



Thirty-day mortality and reliability of Nottingham Hip Fracture Score in patients with COVID19 infection

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ARTICLE INFO

Keywords:

COVID-19
Coronavirus
Neck of femur fracture
Hip fracture
Mortality

ABSTRACT

In March 2020 Coronavirus-19 pandemic led to significant changes in operations in healthcare in the United Kingdom with national lockdown measures imposed to help protect the vulnerable and prevent transmission. Those deemed vulnerable fall into the cohort of patients at risk of fragility fractures such as fracture neck of femur (NOF). British Orthopaedic Association released guidelines advising that NOF fractures should continue to be treated urgently.

Aim: Our unit aimed to identify changes in NOF caseload during the national lockdown and identify if Nottingham Hip Fracture Scores (NHFS) were reliable at predicting 30-day mortality in COVID-19 positive patients.

Methods: A retrospective observational study identifying NOF admissions over a 6-week period in 2020 during lockdown period, where demographics, NHFS, and 30-day mortality rates were compared against the same period in 2019.

Results: There was a reduction in NOF admissions by 17.8% (55 vs 67). No significant difference in patient demographics between groups. 30-day mortality rates were not significantly increased in 2020 compared with 2019. COVID-19 positive patients had significantly increased 30-day mortality rates (54%, $p = 0.001$) compared to COVID-19 negative (9.1%, $p = 0.395$) and 2019 (6%).

Discussion: NHFS was not reliable as a predictor for 30-day mortality in COVID-19 positive patients. Our unit reports increased mortality rates in NOF patients with covid-19 infection. This adds to the building evidence that COVID-19 is an independent predictor for mortality in NOF patients irrespective of NHFS. This should be communicated to patients who are admitted to hospital with NOF and units should continue with efforts to prevent hospital acquired COVID-19 infection.

1. Introduction

The rise of the novel coronavirus-19 in the United Kingdom led to the most significant and fundamental change in the operation of the National Health Care System since its inception. This led the Government to implement guidelines for the public to restrict their movement and contact with others and those deemed at high risk to shield and isolate at home for 12 weeks.

This ultimately had an impact on hospital admission to Orthopaedic departments¹ and there were fundamental changes to how patients with injuries were treated with the British Orthopaedic Association releasing the BOAST COVID-19 guidelines with recommended changes to practice.² In these guidelines proximal femoral fractures were noted to be an

urgent condition requiring surgical priority and the need to maintain care standards for these patients was necessary.

With over 66,000 cases a year in the UK³ proximal femur fractures is a major part of acute work for orthopaedic departments. The demographics for patients suffering proximal femoral fractures overlap with those deemed at high risk from COVID-19 infection. With evidence indicating that COVID-19 infection leads to increased perioperative mortality rates⁴ there is a need to identify risk factors that are linked with increased mortality. The Nottingham hip fracture score^{5,6} is a validated predictor of 30-day mortality for NOF patients but its use has not been studied in COVID-19 positive patients.

Our unit looked to identify the impact of the pandemic on our Neck of Femur fracture caseload during the period of strictest lockdown to

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<https://doi.org/10.1016/j.jor.2021.07.009>

Received 17 May 2021; Accepted 11 July 2021

Available online 16 July 2021

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add to the building evidence of how the COVID-19 pandemic has impacted proximal femoral fracture patients. We also aimed to identify validity of Nottingham Hip Fracture Scores in 30-day mortality prediction when in presence of COVID-19 infection.

2. Methods

In this retrospective observational cohort study following approval by the research ethics committee of our organization, and using the hospital's neck of femur database, we identified all patients admitted with neck of femur fracture during the lockdown period. More specifically from 23rd March to May 12, 2020. Data collected from the same 6-week period in 2019 as a control. Inclusion criteria were patients older than 60 years admitted with proximal femoral fracture. Periprosthetic, mid shaft and distal femur fractures were excluded.

The detailed records and x-rays of all patients meeting the eligibility criteria were accessed. Demographic and epidemiological data taken from our institutions Hip Fracture Database along with electronic patient records to confirm injury, COVID-19 infection status and treatment. Details regarding the patients' COVID status, age, sex, mental score, hemoglobin, comorbidities, usual residence, admission length, discharge destination side and type of fracture were recorded. In addition, 30-day mortality and NHFS were calculated and recorded for all patients.

