

The Effect of COVID-19 on 30-Day Mortality Rates Amongst Fragility Hip Fracture Patients

C. Medlar ¹, C. Downey ¹, P. O'Kelly ², B. Murphy ³, J.F. Quinlan ¹

1. Department of Trauma and Orthopaedic Surgery, Tallaght University Hospital, Dublin 24, Ireland.
2. Department of Nephrology and Transplantation, Beaumont Hospital, Dublin 9, Ireland.
3. Department of Orthopaedic Surgery, St. Vincent's University Hospital, Dublin 4, Ireland.

Abstract

Aim

Fragility hip fracture patients have always been vulnerable to high rates of short term mortality, an issue that may have been exacerbated by the ongoing COVID-19 pandemic. To date, published data regarding Irish hip fracture patients in the era of COVID-19 is limited. This study aims to assess the effect of COVID-19 on 30-day mortality rates amongst a group of Irish hip fracture patients. Additionally, patient demographics, length of stay, admission haematological parameters, fracture type and surgical procedure will be assessed.

Methods

A multicentre, observational, retrospective study of hip fracture patients (n = 1,017) admitted to six Dublin teaching hospitals during the COVID-19 pandemic (4th February to 9th July 2020) was performed. For comparative purposes, equivalent data was retrospectively collected relating to hip fracture patients admitted to the same six teaching hospitals during the same time period in 2019.

Results

481 patients were admitted during the specified timeframe in 2020, compared with 536 in 2019. The mean patient age was 77.6 years and 65.9% of patients were female. There was no statistically significant overall difference in 30-day mortality rates between the study and control groups, at 5.4% in 2020 and 4.3% in 2019 (p=0.338). There was an insignificant decrease in mean length of stay (17.85 days in 2020 vs. 18.82 days in 2019; p=0.106). Advancing age (p=0.021), male gender (p=0.019), low admission haemoglobin (p=0.024) and high admission white cell count (p=0.019) were all associated with increased 30-day mortality.

Conclusion

We found no significant difference in 30-day mortality rates amongst our cohort of hip fracture patients at the height of the COVID-19 pandemic in Ireland. Advancing age, male gender, anaemia at admission and leucocytosis at admission were associated with increased 30-day mortality. The continuation of COVID-19 related safety protocols in the treatment of hip fracture patients is essential in maintaining a safe hip fracture service.

Introduction

SARS-CoV-2 (COVID-19), a viral illness first identified in Wuhan, China in December 2019 and spread by respiratory droplets, results in a wide spectrum of disease severity including critical illness and resultant death. Its symptomatology comprises fever, fatigue, cough, shortness of breath and a loss of taste/smell ^{1,2}. The COVID-19 pandemic has stretched the limits of healthcare systems worldwide and has restructured the manner in which orthopaedic trauma care is delivered.

Government-led restrictions on movement and population activity have assisted in curbing the spread of COVID-19 infection, although their effect on the incidence of hip fractures in Ireland is not yet known. In 2020, there were 3,666 hip fractures registered with the Irish Hip Fracture Database (IHFD) ³. 67,302 hip fractures were registered in the United Kingdom (UK) in 2019, with a reported 30-day mortality rate of 6.5% ⁴.

COVID-19 infection conveys an overall case fatality rate of 0.5–2.8%, with significantly higher rates (3.7–14.8%) seen amongst elderly patients ⁵. Being of male gender and possessing co-morbidities such as hypertension, diabetes mellitus, chronic obstructive pulmonary disease, cardiovascular disease, and cerebrovascular disease place infected patients at greater risk of adverse outcomes ⁶⁻⁸. Hip fracture patients are often of older age and, therefore, likely suffer from a greater number of co-morbid conditions, placing this already fragile cohort of patients at high risk for adverse COVID-19 related outcomes ⁹. Worldwide, there has been a substantial increase in hip fracture mortality rates owing to concomitant COVID-19 infection ¹⁰.

The primary aim of this study is to quantify and compare 30-day mortality rates amongst a cohort of hip fracture patients before (2019) and during the COVID-19 pandemic (2020). We aim to examine the effects of pandemic-related disruptions to routine standard-led hip fracture care. The study's secondary aim is to explore the significance of patient demographics, haematological parameters, fracture type and surgical procedure in predicting short term mortality rates and COVID-19 infection in hip fracture patients.

