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The 1-Year Mortality of Patients Treated in a Hip Fracture Program for Elders

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Abstract

Comanagement of geriatric hip fracture patients with standardized protocols has been shown to improve short-term outcomes after surgery. A standardized, patient-centered, comanaged Hip Fracture Program for Elders is examined for 1-year mortality. Patients ≥60 years of age who were treated in the Hip Fracture Program for Elders were comanaged by orthopaedic surgeons and geriatricians. Data including age, place of origin, procedure, length of stay, 1-year mortality, Charlson score, and activities of daily living (ADLs) were retrospectively collected. A total of 758 patients ≥60 years of age with hip fractures between April 15, 2005, and March 1, 2009, were included. Their data were analyzed, and the Social Security Death Index and the hospital data system were searched for mortality data. Seventy-eight percent were female, with a mean age of 84.8 years. The mean Charlson score was 3. Fifty percent were admitted from an institutional setting. The overall 1-year mortality was 21.2%. Age (odds ratio [OR] = 1.03, 95% confidence interval [CI] = 1.00-1.05; $P = .02$), male gender (OR = 1.55, 95% CI = 1.01-2.36; $P = .04$), low Parker mobility score (OR = 2.94, 95% CI = 1.31-6.57; $P = .01$), and a Charlson score of 4 or greater (OR = 2.15, 95% CI = 1.30-3.55; $P = .002$) were predictive of 1-year mortality. ADL dependence was a borderline predictor, as was medium Parker mobility score. Prefracture residence and moderate comorbidity (Charlson score of 2-3) were not independently predictive of mortality at 1 year after adjusting for other characteristics. A comprehensive comanaged hip fracture program for elders not only improves the short-term outcomes but also demonstrates a low 1-year mortality rate, particularly in patients from nursing facilities.

Keywords

geriatric trauma, systems of care, fragility fractures, hip, fractures, mortality

Hip fractures in older adults are a leading public health concern. The incidence of hip fractures has been declining over the past decade; however, the total number of fractures has grown exponentially.[1] The number of hip fractures in the United States could total 840 000 by the year 2040.[2,3] Older adults are the fastest growing segment of the US population. The population aged 65 years and older is predicted to more than double by 2050, increasing from 39 million today to 89 million.[4] It has been estimated that 1 in 3 women and 1 in 12 men will sustain a hip fracture in their lifetime.[5] It has been reported that 86% of hip fractures occur in individuals aged 65 years and older.[6]

Hip fractures are associated with significant morbidity, mortality, loss of independence, and financial burden.[6-12] In usual care, the reported 1-year mortality after sustaining a hip fracture has been estimated to be 14% to 58% (Table 1).[1,7,13-29] The relative risk of mortality in the elderly patient population increases 4% per year.[30] The first year after a hip fracture appears to be the most critical time. A recent meta-analysis revealed that women sustaining a hip fracture had a 5-fold increase and men almost an 8-fold increase in relative likelihood of death within the first 3 months as compared with age- and sex-matched controls.[31] The relative hazards decreased substantially over the first 2 years after fracture but never returned to the mortality rates of the controls.[32]

To optimize the care of this rapidly growing population, a hip fracture program for elders has been implemented with the orthopaedic and geriatric medical services to improve patient care. This hip fracture program for elders uses evidence-based protocols and comanagement of the patients by orthopaedic surgeons and geriatricians. This model of care has previously been shown to decrease length of stay (LOS), re-admission rates, complications, costs of care, and in-hospital mortality.[25,31-36]

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Table 1. Summary of Published Mortality Rates in Patients With Hip Fractures Treated in Usual Care

Author	Year	Number of Patients	In-Hospital Mortality, %	Overall 1-Year Mortality, %; Male/Female, %	1-Year Mortality of NH Patients, %	1-Year Mortality of Community Patients, %
White et al[29]	1987	241	NS	22; M 34, F 18	NA	NA
Keene et al[23]	1993	1000	15	33	NA	NA
Aharonoff et al[22]	1997	612	4	12.7; M 20.7, F 10.7	Excluded	12.7
Leibson et al[21]	2002	312	NA	NA	30	15
Elliot et al[20]	2003	1780	NA	22; M 30.1, F 19.5	NA	NA
Richmond et al[58]	2003	836	2.7	11.5; NA	Excluded	11.5
Wehren et al[18]	2003	794	NA	18.9; M 31.4, F 23.3	Excluded	18.9
Roche et al[7]	2005	2448	NA	33; NA	NA	NA
Haentjens et al[17]	2007	170	6.5	18.8; NA	NA	NA
Rapp et al[16]	2008	4342	NA	M 58.3, F 44.8	M 58.3, F 44.8	Excluded
Von Friesendorff et al[15]	2008	163	NA	21; NA	NA	Na
Brauer et al[1]	2009	786 717	NA	M 32.5, F 21.9	NA	NA
Berry et al[14]	2009	195	NA	39.5; M 53.5, F 35.6	39.5; M 53.5, F 35.6	Excluded
Bentler et al[13]	2009	495	3	26	NA	NA

NA, not available; M, male; F, female.

Our hypothesis was that, relative to other hip fracture studies in which a comanagement approach is not employed, our cohort of hip fracture patients, treated, as described, by our comanagement team, would have similar 1-year mortality. We also sought to describe patient characteristics that would be associated with increased 1-year mortality.

