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Original Article

Characteristic and Management of Neck Trochanteric Femur Fracture at a Tertiary Hospital Indonesia: A Retrospective, Single-Center Study

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ABSTRACT

Background: Although hip fractures are common among the elderly population, there are still limited studies on neck-trochanteric fractures, one of the less common types of hip fractures. This study aims to describe the characteristics of patients and their management in patients with neck trochanteric fractures.
Methods: This retrospective cross-sectional study analyzed medical records of patients aged >18 years with trochanteric fractures from a tertiary hospital in Central Java, Indonesia, between January and December 2021. Fracture types were identified and classified using the Garden, Pauwels, and AO/OTA classifications. Demographic data, risk factors, fracture locations, and treatment types were also collected. Statistical analysis was performed using SPSS 21.0 to describe patient characteristics.
Results: The total sample was 77 patients, most were female (n = 55 (71.4%)) and aged > 60 years. More than a third of diagnosed fractures were neck of the femur fractures in 33 patients (42.9%). Among the most common classification types of fractures were Garden Type 3, Pauwels Type 3, and AO/Orthopedic Traumatology Association (OTA) type A1.1. A total of 33 patients (42.9%) underwent open reduction of the fracture with internal fixation.
Conclusion: Our findings show that the prevalence of neck-trochanteric fractures mostly occurs in patients > 60 years of age and in females. Although open reduction with internal fixation is generally performed, there are several cases of fractures that are not classifiable due to limited imaging examinations. Further research on a wider population is needed to confirm the findings of this study

Keywords: Femur fracture; Hip fracture; Human and medicine; Management; Neck-trochanteric fracture; Surgery

INTRODUCTION

Hip fractures are one of the most common injuries among the elderly population.[1] Hip fractures pose a global challenge to the healthcare system, with 1.6 million cases in 2000 and an expected increase to 4.5–6.3 million cases globally by 2050.[2] The prevalence of hip fractures is shifting from North America and Europe to Asia, particularly in countries like Japan, South Korea, and China, due to the rapid increase in the elderly population and longer life expectancy.[3] These fractures can be catastrophic events, incurring a socioeconomic cost of up to 0.1% of the global burden.[4]

Trochanteric fractures are a classification within the hip fracture category, involving the proximal femur between the cervical area and the shaft.[5] This definition also includes fractures originating from the subtrochanteric region, with the fracture line extending from an area within

5 cm distal to the lesser trochanter.[6] Trochanteric fractures account for one-third to one-half of all proximal femoral fractures, with 50–60% classified as unstable.[7] Hip fracture classification aims to assess the risk of fixation failure (FF) due to avascular necrosis (AVN), which guides management options.[8] Song et al. found that the risk of FF and 15° AVN increased after screw osteosynthesis in cases with valgus deformities of the femoral neck exceeding a certain angle, with the incidence of FF being 17-fold higher than in deformities with lower angulation.[8] Hip surgery failure can result from various factors, including poor bone quality, damage to the femoral head during previous internal fixation, and limb shortening.[9,10]

The occurrence of trochanteric fractures involves a complex pathology associated with various modifiable (e.g., history of trauma or falls, nutritional status, history of metabolic disease, BMI, and medication history) and non-modifiable (age, sex, and genetic factors) risk factors.[11–13] Trochanteric fractures significantly impact survival, morbidity, and quality of life, affecting patients' daily functions.[14] A systematic review revealed a worsening prognosis, with mortality increasing from 36% at 30 days to 60% at one year.[14] Additionally, 33% of patients may develop complications during hospitalization. Furthermore, the recovery rate for this type of injury is incomplete, with only 40–60% of elderly patients achieving full recovery to pre-injury activity levels.[15] Although femoral neck fracture assessment is common for determining surgical management, similar studies in Indonesia are limited. Understanding patient characteristics and clinical features can enhance therapeutic management. This study aims to describe the characteristics of patients with trochanteric neck fractures of the femur undergoing treatment at the hospital.

