



■ GENERAL ORTHOPAEDICS

30-day outcomes in hip fracture patients during the COVID-19 pandemic compared to the preceding year

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Aims

To establish if COVID-19 has worsened outcomes in patients with AO 31 A or B type hip fractures.

Methods

Retrospective analysis of prospectively collected data was performed for a five-week period from 20 March 2020 and the same time period in 2019. The primary outcome was mortality at 30 days. Secondary outcomes were COVID-19 infection, perioperative pulmonary complications, time to theatre, type of anaesthesia, operation, grade of surgeon, fracture type, postoperative intensive care admission, venous thromboembolism, dislocation, infection rates, and length of stay.

Results

In all, 76 patients with hip fractures were identified in each group. All patients had 30-day follow-up. There was no difference in age, sex, American Society of Anesthesiologists (ASA) classification or residence at time of injury. However, three in each group were not fit for surgery. No significant difference was found in 30-day mortality; ten patients (13%) in 2019 and 11 patients (14%) in 2020 ($p = 0.341$). In the 2020 cohort, ten patients tested positive for COVID-19, two (20%) of whom died. There was no significant increase in postoperative pulmonary complications. Median time to theatre was 20 hours (interquartile range (IQR) 16 to 25) in 2019 versus 23 hours (IQR 18 to 30) in 2020 ($p = 0.130$). Regional anaesthesia increased from 24 (33%) cases in 2019 to 46 (63%) cases in 2020, but ten (14%) required conversion to general anaesthesia. In both groups, 53 (70%) operations were done by trainees. Hemiarthroplasty for 31 B type fractures was the most common operation. No significant difference was found for intensive care admission or 30-day venous thromboembolism, dislocation or infection, or length of stay.

Conclusion

Little information exists on mortality and complications after hip fracture during the COVID-19 pandemic. At the time of writing, no other study of outcomes in the UK has been published.

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Introduction

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, has had a huge impact on healthcare systems, their staff, and the patients they serve. Mortality rates are highest in the older less healthy population, who are also at high risk of hip fracture.¹

COVID-19 could potentially have a double effect on mortality and morbidity; directly on those infected and indirectly by

overwhelming hospitals. The normal prioritization of early surgery for hip fractures is also at risk.

In the UK, advisory restrictions on social activities were announced on 20 March 2020. Shortly thereafter, a “lockdown” was instituted, as many other countries had already done. It was not known if this would reduce overall numbers of those requiring orthopaedic fracture care.

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In Edinburgh, it was reported by Scott et al² that overall orthopaedic trauma referrals reduced by 42% (764 patients), but the number of hip fragility fracture admissions was unchanged compared to 2019. In England, Hampton et al³ published a multicentre study into the effect of lockdown on trauma, this reported 48 hip fractures compared to 43 in the analogous two-week period in 2019.

A reduction in the case load in trauma was also reported by Kenanidis and Tsiridis in Greece, with a nearly 90% reduction in admissions; however, the number of hip fracture admissions reduced similarly.⁴

None of these studies reports outcomes in patients with hip fractures.

A recent, large study by The CovidSurg Collaborative showed a considerable increase in mortality for all forms of surgery in the time of COVID-19 compared to previous studies but did not detail the effect on hip fracture patients.⁵

A PubMed search for 'hip fracture AND COVID-19' found only three studies in addressing mortality in hip fracture patients in the COVID 19 era. A multicentre study from Spain, including 136 hip fracture patients with a mean follow-up of 14 days, showed a mortality rate of 30% (seven patients) for those testing positive for SARS-CoV-2.⁶

In a study from New York, LeBrun et al⁷ reported an overall 12% (seven out of 59 patients) 'inpatient' mortality rate for hip fracture patients. Among the nine patients who tested positive for SARS-CoV-2, mortality increased to 56% (five patients), although the exact duration of follow-up is not clear.

Another New York study, by Egol et al,⁸ compared mortality in patients with hip fractures presenting during the COVID-19 pandemic to the same time in 2019. All cause mortality at 30 days was 3% (three patients) in 2019 compared to 12% (17 patients) in 2020. For those testing positive for COVID-19, this rose to 53% (nine patients).

