Preoperative Cardiac Evaluation of Patients With Acute Hip Fracture

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Abstract

The goals of the present study were to assess if there is an association between preoperative cardiac evaluation and surgery timing in patients with a hip fracture, to evaluate the relationship between surgery timing and postoperative morbidity and mortality, and to determine if the proper patients are being selected for noninvasive cardiac testing based on the practice guidelines published by the American College of Cardiology/American Heart Association Task Force. Surgery delay secondary to cardiac clearance may be a risk factor for increased postoperative complications that is independent of a patient's general medical condition. Surgical treatment of acute hip fractures may be delayed by many factors besides preoperative cardiac clearance, but it is the job of the orthopedic surgeon, who best understands the importance of timely surgery for a hip fracture, to minimize delays. Careful screening of patients who have sustained a hip fracture can improve overall outcomes by minimizing the number of patients whose surgical treatment is unnecessarily delayed for cardiac clearance.

Preoperative cardiac evaluation of patients who have sustained a hip fracture can delay operative treatment. Previous investigators have reported that hip fracture morbidity and mortality are affected by time between injury and operative fixation.[1,2]

Numerous studies have outlined criteria for further evaluation of cardiac function in the preoperative period for patients undergoing noncardiac surgery.[3-12] However, the criteria by which patients are evaluated in practice are unclear. If preoperative cardiac evaluation of patients who have sustained a hip fracture does indeed delay operative treatment, then the benefit of the preoperative cardiac evaluation must be balanced by the morbidity associated with delayed treatment.

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In patients with hip fractures, an operative delay of 2 calendar days from time of hospital admission doubles the mortality rate in the first year[2]; other studies have had similar findings.[13-21] None of these studies has isolated preoperative cardiac evaluation as a specific cause of operative delay.

The goals of the present study were to assess if there is an association between preoperative cardiac evaluation and surgery timing in patients with a hip fracture, to evaluate the relationship between surgery timing and postoperative morbidity and mortality, and to determine if the proper patients are being selected for noninvasive cardiac testing based on the practice guidelines published by the American College of Cardiology/American Heart Association (ACC/AHA) Task Force.[5]

Study Background

Preoperative cardiac evaluation, often called *cardiac clearance,* is a means for specific evaluation of the patient's cardiac function before surgical treatment. Cardiac clearance is a misnomer in that it implies that the patient has sufficient cardiac function to tolerate a given procedure and its perioperative demands. Rather, preoperative cardiac evaluation is established to answer several important questions: Are there modifiable operative risk factors? Can the operation be modified? Are there indications for coronary revascularization? And, if so, what is the optimal sequence of angiography, coronary revascularization, and noncardiac surgery?[1]

Multiple studies of orthopedic populations have found inferior outcome results when treatment of hip fractures is delayed, especially in older populations. Villar and colleagues[21] studied 145 patients to evaluate rehabilitation after a femoral neck fracture. Mean time to surgery was 29 hours in the group with a "good" outcome and 57 hours in the group with a "poor" outcome. Kenzora and colleagues[15] found that patients operated on between days 2 and 5 after admission had a 1-year mortality rate of 6%, whereas those operated on after day 5 had a 1-year mortality rate of 35%. These studies did not evaluate the specific reason for operative delay or comment on the ultimate cause of mortality or whether delay and mortality were related.

Methods

We conducted a retrospective review of patients who had been treated for an acute hip fracture (*International Classification of Diseases–Ninth Revision* codes 820.0, 820.2, 820.8) at our institution between 2000 and 2002. Treatments were either

Table I. Patient Demographics at Hospital Admission

Demographic	No. (%) of Patients
Age (y)	
≥85	42 (39%)
<85	66 (61%)
Sex	
Male	27 (25%)
Female	81 (75%)
No. preexisting medical conditions[a]	
0 or 1	68 (63%)
2	25 (23%)
>2	15 (14%)
Fracture type	
Femoral neck	48 (44%)
Intertrochanteric	60 (56%)

[a]Diabetes, coronary artery disease, congestive heart failure, hypertension, peripheral vascular disease, or cardiac arrhythmia.

hemiarthroplasty or open reduction and internal fixation (ORIF) with a sliding screw and side plate.

Inclusion criteria for this study were age over 60 years, femoral neck or intertrochanteric fracture of hip, preoperative electrocardiogram (ECG) available, and community or household ambulatory status before injury. Ambulatory status was needed as an inclusion criterion so that ambulation timing could be used as a postoperative measure. Of the 126 patients whose hospitalization charts were reviewed, 108 met these inclusion criteria. Institutional review board approval was obtained before data collection.

