

Operative treatment of hip fractures in patients receiving hemodialysis

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Abstract Fifteen hips in 13 patients with hip fracture were treated in patients receiving hemodialysis for chronic renal failure. There were four intertrochanteric and 11 femoral neck fractures. 10 of the 11 femoral neck fractures and one of the four intertrochanteric fractures were treated with cemented bipolar hemiarthroplasty. Two intertrochanteric fractures fixed with sliding compression screws. External fixation was used for stabilization in two patients who had femoral neck and intertrochanteric fractures. Two intertrochanteric fractures that were treated with sliding hip screw showed radiological union postoperatively at the 6th month. Of the 11 hemiarthroplasty, four hips developed aseptic loosening (36%). According to Harris hip score grading system, three (37.5%) poor, two (25%) fair, two (25%) good and one (12.5%) case had excellent outcome in the hemiarthroplasty group. The survival of dialysis patients with a hip fracture is markedly reduced. Initial treatment of hemiarthroplasty allows early mobilization and prevents revision surgery.

Keywords Hip fracture · Dialysis · Arthroplasty · Implant loosening · Mortality

Introduction

The interactions between renal failure and bone disease have been well recognized for several decades. Renal

osteodystrophy, dialysis-related amyloidosis, pathological fractures due to amyloid bone cyst and osteoporosis are the main manifestations of dialysis therapy in patients with end-stage renal disease (ESRD) [1–3].

Patients undergoing hemodialysis are at an increased risk of fracture due to the fragile bone quality [1, 4, 5]. The risk of hip fracture for patients with ESRD on dialysis has been estimated to be 4.4 times greater than the general population [4]. The medical problems associated with ESRD complicate care in the perfracture period and contribute to increased mortality [6–9].

Materials and methods

The study included 13 patients (15 hips) with ESRD on hemodialysis, who underwent operative treatment between 2002 and 2007. The patient population consisted of 9 men and 4 women, whose average age was 63 years (range, 34–77) when they sustained hip fracture. The mean height and weight of the patients were 170.5 cm (range, 158–185) and 71.5 kg (range, 53–93), respectively. Causes of renal failure were diabetes mellitus in 8 patients, glomerulonephritis in 5 patients. All fractures were caused by a simple fall from a standing height. Two of the 13 patients were ambulatory with assistive devices, and one was nonfunctional ambulatory before their fractures. All patients were on hemodialysis at the time of the fracture. The duration of the dialysis preceding the fracture in the patients ranged from 2 to 156 months (mean = 66.5 months). Operative treatment was delayed until the patients were considered to be in medically stable condition (Table 1). Coexisting diseases was the main reason for significantly delayed surgery in the majority of the patients.

Level of Evidence: Level 2b (retrospective study).

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Table 1 Patient characteristics and associations with other medical problems

Patient number	Age (years)	Height (cm)	Weight (kg)	Cause of renal failure	Frequency of hemodialysis (per week)	Associated medical problems	Duration of dialysis preceding the fracture (month)	Preoperative ambulation status	Canal-to-calcar ratio	Cortical thickness	Preoperative Dorr
1	77	160	60	Idiopathic	3	HT	132	Nonambulatory	0.70	0.45	B
2	72	170	75	DM	3	HT, DM, CHF	5	With assistance	–	–	B
3	62	180	90	DM	2	HT, DM, CHF	36	Ambulatory	–	–	A
4	49	170	53	Idiopathic	3	–	120	Ambulatory	0.83	0.42	A
5	60	158	90	DM	3	HT, DM, CHF	72	Ambulatory	0.83	0.41	B
6	70	168	70	DM	3	DM	36	Ambulatory	–	–	B
7	59	175	70	Idiopathic	3	HT, DM, Stroke	72	Ambulatory	0.84	0.52	A
8	73	176	93	DM	3	HT, DM	60	With assistance	–	–	B
9	34	185	61	Idiopathic	3	HT, Hepatitis	2	Ambulatory	0.81	0.62	A, A
10	70	170	68	DM	3	HT, DM, CHF	2	Ambulatory	0.76	0.56	A
11	64	165	65	DM	3	HT, DM	72	Ambulatory	0.75	0.57	A
12	75	180	70	DM	3	HT, DM, CHF	36	Ambulatory	0.80	0.65	B
13	54	160	65	Idiopathic	3	Stroke	156	Nonambulatory	0.52	0.47	B, B

DM diabetes mellitus, HT hypertension, CHF chronic heart failure

Type of surgery was decided on the basis of patients' age, fracture region, ambulation status and medical condition of the patients. There were 4 intertrochanteric and 11 femoral neck fractures. Ten of the eleven femoral neck fractures and one of the four intertrochanteric fractures were treated with cemented bipolar hemiarthroplasty. Sliding compression screw was used for the treatment of two intertrochanteric fractures. Due to the unstable medical condition in two patients who had femoral neck and intertrochanteric fractures, respectively, unilateral external fixation was used for stabilization (Table 2).

