ABSTRACT

Background: The geriatric population has continued to grow globally. The incidence of geriatric fractures increases along with the population. The geriatric assessment could be useful to build a warning sign for the fall risk.

Aim: The authors aimed to describe the geriatric fractures; the factors affecting; to further give recommendation regarding its prevention and management.

Methods: This is a cross-sectional study involving 741 patients with geriatric fractures admitted to Surabaya Orthopedics and Traumatology Hospital from 2012-2017. All data acquired from medical records.

Results: The number of female patients in our study are three times the male patients. The distribution of the cases across ethnicity, gender, and different age group were quite similar. The case of vertebral and hip fracture was significantly higher. Domestic accident was the mechanism of injury in 80% of all cases, and this MOI is significant across all fracture types. Only 32% patients do not have confounding disease. However 25% has diabetes mellitus, and 42% has hypertension. Although patients with diabetes mellitus, hypertension, moderate to severe anemia, and hyponatremia were more frequent but not significant to be the risk factor for certain fracture type.

Conclusion: Domestic accident, female, and confounding disease were the most common factors found for all type of fractures. The most common geriatric fractures admitted to our institution were hip and vertebral fractures.

Keywords: geriatric fracture; hip fracture; vertebrae fracture; mechanism of injury

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characteristics included were cofounding diseases (diabetes mellitus, hypertension) and hematologic findings that were taken on admission (hemoglobin, serum albumin, and serum sodium, potassium, chloride). The fractures were classified according to the location of fractures (vertebral compression fracture, hip fracture, wrist fracture, and proximal humeral fractures).

The comparison of each variable to different fracture site was evaluated using Chi-square test, or Fisher’s exact test when the data were not met. The analysis was conducted with SPSS version 22 for Windows.

RESULTS
There was a total of 8362 geriatric patients during the study period, 835 (9.9%) of them was admitted with fracture (traumatic and non-traumatic fractures). Inclusion cases were 741 (8.9%), where 94 cases had to be excluded due to pathological nature of the fractures (malignancy and infection). The number of female patients were 560 (75.6%), three times compared to 181 male patients (24.7%). Only 32% patients do not have cofounding disease. Conversely 25% has diabetes mellitus, and 42% has hypertension. The primary MOI was domestic fall, 82.2% of all cases, followed by traffic accidents (14.2%) and work-related accidents (3.6%). Patients’ demographic and clinical characteristics, including the MOI, are presented in Table 1.

The most common anatomical location are vertebral fracture and hip fracture; each comprising one-fourth of all cases; wherein the female patients comprised 70-80% of each fracture type. The mechanism of injury was more than 90% due to domestic fall in vertebral, hip, wrist and humeral fracture cases. These are the significant factor found (Table 2). However, the distribution of the cases across ethnicity, gender, and different age group were quite similar. The hematology findings abnormality (hemoglobin value, hypo albumin, and the decrease electrolyte value) were not many and thus, also showed no significant difference (Table 2).

The BMI of the fracture patient was mostly normal and not differ within each fracture type. But among the underweight patients, hip fracture was exceeding; 24/59 cases (40%); among other fracture type. Similar fact was found in the hematology factor where 28/60 (47%) moderate to severe anemia cases was hip fracture.

Table 1  Demographic characteristics (n=741)

| Baseline Characteristics | N (%) |
|--------------------------|-------|
| Sex                       |       |
| - Male                    | 181 (24.4%) |
| - Female                  | 560 (75.6%) |
| Age Group                 |       |
| - 60-69 years old         | 287 (38.7%) |
| - 70-79 years old         | 277 (37.4%) |
| - >80 years old           | 177 (23.9%) |
| Ethnicity                 |       |
| - Non-Chinese             | 417 (56.2%) |
| - Chinese                 | 324 (43.8%) |
| BMI                       |       |
| - Underweight (<18.5)     | 59 (8.0%) |
| - Normal (18.5-24.9)      | 542 (73.1%) |
| - Overweight (25-29.9)    | 103 (13.9%) |
| - Obese (>30)             | 37 (5.0%) |
| Fracture Site             |       |
| - Vertebrae               | 185 (25%) |
| - Hip                     | 178 (24%) |
| - Wrist                   | 101 (13.6%) |
| - Proximal Humerus        | 53 (7.2%) |
| - Other Site              | 224 (30.2%) |
**Table 2** Descriptive variables to each fracture site

