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Causes and Effects of Surgical Delay in Patients With Hip Fracture

A Cohort Study

María T. Vidán, MD, PhD; Elisabet Sánchez, MD; Yassira Gracia, RN; Eugenio Marañón, MD; Javier Vaquero, MD, PhD; and José A. Serra, MD, PhD

Background: The clinical effect of surgical delay in older patients with hip fracture is controversial. Discrepancies among study findings may be due to confounding that is caused by the reason for the delay or a differential effect on patient risk subgroups.

Objective: To assess the effect of surgical delay on hospital outcomes according to the cause of delay.

Design: Prospective cohort study.

Setting: A hip fracture unit in a university hospital in Spain.

Patients: 2250 consecutive elderly patients with hip fracture.

Measurements: Time to surgery, reasons for surgical delay, adjusted in-hospital death, and risk for complications.

Results: Median time to surgery was 72 hours. Lack of operating room availability (60.7%) and acute medical problems (33.1%) were the main reasons for delays longer than 48 hours. Overall, rates of hospital death and complications were 4.35% and 45.9%, respectively, but were 13.7% and 74.2% in clinically unstable patients. Longer delays were associated with higher mortality rates and rates of medical complications. After adjustment for age, dementia, chronic comorbid conditions, and functionality, this association did not persist for delays of 120 hours or less but did persist for delays longer than 120 hours ($P = 0.002$ for overall time effect on death and 0.002 for complications). The risks were attenuated after adjustment for the presence of acute medical conditions as the cause of the delay ($P = 0.06$ for time effect on mortality and 0.31 on medical complications). Risk for urinary tract infection remained elevated (odds ratio, 1.54 [95% CI, 0.99 to 2.44]). No interaction between delay and age, dementia, or functional status was found.

Limitation: This was a single-center study without postdischarge follow-up.

Conclusion: The reported association between late surgery and higher morbidity and mortality in patients with hip fracture is mostly explained by medical reasons for surgical delay, although some association between very delayed surgery and worse outcomes persists.

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For author affiliations, see end of text.

The issue of whether early surgery to treat hip fracture is beneficial in terms of clinical outcomes remains controversial. A general assumption in clinical practice is that surgery should take place as soon as possible after fracture and preferably within 24 hours. Guidelines on hip fracture management from various countries recommend surgery in the first 24 hours after fracture (1, 2). However, this recommendation is not based on solid evidence of clinical benefit, and some authors suggest that surgical delay cannot strictly be considered a quality indicator (3).

Some studies have shown early surgery to be associated with lower rates of in-hospital (4) and 1-year mortality (5–9), although other important cohort studies (10–12) and population-based studies (3, 13) revealed no benefit of early surgery in reducing mortality or improving functional recovery (10). A recent meta-analysis concluded that early surgery was associated with a lower risk for death and some specific complications (14). However, a systematic review showed that studies performed with a more careful methodology were less likely to report a beneficial effect of early surgery, particularly on mortality (15). Most studies used 24 or 48 hours as a cutoff for the definition of "early surgery" and adjusted the results for age and comorbid conditions. However, the reasons for the delay in surgery are often unknown. This is of key importance, because these reasons may be major confounders in the analysis of their effect on outcomes.

Moreover, it is unclear whether the effect of a delay differs in patients who are in theory more vulnerable, such as those with poor baseline functional status, those with dementia, and very elderly patients. Although these conditions are independently associated with an increased risk for postsurgical complications (16–19), the existence of an interaction between them and surgical delay has not been addressed. The demand for early surgery often exceeds available resources, and considerable variability among hospitals in time to surgery has been reported (4). Confirmation of the clinical consequences of surgical delay on different patient groups could help in the decision-making process when not all patients can be operated on as early as desired.

We prospectively analyzed a large cohort of patients admitted for surgery to the hip fracture unit of a university hospital between 2003 and 2008 to assess the effect of

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delay in surgery on in-hospital outcomes and the reasons for delay.

METHODS

The study sample comprised all patients who were consecutively admitted to the hip fracture unit of Hospital General Universitario Gregorio Marañón in Madrid, Spain, between August 2003 and September 2008. Admission to the unit is reserved for patients aged 65 years or older with planned surgery after a hip fracture. The unit is managed by surgeons, geriatricians, and nurses who visit and care for patients daily. Several baseline variables were collected from the medical records and patient clinical evaluation. These included previous hip fracture; prefracture living situation; and history of heart disease, chronic obstructive pulmonary disease, diabetes, hypertension, cancer, and dementia. Data on treatment and outcome variables were prospectively collected in all cases.