Methods

Patient Care Setting

The study hospital is a 262-bed, level-3 community teaching hospital affiliated with a large university medical center. This program was developed incrementally, starting in 1995, with use of standard orders sets and a standard nursing care plan. In 2004, this program was standardized, redesigned, and expanded to include comanagement with geriatricians, total quality management of each aspect of patient care, and lean business principles. All hip fracture patients were comanaged by orthopaedic surgeons and geriatricians throughout their entire hospitalization. Patient-centered, evidence-based, standard protocols were used in all phases of patient care. Patients with hip fractures were admitted through the emergency department or directly from other institutions. Medically stable and medically complex patients were admitted to the orthopaedic service on a designated fracture unit. All patients admitted to the orthopaedic service were seen by a geriatrician preoperatively. Medically unstable patients are admitted to the geriatric medicine service or to the intensive care unit. When the team decided the patient had been medically optimized, the patient was brought to surgery. Stability and fitness for surgery were determined when surgery was scheduled. Standardized patient care order sets were used from admission until discharge and are matched to integrated nursing care plans. Some care is provided by house staff, nurse practitioners, and physician assistants. Throughout the hospital stay, orthopaedic surgeons and geriatricians shared "ownership" of the patients and saw the patients daily.[33] Specifics of this program have previously been described in detail.[33,37]

Data Collection

Most data were prospectively collected as part of a quality management program, starting 6 months after the inception of the program. Data needed to calculate the Charlson Comorbidity Index (CCI) were obtained by chart review retrospectively. The Parker mobility score was primarily collected prospectively. Data were collected by a dedicated research nurse, using clinical information from charts. Chart review and interrater reliability testing were used to verify and maintain data integrity. The Research Subjects Review Board has reviewed and approved this study.

Patient Population

Patients 60 years of age or older who sustained a proximal femur fracture and were treated between April 15, 2005, and March 1, 2009, were included in the study for analysis. Subjects were excluded from the study if they were found to have a pathological fracture, a high-energy trauma, periprosthetic fracture, a previous hip fracture treated, or treated nonoperatively. This left 758 patients for evaluation.

Variables

Predictors included age, race, gender, comorbidities, preinjury living situation, LOS, Parker Mobility Index,[23] prefracture activities of daily living (ADLs), and Charlson[38] score. The Parker mobility score is an assessment tool that ranks prefracture mobility on a scale of 0 to 9.[39] A person with a score of 9 is

Table 2. Characteristics of the Patients

Total N	758
Gender, %	
Female	77.8
Age, y, mean ± SD	
Overall	84.8 ± 8.4
Race, %	
White	94.7
Hispanic	1.2
Black	1.2
Asian	2.1
American Indian	0.1
Other	0.3
Prefracture residence, %	
Community	47.1
Assisted living	12.8
Nursing home	37.3
Unknown	2.8
Charlson score, mean ± SD	
Overall	2.9 ± 2.1
Female	2.8 ± 2.1
Male	3.3 ± 2.3
Dementia, %	47.8
Length of stay, mean ± SD	4.3 ± 3.3
Readmission rate, %	10.4
Reoperation rate, %	1.85
Admit average Parker mobility, mean ± SD	4.9 ± 2.7
Inpatient mortality, %	2.8
Admission activities of daily living, mean ± SD	3.9 ± 2.4

independent in mobility at home and in the community, whereas someone with a score of 0 is completely dependent for ambulation. ADLs were given a value of 1 for independent and 0 for dependent. ADL independence was summed, giving a value between 0 (fully dependent) and 6 (fully independent). The CCI is a validated tool used to predict 1-year mortality. The CCI is a weighted score that takes into account the severity of certain medical comorbidities. In the original study, a patient with a CCI between 1 to 2 and 3 to 4 had 1-year mortality rates of 26% and 52%, respectively.[38]

The primary outcome measure was 1-year mortality. This was determined by searching the Social Security Death Index and the hospital data system. Social security numbers were submitted to the Social Security Death Index first. If mortality could not be confirmed, death was verified through hospital records. One hundred percent of patients with charts had 1-year mortality information confirmed in this way. Time to surgery, LOS, discharge Parker mobility score, and in-hospital mortality were secondary outcomes that were evaluated.

Statistical Analysis

The patient population was described using means and standard deviations for continuous variables, with medians reported for skewed data. Proportions were reported for categorical variables.

One-year mortality was reported for the entire population and then divided by predictor variables. For purposes of categorization, Parker mobility score was divided into low (below the median of 5), high (9, or fully mobile), and medium (5-8). ADLs had a bimodal distribution, and ADL was therefore divided into 3 categories, namely, independent (score of 6/6), partial dependence (1-5), and dependent (0/6). Charlson comorbidity was divided into low (0 or 1), medium (2-3), and high (4 or more). χ^2 analyses were performed to determine statistical significance.

A logistic regression model was performed to evaluate independent predictors of mortality at 1 year. Variables included in the model were age, gender, Parker mobility category, ADL category, Charlson category, and residence prior to admission.

Statistical analyses were conducted using Statview 5 software for Windows (SAS Institute, Inc, Cary, North Carolina).