This study set out to examine the difference in outcomes for hip fracture patients in Queen Elizabeth University Hospital, Glasgow, a major UK centre, at the height of the coronavirus pandemic and to compare with the same period in the preceding year.

Methods

All patients presenting with orthopaedic trauma to our institution are logged on a database prospectively. This work was registered as a departmental audit. Data collection was carried out for the time period of 20 March to 25 April 2020 and the same five-week period in 2019, using electronic patient records and the national imaging system.

We included all patients with an acute AO type 31 A or B hip fracture of any aetiology, including pathological fractures. Patients that were deemed unfit for surgery were included in mortality data. For those already an

inpatient at the time of injury, the time of orthopaedic clerk in was used as the time of admission for this fracture. This allowed direct comparison of timepoints, e.g. time to theatre.

The primary outcome measure was mortality at 30 days. Secondary outcomes included: COVID-19 status, pre- and postoperative pulmonary complications (requiring oxygen support, evidence of acute infective or inflammatory pathology on chest radiograph, evidence of sepsis from the chest); time to theatre; type of anaesthesia; grade of primary operating surgeon; management of fracture; need for admission to intensive care; 30-day rate of venous thromboembolism (VTE) (proven by imaging); dislocation; and deep infection. Length of stay was defined as the date of orthopaedic admission to the date of discharge from hospital or the rehabilitation ward. For patients that had yet to leave hospital at the time of the study, the day of final data collection (28 May 2020) was used as an endpoint to calculate length of stay.

Demographics recorded were age, sex, American Society of Anesthesiologists (ASA) classification, and place of residence at the time of injury.

Data were analyzed using a commercially available statistical software platform, R (R Institute for Statistical Computing, Vienna, Austria).⁹ The Shapiro-Wilk test was used to assess normality. Results are presented as proportions (%), mean values with range, or median values with interquartile ranges as appropriate.

Mann-Whitney U test was used to compare variables between groups with non-parametric data. The chi squared test was used to compare categorical data: Pearson's chi squared test for ordinal data, and Fisher's Exact test for binary data. All p-values < 0.05 were considered to be statistically significant.

Results

Overall, 76 patients with a hip fracture were identified in each of the five-week study periods in 2019 and 2020. The dataset was complete, with the exception of anaesthetic type and pulmonary complications for one patient in 2020. Three patients in each group were not fit for theatre and have no data for operative outcomes. Demographic data are recorded in Table I. There were no significant differences between the groups.

There was no difference in the 30-day mortality rate between the 2019 and 2020 groups. In the 2020 group, 11 (14%) patients had died at 30 days, compared to ten (13%) in the 2019 group. This difference was not significant ($p = 0.341$, Fisher's Exact test).

Within the 2020 group, SARS-CoV-2 ribonucleic acid polymerase chain reaction (PCR) tests were used to assess for COVID-19. Ten (13%) patients tested positive, 44 (59%) were negative, and 21 (28%) were not tested. Of the ten positive cases, one had a positive test before

Table I. Demographic information between groups.

Variable	2019	2020	p-value
Median age, yrs (IQR)	83 (74 to 88)	83 (73 to 87)	0.800*
ASA grade, n			0.240†
1	2	2	
2	18	12	
3	42	51	
4	13	9	
5	0	2	
Sex, n			1.00‡
Female	18	18	
Male	58	58	
Residence at time of injury			0.95‡
Home	58	61	
Residential care	10	11	
Hospital	5	4	

*Mann-Whitney U test.

†Chi squared test.

‡Fisher's Exact test.

ASA, American Society of Anesthesiologists.

surgery. The remaining nine patients became positive at a mean of 25 days (1 to 27) after surgery. Two of these COVID-19-positive patients had died by 30 days (20 to 23) after surgery. The primary cause of death for both was COVID-19.

Pulmonary complications were seen in greater numbers during the pandemic (Table II). In 2020, 15 (21%) patients had postoperative pulmonary complications; almost double the eight (11%) from 2019. This is, however, only an absolute rise of 10% and the difference was not significant ($p = 0.172$, Fisher's Exact test).

