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The Treatment of Hip Fractures

Variations in Care

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The purpose of this descriptive study was to identify the ranges of operative treatment, perioperative management, and mortality rate of elderly patients with hip fractures. We retrospectively identified 1001 elderly patients who had operative treatment for a fractured hip in 49 medium- and high-volume California hospitals using a two-stage stratified cluster sample of hospitalizations for hip fractures. This sampling method allowed for generation of weighted estimates that described the overall care of all patients with hip fractures in California from 1995 to 1996. The in-hospital, 30-day, and 6-month mortality rates were 1.7%, 5%, and 12% respectively. Bipolar hemiarthroplasties were used more often than unipolar implants (73% versus 26%). There were some deviations from generally accepted guidelines for care of patients with hip fractures particularly related to administration of antibiotic and deep vein thrombosis prophylaxis. Fourteen percent of patients did not receive any antibiotic prophylaxis before and during surgery, and 24% did not receive prophylaxis within 4 hours of the beginning of the surgical procedure. Twenty-four percent of patients received no prophylaxis for deep vein thrombosis, and 81% of patients did not receive prophylaxis after hospital discharge. Surgeons need to continually evaluate the treatment regimens for patients with hip fractures to optimize care.

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Hip fractures are a serious public health problem throughout the world. Elderly individuals are the fastest growing demographic in the world. Although the incidence of hip fractures is not increasing, the number of hip fractures per year will continue to increase as the population continues to age. It is estimated that hip fractures worldwide could total between 8 and 21 million per year by 2020.[8,12] Hip fractures cost approximately 8 billion dollars per year in the United States.[23] Inpatient medical services and nursing home care are responsible for the majority of these expenses.[25] Hip fractures leave some patients with functional impairments. Approximately 50% of the patients cannot ambulate independently after a hip fracture.[19] One-third of individuals who sustain a hip fracture become totally dependent, and many patients no longer can reside in their own homes.[19] The inpatient mortality after hip fracture is approximately 3%, and the 1-year mortality ranges from 10% to 20% in different series.[4,6,13] In light of the increasing public health burden of hip fractures throughout the world, it is critical that we optimize the perioperative and postoperative management of these patients.[8,14,22] General guidelines for treatment of these patients have been established.[17]

Because patients with hip fractures require multidisciplinary management, there is potential for great variability in care. There are various options with respect to operative treatment of femoral neck and intertrochanteric hip fractures in elderly patients. Fracture treatment may be influenced by the degree of fracture displacement and the extent of comminution. Various devices have been developed to treat hip fractures, including pins, compression screws, intramedullary nails, and arthroplasty implants.[1,2,21,26] Which devices surgeons use to treat different fractures has not been reported previously on a statewide basis.

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The perioperative management of patients with hip fractures also may vary among surgeons and other physicians who care for these patients. There are numerous options to select with respect to type of anesthesia and deep vein thrombosis (DVT) prophylaxis. Patients with hip fractures also require antibiotic prophylaxis.[7,10,11,16,27-29] The management of patients with hip fractures with respect to these perioperative issues has, to our knowledge, not been reported for a large population of patients. Hip fracture procedures also often are done on a semiurgent basis and in the evening or on weekends. Therefore, there may be increased opportunities for lapses with respect to the appropriate administration of DVT and antibiotic prophylaxis.[28] Because these patients may be admitted to a medical service, there may be greater focus on medical problems that are critically important than on such seemingly mundane issues as the timing of antibiotic prophylaxis and selection of a DVT prophylaxis regimen. However, failure to properly administer these regimens could increase morbidity and mortality.[27,29]

The purpose of this descriptive study was to characterize the ranges of operative treatment, perioperative management, and mortality of elderly patients with hip fractures in California.

MATERIALS AND METHODS

We retrospectively identified 1001 elderly patients randomly sampled from 49 California hospitals who were treated operatively for a hip fracture between 1995 and 1996. Because of the sampling design, the weighted results presented can be generalized to the entire population of patients with hip fractures who were older than 65 years and who were treated at medium- or high-volume hospitals in California. Therefore, most of the data will be presented using percentages rather than numbers. This study was completed as part of the California Hospital Outcomes Project (CHOP), which is a legislatively mandated effort by the Office of Statewide Health Planning and Development (OSHPD) to improve the quality of care in California's acute care hospitals and to inform purchasers and consumers of health care by producing and disseminating risk-adjusted outcomes data. California Hospital Outcomes Project reports are based on OSHPD's Patient Discharge Data Set (PDDS), which includes an abstract of every discharge from every nonfederal licensed hospital in California.