Comparison Literature

As this was a case series, without a comparison population, comparison data were derived from a thorough literature review. We searched for English articles by using PubMed.org. The search terms included *hip fracture*, *one-year mortality*, and *comanagement*. The papers were then reviewed and included if they contained patients older than 50 years with surgically treated hip fractures and 1-year mortality data. Search results were divided into usual care and comanaged programs.

Results

Demographics

A summary of the patient demographics can be found in Table 2. A total of 758 patients aged ≥60 years with low-energy, nonpathologic fractures treated in this program had 1-year mortality data available (April 15, 2005, to March 1, 2009) and were included in the study (Table 2). Hip fractures included all fractures from the femoral neck to subtrochanteric region. These were not analyzed by type of fracture in this article as the study does not have sufficient power to detect these differences. The mean age was 84.8 ± 8.4 years, 77.8% were female, and 94.7% were Caucasian. Forty-seven percent of the patients were admitted to the hospital from home. Fifty percent of the patients required a higher level of preadmission care and were admitted from assisted living and skilled nursing facilities. For purposes of this study, assisted living was defined as an adult-living community or facility that provided assistance or supervision with at least 1 ADL but was not licensed as a skilled nursing facility. The mean Charlson[38] score was 2.9 ± 2.1. The average Parker mobility score on admission was 5.0 ± 2.7. The mean preadmission ADL score was 3.9 ± 2.4.

Surgical and Postsurgical Data

The average hospital LOS was 4.3 ± 3.3 days. The average time to the operating room was 23:25 ± 17:13 hours. Sixty-eight percent of the patients went to the operating room within 24 hours, and 94.6% went to the operating room within

Table 3. 1-Year Mortality, According to Baseline Characteristics

Characteristic	n	Mortality Rate	*P* Value
Overall mortality	758	21.2	
Age, y			.0002
60-69	48	2.1	
70-79	139	14.4	
80-89	364	22.8	
≥90	207	27.5	
Gender			.04
Male	590	26.8	
Female	168	19.7	
Preadmission residence[a]			<.0001
Nursing home	283	30.7	
Assisted living	97	23.7	
Community	357	13.2	
Preoperative Parker mobility score			<.0001
High (9)	149	6.7	
Medium (5-8)	327	18.3	
Low (0-4)	282	32.3	
Preoperative levels of activity of daily living			<.0001
Independent (6/6)	348	11.2	
Partial dependence (1-5/6)	268	29.5	
Dependent (0/6)	142	30.3	
Charlson score			<.0001
Low (0-1)	221	12.7	
Medium (2-3)	277	19.1	
High (4 or more)	260	30.8	
Dementia			<.0001
Yes	362	29.3	
No	396	13.9	

48 hours. The average Parker mobility score upon discharge was 1.2 ± 0.9.

Mortality

The 1-year mortality according to baseline characteristics is provided in Table 3. The overall unadjusted 1-year mortality was 21.2%. The 1-year mortality for men versus women was 26.8% and 19.7%, respectively. Individuals who resided in the community prior to fracture had a 1-year mortality of 13.2% versus 30.7% and 23.7%, respectively, for those residing in nursing homes and assisted-living facilities. The mortality rate was 2.7% for the initial inpatient hospital stay.

Table 4 provides the independent predictors of 1-year mortality. Age (odds ratio [OR] = 1.03, 95% confidence interval [CI] = 1.00-1.05; $P = .02$), male gender (OR = 1.55, 95% CI = 1.01-2.36; $P = .04$), low Parker mobility score (OR = 2.94, 95% CI = 1.31-6.57; $P = .01$), and a Charlson score of 4 or greater (OR = 2.15, 95% CI = 1.30-3.55; $P = .002$) were predictive of mortality at 1 year after adjusting for other factors. ADL dependence was a borderline predictor, as was medium Parker mobility score. Prefracture residence and moderate comorbidity (Charlson of 2-3) were not independently predictive of mortality at 1 year after adjusting for other characteristics.

Table 4. Independent Predictors of Mortality

Characteristic	Odds Ratio (95% Confidence Interval)	*P* Value
Age (per additional year)	1.03 (1.00–1.06)	.02
Male gender	1.56 (1.02–2.40)	.04
Parker mobility score (vs high)		
Medium (5–8)	2.17 (0.99–4.42)	.05
Low (0–4)	2.79 (1.24–6.27)	.01
Activity of daily living independence (vs independent)		
Partial (1–5)	1.60 (0.93–2.76)	.09
Dependent (0)	1.84 (0.99–3.44)	.05
Charlson score (vs 0–1)		
2–3	1.36 (0.81–2.28)	.25
4 or more	2.19 (1.32–3.64)	.002
Residence (vs community)		
Assisted living	1.23 (0.66–2.28)	.52
Skilled nursing facility	1.31 (0.78–2.20)	.32