Prophylactic antibiotics were given routinely for 5 days in the perioperative period. Subcutaneous administration of low molecular weight heparin, use of antithrombotic stockings and early mobilization were used for the prophylaxis of deep venous thrombosis.

Patients were questioned and examined regarding their level of function using a grading system of Harris hip score. Component loosening was evaluated on plain radiographs based on the criteria of Engh et al. Preoperative radiographs were evaluated for measurement of the canal-to-calcar ratio and cortical thickness indices as described by Dorr et al.

Statistical analysis included the use of descriptive statistics and the application of nonparametric tests such as the Mann–Whitney *U* test. A *P*-value of <0.05 was taken to be statistically significant.

Results

Outcome after operative treatment

Two intertrochanteric fractures that were treated with sliding hip screw showed radiological union postoperatively at the 6th month. Persistent serous wound drainage occurred in 4 hips (26%) in the hemiarthroplasty group. Laboratory studies including the leukocyte count, C-reactive protein level and erythrocyte sedimentation rate were obtained to rule out septic loosening and found within normal limits. Four hips including *one hip with prolonged serous drainage* developed aseptic loosening (36%). Only one patient in this group had revision hemiarthroplasty (9%) due to the pain and subsidence of the implant.

Hospitalization dates were ranged from 2 to 150 days (mean = 18.4).

Life expectancy

At the time of the last follow-up, 5 of the 13 patients were deceased. Causes of renal failure in this patient group included diabetes in 4 patients and glomerulonephritis in 1 patient.

Table 2 Postoperative results of the patients, according to the types of treatment

Patient number	Frx	Duration between frx and surgery (day)	Treatment	Hospitalization (day)	Postoperative ambulation status	Harris hip score	Implant failure/loosening	Follow-up (month)	Mortality
1	Intertrochanteric	1	Arthroplasty	15	Nonambulatory	1	-	2	+
2	Intertrochanteric	17	ORIF	7	With assistance	1	-	28	+
3	Femoral neck	4	ORIF	7	Ambulatory	1	-	21	+
4	Femoral neck	7	Arthroplasty	10	Nonambulatory	58	+	25.5	-
5	Femoral neck	7	Arthroplasty	7	With assistance	36	+	21	-
6	Femoral neck	8	External fixation	2	With assistance	1	-	4	+
7	Femoral neck	22	Arthroplasty	4	Ambulatory	82	-	18.5	-
8	Intertrochanteric	12	External fixation	6	Nonambulatory	1	-	0	+
9	Bilateral femoral neck	60	Bilateral Arthroplasty	150	With assistance	94	+	13.5	-
10	Femoral neck	12	Arthroplasty	5	With assistance	75	-	12	-
11	Femoral neck	5	Arthroplasty	5	Ambulatory	89	-	8	-
12	Intertrochanteric	20	Arthroplasty	15	With assistance	66	-	6	-
13	Bilateral femoral neck + periprosthetic frx	10	Bilateral arthroplasty + revision arthroplasty	7	Nonambulatory	38	+	4	-

Three patients died within 1-year follow-up. Causes of death were heart attack in 2 patients; 2 patients died after secondary surgery for colon cancer and diabetic ulceration of foot. One patient died due to the postoperative thromboembolic complication. The overall mortality rate in this study was 23% at 1 year and 30% at 2 years. According to the types of treatment, postfracture mortality rate was 11% in cemented hemiarthroplasty. The overall survival rate in this study was 61%.

Ambulation status

In the group of intertrochanteric hip fractures, of 2 prefracture-independent ambulatory patients, one became nonfunctional ambulatory and one ambulator with assistive devices. Of 2 prefracture-dependent ambulatory cases, one regained prefracture ambulatory ability, one became nonambulator.

Nevertheless, of 8 prefracture-independent ambulatory patients that treated with hemiarthroplasty, 3 regained their prefracture ambulatory status, 4 became dependent and one nonfunctional ambulator.

Functional outcome

Level of function data was available for 8 alive patients treated with cemented hemiarthroplasty. Data were recorded at the most recent follow-up. According to Harris hip score grading system, 3(37.5%) poor, 2(25%) fair, 2(25%) good and 1(12.5%) case had excellent outcome. The average score was 67.25 (range, 36–94).