Our cohort study used a two-stage, stratified cluster sample of hospitalizations for hip fractures found in the PDDS.[2] Through this sampling method, weighted estimates were generated that described the overall care of patients with hip fractures in California during 1995 and 1996. The sampling frame included all patients in the PDDS who were discharged from a nonfederal acute care hospital between January 1, 1995 and December 1, 1996, were at least 65 years of age, had a reparative procedure for a hip fracture (ICD-9-CM procedure codes 78.55, 79.05, 79.15, 79.25, 79.35, 79.45, 79.55, 81.51, 81.52),[5,15] and had a principal diagnosis of hip fracture (ICD-9 CM 820.xx)[15] or a related injury or condition (eg, osteoporosis) with a secondary diagnosis of hip fracture. Exclusion criteria included prior operative treatment of a fracture of the hip, metastatic cancer potentially involving the femur, aseptic necrosis of the hip, fracture of the femoral shaft, and significant head, chest, or abdominal trauma in the same episode of care. Patients without social security numbers were excluded because of an inability to obtain postdischarge mortality data. If a patient was transferred from one hospital to another, he or she was assigned uniquely to the first hospital in which reparative surgery was done. This sampling frame, after exclusions, included 38,939 hip fracture procedures completed at 377 hospitals.

Multivariate logistic regression analysis then was used to estimate the probability of 30-day mortality for each patient in the sampling frame, adjusting for age (5-year strata), skilled nursing facility residence, number of hospitalizations in the previous 12 months, mechanism of injury (eg, fall from bed or chair, fall while standing or walking, other activity), fracture site (eg, femoral neck, intertrochanteric, subtrochanteric), 11 comorbidities (eg, atrial fibrillation, chronic renal failure, congestive heart failure, chronic obstructive lung disease, dementia or delirium, diabetes with complications, fall from bed or chair, valvular heart disease, concurrent fracture of other bone [most often wrist], high-risk cancer [without bony metastasis], and high-impact injury), and statistically significant interaction terms involving age and gender. These comorbidities were selected by clinical literature reviews, discussions with a clinical advisory panel, and empirical analyses. This model was validated through a split-sample approach, and showed adequate calibration and discrimination ($c = 0.729$).

In the first stage of sampling, 127 low-volume hospitals with fewer than 50 eligible patients were excluded, leaving 250 hospitals eligible for sampling. Low-volume hospitals were excluded because they rarely meet statistical criteria to be designated as mortality outliers, and the primary aim of our study was to evaluate differences in severity of illness and treatment across hospital strata. Although 127 of 377 hospitals were excluded, these hospitals only had 3190 hip fractures (8.2% of the statewide total during the study years). The remaining hospitals were stratified according to their mortality rate (ie, better than expected, worse than expected, neither) based on the exact probability ($p < 0.05$) of experiencing at least (or at most) the number of observed deaths by chance, given the expected number of deaths at each hospital. All 14 of the better-than-expected hospitals (low-mortality stratum), all nine of the worse-than-expected hospitals (high-mortality stratum), and 30 randomly selected hospitals with neither lower nor higher than expected mortality (intermediate-mortality stratum) were included in the study. The last set of hospitals was sampled with probability proportional to size to maximize the reliability of our population-based estimates.

The second sampling stage involved randomly sampling 390 patients from each of the three hospital sampling strata. Among the hospitals in the high and low mortality strata, all 30-day deaths and a random sample of survivors were sampled. Among the 30 hospitals in the intermediate-mortality stratum, deaths

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were oversampled to achieve a target death rate of 21.4% and a total sample of 13 incidences from each hospital. The administrator and director of medical records of each sampled hospital were contacted and invited to join the study. Despite being guaranteed anonymity, four hospitals refused to participate, and were not replaced. Once a hospital consented to participate, its director of medical records was asked to provide complete photocopies of all sampled records. Overall, 1001 of 1047 requested records were received (96.2%).

With input from our interdisciplinary Clinical Advisory Panel, an abstraction and recording instrument was developed that was programmed for direct computer data entry. Detailed guidelines were written to accompany the abstraction instrument. The draft instrument and guidelines were pretested, and all identified problems were addressed. The clinical abstractors were registered nurses or health professional students working under direct supervision of a registered nurse. All abstractors had prior experience in medical record review for utilization management or quality improvement and received special training for the project. At least 5% of records were overread by a second abstractor to maintain more than 95% accuracy throughout the project. On-site supervisors were available to answer questions. The data entry program included limited response options and logic checks to minimize errors by precluding entry of incorrect data (eg, age younger than 65 years, out-of-range dates). The univariate distribution of each variable was examined; implausible and missing values were verified or corrected (by registered nurse or physician review) whenever necessary.