Discussion

Health centers worldwide have begun to incorporate the comanagement of patients by geriatricians or hospitalists and orthopaedists. Many use evidence-based treatment protocols for the care of elderly patients with proximal femur fractures.[25,34,37,40-46] This is likely in response to the large number of elderly patients with hip fractures, the poor outcomes that these patients experience, and the high cost of hip fracture care. To provide cost-effective, efficient, and evidence-based care to this medically complex population, health care systems have sought new treatment paradigms. The practice of comanagement has not been widely instituted in the United States. The research supporting the use of this model of care has been mixed. Multiple randomized controlled trials have failed to show significant improvements in long-term mortality after hip fracture surgery with this model of care.[41,47-49] Other studies that have included comanagement or special clinical pathways have shown a decrease in mortality rates; however, few report long-term mortality rates (Table 5).[25,33,42,44,46] In a cohort comparison by Pedersen et al[25] of 535 patients with hip fractures treated within a multidisciplinary hip fracture program, the overall 1-year mortality was 23% compared with 29% for those who were treated with standardized care. However, this improved mortality was only a trend in the Kaplan-Meier analysis and not significant ($P = .2$). Barone et al[50] compared comanaged patients with controls and revealed 1-year mortalities of 25% and 35.3%, respectively. However, patient inclusion and exclusion criteria were not clear.[50]

When this hip fracture program for elders was developed, the primary goal was to improve the morbidity and mortality

Table 5. Hip Fracture Studies Involving Comanagement or Specialized Clinical Pathways

Author	Year	Type	n	Care Model	Included Instutionalized Patients	In-Hospital Mortality for IG, %	1-Year Mortality for IG, %
Gilchrist[47]	1988	RCT	374	Comanagement	Yes	5	n/a
Huusko[48]	2000	RCT	243	Comanagement	No	n/a	n/a
Naglie[41]	2000	RCT	279	Comanagement	Yes	n/a	n/a
Khan[49]	2002	Prospective cohort	745	Comanagement	Yes	11.1	n/a
Koval[45]	2004	Retrospective	1065	Clinical pathway	No	1.5	8.8
Phy[31]	2005	Retrospective	466	Comanagement	Yes	4.4	n/a
Vidàn[46]	2005	RCT	319	Comanagement	No	0.6	18.9
Thwaites[43]	2005	Retrospective	150	Comanagement	Yes	0.7	n/a
Fisher[42]	2005	Prospective cohort	951	Comanagement	Yes	4.7	n/a
Parker[44]	2000	Prospective cohort	2846	Team management	Yes	n/a	n/a
Beaupre[34]	2006	Prospective cohort	663	Clinical pathway	Yes	7	n/a
Pedersen[25]	2008	Retrospective	535	Clinical pathway	Yes	n/a	23%
Hommel[12]	2008	Retrospective	478	Clinical pathway	Yes	2% F, 3% M	22% F, 36% M
Present study	2010	Retrospective	758	Comanagement	Yes	2.8	21.2

RCT, randomized controlled trial; F, female; M, male; IG, intervention group.

of patients in the acute care setting. Initial investigations described an in-hospital mortality rate of 1.5% for a much smaller cohort of patients. The current in-hospital mortality is 2.7%. The 2005 National Inpatient Sample quoted an inpatient mortality rate of 3% for hip fracture.[51] Other studies on comanaged hip fracture care have found in-hospital mortality rates between 0.6% and 11.1%.[33] A recent meta-analysis of 9 studies including 4637 patients that compared patients treated within a hip fracture clinical pathway versus usual care found no significant improvement in short-term mortality.[52] The substantially lower mortality at 1 year in this program was not expected. The 1-year unadjusted mortality rate of 21.2% is lower than other published studies of patients treated in usual care when including institutionalized patients (Table 1). Other studies involving comanagement of patients have quoted lower mortality rates at 1 year but excluded patients with dementia, nursing home residents, or nonambulatory patients who typically have multiple medical comorbidities.[16,45,46] This study did not exclude patients based on their mental status, previous living arrangements, or functional levels and may provide broader applicability to the population. The incorporation of evidence-based protocols and comanaged care is a possible reason for the low overall mortality rate described in this study. In addition, the surgeons and geriatricians working at this facility care for a high volume of geriatric fractures, and this likely improves surgical and medical outcomes. In a retrospective review of 97 894 patients with hip fractures, the authors found a significant decrease in in-hospital mortality when high-volume surgeons (greater than 15 fracture cases per year) were involved. In addition, they found that the increased surgeon and hospital volume was associated with decreased nonfatal morbidity and decreased LOS.[53] In a recent review of mortality after intertrochanteric hip fractures, the researchers found inpatient mortality rates to be 10% to 20% higher in patients cared for in less than median volume hospitals.[54]

The Parker mobility score is a tool to assess preinjury mobility function and help stratify 1-year mortality after proximal femur fractures.[39] We found that this index was predictive of 1-year mortality in our study population. The ORs of 1-year mortality were 2.79 ($P = .01$) and 2.17 ($P = .05$) for low (0-4) and medium (5-8) mobility scores, respectively. A prospective 10-year study found that patients needing an assistive device for ambulation prior to their hip fracture had a 28% increased risk of mortality. In addition, patients who were limited to ambulation within their home had a 2.2 times greater risk of mortality.[30] Another indicator of general health is the patient's level of independence with ADLs. This study demonstrates that patients who were totally dependent with ADLs prior to hip fracture had an OR of 1.84 ($P = .05$) higher likelihood of mortality. This is consistent with previously published data. Aharonoff et al[22] analyzed 612 community-dwelling geriatric patients in whom prefracture dependency in basic ADLs predicted an increased hazard ratio 1-year mortality of 2.422.

