Thirty-Day Mortality Rate of Patients With Hip Fractures During the COVID-19 Pandemic: A Single Centre Prospective Study in the United Kingdom

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Objectives: During the COVID-19 pandemic, the care of hip fracture patients remains a clinical priority. Our study aims to investigate the 30-day mortality rate of hip fracture patients during the first 30 days of the pandemic in the United Kingdom.

Methods: A single-center, observational, prospective study of patients presenting with hip fractures. Data collection started from "day 0" of the COVID-19 pandemic in the United Kingdom and continued for 30 days. We collected data on time to surgery, Clinical Frailty Scale score, Nottingham Hip Fracture Score, COVID-19 infection status, 30-day mortality, and cause of death. For comparison, we collected retrospective data during the same 30-day period in 2018, 2019, and the previous 6 months (Control groups A, B, and C, respectively).

Results: Forty-three patients were included in the study. There was no difference in age or gender between the Study and Control groups. The 30-day mortality rate of the Study group was 16.3%, which was higher than Control groups A ($P = 0.022$), B ($P = 0.003$) and C ($P = 0.001$). The prevalence of COVID-19 infection in our Study group was 26%. Of the 7 mortalities recorded, 4 patients tested positive for COVID-19 infection. In our Study group, COVID-19 infection correlated significantly with 30-day mortality ($P = 0.002$, odds ratio 2.4).

Conclusions: Our study demonstrated a significant increase in 30-day mortality among hip fracture patients during the first 30 days of the COVID-19 pandemic in the United Kingdom. A positive COVID-19 test result in patients with hip fractures is associated with a 2.4-fold increase in risk of 30-day mortality.

Key Words: COVID-19, pandemic, hip fracture, trauma, mortality

Level of Evidence: Prognostic Level II. See Instructions for Authors for a complete description of levels of evidence.

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INTRODUCTION

The COVID-19 pandemic has taken an unprecedented toll on the National Health Service (NHS). Hospitals across the United Kingdom have been placed under immense strain managing the increase in medical COVID-19 admissions with stretched resources. Government mandated lockdown measures seem to have resulted in fewer general trauma admissions but had little effect on the incidence of hip fractures. The care of patients with hip fractures therefore remains a clinical priority requiring urgent surgical intervention. COVID-19 infection is not a reason to delay or cancel urgent surgery for hip fractures.[1] The effect of COVID-19 infection on the clinical presentation and outcomes of hip fracture trauma patients has yet to be determined.

Hip fracture patients are usually elderly, frail, living in nursing homes, and have multiple comorbidities. This inherently puts them at a higher risk of developing severe COVID-19 illness.[2,3] Furthermore, there have been suggestions, albeit anecdotal, that surgery during the pandemic may place patients at an increased risk of developing severe COVID-19 infection. Indeed, early reports from China suggest that surgery may be a risk factor for COVID-19 disease exacerbation. A retrospective study of 34 patients in China showed that patients who underwent surgery during the incubation period of COVID-19 developed pneumonia after surgery.[4]

The aim of this study is to investigate the effects of the global pandemic and COVID-19 infection on the outcomes of patients with hip fractures. The objective of our study is to investigate and describe associated risk factors for 30-day mortality of patients with hip fractures in a single center for a 1-month follow-up period since "day 0" of the COVID-19 pandemic in the United Kingdom. The results of this study endeavor to contribute to the rapidly evolving body of evidence surrounding emergency trauma surgery during the pandemic and aid in the development of recommendations.

MATERIALS AND METHODS

We conducted a single-center prospective study in the United Kingdom, investigating the all-cause 30-day mortality

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rate of patients with hip fractures during the COVID-19 pandemic. The data collection period started at "day 0," which we considered to be the first day that 50 deaths were reported in the United Kingdom (March 15, 2020).