Charts were reviewed to determine patients' preoperative risk factors, cardiac workup, and postoperative course. Information gathered included patient demographics, cardiac risk factors, cardiac evaluation, timing of admission and surgery, procedure, operative complications, and postoperative course. We defined cardiac risk factors as family history of cardiac disease, previous history of myocardial infarction (MI), hypertension, diabetes, hypercholesterolemia, tobacco use, coronary artery disease, symptoms of angina before surgery, congestive heart failure, history of arrhythmias, peripheral vascular disease, and history of prior cardiac surgery.

Major postoperative complications included death, MI, pulmonary embolus, deep vein thrombosis, and stroke. Other complications recorded were pneumonia, urinary tract infections, and local wound infections.

Postoperative course was assessed with time between surgery and ambulation and time between surgery and discharge. In addition, ambulation status at discharge, requirement of ambulatory aids, general health at discharge, and discharge location (home, acute rehabilitation center, or skilled nursing facility) were also reviewed.

Statistical analysis was conducted with the Fisher exact test for all nonparametric data; parametric data were analyzed with the Student *t* test. An arbitrary *P* of .05 was used to determine statistical significance.

Results

Sixty-one percent of the 108 patients included in this study were younger than 85 at time of admission, and 75% were female. Most patients (63%) had 0 or 1 medical comorbidity, 23% had 2 comorbidities, and 14% had more than 2 comorbidities (Table I). Forty-eight patients (44%) had femoral neck fractures; the other 60 (56%) had intertrochanteric hip fractures.

Patients were assessed in 2 groups—86 patients who did not require cardiac testing beyond an ECG and 22 patients who required additional cardiac evaluation (Table II). Mean age was 83 years for the ECG-only group versus 80 for the additional-clearance group; the age difference did not reach statistical significance ($P = .18$). Mean time to surgery was 34 hours for the ECG-only group versus 96 hours for the additional-clearance group ($P<.0001$). Percentage of patients who were able to ambulate before discharge was 72% (62/86) in the ECG-only group versus only 50% (11/22) in the additional-clearance group ($P = .03$). Mean time to ambulation was only 57 hours in the ECG-only group versus 84 hours in the additional-clearance group ($P = .02$). Mean time to discharge was 140 hours in the ECG-only group versus 151 hours in the additional-clearance group ($P = .75$). There were 8 major complications (defined as death, MI, pulmonary embolus, stroke, deep vein thrombosis, cardiac arrest, or pneumonia) in the ECG-only group versus 6 in the additional-clearance group—a statistically significant ($P = .04$) difference.

Table II. Outcomes in Association With Additional Cardiac Testing

Outcome	Cardiac Testing Group: ECG Only (n = 86)	Cardiac Testing Group: Additional Testing[a] (n = 22)	*P*
Mean age (y)	83	80	.18
Mean time (h) from triage to surgery	34±27	96±120	<.0001
Ambulatory patients at discharge	72% (62/86)	50% (11/22)	.03
Mean time (h) from surgery to ambulation[b]	57±35	84±34	.02
Mean time (h) from surgery to discharge[c]	140±139	151±75	.75
No. of major complications[d]	8	6	.04

[a]Echocardiogram, stress test, or cardiac intervention (pacemaker, angioplasty, cardioversion).
[b]Nonambulatory patients not included in means.
[c]Deceased patients not included in means.
[d]Major complications: death, myocardial infarction, pulmonary embolus, stroke, deep vein thrombosis, cardiac arrest, pneumonia.

Table III. Clinical Predictors of Increased Cardiovascular Risk[7]

Cardiovascular Risk[a]	Cardiac Testing Group: No Testing (n = 86)	Cardiac Testing Group: Noninvasive Testing (n = 22)	*P*
Major			
Unstable coronary syndromes[b]	0	1	.204
Decompensated CHF	0	0	NA
Significant arrhythmias[c]	0	1	.204
Intermediate			
Mild angina pectoris	6	4	.117
Prior MI or pathologic Q waves on ECG	5	6	.008
Compensated or prior CHF	7	2	.584
Diabetes mellitus	9	4	.255
Minor			
Advanced age (>75 years)	55	19	.026
Abnormal ECG	32	8	.574
Rhythm other than sinus[d]	2	3	.050
Low functional capacity[e]	8	5	.092
Uncontrolled hypertension	6	5	.045

[a]CHF, congestive heart failure; MI, myocardial infarction; ECG, electrocardiogram; NA, not applicable.
[b]Acute or recent myocardial infarction; unstable or severe angina.
[c]High-grade atrioventricular block, symptomatic ventricular arrhythmia in presence of underlying heart disease, or supraventricular arrhythmia with uncontrolled ventricular rate.
[d]Atrial fibrillation, for example.
[e]Inability to climb a flight of stairs while carrying a bag of groceries, for example.

