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Impact of time to surgery in upper femoral fracture in orthogeriatrics

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ABSTRACT

Introduction: Treatment of hip fracture in the elderly is a major public health issue. Orthogeriatric departments have been developed for these patients at high risk of complications. Time to surgery seems to be an important factor in the care pathway, but remains controversial.
Objectives: The aim of this study was to assess the impact of less than 24 hours' time to surgery on 1-year morbidity and mortality in patients managed in our orthogeriatric department.
Hypothesis: The study hypothesis was that < 24 hours' time to surgery decreases mortality in elderly patients with upper femoral fracture.
Materials and methods: A retrospective cohort study from September 2015 to July 2016 included patients aged 75 years and older, eligible for orthogeriatric management of upper femoral fracture. Patients with comorbidities were prioritized for admission and for access to the operating room. Time to surgery was defined as time between the arrival in A&E and transfer to the operating room. The primary endpoint was 1-year survival. Comorbidities were assessed on Charlson score. ROC curve analysis determined the optimal cut-off for time to surgery. Variables significantly associated with mortality were included in a Cox regression model to estimate the adjusted effect of time to surgery on mortality.
Results: One hundred and eight patients were included; mean age, 87 ± 6.2 years; 26 male (24.1%), 82 female (75.9%). One-year mortality was 24.1% (26/108). Mean time to surgery was 14.1 ± 30.9 hours. ROC curve analysis showed a rise in mortality after a cut-off of 22 hours 37 minutes ($p < 0.0001$).
Conclusion: Within a dedicated orthogeriatric department, time to surgery is a significant factor in the management of hip fractures in the elderly. Patients should be prioritized for theater and ideally receive "early" surgery within 24 hours of admission to A&E. The potential benefit of "ultra-early" surgery (time to surgery < 6 hours) requires robust assessment.
Level of evidence: IV, Retrospective cohort study.

1. Introduction

Orthogeriatric structures have proved effective in post-operative management of upper femoral fracture in the elderly [1,2]. This population of patients is constantly increasing, constituting a major public health issue. Worldwide, there are 1.6 million hip fractures each year [3]. Consequences are severe, with around 30% 1-year mortality in over-75 year-olds [4].

Several factors affect mortality: age, comorbidity, and the care pathway, in which teamwork between surgeons and geriatricians has shortened the interval to surgery and improved survival for these fragile patients [5]. Time to surgery remains a controversial factor, and varies widely between centers. It has important impact, as shown in the meta-analysis by Simunovic et al. [6], where mortality decreased significantly as time to surgery decreased from 72 to 48 and 24 hours ($p = 0.01$). An on-going international trial, Hip Attack [7], is analyzing the relevance of early surgery (within 6 hours) as its main endpoint.

Optimizing the multidisciplinary orthogeriatric pathway has accelerated our time to surgery, with benefit for the patient and from a practical point of view, as the orthogeriatric department is located at a distance from the A&E department and from the operative rooms, thus requiring patient transfer by ambulance. The aim of the present study was to assess the impact of < 24 hours' time to surgery on 1-year morbidity and mortality in patients managed in the orthogeriatric department. A second analysis concerned

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"ultra-early" surgery, within 6 hours of admission. The study hypothesis was that < 24 hours' time to surgery decreases mortality in elderly patients with upper femoral fracture.

2. Materials and Methods

A single-center retrospective cohort study in the university hospital center of Poitiers (France) included all patients managed for upper femoral fracture in orthogeriatrics between September 2015 and July 2016, with 1 year's follow-up.

2.1. Orthogeriatric population

Included patients were aged ≥ 75 years, and presented with upper femoral fracture (femoral neck or pertrochanteric), operated on after admission via the accident and emergency department. Anti-vitamin K or antiplatelet treatment (Kardégic® and/or Plavix®) was not an exclusion criterion. In coordination with the emergency department anesthetist, the surgeon sought to schedule surgery within 6 hours of making the indication. Patients were prioritized according to comorbidity. Orthogeriatric patients not operated on the same day were scheduled first on the following day's surgery list, so as not to jeopardize their admission in the orthogeriatric department.