Patients residing in an institution prior to hip fracture have a significantly greater risk of sustaining a hip fracture than those residing at home.[55] Nursing home patients have a greater likelihood of having dementia and more comorbidities than those residing at home. In addition, the nursing home population has a high prevalence of osteoporosis and falls.[16] Berry et al[14] have shown 1-year mortality rates in hip fracture patients from nursing homes to be 36% for women and 54% for men.[14] Other authors have found a greater prevalence in pneumonia and pressure ulcers after surgery in the institutionalized patients. A recent 3-year study reviewing Medicare patient claims for intertrochanteric hip fractures found the 90-day mortality rate was double for nursing home residents.[54] It is likely that these associated characteristics are the source of increased risk for hip fracture patients who reside in institutions. In our study, the 1-year mortality rate for home-dwelling patients was 13.2% compared with 30.7% in patients from nursing facilities, which

was significantly different on bivariate analysis. However, after adjusting for other characteristics, such as preoperative comorbidity and function, there was no longer a significant difference between community and noncommunity dwellers.

Forty-seven percent of our study population was diagnosed with dementia prior to their hip fracture. The 1-year mortality rate of demented patients was 29.3% versus 13.9% for those without dementia ($P < .0001$). Patients with dementia are known to have higher mortality rates after hip fractures. A 5-study by Khan et al[49] of hip fractures revealed a 1-year mortality rate of 28% of patients with severe dementia versus 12% without. A study by Hershkovitz et al[56] of 376 patients with hip fractures revealed a 2-year mortality rate of 26.4% in patients with dementia versus 6.5% with those without dementia.

This study, as well as others, shows an increased mortality after surgery with increasing age.[6,18,29,30] Mortality was 2% for patients younger than 70 years and more than 27% for those aged 90 years or older. In a study of 612 patients, Aharonoff et al[22] found that an age >85 years was predictive of 1-year mortality. However, other studies have not shown a significant correlation between age and mortality after hip fracture.[57-59] Richmond et al[58] found a significantly increased mortality risk in patients in the 64- to 85-year-old group as compared with those older than 85 years. Berry et al[14] showed that in a study of 195 nursing home residents aged 65 years and older with hip fractures, there was a 30% increase in mortality with every 5 years of advancing age. These findings are not surprising, as one would expect increased mortality with increasing age.

Patients with a Charlson score of 4 or greater were found to have twice the risk of death before 1 year. Studies have used the CCI to assess risk and predict 1-year mortality.[21,60-63] The CCI uses a cumulative score of comorbidities to provide prognostic data.[38] Roche et al[7] in their study of 2448 hip fractures found that having 3 or more medical comorbidities was related to higher complication rates and mortality. Bentler et al[13] studied 495 hip fractures and found that patients with 3 or more comorbid conditions were 65% more likely to die than those with fewer conditions. Our study patients had a mean Charlson score of 2.9 ± 2.1, which suggests a segment of the population who may have more severe or multiple medical comorbidities and presumed higher 1-year mortality rate. The predictive 1-year mortality of a patient with a Charlson score between 3 and 4 is 52%.[64] Greater than 34% of our patients had a Charlson score of 4 or greater. Despite this sicker population, our overall 1-year mortality rate was 21.2%.

Multiple studies have shown the association between the subject's gender and mortality.[11,58,65,66] Similar to other studies, we found that men had a higher risk of mortality at 1 year. The study by Endo et al[65] of 983 hip fracture patients (206 men) found that men had an increased postoperative complication risk and almost double 1-year mortality, even when controlling for age and health status. In their study, Endo et al found no significant difference in the number of comorbidities between the sexes, but men on average had higher American Society of Anesthesiology scores, suggesting more severe morbidities.[65] A study of patients treated within a hip fracture clinical pathway revealed a 12-month mortality of 35% for men versus 22% for women.[12] Data from the Scottish Hip Fracture audit revealed that men presented with a fracture at a younger age and were likely to have more medical comorbidities. They also found that men had a significantly higher mortality rate at 30 and 120 days.[26] The reason for this disparity in mortality between the sexes is unclear and warrants further investigation. Some have postulated that men's health is less stable at the time of fracture, making them more susceptible to postoperative mortality secondary to infections such as pneumonia and influenza.[11,18]

Sixty-eight percent of our patients underwent surgical correction of the hip fracture within 24 hours of admission. The average time from admission to the operating room was $23:25 \pm 17:13$ hours. We suspect the shorter time to surgery was facilitated by the team approach to the patient and emphasis placed on early surgery in this program. A prospective study of 850 patients revealed that patients who had surgery within 36 hours of admission experienced shorter hospital LOSs, fewer pressure ulcers, and greater likelihood to return to independent living.[67] In an analysis of 18 209 Medicare recipients who underwent surgery for a hip fracture, a delay in surgery of 2 days or greater from admission was associated with a 17% increase in 30-day mortality.[68] Other studies have not shown a decrease in mortality with surgery within 48 hours of admission,[69] but they have revealed decreased minor and major complication rates.[70,71] We believe that once the patient is medically optimized, he or she should be taken to surgery in an expeditious manner to prevent potential complication and possibly improve mortality. However, the literature remains mixed in support of this notion.