Prefracture functional status was assessed by asking the patient about independence in 6 basic activities of daily living (bathing, dressing, transfer from bed to chair, toileting, continence, and eating) 2 weeks before fracture. Each item was scored as 1 (complete independence) or 0 (need for personal assistance or dependence) (20). Baseline prefracture locomotion was assessed by using the Functional Ambulation Classification scale (21), which classifies ability to walk independently on a scale of 0 (no ambulation) to 5 (completely independent). In our study, we considered a score of 4 (independent on a flat floor) or 5 (independent on a flat floor and stairs) to indicate independent ambulation. Functional ability information was collected from proxies if the patient was cognitively impaired. Time from admission to surgery (in hours) was recorded in all cases.

All patients received a presurgical geriatric evaluation by the geriatrician and the nurse involved in the regular care of patients admitted to the unit. When surgery was delayed for more than 48 hours, the main cause of the delay was collected according to the following classification: 1) lack of available operating room; 2) current treatment with antiplatelet drugs that had to be interrupted before surgery at the anesthesiologist's request; 3) need for preoperative study (echocardiography or any other test) indicated by the anesthesiologist; 4) clinical instability (defined as decompensated heart failure, pneumonia, acute renal failure, marked electrolyte abnormality, or any other acute medical reason considered by the geriatrician or anesthesiologist to be a contraindication for early surgery); 5) lack of stored blood for transfusion if necessary; or 6) delay in signing the informed consent or other organizational reasons. If more than 1 reason was present, the main reason was registered according to the following order of priority, from most important to least important: clinical instability, antiplatelet treatment, preoperative study needed, lack of stored blood, lack of operating room. The assessment was made by a specialist geriatrics nurse and the geriatrician involved in patient care.

Context

When patients with hip fractures are eligible for surgery, many clinicians encourage operating with minimal delay, although it is unclear from previous studies whether shorter delays lead to better outcomes.

Contribution

After adjustment for acute medical conditions, surgical delays were not associated with in-hospital mortality or medical complications other than urinary tract infections.

Caution

Bias is difficult to detect in observational studies, such as this one.

Implication

Early surgery may be the better choice for patients with hip fracture and no acute medical conditions, but the optimal time for surgery in other patients has not been determined.

—The Editors

Outcomes

Postsurgical medical complications were prospectively assessed and recorded every working day by the geriatric nurse. Major medical complications were delirium (defined by using the Confusion Assessment Method) (22), pneumonia (respiratory symptoms and compatible radiographic abnormalities), heart failure, urinary tract infection, and pressure sores not present at admission. Other complications were also recorded, including urine retention, severe pain (requiring a larger dosage of analgesics than prescribed by the clinical protocol currently used in the unit), severe depressive symptoms (requiring specific medical treatment), electrolyte abnormalities, need for blood transfusion, and surgical complications (local superficial or deep infection, prosthesis luxation, fixation instability, and need for reintervention). Mortality during admission and length of in-hospital stay were recorded.

Statistical Analysis

Data are reported as means (SDs) or medians as appropriate for continuous variables and number (percentage) for categorical variables. The primary independent variable was delay to surgery, which was categorized into 5 groups for risk estimation: 48 hours or less, 49 to 72 hours, 73 to 96 hours, 97 to 120 hours, and more than 120 hours. We compared crude rates of in-hospital mortality and complications among the delay categories by using the chi-square test and the length of hospital stay with analysis of variance.

The independent effects of delay in surgery on in-hospital mortality and complications were evaluated by using logistic regression analysis. Time to surgery was in-

