International Orthopaedics (2020) 44:1565–1570
https://doi.org/10.1007/s00264-020-04575-0

ORIGINAL PAPER

Epidemiologic characteristics of traumatic fractures in elderly patients during the outbreak of coronavirus disease 2019 in China

Yanbin Zhu[1,2,3] · Wei Chen[1,2,3] · Xing Xin[2] · Yingchao Yin[1,2,3] · Jinglve Hu[2] · Hongzhi Lv[2] · Weixu Li[4] · Xiangtian Deng[5] · Chao Zhu[6] · Jian Zhu[7] · Jinli Zhang[8] · Fagang Ye[9] · Aimin Chen[10] · Zhanyong Wu[11] · Zhanbei Ma[12] · Xinhu Zhang[13] · Fengmei Gao[14] · Jidong Li[15] · Conglin Wang[16] · Yingze Zhang[1,2,3] · Zhiyong Hou[1,2,3]

Received: 1 April 2020 / Accepted: 15 April 2020 / Published online: 29 April 2020

Abstract

Purpose This study aimed to describe the epidemiologic characteristics of fracture in the elderly during the COVID-19.

Methods This was a retrospective multi-centre study, which included patients who sustained fractures between 20 January and 19 February 2020. The collected data included patients' demographics (age and gender), injury-related (injury type, fracture location, injury mechanism, places where fracture occurred), and treatment modality. SPSS 23.0 was used to describe the data and perform some analysis.

Results A total of 436 patients with 453 fractures were included; there were 153 males and 283 females, with an average age of 76.2 years (standard deviation, SD, 7.7 years; 65 to 105). For either males or females, 70–74 years was the most commonly involved age group. A total of 317 (72.7%) patients had their fractures occurring at home. Among 453 fractures, there were 264 (58.3%) hip fractures, accounting for 58.3%. Fall from standing height was the most common cause of fracture, making a proportion of 89.4% (405/453). Most fractures (95.8%, 434/453) were treated surgically, and 4.2% (19/453) were treated by plaster fixation or traction. Open reduction and internal fixation (ORIF) was the most used surgical method, taking a proportion of 49.2% (223/453).

Conclusion These findings highlighted the importance of primary prevention (home prevention) measures and could be used for references for individuals, health care providers, or health administrative department during the global pandemic of COVID-19.

Keywords COVID-19 · Pandemic · Elderly · Fracture · Epidemiology

Introduction

By 27 March 2020, the outbreak of coronavirus disease 2019 (COVID-19) has generated 529,442 confirmed cases in 173 countries or areas around the world, including 23,998 deaths (https://voice.baidu.com/act/newpneumonia/newpneumonia). Numerous countries have implemented strict control measures to limit the flow of people, including blockade of city, traffic control, strict access to the community, and self-isolation at home. China has the most serious COVID-19 outbreak since 20 January 2020, and governments at levels implemented the multi-aspect prevention measure to control the epidemic situation and by now these measures have demonstrated to be highly effective.

The adequate evidences have demonstrated the higher morbidity and mortality rate in elderly patients who were infected with Covid-19 [1–3]. Furthermore, in the context of Covid-19, the physical deterioration, prevalent comorbidities, and the potential psychological effects generally place the elderly population at increased risk of accidental events, including cerebrovascular disease (stroke and transient cerebral haemorrhage). In addition, there is an increased concern that the elderly might be at a higher risk of falls and related fractures, due to the more prevalent osteopenia and osteoporosis with aging [4, 5]. These accidental events not only increase the consumption of medical resources that have been already scarce but also make the sustainers susceptible to or infected with COVID-19 via the way of transmission in the hospital.

Yanbin Zhu, Wei Chen and Xing Xin contributed equally to this work.

✉ Yingze Zhang
drzhang2013@126.com

✉ Zhiyong Hou
drzyhou@gmail.com

Extended author information available on the last page of the article

Between 20 January and 19 February, which was the most important period for Chinese to struggle against COVID-19, and after then the true inflection point emerged. In this multicentre study, we retrospectively collected data of hospitalized elderly patients who sustained fractures during this period, and our aim was to investigate the epidemiologic characteristics. We hope these data could provide valuable references for the prevention of such accidental injury in this special international situation.

