to our hospital with hip fractures during one year. Potential transfusion risk factors were recorded: age, gender, type of fracture, antiplatelet and anticoagulant drugs intake, admission haemoglobin levels, delay of surgery, associated comorbidities, duration of the surgical procedure and surgeon training model. Number of units transfused and date of transfusion were collected from blood bank database. Logistical regression analysis was performed in order to control the effect of confounding variables.
Results: After multivariate analysis, only haemoglobin levels on admission remained as a risk factor of allogenic blood transfusion in this group of patients (p=.000; OR: 0.039; 95% CI: 0.012-0.124). Haemoglobin levels below 11 g/dL on admission significantly increase the risk of undergoing allogenic blood transfusion in patients with hip fractures.
Conclusion: We strongly recommend maximizing the measures to prevent excessive bleeding in this group of patients.

PALABRAS CLAVE
Fracturas de cadera;
Transfusión sanguínea;
Factores de riesgo

Factores que incrementan el riesgo de transfusión sanguínea en los pacientes con fractura de cadera

Resumen
Objetivo: Determinar los factores que aumentan el riesgo de recibir una transfusión en pacientes con fractura de cadera.
Pacientes y método: Se revisaron 188 pacientes mayores de 64 años, ingresados con el diagnóstico de fractura de cadera, de forma prospectiva y consecutiva, durante un año.

☆The study was approved by the Ethical Committee of the "Virgen de la Luz" Hospital in Cuenca and authorized by the Research Commission.

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Se analizaron como potenciales factores de riesgo: la edad, sexo, tipo de fractura, tratamiento con fármacos antiagregantes plaquetarios y anticoagulantes, niveles de hemoglobina al ingreso, retraso en el procedimiento quirúrgico, comorbilidad asociada, duración de la cirugía y formación de los cirujanos. El número de unidades transfundidas y la fecha de transfusión se obtuvieron de la base de datos del banco de sangre. Se elaboró un modelo de regresión logística multivariante para controlar el efecto de las variables de confusión.

Resultados: Tras el análisis estadístico multivariante, sólo el nivel de hemoglobina al ingreso se mostró como un factor de riesgo para recibir una transfusión sanguínea (p = ,000; OR: 0.039; 95%CI: 0.012-0.124). Los niveles de hemoglobina inferiores a 11 g/dL al ingreso, incrementaron el riesgo de transfusión sanguínea en los pacientes con fractura de cadera.

Conclusión: Deben extremarse las medidas orientadas a disminuir el sangrado en todas las fases que comprende el tratamiento de estos pacientes.

Introduction

Fractures of the hip represent an important health concern, due to their high incidence and morbi-mortality.[1] Many patients who suffer a hip fracture require blood transfusion during the course of treatment. It is therefore of interest to predict the risk of transfusion in patients with fractures of the hip based on their prior characteristics, since there is decreased survival in the group of patients who receive a transfusion,[2] even though it is a controversial issue.[3,4] An increased incidence of infections has also been reported in patients with hip fracture who receive a blood transfusion; this increment has been attributed to the immunomodulating effect of allogenic blood.[5] Finally, it is suspected that an excessive number of cross tests are performed in patients with fractures of the hip, which leads to unjustified resource utilization. Prior knowledge of the risk of transfusion could contribute to rationalizing the use of these techniques, preventing unnecessary cross testing in patients with a low risk of transfusion.[6]

Different variables have been related with the need to carry out a blood transfusion in patients who suffer hip fractures, including age,[7] taking salicylates,[8] the type of fracture,[6] as well as haemoglobin levels at the time of admission.[6,9] Other factors, such as delayed surgery, have not been specifically studied, but may impact the need for transfusion. Delays in surgery by more than 48 hours are associated with a significant increase in morbi-mortality,[10,11] although not all authors concur on this issue.[12]

The adverse effects derived from transfusion can negatively affect prognosis in patients who suffer a delay in the surgical procedure, adding one more argument in favour of performing the surgery as soon as possible.

The aim of our study is to determine which factors increase the risk of requiring blood transfusion in patients over the age of 64 years with hip fracture and to see if a delay in surgery of more than 48 hours is another risk factor. With this model, it would be possible to predict which patients with hip fracture are exposed to a high risk of needing a blood transfusion.