The 2019 group was used as control and the 2020 patients were divided into two groups positive and negative for COVID, both of those groups were assessed against the 2019 control.

2.1. Statistical analysis

Descriptive statistics were performed for all variables measured, including kurtosis and skewness. Quantitative variables were calculated as median and standard deviation, or median and range, while qualitative variables were presented as frequency counts and percentages. The difference between medians of quantitative data was measured using non-parametric tests (Mann-Whitney U). Quantitative data were assessed using Chi2 tests (Pearson and Fisher's). A p-value of <0.05 was considered statistically significant. Statistical analyses were performed with the SPSS software (IBM, version 26).

3. Results

A total of 122 patients met the inclusion/exclusion criteria of the study, 67 from the 2019 period and 55 from the COVID year. Patients in 2020 cohort underwent COVID-19 testing by RT-PCR if showed signs and symptoms as per testing protocols at the time. Patients were divided into two groups, COVID negative (n = 44), deemed to be those with negative PCR test (n = 27) and those asymptomatic with no test (n = 17), and those with a positive COVID-19 PCR test (n = 11). Those with no test were deemed COVID-19 negative and included in that cohort for analysis.

The median age of all the 2019 patients was 84 years (SD: ± 9.37), 76.1% were female. From the 2020 patients, the average age of the negative group was 86 years (SD: ± 7.8), 72% female, and of the positive 90 years (SD: ± 7.6) 45% female. There was no significant difference in the age between the patients, but the positive patients tended to be male. Comparing admission length between 2019 and during the COVID period this was significantly less both for negative (p = 0.001) and positive patients (p = 0.029). [Table 1](#).

The postoperative discharge was similar between 2019 and negative patients (p = 0.461) but significantly different for COVID positive patient (p = 0.013). The 2 most important differences in the two periods were in hospital mortality rates in 2020 (36.4%) compared to 2019 (4.5%) and the discharge to either home or hospital but not to residential or nursing care. [Table 2](#).

Overall, there were no significant differences between the fracture

Table 1
Demographic spread of patients during two periods.

	2019, n = 67	negative, n = 44	positive, n = 11
age (year, median)	84 (SD:9.375)	86 (SD:7.85), p = 0.655	90 (SD:7.653), p = 0.074
sex female	51 (76.1%)	32 (72.7%) p = 0.426	5 (45.5%), p = 0.46
admission length (days)	13 (11.28)	5 (5.9), p = 0.001	7 (7.35), p = 0.029
side right	35 (52.2%)	15 (16.4%), p = 0.074	8 (55.1%), p = 0.175

side and type between all groups. [Table 3](#).

Number of patients with ASA grade 3 and 4 was 40/54 (74%) in 2020 compared with 54/67 (80.6%) in 2019.

Similarly, the overall NHFS was similar between the 2019 and the negative patients (p = 0.635) and the positive patients (p = 0.092). Of all the components of the NHFS the AMTS was significantly worse for the positive patients (p = 0.02) but similar between the 2019 and negative patients (p = 0.566). Despite the fact that the total NHFS was similar between groups 30-day mortality was worse for the positive patients (54.5%, p = 0.001) compared to 2019. Negative patients on the other had had similar 30-day mortality (9.1%, p = 0.395) compared to the 2019 group (6%). These findings suggest that NHFS is not reliable for COVID positive patients. [Table 4](#).

4. Discussion

At our unit there was a significantly increased mortality rate when comparing COVID-19 positive patients with negative patients and to the control cohort in 2019. Our in hospital 30-day mortality rate for COVID-19 positive patients was 54.5% and 9.1% in COVID-19 negative patients.

There have been many publications recently from single centre and multicenter study showing increased mortality rates in NOF patient with COVID-19 positive infection⁷⁻¹³ reporting between 30 and 35% mortality compared to 7 and 10% in non-COVID positive patients. The largest from Dupley et al.⁹ involving 64 COVID-19 positive patients showed 32.8% 30-day mortality. A recent Meta-analysis by Lim et al.,¹⁴ found the mortality rate to be 28% in COVID-19 positive patients compared to 10.3% in COVID-19 negative patients. Our units mortality rates for COVID-19 positive are higher but similar to the COVID-19 negative rates.