Inclusion criteria for the study were patients presenting to our unit with radiologically confirmed hip fractures (OTA/AO 31A, 31B, and 31C)[5] or periprosthetic hip fractures (OTA/AO IV).[5] Electronic patient databases (Bluespier, eHandover, CyberLab, and Medway) were used to record data for all patients treated for hip fractures during the data collection period and to extract data for the Control groups. We collected data on patient demographics, Clinical Frailty Scale (CFS), Nottingham Hip Fracture Score (NHFS), time to surgery, operation type, COVID-19 testing, COVID-19 infection status, 30-day mortality, and cause of death.

The NHFS and the CFS are both validated scoring systems.[6,7] The NHFS, which ranges from 0 to 10, is a predictor of 30-day mortality in patients with hip fractures and incorporates the following variables: age, gender, abbreviated mental test score, hemoglobin level on admission, place of residence (institution or other), comorbidities, and evidence of active malignancy in the past 20 years. The CFS, which ranges from 0 to 9, is a predictor of inpatient mortality as well as length of stay and readmission rate in the elderly population. It assesses the patient's overall level of frailty and is recommended by the UK's National Institute for Health and Care Excellence as part of the initial assessment of patients with suspected COVID-19 infection.[8]

Positive COVID-19 status was determined by presence of clinical signs and symptoms of respiratory infection, diagnostic investigation results supporting COVID-19 illness, and a positive result for detection of the SARS-CoV-2 S gene (VIASURE SARS-CoV-2 gene Real-Time PCR Detection Kit, CerTest Biotec) from nose or throat swab samples. COVID-19 status was considered negative in the absence of clinical symptoms or 2 consecutive negative results for detection of the SARS-CoV-2 S gene. The method of testing was in accordance with national Public Health England guidance for COVID-19 testing.[9] Statistical data analysis was conducted using IBM SPSS Statistics and Microsoft Excel software with a 0.05 significance level.

We additionally collected retrospective 30-day mortality data from the same time period in 2018 and 2019 (control groups A and B, respectively), as well as the mean data for the 6 months before the study period (Control group C), to allow for comparison of the results of this study.

RESULTS

During the 30-day data collection period, 43 patients presented to our trauma service with a hip fracture requiring surgical treatment and will subsequently be referred to as the "Study group." In the same period in 2018, our service treated 51 patients with hip fractures (Control group A), and in 2019 we treated 48 patients with hip fractures (Control group B). In the 6 months before our data collection period, the mean monthly number of patients treated was 55.3 (control group C). There was no statistically significant difference in the number of patients presenting during the data collection period (Study group) compared with the same period in the previous 2 years (Control groups A and B) or over the previous 6 months (Control group C) (P = 0.349).

Of the 43 patients in the Study group, 23 (53%) were men and 20 (47%) women. The mean age was 81.6 years (SD 11.3, range 54–100). There was no statistically significant difference with respect to gender (P = 0.456) or age (P = 0.543) between any of the groups. Notably, the results showed that increasing age was a significant independent risk factor for 30-day mortality across all groups (P = 0.003) (Table 1).

A total of 43 operations were performed and details are presented in Table 2.

Seven deaths were recorded in the Study group during the data collection period, resulting in a 30-day mortality rate of 16.3%. Cause of death was collated from death certificates. Four patients were reported to have died due to COVID-19 infection, one due to suspected (but not confirmed) COVID-19 infection and two patients due to aspiration pneumonia. The highest 30-day mortality rate was observed in the Study group at 16.3%. By contrast, the 30-day mortality rates in Control groups A, B, and C were 9.8%, 2.1%, and 4.2%, respectively (Table 3). Statistical analysis showed a significant difference in the 30-day mortality rate between the Study group and each of the Control groups as follows: group A (P = 0.022), group B (P = 0.003), and group C (P = 0.001). Conversely, there was no significant difference in the 30-day mortality rate between the 3 Control groups A, B, and C (Table 4).

In the Study group, 18 of the 43 (42%) patients were tested for COVID-19 infection, and of those, 12 (67%) tested positive, generating a COVID-19 infection rate of 28% in the Study group. Of the 12 patients who tested positive for COVID-19, 4 went on to record 30-day mortality. The presence of COVID-19 infection correlated significantly with 30-day mortality (P = 0.002, odds ratio 2.424) (Table 5). Critically, our results demonstrated that a positive COVID-19 status in the context of hip fracture is a major predictor of 30-day mortality.

