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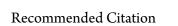**eCommons@AKU**

Department of Surgery

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Kashif Abbas
Aga Khan University

masood umer
Aga Khan University, masood.umer@aku.edu

Raza A Zaidi
Aga Khan University

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Preoperative cardiac evaluation in proximal femur fractures and its effects on the surgical outcome

Kashif ABBAS, Masood UMER, Raza ASKARI

Section of Orthopedic Surgery, Department of Surgery, The Aga Khan University Hospital, Karachi, Pakistan

Objective: The aim of the current study was to evaluate the impact of cardiac risk stratification and preoperative cardiac evaluation on final outcomes in patients with acute proximal femur fractures.

Methods: This retrospective review included one hundred and three patients who underwent a preoperative cardiac evaluation prior to proximal femur fracture operation between 2004 and 2007 at a tertiary care hospital. Patients were divided into two groups. Group A included 76 patients who were tested with ECG only and Group B included 27 patients with additional clearance. All of these files were reviewed according to a set pro forma. Statistical analysis was done using the SPSS 17 software. The Student's t-test and Mann-Whitney U test were applied to compare two means.

Results: Fifty-three patients had intertrochanteric fractures and 50 had femoral neck fractures. Only 7 patients had a metabolic equivalent task of less than 4. Group B patients had significant delay in time from triage to surgery (p<0.0001) and from surgery to ambulation (p<0.005). Group B patients also had an increased length of hospital stay, although no significant effect on perioperative mortality was observed.

Conclusion: Preoperative cardiac evaluation is associated with delay in surgery and subsequent ambulation. Delay in surgery is not associated with increased perioperative mortality at our institute. However, the set of guidelines proposed by ACC/AHA should be followed, as the selection of patients for additional investigation was not justifiable in most cases.

Key words: ACC/AHA guidelines; cardiac risk stratification; proximal femur fracture.

The prevalence of cardiovascular disease increases with age. It is estimated that, in the United States, the population of persons older than 65 years will increase 25% to 35% over the next 30 years.[1] In addition, this is the age group in which the largest number of surgical procedures is performed.[2] Therefore, it is possible that the number of non-cardiac surgical procedures performed in the elderly will increase from the current 6 million to nearly 12 million per year. Nearly one-fourth of these major intra-abdominal, thoracic, vascular, and orthopedic procedures have been associated with significant perioperative cardiovascular morbidity and mortality.

Preoperative cardiac evaluation of patients who have sustained a proximal femur fracture can delay operative treatment. Previous investigators have reported that proximal femur fracture morbidity and mortality are affected by the interval 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 non-cardiac surgery.[3-12]

Correspondence: Kashif Abbas. The Aga Khan University Hospital, Karachi 74800, Pakistan.
Tel: +92-21 - 486 3190, 486 3191   e-mail: kashah_pk@yahoo.com

Considering that preoperative cardiac evaluation delays operative treatment, the benefit of the preoperative cardiac evaluation must be balanced by the morbidity associated with delayed treatment. The financial implications of cardiac risk stratification cannot be ignored. The need for a better method to objectively measure cardiovascular risk has led to the development of multiple noninvasive techniques in addition to the established invasive procedures. Although a variety of strategies to assess and lower cardiac risk have been developed, their aggregate cost has received relatively little attention.

The goals of the present study were;

(1) To assess the association between preoperative cardiac evaluation and surgery timing in patients with a proximal femur fracture,

(2) To evaluate the relationship between surgery timing and postoperative morbidity and mortality, and

(3) 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]

Patients and methods

We conducted a retrospective review of patients who were treated for an acute proximal femur fracture at our institution between 2004 and 2007. During this period, 298 patients with proximal femur fractures were identified. One hundred and three patients for whom a preoperative cardiology consult was requested by the anesthetist were included. Delays in surgery for any other reasons were excluded from the study. Patients were divided into two groups based on their cardiac investigations. Group A (n=76) included patients evaluated with ECG only and Group B (n=27) included those with additional investigations for clearance.