Methods

Data resource

All the data were provided by the 14 hospitals of China mainland, including the Third Hospital of Hebei Medical University, the Second Affiliated Hospital of Zhejiang University School of Medicine, The Affiliated Hospital of Southwest Medical University, Jiangning Hospital Affiliated to Nanjing Medical University, Shanxi Bethune Hospital, Tianjin Hospital, The Affiliated Hospital of Qingdao University, Changzheng Hospital of Naval Medical University, General Hospital of Jizhong Energy Xingtai Mining Group, Baoding First Central Hospital, Hengshui Halison International Peace Hospital, The Second People's Hospital of Hengshui, Jingxing County Hospital, and People's Hospital of Lincheng County. Of them, there were 11 tertiary referral hospitals and three secondary referral hospitals.

This study was approved by the institutional review board of the third Hospital of Hebei Medical University and consent was waived for its retrospective nature.

Inclusion and exclusion criteria

All elderly patients aged 65 years or older who sustained a fracture between 20 January and 19 February 2020 were included in this study. The exclusion criteria were age less than 65 years, pathologic (metastatic) fracture, old fracture, and patients with missing medical data.

Data collection and groups

The collected data of interest included demographics (age and gender), fracture location, side of the lesion, open or closed fracture, mechanism of injury, place where fractures occurred, and concurrent fractures. All medical charts and radiographs for fracture patients in each participating hospital were evaluated by two local orthopaedic surgeons and were addressed by discussion if there is any inconsistency.

Based on age in five-year interval, patients were divided into five groups: 65–69 years, 70–74 years, 75–79 years, 80–85 years, and 85 years above. The fracture location was proximal, shaft and distal fracture for each limb long-bone (humerus, ulnar and radius, femur, tibia and fibula), pelvic and acetabular fracture, scapula, clavicle, patella, cervical vertebra, thoracolumbar fracture, hand (wrist) fracture, foot, and ankle fractures.

The injury mechanism included fall from standing height, fall from a low height (< 1 m, e.g., bed, chair, stool), fall from a height > one metre (e.g., roof or tree), bicycle injury, electronic bike (E-bike) injury, motor vehicle injury, and others. Lower-energy fracture was defined as a fracture caused by fall from standing height, low height (< 1 m), or bicycle injury, and high-energy fracture as from high height, electronic bike (E-bike) injury, motor vehicle injury, and others.

Statistics

Continuous variables were expressed by mean and standard deviation (SD) and were evaluated by Student t test or Mann-Whitney U test. The categorical data were expressed as number and percentage (%) and were evaluated by chi-square or Fisher's exact test. The linear-by-linear association test was used to evaluate the trend of ratio of female to male in different age groups. The statistical test level was set as $p < 0.05$. SPSS23.0 was used to perform all the tests (IBM, Armonk, New York, USA).

Results

Age- and gender-specific characteristics

During the study timeframe, there were a total of 436 patients with 453 fractures, including 11 patients each having concurrent two fractures and three patients each with concurrent three fractures. There were 153 male patients and 283 female patients, with an average age of 76.2 years (standard deviation, SD, 7.7 years; range, 65 to 105). The age of males was 75.0 years (SD, 7.0), significantly younger than that (mean, 76.8; SD, 7.9) of females ($p = 0.016$).

For either males or females, 70–74 years was the most commonly involved age group. The detailed characteristics stratified by age and gender were presented in Fig. 1. There was significant difference between males and females in age composition ($p = 0.042$). The ratio of females to males was 1.63, 1.56, 1.52, 1.83, and 4.31 in each age group, and the trend was significant statistically ($p = 0.019$).

Place of fracture occurrence

A total of 317 patients had their fracture occurring at their own home, taking a proportion of 72.7%; 72 (16.5%) patients had their fracture occurring at the community court or on the way to or from outside (31, 7.1%); other places included public sites (market, park, hospital, etc.) (9, 1.4%), staircase (5, 1.1%), and sports field (2, 0.5%).

