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A Comparative Multicenter Study on the Epidemiology of Traumatic Fractures during the Coronavirus Disease 2019 Early Emergency Response Period in Yogyakarta Special Region, Indonesia

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Abstract

BACKGROUND: The changes of lifestyle and mobility during the coronavirus disease 2019 (COVID-19) pandemic may influence the epidemiology of traumatic fractures.

AIM: This study aimed to investigate the epidemiology of traumatic fractures in Yogyakarta Special Region (Daerah Istimewa Yogyakarta [DIY]) during the COVID-19 emergency response period and compare the data with the similar period in the previous year.

METHODS: This was a retrospective study involving five secondary referral hospitals and one tertiary referral hospital. We included all patients who presented to the emergency departments or orthopedic clinics who were then diagnosed with new-onset fractures. We compared the data during the emergency response period (COVID group) with a similar period in 2019 (control group).

RESULTS: There were 1249 patients with 1428 fractures included in this study. There was 47.68% reduction of patients during the emergency response period. There was no significant difference in proportion of gender and mean of age (control group vs. COVID group: 55.9% vs. 54.8%, p = 0.717 for male gender; 42.64 ± 24.03 years vs. 42.20 ± 23.34 years, p = 0.886 for mean of patients' age). There were significant increases in the proportions of patients experiencing low-energy injuries (38.0% vs. 30.8%, p = 0.012), injuries occurring at home (34.0% vs. 23.8%, p = 0.001), and surgically treated closed fractures (51.8% vs. 45.3%, p = 0.038), along with decrease of patients' referrals (1.6% vs. 4.1%, p = 0.018) during the pandemic. The difference in proportions of fracture type, osteoporotic fractures, and multiple trauma was not significant (control group vs. COVID group: 19.2% vs. 17.4%, p = 0.418 for open fracture; 15.4% vs. 14.7%, p = 0.750 for osteoporotic fracture; and 9.0% vs. 7.0%; p = 0.217 for multiple trauma).

CONCLUSIONS: During the COVID-19 emergency response period in DIY, there were nearly half reduction of patients with fractures, increased proportion of patients injured at home, reduced proportion of patients referred to another hospital, and increased proportion of surgically treated closed fractures. The knowledge about this epidemiological trend may help in developing preventive programs and treatment policy for fractures and other injuries during the current pandemic.

Introduction

In the end of 2019, a new coronavirus was identified as a cause of a severe respiratory system disease in Wuhan, China [1]. The World Health Organization (WHO) named the disease as coronavirus disease 2019 (COVID-19) and later declared it as a global pandemic on March 11, 2020 [2], [3]. On March 13, 2020, the first confirmed case in Yogyakarta Special Region (Daerah Istimewa Yogyakarta [DIY]) was announced [4]. Shortly thereafter, the governor of DIY announced the COVID-19 emergency response period, lasting from March 20, 2020, until May 29, 2020, which could be extended whenever required [5].

To reduce the disease transmission, people were appealed to do some preventive measures, such as hand hygiene, postpone unnecessary travel, stay at home, and physical distancing [6], [7]. The schools were closed and people should work from home whenever possible [8].

The changes of lifestyle and mobility during the COVID-19 pandemic have been proven to influence the epidemiology of traumatic fractures. Worldwide, many studies had reported significant reduction in fracture or trauma cases [9], [10], [11], [12], [13], [14]. The epidemiological characteristics of traumatic fractures were changed during the COVID-19 pandemic: There were higher patients' average age, with an increase in

the proportion of home/domestic accidents, osteoporotic fractures, and fractures caused by low-energy trauma [9], [10], [15], [16]. The surgeries performed for fractures or other trauma cases were also seen decreased during COVID-19 pandemic period [12], [16].

The application of epidemiological data may aid in determining the need of the community, developing preventive measures, and ensuring the provision of appropriate treatment strategies. However, the epidemiological information and studies of traumatic fractures in Indonesia are still rare. The current available studies were single-center studies that may limit the generalizability of their results [17], [18], [19], [20]. Moreover, there were still no data found during the COVID-19 pandemic emergency period in DIY.

Therefore, this study aimed to investigate the traumatic fractures' epidemiology in DIY during the COVID-19 early emergency response period and compare the data with the similar period in the previous year. We hope our results could be beneficial for the clinician and governments in developing more accurate preventive programs and treatment policy for fractures and other injuries during the similar upcoming situations (pandemic and non-pandemic situations).