Methods

Following an increase in COVID-19 cases nationwide, Ireland entered a period of strict 'lockdown' with restrictions on social gatherings and non-essential travel. This lockdown period lasted for fifty-two days, from March 27th to May 18th, 2020. A retrospective, multicentred analysis was carried out to assess 30-day mortality rates amongst hip fracture patients admitted to six teaching hospitals across Dublin, Ireland during this period, as well as the fifty-two days before and after these dates. Recorded 30-day mortality rates were compared with those of hip fracture patients admitted to these teaching hospitals during the same time period in 2019. Patients' length of stay was also assessed, being defined as the period from admission to discharge from one of the included orthopaedic teaching hospitals.

Included hip fracture patients were required to have been admitted to one of six teaching hospitals between the dates of February 4th and July 9th, 2020. For each hip fracture patient, 30-day mortality and length of stay were assessed. Patient admitted with a periprosthetic hip fracture, or with a hip fracture outside the aforementioned dates, were excluded.

Within the patient cohort of one of the included teaching hospitals ('Hospital A'), a separate single-centred extended analysis was performed. Considered fracture types included intracapsular neck of femur fractures, intertrochanteric and subtrochanteric fractures. Patients' admission haematological parameters, fracture type, surgical procedure, and COVID-19 status (where applicable) were analysed and compared with patients admitted in 2019. Patients were deemed to have tested positive for COVID-19 infection if any nasopharyngeal PCR SARS-CoV-2 test during their inpatient stay returned a positive result.

A logistic regression model was used for the multivariable analyses of collected patient data. Stata SE (version 16, College Station, Texas) was used, with significance being determined as the probability of a type one error occurring being less than 5% ($p < 0.05$). Ethical approval was sought and received from the research ethics committee of the included 'Hospital A' teaching hospital prior to commencement of the study.

Results

Across the six teaching hospitals, a total of 481 hip fracture patients were admitted during the 2020 study period, compared with 536 patients in 2019. The 2019 and 2020 patient groups had an average age of 78.6 years and 77.6 years, respectively. Of the 481 hip fracture patients admitted during the 2020 time period, 26 (5.4%) died within thirty days of admission, compared with 23 (4.3%) of 536 patients admitted during the same period in 2019 ($p = 0.338$). The average time to death for the 2019 and 2020 hip fracture groups was 10.45 days and 13.27 days, respectively. There was no significant difference in the mean length of stay between 2019 and 2020 hip fracture patients (Mann-Whitney Test; $p = 0.106$). These results are presented in *Table 1* below. Across the six included teaching hospitals, 30-day mortality was associated with advancing age (OR 1.094; 95% CI 1.048-1.142; $p = 0.000$) and male gender (OR 2.203; 95% CI 1.139-4.258; $p = 0.019$), as outlined in *Table 2*.

The 2019 'Hospital A' group included 79 patients with 82 hip fracture patients admitted to 'Hospital A' during the same time period in 2020. Only two of forty-five patients tested for COVID-19 in the 2020 'Hospital A' group recorded a positive result, which was too few for statistical analysis. There was no significant difference in 30-day mortality rates observed between 2019 and 2020 'Hospital A' hip fracture patients. Advancing age ($p = 0.021$), low admission haemoglobin (Hb) level ($p = 0.024$) and high admission white cell count (WCC) ($p = 0.019$) were associated with 30-day mortality. Patient gender, admission C-reactive protein (CRP) level and fracture side were not predictive of 30-day mortality amongst 'Hospital A' hip fracture patients. Fracture type and surgical procedure performed were also examined, with no significant difference observed between 2019 and 2020 patients (see *Table 3*).

Dublin Teaching Hospital*	Survival at 30 days - 2019 (%)	Death at 30 days - 2019 (%)	Total - 2019	Survival at 30 days - 2020 (%)	Death at 30 days - 2020 (%)	Total - 2020
BH	101 (95.3)	5 (4.7)	106	104 (92.0)	9 (8.0)	113
CHB	83 (97.6)	2 (2.4)	85	71 (97.3)	2 (2.7)	73
MMUH	55 (96.5)	2 (3.5)	57	44 (95.6)	2 (4.4)	46
SJH	49 (98.0)	1 (2.0)	50	39 (97.5)	1 (2.5)	40
SVUH	149 (93.7)	10 (6.3)	159	120 (94.5)	7 (5.5)	127
TUH	76 (96.2)	3 (3.8)	79	77 (93.9)	5 (6.1)	82
Total	513 (95.7)	23 (4.3)	536	455 (94.6)	26 (5.4)	481

Table 1: 30-Day Mortality in hip fracture patients across six teaching hospitals; 2019 vs. 2020.

