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Blood loss in trochanteric fractures: multivariate analysis comparing dynamic hip screw and Gamma nail

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KEYWORDS

Trochanteric fractures
Blood loss
Dynamic hip screw
Gamma nail

ABSTRACT

Introduction: Anaemia in patients with trochanteric fracture is associated with increased morbidity and mortality and it is an independent risk factor for functional mobility of patients. Several authors have reported the blood loss following operative treatment comparing different fixation systems but few authors have evaluated many associated variables that could influence the perioperative blood loss.
Purpose: To evaluate the blood loss in patients that had their trochanteric fracture stabilized with dynamic hip screw (DHS) or Gamma nail. Multivariate analysis of different variables that can influence blood loss was carried out (type of fracture, antiaggregant or anticoagulant therapy, time to surgery). The hypothesis was that there is no difference in terms of blood loss in patients with trochanteric fracture treated with DHS or Gamma nail considering all these variables.
Materials & Methods: Perioperative blood loss was evaluated in 417 consecutive patients treated for trochanteric fracture with DHS or Gamma nail between January 2010 and March 2013. The perioperative blood loss was calculated using the Lisander formula modified by Foss-Kehlet based on pre- and post-operative haemoglobin values and transfusion rates. Univariate and multivariate analysis were performed integrating the following variables: type of fracture (A1 *vs* A2), antiaggregant/anticoagulant therapy *vs* no therapy, time to surgery (<24 *vs* >24 hours from trauma), type of implant (DHS *vs* Gamma nail).
Results: A significant blood loss ($p < 0.05$) was observed between A1 and A2 fracture types (1247 ml *vs* 1796.7 ml), antiaggregant/anticoagulant therapy and no therapy (1592.7 ml *vs* 1470.2 ml), time-to-surgery <24 and >24 hours from trauma (1584.4 ml *vs* 1323.9 ml), DHS and Gamma nail (894.7 ml *vs* 1720.6 ml). At multivariate analysis, in the A1 fracture groups the DHS showed a significant lower blood loss compared to Gamma nail ($p < 0.05$).
Conclusions: According to the perioperative blood loss, DHS should be used in A1 fractures while Gamma nail can be taking in account for the unstable A2 fractures.

Introduction

The morbidity rate in the elderly following hip fractures is high and the percentage of mortality ranges between 15% and 25% within the first 6 months [1]. Every year more than 250,000 hip fractures are occurring in the United States and the data from the Centers for Disease Control and Prevention estimates the direct cost of hip fracture care to $54.9 billion by 2020 [2].

Anemia is a strong negative prognostic factor in patients with hip fracture and it is associated with increased postoperative mortality, poor physical performance, increased length of hospitalization, poor functional recovery, readmission rates, and death [3]. Moreover, in the early post-operative phase it is an independent risk factor for functional mobility of patients since they are not able to walk [3].

Early fixation is the widely accepted treatment for trochanteric fractures and different implants are described according to the personality of the fracture and the surgeon's choice. Several authors have reported the degree of blood loss following operative treatment comparing different fixation systems [4–12] and few authors have

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evaluated many associated variables that could influence the final result [13,14].

Aim of this study is to evaluate the incidence of blood loss in patients undergoing fixation of trochanteric fractures with dynamic hip screw (DHS) (Dynamic Hip Screw, Zimmer, Warsaw, Indiana, USA) or Gamma nail (Stryker Trauma®, Geneve, Switzerland). Using a multivariate analysis, different variables that can influence blood loss (type of fracture, antiaggregant or anticoagulant therapy, time to surgery) were investigated. Our hypothesis is that there is no difference in terms of blood loss in patients with trochanteric fracture treated with DHS or Gamma nail when considering the above set variables.

Materials and methods

A retrospective study was conducted between January 2010 and March 2013. Overall, 512 consecutive patients underwent to surgical reduction and fixation of trochanteric fracture at the Division of Orthopaedic and Traumatology of University of Insubria, Hospital di Circolo, Varese – Italy. Institutional board review approval was obtained.

Inclusion criteria were:

- age >65 years old
- AO 31-A1, A2 fractures
- no previous ipsilateral proximal femoral fracture or surgery

Exclusion criteria were:

- AO 31 A-3 fracture
- pathological fractures
- gastrointestinal diseases
- neoplastic diseases
- hematologic disorder (clotting disorders, thrombocytopenia, etc.)

An independent observer (MR) blinded to the surgical treatment classified the fractures on the preoperative X-rays according to the AO classification. A second independent observer (DB) blinded to the surgical treatment recorded the following data from the hospital records: preoperative haemoglobin value and on the third-fourth post-operative days, anticoagulant or/and antiaggregant therapy, day of hospitalization, day of surgery, red blood cell transfusions, weight, height, sex and age.