Methods

This was a comparative-retrospective study, involving five secondary referral and one tertiary referral hospitals in Yogyakarta Special Province: Yogyakarta Regional Public Hospital, Wates Regional Public Hospital, Wonosari Regional Public Hospital, Panembahan Senopati Bantul Regional Public Hospital, Universitas Gadjah Mada Academic Hospital, and Dr. Sardjito General Hospital. This study was performed in compliance with the Declaration of Helsinki and was approved by the Medical and Health Research Ethics Committee Faculty of Medicine, Public Health and Nursing Universitas Gadjah Mada (no. KE/FK/0813/EC/2020).

We included all patients who presented to the emergency departments or orthopedic clinics who were then diagnosed with new onset (<1 week) fractures based on history clinical and radiological examinations. The fractured bones included in this study were clavicle, scapula, humerus, radius, ulna, hand, spine, pelvic, femur, tibia, fibula, and foot. For the COVID group (during the pandemic period), we included all patients who presented to the hospital from March 20, 2020, to May 29, 2020. For the control group, the period was from April 1, 2019, to June 10, 2019.

We excluded the patients with pathological fractures due to bone tumors (primary and metastatic), genetic bone abnormalities, unhealed previous fractures (poor union or non-union), periprosthetic fractures, and patients with data missing from their medical records.

The collected data included the sociodemographic characteristics of the patients (age and gender), mechanisms of injury, injury location, fractured bone, type of fracture (closed/open fracture), concurrent fracture, osteoporotic fracture, multiple trauma, hospital stay duration, referral, treatment, and patients who refused recommended surgery or inpatient care. The data were obtained from the medical records.

We categorized the mechanisms of injury as fall from standing height, fall from height <1 m, fall from height >1 m, bicycle injury (not involving collision with motor vehicle), motor vehicle accident (MVA) (any injuries involving collision with motor vehicle, as the vehicle rider or hit by motor vehicle), others (any specific mechanisms of injury such as being hit, trapped, cut, and machine-related, not classified in the other groups), and unknown (unspecific mechanisms of injury). We considered fall from standing height, fall from height <1 m, and the bicycle injury as low energy trauma; where fall from height >1 m, MVA, and others as high-energy trauma. The injury locations were grouped as at home (in the house/living place and the surroundings), road (including the sidewalks), others (school, workplace, sports fields, and other specified places), and unknown.

The fractured bone was documented as clavicle, scapula, humerus, radius and/or ulna, hand, spine, pelvic, femur, tibia and/or fibula, foot, and patella. The patients were stated to have concurrent fracture when they had more than one fracture based on the mentioned bone group. We considered a fracture as an osteoporotic fracture when it fulfilled all the following criteria: (1) The patient age was more than 50 years old (female)/more than 60 years old (male); (2) occurred in proximal humerus, distal radius, thoracic/lumbar vertebrae, or proximal femur; and (3) caused by a low-energy trauma [21], [22]. The patients were classified as having multiple trauma when they had any injuries involving more than 1 body region and required treatment from more than 1 specialist for the injuries [23].

We grouped the treatment as conservative and surgical treatment. For analyzing the treatment, we excluded patients who were referred to another hospital. The patient was classified to receive the surgical treatment for the specified fracture when they received the treatment involving incision with an instrument, performed by orthopedic surgeon, in the operating theater.

The statistical analysis was performed using SPSS 23.0 (IBM Corp., Armonk, New York). We tested all the numeric variables with Kolmogorov–Smirnov test for the normality of distribution. The difference of mean was analyzed with t-tests for data with normal distribution and with Mann–Whitney tests for data with abnormal distribution. For categorical variable,

we conducted Chi-squared and used Fisher's exact tests when the expected count was <5. $p < 0.05$ was considered statistically significant.

Results

During the specified period, we found 1249 patients (693 males and 556 females) presented with fractures of the defined bones: 820 patients in the control group; 429 patients in the COVID group. The proportion of patients' gender did not significantly differ between groups (male in the control group: 55.9%; male in the COVID group: 54.8%; p = 0.717). The patients' age ranged from <1 year old to 100 years old (mean: 42.49 ± 19.96). There was no significant difference in mean of age between patients in the control group and the COVID group (control group: 42.64 ± 24.03 years; COVID group: 42.20 ± 23.34 years; p = 0.886). Three patients from the COVID group were suspected to be affected by COVID-19. However, all of them were negative on polymerase chain reaction swab test.

There was reduction in the number of all cases caused by any mechanism of injury during the pandemic, although the difference in proportion between the groups was not significant (Table 1). When grouped as low- or high-energy injury, the proportion of low-energy injuries increased during the pandemic period (38.0% vs. 30.8%; p = 0.012). However, the high-energy injuries were still the main cause of fractures in both groups.