This study has several strengths. It includes a large cohort of patients. The study defines factors that predict 1-year mortality after hip fractures. In addition, it gives support to the implementation of a comanagement model for the treatment of patients of with hip fractures.

The limitations include the retrospective design and lack of controls. In addition, the number of men and minorities were limited, and the data may not be applicable to all geriatric populations.

In conclusion, a comprehensive comanaged geriatric hip fracture program had better short-term outcomes and lower 1-year mortality compared with studies in the recent literature, particularly in patients from nursing facilities.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

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References

1. Brauer CA, Coca-Perraillon M, Cutler DM, Rosen AB. Incidence and mortality of hip fractures in the United States. *JAMA*. 2009; 302(14):1573-1579.

2. Schneider EL, Guralnik JM. The aging of America: impact on health care costs. *JAMA*. 1990;263(17):2335-2340.
3. Melton LJ III. Hip fractures: a worldwide problem today and tomorrow. *Bone*. 1993;14(suppl 1):S1-S8.
4. Edwards T. Census Bureau reports: world's older population projected to triple by 2050. 2009;(1). http://www.census.gov/Press-Release/www/releases/archives/international_population/013882.html.
5. Chami G, Jeys L, Freudmann M, Connor L, Siddiqi M. Are osteoporotic fractures being adequately investigated? A questionnaire of GP & orthopaedic surgeons. *BMC Fam Pract*. 2006;7:7.
6. Braithwaite RS, Col NF, Wong JB. Estimating hip fracture morbidity, mortality and costs. *J Am Geriatr Soc*. 2003;51(3):364-370.
7. Roche JJ, Wenn RT, Sahota O, Moran CG. Effect of comorbidities and postoperative complications on mortality after hip fracture in elderly people: prospective observational cohort study. *BMJ*. 2005;331(7529):1374.
8. Holt G, Smith R, Duncan K, Hutchison JD, Gregori A. Outcome after surgery for the treatment of hip fracture in the extremely elderly. *J Bone Joint Surg Am*. 2008;90(9):1899-1905.
9. Haentjens P, Autier P, Barette M, Boonen S. The economic cost of hip fractures among elderly women: a one-year, prospective, observational cohort study with matched-pair analysis. Belgian Hip Fracture Study Group. *J Bone Joint Surg Am*. 2001; 83-A(4):493-500.
10. Hirose J, Ide J, Irie H, Kikukawa K, Mizuta H. New equations for predicting postoperative risk in patients with hip fracture. *Clin Orthop Relat Res*. 2009;467(12):3327-3333.
11. Penrod JD, Litke A, Hawkes WG, et al. The association of race, gender, and comorbidity with mortality and function after hip fracture. *J Gerontol A Biol Sci Med Sci*. 2008;63(8):867-872.
12. Hommel A, Ulander K, Bjorkelund KB, Norrman PO, Wingstrand H, Thorngren KG. Influence of optimised treatment of people with hip fracture on time to operation, length of hospital stay, reoperations and mortality within 1 year. *Injury*. 2008; 39(10):1164-1174.
13. Bentler SE, Liu L, Obrizan M, et al. The aftermath of hip fracture: discharge placement, functional status change, and mortality. *Am J Epidemiol*. 2009;170(10):1290-1299.
14. Berry SD, Samelson EJ, Bordes M, Broe K, Kiel DP. Survival of aged nursing home residents with hip fracture. *J Gerontol A Biol Sci Med Sci*. 2009;64(7):771-777.
15. von Friesendorff M, Besjakov J, Akesson K. Long-term survival and fracture risk after hip fracture: a 22-year follow-up in women. *J Bone Miner Res*. 2008;23(11):1832-1841.
16. Rapp K, Becker C, Lamb SE, Icks A, Klenk J. Hip fractures in institutionalized elderly people: incidence rates and excess mortality. *J Bone Miner Res*. 2008;23(11):1825-1831.
