

ORIGINAL ARTICLE

Development and implementation of a perioperative management guide for patients with hip fracture: Health management and clinical impact[☆]



L. Hormaechea Bolado^{a,*}, J.R. Ortiz Gómez^b, I. Fornet Ruiz^a, A. Guijarro Valdueña^c, S. del Valle Quintans^a, A. Álvarez Bartolomé^a, A. del Campo Mur^a

^a *Facultativo especialista de Área de Anestesiología y Reanimación, Hospital Universitario Puerta de Hierro, Majadahonda Madrid, Spain*

^b *Facultativo especialista del Área de Anestesiología y Reanimación, Complejo Hospitalario de Navarra, Pamplona, Navarra, Spain*

^c *Facultativo especialista de Área de Cirugía Ortopédica y Traumatología, Hospital Universitario Puerta de Hierro, Majadahonda, Madrid, Spain*

Received 9 July 2020; accepted 9 October 2020

KEYWORDS

Hip fracture;
Clinical guide;
Surgical delay;
Anaemia;
Morbidity and
mortality

Abstract

Introduction: Hip fracture (HF) in the elderly has a high prevalence and risk of morbidity and mortality in the short and long term. It can reduce life expectancy by almost 2 years, and require permanent socio-sanitary assistance in one in 5 patients. Its management as a process where the patient takes priority over the activities of the organisation can bring new perspectives, optimisation tools and redesign of the workflow to make it more efficient.

Objective: to develop an in-hospital clinical guide for the management of patients with HR adapted to the environment, clear and concise, to be able to intervene in the best possible conditions and favour their adequate recovery.

Material and methods: 407 patients divided into 3 groups: pre-implementation (knowing the scope of the problem and areas for improvement); implementation (after the development of the management guide) and post-implementation (valued its implementation).

Results: The clinical results obtained with this guide allowed improving surgical programming and reducing delay times (increasing the proportion of patients operated in the first 48 h and reducing the average hospital stay in 3 days), raising awareness of the problem at all Services involved, improve the management of drugs that altered hemostasia, optimise transfusion therapy and reduce hospital stay and perioperative complications.

[☆] Please cite this article as: Hormaechea Bolado L, Ortiz Gómez JR, Fornet Ruiz I, Guijarro Valdueña A, del Valle Quintans S, Álvarez Bartolomé A, et al. Desarrollo e implementación de una guía de manejo perioperatorio de pacientes con fractura de cadera: gestión sanitaria e impacto clínico. Rev Esp Cir Ortop Traumatol. 2021;65:294–304.

* Corresponding author.

E-mail address: luciahormaechea@hotmail.com (L. Hormaechea Bolado).

Conclusion: The implementation of this guide, with integrated global criteria, has improved the results of this process, and achieved a more efficient management, reducing the consumption of resources and as a consequence, health expenditure.

© 2021 The Author(s). Published by Elsevier España, S.L.U. on behalf of SECOT. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

PALABRAS CLAVE

Fractura de cadera;
Guía clínica;
Demora quirúrgica;
Anemia;
Morbimortalidad

Desarrollo e implementación de una guía de manejo perioperatorio de pacientes con fractura de cadera: gestión sanitaria e impacto clínico

Resumen

Introducción: La fractura de cadera (FC) en el anciano tiene elevada prevalencia y riesgo de morbilidad a corto y largo plazo. Puede disminuir la esperanza de vida casi 2 años y precisar asistencia socio-sanitaria permanente en uno de cada 5 pacientes. Su gestión como un proceso donde prime el paciente sobre las actividades de la organización puede aportar nuevas perspectivas, herramientas de optimización y rediseño del flujo de trabajo para hacerlo más eficiente.

Objetivo: Desarrollar una guía clínica intrahospitalaria para el manejo de pacientes con FC adaptada al entorno, clara y concisa, para poder intervenir al paciente en las mejores condiciones posibles y favorecer su adecuada recuperación.

Material y métodos: Cuatrocientos siete pacientes divididos en 3 grupos: preimplantación (conocer el alcance del problema y las áreas de mejora); implantación (tras el desarrollo de la guía de manejo) y postimplantación (valoró la implementación de esta).

Resultados: Los resultados clínicos obtenidos con la presente guía permitieron mejorar la programación quirúrgica y reducir los tiempos de demora (aumentando la proporción de pacientes intervenidos en las primeras 48 h y reducir la estancia media hospitalaria en 3 días), concienciar del problema a todos los servicios implicados, mejorar el manejo de los fármacos que alteraban la hemostasia, optimizar la terapia transfusional y reducir la estancia hospitalaria y las complicaciones perioperatorias.

Conclusión: La implantación de esta guía, con criterios globales integrados, ha logrado mejorar los resultados de este proceso y conseguido una gestión más eficiente, reduciendo el consumo de recursos y, como consecuencia, el gasto sanitario.

© 2021 El Autor(s). Publicado por Elsevier España, S.L.U. en nombre de SECOT. Este es un artículo Open Access bajo la licencia CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Hip fracture (HF), or fracture of the proximal third of the femur from the femoral head to 5 cm below the lesser trochanter, is a current major public health problem in the older population in developed countries. It is the most frequent cause of hospital admission to trauma services,¹ and the World Health Organisation expects its incidence to triple over the next 50 years. In 2015, according to the Minimum Basic Data Set of the Spanish National Health System (SNS), there were 53,867 hospitalisations due to HF in Spain, primarily in women (72.6%) and at over 65 years of age (92.6%).

HF (together with the physiological changes of ageing (Fig. 1), presents a high risk of morbidity and mortality in the short and long term (reducing life expectancy by almost 2 years), functional deterioration, dependence (one in every 5 patients will require permanent health and social care²) and the need for institutionalisation following the fracture.³

HF surgery has increased in the last 20 years, from 86% in 1997 to 91.48% in 2007, and conservative treatment of

these fractures is currently uncommon. Surgery enables early mobilisation, avoiding bed rest and the risk of developing respiratory or urinary infections, deep vein thrombosis or pressure ulcers. Surgery should be performed early (preferably within 48 h) after the patient's medical condition has been optimised and their medication adjusted. Surgical delay is associated with a worse prognosis and higher mortality at one year, sometimes due to a lack of consensus on haemostasis-altering drugs or difficulty in scheduling operating theatres.