Table 1. **Patient Characteristics**

Characteristic	All Patients (*n* = 2250)	Stratified by Time to Surgery					*P* Value
		≤48 h	48–72 h	73–96 h	97–120 h	>120 h	
Mean age (SD), *y*	83.6 (7.2)	83.9 (7.3)	84 (6.6)	83.1 (7.4)	82.8 (7.3)	83.1 (7.2)	0.056
Women, *n (%)*	1840 (81.8)	668 (84.7)	384 (85.5)	294 (79.2)	173 (82.0)	320 (75.3)	<0.001
Resident of a nursing home, *n (%)*	463 (20.6)	171 (21.6)	100 (22.2)	74 (20)	33 (15.9)	85 (20.1)	0.51
Prefracture comorbid condition, *n (%)*							
Heart disease	713 (31.7)	166 (21)	133 (29.6)	126 (33.8)	86 (41.3)	202 (47.5)	<0.001
Diabetes mellitus	539 (24.0)	172 (21.9)	109 (24.3)	89 (23.9)	59 (28.2)	110 (25.9)	0.06
Cancer	320 (14.2)	103 (13.1)	59 (13.2)	56 (15.1)	23 (11)	79 (18.6)	0.045
Dementia	734 (32.6)	259 (32.9)	141 (31.5)	109 (29.2)	68 (32.2)	157 (36.9)	0.26
COPD	222 (9.9)	53 (6.7)	48 (10.7)	43 (11.5)	21 (10.0)	57 (13.4)	0.02
Chronic comorbid conditions, *n*	3.62 (1.94)	3.17 (1.8)	3.51 (1.8)	3.75 (1.9)	4.07 (2.0)	4.22 (2.0)	<0.001
Dependence for any ADL, *n (%)*	1521 (67.7)	517 (65.4)	302 (67.4)	248 (66.5)	141(67.1)	313 (73.6)	0.061
Dependence for ambulation, *n (%)*	506 (22.5)	182 (23.0)	94 (21.0)	83 (22.3)	50 (23.9)	97 (22.9)	0.91
Type of hip fracture, *n (%)*							0.016
Femoral neck	912 (40.5)	315 (39.9)	181 (40.2)	140 (37.5)	80 (37.9)	196 (46.1)	
Intertrochanteric	1089 (48.4)	398 (50.4)	211 (46.9)	194 (52.0)	110 (52.1)	176 (41.4)	
Subtrochanteric	129 (5.7)	44 (5.6)	38 (8.4)	14 (3.8)	9 (4.3)	24 (5.6)	
Other	117 (5.2)	32 (4.1)	20 (4.4)	25 (6.7)	11 (5.2)	29 (6.8)	
ASA risk for early mortality, *n (%)**							
Class III	716 (47.6)	173 (39.2)	131 (45.1)	140 (50.0)	74 (51.0)	198 (56.9)	<0.001
Class IV	90 (6.0)	14 (3.2)	9 (3.1)	11 (3.9)	12 (8.3)	44 (12.6)	<0.001
Regional anaesthesia, *n (%)*	2112 (93.9)	738 (93.4)	425 (94.4)	354 (94.9)	197 (93.4)	398 (93.4)	0.89

ADL = activities of daily living; ASA = American Society of Anesthesiology; COPD = chronic obstructive pulmonary disease.
* Collected only in patients admitted from July 2005 to December 2008 (*n* = 1504).

cluded as a categorical variable, with surgery in 48 hours as the reference group for comparisons. In the first step, we included the patient characteristics and chronic conditions known to be relevant for the outcomes in the model; these were age (as a continuous variable), dementia, presence of prefracture disability for any activity of daily living, and number of chronic diseases. In the second step, we introduced acute clinical reason as the main cause of surgical delay. This variable is the result of grouping the main reasons for delay to surgery into 2 categories: "presence of any acute medical reason," which includes clinical instability, need for echocardiography or other preoperative studies, and need for interruption of antiplatelet treatment, and "absence of acute medical reason," which encompasses all other categories or delay in surgery of 48 hours or less. Unadjusted and adjusted odds ratios (ORs) with 95% CIs were calculated. The interactions between time and age, dementia, independence in activities of daily living, and prefracture independent ambulation were tested in the logistic regression analysis.

Sensitivity analyses were performed in which the logistic regression analyses were repeated only in the subgroup of patients for whom there was no clinical reason to justify the delay (those who received surgery within 48 hours or less and those in whom the delay was due to nonmedical reasons). Fifty patients with a delay in surgery greater than 48 hours and in whom the main reason for the delay was not recorded were not included in the logistic regression analyses. All analyses were performed by using SPSS software, version 15 (SPSS, Chicago, Illinois).

Role of the Funding Source

The study received no external funding.

Results

During the study period, 2283 patients aged 65 to 104 years were admitted to the hip fracture unit; 33 patients did not undergo surgery and were excluded from the analysis. **Table 1** shows the characteristics of the 2250 included patients, stratified by surgical delay. Patient characteristics differed by duration of delay: Longer delays were more common in men; patients who had heart disease, chronic obstructive pulmonary disease, or previous cancer; and those with higher surgical risk according to the American Society of Anesthesiologists classification. Median time to surgery was 72 hours. Only 56 patients (2.5%) underwent immediate surgery; 311 (13.8%) had surgery within 24 hours of admission, and 1459 (64.9%) had surgery more than 48 hours after admission.

