



Original Article

Impact of the earthquake during COVID-19 lockdown on fracture admission at a tertiary trauma centre in Croatia

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ARTICLE INFO

Article history:

Received 12 October 2020

Received in revised form

25 November 2021

Accepted 24 December 2021

Available online 10 January 2022

Keywords:

Coronavirus

Pandemics

Earthquakes

Wounds and injuries

ABSTRACT

Purpose: To determine the impact of an earthquake during COVID-19 lockdown on fracture admission at a tertiary trauma centre in Croatia.**Methods:** A case-control study was performed at the tertiary trauma centre registry. Two different periods were studied. The case group included a period during COVID-19 lockdown right after the earthquakes until the end of the confinement period in Croatia. And the control group corresponded to the equivalent period in 2019. We identified all consecutive patients who were admitted due to urgent care requirements for the musculoskeletal trauma. Patient's demographic data and admitting diagnoses were assessed. Data were analyzed by statistical procedures using the program MedCalc statistical software version 16.4.3.**Results:** We identified 178 emergency admissions due to musculoskeletal trauma. During the COVID-19 lockdown and post-earthquake period, there was a drastic reduction in total admissions (359 vs. 662; $p < 0.0001$) with an increased proportion of trauma admissions within the emergency admissions (34.9% vs. 26.5%; $p = 0.02926$, $Z = -2.1825$). Furthermore, in the case group there was a significant increase in hospital admissions due to ankle/foot trauma (11 vs. 2, $p = 0.0126$) and a trend towards a decrease in the admissions due to tibia fractures (5 vs. 12, $p = 0.0896$), however without statistical significance. Also, an increased proportion of women within the group of femoral fractures in both case group (81.6% vs. 52.6%, $p = 0.00194$, $Z = 3.1033$) and the control group (82.3% vs. 60.5%, $p = 0.0232$, $Z = 2.2742$) was observed. In both analyzed periods, the osteoporotic hip fracture was the most common independent admitting diagnosis.**Conclusion:** It is crucial to understand how natural disasters like earthquakes influence the pattern of trauma admissions during a coexisting pandemic. Accordingly, healthcare systems have to be prepared for an increased influx of certain pathology, like foot and ankle trauma.© 2022 Chinese Medical Association. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Since the first identified patient in Wuhan, Hubei province, China in December 2019,¹ coronavirus disease 2019 (COVID-19) emerged from epidemic to pandemic in just a few weeks. The number of COVID-19 positive patients, with a differing illness severity, has grown exponentially, first in Asia and then in the rest of the world.² The World Health Organization classified the COVID-

19 outbreak as a public health emergency of international concern on January 30, which was reclassified to pandemic on March 11. Different strategies have been recommended and implemented worldwide. Governments and healthcare systems responded to the pandemic in various ways, but self-isolation, social distancing, curfews, and lockdowns were common across the world.³ Similar to many European countries, the Croatian government decided to impose lockdown on March 19 until April 27, 2020, to reduce contact rates in the population.⁴ Consequently, there was a noticeable decrease in outdoor activities and road traffic. During the lockdown period, a Croatian healthcare system was reorganized to maximize hospital beds and shift manpower towards confronting the expected large cohort of acute COVID-19 patients. In order

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Peer review under responsibility of Chinese Medical Association.

to achieve that, some hospitals throughout the country were transformed into the COVID-19 centres exclusively.⁵ Consequently, all patients requiring urgent care for musculoskeletal trauma, who were not COVID-19 positive, were redistributed to other trauma centres. Moreover, in this critical period, on March 22, 2020, the city of Zagreb was hit by a series of earthquakes with the biggest being a 5.3 Mw magnitude, centered just 7 km north of the city centre.⁶ It caused substantial damage to the suburbs and the historic city centre with many of the buildings left in the unusable state. Although some authors have investigated the impact of the lockdown on the trauma emergencies,^{7–9} none of these studies deals with such a unique situation of a coexisting natural disaster during the studied period. Therefore, the purpose of this study was to determine the impact of an earthquake during COVID-19 lockdown on fracture admission at a tertiary trauma centre in Croatia.

Methods

Data collection

After obtaining an institutional review board approval (Class: 8.1–20/153-2 No: 02/21 AG), a case-control study was performed at the University Hospital Centre Zagreb, Croatia, Europe. Two different periods were studied. The case group includes a period during COVID-19 lockdown right after the earthquakes until the end of the confinement period in Croatia (March 22 to April 27, 2020). And the control group corresponds to the equivalent period in 2019 (March 22 to April 27, 2019). We identified all consecutive patients who were admitted to the Department of Surgery due to urgent care requirements for the musculoskeletal trauma. Patients under the age of 18 years were excluded from the study. The variables collected were patient age, gender, and admitting diagnoses, which were divided into five major categories: head, thorax, spine/pelvis, upper and lower limb trauma. Also, osteoporotic hip fractures (femoral neck and trochanteric fractures) were analyzed in both periods independently.