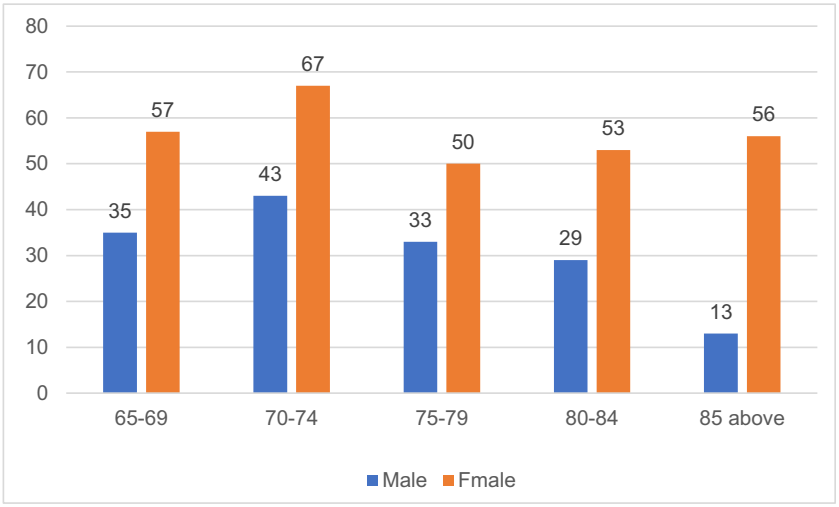

Fig. 1 The detailed distribution of fracture stratified by age and gender

Fracture location, type, and injury mechanism

Among 453 fractures, there were 264 hip fractures, accounting for 58.3%, followed by thoracolumbar vertebra fracture (34, 7.5%), proximal humerus fracture (20, 4.4%), and patella fractures (18, 4.0%) (Fig. 2).

The proportion of fall from standing height causing fractures was 89.4% (405/453), followed by fall from a low height (23, 5.1%), motor vehicle injury (14, 3.1%), fall from a height (7, 1.5%), and others (4, 0.9%).

There were 439 cases of closed fractures, taking a proportion of 96.9%. Among the 14 (3.1%) open fractures, three involved the hand, which were caused by chainsaw injury at their respective home, one by machine crush, eight by motor vehicle injury, and two were caused by a fall from roof or a tree.

Of the 14 (3.2%) patients with concurrent fractures (31 fractures, total), three (0.7%) patients sustained the motor vehicle injury and one sustained a fall from a high height, with at least one lower-extremity diaphyseal fracture involved in each patient, with concurrent lumbar vertebra fracture, foot fracture, or acetabulum fracture. The remaining 11 patients all sustained a low-energy injury and fall from a standing height or a low height.

Treatment modality

Most fractures (95.8%, 434/453) were treated surgically, and 4.2% (19/453) were treated by plaster fixation or traction. Open reduction and internal fixation (ORIF) was the most used surgical method, taking a proportion of 49.2% (223/453), followed by closed reduction and internal fixation (36.2%, 164/453) and joint placement (10.4%, 47/453).

Discussion

Under the current global pandemic of COVID-19, knowledge of injury characteristics in the elderly are more important than ever before, because of the higher of morbidity and mortality in such population, if they are infected with 2019 Novel

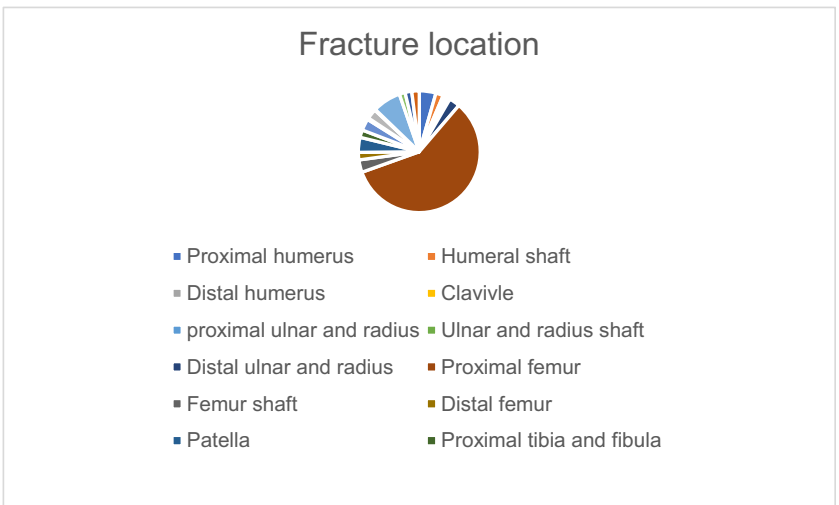

Fig. 2 The distribution of fracture based on different locations

Coronavirus (2019-nCoV). This study retrospectively collected data on fractures in the elderly patients of 14 hospitals in China within a month of the worst COVID-19 outbreak, showing the disproportionately high prevalence of hip fractures (58.3%), low-energy falls being the major injury mechanism, and predominance of home for fractures occurrence.