(*BH = Beaumont Hospital, CHB = Connolly Hospital Blanchardstown, MMUH = Mater Misericordiae University Hospital, SJH = St. James's Hospital, SVUH = St. Vincent's University Hospital, TUH = Tallaght University Hospital)

Variable	Odds Ratio	95% confidence interval	P-value
Age	1.094	1.053 - 1.135	<0.001*
Male sex	2.187	1.215 - 3.936	0.009*
Year 2020	1.333	0.741 - 3.399	0.338
Constant	0.000	0.000 -	0.328

Table 2: Logistic regression model displaying predictors of 30-day mortality across the 6 included hospitals (*significant p-value)

Variable	Odds Ratio	95% confidence Interval	P-value
Age	1.233	1.032 - 1.472	0.021*
Male Gender	3.168	0.381 - 26.369	0.286
Year 2020	1.837	0.167 - 20.181	0.619
Admission Hb	0.304	0.109 - 0.853	0.024*
Admission WCC	1.735	1.095 - 2.752	0.019*
Admission CRP	1.011	0.988 - 1.034	0.360
Left sided	5.193	0.292 - 92.257	0.262
Surgical procedure			
Arthroplasty	Reference	-----	-----
IM Nail	1.817	0.069 - 47.928	0.721
Dynamic Hip Screw	0.969	0.029 - 32.414	0.986
Fracture type			
Neck of Femur	Reference	-----	-----
Intertrochanteric	0.394	0.013 - 12.091	0.594
Subtrochanteric	5.448	0.068 - 439.453	0.449

Table 3: Logistic regression model displaying predictors of 30-day mortality at TUH (*significant p-value)

Discussion

Hip fracture patients are typically of advancing age with multiple co-morbidities and as such, are exposed to considerable rates of short-term mortality. Given the spread of COVID-19 infection, and with consideration for the susceptibility of hip fracture patients, existing treatment pathways have undergone important alterations. This study's primary aim was to assess the impact of the COVID-19 pandemic on 30-day mortality rates amongst a cohort of hip fracture patients (n = 1,017).

The IHFD 2020 national report highlights an inpatient mortality rate of 28% in 2020 for seventy-four hip fracture patients with a confirmed diagnosis of COVID-19 infection, compared with an overall inpatient mortality rate of 5% in 2019³. In the UK, the 30-day mortality rate amongst hip fracture patients was 6.5% in 2019⁴. Worldwide, strong evidence exists demonstrating that concurrent COVID-19 infection in hip fracture patients considerably increases 30-day mortality rates. One study revealed an increase in 30-day mortality rates to 50% amongst fragility hip fracture patients testing positive for COVID-19 infection¹¹. Dupley et al. supported these findings, documenting a 32.8% 30-day mortality rate amongst COVID-19 positive hip fracture patients, with greater mortality rates observed in patients with previous myocardial infarction¹². There is, however, conflicting evidence as to whether non-COVID-19 infected hip fracture patients are also exposed to an elevated 30-day mortality rate secondary to service interruptions of established hip fracture standard-led care¹³⁻¹⁵. Barker et al. found that COVID-19 indirectly increased the rate of 30-day mortality amongst *non*-COVID-19 infected hip fracture patients, from 8.5% in 2019 to 13.8% in 2020¹⁶. Our study demonstrates that, amongst non-COVID-19 infected hip fracture patients, the COVID-19 pandemic did not significantly increase 30-day mortality rates (5.4% in 2020 vs. 4.3% in 2019; p=0.338). Increased 30-day mortality rates in the era of COVID-19 (from 2.2% in 2019 to 8.3% in 2020) have been noted amongst hip fracture patients in Ireland¹⁷.

Hip fractures often affect individuals of advancing age, commonly a result of osteoporotic disease processes. Such findings were supported by this study, wherein a logistical regression model found that 30-day mortality for all included patients, across both 2019 and 2020 patient groups, increased with advancing age (OR 1.094; 95% CI 1.048-1.142). 65.9% of included hip fracture patients were female, although male patients were exposed to a greater risk of inpatient mortality when compared with female patients (OR 2.203; 95% CI 1.139-4.258). These findings are in keeping with published literature, with advancing age and male gender being predictive of inpatient mortality amongst hip fracture patients¹⁸.