The mean time to surgery was 51.2 hours (SD 4.65, range 10.2–128.8 hours), with one statistical outlier (326.7 hours, z = 2.09) excluded from this calculation. The outlier was a patient who presented with a suspected pathological subtrochanteric neck of femur fracture. Delay to surgery was due to time for further radiological investigations and referral to the local bone cancer unit, before definitive surgical fixation. Overall, 60% of patients were treated within the 36 hours target of the Best Practice Tariff as recommended by NHS England[10] (Table 2).

The mean CFS for the Study group was 4.6 (median 4, range 1–7), and the mean NHFS score for the Study group was 5.2 (median 5, range 1–8) (Table 2). Statistical analysis showed no significant correlation between 30-day mortality rate and either CFS (P = 0.971) or NHFS scores (P = 0.124). The predicted 30-day mortality rate for our Study group based on the NHFS ranged from 0.6% to 18.2% (mean 6.6%, median 4.6%). There was no statistically significant difference between the predicted mortality and the observed mortality (P = 0.083).

TABLE 1. Patient Demographics and Mortality Rates of the Study Group and Control Groups A, B, and C

	Study Group: Data From 30-Day Study Period	Control Group A: Data From Same 30-Day Period in 2018	Control Group B: Data From Same 30-Day Period in 2019	Control Group C: Mean Monthly Data From Previous 6 Months	*P*
Total patients	43	51	48	55.3	**0.349**
Gender					
Male	23	13	12	15.7	**0.456**
Female	20	38	36	39.7	
Age (y)					
Mean	81.6	81.6	84.0	81.5	**0.543**
Range	54–100	51–98	59–99	44–101	
SD	11.3	12.3	8.7	11.0	

The Study group consists of the patients presenting in the 30 days since "day 0" of the COVID-19 pandemic in the United Kingdom. Control groups A and B consist of the patients from the same 30-day period in 2018 and 2019, respectively. Control group C consists of the mean monthly data of the patients who presented to our unit in the previous 6 months. No statistically significant difference between the groups with respect to the number of patients, gender, or age is demonstrated.

DISCUSSION

This study was borne from anecdotal observations of possible increased mortality in our hip fracture patients during the COVID-19 pandemic. The aim of our study was to determine if there was indeed a true increase in 30-day mortality among our hip fracture patients and to investigate if this observation could be attributable to COVID-19 infection.

Our results show a significant increase in the 30-day mortality rate in our hip fracture patients in the 30 days since "day 0" of the COVID-19 pandemic in the United Kingdom (March 15, 2020). This study found a 16.3% 30-day mortality rate, which is statistically greater than the same period in 2018, 2019, and over the previous 6 months. This is also higher than the most recent nationally recorded annual 30-day mortality rate of 6.2%.[11]

We found that of the 7 mortalities recorded in the Study group, 4 were COVID-19 positive. Statistically this was sufficient to show correlation between COVID-19 infection status and 30-day mortality. The findings of this study, therefore, highly suggest a positive correlation between COVID-19 infection and 30-day mortality.

The authors reviewed the literature for studies on the hip fracture mortality rate during the COVID-19 pandemic.

In a study based in Northern Italy by Catellani et al,[12] 16 patients presented with COVID-19 infection and proximal femoral fracture, of which 13 proceeded to have surgery. Three of the 16 patients died before surgery because of severe respiratory insufficiency and multiorgan failure, and 4 of the 13 (30.7%) patients died after surgical treatment. Comparatively, the 30-day mortality rate of patients treated surgically in our study was lower at 16.2% (7 of the 43). In the Northern Italy study, the mortality rate of patients with COVID-19 infection and proximal femoral fractures was 43.8% (7 of the 16). By contrast, the 30-day mortality of COVID-19 positive patients in our study was lower at 36% (4 out of 11). Catellani et al found that in 9 of the 13 postoperative patients, improvements in respiratory parameters, physiological ventilation, and overall stability of the patient were observed.