Exclusion criteria comprised new oral anticoagulant (Xarelto®, Eliquis®, Pradaxa®), Efient® or Brilique® therapy, in which surgery was postponed.

2.2. Data collection

Data were harvested from medical files, or by telephone if there had been no follow-up consultation by 1 year.

Time to surgery was measured as the exact time between arrival in the A&E department and transfer to theater, according to the computerized medical data. The main endpoint was 1-year mortality. Comorbidities were assessed on Charlson score [8]. Postoperative morbidity was assessed from all-cause readmission and fracture recurrence at 1 year and from change of residence (reflecting loss of autonomy).

2.3. Statistics

The variable "time from arrival in A&E to transfer to theater" was analyzed in 89 patients. Nineteen patients had had a fall in the 24 hours before arrival in A&E, constituting a major bias, and were therefore excluded from main endpoint analysis. One patient was lost to follow-up. ROC (receiver operating characteristic) curve analysis determined the optimal time-to-surgery cut-off predictive of 1-year mortality. Univariate analysis (log-rank test, Kaplan-Meier estimator) determined the impact of A&E wait time on mortality, and significantly associated variables were included in a Cox logistic regression model to assess adjusted impact.

3. Results

108 patients were included, with a mean age of 87 ± 6.2 years. Mean time to surgery was 14.1 ± 30.9 hours. One-year mortality was 24.1%. Patients most frequently received partial hip replacement (48.1%), on a minimally invasive Röttinger approach (64.1%). There was no significant difference in blood loss according to approach (Röttinger, Hardinge, or Moore), or in 1-year mortality according to partial hip replacement versus nail or screw internal fixation ($p = 0.37$). In-hospital mortality was 3.7%, cause of death in these 4 cases being respiratory distress on inhalation ($n = 2$), acute intestinal occlusion ($n = 1$) and prosthetic infection ($n = 1$).

Table 1
Demographic and clinical data.

Patient characteristics	Mean (SD)	Frequency
Age (years)	87 (6.2)	
Gender (male/female)		M: 24.1% (26/108) F: 75.9% (82/108)
Charlson score	1.6 (1.9)	
0 (12% 1-year mortality)		3.6% (1/28)
1–2 (26% 1-year mortality)		24.1% (14/58)
3–4 (52% 1-year mortality)		35.7% (5/14)
>4 (85% 1-year mortality)		75.0% (6/8)
Time to surgery (hours)	14.1 (30.9)	
Time to surgery <6 hours		31.5% (34/108)
In-hospital mortality		3.7% (4/108)
1-month mortality		5.6% (6/108)
3-month mortality		10.2% (11/108)
1-year mortality		24.1% (26/108)
Hospital stay (days)	13.3 (8.9)	
Indications for surgery[a]		R: 48.1%, N: 38.9%, S: 13.0%
Minimally invasive hip replacement		64.7% (33/51)
Readmission within year		44.4% (48/108)
New fracture within year		11.1% (12/108)
Change of residence within year		18.5% (20/108)

[a] R: partial hip replacement; N: standard gamma nail; S: femoral neck screwing.

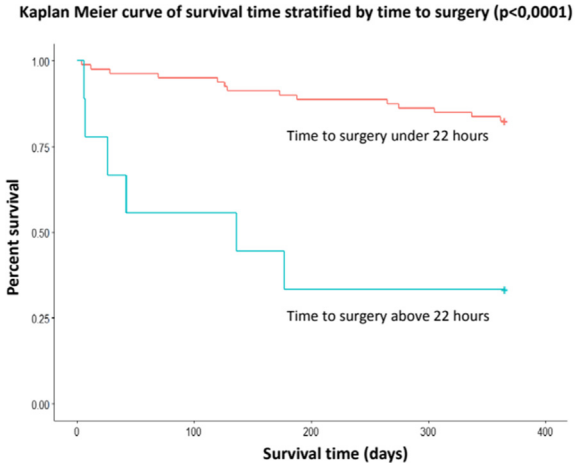

Fig. 1. Kaplan-Meier survival curve according to time to surgery ($p < 0.0001$).

