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Factors That Influence Time to Operating Room for Geriatric Hip Fractures: A Quality Improvement Initiative

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ABSTRACT

Background: For geriatric hip fractures, the current American College of Surgeons guideline recommends surgery within 48 hours. We sought to identify which factors delayed a patient's progression to definitive surgery at 2 associated level II trauma centers using chart abstraction.
Methods: We reviewed all geriatric patients who underwent a surgical procedure for a hip fracture. Data regarding age, length of stay, procedure, and minutes from emergency department arrival to operating room (OR) were evaluated. Chart abstraction determined if cardiac or medical clearance and an echocardiogram were obtained. For patients that entered the OR over 24 hours, a reason was identified for the delay. Analysis of variance was used to compare continuous data, and chi-squared tests were used for categorical data.
Results: Of 477 patients, 288 (60%) presented to the OR in under 24 hours, 114 (24%) between 24 and 36 hours, and 75 (16%) over 36 hours. There was a significant increase in length of stay for patients, over 36 hours. Patients presenting to the OR between 24 and 36 hours were often delayed due to facility reasons such as OR or surgeon availability while patients presenting over 36 hours were delayed due to medical comorbidities. Of all patients in the under-24-hours group, 34.7% had an echocardiogram compared with 56.1% and 69.3%, respectively. Similarly, 17.7% of patients received cardiac clearance in the under-24-hours group, compared with 31.8% and 48%, respectively.
Conclusions: The timeliness of presentation of hip fractures to the OR is a multidisciplinary effort and requires cooperation between a variety of services to increase safety and efficiency as well as to control costs.

Introduction

Hip fractures are a significant cause of morbidity in the elderly population. One-year mortality rates are commonly accepted in the 30% range but have been cited as high as 51.6% [1]. When best to perform surgery has long been a topic of debate. For geriatric hip fractures, the current American College of Surgeons guideline recommends surgery within 48 hours [2]. Our state's trauma quality improvement program grades members on timely surgical repair in geriatric isolated hip fractures, with 10 points assigned if greater than 92% of patients enter the operating room (OR) within 48 hours. In a review of 16,177 patients treated with hip fractures from 2008 to 2016 in the state's trauma registry, approximately 52% were surgically treated within 24 hours, 36% between 24 to 48 hours, and 12% >48 hours [3]. Several studies have suggested a benefit with entering the OR sooner than 48 hours. A 2011 study of over 26,051 cases found reduced pulmonary complications with early surgery [4]. A 2017 Canadian study of over 42,000 adults found that surgery within 24 hours of presentation was associated with significantly lower 30-day mortality, fewer postoperative complications, and significantly fewer adverse outcomes at 30 days [5]. One study even suggested that only surgery performed within 12 hours improved the 30-day mortality with

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no differences thereafter [6]. Still, multiple other studies have demonstrated that increased time to surgery did not result in an increase in morbidity but did increase in length of stay (LOS) and overall costs of care [7,8]. When looking at functional outcomes, Orosz et al. demonstrated that early surgery was associated with reduced pain but not a significant difference in functional outcome [9].

Delays in surgery may occur as the result of medical comorbidities. A Danish study of 36,552 hip fractures found an association between the surgery delay and the 30-day mortality in hip fractures in patients with no or one level of medical comorbidity, but no association for patients who had a high comorbidity level [10]. Other studies have shown significant factors that influenced surgical delay including comorbidity score, race, insurance status, hospital region, and day of admission [11]. Our goal was to determine which factors prevented patients from having surgery within 24 hours at 2 affiliated level II trauma centers.