Table 1: Comparison of mechanism of injury between the control and COVID groups

Mechanism of injury	Control group		COVID group		p-value
	Frequency	Percentage	Frequency	Percentage	
Fall from standing height	193	23.5	119	27.7	0.102
Fall from a low height	24	2.9	22	5.1	
Bicycle injury	26	3.2	15	3.5	
Fall from height >1 m	57	7.0	33	7.7	
MVA	379	46.2	180	42.0	
Others	111	13.5	42	9.8	
Unknown	30	3.7	18	4.2	

COVID: Coronavirus disease, MVA: Motor vehicle accident.

The COVID-19 pandemic has significantly influenced the injury location, where the proportion of injuries at home increased and the injuries outside home decreased (p = 0.001) (Figure 1).

The road remained the main location where the injuries occur.The total fractures found in the current study were 1428 with 945 (66.2%) in the control group and 483 (33.8%) in the COVID group. Most patients (1118 patients or 89.5%) had a fracture, while the rest had concurrent fractures: 103 patients (8.2%) had two fractures, 19 patients (1.5%) had three fractures, and nine patients had four or more fractures (0.7%). During the pandemic period, the total of bone fractures was decreased in frequency by 30% or more (Table 2).

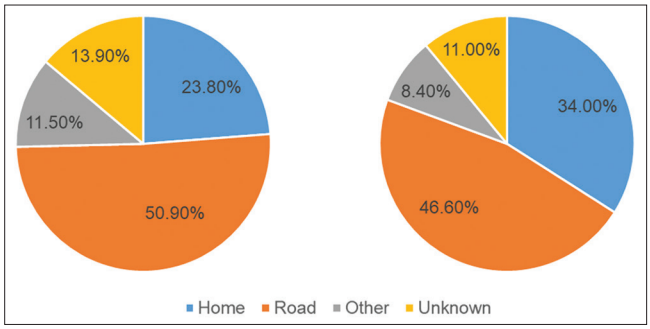

Figure 1: Comparison of injury location between the control and coronavirus disease groups

The COVID-19 pandemic has caused more than half reduction in open fracture cases (Table 2). The proportion was reduced by 1.8%, but the difference was not statistically significant (p = 0.418). The five most frequently affected bones were hand (38.9%), foot (22.3%), tibia/fibula (16.6%), femur (9.1%), and radius/ulna (8.7%).

Table 2: Comparison of fractured bone and fracture type between the control and COVID groups

Characteristics	Control group		COVID group		p-value
	Frequency	Percentage	Frequency	Percentage	
Fractured bone					
Clavicle	80	8.5	45	9.3	0.597
Scapula	10	1.1	6	1.2	
Humerus	76	8.0	50	10.4	
Radius and/or Ulna	226	23.9	115	23.8	
Hand	124	13.1	47	9.7	
Spine	34	3.6	17	3.5	
Pelvic	19	2.0	12	2.5	
Femur	141	14.9	80	16.6	
Tibia and/or Fibula	132	14.0	55	11.4	
Foot	93	9.8	49	10.1	
Patella	10	1.1	7	1.4	
Fracture type					
Closed	764	80.8	399	82.6	0.418
Open	181	19.2	84	17.4	

COVID: Coronavirus disease.

Our study revealed 189 (15.1%) patients suffering osteoporotic fractures. The proportion of osteoporotic fractures was also not significantly different between the control and COVID groups (15.4% in the control group; 14.7% in the COVID group; p = 0.750). Most patients suffering osteoporotic fractures were women (81.0%).

There was almost 60% decrease of patients who presented with multiple trauma during the COVID pandemic period, compared to the pre-pandemic period (30 patients in the COVID group; 74 patients in the control group). The proportion of patients experiencing multiple trauma with fracture was also less in COVID pandemic period although the difference was not significant (7.0% in the COVID group; 9.0% in the control group; p = 0.217).

Table 3 describes the comparison of fracture treatment, patient referral, patient received inpatient care, and patients refused recommended treatment between the control and COVID groups. For the patients receiving the inpatient care, the mean of hospital stay duration was slightly higher in the control group than in the COVID group (4.91 ± 3.75 days vs. 4.39 ± 3.45 days, p = 0.008). Although the difference in surgically treated fractures (both open and closed) across the groups was not significant,

we found significant difference in surgically treated closed fracture: More proportion of closed fractures treated surgically during pandemic period.

Table 3: Comparison of referred patients, inpatient care, patients refused recommended treatment, and fracture treatment between the control and COVID groups

Characteristics	Control group		COVID group		p-value
	Frequency	Percentage	Frequency	Percentage	
Referred patients	34	4.1	7	1.6	0.018
Inpatient care	526	64.1	295	68.8	0.102
Patients refused surgery/inpatient care	82	10.0	46	10.7	0.689
Surgical treatment	477	52.7	266	56.2	0.212
Surgically treated closed fracture	333	45.3	203	51.8	0.038

COVID: Coronavirus disease.