MATERIAL AND METHODS

Study Design and Setting

This retrospective cross-sectional study used descriptive methods to examine medical records at a single data collection center: Soeradji Tirtonegoro Central Regional Hospital, a tertiary hospital in Klaten, Central Java, Indonesia.

Data Collection

Data were collected using total sampling from patient medical records between January and December 2021. The International Classification of Diseases, Tenth Revision (ICD-10) was used to identify the type of trochanteric fracture. Inclusion criteria were adult patients over 18 years of age with complete medical records, including sociodemographic data (age and gender). Age distribution was analyzed using the following age group subgroups: under 60 years old, 61 to 75 years old, and over 75 years old.

Radiological Classification

Diagnosis and classification of femoral neck fractures were based on radiological features using three classification systems: Garden, Pauwels, and AO Foundation/Orthopedic Traumatology Association (OTA). The Garden classification was used to assess the slope of the fracture line, which varies with the rotation of the foot.[16] The Pauwels classification was used to calculate the angle between the fracture line of the distal fragment and the horizontal line to determine shear stress and compressive force. The AO Foundation/OTA classification describes the severity of fractures, ranging from simple to multi-fragmentary.[18,19] The classification systems for femoral neck fractures are shown in Table 1.

Neck Shaft Angle and Osteoporosis Assessment

The neck shaft angle was assessed by measuring the anteroposterior (AP) radiographic images of the hip.[20] Coxa vara was defined as a neck shaft angle less than 126°, and coxa valga was defined as an angle greater than 139°, based on the definition by Clohisy et al.[20] Osteoporosis was identified using the Singh index, with patients classified into two groups: normal and osteoporosis.[21]

Table 1. Classification of femoral neck fractures based on Garden, Pauwells, and AO Foundation/OTA classifications.

Garden classification for trochanter neck femur fractures		
	Description	**Displacement/Non-displacement**
Type I	The valgus section has an incomplete fracture, with the appearance of the lateral cortex being fractured without affecting the medial portion.	Non-Displacement
Type II	Complete fracture	Non-Displacement
Type III	Complete fracture with partial displacement of the trabecular angle	Partial Displacement
Type IV	Complete fracture with displacement to parallel orientation of the trabeculae	Total Displacement
Pauwel classification for trochanter neck femur fractures		
Type I	up to 30°, Dominant compressive strength.	
Type II	30°–50°, Shear forces occur and may hurt bone healing.	
Type III	50° and over, In this condition, shear forces are dominant and cause the fracture to experience displacement and the varus to collapse.	
The AO foundation / Orthopedic Traumatology Association (OTA) classification		
A1	**Simple pertrochanteric fracture**	
A1.1	Isolated trochanter fracture: greater or lesser trochanter	
A1.2	A1.2 two-part fracture	
A1.3	A1.3 lateral wall intact (lateral wall thickness ≥20.5 mm)	
A2	**Multifragmentary pertrochanteric fracture/incompetence of the lateral wall (thickness≤20.5 mm)**	
A2.1	A break across the neck of the femur that doesn't involve the femoral head shifting out of place	
A2.2	One intermediate fragment	
A2.3	Two or more intermediate fragments	
A3	**Intertrochanteric or reverse oblique fracture**	
A3.1	Simple oblique fracture	
A3.2	Simple transverse fracture	
A3.3	Wedge fracture or multi-fragmentary fracture	

Treatment Classification

Treatment of patients with femur fractures was classified as either invasive (surgical) or non-invasive (conservative).

Ethical Approval

The study was approved by the local hospital ethics committee and the Medical and Health Research Ethics Committee (MHREC) of the Faculty of Medicine, Public Health, and Nursing from Universitas Gadjah Mada (KE/0553/04/2024).