During the initial months of the COVID-19 pandemic (February 4th to July 9th, 2020), 481 patients were admitted with a fragility hip fracture across the six included teaching hospitals. A total of 536 patients were admitted to these institutions during the same timeframe in 2019. This slight reduction in the numbers of hip fracture admissions is likely due to an overall curtailment of physical activity levels amongst vulnerable individuals. Despite widespread advice to remain at home, patients continued to sustain hip fractures. Scottish trauma units reported an overall reduction in musculoskeletal trauma cases, but a relative increase in hip fracture incidence following the onset of the COVID-19 pandemic¹⁹.

Despite the disruption caused to hip fracture care pathways during the COVID-19 pandemic, patients within our cohort admitted in 2020 (n=481) had a mean length of stay of 16.4 days. This compares favourably with 2019 patients (n=536), who had a mean length of stay of 17.2 days (p=0.106). Similar studies elsewhere have produced comparable results, with the pandemic failing to significantly affect the length of stay of hip fracture patients^{14,20}. Hall et al. found that during the COVID-19 pandemic, the mean length of stay for hip fracture patients reduced to 7.8 days from a pre-pandemic figure of 11.3 days²¹.

This study's secondary aim was to further analyse a subset of patients admitted to one included hospital ('Hospital A'), examining patient demographics, admission haematological parameters, fracture type and surgical procedure. Year of admission (2019 vs. 2020) was not a significant predictor of mortality amongst 'Hospital A' hip fracture patients. Additionally, male gender is a less significant predictor of mortality within this group. There were no statistically significant associations between 30-day mortality rates and fracture type/surgical procedure in 'Hospital A' patients. All other examined variables were not significantly predictive of 30-day mortality (as in *Table 3*).

Advancing age was a significant predictor of 30-day mortality amongst 'Hospital A' patients, as were low admission Hb levels and a high admission WCC. Prior studies have examined the relationship between admission haematological parameters and mortality amongst hip fracture patients. Anaemia at admission is strongly linked with short-term mortality as well as being predictive of a prolonged inpatient stay²²⁻²³. Evidence for the association between high admission WCC and short-term hip fracture mortality is not as well established. One large 2017 study in the UK demonstrated that *both* high and low admission WCC's were significantly associated with 30-day mortality in hip fracture patients²⁴. Hip fracture patients with a low Hb level and/or high WCC at admission may benefit from optimisation of their haemoglobin level and/or antimicrobial therapy in the peri-operative period. Admission haematological parameters can be utilised as pre-operative predictors of short-term mortality in hip fracture patients.

In light of the COVID-19 pandemic, new peri-operative and ward-based protocols for the management of all surgical patients have been introduced. Such protocols involved the mandatory COVID-19 testing of all operative patients alongside more frequent and intense cleansing of theatre space between cases. Orthopaedic surgeons are known to be exposed to a high level of COVID-19 infection when treating hip fracture patients and as such, the continued implementation of these preventative measures is essential in delivering efficient, high-quality hip fracture care²⁵.

Limitations of this study include its retrospective design and a lack of available data pertaining to 'time to surgery' during the COVID-19 pandemic. During the study period, Ireland's social restrictions and hospital protocols were in their infancy and have since become more streamlined. Patients admitted early in this period were therefore not universally tested for COVID-19 as this only later became routine practice.

This therefore resulted in too few confirmed COVID-19 positive patients for accurate statistical analysis. Data pertaining to the number of periprosthetic hip fractures admitted to the included hospitals (excluding 'Hospital A') during the specified timeframe was unavailable.

The ongoing COVID-19 pandemic has not impacted 30-day mortality rates amongst our cohort of fragility hip fracture patients admitted to six Dublin teaching hospitals, representing their capacity to maintain efficient hip fracture services without affecting short-term mortality rates. Advancing age, low haemoglobin levels at admission and high admission white cell counts are all predictive of 30-day mortality. Continued caution must be taken when treating hip fracture patients during the era of COVID-19 to help minimise nosocomial viral spread amongst this vulnerable patient group.

Keywords: Hip Fracture; Fragility Hip Fracture; COVID-19; SARS-CoV-2; 30-Day Mortality; Short-Term Mortality

Declaration of Conflicts of Interest:

There are no conflicts of interest to declare.

Corresponding Author:

Conor Medlar

Tallaght University Hospital,

Dublin 24.

E-Mail: conormedlar@gmail.com

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