In its practice guidelines, the ACC/AHA Task Force[5] stratified clinical predictors of increased cardiovascular risk into major, intermediate, and minor criteria (Table III).

According to these guidelines, major clinical predictors include unstable coronary syndromes, decompensated congestive heart failure, significant arrhythmia, and severe valvular disease. Of the 108 patients in our study, only 1 had major clinical predictors (n = 2) of increased cardiovascular risk.

Intermediate clinical predictors include mild angina, prior MI, compensated or prior congestive heart failure, and diabetes mellitus. Forty-three of our 108 patients had intermediate clinical predictors for increased cardiovascular risk (Table III).

Minor clinical predictors of cardiovascular complications include advanced age (>75 years), abnormal ECG, rhythm other than sinus, low functional capacity, history of stroke, and uncontrolled systemic hypertension. The 86 patients in our ECG-only group had 103 minor predictors, and the 22 patients in our additional-clearance group had 40 minor predictors (Table III).

These 2 clinical groups were compared on number of occurrences of each of the major, intermediate, and minor clinical predictors of cardiac risk. Of all the risk factors, the only ones that reached between-groups statistical significance were history of prior MI and/or pathologic Q waves on ECG ($P = .01$), age over 75 ($P = .03$), rhythm other than sinus ($P = .05$), and uncontrolled hypertension ($P = .05$) (Table III).

In this cohort, patients treated within 48 hours of their arrival in the emergency department had an almost 33% chance of being ambulatory within 2 days of surgery, whereas only 11% of patients delayed more than 48 hours were ambulatory on postoperative day 2 ($P = .02$) (Table IV). Thirty percent (24/80) of patients operated on within 48 hours of admission were nonambulatory at time of discharge, whereas 46% (13/28) of the patients delayed more than 48 hours were nonambulatory.

Discussion

According to ACC/AHA Task Force guidelines,[5] orthopedic surgery is intermediate-risk surgery, meaning that cardiovascular complications occur less than 5% of the time. Regarding cardiac clearance for intermediate-risk surgery, the task force recommended further cardiac testing for patients with 1 major clinical predictor of risk. For patients who have intermediate clinical predictors and are undergoing intermediate-risk surgery, the next step on the algorithm is to determine functional status. Patients who can climb 2 flights of steps (>4 metabolic equivalent tasks) do not require additional cardiac testing, whereas patients with intermediate clinical predictors and poor functional status should undergo noninvasive testing before surgical intervention. A patient with minor clinical predictors of cardiac risk does not require further cardiac evaluation.

According to this algorithm, the only patients in our study who would require noninvasive cardiac testing were those with major predictors for cardiovascular complications and those with intermediate clinical predictors and poor functional capacity. As patients with poor functional capacity were excluded from this study, the only patients who truly required additional preoperative clearance were those with major clinical predictors for cardiac complications, and only 1 patient met this criterion. Therefore, 21 of the 22 patients in this analysis were unnecessarily delayed for surgical treatment of an acute hip fracture by obtaining additional cardiac evaluation.

Table IV. Effect of Time From Admission to Surgery on Postoperative Course

Postoperative Course	Time From Admission to Surgery ≤48 Hours	>48 Hours	*P*
Ambulatory within 2 days, no. (%)	26 (32.5%)	3 (11%)	.02
Ambulatory after 2 days, no. (%)	30 (37.5%)	12 (43%)	.39
Nonambulatory at discharge, no. (%)	24 (30%)	13 (46%)	.09
Total no. of patients	80	28	

It is understandable to rationalize that patients of poorer general medical health are the ones being selected for additional cardiac evaluation and that this lower preinjury health status is the reason that these patients have worse postoperative outcomes. Nevertheless, as indicated in this cohort, the sickest patients were not necessarily the ones undergoing supplementary cardiac testing. The cardiac evaluation itself—usually consisting of cardiac laboratory tests and either a stress test or a stress ECG—is associated with very low morbidity and mortality. Therefore, we must recognize that surgery delay secondary to cardiac clearance may be a risk factor for increased postoperative complications that is independent of a patient's general medical condition.