During the epidemic period, governments at all levels in China implemented the strictest measures, and community workers adopted grid checking and voucher access, which greatly reduced the flow of people. On January 23, 2020, the day Wuhan was closed, the foot fall of the shopping malls and supermarkets decreased significantly by more than 95% in numerous cities of China (https://baijiahao.baidu.com/s?id=1659210676897303602&wfr=spider&for=pc). Up to 19 February, almost all the population was isolated at their own home, except for some workers transporting anti-epidemic materials, health care providers, and administrative staff. In this study, fractures occurring at home or nearby accounted for a proportion of 89.2%, and 94.5% were caused by fall from a standing height or a low height (< 1 m), which was consistent with the strictest anti-epidemic measures. Therefore, targeted measures at home should be considered for effective prevention of such injury. These measures could include keeping adequate light and dry ground in the living room and washing room, antiskid shoes, and Loose fitting and comfortable clothes should be worn on a daily basis, and sitting rather than standing for a bath is important. We also suggest that, for individuals who are seated or lying a long time, slowly getting up by holding on to something (handrail, armchair, or wall) should be considered. Of particular note, for patients who had one or several comorbidities with need of long-term medication management, medications for at least six months should be stocked, considering the epidemic situation of COVID-19.

In this study, the disproportionately high prevalence of hip fractures was a concern, taking approximately three-fifths of the overall fractures. This figure was about two to three times as that reported in the elderly patients in the literature [6, 7]. It can be predicted that this will present a great pressure to the medical and health-care centres, given the burden of hip fracture and the increased rate of related morbidities. Based on our an aesthesia and treatment policy which was reviewed during the outbreak of COVID-19, most patients with hip fractures or others will be selected to receive regional/local or intrathecal anaesthesia; general anaesthesia is prescribed only in patients with spinal fractures, pelvis fractures, combined injuries, or in the case of a full stomach but in need of emergency operation. Even in those requiring general anaesthesia, laryngeal mask anaesthesia (LMA) instead of intratracheal intubation anaesthesia (IIA) is chosen, with the aim to reduce or avoid the potential respiratory symptoms to confuse that which was caused by COVID-19. Minimal invasive surgery should be chosen as possible for these fracture patients, to reduce hospitalization stay and to reduce the workload burden of healthcare providers. We suggest that reasonable decision-making for peri-operative management of fractures in elderly will be of great significance in the reduction and even prevention of spread of 2019-nCoV in hospitals.

In this study, we also found some patients who had open fractures caused by chainsaw accidental injury and a fall from a roof or tree. The detailed reasons for this include the depressed mood caused by long-term self-isolation and use of unfamiliar chainsaws to repair something due to professional and skilled workers having stopped providing door-to-door services during COVID-19. Accordingly, how to relieve panic, depression, or irritability during the epidemic period is also a topic that needs to be paid attention to. Emotional relief should not only address behaviour but also should provide psychological guidance, such as appeals to the network, relatives, and friends or even psychological doctors. In addition, we suggest that elderly population should not try something unfamiliar and dangerous for them, which might place them at a high risk of injury.

The shortcomings of this study have to be mentioned. Firstly, the inherent limitation of retrospective design might compromise the accuracy in data collection. However, the variables in this study were relatively few, including demographics, injury-related characteristics, and treatment modality. Therefore, recall bias for patients might is likely to be small. Secondly, there were no relevant data on patients' medical conditions, such as comorbidities, presence of osteoporosis, and medications management strategies, which might also have effects on fractures in the elderly. Thirdly, no control group was set for intuitive comparison with findings of this study. But based on strict measures taken currently during COVID-19, we think the differences are dramatic.

In conclusion, this study revealed the disproportionally prevalent hip fracture, low-energy injury (fall from standing height and fall from a low height) being the most prevalent injury mechanism, and home being the predominant place where fracture occurred. These findings highlighted the importance of primary prevention (home prevention) measures, and could be used for references for individuals, health care providers, or health administrative department, during the global pandemic of COVID-19.

