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Case Control Study

SARS-CoV-2 outbreak impact on a trauma unit

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Abstract**BACKGROUND**

From February 2020 onwards, our country has been hit by the coronavirus severe acute respiratory syndrome-2 (SARS-CoV-2) infection. At a glance, hospitals became overrun and had to reformulate all the assistance guidelines, focusing on the coronavirus disease 2019. One year after the start of the pandemic, we present the results of a morbimortality study.

AIM

To analyze how our department was affected by the outbreak in terms of morbimortality, and to analyze demographic data, admission to hospital-related data, and subgroups analyses for patients with hip fractures and polytrauma.

METHODS

We designed a study comparing data from patients who were admitted to our unit due to a lower limb fracture or a high energy trauma during the pandemic (from March to April 2020) to those admitted during the same period in 2019 before the pandemic. during the pandemic situation. Both cohorts completed a minimum of 6 mo of follow-up.

RESULTS

The number of patients admitted to hospital in 2020 was nearly half of those in 2019. Hip fractures in the elderly represented 52 out of 73 of the admitted patients. Twenty patients had a positive test result for SARS-CoV-2 infection. Patients with

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SARS-CoV-2 infection were admitted to the hospital for a longer time than the non-infected ($P < 0.001$), and had a higher mortality rate during hospitalization and follow-up ($P = 0.02$). Patients with a hip fracture associated with a severe respiratory syndrome were mostly selected for conservative treatment ($P = 0.03$).

CONCLUSION

Mortality and readmission rates were higher in the 2020 cohort and during follow-up, in comparison with the cohort in 2019.

Key Words: Trauma department; COVID-19 pandemic; SARS-CoV-2 outbreak; Hip fractures; Morbimortality; Polytraumatic patients

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Core Tip: Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection was not a criterion for choosing conservative treatment, unless those patients infected with the virus had a poor general condition that made surgery unadvisable. We did not find a relationship between the employment of anticoagulant therapy and the severity of coronavirus disease 2019 (COVID-19) infection or a different mortality rate. Patients who died during hospitalization due to COVID-19 had higher C-reactive protein levels ($P < 0.001$) and higher urea levels ($P = 0.006$). The mortality rate in 2020 was 13.7% during hospitalization; 19% during the first month after discharge, and 24.6% in the 3 mo after discharge. The mortality rate in the COVID-19 positive patient subgroup was 38.9% after 6 mo of follow-up. Non-operative treatment in hip fractures was related to SARS-CoV-2 infection ($P = 0.03$) and with AO 31.B fractures. Polytrauma patients and high energy fractures were more common in 2019 (24%) than in 2020 (11.5%). The main difference between both periods was the injury mechanism.

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INTRODUCTION

A cluster of atypical pneumonia was identified in Wuhan, China, in December 2019, affecting China first, and rapidly spreading all over the world, starting a pandemic[1]. By the end of February 2020, the first case of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection was reported in our community (Madrid, Spain). As a consequence of the outbreak, elective surgeries were suspended. Some of the surgeons were assigned to interdisciplinary teams headed by Internal Medicine, aiding the fight against coronavirus disease 2019 (COVID-19). Surgeries and outpatient appointments were minimized to provide only essential services: emergencies, fractures, some surgical complications, and a few bone or soft tissue tumors.

This study aims to analyze the effect that the SARS-CoV-2 pandemic had on our Orthopedic and Trauma Department. We wanted to evaluate if COVID-19 influenced the decision-making with those patients admitted during the first wave of the SARS-CoV-2 outbreak and if conservative treatment was more frequently chosen. As we noticed that the number of patients admitted and their characteristics varied markedly, we decided to compare the 2020 results with a cohort of patients admitted to our hospital during the same period in 2019, using the same inclusion criteria for both groups.

MATERIALS AND METHODS

This study consists of a prospective single-center observational study. We selected a cohort of patients under the following inclusion criteria: Patients that came to the Emergency Room (ER) after a traumatic injury, requiring hospitalization because of a lower limb fracture, or polytrauma patients from March 11th, 2020 (date of admission of the first positive case amongst our patients) to April 30th, 2020. Patients presenting a surgical complication were not included if they underwent surgery before the pandemic period. Tumors, upper limb, and spine fractures were omitted (unless polytraumas were presented with them), following the common criteria for admission in our Unit. A minimum of 6 mo of follow-up was required for inclusion in this analysis.