Material and methods

We reviewed all patients aged 55 years and older who underwent a surgical procedure for a hip fracture at 2 affiliated level II trauma centers from March 1, 2018, to June 30, 2020. The department's quality aim was to move a patient to the OR within 24 hours from arrival to the emergency room. We used this study to explore the reasons we were not meeting this goal. Institutional review board approval was acquired through the hospital system prior to initiation of the data abstraction. The 2 hospitals are approximately 20 miles apart and within the same health system. Both hospitals were covered by the same on-call orthopedic surgeon each night. There is a backup call surgeon. There are 2 reserved add-on time slots for orthopedic trauma cases at 07:00 and 15:00 on weekdays and 08:00 on weekends. All hip fractures resulting from a fall were admitted to the trauma surgery service that did have the ability to provide clearance for the OR; alternatively, the primary service may consult other medical services for assistance. The trauma team is responsible for notifying the orthopedic surgeon of the consult. Data regarding age, race, sex, LOS, procedure performed, surgeon, and time in minutes from emergency department (ED) arrival to OR were evaluated. The ED arrival to OR time was categorized as within 24 hours, 24 to 36 hours, or greater than 36 hours. Chart abstraction was performed to determine if cardiac clearance, medical clearance, and/or an echocardiogram were obtained preoperatively. For patients that did not enter the OR within 24 hours, a reason was identified for the delay. Reasons for delay were identified as "medical" or "hospital." Medical included awaiting cardiac clearance, medicine clearance, neurosurgery clearance, pulmonary clearance, pacemaker interrogation, presence of pulmonary embolism or blood thinners, and/or family decision-making issues. Hospital factors included magnetic resonance imaging (MRI) to identify fracture, OR availability, and surgeon availability. There is no pathway at our hospital for when an MRI is necessary. MRI is ordered after a concerning clinical exam by an orthopedic team member in the presence of negative imaging. In addition, some patients were in the OR within 24 hours of their initial radiographic study being read by a radiologist but not within 24 hours of initial presentation to the ED. In addition, some patients entered the OR within 24 hours of the orthopedic surgeon being notified of the consultation.

Analysis of variance was used to compare continuous data, with a Tukey's post-hoc using Microsoft Excel (Redmind, WA). Chi-squared or Fisher's exact test was used to compare categorical data. An alpha of $P = .05$ was used to define significance.

Results

There were 477 operative geriatric hip fractures. Patient characteristics are listed in Table 1. Of these, 288 patients (60%) presented to the OR in under 24 hours, 114 (24%) between 24 and 36 hours, and 75 (16%) at more than 36 hours. Overall, the average time to the OR was 1490.2 minutes (24.84 hours). The average LOS was 4.54 days. There were no significant differences in the LOS between the under-24-hour (4.08) and 24- to 36 (4.36)-hour groups ($P = .3797$). However, there was a significant difference in LOS when comparing those entering the OR over 36 hours (6.59) to both the under-24-hour group and 24- to 36-hour group ($P \leq 0.00001$).

Three common potential reasons for delay include medical clearance, cardiac clearance, and echocardiogram (Table 2). Medical clearance was sought in 48.2% of patients under 24 hours, 77.2% between 24 and 36 hours, and 80% over 36 hours. This was significant between the under 24-hour and 24- to 36-hour ($P = .0001$) and greater than 36-hour ($P = .0001$) groups, but not the 24- to 36-hour and greater than 36-hour groups ($P = .7200$). Of patients requiring medical clearance, only 5 did not have cardiac history. When looking at cardiac clearance, 17.7% of patients required cardiac clearance in the under-24-hour group, compared with 31.8% and 48%, respectively. This was significant between all groups. Preoperatively, 34.7% of patients who went to the OR in under 24 hours had an echocardiogram compared with 56.1% for 24-36 hours and 69.3% for over 36 hours (Table 2).

At site A, 245 patients received medical clearance compared with 42 at site B (Table 3). For both hospitals, the main reason for delay in the 24- to 36-hour group was OR availability (35.1%) while the main reason for delay in the over-36-hour group was surgeon availability (33.3%) (Table 4).

Differences were also seen based on which operative procedure was performed. Patients receiving a hip hemiarthroplasty as compared to a total hip arthroplasty presented to the OR faster ($P = .0001$). There was also a significant difference between closed reduction and percutaneous pinning and intramedullary nailing with closed reduction and percutaneous pinning having surgery earlier (Table 5).

Discussion

Operative delays for hip fracture surgery can increase patient morbidity and mortality. Therefore, as a quality improvement initiative, we sought to characterize the primary contributors to operative delays at our institutions. Our quality aim was to have patients in the OR within 24 hours of presentation to the emergency room. In the group of patients who had surgery between 24 and 36 hours, OR availability was the most identified reason for delay. This was despite a policy that "protected" an OR for just these sorts of cases. The finding was consistent with previous studies that

Table 1
Patient characteristics.

Characteristics	Under 24 h	24-36 h	36+ h
Average age (SD)	80.1 (11.1)	82.4 (11.2)	79.8 (10.9)
% Females	73	68	56
% Caucasian ethnicity	82	82	76
% Obese	29	20	29
Mean LOS (d)	4.1	4.3	6.5

There was a significant difference in total length of stay between both the under-24-h group and 36+-h ($P < .00001$) and the 24- to 36-h group and 36+-h group ($P = .0005$). There was no significant difference between under-24-h and 24- to 36-h groups ($P = .3797$).

Table 2
Cardiac clearance, medicine clearance, and echocardiogram preoperatively.