At last follow-up, seven patients remained in hospital, five of whom had pulmonary complications (three COVID-19 and two pneumoniae), and data was missing for one patient. Length of stay for these patients was calculated from day of last follow-up.

The median length of stay in 2019 was 12 (7 to 26) days and 11.5 (6 to 22) days in 2020. The difference is not significant ($p = 0.570$, Wilcoxon rank sum test). The remaining data can be seen in Table II.

Discussion

In our study, 30-day mortality was unchanged during the COVID-19 pandemic when compared with an equivalent time period in 2019. Given the frail nature of this elderly population group, it was expected that COVID-19 would increase this figure for 2020. In the COVID-19-positive patients, two out of ten (20%) had died by 30 days after surgery.

A study of Spanish outcomes by Vives et al⁶ had population demographics similar to those of our study population with a mean age of 85 years. In all, 88 patients (75%) of those with a recorded ASA classification were grade III and 75% (102 patients) were female. The overall mortality rate

Table II. Results for 2019 and 2020.

Variable	2019	2020	p-value
Pre-operative pulmonary complication	9	7	0.793*
Postoperative pulmonary complications	8	15	0.172*
Median time to theatre, hours (IQR)	20 (16 to 15)	23 (18 to 30)	0.130†
Anaesthetic type			< 0.001‡
General	49	26	
Local/regional	22	36	
General after failed local/regional	2	10	
Grade of Surgeon			
Consultant	20	20	
Registrar	53	53	
Fracture Type			0.313‡
AO 31 A	31	25	
AO 31 B	45	51	
Management			
Non-operative	3	3	
Dynamic hip screw	26	14	
Short intramedullary nail	2	4	
Long intramedullary nail	7	9	
Hemiarthroplasty	31	40	
Total hip Arthroplasty	7	3	
Long stem hemiarthroplasty	0	2	
Cannulated screws	0	1	
Need for ITU/ventilation	1	0	
30-day outcomes			
VTE	1	0	
Infection	1	2	
Dislocation	1	0	

*Fisher's Exact test.

†Mann-Whitney U test.

‡Chi squared test.

VTE, venous thromboembolism.

in this study was lower at 9.6% (13 patients), but this was at 14 days and makes direct comparison with our results difficult. They had 23 confirmed cases of COVID-19, of whom seven (30%) died.

It is worth considering, that if one further patient tested positive for COVID-19 among the patients who died in our group, the mortality for the disease would also have been 30% (three patients).

The paper from New York by LeBrun et al⁷ looked at outcomes for 59 hip fracture patients over the same period as our pandemic group. Demographics were similar to our groups with a mean age of 85% and 75% (44 patients) being female. The overall mortality of 12% (seven patients) was similar to that in Glasgow, but the mortality in those with COVID-19 was nearly three-times as much as ours at 56% (five patients).⁷ No comparison was made to pre-pandemic times.

The other paper from New York by Egol et al⁸ compared the time frame of February to April 2020 to the same period in 2019. Their overall 30-day mortality of 12% (17 patients) is comparable to our groups but it was a marked increase from 2019 rates of 3% (three

patients). In addition, 53% (nine patients) of those positive for COVID-19 had died by 30-day follow-up, and this increased to 60% (ten patients) if presumptive cases were included.⁸ Data from this study may need cautious interpretation as the study period commenced on 1 February 2020, one month before New York had its first confirmed case of COVID-19.¹⁰

One factor may be that we did not exclude hip fractures for patients under 65 years; unlike the Spanish study by Vives et al⁶ and that of LeBrun et al⁷ from the USA. There were ten patients with hip fractures before the age of 65 years in both our 2019 and 2020 groups. However, the youngest patient with COVID-19 at our institution was 69, and the mean age was 82 years (69 to 93). Given the lack of difference in age between our two cohorts, a larger difference in mortality between the groups would still potentially be expected due to COVID-19. The fact that all of the COVID-19-positive patients were older than 65 may negate the inclusion of the under 65s.