Patients and method

We prospectively analyzed all the patients over 64 years of age with hip fracture consecutively admitted to our unit during 2008 who underwent surgical treatment. Pathological fractures were excluded from the study, as were those patients referred from other centres. All patients received anti-thrombotic prophylaxis (enoxaparin, at a dose of 40 mg, every 24 hours), which was suspended 12 hours prior to surgery. In the patients being treated with platelet anti-aggregant drugs, surgery was delayed for a mean of 4 days in accordance with the protocol proposed by the Anaesthesia Department at our hospital.

Finally, we enrolled 188 patients with hip fracture; nine patients failed to meet the inclusion criteria. The mean age was 84 (SD: 7) years. Eighty per cent of the patients were female. Fifty-six per cent of the fractures were extracapsular. Forty-two percent of the patients received a blood transfusion, 20% of which were performed during the pre-operative period. The same surgical indication was followed in all the patients according to the type of fracture, bipolar arthroplasty in the cases of intracapsular fractures and intramedullary nailing for extracapsular fractures.

All the patients filled in a questionnaire by means of a personal interview and review of the case history. On admission, we recorded socio-demographic factors (age and gender), whether or not the patient was on platelet anti-aggregant drugs and oral anti-coagulants, associated co-morbidity, as well as haemoglobin levels. Insofar as surgery-related factors are concerned, note was taken of the delay in surgery, duration of the surgical procedure, and the type of training received by the surgeons (whether they trained in Spain's MIR programme or not).

The number of units transfused and the date of transfusion were obtained from the hospital's blood bank database. No protocol was followed to select the patients requiring transfusion; thus, the decision to transfuse was left to the treating physician's discretion based on the patient's case history and laboratory tests.

Table 1 Univariate analysis of the risk factors for transfusion

	Transfusion (%)	p value
Age (yes/no)		
> 75 years	43.6/30.4	0.229
> 85 years	41.6/42.3	0.915
Sex (male/female)	44.7/41.3	0.704
Type of fracture (intra/extracapsular)	29.3/51.9	0.002
Anti-aggregants (yes/no)	38.6/44.1	0.460
Oral anti-coagulants (yes/no)	52.6/40.8	0.323
Clopidogrel (yes/no)	28.6/43.1	0.401
Delayed surgery (yes/no)		
> 24 hours	45.9/26.7	0.182
> 48 hours	48.5/31.8	0.055
ASA (II-III/IV-V)	42.2/47.8	0.508
Co-morbidity (yes/no)		
No	42.9/41.6	0.869
> 1	46.2/39.8	0.404
> 2	45.0/41.7	0.814
Pre-op. haemoglobin level (< 11/≥ 11)	87,5/25.4	0.000
Duration of surgery (< 1 hour/≥ 1 hour)	45.2/43.8	0.872
Surgeon training (MIR/not MIR)	37.0/47.0	0.222

All the variables were previously transformed into dichotomic variables so as to match clinical reality better. First of all, a univariate analysis was conducted using the chi-square test (Fisher's exact test was substituted for some variables) with the purpose of determining the existence of a statistical association between the different factors and the need for blood transfusion. In a second step, those variables presenting a p value of less than 0.1 in the univariate analysis were included in the model of multivariate logistic regression to control the effect of the potential confounding variables.

The probability of transfusion (PT) and the transfusion index (TI) was calculated for each group; that is, the mean number of units transfused per patient at risk for being transfused. The statistical analyses were made using the SPSS software package (version 15.0).

Results

After the univariate analysis, the type of fracture (p=0.002) and levels of haemoglobin at the time of admission (p=0.000) showed a statistical association with receiving a blood transfusion. A delay in surgery of more than 48 hours was found to be on the limit of statistical significance (p=0.055) (table 1).

Table 2 Model of multivariate logistic regression

Variables	OR	OR (95%CI)	p value
Age	1.027	0.972-1.086	0.344
Sex	0.574	0.240-1.373	0.212
Type of fracture	1.251	0.575-2.724	0.573
Delay in surgery >48 hours	1.847	0.743-4.589	0.186
Haemoglobin at admission > 11 g/dL	0.039	0.012-0.124	0.000

However, after applying the model of multivariate logistic regression, only the level of haemoglobin upon admission persisted as a risk factor for requiring blood transfusion (p=0.000; OR: 0.039; 95%CI: 0.012-0.124) (table 2).