Radiographic evaluation and outcome

According to Dorr's criteria, proximal femoral geometry of the 15 hips sorted into 7 type A (46%), 8 type B patterns (53%). Nevertheless, of the 11 hips that treated with bipolar arthroplasty, 6 were type A and 5 were type B.

Objective radiographic measurements including cortical thickness index and canal-to-calcar ratio were determined on the preoperative anteroposterior radiograph of the 11 hips that treated with bipolar hemiarthroplasty.

The mean cortical thickness index and canal-to-calcar ratio were 0.52 (range, 0.41–0.65) and 0.74 (range, 0.52–0.84), respectively. These parameters were correlated with the loosening of the femoral stem. Even though the mean cortical thickness index of the 4 patients who got loosening was 0.44 (range, 0.41–0.47), 0.57 (range, 0.45–0.65) was measured in the femoral components that exhibited radiographic signs of stability. Cortical thickness index demonstrated a significant and positive correlation with radiographic signs of stability ($P = 0.024$). Statistical studies revealed a threshold for cortical thickness index set

a value of ≤ 0.45 has suitable discriminatory power for loosening of prosthesis. There was no correlation between canal-to-calcar ratio and prosthesis loosening ($P = 0.78$).

Discussion

Hip fractures are common injuries in the elderly especially in patients who are debilitated [7]. Hip fracture leads to adverse outcomes in patients undergoing hemodialysis, similar to those reported in elderly nonhemodialysis patients.

The most common fracture site in dialyzed patients is the ribs, followed by spine and femoral neck [10, 11]. With the use of hemodialysis for the treatment of renal failure, hip joint diseases, including osteoarthritis, fracture or osteonecrosis due to amyloid arthropathy and renal osteodystrophy, have gradually increased [4, 12].

Dual-energy X-ray absorptiometry (DEXA) may be performed for verifying and observing the progression of osteoporosis. Sah et al. [13] found a close relationship between the proximal femoral geometry on plain radiographs and osteoporosis. Intervention of occult osteoporosis was supplied routinely with the aid of radiographic features of osteoporosis that described by Sah et al. [13].

Poor bone quality and delayed bone healing due to the amyloid deposition and renal osteodystrophy may necessitate a joint replacement instead of osteosynthesis. As a result of poor healing capacity, joint replacement procedures have cumulative incidence in this patient population. Hence, we have treated some intertrochanteric fractures with prosthetic replacement. Nevertheless, recent reports have described poor clinical outcomes for prosthetic replacements in patients on long-term hemodialysis [14–18].

There was delay in surgery beyond 24 h in all fractures in our series. This can be explained by the need to optimize the preoperative medical condition of these patients in terms of serum urea, creatinine, potassium level and hematocrit.

The rate of loosening of the cemented implants was reported 33% at an average of 4.6 years after implantation by Naito et al. [16], and Toomey and Toomey [17] also reported a 58% mechanical failure of cemented stems and 46% of cemented cups. Thirty-six percentage rate of femoral stem loosening in our patients that treated with bipolar hemiarthroplasty is concordant with the literature.

On the contrary to Liberman et al. [15] and Naito et al. [16] that reported an infection rate of 19 and 12%, respectively, no patient developed deep infection in our series during the average of 12.5-months follow-up.

The first-year mortality after a hip fracture is 11–24% in nonhemodialysis patients and 38–50% in patients

undergoing hemodialysis [1, 4, 6–9, 19]. Related problems include not only the cardiovascular, endocrine, gastrointestinal, skeletal and infectious conditions that accompany ESRD, but also diabetes- and cardiovascular-related disorders that commonly are the cause of the patient's kidney disease [7]. Death has been related to comorbidities such as cardiopulmonary disease and postoperative complications [19]. We report a 1-year mortality rate of 23% that is less than reported before in this group of patients. This rate is comparable to the 11–24% 1-year mortality rate in non-hemodialysis patients with hip fracture [19].

The risk of nonunion or avascular necrosis following internal fixation of hip fractures is significantly high in hemodialysis patients. Kalra et al. [9] reported 83.3% rate of revision following failure of internal fixation due to the nonunion. Rate of revision is extremely high compared to that in the general population, which ranges 20–36% [9, 20].

Limitations of this study include small patient group and loss of follow-up due to comorbidities and death. Furthermore, intra- and extra-capsular fractures evaluated together and bone mineral densitometry was not documented.

In conclusion, hip fractures are associated with an increased risk of mortality in the end-stage renal disease population. The survival of dialysis patients with a hip fracture is markedly reduced. Therefore, treatment procedure should allow early mobilization and prevent revision surgery. With the aim of avoiding from revision surgery, initial treatment of hemiarthroplasty may be the most suitable way of intervention.

Conflict of interest None.

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