Patients were tested when they arrived in the ER: blood tests, chest AP radiographs and nasopharyngeal swabs. In some cases, if the complementary tests were highly suggestive of SARS-CoV-2 infection but the polymerase chain reaction (PCR) test was negative, a chest computed tomography scan was also performed. Patients with severe acute respiratory insufficiency and bilateral pneumonia were assumed as positives even if the PCR was negative.

Depending on those test results, patients were admitted to the hospital in different areas and operated on in different operating rooms. Postoperatively, we tried to reduce to the maximum the time spent in the hospital, at all times prioritizing clinical status, to avoid nosocomial transmission.

We collected demographic data, lesion mechanism and characteristics, previous functional status, different parameters obtained from chest AP view radiographs, blood tests, or SARS-CoV-2 tests. Time to surgery and average in-hospital stay were recorded. Complications were recorded, as well as readmissions to the hospital due to surgical or medical problems.

Another cohort, with the same characteristics and inclusion criteria, was obtained in the same period in 2019, to compare differences in our unit between a normal period and the pandemic period, the aim being that the only difference between them was the presence of SARS-CoV-2.

Selected data were collected in an electronic database [Microsoft® Excel for Windows® (Microsoft Corp, Redmond, WA, United States)], kept under restricted access in accordance with data protection legislation. All statistical analyses were performed by the Biostatistics Unit at our center. The level of significance was established at $P < 0.05$. The present study was approved by our Hospital's Ethics Committee.

RESULTS

Cohort of patients in 2020

During a period of 50 d, from March 11th, 2020 (date of admission of the first positive case among our patients) to April 30th, 2020 (last day of severe restrictions at the hospital), 73 patients fulfilled inclusion criteria and were included in this study. The most representative descriptive analysis results from the demographic data of the cohort of patients in 2020 are shown in [Table 1](#). The age range was from 17-years-old to 97-years-old. The vast majority of the patients (71%) had a hip fracture, the mean age in this subgroup being 87-years-old (61-97-years-old). Except for those patients classified as polytraumas (11.5%), all patients suffered a fracture due to a low energy traumatism. In this cohort, 14 patients were under anticoagulant therapy and 7 under antiplatelet therapy. The use of these drugs had no relation to COVID-19 development nor the mortality rate. Patients who used them had a longer time to surgery ($P < 0.001$). While admitted to hospital, 3 patients developed a pulmonary embolism despite adequate treatment with low molecular weight heparin; all cases were related to COVID-19. During follow-up, no patients developed complications related to thromboembolic disease (deep vein thrombosis nor pulmonary embolisms).

Wide blood tests were performed systematically on all the patients when they arrived in the ER as part of a protocol to study COVID-19 patients. We noticed that COVID-19 positive patients presented higher values of C-reactive protein ($P < 0.001$). Patients who died during hospitalization had higher C-reactive protein levels ($P < 0.001$) and higher urea levels ($P = 0.006$). Nasopharyngeal swabs were performed systematically when patients arrived in the ER from March 24th onwards, following center protocols; previously it was ordered only in suspected cases. When swabs were not still mandatory, a lower time to surgery was observed ($P = 0.01$).

Table 1 Demographic data of the cohort of patients from 2020

	Minimum	Maximum	Mean	SD
Age (yr)	17	97	76.99	20.25
FAC	0	5	3.11	1.257
Barthel Index	0	100	71.82	29.649
Pfeiffer mental status	0	10	2.89	3.46
Charlson Comorbidity Index	4	11	6.66	1.75
Body temperature (°C)	35	37.4	36.1	0.5
Blood oxygen saturation (%)	82	100	94.7	3.37
Urea blood levels (mg/dL)	12	219	57.94	37.5
D-dimer (ng/mL)	2010	123070	23939.68	29893.51
Lactate dehydrogenase (UI/L)	152	851	307.66	125.75
C-reactive protein (mg/dL)	0	248	40.7	60.5

FAC: Functional Ambulation Classification; SD: Standard deviation.