HF also has a high economic impact on healthcare (in Spain, the average cost is between euro7031 and euro12,331, depending primarily on the number of days spent in hospital, and is double the average cost of other causes). To this must be added the costs generated in the patient's environment and the non-quantitative costs derived from changes in lifestyle and loss of productivity for the patient, their families and society.

For all these reasons, an action protocol is needed for all professionals involved in this process to ensure comprehensive care from admission to discharge from hos-

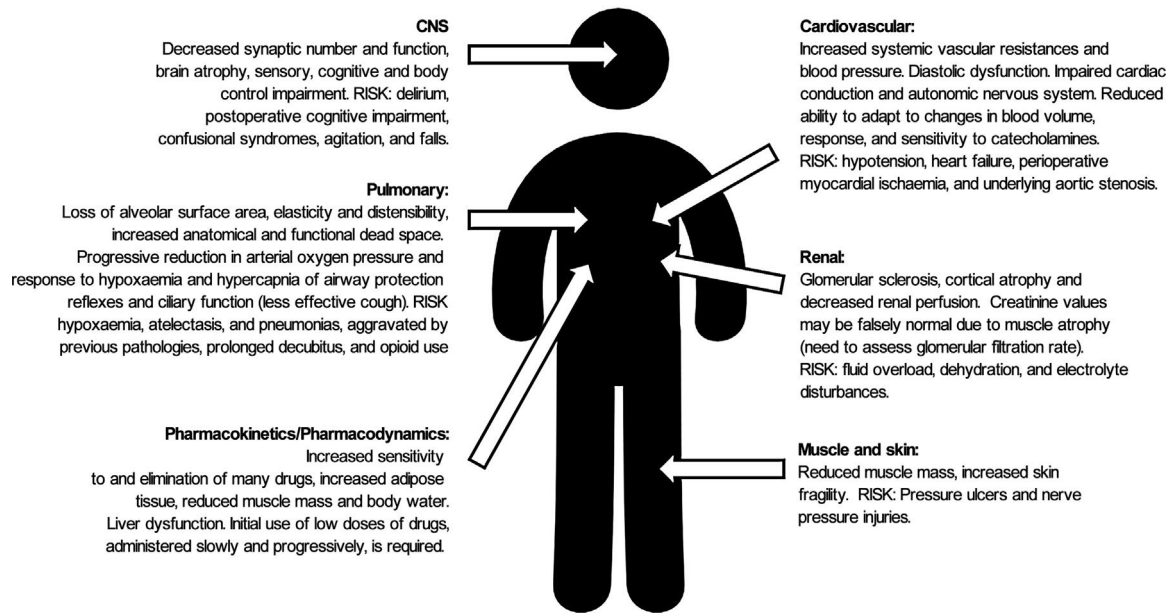


Figure 1 Physiological changes of ageing.

pital, and even after the process is over, to help these patients maintain their quality of life for a few more years. Orthogeriatric services have established themselves as the most efficient in the comprehensive treatment of the older patient.^{4,5}

This article describes the experience in implementing an intrahospital clinical guideline for the perioperative management of patients with HF at the Hospital Puerta de Hierro Majadahonda in Madrid. [Annex 1](#) shows the summary of the guidelines with the most important aspects to be considered for the comprehensive care of HF patients and the measures to be adopted. It was drawn up after a prior analysis of the situation that assessed the existing shortfalls in the process in our setting.

The aim of the clinical guideline was to set out clearly and concisely the necessary perioperative care to ensure patients are operated as soon as possible in the best possible conditions with a more efficient recovery.

Material and methods

Study conducted in 3 phases after approval by the Ethics Committee (Act n. 309, dated 27 April 2015) at the Hospital Universitario Puerta de Hierro Majadahonda (HUPHM), a tertiary level hospital of the Public Health Service of the Community of Madrid, which complies with the ethical standards of the Research Committee and the Helsinki Declaration of 1975 with the revision of October 2013 (<https://jamanetwork.com/journals/jama/fullarticle/1760318>).

Inclusion criteria: patients diagnosed with HF aged 65 years or older, admitted to the emergency department of HUPHM and scheduled for surgery.

Exclusion criteria: patients under 65 years of age, pathological or periprosthetic HF, polytrauma patients, conservative treatment, and failure to obtain informed consent for data collection.

Timeframe: the study was divided into 3 periods, with analysis of the data between the periods prior to taking measures:

First period (pre-implementation group [PRE], $n=88$): retrospective study of patients undergoing HF surgery in 2013, to establish the extent of the problem and possible areas for improvement. From the data obtained, a clinical guideline was drawn up by the anaesthetics and trauma departments, with the support of internal medicine and emergency medicine.

Second period (implementation group [IMPL], $n=112$): prospective study of patients undergoing HF surgery from February to June 2016, applying the guideline developed.

Third period (post-implementation group [POST], $n=207$): prospective study analysing the degree of compliance with the clinical guideline implemented from November 2016 to June 2017.

Demographic data were collected (age, sex), social data (place of residence at the time of HF, home or care home), data on dependency (ability to perform basic activities of daily living without assistance), presence of coexisting diseases (high blood pressure [HBP], diabetes mellitus [DM], atrial fibrillation, heart failure, cerebrovascular disease [CVA]), respiratory failure and chronic renal failure), cognitive impairment (information obtained during anamnesis and clinical history), chronic consumption of antiaggregant and anticoagulant drugs, and anaesthetic (American Society of Anesthesiologists (ASA) classification) and cardiovascular (Goldman criteria) risks.

Data were collected on the type of HF (extracapsular or intracapsular), surgical parameters (osteosynthesis with intramedullary nail, cannulated screws or partial or total arthroplasty) and anaesthetic (general anaesthesia [GA], regional subarachnoid anaesthesia [RA] and femoral and femoral cutaneous nerve blocks).