The multicenter study from Scotland⁷ has reported on the management of Neck of Femur (NOF) patients during the lockdown period. They report increased risk of 30-day mortality in COVID-19 positive patients compared with non COVID-19 patients, which is in line with our findings, they showed no significant differences in epidemiological presentations in 23-days prior to implementation of lockdown guidelines in Scotland. The IMPACT group will release further analysis including data from multiple centers across the UK. Our study follows this with no significant changes in the demographics of patients presenting over our two study periods.

The study from Sobti et al.¹⁰ suggests that there was no difference in mortality rates when compared to pre pandemic period in 2020 and 2019. They report an increase in mortality rates from 4.24% in similar period in 2019 to 8.46% in 2020 but this was deemed not statistically significant with a p value of 0.15.

Our study analyses the Nottingham Hip Fracture Score^{5,6} and despite similar scores between the 2019 (NHFS = 5), COVID negative (NHFS = 5) and COVID positive patients (NHFS = 6), mortality rates were significantly different for COVID positive patients (54.5%, p 0.001) indicating it is not valid for assessment of 30 day mortality in the COVID positive patient. For COVID-19 negative patients the NHFS was a good predictor of 30-day mortality rate with the median scores of 5 corresponding to a 30-day mortality rate of 6.9%.

The NHFS being slightly higher in the COVID-19 positive group but

Table 2
Discharge Destination of patients following treatment.

	Deceased	Own home/sheltered housing	Residential care	Nursing care	Rehabilitation unit	other	Total
2019, n = 67	3 4.50%	44 65.70%	6 9.00%	1 1.50%	10 14.90%	3 4.50%	67 100.00%
negative, n = 44, p = 0.461	2 4.50%	25 56.80%	4 9.10%	2 4.50%	11 25.00%	0 0.00%	44 100.00%
positive, n = 11, p = 0.013	4 36.40%	4 36.40%	0 0.00%	0 0.00%	3 27.30%	0 0.00%	11 100.00%

Table 3
Injury type distribution

	Intertrochanteric - grade A1/A2	Intertrochanteric - grade A3	Subtrochanteric	Intracapsular - undisplaced	Intracapsular - displaced
2019, n = 67	33 49.30%	5 7.50%	2 3.00%	9 13.40%	18 26.90%
negative, n = 44	15 34.10%	2 4.50%	0 0.00%	3 6.80%	24 54.50%
positive, n = 11	5 45.50%	0 0.00%	1 9.10%	1 9.10%	4 36.40%

Table 4
Nottinghamd Hip fracture constituents, median scores and 30-day mortality rates for cohorts.

	2019, n = 67	negative, n = 44	positive, n = 11
Comorbidities >2	40 (62.5%)	21 (47.7%), p = 0.1	7 (63.6%), p = 0.535
nursing home/ institutional residence	14 (21.2%)	10 (22.7%), p = 0.515	4 (35.4%), p = 0.230
AMTS median	10 (SD: 3.6)	10 (3.5), p = 0.566	5 (3.8), p = 0.02
Malignancy	13 (19.4%)	11 (25%), p = 0.319	0 (0%), p = 0.115
Hb	119 (SD:17.7)	127 (SD: 15.7), p = 0.143	119 (SD: 15.9), p = 0.672
NHFS	5 (SD:1.5)	5 (SD:1.6), p = 0.635	6 (SD:1.4), p = 0.092
30 days mortality	4 (6%)	4 (9.1%), p = 0.395	6 (54.5%), p = 0.001

the presence of COVID-19 infection led to a higher predictor of 30day mortality. The most significant factor found in COVID positive patients was a reduced AMTS score in COVID positive patients (Median = 5) compared COVID negative (Median = 10) and 2019 cohorts (Median = 10). Reduced AMTS may have been a symptom of perioperative COVID-19 infection due to hypoxia or may be a marker that these patients were more frail and at a higher risk of postoperative mortality. The difference in AMTS score will have been affected by the low number in the COVID-19 positive group, which influence the score.

Kayani et al.⁸ identified additional risks factors for 30-day mortality in patients with COVID-19 infection such as positive smoking status and >3 comorbidities. Dupley et al.⁹ suggest those wit previous myocardial infarction had high mortality risk as well as identifying high risk if male.