Statistical analysis

Continuous variables are reported using median (range), and categorical variables are presented as count (percent). To compare two different periods, an independent two-sample *t*-test and Chi-square test were used as appropriate. To compare two proportions a two proportions *Z*-test was used. All *p* values are at a significant level <0.05. Data were analyzed by statistical procedures using the program MedCalc statistical software version 16.4.3 (MedCalc Software bv, Ostend, Belgium)

Results

In the period from March 22 to April 27, 2019 and March 22 to April 27, 2020 we identified altogether 1021 hospital admissions to the Department of Surgery, out of which 583 were emergency admissions. Among them, 178 admissions matched the above-mentioned inclusion criteria and were analyzed in this study. The median age of the patients was 77 (range 20–101) years old and 56.2% (100/178) were women. No statistically significant differences were found in age or sex between the two analyzed periods. The demographical data and general characteristics of each group are reported in Table 1.

During the COVID-19 lockdown and post-earthquake period, there was a drastic reduction in total admissions (359 vs. 662, $p < 0.0001$) with an increased proportion of trauma admissions within the emergency admissions (34.9% vs. 26.5%, $p = 0.02926$, $Z = -2.1825$). Also, in the case group we observed a significant

increase in hospital admissions due to ankle/foot trauma (11 vs. 2, $p = 0.0126$), and a trend towards a decrease in the admissions due to tibia fractures (5 vs. 12, $p = 0.0896$), although without statistical significance (Table 2). There was increased proportion of women within the group of femoral fractures in both case group (81.6% vs. 52.6%, $p = 0.00194$, $Z = 3.1033$) and the control group (82.3% vs. 60.5%, $p = 0.0232$, $Z = 2.2742$). In both analyzed periods, the osteoporotic hip fracture was the most common independent admitting diagnosis (Fig. 1). Besides, the proportion of admissions due to osteoporotic hip fractures within trauma admissions remained similar in both periods (40.7% vs. 38.1%, $p = 0.72634$, $Z = 0.3531$). We have found no differences in other admitting diagnoses between two periods (Table 2). In addition, all hospitalized patients were uneventful during inpatient care in both periods.

Discussion

The main finding of our study is that earthquakes during COVID-19 lockdown significantly influenced the pattern of trauma admission diagnoses at a tertiary trauma centre in Zagreb, Croatia. Despite that, osteoporotic hip fractures remained the most common independent admitting diagnosis. The COVID-19 outbreak which caused the pandemic in just a few months forced healthcare systems to rapidly reorganize to provide optimal urgent care for both COVID-19 positive and negative patients. Knowing that there is no healthcare system that can sustain a huge input of infectious cases to emergency departments, the Croatian government imposed drastic measures to decrease the transmission of COVID-19 among the population.¹⁰ Moreover, on the third day of the quarantine, Zagreb was hit by a series of earthquakes with the biggest being of 5.3 Mw magnitude, which caused substantial damage to the city centre and left some of the buildings uninhabitable. As the impact of the natural disaster like the earthquake in a COVID-19 lockdown has not been described in the literature yet, the purpose of this study was to determine the influence of the earthquake during COVID-19 lockdown on the pattern of trauma admission diagnoses. Since healthcare systems have to continue to diagnose and treat other diseases and urgencies, it is crucial to understand which diagnoses are uncommon, and which occur more frequently during the state of emergency. Such data is crucial for planning the action in the event of natural disasters in the future. Analysis of the patient's demographic data in two analyzed periods revealed no connection between these parameters and the state of emergency. In both periods there was an increased proportion of women within the group of osteoporotic hip fractures, which is in agreement with the results of large series published before the COVID-19 outbreak.¹¹ During the COVID-19 lockdown, we observed a significant reduction in total admissions with an increased proportion of trauma admissions within the emergency admissions. Since healthcare system reorganization required suspension of elective/nonemergency surgical activity during COVID-19 lockdown, which is in accordance with scientific societies guidelines,¹² reduction of total admissions is expectable. However, an increase in the trauma admissions during COVID-19 lockdown is contrary to the work of Park et al.¹³ who observed a decline in the number of acute trauma referrals and admissions during COVID-19 lockdown. Our results have to be observed in the context of Croatian healthcare system reorganization where one major trauma centre was temporally out of function due to its conversion to COVID-19 hospital exclusively. One of the major results of our study is the significant increase in hospital admissions due to ankle/foot trauma during the post-earthquake lockdown period. These results support the previous studies on earthquake victims during earthquakes in Iran, China, Pakistan and Nepal whose findings suggest that the majority of survived victims sustained lower limb

Table 1
Demographical data and general characteristics of each group in two analyzed periods.