Discussion

We found several impacts of the COVID-19 pandemic on the epidemiology of fractures in our region. As seen worldwide, the total of patients with fractures was reduced. In our study, the reduction was 47.68%. The amount of reduction was similar to a study in China (reduction of 46.74%) but lower than the study in Italy (reduction of 73.8%) [9], [10].

While some studies found increases in the patients' mean age during the pandemic period [9], [10], our study did not demonstrate a significant difference in the patients' age across the period groups. The proportions of osteoporotic fractures were not different as well. These findings might be caused by the fear of the elderly being infected by COVID-19 virus in the hospital, since they have more risks to develop severe disease when getting infected [10], [24]. The recommendation to not go to the health facilities unless urgent might also lead to the reluctance of elder people and people with osteoporotic fractures to go to the hospital [25].

This study reveals a transition of the mechanism of injury toward the low-energy injury. In addition, this pandemic contributes to more injuries occurring at home. These findings can be explained by the facts that people spent more time at home that contains several hazards to low-energy injury such as slip or trip on steps or in the bathroom [26]. Consequently, more social education to increase the safety at home is needed to prevent any injuries at home during the pandemic.

In our study, the MVA was still the number one cause of fractures during the pandemic period, although the number of cases was reduced 52.5%. However, the decrease was much less compared to the previous studies in Italy and China where the reduction of MVA cases was 79.6% and 88.9%, respectively [9], [13]. Less reduction of case numbers and the dominance of MVA in the pandemic period might be associated by less restriction in the mobility of people in Indonesia and less compliance of Indonesian people to stay at home and maintain safe social distancing. In contrast to China and Italy, Indonesia was not applying a lockdown due to the economic considerations [27], [28]. The domination of MVA even during COVID-19 pandemic necessitates more prevention to decrease the high case number. People should be more educated to drive/ride motorcycle safely, that is, using helmets, not riding/driving when sleepy, limitation of the speed, etc.

The previous studies demonstrate significant reduction in the proportion of open fractures and concurrent fractures, along with reduction in the Injury Severity Score in patients with multiple trauma [9]. However, our study cannot demonstrate similar results. It is known that the occurrence of open fractures, concurrent fractures, and multiple trauma was associated with high-energy injuries [29], [30], [31]. In our study, the reduction in percentage of high-energy injuries during the pandemic period was relatively small, and the high-energy injury remains the main cause of people presenting to the ED with fractures. In contrast, the previous study reported significantly more reduction in the proportion of high-energy injuries [9].

The current study found that the total number of surgically treated fractures was reduced by 44.2%. This finding was similar to the previous study in China where the surgically treated fractures were reduced to almost 50% [9]. For all trauma cases, studies in London and Pakistan reported that the number of surgeries for trauma was reduced about 30% and 40%, respectively [12], [16].

This study shows a higher proportion of closed fractures treated surgically during the pandemic. There were several possibilities to explain this finding. First, patients with closed fracture with minimal displacement caused by low-energy trauma did not go to the hospital because they thought that the injury would not cause fractures. This will decrease the number of fractures which were usually treated conservatively. Second, due to the decrease of the number of surgeries because of the decreased patient number and postponed elective procedures, more staff and facilities were available for surgery.

There are several limitations of this study. First was its retrospective design. Second, for osteoporotic fractures, we did not use the bone mineral density value that would be more accurate to see the extent of osteoporosis. Third, we only included the patients from public and academic hospitals. We had no data from private hospitals.

We recommend future studies to examine the epidemiology of fractures with a longer time period and involving more variety of treatment centers to add to the strength of the study and so that we can see the trends during the year. Because this research only included the acute fractures, further study is recommended to investigate the neglected fractures or injuries other than fractures.

Conclusions

The COVID-19 pandemic has led to several changes in fracture epidemiology. During the COVID-19 early emergency response period in DIY, there was almost half reduction (47.68%) of patients with fractures who presented to the hospital. The proportion of fractures due to low-energy injury increased, as well as the proportion of patients being injured at home. There was a reduction in the proportion of patients referred to another hospital and an increase in the proportion of surgically treated closed fractures. The knowledge about this epidemiological trend may help in developing preventive programs and treatment strategies for fractures and other injuries during the similar upcoming situations. This study highlights the importance of social education with more focus on home and road safety practices, both during pandemic and non-pandemic situations.

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