Surgery-related complications comprised 1 periprosthetic fracture, 1 implant dislocation requiring totalization, 1 neck screw displacement, and 1 early prosthetic infection. Table 1 shows surgical and demographic data.

On ROC curve analysis, time to surgery was only weakly discriminative for 1-year post-trauma mortality (AUC = 0.57; 95%CI = [0.38;0.71]) and did not predict survival (i.e., low specificity). On the other hand, mortality rose after 22 hours 37 minutes ($p < 0.0001$), as seen in the survival curve (Fig. 1): 6 of the 9 patients operated on later than 22 hours 37 minutes after admission to A&E died, and this survival analysis thus determined a cut-off of 22 hours 37 minutes.

Relative risk analysis showed that A&E wait time before surgery was significantly longer in patients receiving implant surgery ($p = 0.02$) (Table 2).

Relative risk of death was greater in case of comorbidity ($p = 0.001$). Age was not significantly associated with mortality, perhaps due to the low variance in age in the series (Table 3). Cox

Table 2
Relative risk of A&E wait time adjusted by covariables.

Variable	Exponential (coefficient)	95%CI	*p*-value
Age	0.99	[0.96; 1.03]	0.78
Charlson score	0.99	[0.84; 1.15]	0.87
Preoperative CBC (g/dL)	1.11	[0.98; 1.26]	0.11
Hip replacement	0.37	[0.15; 0.86]	0.02
Pertrochanteric fracture	0.69	[0.30; 1.46]	0.37

CBC: complete blood count.

Table 3
Relative risk of death adjusted by covariables.

Variable	Exponential (coefficient)	95%CI	*p*-value
Age	1.07	[0.98; 1.17]	0.15
Charlson score	1.34	[1.12; 1.59]	0.001
Preoperative CBC (g/dL)	1.07	[0.85; 1.34]	0.57
Hip replacement	1.45	[0.59; 3.56]	0.41
Pertrochanteric fracture	0.89	[0.36; 2.22]	0.81

CBC: complete blood count.

Table 4
Relative risk of death adjusted by covariables significantly and clinically related to mortality.

Variable	Exponential (coefficient)	95%CI	*p*-value
Logarithm of wait time	1.50	[0.93; 2.41]	0.093
Charlson score	1.42	[1.18; 1.70]	0.0002
Age	1.06	[0.97; 1.15]	0.17

Table 5
Comparison of mortality, Charlson score and hospital stay according to time to surgery (<6 hours, 6–22 hours, >22 hours).

Time to surgery	<6 hours (n = 29)	6–22 hours (n = 51)	> 22 hours (n = 9)	*p*-value
Charlson score (SD)	1 (1)	1 (2)	1 (2)	0.16
1-year mortality	24.1% (7/29)	13.7% (7/51)	66.7% (6/9)	0.004
Hospital stay (days) (SD)	10 (4)	12 (4)	12 (3)	0.6

analysis of the adjusted effect of wait time on survival revealed poorer survival with longer time to surgery ($p = 0.093$) (Table 4).

Mortality, Charlson score and hospital stay were compared between 3 groups: group 1 with < 6 hours' time to surgery; group 2 with 6–22 hours; and group 3 with > 22 hours. Mortality was greater in group 1 (< 6 hours) than in group 2 (6–22 hours) (Table 5).

4. Discussion

The present study showed significantly better survival in patients operated on before 22 hours 37 minutes ($p < 0.0001$) in orthogeriatrics (Fig. 1). This may because confinement to bed and preoperative stress following hip fracture incur extra risk of cardiovascular, respiratory, thrombotic and infectious complications [9–11]. Management in orthogeriatrics was accelerated, with mean time to surgery of 14.1 hours between admission in A&E and transfer to theater. 31.5% of patients (34/108) had less than 6 hours' wait time. There are few reports of series with similar times to surgery. A single observational study [12], not in an orthogeriatric context, had comparable times, with a mean 12 hours; in-hospital mortality was lower in surgery performed within 12 hours (adjusted OR, 3.9; $p < 0.05$). Time to surgery is not measured in a standardized homogeneous fashion in the literature. It is often calculated between diagnosis of fracture and surgery. The present study included the time spent in the A&E department between admission and diagnosis, as this is a non-negligible management factor that varies greatly depending on the particular center's logistics. Our approach here seems more appropriate, and transposable between centers.