Time to OR	N (%)	Cardiac clearance preop		Medicine clearance preop		Echocardiogram preop
		Y (%)	N (%)	Y (%)	N (%)	Y (%)
24-36 h	78 (68.4)	36 (31.6)	26 (22.8)	88 (77.2)	50 (43.8)	64 (56.2)
36 h or Greater	39 (52.0)	36 (48.0)	15 (20.0)	60 (80.0)	23 (30.7)	52 (69.3)
Under 24 h	237 (82.3)	51 (17.7)	149 (51.7)	139 (48.3)	188 (65.3)	100 (34.7)
Grand total	354	123	190	287	261	216

For obtaining medical clearance or an echocardiogram preoperatively, there was a significant difference between the under-24-hour group and both the 24- to 36-hour group and 36+-hour group ($P = .0001$). For cardiac clearance, there was a significant difference between the under-24-hour group and 24- to 36-hour group ($P = .0031$), the under-24-hour group and over-36-hour group ($P = .0001$), and the 24- to 36-hour group and over-36-hour group ($P = .0318$).

found that the main reason for surgical delay in hip fractures was the lack of available OR [12]. While theoretically there are 2 protected trauma slots in the morning and afternoon, there must be an OR and perioperative staff available. Surgeon availability can also be a challenge to meet these time restraints as they may have elective cases or clinic patients scheduled.

The second most common issue was obtaining medical clearance from other services. Delays attributed to surgeon availability was observed in less than 10% of the cases; however, this does not mean there was no room for improvement. Surgeon availability was attributed to one-third of the delays (25 cases), in the group with 36 hours or greater time to OR. Despite this finding, the medical factors were still more prominent in this group. The take-home message may be the data suggested that for patients entering the OR between 24 and 36 hours, hospital reasons were the prominent reason for the delay, while for those entering after 36 hours, medical reasons attributed to more delays.

When evaluating patient characteristics alone, age, gender, or obesity did not affect time to the OR. However, there was a significant difference for those who required an echocardiogram or cardiac clearance. Only 35% of patients who had surgery within 24 hours had an echocardiogram, with the percentage increasing with each time frame. Cardiac clearance had a similar impact with 18% of patients who went under 24 hours up to 48% for greater than 36 hours. These percentages are incredibly high compared with the current standard in the literature. The American College of Cardiology and the American Heart Association have published guidelines for perioperative assessments of patients [13]. Smeets et al. examined the adherence to these guidelines in a prospective cohort study [14]. They found that 87% of patients received the correct screening, with "overscreening" being the predominant reason for incorrect screening [14]. A larger retrospective study found that only 29% of the patients with cardiac consultations met the guidelines [15]. For echocardiography, a preoperative echocardiogram delayed a patient's presentation to the OR by an additional 1.6 days compared with the nonechocardiogram group [16]. Another retrospective study identified that a preoperative echocardiogram increased time to OR, LOS, and cost of admission [17]. Interestingly, there has been advocates in anesthesia literature for preoperative echocardiogram screening routinely in hip fracture patients [18]. A retrospective study of 116 patients found that additional cardiac tests caused a delay in surgery without changing their cardiac treatment plan [19].

Table 3
Medicine clearance outside primary team by site.

Site	Medicine clearance		Grand total
	N	Y	
Site A	121	245	366
Site B	69	42	111
Grand total	190	287	477

The P value was <0.0001, which is significant at $P < .05$.

In our cohort, only 2 patients had a cardiac intervention based on their echocardiogram before proceeding with hip fracture surgery. Ultimately, the necessity of additional tests and clearances suggests that increased comorbidities did affect the time to OR. However, in theory, if comorbidities are well managed, they should not cause delay. Furthermore, unnecessary testing can increase health care costs as well. Based on this study, there has been discussion between the cardiology and trauma teams to ensure that consults are initiated immediately rather than through the electronic medical record. In addition, if required, echos are communicated directly to the cardiology fellows for prompt processing.

Between our 2 hospital campuses, there was a significant difference in when the primary trauma service sought medical clearance. In addition to the trauma surgeon, the trauma service is staffed by advanced practice providers at site A and surgical residents at site B. Interestingly, site B required fewer medical clearances yet had a lower percentage of patients entering the OR within 24 hours. Despite site B having a third of the volume, there were an equal number of surgeon delays at each campus. This combined with the quicker clearance by the primary team suggests that delays were driven by the orthopedic service. While site B does have fewer orthopedic procedures performed, it is a larger hospital with 70,000 annual ED visits, 492 beds, and 20 ORs compared with 50,000 visits at site A, 259 beds, and 10 ORs.