Variables	2019	2020	Proportion 2020:2019	p value
A				
Age (years), median (range)	70 (21–99)	77 (20–101)		
Woman, n (%)	49 (60.5)	51 (52.6)	104.1%	0.8415
Total admission, n	662	359	52.1%	<0.0001
Emergency admission, n	305	278	90.2%	0.2635
Trauma admission, n	81	97	115.9%	0.2304
B				
Age (years), median (range)	82 (30–99)	82 (60–101)		
Woman, n (%)	28 (82.3)	31 (81.6)	110.7%	0.6961
Total admission, n	34	38	111.8%	0.6374
Femoral neck, n	21	16	76.2%	0.4111
Trochanter, n	12	21	175%	0.1172
Femoral shaft, n	1	1	100%	1

Note: A: all consecutive patients admitted due to musculoskeletal trauma; B: only femoral fractures.

Table 2
Admission diagnoses of each group.

Injury sites	2019 (n)	2020 (n)	Proportion 2020:2019	p value
Head	0	3		0.0833
Thorax	4	1	25%	0.1797
Upper limb	19	28	147.4%	0.1893
Shoulder/elbow	16	21	131.2%	0.4111
Forearm/hand	3	7	233.3%	0.2059
Spine/pelvis	10	11	110%	0.8273
Lower limb	48	54	112.5%	0.5525
Femur	34	38	111.8%	0.6374
Tibia	12	5	41.7%	0.0896
Ankle/foot	2	11	550%	0.0126

injuries.^{14–18} We may presume that the reason for the increased frequency of lower limb injuries during earthquakes is that people during earthquakes rush panicky out of the houses and therefore suffer lower extremity injuries. However, this supposition requires further research to be fully understood. Another interesting result is the trend towards a decrease in admissions due to tibial fractures. In the urban population, tibial fractures most commonly occur due

to road traffic accidents, precisely motorcycle accidents.¹⁹ Therefore, it can be expected that during lockdown when road traffic is decreased, there will be fewer tibial fractures. In both analyzed periods, the osteoporotic hip fracture was the most common independent admitting diagnosis. In addition, the proportion of hospital admissions for osteoporotic hip fractures within trauma admissions remained relatively stable during the case and control period (Fig. 1). This supports the recent work of Nuñez et al.²⁰ who found that during the Spanish state of emergency, due to the COVID-19 outbreak, the frequency of traumatized patients has lessened, yet the number of osteoporotic hip fractures remained permanent.

In conclusion, when facing future crises, it is crucial to understand how natural disasters like earthquakes influence the pattern of trauma admissions during a coexisting pandemic. Accordingly, healthcare systems have to be prepared for an increased influx of certain traumatic injuries, like foot and ankle trauma. This study has several limitations due to its retrospective single-centre design and specific local healthcare system organization. However, we believe that our results may predict a similar scenario in some future crisis.

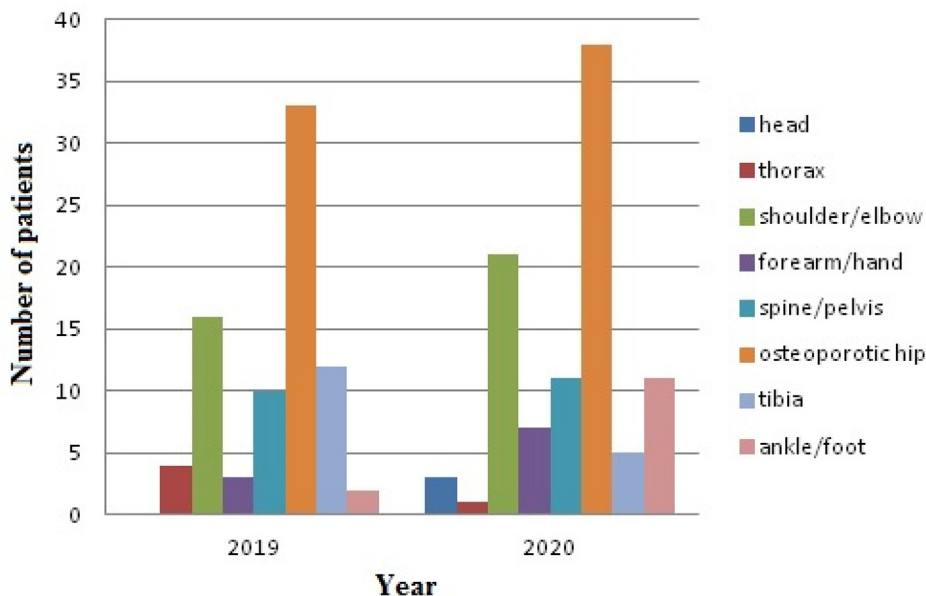


Fig. 1. Reasons for hospital admissions for trauma emergencies in two analyzed periods.

Funding

Nil.

Ethical statement

Ethical approval was waived by the Ethical Committee of the University Hospital Centre Zagreb, Zagreb, Croatia (Class: 8.1-20/153-2 No: 02/21 AG).

Declaration of competing interest

The authors declare that they have no conflict of interest.

Author contributions

Ivan Dobrić designed the study and supervised the research. All authors contributed to the study conception. Material preparation, data collection and analysis were performed by Dino Bobovec, Andreja Prtorić and Tin Ehrenfreund. The first draft of the manuscript was written by DB, Tomislav Žigman and Daniel Rajčić. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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