Overall, 98 patients (4.35%) died and 1031 (45.9%) had at least 1 postsurgical medical complication during hospitalization. **Table 2** shows the relationship between time to surgery and in-hospital outcomes. Higher mortality rates were seen with delays longer than 120 hours. Unadjusted analyses also showed that longer delays to surgery were associated with higher rates of major medical complications. Although a time-related trend was observed, it did not show a linear pattern. Patients with longer surgical delays also had longer in-hospital stays; this was mostly due to preoperative waiting time because length of postsurgery stay was similar for all time frames.

Table 2. **In-Hospital Outcomes After Hip Fracture, by Time to Surgery**

Variable	Patients, *n*	Outcome			
		In-Hospital Mortality, *n (%)*	Major Medical Complications, *n (%)*	Median In-Hospital LOS (IQR), *d*	Median Postsurgery LOS (IQR), *d*
Overall	2249	98 (4.35)	1031 (45.9)	10 (7–14)	7 (4–10)
Time to surgery					
≤24 h	311	15 (4.8)	124 (40.1)	7 (5–11)	7 (4.5–11)
25–48 h	479	14 (2.9)	202 (42.2)	9 (7–12)	7 (5–11)
49–72 h	450	11 (2.4)	203 (45.1)	9 (7–12)	7 (4–9)
73–96 h	373	17 (4.6)	177 (47.6)	10 (8–13)	7 (4–10)
97–120 h	211	7 (3.3)	96 (45.7)	12 (9–15)	7 (4–10)
>120 h	425	34 (8.0)	229 (54.3)	13 (11–18)	6 (4–10)
P value*		0.004	0.001	0.001	0.35

IQR = interquartile range; LOS = length of stay.
* *P* values for linear trends of crude rates are presented.

Table 3 shows the reasons for surgical delays longer than 48 hours and the associated mean delays. Lack of an available operating room for programmed surgery (60.7%) and acute medical reasons (33.1%)—which included the need to interrupt antiplatelet treatment (16.8%), need for echocardiography or other examinations (7.8%), and clinical instability (8.5%)—were the most frequent causes for delay. Longer delays and poorer outcomes were observed in patients who were clinically unstable on admission, of whom 13.7% died and 74.2% had a major medical complication during hospitalization (compared with 3.7% and 41.4%, respectively, among patients who had surgery within the first 48 hours; $P < 0.001$ for both comparisons).

Older age, dementia, and prefracture dependence in activities of daily living were also associated with higher rates of medical complications (**Table 4**). Analysis of each postoperative complication according to delay categories revealed an increase in the rate of pneumonia, heart failure, urinary tract infection, and pressure sores among patients for whom surgery was delayed for more than 5 days (**Appendix Table 1**, available at www.annals.org).

Logistic regression analysis showed that only delays to surgery longer than 120 hours remained associated with higher risk for mortality after adjustment for age, dementia, chronic comorbid conditions, and prefracture functional status (OR, 2.14 [95% CI, 1.25 to 3.63]). An increase in the adjusted risk for major medical complications was also observed (OR, 1.66 [CI, 1.27 to 2.17]). However, when "acute medical reasons" for delay was included in the model (model 2), the effect of time to surgery was clearly attenuated and did not reach statistical significance (OR, 1.46 [CI, 0.75 to 2.85] for mortality and 1.21 [CI, 0.89 to 1.66] for any major medical complication). After adjustment for any acute medical reason preventing early surgery (model 2), delays to surgery longer than 120 hours were independently associated only marginally with a higher risk for urinary tract infection (OR, 1.54 [CI, 0.99 to 2.44]).

Analyses of in-hospital mortality were repeated after pooling the delays to surgery into 3 time categories (≤48, 49 to 120, and >120 hours) to balance the number of mortality events among groups. The odds ratios for death in the fully adjusted model (model 2) were 0.70 (CI, 0.40 to 1.23) for delays of 49 to 120 hours versus 48 hours or less, 1.46 (CI, 0.75 to 2.86) for delays longer than 120 hours versus 48 hours or less, and 2.1 (CI, 1.02 to 3.70) for delays less than 120 hours versus 49 to 120 hours ($P =$ 0.029 for the overall time effect), showing a significant association between very long delays and in-hospital mortality.

