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Original Article

Hip fractures in extremely old patients

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ABSTRACT

Aims: The purpose of this study was to report a less seen age-group (>90) of hip fractures and to assess the predictors of functional loss, complications and mortality.
Methods: Thirty-two patients at a mean age of 92.8 (±2.7) were treated in a single institution and reported at a mean follow-up of 2.02 (±1.35) years.
Results: Mortality was similar between proximal femoral nailing (PFN) and bipolar cemented hemiarthroplasty (BCH) in first year ($p = 0.17$) but significantly high in following years in BCH ($p = 0.035$) and patients with cardiac disease ($p = 0.054$).
Conclusion: Hip fractures are challenging in extremely old patients and associated with increased mortality and disability.

1. Introduction

Hip fractures are challenging in extremely old population and show increased post-operative complications.[1–3] Poor prognostic factors for a hip fracture includes male gender,[4–7] poor mental condition, dementia, cognitive problems,[6,8] cardiopulmonary disease,[4,5] limited pre-operative function and mobility,[6] delayed surgery[9] and older age.[4–7]

Life time incidence of hip fracture is approximately 18% in women and 8% in men.[10,11] Incidence increases with age.[11] Previous studies showed 15 times increased risk of hip fracture in patients over 90 than below 65 years old.[12] At present, there are 89.700 (0.11% of all population) people over the age of 90 residing in the Turkey and it is predicted that this number will increase next decade.[13]

Multiple studies showed increased mortality rates[14,15] and poorer functional recovery and independency[7] after hip fracture in elderly population. This increased mortality in hip fracture patients has been documented in the first year after fracture and remains high in the subsequent years of follow-up.[16,17] The purpose of this study is report a less seen age-group of hip fracture patients and to investigate mortality, walking ability, functional status changes after surgical intervention.

2. Material – methods

This is a retrospective review of all patients diagnosed with a hip fracture older than 90-year-old at a single institution from 2007 to 2012. Patients who did not undergo surgery, due to systemic comorbidities, were excluded from the study.

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Patient's clinical and radiographical features were evaluated at initial presentation, surgery and last follow-up retrospectively. Collected data's were demographics, pre-operative mobilization status, use of assistive devices for walking, ASA (American Society of Anesthesiologists) classification,[18,19] time between injury and surgery, initial fracture pattern, comorbidities, type of surgical procedure (osteosynthesis with a proximal femoral nail (PFN, PFNA® DePuy Synthes, West Chester, PA) or cemented bipolar hemiarthroplasty (CBH, Spectron® or Echelon® Smith & Nephew, Memphis, TN, USA)),duration of surgery, blood transfusion, post-operative mobility and complications.

Pre-existing comorbidities were chosen as based on reported previous studies[20,21] and classified as hypertension, ischemic cardio-vascular disease, cardiac arrhythmia, renal impairment, chronic obstructive airway disease, diabetes mellitus, malignancy, cerebrovascular disease, Alzheimer's disease, Parkinson disease or other cognitive problems.

Delayed surgery was defined as ≥4 days. PFN was preferred in intertrochanteric fractures and CBH was the first choice in collum femoris fractures and performed in some patients with intertrochanteric fractures. All patients had similar post-operative protocol with mobilization on the first post-operative day if possible. Full weight bearing was allowed in CBH but limited in PFN. When patients were considered to discharge from hospital, they were transferred to their home or a rehabilitation unit. Complications were classified as varus collapse, implant related problems (lateral sliding or cut out), secondary fractures, infection (deep or superficial), hip dislocation, non-union and systemic problems such as; pulmonary embolism, cardiac ischemia, pneumonia.

Patients were called back for a last follow-up. Talk on the phone was made either with family or patient him- her-self. Patients or families who can't be reached were excluded from the study. If the patient was alive, functional status, walking ability and type of walking aids used were questioned. If the patient was dead, the time gap between operation and death were noted. If the cause of death was known by family, noted too.

Complications; mortality in first year; following years and surgical time were compared in between different ASA grades, comorbidities and surgical approaches regardless to fracture pattern.

2.1. *Statistical analysis*

Statistical analysis was performed using Microsoft Excel (Redmond, WA) and MedCalc B-8400 (Ostend, Belgium). Anova test was used for variance analysis, student's *t*-test was used for parametric data and chi-squared test for categorical data. A p value of ≤0.05 was considered significant.