Information gathered included patient demographics, comorbidities, number of preexisting medical conditions, principal diagnosis (type of fracture), preoperative ambulation status, type of anesthesia, ASA grading, induction medications, and date and time of presentation.

The postoperative course was assessed using the date and time of surgery, ambulation and discharge. The surgical procedure used (hemiarthroplasty, dynamic hip screw, dynamic condylar screw), ambulation at discharge, ambulatory aid (stick, walker), general health at discharge, discharge location (home, nursing home, rehabilitation center), and complications during hospital stay were recorded. Major complica-

tions included death, MI, pulmonary embolus, DVT, cardiac arrest, stroke and pneumonia, while other complications were categorized as minor.

Cardiac work-up was made according to cardiology team recommendations. The process of risk stratification was compared for compatibility with AHA guidelines.

Statistical analysis was performed with SPSS 17 software (SPSS Inc., Chicago, IL, USA). The Student's t-test and Mann-Whitney U test were applied to compare two means, depending on the data distribution.

Results

Ninety-seven patients had evidence of systemic illness with 61 patients having more than one comorbidity. Fifty-three patients had intertrochanteric fractures and 50 had femoral neck fractures. Seven patients had a metabolic equivalent task (MET) of less than 4. Twenty-one patients were ambulant with support and 82 without support pre-operatively. Out of these 82 patients, 21 underwent additional cardiac work-up while 16 proceeded to the operating room without any additional work-up.

Preoperative functional status of the patients was noted (Table 1). The mean time between surgery and ambulation was 19 hours in Group A and 22 hours in Group B (p=0.005) (Table 2). The mean time between surgery and discharge was 85 hours in Group A and 75 hours in Group B (p=0.079) (Table 2). Two patients in Group A and 3 in Group B (p=0.080) had major complications (Table 2). The mean hospital stay was 6.24 days in Group A and 8.05 days in Group B (p=0.003) (Table 3).

All patients had risk stratification done by our hospital cardiology team (Tables 4 and 5).

Group B patients had a significant delay in time between triage and surgery (p<0.0001) and between surgery and ambulation (p<0.005). Group B patients also had increased length of overall hospital stay (p=0.003), but no significant delay in time between surgery and discharge (p=0.079). No significant effect (p=0.080) on perioperative mortality and morbidity was either observed.

Table 1. Preoperative functional status of the patients.

| | Preoperative ambulation | | |
	Community ambulant	House ambulant	Total
ECG only	60	16	76
Additional work-up	21	6	27
Total	81	22	103

Table 2. Outcome measures.

Outcome	ECG only (n=76)	Additional testing (n=27)	p
Mean age (yrs)	71	72	
Mean time from triage to surgery (hrs)	40	95	0.000
Ambulation at discharge			
Partial weight-bearing	17 (22%)	4 (15%)	
Full weight-bearing	44 (58%)	17 (63%)	
Bed to chair	15 (20%)	6 (22%)	
Mean time from surgery to ambulation (hrs)	19	22	0.006
Mean time from surgery to discharge (hrs)	85	75	0.079
No. of major complications	2 (2.6%)	3 (11%)	0.080

ACC/AHA Task Force[5] had categorized clinical predictors of increased cardiovascular risk into major, intermediate, and minor criteria. Major clinical predictors include unstable coronary syndromes; decompensated congestive heart failure, significant arrhythmia, and severe valvular disease. Of the 103 patients in our study, only 2 had major clinical predictors of increased cardiovascular risk.

Intermediate clinical predictors include mild angina, prior MI, compensated or prior congestive heart failure, and diabetes mellitus. Thirty-eight patients

Table 3. Length of hospital stay.

	n	Mean	Standard deviation	p
ECG only	76	6.24	2.66	0.003
Additional work-up	27	8.06	2.53	

Table 4. Risk stratification by the cardiology team.

	ECG only	Additional work-up	Total
Major	4	4	8
Intermediate	36	18	54
Minor	36	5	41

Table 5. Revised risk stratification according to ACC/AHA guidelines.

	ECG only	Additional work-up	Total
Major	0	2	2
Intermediate	23	15	38
Minor	53	10	63

had intermediate clinical predictors for increased cardiovascular risk.