17. Haentjens P, Autier P, Barette M, Venken K, Vanderschueren D, Boonen S. Survival and functional outcome according to hip fracture type: a one-year prospective cohort study in elderly women with an intertrochanteric or femoral neck fracture. *Bone*. 2007; 41(6):958-964.
18. Wehren LE, Hawkes WG, Orwig DL, Hebel JR, Zimmerman SI, Magaziner J. Gender differences in mortality after hip fracture: the role of infection. *J Bone Miner Res*. 2003;18(12):2231-2237.
19. Richmond J, Aharonoff GB, Zuckerman JD, Koval KJ. Mortality risk after hip fracture. *J Orthop Trauma*. 2003;17(1):53-56.
20. Elliott J, Beringer T, Kee F, Marsh D, Willis C, Stevenson M. Predicting survival after treatment for fracture of the proximal femur and the effect of delays to surgery. *J Clin Epidemiol*. 2003;56(8): 788-795.
21. Leibson CL, Tosteson AN, Gabriel SE, Ransom JE, Melton LJ. Mortality, disability, and nursing home use for persons with and without hip fracture: a population-based study. *J Am Geriatr Soc*. 2002;50(10):1644-1650.
22. Aharonoff GB, Koval KJ, Skovron ML, Zuckerman JD. Hip fractures in the elderly: predictors of one year mortality. *J Orthop Trauma*. 1997;11(3):162-165.
23. Keene GS, Parker MJ, Pryor GA. Mortality and morbidity after hip fractures. *BMJ*. 1993;307(6914):1248-1250.
24. Haleem S, Lutchman L, Mayahi R, Grice JE, Parker MJ. Mortality following hip fracture: trends and geographical variations over the last 40 years. *Injury*. 2008;39(10):1157-1163.
25. Pedersen SJ, Borgbjerg FM, Schousboe B, et al. A comprehensive hip fracture program reduces complication rates and mortality. *J Am Geriatr Soc*. 2008;56(10):1831-1838.
26. Holt G, Smith R, Duncan K, Finlayson DF, Gregori A. Early mortality after surgical fixation of hip fractures in the elderly: an analysis of data from the scottish hip fracture audit. *J Bone Joint Surg Br*. 2008;90(10):1357-1363.
27. Abrahamsen B, van Staa T, Ariely R, Olson M, Cooper C. Excess mortality following hip fracture: a systematic epidemiological review. *Osteoporos Int*. 2009;20(10):1633-1650.
28. van den Berg P. Zoledronate, fractures, and mortality after hip fracture. *N Engl J Med*. 2008;358(9):967.
29. White BL, Fisher WD, Laurin CA. Rate of mortality for elderly patients after fracture of the hip in the 1980's. *J Bone Joint Surg Am*. 1987;69(9):1335-1340.
30. Paksima N, Koval KJ, Aharanoff G, et al. Predictors of mortality after hip fracture: a 10-year prospective study. *Bull NYU Hosp Jt Dis*. 2008;66(2):111-117.
31. Phy MP, Vanness DJ, Melton LJ III, et al. Effects of a hospitalist model on elderly patients with hip fracture. *Arch Intern Med*. 2005;165(7):796-801.
32. Haentjens P, Magaziner J, Colon-Emeric CS, et al. Meta-analysis: excess mortality after hip fracture among older women and men. *Ann Intern Med*. 2010;152(6):380-390.
33. Friedman SM, Mendelson DA, Kates SL, McCann RM. Geriatric co-management of proximal femur fractures: total quality management and protocol-driven care result in better outcomes for a frail patient population. *J Am Geriatr Soc*. 2008;56(7):1349-1356.
34. Beaupre LA, Cinats JG, Senthilselvan A, et al. Reduced morbidity for elderly patients with a hip fracture after implementation of a perioperative evidence-based clinical pathway. *Qual Saf Health Care*. 2006;15(5):375-379.
35. Miura LN, DiPiero AR, Homer LD. Effects of a geriatrician-led hip fracture program: improvements in clinical and economic outcomes. *J Am Geriatr Soc*. 2009;57(1):159-167.
36. Kates SL, Mendelson DA, Friedman SM. Financial impact of an organized fracture program for the elderly: early results. *J Orthop Trauma*. In press.