Data were collected via meticulous chart review and review of linked computerized mortality records. Chart reviewers were trained specifically to review all components of the record to obtain the most accurate possible information from each patient's chart. When there were questions about the data in the patient's chart, the original records were reviewed with internists experienced in perioperative consultation (regarding medical issues) or orthopaedic surgeons with expertise in the treatment of hip fractures. When key documents (eg, operative note, radiology report, admission history and physical, discharge summary) were missing, we resolicited hospitals to obtain these documents but were unable to resolve a few cases with missing information. The parameters assessed included age, gender, type of fracture, implants used, surgical approach, type of anesthesia, date and time of each procedure, antibiotic and DVT prophylaxis, use and timing of physical and occupational therapy, and mortality.

All analyses were weighted to account for our oversampling of high-mortality and low-mortality hospitals and deaths in those hospitals. Weights were constructed as the inverse of the probability of sampling each record and adjusted for hospital withdrawals and nonresponse. Consequently, the weighted results provided unbiased estimates of patient characteristics and processes of care for all surgically treated hip fractures at medium-to-high–volume hospitals in California. Differences in proportions were compared using the first order Taylor series linear approximation for estimation of variance. This approximation was required because subjects were clustered within hospitals and therefore could not be considered independent observations. To account for the sampling design and the clustering of observations within hospitals, the second-order Rao and Scott corrections of the Pearson chi square statistics were applied. These procedures were implemented using the svytab options in Stata Release 6 (Stata Corporation, College Station, TX).

RESULTS

Of the 1001 patients, 52% had sustained a femoral neck fracture (520 hips), 42% had sustained an intertrochanteric hip fracture (416 hips), and 6% had sustained a subtrochanteric hip fracture (65 hips). The hip fractures were treated with hemiarthroplasty (37.6%), some type of internal fixation (62%), or total hip arthroplasty (THA) (0.4%). There were 768 women (79%) and 233 men (21%). The average age of all patients was 82.7 years (range, 65–99 years), but most patients (71%) were between 75 and 98 years (Table 1).

Of fractures involving the femoral neck, 85% were displaced and 15% were nondisplaced. Operative treatment for femoral neck fractures included some type of hip arthroplasty (68%) or internal fixation (32%). In general, the displaced femoral neck fractures were treated with a hemiarthroplasty (85%). Fifteen percent of displaced femoral neck fractures were treated with internal fixation. In contrast, the majority of nondisplaced femoral neck fractures were treated with internal fixation (92%) and only 8% were treated with hemiarthroplasty. The patients with femoral neck fractures who were treated with an arthro-

TABLE 1. Hip Fracture Type According to Patient Age

Age (years)	Percent of Patients (by age)*	Femoral Neck Fractures (%)	Intertrochanteric Fractures (%)	Subtrochanteric Fractures (%)
65–69	4	40	42	18
70–74	9	46	45	9
75–79	18	59	38	3
80–84	26	60	37	3
85–89	27	45	48	7
> 89	16	45	47	8

*Percent of patients who were analyzed in each age group

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plasty received a bipolar hemiarthroplasty (73%), unipolar hemiarthroplasty (26.8%), or THA (0.2%). The bipolar implants were cemented 84% of the time and the unipolar arthroplasties were cemented 57% of the time. The posterior approach to the hip was used in 75% of cases. The lateral approach was used for 22% of the hips and the anterolateral approach was used in only 2% of arthroplasties.

The majority of intertrochanteric fractures were treated with internal fixation (94%). Five percent of intertrochanteric hip fractures were treated with a hemiarthroplasty and 1% with a THA. The fixation devices for the intertrochanteric hip fractures were a compression screw (96%), intramedullary rod (1.7%), or percutaneous pins (2.3%). Ninety two percent of subtrochanteric fractures were treated with internal fixation and 5% were treated with a hemiarthroplasty. The most common internal fixation device used was a compression screw (86%), followed by intramedullary rods (13%) and pins (1.4%).

General anesthesia was used in the majority of cases (57%), but regional anesthesia (40%) and combined regional and general anesthesia (3%) also frequently were used. The type of anesthesia used could not be determined in 0.6% of cases because of missing or unreadable operative and anesthesia notes.