The PT in patients with haemoglobin at admission of less than 11 g/dL was 87% whereas the group with a level of haemoglobin of 11 g/dL or more had a PT of 27% The TI was 2.29 units/patient in the first group versus 0.62 in the second. Both differences were statistically significant (p=0.000).

Discussion

According to the results of the study, only the level of haemoglobin at the time of admission predicts the need for transfusion when other variables are controlled for, such as the type of fracture and delay in surgery.

Dillon et al.[6] found that the mean haemoglobin value at admission of the patients requiring transfusion was 11.2 g/dL, compared to 12.7 g/dL in the group that did not need to be transfused. Adunsky et al.[9] noted that patients whose levels of haemoglobin at the time of admission of less than 12 g/dL have a fivefold risk of receiving a transfusion. In our study, the PT of the patients with levels of haemoglobin at admission of less than 11 g/dL was 87.5% in comparison to 27% in the group that exceeded these levels, representing a threefold likelihood of needing to be transfused.

The delay in surgery has been established as one of the main factors determining prognosis in patients with hip fracture. Delays of more than 48 hours significantly worsen prognosis; nevertheless, this statement is not without controversy, since other authors have been unable to demonstrate a worsening of outcomes when surgery was delayed. Recently, Engoren et al.[2] reported increased mortality among patients with hip fracture receiving a blood transfusion. Nevertheless, we have not been able to demonstrate an increase in the risk of transfusion in patients in whom surgery was delayed by more than 48 hours. Although in the univariate analysis the p value was close to statistical significance, the association disappeared when the levels of haemoglobin at admission were controlled in the multivariate model. The PT in patients whose surgical procedure was delayed by more than 48 hours was 48.5% whereas that in patients in whom surgery was not delayed, the probability of transfusion was 31.8% With this difference

in mind, an "*a posteriori*" analysis of statistical power was carried out and it was estimated that for a power of 80%, some 350 patients would have had to have been included in the study.

We have also been unable to verify that the type of fracture represents a factor predicting the need for transfusion. Adunsky et al.[9] found higher rates of transfusion in patients with extracapsular fractures. In our study, we observed a statistical association between the type of fracture and the need for transfusion in the univariate analysis (p=0.002) that disappeared when haemoglobin levels at the time of admission were controlled. In contrast, there is a robust statistical association between the initial levels of haemoglobin and the type of fracture; only 7.5%of the patients with intracapsular fractures presented haemoglobin levels upon admission of less than 11 g/dL versus 36.8%of the patients with extracapsular fractures, which indicates that the type of fracture is in fact a confounding factor that influences the need for transfusion by means of the levels of haemoglobin at the time of admission. In fact, all the intracapsular fractures presenting levels of less than 11 g/dL (6 cases) required transfusion. In the work by Adunsky et al.,[9] extracapsular fractures underwent plate osteosynthesis, whereas intracapsular fractures were treated with hemiarthroplastic surgery. This might indicate that the association would be due more to the treatment type than to the type of fracture.

We have also been unable to prove that age is a risk factor for transfusion. Swain et al.[7] found that age is a risk factor; however, they included a much broader range of ages (51-100) in their study and did not carry out a multivariate statistical analysis. Hence, it could, in fact, be a confounding factor, since haemoglobin levels decrease with age. In our work, patients over the age of 85 years had lower levels of haemoglobin (12.4 g/dL versus 12.04 g/dL in patients younger than 85), but these differences were not statistically significant.

The study presents limitations, as it does not assess intra-operative bleeding. We also did not record the output of the surgical drains, as we do not use them systematically. Finally, we did not follow any kind of protocol to determine which patients required transfusion and, consequently, the decision was always made by the treating physician, based on the case history and post-operative haemoglobin levels.

Therefore, based on the results of this study, we recommend that measures aimed at decreasing peri-operative bleeding be increased in patients whose levels of haemoglobin at the time of admission are less than 11 g/dL, in order to decrease the need for blood transfusion, since the transfusion itself might worsen the prognosis in this group of patients. However, with the number of patients included in our study, we cannot recommend that blood not be cross tested and reserved for patients with fractures of the hip and levels of haemoglobin upon admission of more than 11 g/dL, since the TI is greater than 0.5 units/patient in this group of individuals, which is still considered to be a surgery of high risk for transfusion.

Level of evidence

Case series without a control group. Level of evidence IV.

Conflict of interest

The authors state that they have no conflict of interest.

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