Mortality in our population with a mean age of 87 ± 6.2 years was 10.2% at 3 months and 24.1% at 1 year. In 2008-2009 in France, 1-year mortality after femoral neck fracture was greater than 30% in over-75 year-olds [4]. The rate varies from 20% to 30% in international studies [13,14]. In-hospital mortality was 3.7% (4/108) in the present series, comparable to that reported by Fisher et al., who found significantly lower mortality in an orthogeriatric department than in an orthopedic department: 4.7% versus 7.7% ($p < 0.01$) [15]. The present rate of all-cause readmission was 44.4%, the rate of new fracture was 11.1% and 18.5% of patients changed place of residence in the year following surgery. Readmission was not significantly associated with mortality ($p = 0.45$), and mortality was comparable between hip replacement and internal fixation ($p = 0.37$).

The present study was limited by small sample size and the retrospective design. Moreover, pre-to-post-operative unassisted walking (Parker mobility score) was not analyzed, although this is a factor for mortality [16]. Mortality was higher with < 6 hours' than 6–22 hours' time to surgery (Table 5), which does not support the concept of "ultra-early" surgery (within 6 hours), although the study lacked power to determine the optimal time to surgery.

Multidisciplinary orthogeriatric management seems beneficial, as shown by Boddaert et al., who reported 15% 6-month mortality, versus 24% in orthopedics ($p = 0.04$) [1]. Leung et al. reported 11.5% 1-year mortality in their orthogeriatric department [2]. Other studies confirm this lower mortality in orthogeriatrics [17–20].

Several studies showed the importance of early surgery in reducing mortality [6,21–23]. A meta-analysis by Moja et al., with 35 independent studies including 191,873 patients with 34,448 deaths, found an association between early surgery (24–48 hours) and lower mortality (grouped OR, 0.74; 95%CI = [0.67;0.81]; $p < 0.001$), even after eliminating confounding factors. The most recent study, conducted in Canada with 42,230 patients, found greater 30-day mortality when time to surgery exceeded 24 hours [24]; in this high-powered multicenter study, mean time to surgery was 38.8 ± 28.8 hours. By comparison, in the present series, despite greater age (mean, 87 versus 80 years), 30-day mortality was 5.6% (versus 7%).

The Hip Attack pilot trial [7] sought to determine the feasibility of less than 6 hours' time to surgery in the same kind of patient population. Median time from diagnosis to surgery was 6.0 hours in the accelerated care group and 24 hours in the standard group ($p < 0.001$). At 30 days' follow-up, complications rates were 30% (9/30 patients) versus 47% (14/30 patients), respectively. The pilot study enabled the launch of a high-power multicenter trial to determine the impact of ultra-early surgery [25].

5. Conclusion

The present study of hip fracture, conducted in a multidisciplinary orthogeriatric setting, showed significant reduction in mortality when surgery was performed within 24 hours of arrival in A&E. The specific orthogeriatric organization reduced time to surgery in hip fracture in the elderly. The combination of early surgery and the orthogeriatric care pathway showed real benefit. The interest of "ultra-early" surgery within 6 hours, on the other hand, remains to be proven.

Disclosure of interest

The authors declare that they have competing interest.

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None.

Author contributions

Adrien Delaveau: Study Design, author of the manuscript, data collection, revising.

Florian Saint-Genez: data collection, review of the study.

Amine Ounajim: Methodology and Statistics.

Louis-Etienne Gayet, Marc Paccalin, Tanguy Vendeuvre: Study Design, review of the study.

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