For 50 patients, the delay to surgery was longer than 48 hours, but the main reason for the delay was not recorded; the baseline characteristics of these patients were similar to those of the overall sample. Results were similar when we repeated the analyses with the assumption that these 50 patients either did or did not have an acute medical reason for the delay. In either case, surgery delayed longer than 120 hours was not statistically associated with an increased risk for death or medical complications; ORs were 1.43 (CI, 0.74 to 2.77) and 1.21 (CI, 0.89 to 1.65),

Table 3. **Reasons for Surgical Delay and Time to Surgery in 1459 Patients Who Had Hip Fracture Surgery More Than 48 Hours After Hospital Admission**

Reason for Surgical Delay	Patients, *n (%)*	Time to Surgery, *h*	
		Median (IQR)	Minimum, Maximum
Lack of operating room availability	885 (60.7)	78 (69–104)	49, 264
Acute medical reason			
Total	483 (33.1)	125 (92–171)	52, 912
Need for interruption of antiplatelet treatment	245 (16.8)	124 (93–168)	60, 480
Need for echocardiography or other examinations	114 (7.8)	120 (81–165)	52, 336
Clinical instability	124 (8.5)	145 (96–235)	56, 912
No blood supply available for transfusion	12 (0.8)	140 (96–183)	72, 216
Delay in signing informed consent	29 (2.0)	120 (87–153)	50, 288
Unknown	50 (3.4)	70 (52–80)	49, 192

IQR = interquartile range.

Table 4. **Adjusted Risk for In-Hospital Death and Major Medical Complications**

Outcome and Complication	Model 1*		Model 2†	
	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value
In-hospital death				
Age	1.06 (1.03–1.09)	0.001	1.06 (1.03–1.10)	0.001
Dementia	0.72 (0.45–1.14)	0.161	0.72 (0.45–1.15)	0.171
Number of comorbid conditions	1.14 (1.03–1.26)	0.013	1.13 (1.02–1.26)	0.021
Dependence for any ADL	1.68 (0.95–2.99)	0.07	1.83 (1.00–3.35)	0.051
Time to surgery		0.002		0.066
≤48 h	Reference		Reference	
49–72 h	0.58 (0.28–1.23)	0.158	0.50 (0.23–1.10)	0.086
73–96 h	1.24 (0.66–2.33)	0.49	0.98 (0.50–1.92)	0.95
97–120 h	0.76 (0.31–1.87)	0.54	0.68 (0.24–1.57)	0.30
>120	2.14 (1.25–3.63)	0.005	1.46 (0.75–2.85)	0.27
Acute medical reason			1.75 (0.98–3.09)	0.056
In-hospital major medical complication				
Age	1.05 (1.04–1.06)	0.001	1.05 (1.04–1.07)	0.001
Dementia	4.16 (3.38–5.13)	0.001	4.19 (3.39–5.18)	0.001
Number of comorbid conditions	1.03 (0.98–1.08)	0.27	1.01 (0.96–1.06)	0.71
Dependence for any ADL	1.56 (1.26–1.95)	0.001	1.49 (1.19–1.86)	0.001
Time to surgery		0.002		0.31
≤48 h	Reference		Reference	
49–72 h	1.19 (0.93–1.55)	0.170	1.06 (0.81–1.39)	0.65
73–96 h	1.48 (1.12–1.95)	0.005	1.31 (0.98–1.74)	0.06
97–120 h	1.21 (0.86–1.71)	0.26	0.98 (0.68–1.40)	0.91
>120 h	1.66 (1.27–2.17)	0.001	1.21 (0.89–1.66)	0.21
Acute medical reason			1.74 (1.33–2.27)	<0.001

ADL = activities of daily living.
* Adjusted for age, dementia, number of chronic comorbid conditions, and prefracture dependence for any ADL.
† Adjusted for the factors in model 1, plus any acute medical reason for delay to surgery.

respectively, if all patients were considered to have an acute medical reason for delay and were 1.51 (CI, 0.79 to 2.93) and 1.23 (CI, 0.91 to 1.68), respectively, if all patients were considered not to have an acute medical reason for delay.

Sensitivity analyses of patients who were eligible for early surgery on admission (those who had surgery within 48 hours or who had no medical reasons to justify surgical delay) showed that time to surgery was not associated with an increased risk for in-hospital mortality or medical complications (**Appendix Table 2**, available at www.annals.org).

Older age, dementia, and prefracture dependence in activities of daily living were associated with higher rates of medical complications in this cohort; however, no interactions were found between time to surgery and age ($P = 0.50$), dementia ($P = 0.168$), or prefracture functional status ($P = 0.78$). The absence of a deleterious effect of delay on mortality and major complications was consistent across subgroups of patients according to age, prefracture diagnosis of dementia, and baseline independence in activities of daily living or locomotion (**Figure 1**).