3. Results

Retrospective data-base search found 32 patients over 90 years old had a surgery for a hip fracture. The mean age was 92.8 years (90.4–102.2). Ten patients (31.2%) were male and twenty-two (68.7%) patients were female. All patients were ambulatory before injury with or without an assistive walking device. The mean follow-up was 2.02 years (±1.35). Fractures were classified as 10 collum femoris fractures and 22 intertrochanteric femur fractures. Age distribution are similar between collum fractures and intertrochanteric fractures (94.1 vs. 92.4, $p = 0.22$) (Table 1). First year mortality of collum fractures were significantly high ($p = 0.031$). There were 22 patients (68%) with identified comorbidities. The most common comorbidities were hypertension with or without ischemic heart disease (18 patients) and neurologic disorders such as dementia, Alzheimer's disease or Parkinson disease (9 patients). There is statistically significant correlation found between cardio-vascular diseases and first year mortality ($p = 0.054$). The numbers of comorbidities and ASA grade are shown on Tables 2 and 3.

The mean day of operation for PFN was 5.4 (±5) and BCH was 7 (±5.1) after hospitalization which are statistically similar ($p > 0.05$). Duration of surgery for BCH was significantly long (74.1 vs. 110 min, $p < 0.001$). Duration of surgery and delayed surgery had no impact on first year and last follow-up mortality ($p > 0.05$). PFN was performed in 17 patients and BCH was performed in 15 patients (Fig. 1). The mean blood transfusion requirement was 450 cc (1.1 package). Transfused blood products were higher in BCH group but statistically similar in between two surgical approaches ($p = 0.07$).

Complications were common in elderly patients with proximal femur fractures. Any type of complication was occurred in 12 patients (37%). Overall the most common complication was varus collapse in 4 patients. PFN removed and BCH was applied in 1 patient because of excessive varus collapse. Compilation rates were similar between PFN and BCH ($p = 0.24$). The numbers of complications are recorded in Table 4.

Complications and first year mortality were significantly high in ASA grade 3 group compared to ASA grade 1 respectively ($p = 0.041$, $p = 0.022$), but mortality rates at last follow-up was similar ($p > 0.05$).

Twenty-eight patients were ambulatory with an assistive walking device at discharge. Ten of 16 patients were ambulatory at the last follow-up. Only 2 (6.2%) of the patients were achieved their functional status prior to fracture.

A total of 16 patients (50%) died during follow-up. Nine patients (28%) died post-operative first year. Survivorship following PFN and BCH was similar in first year after surgery ($p = 0.17$), but mortality rates were significantly high in BCH patients in following years ($p = 0.035$).

4. Discussion

In this study, we aimed to identify predictors of mortality and functional loss in hip fractures in extremely old patients. Elderly population is increasing in the modern world. Medical staff is facing new problems when treating extremely old patients. Multiple studies showed increased risk of hip fracture and increased mortality after a hip fracture both 1 year and 5 years of follow-up in elderly patients.[1,4,8,20] There are not many publications concentrated on patients over 90-year-old.

Clinicians have difficulties to determine whether an older patient is “frail” or not. Ensurd et al reported a comparison of

Table 1 – Patient demographics', fracture pattern and type of surgery performed (*All hemiarthroplasties were bipolar and cemented).

	Gender	Age at surgery	Type of fracture	Surgery performed
HC	F	97	Intertrochanteric	PFN
AE	F	95	Intertrochanteric	PFN
MS	F	94	Intertrochanteric	PFN
NT	F	94	Intertrochanteric	PFN
EC	F	93	Intertrochanteric	PFN
TD	F	93	Intertrochanteric	PFN
MI	F	93	Intertrochanteric	PFN
SB	F	92	Intertrochanteric	PFN
MA	F	91	Intertrochanteric	PFN
NB	F	91	Intertrochanteric	PFN
AK	F	90	Intertrochanteric	PFN
KD	M	92	Intertrochanteric	PFN
CD	M	91	Intertrochanteric	PFN
IMS	M	90	Intertrochanteric	PFN
SD	M	90	Intertrochanteric	PFN
MTS	M	90	Intertrochanteric	PFN
RK	M	90	Intertrochanteric	PFN
SM	F	102	Collum	Hemiarthroplasty*
ZY	F	94	Collum	Hemiarthroplasty*
RA	F	94	Intertrochanteric	Hemiarthroplasty*
AU	F	95	Collum	Hemiarthroplasty*
AH	F	97	Intertrochanteric	Hemiarthroplasty*
ND	F	92	Collum	Hemiarthroplasty*
ND	F	91	Collum	Hemiarthroplasty*
NG	F	90	Intertrochanteric	Hemiarthroplasty*
HZ	F	91	Intertrochanteric	Hemiarthroplasty*
RA	F	91	Collum	Hemiarthroplasty*
AS	F	91	Collum	Hemiarthroplasty*
KT	M	97	Collum	Hemiarthroplasty*
MSO	M	96	Collum	Hemiarthroplasty*
ST	M	91	Collum	Hemiarthroplasty*
IHT	M	93	Intertrochanteric	Hemiarthroplasty*

two frailty indexes (Study of Osteoporotic Fractures-SOF index and Cardio-vascular Health Study-CHS index). Weight loss, poor energy, weakness, slowness and low physical activity were identified as predictors of recurrent falls, disability and increased mortality in elderly population.[22]