Statistical Analysis

Statistical analysis was performed to describe the sociodemographic characteristics, classification, and treatment of the patients. Numerical variables were summarized using medians and means, while categorical variables were summarized using numbers and percentages. All data were presented in tabular form. Statistical analysis was performed using SPSS software version 21.0 (IBM Corporation, Armonk, NY, USA).

RESULTS

A total of 77 medical records met the inclusion criteria. The mean age of the patients was 69 years (range: 16-92 years, SD ± 13.676). Most patients were in the 60-75 age group (45.5%, n=35), followed by the >75 age group (39%, n=30). The majority of pa-

Table 2. Characteristics of trochanteric fracture patients

Age group	Number (%)
< 60 years old	12 (15.6)
60 – 75 years old	35 (45.5)
>75 years old	30 (39.9)
Gender	**Number (%)**
Men	22 (28.6)
Women	55 (71.4)

Table 3. Types of Femur Fractures

Type of fracture	Number (%)
Fracture of neck of femur	33 (42.9)
Pertrochanteric fracture	18 (23.4)
Closed fracture of neck of femur	13 (16.9)
Closed fracture of Pertrochanteric	11 (14.3)
Prethrocantric fracture	1 (1.3)
Closed fracture of intertrochanteric of femur	1 (1.3)

tients with femoral fractures were women (71.4%, n=55). Descriptions of patient characteristics are shown in Table 2.

Table 3 shows that fractures of the neck of the femur were the most common type (42.9%, n=33), followed by pertrochanteric and closed fractures of the neck of the femur. Based on the Garden classification, the most common fracture types were Type 3 (22%) and Type 2 (20.8%). Based on the Pauwels classification, the majority of cases were classified as Pauwels Type 3 (32.5%). Based on the AO/OTA classification, the most common fracture type according to the AO/OTA classification was A1.1. The distribution of cases across the Garden, Pauwels, and AO/OTA classifications is shown in Table 4.

The results of the neck shaft angle analysis showed that the majority of patients experienced a shift in the coxa vara (71.4%) and coxa valga angles (16.9%). Based on the Singh index, 41.6% of patients (n=32) had osteoporosis. Based on the type of procedure performed, the most common surgical procedure was the open reduction of fracture with internal fixation of the femur (42.9%), followed by partial hip replacement surgery (31.2%). The types of procedures performed are shown in Table 5.

DISCUSSION

This study described 77 cases of trochanteric fractures in patients over 18 years of age, with the majority of cases occurring in patients over 60 years old and in women. The most common type of trochanteric fracture was a fracture of the neck of the femur. The most frequently performed surgical procedure was an open reduction with internal fixation. By characterizing fracture type, classification, and type of procedure in relation to age and sex, this study provides a comprehensive description of patients with trochanteric fractures and informs appropriate management approaches based on patient characteristics.

In this study, the majority of patients were over 60 years old. Older age increases the risk of trochanteric fracture due to bone loss. The femoral trochanter is particularly vulnerable because it contains more trabecular bone than the femoral neck, which is composed primarily of cortical bone.[22] The Female gender, especially in women over 65, is a risk factor for trochanteric fractures.[23] The higher risk of fractures in women compared to men may be due to trabecular bone turnover, which is more sensitive to hormonal and metabolic factors.

Table 4. Distribution of femur fractures based on Garden, AO/OTA, and Pauwels classifications

Femur fractures based on Garden classification	
Classification	**Number (%)**
Type 1	4 (5.2)
Type 2	16 (20.8)
Type 3	17 (22)
Type 4	10 (13)
Not specific	30 (39)
Femur fractures based on Pauwels classification	
Pauwels 1	10 (13)
Pauwels 2	11 (14,3)
Pauwels 3	25 (32.5)
Not specific	31 (40.2)
Femur fractures based on AO/OTA classification	
A1.1	11 (14.3)
A1.2	4 (5.2)
A1.3	4 (5.2)
A2.1	4 (5.2)
A2.2	4 (5.2)
A3.2	1 (1.3)
Not specific	49 (63.6)