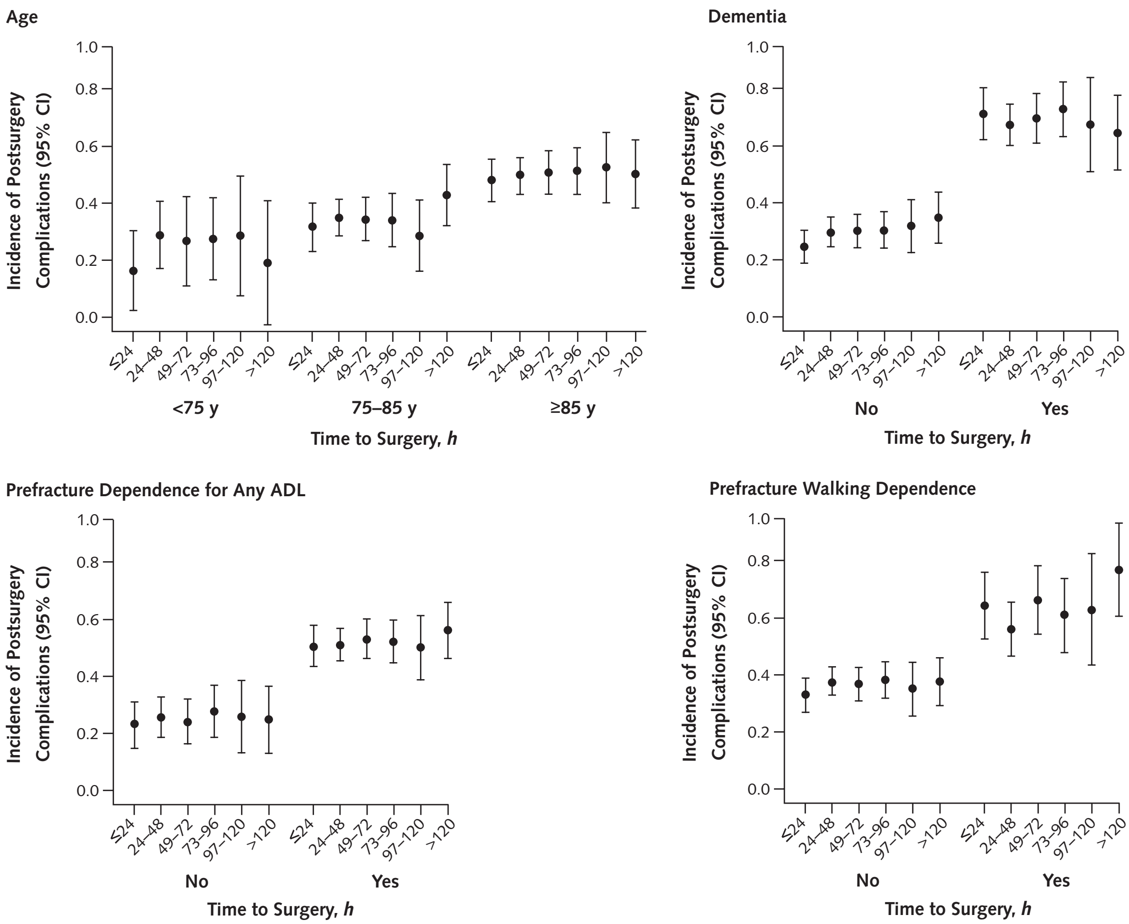
No association was found between time to surgery and the rate of depressive symptoms, blood transfusion, or surgical complications during admission (**Appendix Table 1**). The proportion of patients with severe pain was higher among those who had surgery more than 96 hours after admission, but no differences in the risk for severe pain among delay categories were found in the fully adjusted model.

Discussion

This large prospective study shows that the cause for the delay in surgery explains most of the excess mortality and morbidity risk observed in older patients with hip fracture who do not undergo early surgery. In contrast, longer surgical delays (>5 days) increase length of stay and may be associated with an increased risk for mortality and some complications. We believe our study is the first to demonstrate that the effect of time to surgery in medically stable patients does not differ according to important prognostic factors, such as age, baseline functional impairment, or dementia.