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. Sixty-three patients were categorized to have minor clinical predictors for increased cardiovascular risk.

Discussion

Anesthesia and surgery are physiologically stressful invasive interventions which may exacerbate or uncover underlying disease processes. Complications can include, among others, catastrophic events such as myocardial infarction, difficulty oxygenating or ventilating, and cerebrovascular accident. A proper preoperative assessment allows risk stratification and reduction.

According to ACC/AHA Task Force guidelines,[5] orthopedic surgery is an 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, in addition to electrocardiogram, for patients with one major clinical risk predictor. For patients with intermediate clinical predictors undergoing intermediate-risk surgery, the next step on the algorithm is to determine the functional status. Patients who can climb 2 flights of steps (>4 METs) 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. Patients who are able to exercise on a regular basis without limitations generally have significant cardiovascular reserve to withstand stressful operations. Functional capacity is expressed in terms of the MET. One MET

denotes the energy expended (or oxygen used) during sitting and reading.

According to this algorithm, the only patients in our study who would require additional noninvasive cardiac testing were those with major predictors for cardiovascular complications and those with intermediate clinical predictors and poor functional capacity. Out of the total 103 patients, 63 fell in the minor category and did not need any further cardiac evaluation. Two fell in the major category, requiring further work-up before surgery. Of the 38 patients in the intermediate category, 22 were house ambulant with a functional capacity of less than 4 METs, and presumably needed further work-up. Therefore, only 24 of 103 total patients needed work-up. Twenty-seven patients underwent further cardiac testing, although the selection process was not conducted according to guidelines and was ambiguous.

Both of the patients with major risk factors underwent an additional work-up. Ten out of the 63 with minor predictors were also further evaluated despite the guidelines recommending against it. Fifteen patients of intermediate risk were also evaluated. On the basis of functional status of the 27 patients who underwent additional cardiac testing, 21 had greater than 4 METs while only 6 had a MET of less than 4. Interestingly, 16 patients were taken to the operating room only on the basis of ECG while having a MET of less than 4.

As indicated in this study, 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 delays secondary to cardiac clearance may be a risk factor for increased postoperative complications, independent of the 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 non-cardiac surgery, the focus often turns from the proposed surgery (hemiarthroplasty or ORIF) to the long-term management of coronary artery disease. In this study, not a single patient underwent any intervention for revascularization. Furthermore, no study has shown that prophylactic revascularization decreases the number of postoperative cardiovascular complications after non-cardiac surgery, particularly if complications of revascularization are included.[4]

It is well-established that patient outcomes are superior when the interval between proximal femur fracture and surgery is minimized. As demonstrated in our study, however, preoperative cardiac evaluation significantly delays the surgery (p<0.0001) (Table 2). The major complication rate was 11% (3/27) for patients delayed for additional cardiac evaluation versus 2.6% (2/76) for patients who were not delayed (p=0.080) (Table 2). Previous studies have shown increased mortality, both at 1 month and 1 year, when operative treatment is delayed.[1,2] Other research has demonstrated the benefit of early surgical treatment followed by aggressive mobilization.[2,3,13-17] Patients whose surgical treatment is delayed after a proximal femur fracture are at higher risk for postoperative complications, including pneumonia, deep venous thrombosis, and pulmonary embolism.[13,18-25] Furthermore, these patients are less likely to ambulate in a timely manner after surgery.[2,14,19,21,25,26]

The benefit of preoperative cardiac screening is questionable. 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 undergoing preoperative cardiac clearance. Their perioperative course would therefore include beta-blockers, vigilant blood pressure control and postoperative anticoagulation. These interventions do not delay treatment and may allow patients a better postoperative course by 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.

Orthopedic surgeons often refer to the medical service for preoperative management and cardiac evaluation. Although there is a clear benefit in optimizing patient's general medical health before surgery, it is also important that the orthopedic surgeon inform other physicians involved in the patient's care of the importance of timely operative treatment. The goal of treatment must 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]

Conflicts of Interest: No conflicts declared.

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