| Variables                  | Vertebral | Hip      | Wrist     | Proximal Humerus | Others     |
|----------------------------|-----------|----------|-----------|------------------|------------|
| Sex                        |           |          |           |                  |            |
| - Male                     | 40 (21.9%)| 51 (28.7%)| 21 (20.6%)| 11 (20.8%)       | 58 (25.8%) |
| - Female                   | 143 (78.1%)* | 127 (71.3%)* | 81 (79.4%)* | 42 (79.2%)*       | 167 (74.2%)* |
| Age Group                  |           |          |           |                  |            |
| - 60-69                    | 69 (37.7%)| 62 (34.8%)| 40 (39.2%)| 17 (32.1%)       | 99 (44.0%) |
| - 70-79                    | 73 (39.9%)| 65 (36.5%)| 38 (37.3%)| 20 (37.7%)       | 81 (36.0%) |
| - >80                      | 41 (22.4%)| 51 (28.7%)| 24 (23.5%)| 16 (30.2%)       | 45 (20.0%) |
| Ethnic                     |           |          |           |                  |            |
| - Other                    | 111 (60.7%)| 95 (53.4%)| 64 (63.4%)| 25 (47.2%)       | 120 (53.6%) |
| - Chinese                  | 72 (39.3%)| 83 (46.6%)| 37 (36.6%)| 28 (52.8%)       | 104 (46.4%) |
| BMI (Body Mass Index)      |           |          |           |                  |            |
| - Underweight              | 10 (5.5%) | 24 (13.5%)*| 6 (6.9%)  | 5 (9.4%)         | 14 (6.2%)  |
| - Normal                   | 144 (78.7%)| 124 (69.7%)| 80 (78.4%)| 34 (64.2%)       | 160 (71.1%) |
| - Overweight               | 23 (12.6%)| 23 (12.9%)| 14 (13.7%)| 9 (17.0%)        | 34 (15.1%) |
| - Obese                    | 6 (3.2%)  | 7 (3.9%)  | 2 (2.0%)  | 5 (9.4%)         | 17 (7.5%)  |
| MOI (Mechanism Of Injury)  |           |          |           |                  |            |
| - Domestic                 | 176 (96.2%)*| 164 (92.1%)*| 92 (90.2%)*| 51 (96.2%)*       | 126 (56.0%) |
| - Traffic                  | 6 (3.3%)  | 12 (6.7%) | 8 (7.8%)  | 1 (1.9%)         | 78 (34.7%) |
| - Work                     | 1 (0.5%)  | 2 (1.2%)  | 2 (2.0%)  | 1 (1.9%)         | 21 (9.3%)  |
DISCUSSION

Indonesia has a fair share of geriatric population, the fifth highest among countries in the world. The aging population increased the risk of musculoskeletal and other types of injury. Geriatric patients generally has worse outcomes than younger patients due to comorbidities and frailty syndrome. Frailty impairs homeostasis and increases the risk of fall in the elderly population. As high as one-third of 65 years or older and one-half of those over 80 years of age were at risk of fall every year.

In our study, the most common anatomical locations of the fractures are vertebrae and hip, both of which are osteoporotic fractures. This finding is similar with some studies in developed countries. Epidemiological study in the United States and Japan also reported that the vertebral compression fractures and hip fractures are two of the most prevalent fractures in the elderly, followed by wrist fracture which usually occurs due to falling on outstretched hand. Hip and lower spine vertebrae and hip fractures are common osteoporotic fracture burden, and treatment of osteoporosis in the 27 countries of the European Union (EU27) Osteoporosis and osteoporotic fractures are more common in women than men as women rapidly lose bone density since menopause. This may explain why the number of female patients in our study was three times more than the male patients as both of those osteoporotic fractures comprised almost 50% of total cases.

In our study, hip fracture was more common in underweight patients, shown by the significant difference in the statistical analysis. It is further supported by previous study by Hsieh et al. which found underweight patients more prone to injury compared to obese patients even though the outcome of the injuries varied. Another study also reported that patients with extreme BMI, either low or high, are more prone to complication. Thus both obese and underweight patients require careful planning in their management. In the elderly patients, obesity has been described as a protective factor. This article set out to examine the effect of body mass index (BMI) Several study also reported that overweight and obesity had some protective effect to hip fractures. Some described that it is due to the protective role of estrogen and the fat pad as shock-absorber but there is little information on their combined effects. We report on the separate and combined effects of body mass index (BMI). However, other studies also reported that abdominal obesity increases the risk of hip fracture even though in male with lower BMI. Future studies may focus on this finding to assess the effect of abdominal obesity and BMI in our local population. Moreover, fall risk is greater in those with lower BMI.