Conflicting results on the relationship between early surgery and survival after hip fracture in older patients have been published (3, 4, 6, 10–13, 15, 23). However, patients who undergo early surgery are usually younger and healthier (3, 4, 24), so the time effect described by others may be a consequence of selection bias. Thus, our results may be helpful to understand the discrepancies among previous studies. We used a progressive approach to clarify the relationship between time to surgery and clinical outcomes. Unadjusted analyses showed that patients who did not un-

Figure. **Effects of delay of hip surgery, by subgroup.**



ADL = activities of daily living.

dergo early surgery were more likely to die or develop postoperative complications, a result that is consistent with studies based on administrative databases (4, 25) and those in which results were adjusted only for chronic comorbid conditions (6, 8, 18). When we adjusted for age, comorbid conditions, and previous functional status, we found no increased risk for death or major medical complications with shorter delays, but the increased risk persisted for very long delays. In a second step, we considered acute medical and logistical reasons for delays. When we adjusted for acute medical reasons, the increased risk for death and major medical complications with very long delays was attenuated.

Our study is one of the largest prospective studies on this topic to date and shows that after adjustment for age, functional status, chronic medical problems, and acute medical problems, the association between very delayed surgery and worse outcomes persists. The strength of the association did not reach traditional levels of statistical significance, however; this is probably because the association is not linear, and the selection of different cutoff points for delay categories produces subtle differences in risk estimations that fluctuate around the threshold for statistical significance. Our study does convincingly demonstrate that the worse clinical condition of patients who experience longer delays explains at least most of the previously reported risk associated with delaying surgery in patients with hip fracture.

Our results are concordant with those of most other studies that either excluded patients with acute medical conditions or adjusted for their effects (3, 10, 26–29). One study (24), however, found that delays to surgery longer than 4 days were associated with an increased risk for 90-day mortality. In addition, a recent meta-analysis (14) concluded that earlier surgery was associated with a lower risk for death, but this conclusion applied only to long-term mortality and did not consider the effect of acute medical problems.

The most frequent reason for surgical delay in our cohort was lack of an available operating room within 48 hours of admission, which accounted for more than one half of the delays. This finding indicates that organizational improvement is needed and represents a target for interventions aimed at improving the efficiency of our model of care.

The need for medical stabilization or presurgical preparation was the second most frequent reason for surgery delay, a finding consistent with previous experiences in other clinical environments (30). The concept of readiness for surgery is not thoroughly standardized. Hip fracture guidelines recommend a short delay when medical stabilization is needed; however, the situations that require a delay, the length of postponement, and the risk for worsening condition if surgery is postponed have not been clearly defined. Consequently, hospitals vary greatly in the length of delay to surgery for similar reasons. Moreover, the Scottish Hip Fracture Audit (31) revealed that only 47% of patients with a major abnormality in whom surgery was postponed at the first preoperative assessment had this problem resolved before they went to surgery. Recommendations on the need for presurgical echocardiography or discontinuation of antiplatelet treatment are more clearly established (32), although the degree of implementation may vary among individual anesthesiologists and hospitals.

In our study, longer delays were due to clinical instability and the need to discontinue antiplatelet therapy. Specifically according to current protocol at our institution, clopidogrel therapy must be stopped 5 to 7 days before surgery for hip fracture with regional anesthesia can be safely performed. The optimal care for patients with hip fracture who are not ready for surgery on admission warrants further research.

Our study has limitations. First, although it was prospective and had predefined categories for causes of delay, the reasons for clinical unsuitability for surgery are not standardized; they include acute medical diseases and any other reason considered by the attending physicians during the preoperative evaluation, which is frequently subjective and therefore variable. Nevertheless, the conservative approach that we used to define readiness for surgery, including only patients with no acute reasons and no discrepancy among physician opinions, should reduce that variability. We demonstrated the effect of delayed surgery on hospital outcomes in patients admitted to a hip fracture unit, where patients receive daily geriatric care. Programs that include geriatric care might neutralize the effect of a delay, given that they are effective in reducing medical complications during hospitalization in older patients with hip fracture (33, 34). In addition, we did not follow patients after discharge; therefore, the effect of surgical delay on long-term clinical or functional outcomes could not be addressed.

In summary, our study demonstrates that most of the short-term excess risk for mortality associated with longer delay to surgery in patients with hip fracture is explained by the cause of the delay and not by the delay itself. However, very long delays increase the length of stay and may increase the risk for mortality and some medical complications. Early surgery seems to be the approach of choice for older patients with hip fracture who have no medical contraindications, but the optimal time for surgery in those with clinical instability is a key issue that needs to be determined.

From Hospital General Universitario Gregorio Marañón, Madrid, Spain.