A retrospective multicenter observational study based in Spain by Muñoz et al[13] investigated the mortality rate of 136 patients presenting with hip fractures. One hundred twenty-four (91.2%) patients proceeded to surgery, and 12 (8.8%) were managed nonoperatively. In comparison, all 43 (100%) patients in our study were treated surgically. The mean patient age in the Muñoz et al cohort was 85.3 years, which is comparable to the mean age of 81.6 years in our study.

In the Muñoz et al cohort, 8 of the 12 (67%) patients managed nonoperatively died, and 5 of the 124 (4%) patients treated surgically died, giving a total mortality rate of 9.6%

TABLE 2. Surgical Outcomes and Calculated Nottingham Hip Fracture Score and Clinical Frailty Score of the Study Group

	Study Group
Operations	43
Dynamic hip screw	7
Cannulated screws	3
Hip hemiarthroplasty	15
Intramedullary nail	13
Total hip replacement	1
Revision hip replacement*	4
Time to surgery (hrs)	
Mean	51.2
Range	10.2–128.8
Cases within 36 hours	26 (60%)
Nottingham hip fracture score	
Mean	5.2
Range	1–8
Clinical frailty score	
Mean	4.6
Range	1–7

All operations performed are listed, with most operations being hip hemiarthroplasty or intramedullary nailing. Time to surgery varied greatly, however, 60% of cases were performed within the 36 hours of the Best Practice Tariff. The Nottingham Hip Fracture Score, which ranges from 0 to 10, is a predictor of 30-day mortality and incorporates the following variables: age, gender, abbreviated mental test score, hemoglobin level on admission, place of residence (institution or other), comorbidities, and if any evidence of active malignancy in the past 20 years. The Clinical Frailty Score, which ranges from 0 to 9, is a predictor of inpatient mortality as well as for length of stay and readmission rate in the elderly population.

*Revision hip replacement performed for periprosthetic fracture of total hip replacement.

TABLE 3. Thirty-Day Mortality Rate Across the Four Groups: The Highest Rate was Observed in the Study Group and the Lowest in Control Group B

	Study Group: Data From 30-Day Study Period	Control group A: Data From Same 30-Day Period in 2018	Control group B: Data From Same 30-Day Period in 2019	Control group C: Mean Monthly Data From Previous 6 Months
30-day mortality	7/43	5/51	1/48	2.3/55.3
Percentage	16.3%	9.8%	2.1%	4.2%

(13 of the 136) with a mean follow-up of 14 days. By contrast, the total 30-day mortality rate in our study was higher at 16.2%.

From the study by Muñoz et al, 23 patients tested positive for COVID-19 and 7 patients died, producing a COVID-19 positive mortality rate of 30.4% (7 of the 23). In our study, 11 patients tested positive for COVID-19 and the 30-day mortality rate of these patients was 36% (4 of the 11).

Overall, in comparison to the study by Muñoz et al, our study had a higher mortality rate in both patients treated surgically (16.2% vs. 4%) and in patients with concurrent COVID-19 infection (36% vs. 30.4%).

The findings of the studies from Northern Italy and Spain are compared with our study and presented in **Supplemental Digital Content 1** (see Table 1, http://links.lww.com/JOT/B154). There is notable difference in the total mortality of all studies, however, the study from Northern Italy excluded hip fracture patients without concurrent COVID-19 infection, and so results are not directly comparable. Interestingly, the mortality rate for patients with hip fracture and positive COVID-19 infection is considerably high and similar in all 3 studies as follows: 36.4% (United Kingdom), 43.8% (Northern Italy), and 30.4% (Spain).

In the study from Spain, the total mortality rate during the COVID-19 pandemic was 9.6% at a minimum follow-up of 10 days, exceeding the Spanish national annual 30-day mortality rate of 7.9% in 2018.[14] Our study also demonstrated a higher 30-day mortality rate during the COVID-19 pandemic than the UK national annual recorded in February 2020 (16.2% vs. 6.2%).