Although the ultimate goal of preoperative cardiac evaluation is to determine which patients, if any, may benefit from prophylactic revascularization before noncardiac surgery, the focus often turns from the proposed surgery (hemiarthroplasty or ORIF) to the long-term management of coronary artery disease. Other investigators have found that, in patients with clinically stable angina and in patients with risk factors only for coronary artery disease, noninvasive cardiac testing does not improve outcomes.[4] Furthermore, no study has even shown that prophylactic revascularization decreases number of postoperative cardiovascular complications after noncardiac surgery, particularly if complications of revascularization are included.[4]

It is well established that patient outcomes are superior when time to surgery after hip fracture is minimized. As demonstrated in our study, however, preoperative cardiac evaluation delays surgery significantly ($P<.001$) (Table II). Previous studies have shown increased mortality, both 1 month and 1 year, when operative treatment (either hemiarthroplasty or ORIF) is delayed.[1,2] Other research has demonstrated the benefit of early surgical treatment followed by aggressive mobilization.[2,3,13,14,16,18-29] Patients whose surgical treatment is delayed after a hip fracture are at higher risk for postoperative complications, including pneumonia, deep venous thrombosis, and pulmonary embolism.[13,20,23-29] Furthermore, these patients are less likely to ambulate in a timely manner after surgery.[2,14-17,23,25,29] Our study had similar results. Thirty-three percent of patients (26/80) whose surgery was performed within 48 hours of triage were able to ambulate within 2 days after surgery, whereas only 11% (3/28) who were delayed by more than 48 hours were ambulating by 48 hours ($P = .02$) (Table IV). Early mobilization has been shown to be beneficial to outcomes after hip fracture surgery[25,30]—yet another reason to operate expeditiously.

The benefit of preoperative cardiac screening is questionable. In our study, the major complication rate was 27% (6/22) for patients delayed for additional cardiac evaluation versus 10% for patients who were not delayed ($P = .04$). It has been suggested that elderly patients without major risk factors for cardiac complications be treated as if they had underlying moderate cardiac dysfunction—instead of having them undergo preoperative cardiac clearance. Their perioperative course would therefore include β-blockers, vigilant blood pressure control, and postoperative anticoagulation. These interventions do not delay treatment and may allow patients a better postoperative course in terms of decreasing the number of major postoperative complications and improving ambulation status at time of discharge. Additional research regarding this type of perioperative management is necessary.

At our institution, all patients older than 65 are admitted to the internal medicine service; this service determines whether these patients require additional cardiac evaluation. If ACC/AHA Task Force guidelines were followed exactly, we would expect to find major differences in major and intermediate clinical risk factors between the 2 groups of patients in our study. However, according to our evaluation of these clinical predictors of risk for cardiovascular complications, and according to the major and intermediate criteria in particular, the difference between the 2 groups was statistically significant for only 1 of these 7 criteria (Table III). Therefore, the criteria used to determine which patients were selected for noninvasive cardiac screening were ambiguous; patients were clearly not selected according to ACC/AHA Task Force guidelines.[6]

Orthopedic surgeons often defer to the medical service for preoperative management and cardiac evaluation. Although there is clearly a benefit to optimizing a patient's general medical health before surgery, it is also important that the orthopedic surgeon inform the other physicians involved in the patient's care of the importance of timely operative treatment. The goal of treatment needs to be surgical fixation of the fractured hip followed by early mobilization, not long-term management of potential underlying cardiac disease. Certainly there are patients for whom preoperative cardiac evaluation is warranted, but such evaluation should not be made routine, and a patient's medical history, physical examination, ECG, and basic laboratory data should be used to screen patients for further cardiac evaluation. Primary care physicians and cardiologists should be able to use well-established criteria to determine which patients truly require preoperative cardiac evaluation.[5,6,9]

Surgical treatment of acute hip fractures may be delayed by many factors besides preoperative cardiac clearance—such as the need to obtain consent for surgery and the availability of operating room, surgery staff, anesthesiologist, and orthopedic surgeon. Nevertheless, it is the job of the orthopedic surgeon, who best understands the importance of timely surgery for a hip fracture, to minimize delays. Careful screening of patients who have sustained a hip fracture can improve overall outcomes by minimizing the number of patients whose surgical treatment is unnecessarily delayed for cardiac clearance.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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