The timing of administration of antibiotic prophylaxis was variable. Antibiotic prophylaxis was given within 2 hours before the surgical incision in 65% of the cases. Antibiotics were administered from 2 hours to less than 4 hours before the procedure in 3% of cases. Twenty-four percent of the patients did not receive prophylactic antibiotics within 4 hours before the surgical incision and 14% of patients did not receive antibiotics within this 4-hour period or during the surgery. In 8% of the cases, it was not possible to determine when the antibiotics actually were administered in relation to the beginning of the surgical procedure. Patients who received antibiotic prophylaxis within 4 hours before the surgical incision were less likely to die within 30 days (4.5% versus 6.6%) or within 180 days (8.9% versus 13.5%), more likely to be ambulatory at discharge (68% versus 61%), and had a similar mean length of stay (5.7 versus 5.4 days), compared with patients who received premature, delayed, or no antibiotic prophylaxis. These mortality and ambulation differences were significant ($p < 0.05$) in simple chi square analyses, but not in analyses that accounted for the clustered sample design.

The use of DVT prophylaxis was variable. Twenty four percent of patients did not receive any DVT prophylaxis (Table 2). Various pharmacologic and nonpharmacologic regimens were used, but the most frequent approaches were: low molecular weight heparin alone (17%), standard heparin alone (8%), aspirin alone (6%), warfarin alone (6%) or after heparin (2%), pneumatic compression boots alone (15%), and pneumatic compression boots combined with other modalities such as warfarin, heparin, or aspirin (23%). Prophylaxis for DVT began the day before surgery or the day of surgery in 52% of patients, the day after surgery in 15% of patients, more than one day after surgery in 2% of patients, and never in 24% of patients. Only 19% of patients were discharged with a transfer or discharge order for continued DVT prophylaxis. Overall, 54% of patients with hip fractures received 5 or fewer days of DVT prophylaxis. Patients who received acceptable DVT prophylaxis were similarly likely to die within 30 days (5.2% versus 4.9%) or within 180 days (9.5% versus 12.3%), more likely to be ambulatory at discharge (69% versus 61%), and had a similar mean length of stay (5.8 versus 5.2 days), compared with patients who received no DVT prophylaxis (or aspirin alone). The ambulation difference was significant ($p < 0.05$) in simple chi square analyses, but not in analyses that accounted for the clustered sample design.

The mean length of stay in the hospital was 5.6 days and the weighted median was 5 days. At discharge, 80% of the patients were transferred to a long-term care or skilled

TABLE 2. Deep Vein Thrombosis Prophylaxis after Operative Treatment

Prophylaxis Agent	Received In-hospital (%)	Received at Discharge (%)
Low molecular weight heparin alone	16.8%	5.6%
Unfractionated heparin alone	7.9%	1.8%
Pneumatic compression boots only	14.5%	0%
Aspirin alone	6.0%	
Warfarin alone	5.7%	3.1%
Warfarin and heparin	2.2%	0.7%
Pneumatic compression boots and other modalities	22.9%	7.4%
None	24.0%	81.3%

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nursing facility, an additional 7% were transferred to a rehabilitation or psychiatric unit, and 11% were discharged to home. Although 95% of patients received inpatient physical therapy, 25% never ambulated (with any level of assistance), and almost 10% were unable to transfer to a chair or bedside commode before hospital discharge. The overall in-hospital mortality rate was 1.8%. The overall 30-day mortality rate was 5.2%, and the 6-month mortality rate was 10.4%.

DISCUSSION

Hip fractures are increasing in number because the populations of the United States and other developed countries are living longer.[9,12,13] To decrease morbidity and mortality and reduce the economic costs associated with these fractures, it is important to enhance the care of patients with hip fractures. Although the majority of deaths associated with hip fractures are not directly caused by the fracture,[8,22] the disability associated with complications can decrease the quality of life of these patients and increase healthcare costs. Therefore, it is critical that care of these patients be optimized.

The 1.8% in-hospital mortality rate and the 10% 6-month mortality rate reported in this study were similar to results reported in other series.[13,19] Bhattacharya et al reported an inpatient mortality rate of 3% for patients with hip fracture in the United States using the National Hospital Discharge Survey database; this difference may be attributable to the shorter mean length of hospital stay in California relative to the nation.[4]

Although the mortality data from this study are consistent with data in other reports, some of the other findings were somewhat surprising. In general, antibiotic prophylaxis and DVT prophylaxis are given to patients with hip fractures. However, 24% of patients received antibiotic prophylaxis at a less than optimal time with respect to the start of the surgical procedure, and 14% did not receive antibiotic prophylaxis at all.