Research in the COVID-19 pandemic is emerging at a rapid pace to inform the global community of clinically relevant findings during these uncertain times. Although results may be preliminary, the findings from our study and discussed studies do indicate an increased mortality rate of patients with hip fractures during the COVID-19 pandemic, and importantly, an even higher mortality rate in patients with a hip fracture and concurrent COVID-19 infection.

The authors recognize the limitations of this study.

There are confounding factors to consider. Some patients in the Study group had negative COVID-19 swab results despite high clinical suspicion of COVID-19 infection. However, to maintain objectivity regarding COVID-19 infection status, these patients were not considered COVID-19 positive unless the swab results corroborated the diagnosis. Therefore, the true infection rate in our study and consequently the correlation between COVID-19 infection and 30-day mortality may in fact be higher than observed. Indeed, 2 patients in the Study group had death certification stating COVID-19 as the primary clinical cause of death despite negative swab results in one case and no swab results at all in the other.

NHS England advice at the time of this study was to test only symptomatic inpatients. However, it is known that patients can be asymptomatic carriers of COVID-19 infection. If there is a high prevalence of asymptomatic, and therefore, untested, COVID-19 infections, then this may dilute the significance of our observed correlation between COVID-19 infection status and 30-day mortality.

In response to the pandemic, reallocation of orthopaedic team members to medical specialties and the repurposing of operating theaters to provide Intensive Care Unit capacity, ultimately resulted in a reduction in trauma operating sessions and impacted the provision of trauma services. In addition, staff absences due to illness and government mandated self-isolation and social distancing measures, are all effects of the pandemic that have altered the daily functioning of trauma and orthopaedic departments.

COVID-19 is a novel infectious disease that is attracting significant international research with more data

TABLE 4. Thirty-Day Mortality Rates Compared Between Each of the Four Groups

	Study Group	Control Group A	Control Group B	Control Group C
Study group	—	0.02*	0.003†	0.001†
Control group A	0.02*	—	1.000	1.000
Control group B	0.003†	1.000	—	1.000
Control group C	0.001†	1.000	1.000	—

Statistical analysis *P* value for each comparison is presented.
There was no statistically significant difference in 30-day mortality rate between any of the Control groups.
*Statistically significant difference between the Study group and each of the Control groups ($P < 0.05$) is demonstrated.
†Statistically significant difference between the Study group and each of the Control groups ($P < 0.005$) is demonstrated.

TABLE 5. Binary Logistic Regression Analysis Showed That the Major Predictor of 30-Day Mortality was Positive COVID-19 Infection Status, With W(1) = 7.826; $P = 0.002 < 0.05$, and the Odds Ratio was Exp(B) = 2.424 [CI: 2.061–2.786]

	Mortality	No Mortality
COVID-19 test +ve	4	8
COVID-19 test −ve	1	5
Not tested for COVID-19	2	23
Total	7	36

becoming available on almost a daily basis. Large multicenter and multinational studies such as those organized through collaborative efforts will of course take time. Although we await these higher-powered studies, local studies are essential to help understand the variations we see in our practice.

Patients presenting with hip fractures remain a clinical priority during the COVID-19 pandemic and require urgent surgical intervention. Operative treatment is paramount in reducing patient morbidity and mortality. Although there may be additional risks to patients receiving surgical treatment for hip fractures during the pandemic, COVID-19 infection is not a reason to delay or cancel surgery and the authors advocate that prompt surgical treatment must continue to be delivered. This is because hip fracture surgery improves mobility, pain, physiological ventilation, and overall stability of patients, and ultimately such benefits outweigh the risks.

The findings of our study demonstrated a significant increase in 30-day mortality for our hip fracture patients in the first 30 days of the COVID-19 pandemic in the United Kingdom. In our cohort of hip fracture patients, a positive COVID-19 test was a predictor of 30-day mortality and those who tested positive had a 2.4-fold increase in risk of 30-day mortality. The authors affirm that care must be taken when extrapolating conclusions from single-center studies.

The advent of multicenter and multinational studies will be able to better power such study questions. Not only will this guide our surgical decision making but also help us to better counsel our patients of the risks of surgery during the COVID-19 pandemic.

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