Twenty patients obtained a positive test result for SARS-CoV-2 infection. Patients with SARS-CoV-2 infection were hospitalized for a longer time than non-infected ones ($P < 0.001$) and also had a higher mortality rate during hospitalization and follow-up ($P = 0.02$). Of those patients diagnosed with COVID-19 infection, 80% were operated on. The SARS-CoV-2 disease was not a criterion for not performing surgery, although severe respiratory syndrome was ($P = 0.03$).

The in-hospital stay was 11 d (0-61 d). Logically, COVID-19 had an influence on these data: this number varied from 8 d (0-43 d) for the group of negative patients to 18 d (4-61 d) for the group of positive patients ($P < 0.05$). Analyzing the group of patients with hip fractures, COVID-19 positive patients stayed a mean of 17 d (4-61 d) *vs* a mean of 8 d (1-43 d) for negative patients ($P < 0.05$). On the other hand, a longer time to surgery is related to a longer time to discharge ($P < 0.001$). A relationship between a longer time to surgery and the risk of nosocomial SARS-CoV-2 transmission or death could not be demonstrated. Clinical complications during the 3 mo after discharge were more common amongst COVID-19 positive patients (83.3%) than in those without SARS-CoV-2 infection (32.4%) ($P < 0.05$).

The mortality rate in 2020 was 13.7% during hospitalization, 19% during the first month after discharge, and 24.6% in the 3 mo after discharge. Those rates are high and are related to COVID-19. The mortality rate in the COVID-19 positive patient subgroup was 38.9% after a minimum of 6 mo of follow-up.

Hip fractures and SARS-CoV-2

During the period studied in 2020, 52 patients were admitted to the hospital due to a hip fracture, out of 73 patients. We did some analyses in this subgroup, including Functional Ambulation Classification, Barthel Index Score, Pfeiffer Short Portable Mental Status, and Charlson Comorbidity Index. Scores in these scales had no relation to the place where patients lived (home/nursing home) before the fracture, with COVID-19 infection, time of hospitalization, or death ($P > 0.05$). However, patients coming from a nursing home presented a higher rate of SARS-CoV-2 infection ($P = 0.03$), without any relationship between nursing homes and risk of death ($P = 0.1$).

Regarding the type of fracture (classified following AO criteria), we found a correlation with readmission to the hospital ($P = 0.001$), because all the patients who had a 31.A3 or bifocal femoral fractures were readmitted to the hospital due to medical complications.

In our cohort of 52 patients with hip fractures, 7 patients were treated non-operatively and 5 of them developed a severe respiratory insufficiency due to COVID-19. Non-operative treatment in hip fractures was related to SARS-CoV-2 infection ($P = 0.03$) and with AO 31.B fractures (intracapsular fractures) ($P < 0.001$), corresponding to 6 out of the 7 patients treated non-operatively.

Polytrauma patients

The cohort from 2020 includes 5 patients who suffered a high energy traumatism and were defined as polytraumas. The age range was 20-57-years-old with a mean age of 38-years-old. Three of them presented with open fractures. Two of them died during hospitalization due to respiratory failure, but none of them due to COVID-19.

Other fractures

Lower limb fractures, other than hip fractures in the elderly and fracture patients not considered polytrauma, showed a sharp decrease due to the lockdown.

Comparison to a similar cohort in 2019

In the same period of 50 d in 2019, 143 patients were admitted to the hospital and included in analyses following the same inclusion criteria. During the SARS-CoV-2 outbreak, the number of patients admitted to our unit decreased by 49% in comparison with the same period in 2019.

No statistical differences were found between both cohorts (2019 and 2020) regarding demographic data.

The number of patients that were not suitable for surgery was very similar in both periods, 11.5% in 2020 and 12.6% in 2019. In-hospital stay varied from 1 to 32 d (mean 8 d) in 2019, and from 1 to 61 d (mean 11 d) in 2020 ($P < 0.02$). Readmissions to the hospital in the 3 mo after discharge were higher in 2020 (10.8%) than in 2019 (5%) and more frequently due to a medical complication (71.4%). The mortality rate during hospitalization was 2% during the period in 2019, *vs* 13.7% in 2020. Mortality after 6 mo of follow-up was also higher in 2020 (24.6%) than in 2019 (2.8%), ($P < 0.001$).