Prophylaxis for DVT is recommended for all patients having surgery for a hip fracture.[7,10,11] Despite the fact that these recommendations predate the period when our data were collected, 24% of California patients did not receive DVT prophylaxis. Only 19% of patients had prophylaxis continued after hospital discharge, and some patients did not receive prophylaxis during their entire acute hospital stay. Many of these patients are at increased risk to have symptomatic DVT develop after hospital discharge because of lack of mobility. Approximately 20% of the patients received agents with questionable efficacy. Twenty-two percent of patients received standard unfractionated heparin or pneumatic compression boots alone, which have been shown to have questionable efficacy in patients who have THAs and may not provide optimal prophylaxis for patients with hip fractures.[1,7,10,11,18] The Pulmonary Embolism Prevention Trial (PEP) showed that aspirin reduces the risk of venous thromboembolism after surgery for hip fracture. However, there were concerns related to increased gastrointestinal bleeding with aspirin prophylaxis for patients with hip fractures.[24]

During our study, bipolar hemiarthroplasties were used more frequently than unipolar devices. Recent data have suggested that there is no difference in outcome when comparing patients with hip fractures treated with a unipolar arthroplasty versus a bipolar hemiarthroplasty.[20] However, the unipolar devices are less expensive, and more frequent use of unipolar arthroplasties could save healthcare dollars without jeopardizing outcomes. Additional research is necessary to define the indications for these prostheses.[3] Most subtrochanteric hip fractures were treated with compression screws. Intramedullary nails have become more popular with many surgeons because there are biomechanical advantages associated with these devices, there is decreased soft tissue dissection, and they are easier to implant than plates and screws.[2]

The retrospective nature of this study is a limitation, and there are always concerns about the accuracy of mortality data obtained from large databases. Every attempt was made to have the data collection process be as accurate as possible, but the completeness and legibility of physician notes remained a limiting factor. The clinical abstractors were trained carefully, and whenever there was a question about the information to be collected, the data were reviewed with an internist or an orthopaedic surgeon. The two-stage stratified random sampling scheme allowed our weighted estimates to be generalized to the entire elderly population with hip fractures at medium- and high-volume hospitals in California during the years studied. Another weakness is that the study population had their surgical procedures in 1995 and 1996, and it is possible that surgeons and hospitals now are doing a better job with respect to DVT and antibiotic prophylaxis. However, in a recent study evaluating the timing of antibiotic prophylaxis in relation to the time of surgery, it was noted that 61% of patients with hip fractures did not receive antibiotic prophylaxis in an appropriate fashion.[28]

Patients with hip fractures often are admitted to medical services because of their medical problems, and the results of our study suggest that surgeons need to ensure that other physicians also are aware of the necessity of DVT and antibiotic prophylaxis and the appropriate agents to use. We did not have a sufficiently large sample to assess whether patients who did not receive antibiotics or DVT prophylaxis had greater rates of serious wound infections and symptomatic pulmonary emboli.[27,29] We did find lower 30-day and 180-day mortality rates among patients

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who received timely antibiotic prophylaxis and better ambulatory status at discharge associated with antibiotic and DVT prophylaxis, but these findings were statistically significant only when we treated the sample as a convenience sample rather than as a random sample from the entire state.[27,29] A meta-analysis evaluating antibiotic prophylaxis in patients with hip fractures indicated that patients who do not receive antibiotic prophylaxis have increased risks of wound and urinary tract infections.[27] In a study assessing differences in mortality after hip fracture, it also was noted that patients who did not receive DVT prophylaxis after hip fracture surgery were at increased risk of having a symptomatic pulmonary embolism develop.[29]

Our findings suggest that during the study period (1995–1996), certain aspects of the care of patients with hip fractures could be improved. All patients with hip fractures require antibiotic prophylaxis.[27] Deep vein thrombosis prophylaxis with agents that have proven efficacy also is necessary. Although the duration of prophylaxis is controversial, prophylaxis should be continued after hospital discharge, particularly in patients who are sedentary.[7,10,11] The development of clinical pathways for patients with hip fractures could improve care. Additional research regarding the specific indications for unipolar arthroplasty and bipolar hemiarthroplasty is necessary because of the differences in cost between the two implants. Although our study did not allow us to determine the effect of inadequate antibiotic prophylaxis and DVT prophylaxis on orthopaedic complication rates, proper administration of these therapies should improve outcomes for patients with hip fractures. Because the number of individuals worldwide experiencing hip fractures is increasing, greater emphasis should be placed on ensuring that the care of these patients is optimized.

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