The total amount of blood loss was calculated based on the haemoglobin level and the estimated blood volume. The latter was determined according to gender, body mass and height and assuming that blood volume (BV) on the third or fourth day after surgery was the same as that before surgery. The formulae used were as follows [15]:

$$\text{Blood volume (l)} = \text{height (m)}^3 \times 0.356 + \text{weight (kg)} \times 0.033 + 0.183 \text{ for women, and}$$

$$\text{Blood volume (l)} = \text{height (m)}^3 \times 0.367 + \text{weight (kg)} \times 0.032 + 0.604 \text{ for men.}$$

The calculated loss of haemoglobin in the peri-operative period was based on the assumptions that the blood volume would be the same on admission and on the third postoperative day, and that all the red blood cell transfusions contained the same number of cells. The formulae used was as follows [16]:

$$\text{Hgb}_{\text{loss}} = \text{blood volume} \times (\text{Hgb}_{\text{adm}} - \text{Hgb}_{\text{fin}}) + \text{Hgb}_{\text{trans}}$$

where Hgb_{loss} is the calculated total haemoglobin loss (g), Hgb_{adm} is the haemoglobin value on admission, Hgb_{fin} is the final recorded haemoglobin value on day three or four and $\text{Hgb}_{\text{trans}}$ is the total amount of haemoglobin (g) in the transfused red blood cells before the measurement of Hgb_{fin}.

In order to assess the potential impact of dehydration on admission on the entire model and the results, the total peri-operative blood loss was also calculated from the level of haemoglobin on admission, corrected by a factor of 0.9, in order to simulate 10% dehydration in all patients.

The calculated blood loss was estimated using the following formula [17]:

$$\text{Blood loss in ml} = (\text{Hgb}_{\text{loss}}/\text{Hgb}_{\text{adm}}) \times 1000.$$

The data were evaluated with an univariate analysis comparing the following variables:

- Type of fracture (AO 31 A-1 *vs* AO 31 A-2)
- Antiaggregant/Anticoagulant therapy (AAT/OAT) *vs* no therapy
- Time to surgery (<24 hours *vs* >24 hours from trauma)
- Type of implant (DHS *vs* Gamma nail)

Multivariate analysis was used to compare the two implants in the two patient groups with equal risk factors for blood loss. Univariate and multivariate analysis were performed using a chi-square test (χ^2) with a 95% of confidence interval. All data analyses were performed using IBM SPSS 20 Inc.

Results

Out of the 512 consecutive patients, 95 patients were excluded because of different fracture pattern (19 AO 31-A3), fixation with other systems (35), pathological fractures (16), patients with neoplastic or hematologic disorders (25). The study included 417 patients for the final analysis, 307 females (73.6%), 110 males (26.4%). The mean age was 82.2 years (range, 65–101 years).

208 patients sustained an A-1 fracture (49.8%), 209 patients an A-2 (50.2%). 317 patients were treated with Gamma nail (76.1%), 100 patients with DHS (23.9%). 116 Gamma nails (27.8%) were used in A-1 fractures and 201 (48.2%) in A-2 fractures; 92 DHS (22%) were used in A-1 fractures and 8 in A-2 fractures (2%) (Figure 1). 178 patients (42.7%) were on antiaggregant (AAT) or oral anticoagulant therapy (OAT). The remaining 239 patients (57.3%) were not in ATT/OAT therapy. 318 patients (76.2%) were operated within 24 hours, 99 patients (23.8%) over 24 hours from trauma.

A significant blood loss ($p < 0.05$) was observed between A1 and A2 fracture types (1247 ml *vs* 1796.7 ml), antiaggregant/anticoagulant therapy and no therapy (1592.7 ml *vs* 1470.2 ml), time-to-surgery <24 and >24 hours from trauma (1584.4 ml *vs* 1323.9 ml), DHS and Gamma nail (894.7 ml *vs* 1720.6 ml) (Table 1). At multivariate analysis, in the A1 fracture groups the DHS showed a significant lower blood loss compared to Gamma nail ($p < 0.05$), (Table 2).

Discussion

Proximal femoral fractures continue to be of great interest to clinicians [18–25]. In hip fracture treatment perioperative blood loss is

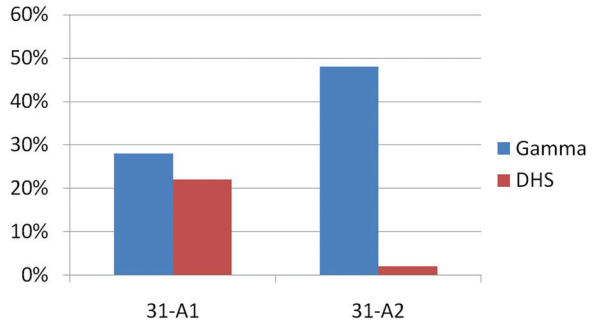

Fig. 1. Percentage of the different implants used for 31–A1 and A2 fractures fixation.