Domestic fall was the mechanism of injury in four-fifths of all cases. Several studies also reported domestic fall as the leading cause of fracture in the elderly, most commonly occurring in the bathroom and the kitchen. Fall in the elderly is of complex nature which is affected by many factors. Also, patients who have fallen or have a gait or balance problem are at higher risk of having a subsequent fall and losing independence. Thus, comprehensive

| Variables               | Vertebræ | Hip | Wrist | Proximal Humerus | Others |
|-------------------------|----------|-----|-------|------------------|--------|
| Cofounding Disease      |          |     |       |                  |        |
| - Diabetes Mellitus     | 34 (18.6%) | 56 (31.5%) | 19 (18.6%) | 18 (34.0%) | 60 (26.7%) |
| - Hypertension          | 60 (32.8%)* | 92 (51.7%)* | 39 (38.2%) | 24 (45.3%) | 96 (42.7%) |
| - None                  | 89 (48.6%) | 30 (16.8%) | 44 (43.2%) | 11 (20.7%) | 69 (30.6%) |
| Hematologic Findings    |          |     |       |                  |        |
| - Moderate-severe Anemia| 4 (2.2%) | 28 (15.8%)* | 4 (3.9%) | 8 (15.1%) | 16 (7.1%) |
| - Mild Anemia           | 66 (36.1%) | 52 (29.2%) | 26 (25.5%) | 12 (22.6%) | 76 (33.8%) |
| - No Anemia             | 113 (61.7%) | 98 (55%) | 72 (70.6%) | 33 (52.3%) | 133 (59.1%) |
| - Hypoaalbuminemia      | 11 (6.0%) | 22 (12.4%) | 4 (3.9%) | 8 (15.1%) | 21 (9.3%) |
| - Hypokalemia           | 10 (5.5%) | 26 (14.6%) | 6 (5.9%) | 5 (9.4%) | 27 (12.0%) |
| - Hyponatremia          | 12 (6.6%) | 31 (17.4%)* | 5 (4.9%) | 10 (18.9%) | 21 (9.3%) |
| - Hypochloremia         | 8 (4.4%) | 18 (10.1%) | 3 (2.9%) | 5 (9.4%) | 11 (4.9%) |

* p value < 0.005
management to prevent fall in geriatric population is mandatory. Some suggestions from a systematic review by Crandall et al. includes vitamin D supplementation, hip protector, exercise, frailty screening and stratification of fall risk. A sophisticated measure such as inertia sensor is also in development. Frailty syndrome is one of the precipitating factors of fall in geriatric patients, thus making frailty screening and management an important aspect in comprehensive management of geriatrics. Future studies may include frailty assessment as it is one of the important aspects of geriatric health assessment.

Diabetes mellitus and hypertension were significant factors in vertebral and hip fractures, both of which are osteoporotic fractures. Recent meta-analysis stated that diabetes mellitus increased the risk of fracture of any type. Hypertension also plays a role in bone mineral density (BMD) reduction, either by reducing local blood supply of the bone or by the effects of antihypertensive medication taken by the patients. These factors may explain why these comorbidities were significant for these osteoporotic fractures.

Anemia also affected the osteoporotic fractures aforementioned in our study. Anemia has been described as an independent risk factor of osteoporosis. Several mechanisms have been proposed including decreased synthesis of collagen, expression of acidosis-induced transcription factors which promotes osteoclast maturation, and an increase in erythropoietin level. Potassium plays an important role in bone metabolism as it is one of the contributors to acid-base balance, and systemic acidosis was known to induce osteoclast activation.

In our findings, hypokalemia, and hypocalcemia although present yet could not arise as a risk factor.

Hyponatremia was also significant in hip fractures. Hyponatremia is one of the independent risk factors of osteoporosis and fractures. Setting, and participants: Osteoporosis (n = 30,517) However, the number of patients who had hyponatremia in our study was only 79 cases which 31 (39%) were hip fractures; the small number of cases may cause the insignificant statistic result.

The authors realized the limitations of this study. There are many factors affecting fractures in geriatric population. A comprehensive management including fall-risk assessment and prevention; nutritional status assessment; and nutritional supplementation are required to address geriatric-related fracture problems. All these factors should be integrated into the history and physical examination of all geriatric patients. Clinicians caring for older patients need to routinely inquire about falls, assess for fall risk, and address modifiable underlying risk factors.

A number of the physical conditions and environmental situations that predispose to falls are modifiable. Future studies should address this issue to improve geriatric health care further. Nevertheless, this study may provide some insight regarding the prevalence of geriatric fractures in our population and hopefully may be used to aid future studies.

CONCLUSION

Domestic accident is the primary mechanism of injury. Geriatric fracture is more frequent in female than male group. Both vertebral and hip fracture were the most common fracture types in this study. Comprehensive geriatric assessment is mandatory to address fracture-related problems in the elderly.

CONFLICT OF INTEREST

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