Data obtained from Turkish Statistical Institute, the annual rate of mortality over 75 years old was 7.6% in 2012.[13] Comparison would be meaningless to our study because of age conflict. According to Scotland Government Actuary's Department information, standardized mortality rate in population aged 95 is 26% per year.[23] First year mortality rate in this study (28%) and estimated mortality at age 95 in Scotland (26%) is similar. This data shows that, hip fractures in extremely old population do not increase estimated first year mortality.

Holt et al[21] were studied on a small group of extremely old population. In their study 50 patients with a mean age of 98.1 were retrospectively evaluated. Data collected from >95 years old hip fracture patients were compared with a 200 consecutive individuals under the age of 95 years old who underwent similar type of surgery. In that study post-operative mortality was significantly higher at 1 and 4 month ($p = 0.005$), but not significantly different from control group at 1 year ($p = 0.229$).

Overall first year mortality was 28% in this study (>90), which is similar to literature knowledge for elderly patients in

Table 2 – Pre-existing comorbidities.

Comorbidities	Proximal femoral nail	Hemiarthroplasty
Hypertension	12	6
Ischemic heart disease	7	4
Cardiac arrhythmia	1	0
Renal impairment	1	0
Chronic obstructive airway disease	2	1
Diabetes mellitus	3	3
Malignancy	2	1
Cerebrovascular disease	2	2
Alzheimer's disease	5	3
Parkinson disease	1	0
Hypo-thyroid	0	1

Table 3 – ASA grade.

	Proximal femoral nail	Hemiarthroplasty
ASA grade 1	2	3
ASA grade 2	7	4
ASA grade 3	8	7
ASA grade 4	0	1
ASA grade 5	0	0