Laboratory data were collected, including serial haemoglobins (Hb) (on admission, at 24 h, at 48 h, post-

surgery and before discharge), transferrin saturation (values <20% were considered indicative of depleted iron stores), International Normalised Ratio (INR) in case of chronic treatment with acenocoumarol on admission, at 24 h and at 48 h (an INR below 1.5 is required for neuroaxial anaesthesia) and creatinine (as a marker of renal function, on admission, at 48 h and before discharge from hospital).

In terms of transfusion therapy, the number of packed red blood cell units, time of administration and transfusion threshold were recorded. Optimisation with IV iron for anaemia correction was also recorded; ferric carboxymaltose was administered to anaemic patients (Hb on admission below 13 g/dl⁻¹ in men and 12 g/dl⁻¹ in women) and to those who although they had Hb levels in range had transferrin saturation <20% and vitamin K (to accelerate the correction of coagulation parameters).

Dates of admission, surgery and discharge were recorded to calculate the surgical delay (determining whether it was for medical reasons or due to operating theatre management), hospital stay, discharge destination (home, care home or intermediate care centre).

The intrahospital morbidity parameters collected were the degree of anaemia (assessment of decrease in Hb levels in relation to time and according to fracture type), impair-

ment of renal function (assessed by creatinine and urea), morbidity after hospital discharge (readmission within the first 3 months after surgery) and intrahospital mortality rate, at 6 weeks (first post-surgical check-up) and at 3 and 6 months after surgery.

Statistical analysis: a descriptive analysis was performed for categorical variables using absolute and relative frequencies, and for numerical variables, using mean and standard deviation or median and 25th and 75th percentiles, minimum and maximum values, according to compliance with the assumption of normality. The Mann–Whitney *U* test or Student's *t*-test were used for the univariate analysis to contrast numerical variables and the chi-squared test or Fisher's exact statistic to contrast hypotheses of categorical variables, as appropriate. For comparisons between the 3 groups, the Kruskal–Wallis non-parametric test or one-way ANOVA was performed, as appropriate. The Bonferroni correction was used to eliminate accumulated type I error because of multiple comparisons and multivariate logistic regression analysis was performed to assess the association between being transfused, being anaemic on admission and fracture type. To assess the risk factors associated with overall mortality, a multivariable logistic regression analysis was performed, plotting odds ratios (OR)

Table 1 Demographic characteristics.

Group	PRE	IMPL	POST
<i>Age (mean ± SD)</i>	86.8 ± 5.9	84.8 ± 6.8	85.1 ± 7.1
<i>Sex</i>			
Female	75%	63.4%	77.9%
Male	25%	36.6%	22.1%
<i>ASA</i>			
I	0%	0%	0%
II	5.3%	10.7%	9.0%
III	93.7%	83.9%	85.2%
IV	0.9	4.4%	4.5%
<i>Fracture type</i>			
Extracapsular	100%	48.2%	37.3%
Intracapsular	0%	51.8%	62.7%
<i>Anaesthetic technique</i>			
General	9.52%	18.02%	8.82%
Subarachnoid	90.48%	81.98%	87.75%
Blocks	0%	0%	3.43%
<i>Haemostasis-altering drug consumption</i>			
A 100	31.82%	27.68%	27.45%
A 300	5.88%	1.79%	0.49%
Clopidogrel	4.55%	3.57%	6.37%
Acenocoumarol	20.45%	21.43%	12.75%
DOACs	1.14%	1.79%	2.45%

A: aspirin; ASA: American Society of Anaesthesiologists anaesthetic risk classification.

No statistically significant differences between the groups in age, sex, or ASA grade.

In the PRE group all the fractures were extracapsular, due to the code used to locate the medical records (this part of the study was carried out retrospectively).

Unit of age: years.

No statistically significant differences between groups in distribution or percentage of antiaggregant ($p = .165$) or anticoagulant ($p = .318$) drugs consumed.

DOACs: direct acting oral anticoagulants.

Table 2 Perioperative anaemia.

	PRE	IMPL	POST
Haemoglobin on admission*	12.1 ± 1.6	12.5 ± 1.8	12.5 ± 1.7
Haemoglobin at 24 h*	10.3 ± 1.7	11.7 ± 1.9	11.2 ±
Haemoglobin at 48 h*	9.8 ± 1.4	11.2 ± 2	10.6 ±
Postoperative haemoglobin	9.0 ± 1.4	10.0 ± 1.7	9.6 ± 1.7
Haemoglobin on discharge	10.3 ± 1.1	10.2 ± 1.2	10.1 ± 1.2
Anaemia on admission	49%	61%	62%
Anaemia on discharge	97.73%	88.99%	94.12%

* $p < .001$ (mean ± SD).**Table 3** Transfusion therapy.

	PRE	IMPL	POST
Total patients transfused*	68.97%	44.55%	49.51%
N of packed blood cell units transfused**			
1	6.67%	26.53%	29.70%
2	66.67%	59.18%	48.51%
3	15%	2.04%	11.88%
4	10%	12.24%	7.92%
Transfusion threshold***			
<7 g/dl Hb	6.67%	0%	14.14%
≥7–8 g/dl Hb	38.33%	50%	5.57%
≥8–9 g/dl Hb	53.33%	50%	29.29%
Time of transfusion****			
Prior to surgery	20%	10.20%	3.96%
Intraoperative	1%	2%	1.98%
Postoperative	55%	73.47%	81.19%

* $p = .002$ between IMPL and POST compared to PRE.** $p = .041$ between POST and PRE in the number of patients transfused with only one unit of packed red blood cells compared to those transfused with 2 units or more.*** $p = .004$ between PRE and IMPL compared to POST.**** $p = .006$. In the PRE group there is a high rate of preoperative transfusion.

and their respective 95% confidence intervals (CI). The significance level was set at .05. The statistical package used was Stata/IC v.14.1. (StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX, USA: StataCorp LP).

Results

There were no differences between the groups in terms of demographic characteristics (Table 1).

The distribution of medical diseases is typical for older patients (median age 88 years (PRE) and 86 (IMPL and POST), with 25% over 90 and only 25% under 80 years of age). The most frequent were: HBP, DM and heart rhythm disturbances, followed by heart failure, stroke and chronic respiratory disease.