Our institution saw a 17.8% (67 vs 55) reduction in NOF admissions during the 6-week study period compared to 2019. This was not statistically significant and compares similarly with the Scottish IMPACT study,⁷ Sobti et al.¹⁰ and Hampton et al.¹ who note no significant differences in admission rates during the lock down period. This indicates that the effects of the countrywide lockdown effort made a small impact in incidence of NOF during these study periods. This highlights the typical mechanism of injury, typically fall in elderly at home, limiting the general populations movement outside of the home did not significantly reduce the caseload. Further National studies may reveal a significant reduction in NOF incidence during 2020 compared with previous years.

Our institution saw no change in demographics (Table 1) in NOF

with just over 70% female and 30% male. Average ages were similar. Fracture side and type also did not vary significantly between the cohorts indicating that the lockdown period had little affect on presentation of NOF patients and their characteristics.

COVID-19 positive patients tended to be male (54.6%) and were older (AVERAGE 90years p 0.07) compared with COVID negative and 2019 cohorts.

Those dying due with COVID infection tended to be male. This is in line with studies showing male susceptibility COVID-19 infection.¹⁵ Our institution did not see a change in patients who were more high risk for surgery, which mirrors that of the current literature.⁷⁻¹³

Admission length was reduced significantly during the lockdown period for COVID positive (7 (7.35) p = 0.029), COVID negative (5 (5.36) p = 0.001) compared with 2019 (13 (11.28)). This is due improvement to our institution discharge pathways and focus on reducing hospital stays to reduce potential risk to patients acquiring hospital acquired COVID-19 infection. There was no statistically significant increase in 30-day mortality rate (9.1% in 2020 compared with 6% 2019) associated with this greatly reduced length of stay. These patients in the 30-day follow up period did not subsequently test positive for COVID-19. This indicates discharges were made appropriately, safely and achieved the aim of protecting COVID negative patients from hospital acquired COVID-19 infection in the perioperative period. Majority of other research in this area has shown prolonged length of stay in patients especially those with COVID-19 infection.

Our institution used twice daily Multidisciplinary team (MDT) discharge meetings to achieve safe discharge for these patients. It has been well studied the involvement of a MDT for NOF patients improves outcomes.^{16,17} The need to maintain this organisation and MDT input during further waves of the pandemic to ensure timely but safe discharge is important to help protect these high-risk patients.

4.1. Limitations

Owing to the retrospective nature of the study with data from only one hospital this leads to regional variance in infection burden and demographic differences that may not be attributable to other areas of the country. Our study has low number of patients in each cohort compared to bigger multicentre studies, which leads to skewing of analysis.

There were significant changes to our institutions COVID testing policy in line with national guidance throughout the study period due to the dynamic and changing nature of the COVID-19 pandemic. Patients initially were only tested if symptomatic. Routine testing on admission came in to place towards the end of April 20, 20.¹⁸ This potentially led to asymptomatic patients being missed at the beginning of the study

period.

5. Conclusion

Our study reports the experience our unit had during the initial wave of the COVID-19 pandemic reinforcing the consensus that COVID-19 infection in hip fracture patients is a major risk factor for mortality in the perioperative period. This adds to the volume of research around the affects of the COVID-19 pandemic on proximal femoral fracture patients and the need for careful management of these pathways to avoid COVID-19 infection in these patients. The Nottingham Hip Fracture Score was deemed not a valid tool for predicting 30-day mortality rates in COVID-19 positive patients. There should be emphasis of protecting these high-risk patients from in-hospital infection and maintaining Hip fracture standards with early MDT input to ensure swift and safe discharge. More research is needed into the effect of the pandemic on the neck of femur population long term and the effects it continues to have on Neck of Femur services in the face of the on going pressures to health services.

Adam Fell: Data Collection, Data Analysis, Manuscript writing and editing, Khalid Malik-Tabassum: Study design, Data collection, Stephen Rickman: Data Collection, Georgios Arealis: Data Collection, Data analysis, Manuscript writing and editing.

Ethics

This research article was approved by the East Kent Research and Innovations Ethics committee in line with data protection guidelines. Reference 2020/GAP/09.

CRedit authorship contribution statement

Adam Fell: Data collection, Formal analysis, Writing – review & editing. **Khalid Malik-Tabassum:** Study design, Data collection. **Stephen Rickman:** Data Collection. **Georgios Arealis:** Data Collection, Formal analysis, Writing – review & editing.

Declaration of competing interest

All Authors have no financial or institutional conflicts of interest to declare.

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