Hip fractures 2019 vs 2020

The most common type of fracture was pertrochanteric (31.A) both in 2019 and 2020. Despite the sharp decrease in the admissions, the number of patients with a hip fracture increased, compared to 2019, when they represented 53% of the admissions. According to the AO Trauma classification, 31.A2 and 31.A3 fractures were more frequent in 2020 than in 2019, and this could contribute to the higher rate of complications and mortality during hospitalization in addition to SARS-CoV-2 infection (Table 2). Medical complications appeared in 50% of patients in 2020 (52% of them related to COVID-19), and over 20% of patients in 2019 ($P < 0.001$). The surgical complications rate was very similar in both periods (3.8% in 2020 and 5.6% in 2019), and no statistical differences were found.

Polytrauma patients

Polytrauma patients and high energy fractures were more common in 2019 (24%) than in 2020 (11.5%), due to lockdown measures implemented by the National Government. The main difference between both periods was the injury mechanism. In 2019, we recorded traffic accidents and suicide attempts as the most common mechanisms. Polytrauma injuries after car crashes or motorcycle accidents were less frequent in the studied period of 2020. After a few days, lockdown measures were modified and construction work was permitted again. Accidents at work then became one of the main causes of injury, with similar numbers of suicide attempts after falls from height.

Other fractures

The most relevant drop-in was observed in ankle fractures, with 6 cases who needed surgery in 2020 *vs* 26 surgical cases in the same period in 2019 ($P < 0.05$).

DISCUSSION

Continuing to provide health care to fracture patients became a challenge during the SARS-CoV-2 outbreak. As is widely known, hospitals were organized following internal protocols to maximize security and minimize the risk of nosocomial infection [2].

We wanted to study if all those changes had an impact on the results obtained by our patients after hospitalization and surgery, which is why we compared the 2020 results with a similar cohort in 2019, the aim being that the only difference was COVID-19 and its implications.

We observed that patients affected by SARS-CoV-2 infection were older than the non-infected ones ($P = 0.004$), even though age is not a risk factor for acquiring the

Table 2 Incidence of different hip fractures in 2019 vs 2020 according to AO trauma classification

	2019	2020
31.A1	18.2%	21.6%
31.A2	33.8%	40.5%
31.A3	6.5%	13.5%
31.B	41.6%	24.3%

infection; some colleagues found similar results[3], and age is a factor to take into consideration during surgery planning.

COVID-19 often presents thrombotic complications[4], which is a reason why some colleagues had hypothesized that patients under anticoagulant or antiplatelet therapy could develop fewer complications or less severe manifestations of COVID-19. We did not find a relationship between the use of these drugs and the severity of COVID-19 infection or a different mortality rate. No patients developed these types of complications during follow-up.

According to this early analysis, our management strategies allowed us to operate on patients safely and early, and in-hospital stay was similar to previous data in our center; except for those patients affected by COVID-19. These results are very similar to others previously published[5].

Sadly, the mortality rate was higher than in other periods and this was associated with SARS-CoV-2 infection, as was the readmission rate in the first 30 and 90 d of follow-up. Mortality rates continued to rise during follow-up, similar to results found by our Italian colleagues[6]; and as many others described, an increase in mortality rate was foreseeable in this group of patients[7].

Hip fractures and SARS-CoV-2

In some cases, COVID-19 pneumonia conditioned the surgeon's attitude. Some colleagues published that surgery could help patients with COVID-19 by stabilizing their respiratory parameters[8]. In our cohort of hip fractures, 7 out of 73 patients were treated non-operatively, patients with an intracapsular femoral fracture and/or SARS-CoV-2 infection were more frequently managed non-operatively ($P < 0.001$ and $P = 0.03$ respectively).

We tend to consider non-operative management as an option for intracapsular fractures when the patient has some comorbidities or a poor ability to perform everyday activities, as it has been demonstrated that they have a higher risk of complications[9]; however during the pandemic, conservative treatment has also been an option for intertrochanteric fractures in some centers[10]. We did not accept conservative treatment as an option for an intertrochanteric fracture except for those patients that were not suitable for surgery due to their medical condition. In our cohort, just one patient with an intertrochanteric fracture was managed under conservative measures, due to a severe respiratory syndrome-related to COVID-19, who in the end died.