Of the patients, 35% had 2 or more cardiovascular risk factors (class II–III of the Goldman criteria for cardiovascular risk in non-cardiac surgery), implying a risk of cardiac death of 1–2% and of serious cardiac complications of 3–10%.

Of the patients, 51.14% were institutionalised prior to admission for HF, 57.5% required some form of assistance in

performing the basic activities of daily living and 40.8% had some degree of cognitive impairment.

Anaemia on admission (Table 2) was a conditioning factor for transfusion (Table 3) in the IMPL and POST groups, but not in the PRE group ($p = .218$), probably due to the high percentage of patients transfused.

In the IMPL group there were differences for both extracapsular ($p = .008$) and intracapsular fractures ($p = .001$), with a 48% lower risk for transfusion compared to the PRE group (OR .52; 95% CI .28–.98; $p = .045$). In the POST group there were differences for intracapsular fractures ($p = .042$), but not for extracapsular fractures ($p = .053$), although in both cases there was less transfusion than in the former 2 groups, with a 42% lower risk of transfusion compared to the PRE group (OR .58; 95% CI .33–1.01; $p = .055$). In all groups, extracapsular HF increased the risk of transfusion 2.08-fold over intracapsular fracture.

Iron deficiency (transferrin saturation <20%) was observed in the patients with anaemia on admission (81.65%) and in those with Hb in the normal range (80.89%), with no differences between groups ($p = .876$). Iron administration did not influence the transfusion rate ($p > .9$),

Table 4 Management data relating to hip fracture surgery.

Group	PRE	IMPL	POST
<i>Surgical intervention*</i>			
In under 48 h	8.43%	17.12%	39.22%
Later than 48 h	91.57%	82.88%	60.78%
<i>Provenance</i>			
Home	48.9%	50.9%	50.5%
Care home	51.1%	49.1%	49.5%
<i>Destination</i>			
Home to home	25.30%	24.53%	30.10%
Home to care home	21.69%	26.42%	21.43%
Care home to care home	53.01%	49.06%	48.47%
<i>Days of admission according to destination (P25-P50-P75)</i>			
Home to home	9-11-13	8-10-13	7-9-11
Home to care home	8-10-13	11-14-16	11-14-18
Care home to care home	9-11-12	8-9-11	6-7-9
<i>Mortality</i>			
Intrahospital	6.82%	3.57%	3.43%
At 6 weeks	14.77%	6.25%	4.41%
At 3 months	17.05%	6.25%	7.84%
At 6 months	18.18%	9.82%	11.27%
<i>Readmission</i>			
In the first 3 months	23.17%	17.59%	6.70%

* $p = .001$ between PRE and IMPL and POST.

P25-P50-P75 are the 25th, 50th and 75th percentiles, respectively.

but did affect the number of patients with anaemia on admission (81.65%) and those with Hb in the normal range (80.89%), 9), and it did influence the number of bags transfused, with a 64% decreased risk for transfusion of a second packed red blood cell bag compared to the patients who were not given iron (OR = .36, 95% CI .15–.84; $p = .018$).

The implementation of the clinical guideline led to changes in the form of transfusion (Table 3), both in the transfusion threshold and in the number of packed red blood cells transfused.

Multivariate analysis of predictors of mortality showed that only age ($p < .001$) was a risk indicator, with an OR of 1.11 (95% CI, 1.05–1.19). Sex ($p = .369$), Hb on admission ($p = .369$), transfusion ($p = .136$), patient provenance ($p = .105$), surgery in under 48 h ($p = .977$), anaesthetic technique ($p = .867$), use of antiplatelet agents ($p = .807$) or anticoagulants ($p = .68$) were not indicators of risk.

Regarding surgical delay (Table 4), there was increased mortality in patients undergoing surgery later than the first 48 h of admission; however, this is not statistically significant ($p = .4$). In the PRE group, the surgical delay was 6 days, and a quarter of the patients underwent surgery with a delay of >7 days. In the IMPL group the delay was reduced to 4 days and in the POST group to 3 days. During the study, the delay in surgery was halved. The proportion of patients undergoing surgery within the first 48 h in the PRE group was below 10%; however, in the POST group it was near 40%.

Twenty percent of the patients previously living at home undergoing HF surgery had to be admitted to an intermedi-

ate care hospital for functional recovery. The patients who returned home needed support from social workers to adapt their home to their new situation. It was possible to reduce this aspect by 18.2%.

In the patients who were institutionalised beforehand, hospital stay was reduced by 36.4%, from an average of 11 days (PRE) to 7 days (POST).

It should be added that the criteria for admission to medium-stay hospitals in the Community of Madrid changed during the study, resulting in a one-day increase in hospital stay in the IMPL and POST groups, due to the centralised management of these hospitals and increased administrative bureaucracy. This influenced hospital stays, which is the major economic cost of HF in its acute phase.

Given that the average daily cost of a trauma bed is euro177–euro199/day,⁶ the cost was reduced by euro708–euro796/day, which means a saving in 6 months of euro144,556–euro164,772. Transfusion therapy is also important in the economic cost of this process, both due to the number of packed red blood cells (it is estimated that each packed red blood cell bag costs euro243), and due to prolonged hospital stay, not counting the indirect costs of complications associated with blood product transfusion. The reduction in transfusion rate and number of packed red blood cell bags transfused results in an average saving of 40% (42% POST [euro23,575.86]) and 38% IMPL [euro21,865.14] in transfusion therapy-related costs compared to the PRE group [euro37,725.75]).

Discussion

The predominance of women in our study is comparable to national and world registers,⁸ mainly due to their longer life expectancy⁹ and postmenopausal bone loss.⁸ The high rate of institutionalised patients is due to the large number of care homes in the study population area. This helps to explain the high degree of dependency prior to admission, more than half the patients needed help with the basic activities of daily living (57.5%) and the advanced age of the patients, values similar to those of Castilla-La Mancha (2016),² Ávila (2015)⁶ or Guadalajara (2017)¹⁰; on the other hand, there is the advantage that hospital stays can be shortened by facilitating discharge back to their care homes.