37. Friedman SM, Mendelson DA, Bingham KW, Kates SL. Impact of a comanaged geriatric fracture center on short-term hip fracture outcomes. *Arch Intern Med*. 2009;169(18):1712-1717.
38. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987; 40(5):373-383.
39. Parker MJ, Palmer CR. A new mobility score for predicting mortality after hip fracture. *J Bone Joint Surg Br*. 1993;75(5): 797-798.
40. Roberts HC, Pickering RM, Onslow E, et al. The effectiveness of implementing a care pathway for femoral neck fracture in older people: a prospective controlled before and after study. *Age Ageing*. 2004;33(2):178-184.
41. Naglie G, Tansey C, Kirkland JL, et al. Interdisciplinary inpatient care for elderly people with hip fracture: a randomized controlled trial. *CMAJ*. 2002;167(1):25-32.
42. Fisher AA, Davis MW, Rubenach SE, Sivakumaran S, Smith PN, Budge MM. Outcomes for older patients with hip fractures: the impact of orthopedic and geriatric medicine cocare. *J Orthop Trauma*. 2006;20(3):172-178.
43. Thwaites JH, Mann F, Gilchrist N, Frampton C, Rothwell A, Sainsbury R. Shared care between geriatricians and orthopaedic surgeons as a model of care for older patients with hip fractures. *N Z Med J*. 2005;118(1214):U1438.
44. Parker MJ, Pryor GA, Myles J. 11-year results in 2,846 patients of the Peterborough Hip Fracture Project: reduced morbidity, mortality and hospital stay. *Acta Orthop Scand*. 2000;71(1): 34-38.
45. Koval KJ, Chen AL, Aharonoff GB, Egol KA, Zuckerman JD. Clinical pathway for hip fractures in the elderly: the Hospital for Joint Diseases experience. *Clin Orthop Relat Res*. 2004:(425): 72-81.
46. Vidan M, Serra JA, Moreno C, Riquelme G, Ortiz J. Efficacy of a comprehensive geriatric intervention in older patients hospitalized for hip fracture: a randomized, controlled trial. *J Am Geriatr Soc*. 2005;53(9):1476-1482.
47. Gilchrist WJ, Newman RJ, Hamblen DL, Williams BO. Prospective randomised study of an orthopaedic geriatric inpatient service. *BMJ*. 1988;297(6656):1116-1118.
48. Huusko TM, Karppi P, Avikainen V, Kautiainen H, Sulkava R. Randomised, clinically controlled trial of intensive geriatric rehabilitation in patients with hip fracture: subgroup analysis of patients with dementia. *BMJ*. 2000;321(7269):1107-1111.
49. Khan R, Fernandez C, Kashifl F, Shedden R, Diggory P. Combined orthogeriatric care in the management of hip fractures: a prospective study. *Ann R Coll Surg Engl*. 2002;84(2):122-124.
50. Barone A, Giusti A, Pizzonia M, Razzano M, Palummeri E, Pioli G. A comprehensive geriatric intervention reduces short- and long-term mortality in older people with hip fracture. *J Am Geriatr Soc*. 2006;54(7):1145-1147.
51. 2005 HCUP Nationwide Inpatient Sample (NIS) Comparison Report. In: HCUP, ed. Vol 2008-1. Rockville, MD: US Department of Health and Human Services; 2008:29.
52. Neuman MD, Archan S, Karlawish JH, Schwartz JS, Fleisher LA. The relationship between short-term mortality and quality of care for hip fracture: a meta-analysis of clinical pathways for hip fracture. *J Am Geriatr Soc*. 2009;57(11):2046-2054.
53. Browne JA, Pietrobon R, Olson SA. Hip fracture outcomes: does surgeon or hospital volume really matter? *J Trauma*. 2009;66(3): 809-814.
54. Forte ML, Virnig BA, Swiontkowski MF, et al. Ninety-day mortality after intertrochanteric hip fracture: does provider volume matter? *J Bone Joint Surg Am*. 2010;92(4):799-806.
55. Cumming RG. Nursing home residence and risk of hip fracture. *Am J Epidemiol*. 1996;143(12):1191-1194.
56. Hershkovitz A, Polatov I, Beloosesky Y, Brill S. Factors affecting mortality of frail hip-fractured elderly patients. *Arch Gerontol Geriatr*. 2010;51(2):113-116.
57. Hannan EL, Magaziner J, Wang JJ, et al. Mortality and locomotion 6 months after hospitalization for hip fracture: risk factors and risk-adjusted hospital outcomes. *JAMA*. 2001;285(21): 2736-2742.
58. Richmond J, Aharonoff GB, Zuckerman JD, Koval KJ. Mortality risk after hip fracture. 2003. *J Orthop Trauma*. 2003;17(8 suppl): S2-S5.
59. van de Kerkhove MP, Antheunis PS, Luitse JS, Goslings JC. Hip fractures in nonagenarians: perioperative mortality and survival. *Injury*. 2008;39(2):244-248.
60. Souza RC, Pinheiro RS, Coeli CM, Camargo KR Jr The Charlson comorbidity index (CCI) for adjustment of hip fracture mortality in the elderly: analysis of the importance of recording secondary diagnoses. *Cad Saude Publica*. 2008;24(2):315-322.
61. Fanuele JC, Lurie JD, Zhou W, Koval KJ, Weinstein JN. Variation in hip fracture treatment: are black and white patients treated equally? *Am J Orthop (Belle Mead NJ)*. 2009;38(1): E13-E17.
62. Radley DC, Gottlieb DJ, Fisher ES, Tosteson AN. Comorbidity risk-adjustment strategies are comparable among persons with hip fracture. *J Clin Epidemiol*. 2008;61(6):580-587.
63. Roos LL, Stranc L, James RC, Li J. Complications, comorbidities, and mortality: improving classification and prediction. *Health Serv Res*. 1997;32(2):229-238.
64. Charlson ME, Ales KL, Simon R, MacKenzie CR. Why predictive indexes perform less well in validation studies: is it magic or methods? *Arch Intern Med*. 1987;147(12):2155-2161.
65. Endo Y, Aharonoff GB, Zuckerman JD, Egol KA, Koval KJ. Gender differences in patients with hip fracture: a greater risk of morbidity and mortality in men. *J Orthop Trauma*. 2005; 19(1):29-35.
66. Cree M, Soskolne CL, Belseck E, et al. Mortality and institutionalization following hip fracture. *J Am Geriatr Soc*. 2000;48(3): 283-288.
67. Al-Ani AN, Samuelsson B, Tidermark J, et al. Early operation on patients with a hip fracture improved the ability to return to independent living: a prospective study of 850 patients. *J Bone Joint Surg Am*. 2008;90(7):1436-1442.
68. McGuire KJ, Bernstein J, Polsky D, Silber JH. The 2004 Marshall Urist award: delays until surgery after hip fracture increases mortality. *Clin Orthop Relat Res*. 2004:(428):294-301.
69. Majumdar SR, Beaupre LA, Johnston DW, Dick DA, Cinats JG, Jiang HX. Lack of association between mortality and timing of

surgical fixation in elderly patients with hip fracture: results of a retrospective population-based cohort study. *Med Care*. 2006; 44(6):552-559.

70. Sircar P, Godkar D, Mahgerefteh S, Chambers K, Niranjan S, Cucco R. Morbidity and mortality among patients with hip fractures surgically repaired within and after 48 hours. *Am J Ther*. 2007;14(6):508-513.
71. Lefaivre KA, Macadam SA, Davidson DJ, Gandhi R, Chan H, Broekhuyse HM. Length of stay, mortality, morbidity and delay to surgery in hip fractures. *J Bone Joint Surg Br*. 2009;91(7):922-927.