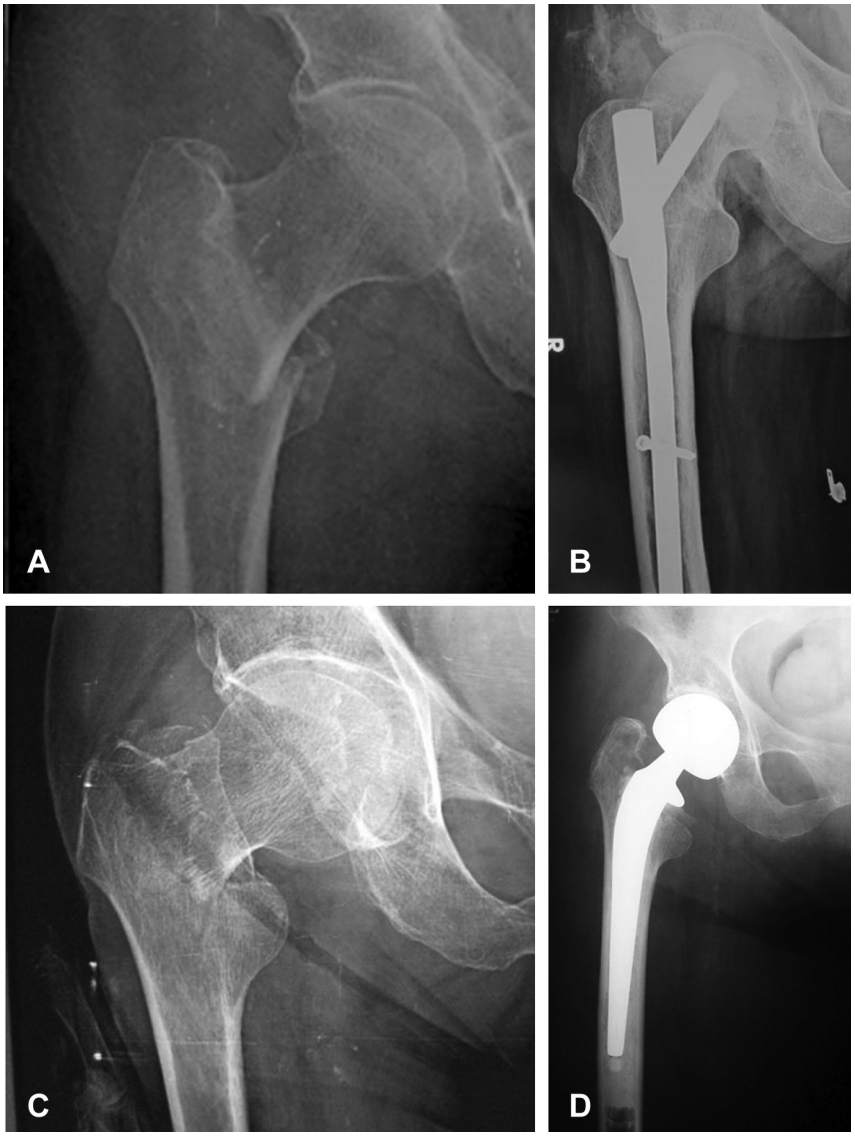

Fig. 1 – A. R intertrochanteric femur fracture, B. One year after proximal femoral nailing (PFNA® DePuy Synthes, West Chester, PA), C. R collum femoris fracture, C. One year after bipolar cemented hemiarthroplasty (Spectron® Smith & Nephew, Memphis, TN, USA).

hip fractures (>65).[1,4,14,17] But, at the mean follow-up for 2.12 years showed 50% mortality in extremely old population, which is higher than elderly population reported in literature.[1,16,17]

Table 4 – Complications.

Complications	Proximal femoral nail	Hemiarthroplasty
Varus collapse	4	0
Blade related problems	1 (lateral sliding) 1 (cut out)	0
Infection (superficial/deep)	1 (superficial)	1 (superficial)
Hip dislocation	0	1
Secondary fractures	0	0
Systemic problems	1	2
Non-union	0	0

Females have higher risk of a hip fracture,[11] but males have higher mortality rates than females with a hip fracture.[24] In our study, extremely old patients showed no differences mortality rates between males and females ($p = 0.11$).

Delirium, during the perioperative period associated with severe worsening of cognitive functions and is a strong predictor of short-term mortality in hip fracture patients.[7] Dementia was found to be associated with 5 years mortality, increasing the death risk by 4 times in elderly hip fractures. But 3 months and 1 year mortality was similar in patients with dementia.[25] Our study showed cognitive disorders were not increased the mortality rates in first year ($p = 0.54$) and at the end of follow-up ($p = 0.13$) in patients >90-year-old.

Kenzora et al[26] found that pre-existing medical conditions, especially cardiac problems, were highly associated with post-operative mortality ($p \leq 0.001$). Presence of medical conditions as the cause of delayed surgery may effect on mortality. Main

medical reason associated with surgical delay is instable cardio-vascular disease. Vidan et al[9] showed that mortality in patients with hip fracture is mostly explained by medical comorbidities and this delay is associated with increased mortality ($p = 0.002$). Our results also showed increased first year mortality in patients with cardiac comorbidities ($p = 0.054$).

Multiple previous studies did not observe any influence of mortality, in type of fracture or surgical treatment selected in hip fractures.[25,27,28] But first year mortality of collum fractures were significantly high ($p = 0.031$) and BCH group mortality rates were found to be significantly high after first year of surgery ($p < 0.01$) in our study. BCH were all performed in collum femoris fracture group, and these patients were slightly older than intertrochanteric fracture patients (94.1 vs. 92.4, $p = 022$). Thus may related with increased mortality in collum fractures and BCH group.

Social environment is extremely important when these patients discharged from the hospital. Mobilization centered rehabilitation is recommended.[29] Recent studies showed that early mobilization can decrease mortality rates in elderly patients with hip fracture.[20,25,28] But some other authors advocate that early mobilization does not have any impact on mortality. Ammann et al showed that pre-fracture motor level is the most important predictive factor for recovery and suggest muscle training and correction of malnutrition (protein supplements and vitamin D) to improve functional status.[15,30]

Although most orthopedic surgeons accomplish their goal for early mobilization after a hip surgery in old patients, majority of extremely old patients have difficulties with mobility even before fracture. This study showed patients who were treated with a PFN live longer than patients who were treated with BCH, which provides un-limited weight bear immediately after surgery. To make an analysis between mobilization and mortality was not possible because of data limitation in our study. Further studies should be done to understand the impact of mobilization on mortality.

There are several limitations because of retrospective nature of the study. Patient group was small and there is no control group of <90-year-old patients. Because of short life expectancy, long-term analyses were not possible in extremely old population. Elderly population is increasing in most countries and there are not many studies about hip fractures in extremely old patients. Therefore, this study can provide data for surgeons who are dealing with this small group of patients.

Hip fracture in elderly population is associated with increased mortality and disability. Comorbidities, especially cardio-vascular diseases were found to be predictors of increased first year mortality after hip fractures in extremely old patients. Delayed surgery had no impact on first year and last follow-up mortality. First year mortality of collum fractures was significantly higher than intertrochanteric fractures. Compilation rates were similar between PFN and BCH but mortality rates were significantly high in BCH patients after first year.

Conflicts of interest

All authors have none to declare.

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