Another potential explanation may be that time to theatre was not significantly different in our two groups (25 vs 27 hours; $p = 0.130$). The study by Vives et al⁶ had a mean time to theatre of 2.4 days, more than twice that of our median. In New York, this was reported as a mean of 1.5 days by LeBrun et al⁷ and 30 hours by Egol et al.⁸ The cancellation of elective theatres meant that it was possible to scale-up trauma operating to offset the increased time taken for patient transfers, deep cleaning of theatres, and the use of personal protective equipment. There was also a drive to increase the use of regional anaesthesia in order to minimize aerosol-generating procedures (endotracheal intubation included), and an resultant increase in patients for whom a general anaesthetic was required after failed regional anaesthesia.

To offset this, we have had up to five trauma theatres running during the pandemic, where usually there would be three trauma theatres during the week and two at weekends. This ability to compensate with increased theatre capacity is critical to avoid delays, which are known to increase mortality in hip fracture patients.¹¹

This is also relevant when looking at the number of patients requiring surgery, which was unchanged between the two comparable years. While in the other UK studies a similar pattern was seen, in Greece, hip fracture decreased in the first phase of lockdown.⁴ However, admissions returned to normal levels over time. It is clearly the case that adequate provision needs to be made for increased time in theatre dedicated to hip fracture care based on normal admission rates. The prioritization of anaesthetists with experience in regional anaesthesia for hip fracture theatres may help minimize failed procedures, which consume time and may be uncomfortable for the patient.

The proportion of operating done by trainees did not change despite the pandemic. With elective surgery

cancelled, training opportunities in trauma are even more important; continuing to train does not appear to affect patient outcomes.

The international study of COVID-19 and surgery published in *The Lancet*⁵ reported a considerable increase in mortality due to viral infection. Overall, 30-day mortality was 23% (268 of 1,128 patients). For those who had pulmonary complications due to COVID-19 infection, this rose to 38% (219 of 577 patients). For all orthopaedic operations, 30-day mortality was 28.8% (86 patients). An ASA score of 3 to 5 and male sex were found to be predictive of mortality. As our hip fracture population was 75% (116 patients) female, this may offer some protective effect despite the mode in our groups being ASA 3.⁵

Of the COVID-19-positive patients, we found only one with a positive result before surgery. The mean time from operation to first positive result was 16 days (1 to 27). It is likely, therefore, that many of these infections were picked up in hospital. Our unit consists entirely of single rooms and admitted only patients with orthopaedic trauma during the pandemic. Hip fracture patients were transferred after an average of nine days to the offsite rehabilitation wards, which consist mainly of multi-occupant accommodation. It is possible that some infections were transmitted after transfer to rehabilitation. This begs the question, is a COVID-19 infection less lethal the longer it occurs after surgery?

False negative rates associated with PCR for COVID-19 have been reported to be 20% and upwards depending on when the test is performed post-exposure.¹² In addition, not all our patients were screened. It is likely that the rate of infection in our patients was higher; again, this makes it difficult to draw conclusions from the data. It also makes definite segregation of COVID-19-positive and -negative patients impossible in rooms with multiple occupancy.

While we also recorded secondary outcomes of VTE, infection, and dislocation, the numbers were too small to be of any value and we have not therefore carried out statistical analysis of these parameters.

In 2019, only one patient was admitted to intensive care, while in the 2020 group, there were none. This differs from the US results⁸ but likely reflects a divergence in practice as even in their non-COVID-19 infected group there was a 17% (18 patients) rate of admission to higher level care.

The retrospective nature of this study is a weakness. Our definition of a patient with COVID-19 was based on PCR testing. As a result, the number of patients with COVID-19 may be artificially reduced. This approach does, however, remove subjectivity from the assessment. The complete 30-days follow-up and identification of all patients using a prospective database is a strength. Comparing mortality to last year allows an objective assessment of the impact of COVID-19 on patients with hip fracture on the whole, irrespective of difficulty with testing.

Hip fractures will continue to occur despite lockdown measures in times of pandemic. Considerable flexibility is required to avoid delays to surgery. COVID-19 infection after admission is an issue and robust isolation of hip fracture patients should be considered. Mortality has been reported to be much higher during the pandemic, though in our unit this has not been shown to be the case. Meta-analysis and large scale database studies will help to elucidate this further.

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- T. Tan: Collected the data.
- W. J. Leach: Designed the study, Edited the manuscript.
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