More than 80% of the patients were classified as ASA III anaesthetic risk ("major risk"), not differentiating risk between the different patients as most of them had the same level, and therefore other scales should be used, such as The Nottingham Hip Fracture Score (NHFS), which predicts the risk of mortality in the first 30 days after HF,¹¹ an aspect that has been considered in successive revisions of the clinical guideline.

The best practice guidelines on haemostasis-altering drugs are constantly being revised and the clinical guideline should be updated, informing all the actors involved in this process, as this is an essential aspect in the appropriate management of HF patients.

Aspirin does not pose a problem in surgical delay because it is maintained during admission indefinitely.¹²

Clopidogrel must be discontinued to perform neuroaxial anaesthetic techniques safely and, following studies¹³ that demonstrate greater efficacy than aspirin, its use is expected to increase in the future. The recommendations of the Spanish Society of Anaesthesiology indicate that the hypothetical risk of bleeding caused by clopidogrel maintenance cannot justify delaying the intervention until its effect wears off, as thromboembolic complications and mortality increase.¹⁴ The Association of Anaesthesiologists of Great Britain and Ireland recommend not stopping clopidogrel on admission, not delaying surgery and not prophylactically transfusing platelets.¹⁵

Anticoagulants contraindicate neuroaxial anaesthesia and should be discontinued. In the case of acenocoumarol, vitamin K and INR monitoring are recommended, since coagulation can be corrected within 24–48 h.

The recommendations on direct-acting oral anticoagulants (DOACs) are based on their pharmacokinetics.¹⁶ The plasma level drops by about 90% within 3 half-lives after the peak plasma level of the drug is reached following administration (36 h for apixaban, 27 h for rivaroxaban and 48 h for dabigatran). The use of coagulation tests for monitoring is not appropriate; however, they should be performed once the safe withdrawal times for these drugs have been met, as normal test results ensure haemostatic competence. It is recommended¹⁷ to discontinue DOACs 2 days before surgery in patients with normal kidney function (<http://qxaapp.secardiologia.es/landing/>).

Patient blood management (PBM) programmes are based on three pillars: optimising preoperative erythropoiesis, minimising intraoperative blood loss and improving tolerance to anaemia. PBM has excellent results in elective surgeries, however, in HF the priority is early intervention,

and therefore blood management is very limited in these patients.

Anaemia on admission correlates with increased morbidity, mortality, hospital stay and risk for blood product transfusion.⁷ Our data (incidence of 40–50%, and higher prevalence in patients over 85 years of age) are similar to other studies.¹⁸

Anaemia in the older patient is of mixed aetiology: nutritional (iron, folic acid, and vitamin B₁₂ deficiencies), of inflammatory origin, or due to chronic disorders. There is also iron deficiency without anaemia. The European guideline on management of perioperative bleeding¹⁹ recommends treating iron deficiency by intravenous administration in non-delayable surgeries. Several studies²⁰ have found a correlation between IV iron administration and reduced transfusion requirements, it being most effective in patients with Hb > 12 g/dl⁻¹. In studies conducted in anaemic patients, the transfusion rate is maintained; however, the number of packed red blood cells transfused decreases, as in our study.

The "Seville" Consensus Document²¹ on alternatives to transfusion indicates that, in patients with HF, the preoperative administration of IV iron and application of restrictive criteria in transfusion therapy improve transfusion rates and postoperative morbidity, especially in non-anaemic patients or those with subcapital fracture. Vitamin B12 and folic acid are also recommended for nutritional deficit. There are studies comparing the isolated administration of iron with combined administration with erythropoiesis-stimulating agents (rHuEPO at a dose of 40,000 IU or half dose in the case of kidney failure).²² The problem is that rHuEPO is contraindicated in patients with uncontrolled HBP, a history of venous or arterial thromboembolic disease, or in those who cannot receive prophylactic antithrombotic treatment. Therefore, their administration has not become widespread, due to the high number of associated comorbidities in these patients.

The third pillar of PBM is the reduction of intraoperative blood loss with the use of antifibrinolytic drugs, such as tranexamic acid, which has been shown to reduce blood loss in orthopaedic surgery²³ (off-label use). It is contraindicated in patients with a history of arterial thrombosis, severe kidney failure and a history of seizures, and the dose should be adjusted in cases of mild or moderate kidney failure due to the increased risk of thrombotic complications. Given the contraindications to tranexamic acid and erythropoietin, only IV iron administration was considered in this study to optimise anaemia. Some studies also recommend prescribing iron on discharge to improve recovery.²⁴

Transfusion of blood products should always be assessed on an individual basis, since it increases morbidity and mortality, hospital stay and risk for infection, possibly due to its immunomodulatory effect.²⁵ Anaemia on admission is the main factor that increases the risk for transfusion,²⁶ which was also an aspect in our study. Extracapsular HF (doubling the risk for transfusion) and surgical delay were also risk factors (reduced from 20% of patients transfused preoperatively in the PRE group to 3% in the IMPL group). The transfusion threshold has been gradually restricted to the current levels²⁷ of Hb < 8 g/dl⁻¹. Our protocol has reduced the number of patients transfused with Hb > 8 g/dl⁻¹ by 40%.

In terms of mortality, RA was the most common in the 3 groups, similar to other studies.^{2,6} It is important to highlight that there are no differences²⁸ in morbidity and mortality between GA and RA, maintaining adequate intraoperative haemodynamic stability being essential. Delay in surgery has a greater influence on morbidity and mortality than the anaesthetic technique itself.¹⁸

The intrahospital mortality rate in Spain²⁹ is between 5% and 8% (4.8% in women and 8.9% in men). In the first month it is between 6% and 12% and at one year it reaches 30%. The Agency for Healthcare Quality and Research (AHQR) considers intrahospital mortality associated with HF an indicator of quality of care. The risk factors for mortality vary according to the study (advanced age, male sex, frail patient and institutionalisation,²⁹ age and dependency⁵). In our study, only age was a risk factor (a mean of 5 years more in deceased patients).