Table 5. Types of Trochanteric Patient Management

Type of procedure	Number (%)
Open reduction of fracture with internal fixation	33 (42.9)
Mean (age, SD (min-max))	68,26±17,9 (16 – 91) years old
Median (years old)	70
Partial hip replacement	24 (31,2)
Mean (age, SD (min-max))	70,33±9,716 (49 - 92) years old
Median (years old)	72,5
Total hip replacement	11 (14,3)
Mean (age, SD (min-max))	70,27±11,27 (51 - 84) years old
Median (years old)	69
Total knee replacement	3 (3,9)
Mean (age, SD (min-max))	76,33±7,234 (68 - 81) years old
Median (years old)	80
Conservative therapy	5 (6,5)
Mean (age, SD (min-max))	76,33±7,234 (68 - 81) years old
Median (years old)	80
Repair of hip	1

Therefore, further screening is needed in the female population.[24,25]

Another factor that can increase the risk is decreased bone mineral density.[26] Causes of decreased bone mineral density include low vitamin D and calcium intake, high alcohol consumption, smoking, use of drugs that affect bone metabolism, and a history of metabolic diseases

such as diabetes and hyperthyroidism.[27,28] These factors can disrupt bone mineral metabolism, leading to more brittle bones due to a lack of bone-building components and increased bone stressors.[29] The bone component osteocalcin is also affected, as its interaction with and modulation of various metabolic genes, such as insulin and leptin, is disrupted under these abnormal conditions.[30] This disruption of osteocalcin activity can lead to fractures occurring under mild stress that would not typically cause fractures.[26]

Trochanteric fractures can result from low-energy injuries in the elderly and high-energy injuries in younger patients.[31,32] High-impact injuries, such as those sustained in motorcycle accidents or falls from heights, are common causes in the young population.[33] Trauma can also be caused by high BMI and increased intensity or quantity of physical activity, especially new activities in active patients.[34] This can lead to repeated pressure on the femoral neck, resulting in microscopic fractures that may progress to stress fractures if not identified and treated.[35]

The choice of therapeutic management depends on many factors, including the patient's age, activity level, comorbidities, bone graft quality, and the presence of any acetabular damage.[36] While extramedullary fixation (dynamic hip screw (DH)and lateral femoral plate and fixation (LFPF)) and intramedullary fixation (Gamma nail and proximal femoral nail anti-rotation (PFNA)) are the most common fixation methods for intertrochanteric fractures, bone structure and fracture stability are also important considerations. These factors can increase the risk of complications in bones with poor structure or unstable fractures.[10] Several studies have shown that DHS is preferred for stable fractures, while PFNA is recommended for unstable fractures.[37] In elderly patients, total hip arthroplasty is preferred over internal fixation due to the increased risk of fixation failure associated with osteoporosis and more severe bone damage.[38]

This study has some limitations. It relied solely on medical record data to examine patient sociodemographics without considering medical history, thus limiting the ability to identify fracture risk factors. This is inseparable from the choice of studies with retrospective data collection. Additionally, this study was conducted at a single center with a high degree of homogeneity; therefore, further studies in a wider population are needed to confirm these findings. Some fracture images were unclassified, which is a limitation of this study, given that the classification of femoral neck fractures in Indonesia is still limited. However, the main advantage of this study is the comprehensive inclusion of patients during the data collection process, which included all patients with trochanteric fractures to describe the basic characteristics of patients, fracture types, classification, and management.

CONCLUSION

Patients with femoral neck and trochanteric fractures were more common in women and in the elderly group (>60 years). More than a third of diagnosed fractures were fractures of the neck of the femur, and the majority of patients underwent open reduction with internal fixation. Classification of femoral neck fracture types can be useful for determining clinical decision-making regarding surgical options that reduce the risk of postoperative complications such as fixation failure and avascular necrosis. Further research with a prospective study approach in a wider population is needed to describe risk factors for femoral neck and trochanteric fractures in a more heterogeneous group.

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