Authors' contributions Yingze Zhang and Zhiyong Hou conceived the idea for the study; Yanbin Zhu and Wei Chen designed the study. Xing Xin, Yingchao Yin, Hongzhi Lv, Weixu Li, Xiangtian Deng, Chao Zhu, Jian Zhu, Jinli Zhang, Fagang Ye, Aimin Chen, Zhanyong Wu, Zhanbei Ma, Xinhu Zhang, Fengmei Gao, Jidong Li, and Conglin Wang collected the relevant data. Yanbin Zhu performed the statistical analyses. All the authors interpreted the data and contributed to preparation of the manuscript. Yanbin Zhu and Wei Chen contributed equally to this manuscript.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Rothan HA, Byrareddy SN (2020) The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. J Autoimmun 26: 102433. https://doi.org/10.1016/j.jaut.2020.102433
2. Guo YR, Cao QD, Hong ZS, Tan YY, Chen SD, Jin HJ, Tan KS, Wang DY, Yan Y (2020) The origin, transmission and clinical therapies on coronavirus disease 2019 (COVID-19) outbreak - an update on the status. Mil Med Res 7(1):11–20
3. Singhal T (2020) A review of coronavirus Disease-2019 (COVID-19). Indian J Pediatr 87(4):281–286
4. Westbury LD, Syddall HE, Fuggle NR, Dennison EM, Cauley JA, Shiroma EJ, Fielding RA, Newman AB, Cooper C (2020) Long-term rates of change in musculoskeletal aging and body composition: findings from the health, aging and body composition study. Calcif Tissue Int (Mar 3). https://doi.org/10.1007/s00223-020-00679-2
5. Zhang Q, Cai W, Wang G, Shen X (2020) Prevalence and contributing factors of osteoporosis in the elderly over 70 years old: an epidemiological study of several community health centers in Shanghai. Ann. Palliat Med. https://doi.org/10.21037/apm.2020.02.09
6. Zhang Y (2012) Clinical epidemiology of orthopedic trauma. Thieme
7. Court-Brown CM, McQueen MM (2016) Global forum: fractures in the elderly. J Bone Joint Surg Am 98(9):e36–e42

Affiliations

Yanbin Zhu [1,2,3] · Wei Chen [1,2,3] · Xing Xin [2] · Yingchao Yin [1,2,3] · Jinglve Hu [2] · Hongzhi Lv [2] · Weixu Li [4] · Xiangtian Deng [5] · Chao Zhu [6] · Jian Zhu [7] · Jinli Zhang [8] · Fagang Ye [9] · Aimin Chen [10] · Zhanyong Wu [11] · Zhanbei Ma [12] · Xinhu Zhang [13] · Fengmei Gao [14] · Jidong Li [15] · Conglin Wang [16] · Yingze Zhang [1,2,3] · Zhiyong Hou [1,2,3]

Yanbin Zhu
zhuyanbin111@126.com

Wei Chen
surgeonchenwei@126.com

Xing Xin
664050128@qq.com

Yingchao Yin
724921259@qq.com

Jinglve Hu
798253050@qq.com

Hongzhi Lv
190099199@qq.com

Weixu Li
13996532323@139.com

Xiangtian Deng
350144946@qq.com

Chao Zhu
zhuchao3808@sina.com

Jian Zhu
zhuujiann@126.com

Jinli Zhang
Jinlizhang@tom.com

Fagang Ye
fagangye@sina.com

Aimin Chen
aiminchen1@126.com

Zhanyong Wu
drwzy1965@163.com

Zhanbei Ma
zhanbeima@126.com

Xinhu Zhang
xinhuzhang1@126.com

Fengmei Gao
fengmeicao@126.com

Jidong Li
jidongli2@126.com

Conglin Wang
conglinwang1@126.com

[1] Department of Orthopaedics Surgery, The Third Hospital of Hebei Medical University, Shijiazhuang, China

[2] Orthopaedic Institute of Hebei Province, Shijiazhuang, China

[3] Key Laboratory of Biomechanics of Hebei Province, Shijiazhuang, Hebei, China

[4] Department of Orthopaedics Surgery, The Second Affiliated Hospital of Zhejiang University School of Medicine, Hangzhou, China

[5] Department of Orthopaedics Surgery, The Affiliated Hospital of Southwest Medical University, Luzhou, China

[6] Department of Orthopaedics Surgery, Jiangning Hospital Affiliated to Nanjing Medical University, Nanjing, China

[7] Department of Orthopaedics Surgery, Shanxi Bethune Hospital, Taiyuan, China

[8] Department of Orthopaedics Surgery, Tianjin Hospital, Tianjin, China

[9] Department of Orthopaedics Surgery, The Affiliated Hospital of Qingdao University, Qingdao, China

[10] Department of Orthopaedics Surgery, Changzheng Hospital of Naval Medical University, Shanghai, China

[11] Department of Orthopaedics Surgery, General Hospital of Jizhong Energy Xingtai Mining Group, Xingtai, China

[12] Department of Orthopaedics Surgery, Baoding First Central Hospital, Baoding, China

[13] Department of Orthopaedics Surgery, Hengshui Halison International Peace Hospital, Hengshui, China

[14] Department of Orthopaedics Surgery, The Second People's Hospital of Hengshui, Hengshui, China

[15] Department of Orthopaedics Surgery, Jingxing County Hospital, Shijiazhuang, China

[16] Department of Orthopaedics Surgery, People's Hospital of Lincheng County, Xingtai, China