The mean hospital stay for HF in Spain³⁰ is 12–14 days and is associated with delay in surgery, transfusion rates and perioperative infectious and cardiorespiratory complications, especially heart failure.³¹ Delayed HF surgery increases morbidity and mortality.^{32,33} The factors involved in surgical delay can be divided into medical (Charlson comorbidity index >2,³⁴ patient blood management, use of haemostasis-altering drugs (our main factor in delay) and organisational factors³⁵ (day of the week of admission, surgery being delayed if the patient was admitted towards the end of the week³⁶ (operating theatre planning is responsible for 20% of surgical delay³⁷). The different studies and guidelines vary on the recommended period between patient blood management and time of surgery (from 1 to 4 days).³⁸ The Spanish Society of Trauma and Orthopaedic Surgery, within the recommendations of the Ministry of Health, recommend not delaying surgery for more than 48 h in the absence of a formal medical contraindication, in line with current national³⁹ and international⁴⁰ guidelines. However, the latest editions of the New Zealand⁴¹ and Scottish⁴² guidelines consider reducing this time to 24–36 h, although there appear to be no particularly noteworthy benefits, as demonstrated by the Canadian Health System.⁴³ Our results are far from these recommendations, but coincide with the median obtained in the Spanish national health system data.

Regarding clinical and interventional parameters, the surgical delay for the PRE group is similar to Sánchez-Hernández and Sáez-López in 2010,⁶ while it is lower for the POST group. Surgical stay, transfusion rate and the anaesthetic technique used do not differ much from other published articles, but mortality in the POST group is lower.^{2,6,31,35,37,44}

In the PRE group, surgical programming was performed weekly, with a delay of almost 6 days until the intervention, depending on the day of the week when admitted, which increased by an average of one more day in antiplatelet-anticoagulated patients, and 53% with Hb > 8 g/dL⁻¹ were transfused. In light of the data obtained in the second period, a new distribution of the trauma operating theatres was achieved with the approval of management, and one was enabled for fracture interventions, giving priority to hip fractures.

The intrahospital clinical guideline for the perioperative management of patients admitted with HF was disseminated to all the services involved, with the collaboration of Management. Patient collaboration was sought through an information sheet on the process that they were given on their arrival at the emergency department.

The limitations of the present study can be summarised into 3: assuming a previous diagnosis of cognitive deterioration of the patient, and not carrying out a specific assessment on admission. No data were collected on the worsening of cognitive impairment after surgery, resulting in a lack of depth in the analysis of morbidity. With respect to the causes of mortality, the computer system only recorded deaths, not their aetiology, and therefore it was not possible to analyse the main causes of mortality. Finally, the mortality risk factors were not statistically significant for some of the variables because the sample size was not sufficient. A study with a larger number of patients is advisable to reach conclusions.

We should point out that, after completing this study, the hospital opened the orthogeriatrics department, starting the comprehensive treatment of patients with HF, assessing cognitive function, functional status, degree of dependence and nutritional status by means of scales, to provide care for these patients. These data will allow results to be measured.

Conclusion

The implementation of a guideline for the management of patients with HF has achieved more efficient management, reducing resource consumption and healthcare costs. It has reduced the rates of perioperative complications, transfusion, and readmission, as well as the number of days of hospitalisation and intraoperative mortality and mortality in the first 6 months. It has optimised surgical scheduling, increased the number of trauma operating theatres, and reduced surgical delay. It has also improved results and the patients' and their relatives' understanding of this process.

However, we must continue to work to ensure that more patients benefit from the reduction in surgical delay, especially those admitted at the end of the week, where results have been less satisfactory.

Level of evidence

Level of evidence II.

Funding

This work has not been funded or received grants or subsidies of any kind.

Conflict of interests

The authors have no conflict of interest to declare.

Annex 1. Aspects to consider for the comprehensive care of hip fracture patient.

	Considerations/risks	Measures to adopt
Perioperative anaemia	Mixed aetiology	Daily controls of IV ferric carboxymaltose (500–1.000 mg) in the case of Hb 9–3 g/dl ⁻¹
Transfusion	Restrictive criteria (Hb of 8 g/dl ⁻¹) lack significant differences in morbidity and mortality	Based on clinical symptoms, comorbidities, and Hb levels. One at a time administration and reassessment
Antiaggregation and anticoagulation	Increase surgical bleeding, contraindicate neuroaxial anaesthesia	Defined substitution guidelines, stratifying haemorrhagic and thrombotic risk
Thrombosis	Deep vein thrombosis and pulmonary thromboembolism	Mechanical or pharmacological measures (LMWH somewhat increases bleeding risk)
Blood glucose monitoring	Important factor in reducing morbidity	Target: blood glucose between 60–180 mg × dl ⁻¹ , with insulin guidelines
Water and electrolyte control	Dehydration or fluid overload and electrolyte disturbances	Na ⁺ levels between 120–150 meq × dl ⁻¹ and K ⁺ levels between 2.8–6 meq × dl ⁻¹
Kidney function	Falsely normal creatinine values due to muscle atrophy	Assess glomerular filtration rate
Nutrition	Albumin <3.5 g × dl ⁻¹ indicates increased perioperative mortality	High protein nutritional supplements
Haemodynamic status	Quantifiable by Goldman index. Murmurs and arrhythmias without haemodynamic instability do not require specialist assessment	Atrial fibrillation: a ventricular rate <100 bpm is recommended, correcting the causal factors and if this is not sufficient, administering beta-blockers or the verapamil of choice
Respiratory infection	Risk due to prolonged bed rest and coexisting diseases.	Antibiotic prophylaxis and respiratory physiotherapy. Subarachnoid anaesthesia, early mobilisation, and physiotherapy analgesia
Oxygen therapy	There are episodes of hypoxia from admission to postoperative day 5	SpO ₂ > 92% and ideally >95%. Supplemental oxygen at 2–3 bpm from admission until at least 48 h postoperatively
Perioperative analgesia	Reduces respiratory, cardiovascular, gastrointestinal morbidity, risk of delirium and hospital stay and facilitates early mobilisation	Underestimated, especially in disorientated or dementia patients. Should be multimodal, avoiding opioids and excess NSAIDs. The use of peripheral nerve blocks is advisable
Urinary catheter	Both urinary retention and catheterisation favour urinary tract infection	Avoid routine catheterisation (use intermittent voiding catheterisation in the event of retention). If a catheter is placed during surgery, encourage its removal 24 h after starting mobilisation
Intraoperative	Complications, hospital stay, and mortality are reduced as the experience of the surgical and anaesthetic team increases	Antibiotic prophylaxis should be used correctly 30–60 min before surgery. Subarachnoid anaesthesia is recommended whenever conditions permit
Delirium	60% incidence, especially if there are preconditions. Detect patients at risk	Recommend preventive measures and early treatment (haloperidol [.25–.5 mg × 6 h ⁻¹], olanzapine [2.5 mg 24 h ⁻¹ SC or PO] or risperidone [.25–.5 mg PO]), avoiding mechanical restraint
Early mobilisation	Reduces pressure ulcers, respiratory complications and DVT risk	Early mobilisation the day following surgery, if possible
Secondary prophylaxis	There is a high risk of contralateral fracture ²	Treatment on hospital discharge: calcium with vitamin D, unless contraindicated