Comparing the data from both groups, the number of patients selected for conservative treatment was very similar in both periods, 11.5% in 2020 and 12.6% in 2019 ($P = 1$). We can summarize that COVID-19 did not condition us towards conservative treatment, and this was only chosen when the patient was not suitable for surgery.

While most lower limb fractures decreased in frequency during this period due to lockdown, the number of hip fractures in the elderly rose even more than the normal annual increase, and we would like to emphasize the importance of this public health issue[11] and highlight the need for preventing the apparition of these fractures[12,13].

Polytrauma patients

After reviewing our data, we can conclude that the incidence of polytrauma did not vary drastically during the COVID-19 outbreak, although the incidence of these injuries decreased due to lockdown measures, compared to data from 2019. As other colleagues have described, what varied was the mechanism of injury, and a noticeable increase in work-related accidents was observed[14].

Other fractures

Conservative therapeutic approach had been an accepted alternative during the spread of COVID-19[15]. In our cohort we recorded a large decrease in surgical

treatment for certain types of fractures, particularly ankle fractures; however, their total incidence also fell, so clear conclusions cannot be drawn. Similar results were published by Park *et al*[16].

Our study has important limitations. Firstly, the short follow-up period is limited, and stronger conclusions could be made once the follow-up period is enlarged. Secondly, patients with fractures located in the upper extremities and spine were excluded, as well as surgical complications and tumoral lesions. This is due to an intention to enter into a criteria agreement, as we are a group of surgeons belonging to an Orthopedic Department, made up of a unit that works together, and kept working together during the outbreak. As a team, we all share the same principles of treatment and clinical management.

CONCLUSION

Notwithstanding the difficulties, we consider that protocols established in our center provided satisfactory results according to short times to surgery and in-hospital stay. The number of patients that were not suitable for surgery was very similar in both periods, 11.5% in 2020 and 12.6% in 2019, so we conclude that SARS-CoV-2 infection was not a criterion for choosing conservative treatment, unless those patients infected with the virus had a poor general condition that made surgery unadvisable as we do with any other health condition. The mortality rate during hospitalization and follow-up was higher than the previous year, but this was related to COVID-19. Complications during follow-up were also increased, the vast majority of which were also related to COVID-19. No differences were found in surgical complications between the different periods.

ARTICLE HIGHLIGHTS

Research background

From February 2020 onwards our country has been hit by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. At a glance, hospitals became overrun and had to reformulate all the assistance guidelines, focusing on the coronavirus disease 2019.

Research motivation

One year after the start of the pandemic, we present the results of a morbimortality study.

Research objectives

The main objective of this study is to analyze how our department was affected by the outbreak, in terms of morbimortality. As secondary objectives, we analyzed demographic data, admission to hospital-related data, and subgroups analyses for patients with hip fractures and polytrauma.

Research methods

We designed a study based on two sections in our tertiary hospital. The first is a cohort prospective study based on data collected on patients admitted to our unit during the pandemic (from March to April 2020, due to a lower limb fracture or a high energy trauma during the pandemic situation). This cohort completed a minimum of 6 mo of follow-up. The second part consists of the study of another cohort of patients, with the same inclusion criteria but selected in 2019, the only difference between them being the presence of SARS-CoV-2 in 2020 and its implications.

Research results

The number of patients admitted to hospital in 2020 was nearly half of those in 2019. Hip fractures in the elderly represented the vast majority of fractures during the outbreak. The incidence of polytrauma did not vary substantively, although the mechanism of injury did. Patients with a hip fracture associated with a severe respiratory syndrome were mostly selected for conservative treatment. Mortality and readmission rates were higher in the 2020 cohort and during follow-up in comparison with the cohort in 2019. Patients with SARS-CoV-2 infection were admitted to the

hospital for a longer time than the non-infected, and also had a higher mortality rate during hospitalization and follow-up.

Research conclusions

The SARS-CoV-2 disease is not a criterion for not performing surgery. Mortality and readmission rates were higher in the 2020 cohort and during follow-up, in comparison with the cohort in 2019. Hip fractures in the elderly represented the vast majority of fractures during the outbreak. The incidence of polytrauma did not vary substantively although the mechanism of injury did.

Research perspectives

The SARS-CoV-2 disease is not a criterion for not performing surgery.

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