LOS was significantly different between the groups. The average LOS increased from 4.1 for the under-24-hour group to 4.3 to the 24- to 36-hour group and 6.6 for the over-36-hour group. When comparing the individual time frames, there was no significant difference under 36 hours, but a significant difference was observed

Table 4
The reason for delay for patients entering the operating room after 24 h.

Reason for delay	Time to OR		
	24-36 h	36+ h	Grand total
Medical:			
Cardiac clearance	12	11	**23**
Medical clearance	21	20	**41**
Family decision	0	4	**4**
Neurosurgery clearance	1	0	**1**
Pacemaker interrogation	0	1	**1**
Pulmonary clearance	1	2	**3**
Pulmonary embolism	0	1	**1**
Blood thinners	2	4	**6**
Medical total	*37*	*43*	*80*
Hospital:			
Surgeon delay	11	25	**36**
OR availability	40	2	**42**
Additional imaging	1	4	**5**
Within 24 h of consult	11	1	**12**
Within 24 h of imaging	14	0	**14**
Hospital total	*77*	*32*	*109*
Grand total	**114**	**75**	**189**

Numbers are presented as counts. Bold is total for between the two columns. Italics are the grand total.

Table 5
Counts by procedure.

Procedure	Time to OR			Grand total
	Under 24 h	24-36 h	≥36 h	
Arthroplasty hip hemi	82	34	29	145
Arthroplasty hip total	8	4	8	20
Arthroplasty hip total revision	2	1	3	6
Closed reduction w/ percutaneous pinning	42	18	6	66
Intramedullary nail	157	58	32	247
Grand total	288	114	75	477

There was a significant difference between time to OR when comparing total hip arthroplasty to hemi arthroplasty, closed reduction percutaneous pinning, and intramedullary nailing.

over 36 hours. This suggests that a goal of under 36 hours would provide economic benefit for the health-care system. This 2-day increase is higher than the 1.1 longer delay found in a previous study [7]. Economically, an analysis and value proposition would need to be made as to whether to add costs by adding staff, paying over time, or using other measures to create room availability and decrease the costs of the longer LOS.

A major strength of this study is the availability to track to the minute when the patient was checked into the emergency room to the time they entered the OR. Database studies have been limited in the past by day of admission to day to OR. But this does present an unclear picture of when the hip fracture was identified on imaging. Some patients were classified as having surgery within 24 hours of their imaging read. One area in our centers that we defined as needing improvement was the collaboration between the ED team, radiologist, and orthopedic surgeon in quickly identifying hip fractures and care plans. As an example, a delay in notification of the orthopedic team caused 12 patients to miss the 24-hour window. Prompt notification to the surgeon and OR could potentially improve the number of patients entering the OR within 24 hours. These cases resulted from the primary trauma team not notifying the orthopedic surgeon of the consult when the patient was in the ED. Another improvement identified is communication between the primary trauma team and the medicine or cardiology team when a patient needs additional clearance. Although there is both a house officer and cardiology fellow available in-house overnight, they are often not contacted until the morning by the orthopedic service.

One limitation of this study was that it was limited to 2 hospitals covered by private physician groups. There could be differences between the physician groups that affect the data. For example, a sports medicine physician could elect for their arthroplasty partner to perform such as a total hip arthroplasty, but if the patient needed an intramedullary nail, they would have been able to perform surgery the same day. Although total hip arthroplasty procedures accounted for only 4% of the hip fracture procedures performed, there was a statistically significant delay compared with patient's receiving only a hemiarthroplasty. Another limitation was a difference in documentation during chart review. Some charts stated explicit reasons for the delay while it was less clear in others. We also did not look to delays by weekday given there is blocked OR time daily for orthopedic trauma patients. Furthermore, in addition to LOS, other outcomes such as complications and mortality were not compared. Despite the limitations, we believe this study offers valuable information to help our hospital system and others reduce surgical delay.

Conclusions

Delay to the OR for hip fractures is multifactorial ranging from patient's comorbidity optimization to physician and OR availability. LOS is significantly increased with delay to the OR and does create increased hospital costs. The timeliness of hip fractures to the OR is a multidisciplinary effort and requires cooperation between a variety of services.

Conflicts of interests

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: D. C. Markel is a paid consultant for Stryker and Smith and Nephew unrelated to this study; has stock or stock options in Arboretum Ventures and HopCo; receives research support as a principal investigator from OREF and Stryker; and is a board member in Michigan Arthroplasty Registry Collaborative Quality Initiative (MARCQI).

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2022.03.005.

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