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at <https://doi.org/10.1016/j.recot.2020.10.008>.

References

- Heyburn G, Beringer T, Elliott J, Marsh D. Orthogeriatric care in patients with fractures of the proximal femur. *Clin Orthop Relat Res*. 2004;425:35–43.
- Fernández-Ibáñez JM, Morales-Ballesteros MC, Crespo-Romero E, Gómez-Gómez S, Fraga-Fuentes MD, Cruz-Tejado J, et al. Actividad ortogeriatrica en un hospital general de Castilla-La Mancha. *Rev Esp Cir Ortop Traumatol*. 2017;61:88–95.
- Azagra R, López-Expósito F, Martín-Sánchez JC, Aguyé-Batista A, Gabriel-Escoda P, Zwart M, et al. Incidencia de la fractura de fémur en España (1997–2010). *Med Clin (Barc)*. 2015;145:465–70.
- Ellis G, Whitehead MA, Robinson D, O'Neill D, Langhorne P. Comprehensive geriatric assessment for older adults admitted to hospital: meta-analysis of randomised controlled trials. *BMJ*. 2011;343:d6553.
- Handoll HHG, Cameron ID, Mak JC, Finnegan TP. Multidisciplinary rehabilitation for older people with hip fractures. *Cochrane Database Syst Rev*. 2009;CD007125.
- Sánchez-Hernández N, Sáez-López P. Resultados tras la aplicación de una vía clínica en el proceso de atención al paciente geriátrico con fractura de cadera osteoporótica en un hospital de segundo nivel. *Rev Esp Cir Ortop Traumatol*. 2016;60:1–11.
- Canillas F, Gómez-Ramírez S, García-Erce JA, Pavía-Molina J, Gómez-Luque A, Muñoz M. "Patient blood management" en cirugía ortopédica. *Rev Esp Cir Ortop Traumatol*. 2015;59:137–49.
- Kanis JA, Odén A, McCloskey EV, Johansson H, Wahl DA, Cooper C. A systematic review of hip fracture incidence and probability of fracture worldwide. *Osteoporos Int*. 2012;23:2239–56.
- Wang H, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, et al. Global, regional, and national under-5 mortality, adult mortality, age-specific mortality, and life expectancy, 1970–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet*. 2017;390(10100):1084–150.
- Pareja Sierra T, Rodríguez Solís J, Alonso Fernández P, Torralba González de Suso M, Hornillos Calvo M. Intervención geriátrica en el anciano ingresado por fractura de cadera en el Hospital Universitario de Guadalajara: repercusión clínica, asistencial y económica. *Rev Esp Geriatr Gerontol*. 2017;52:27–30.
- Moppett IK, Parker M, Griffiths R, Bowers T, White SM, Moran CG. Nottingham hip fracture score: longitudinal and multi-assessment. *Br J Anaesth*. 2012;109:546–50.
- Becker RC, Meade TW, Berger PB, Ezekowitz M, O'Connor CM, Vorchheimer DA, et al. The primary and secondary prevention of coronary artery disease: American College of Chest Physicians evidence-based clinical practice guidelines (8th edition). *Chest*. 2008;133 Suppl. 6:776S–814S.
- CAPRIE Steering Committee. A randomised, blinded, trial of clopidogrel versus aspirin in patients at risk of ischaemic events (CAPRIE), vol. 348. *Lancet* (London, England): CAPRIE Steering Committee; 1996. p. 1329–39.
- Sierra P, Gómez-Luque A, Castillo J, Llau JV. Guía de práctica clínica sobre el manejo perioperatorio de antiagregantes plaquetarios en cirugía no cardíaca (Sociedad Española de Anestesiología y Reanimación) (versión corta). *Rev Esp Anestesiol Reanim*. 2011;58:243–50.
- Griffiths R, Alper J, Beckingsale A, Goldhill D, Heyburn G, Holloway J, et al. Management of proximal femoral fractures 2011: Association of Anaesthetists of Great Britain and Ireland. *Anaesthesia*. 2012;67:85–98.
- Breuer G, Weiss DR, Ringwald J. "New" direct oral anticoagulants in the perioperative setting. *Curr Opin Anaesthesiol*. 2014;27:409–19.
- Llau JV, Ferrandis R, Castillo J, de Andrés J, Gomar C, Gómez-Luque A, et al. Manejo de los anticoagulantes orales de acción directa en el período perioperatorio y técnicas invasivas. *Rev Esp Anestesiol Reanim*. 2012;59:321–30.
- Maxwell L, White S. Anaesthetic management of patients with hip fractures: an update. *Contin Educ Anaesth Crit Care Pain*. 2013;13:179–83.
- Rossaint R, Bouillon B, Cerny V, Coats TJ, Duranteau J, Fernández-Mondéjar E, et al. The European guideline on management of major bleeding and coagulopathy following trauma: fourth edition. *Crit Care*. 2016;20:1–55.
- Muñoz M, Gómez-Ramírez S, Cuenca J, García-Erce JA, Iglesias-Aparicio D, Haman-Alcober S, et al. Very-short-term perioperative intravenous iron administration and postoperative outcome in major orthopedic surgery: a pooled analysis of observational data from 2547 patients. *Transfusion*. 2014;54:289–99.
- Leal-Noval SR, Muñoz M, Asuero M, Contreras E, García-Erce JA, Llau JV, et al. Documento Sevilla de Consenso sobre Alternativas a la Transfusión de Sangre Allogénica. Actualización del Documento Sevilla. *Med Intensiva*. 2013;37:259–83.
- Lawrence VA, Silverstein JH, Cornell JE, Pederson T, Noveck H, Carson JL. Higher Hb level is associated with better early functional recovery after hip fracture repair. *Transfusion*. 2003;43:1717–22.
- Farrow LS, Smith TO, Ashcroft GP, Myint PK. A systematic review of tranexamic acid in hip fracture surgery. *Br J Clin Pharmacol*. 2016;82:1458–70.
- Prasad N, Rajamani V, Hullin D, Murray JM. Post-operative anaemia in femoral neck fracture patients: does it need treatment? A single blinded prospective randomised controlled trial. *Injury*. 2009;40:1073–6.
- Friedman R, Homering M, Holberg G, Berkowitz SD. Allogeneic blood transfusions and postoperative infections after total hip or knee arthroplasty. *J Bone Joint Surg Am*. 2014;96:272–8.
- Potter LJ, Doleman B, Moppett IK. A systematic review of pre-operative anaemia and blood transfusion in patients with fractured hips. *Anaesthesia*. 2015;70:483–500.
- Brunskill SJ, Milette SL, Shokoobi A, Pulford EC, Doree C, Murphy MF, et al. Red blood cell transfusion for people undergoing hip fracture surgery [review]. *Cochrane database Syst Rev*. 2015;CD009699.
- Guay J, Parker MJ, Gajendragadkar PR, Kopp S. Anaesthesia for hip fracture surgery in adults. *Cochrane Database Syst Rev*. 2016;CD000521.
- González-Montalvo JI, Alarcón T, Hormigo Sánchez AI. ¿Por qué fallecen los pacientes con fractura de cadera? *Med Clin (Barc)*. 2011;137:355–60.
- Alarcón T, González-Montalvo JI. Fractura de cadera en el paciente Mayr. *Rev Esp Geriatr Gerontol*. 2010;45:167–70.
- Pareja Sierra T, Bartolomé Martín I, Rodríguez Solís J, Bárcena Goitiandia L, Torralba González de Suso M, Morales Sanz MD, et al. Factores determinantes de estancia hospitalaria, mortalidad y evolución funcional tras cirugía por fractura de cadera en el anciano. *Rev Esp Cir Ortop Traumatol*. 2017;61:427–35.
- Shiga T, Wajima Z, Ohe Y. Is operative delay associated with increased mortality of hip fracture patients? Systematic review, meta-analysis, and meta-regression. *Can J Anaesth*. 2008;55:146–54.
- Khan SK, Kalra S, Khanna A, Thiruvengada MM, Parker MJ. Timing of surgery for hip fractures: a systematic review of 52 published studies involving 291,413 patients. *Injury*. 2009;40:692–7.