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Requests for Single Reprints: María T. Vidán, MD, PhD, Department of Geriatric Medicine, Hospital General Universitario Gregorio Marañón, Dr. Esquerdo 46, 28007 Madrid, Spain; e-mail, mvidan.hgugm@salud.madrid.org.

Current author addresses and author contributions are available at www.annals.org.

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Current Author Addresses: Drs. Vidán, Sánchez, Gracia, Marañón, and Serra: Department of Geriatric Medicine, Hospital General Universitario Gregorio Marañón, Dr. Esquerdo 46, 28007 Madrid, Spain.
Dr. Vaquero: Department of Orthopedic Surgery, Hospital General Universitario Gregorio Marañón, Dr. Esquerdo 46, 28007 Madrid, Spain.

Author Contributions: Conception and design: M.T. Vidán, E. Sánchez.
Analysis and interpretation of the data: M.T. Vidán, J.A. Serra.
Drafting of the article: M.T. Vidán.
Critical revision of the article for important intellectual content: M.T. Vidán, J. Vaquero, J.A. Serra.
Final approval of the article: M.T. Vidán, E. Sánchez, Y. Gracia, E. Marañón, J. Vaquero, J.A. Serra.
Provision of study materials or patients: J. Vaquero.
Administrative, technical, or logistic support: Y. Gracia, J. Vaquero.
Collection and assembly of data: M.T. Vidán, E. Sánchez, Y. Gracia, E. Marañón.

Appendix Table 1. **Incidence of Postoperative Complications, by Time to Surgery**

Time to Surgery	Complication, *n* (%)								
	Delirium	Pneumonia	Heart Failure	Urinary Tract Infection	Pressure Sores	Severe Pain	Depressive Symptoms	Transfusion	Surgical Complication
≤48 h	274 (34.8)	29 (3.7)	29 (3.7)	58 (7.4)	52 (6.6)	64 (8.1)	33 (4.2)	342 (44.0)	104 (13.3)
49–72 h	172 (38.2)	12 (2.7)	17 (3.8)	45 (10.1)	23 (5.1)	37 (8.3)	23 (5.1)	19 (42.6)	67 (15.1)
73–96 h	137 (36.7)	20 (5.4)	24 (6.2)	35 (9.4)	25 (6.7)	26 (7.0)	14 (3.8)	151 (40.6)	43 (11.6)
97–120 h	72 (34.3)	14 (6.6)	6 (2.8)	28 (13.3)	17 (8.1)	26 (12.4)	12 (5.7)	85 (40.9)	31 (14.8)
>120 h	159 (37.6)	50 (11.8)	49 (11.6)	65 (15.2)	43 (10.2)	44 (10.4)	17 (4)	181 (42.9)	43 (10.4)
Total	814 (36.3)	125 (5.6)	124 (5.5)	230 (10.3)	160 (7.1)	197 (8.8)	99 (4.4)	950 (42.6)	288 (13.0)
P value*	0.52	<0.001	<0.001	<0.001	0.014	0.092	0.98	0.53	0.178

* For linear trend.

Appendix Table 2. **Adjusted Risk for In-Hospital Death and Major Medical Complications: Sensitivity Analysis After Exclusion of Patients With Acute Medical Reason for Delay**

Outcome and Complication	Odds Ratio (95% CI)	*P* Value
In-hospital death		
Age	1.09 (1.05–1.14)	0.001
Dementia	0.68 (0.37–1.25)	0.20
Number of comorbid conditions	1.17 (1.02–1.34)	0.025
Dependence for any ADL	1.73 (0.82–3.66)	0.152
Time to surgery		0.51
≤48 h	Reference	
49–72 h	0.64 (0.28–1.43)	0.27
73–96 h	0.66 (0.29–1.53)	0.33
97–120 h	1.04 (0.39–2.80)	0.93
>120 h	1.40 (0.61–3.18)	0.42
In-hospital major medical complication		
Age	1.05 (1.03–1.07)	0.001
Dementia	4.36 (3.43–5.54)	0.001
Number of comorbid conditions	1.00 (0.94–1.06)	0.99
Dependence for any ADL	1.52 (1.18–1.96)	0.001
Time to surgery		0.70
≤48 h	Reference	
49–72 h	1.09 (0.82–1.46)	0.53
73–96 h	1.19 (0.88–1.62)	0.26
97–120 h	1.24 (0.74–1.70)	0.58
>120 h	1.24 (0.85–1.81)	0.26

ADL = activities of daily living.