34. Reyes C, Estrada P, Nogués X, Orozco P, Cooper C, Díez-Pérez A, et al. The impact of common co-morbidities (as measured using the Charlson index) on hip fracture risk in elderly men: a population-based cohort study. *Osteoporos Int*. 2014;25:1751–8.
35. Sanz-Reig J, Salvador Marín J, Ferrández Martínez J, Orozco Beltrán D, Martínez López JF. Factores de riesgo para la demora quirúrgica en la fractura de cadera. *Rev Esp Cir Ortop Traumatol*. 2017;61:162–9.
36. Ryan DJ, Yoshihara H, Yoneoka D, Egol KA, Zuckerman JD. Delay in hip fracture surgery. An analysis of patient-specific and hospital-specific risk factors. *J Orthop Trauma*. 2015;29:343–8.
37. Mesa-Lampré MP, Canales-Cortés V, Castro-Vilela ME, Clerencia-Sierra M. Puesta en marcha de una unidad de ortogeriatría. *Rev Esp Cir Ortop Traumatol*. 2015;59:429–38.
38. Kenzora JE, McCarthy RE, Lowell JDSC. Hip fracture mortality. Relation to age, treatment, preoperative illness, time of surgery, and complications. *Clin Orthop Relat Res*. 1984;186:45–56.
39. Bardales Mas Y, González Montalvo JI, Abizanda Soler P, Alarcón Alarcón MT. Guías clínicas de fractura de cadera. Comparación de sus principales recomendaciones. *Rev Esp Geriatr Gerontol*. 2012;47:220–7.
40. Swift C, Ftouh S, Langford P, Chesser TS, Johanssen A. Interdisciplinary management of hip fracture. *Clin Med J R Coll Physicians (London)*. 2016;16:541–4.
41. Australian and New Zealand Hip Fracture Registry (ANZHFR) Steering Group. Australian and New Zealand Guideline for Hip Fracture Care: Improving outcomes in hip fracture management of adults. Sydney: Australian and New Zealand Hip Fracture Registry Steering Group; 2014. Available from: <https://anzhfr.org/wp-content/uploads/2016/07/ANZ-Guideline-for-Hip-Fracture-Care.pdf>
42. Scottish Intercollegiate Guidelines Network (SIGN). Prevention and management of hip fracture in older people: a national clinical guideline; 2009. Available from: <https://www.sign.ac.uk/assets/sign111.pdf>
43. Brenner S. Optimal timing to begin an active rehabilitation program after a hip fracture: a rapid review. Toronto: Health Quality Ontario (HQO); 2013. Rapid Review. Available from: <http://www.hqontario.ca/Portals/0/Documents/eds/rapid-reviews/hip-fracture-rehabilitation-program-130419-en.pdf>
44. Mas-Atance J, Marzo-Alonso C, Matute-Crespo M, Trujillano-Cabello JJ, Català-Tello N, de Miguel-Artal M, et al. Estudio comparativo aleatorizado de la intervención quirúrgica temprana frente a la demorada en los pacientes con fractura de cadera tratados con antiagregantes plaquetarios. Determinación de la agregabilidad plaquetaria y el sangrado perioperatorio, y la revisión de la mortalidad al año. *Rev Esp Cir Ortop Traumatol*. 2013;57:240–53.