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ORIGINAL PAPER

Thirty-day mortality following surgical management of hip fractures during the COVID-19 pandemic: findings from a prospective multi-centre UK study

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Abstract

Purpose Thirty-day mortality of patients with hip fracture is well researched and predictive; validated scoring tools have been developed (Nottingham Hip Fracture Score, NHFS). COVID-19 has significantly greater mortality in the elderly and comorbid patients which includes hip fracture patients. Non-operative treatment is not appropriate due to significantly higher mortality, and therefore, these patients are often exposed to COVID-19 in the peri-operative period. What is unclear is the effect of concomitant COVID-19 infection in these patients.

Methods A multicentre prospective study across ten sites in the United Kingdom (responsible for 7% of hip fracture patients per annum in the UK). Demographic and background information were collected by independent chart review. Data on surgical factors included American Society of Anesthesiologists (ASA) score, time to theatre, Nottingham Hip fracture score (NHFS) and classification of fracture were also collected between 1st March 2020 and 30th April 2020 with a matched cohort from the same period in 2019.

Results Actual and expected 30-day mortality was found to be significantly higher than expected for 2020 COVID-19 positive patients (RR 3.00 95% CI 1.57–5.75, $p < 0.001$), with 30 observed deaths compared against the 10 expected from NHFS risk stratification.

Conclusion COVID-19 infection appears to be an independent risk factor for increased mortality in hip fracture patients. Whilst non-operative management of these fractures is not suggested due to the documented increased risks and mortality, this study provides evidence to the emerging literature of the severity of COVID-19 infection in surgical patients and the potential impact of COVID-19 on elective surgical patients in the peri-operative period.

Keywords Hip fracture · COVID-19 · Trauma · Hip surgery

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Introduction

The COVID-19 outbreak is an ongoing global pandemic caused by the SARS (severe acute respiratory syndrome) Cov-2 virus. Initially identified in Wuhan, China, it has rapidly spread to more than 200 countries and territories worldwide, infecting around six million people [1]. The United Kingdom (UK) has been one of the most severely affected countries, with more than 41,000 deaths and almost 300,000 cases reported to date [2]. The SARS Cov-2 infection was first reported in the UK in January 2020, with a rapid increase in cases by early March.

The pandemic caused a significant global impact on the organization and delivery of healthcare services. With the challenge of the pandemic on healthcare capacity, emergency unscheduled care has been prioritised over elective procedures

throughout the world. In the UK, elective surgery was ceased in most National Health Service (NHS) hospitals from the 17th of March 2020 [3]. The Healthcare workforce was re-allocated to areas with urgent clinical need, whilst elective surgical procedures in the UK ceased. During the course of the pandemic, hospitals in the UK have continued to see a large caseload of fragility fractures, including hip fractures due to continued risk of falls in the elderly [4]. Despite the reorganization of NHS services to meet the additional demands of the pandemic, emergency surgery for trauma and hip fractures have continued during this period with strong evidence of improved outcomes with timely surgery as per National guidelines (National Institute for Health and Care Excellence, NICE) [5, 6].

The 30-day mortality following hip fractures in the UK is between 3.5 and 10.4% (mean average 6.1%) [7]. Non-operative management of these fractures is associated with a shorter life expectancy and a higher 30-day mortality [8, 9], whilst delayed management correlates with increased mortality [6, 10].

Validated scoring systems have been developed to predict mortality following hip fractures, for example the Nottingham Hip Fracture Score (NHFS). This score utilises standard logistic regression with seven pre-operative variables to provide an estimated risk of 30-day post-operative mortality. The variables are age, gender, haemoglobin on admission, Mini-mental test score (MMTS), residential status, number of co-morbidities and presence of malignancy (excluding basal cell carcinomas) [11–13].

There have been attempts to develop scoring systems to predict patient outcomes following hip fractures, in order to take decisions to balance the benefits and risks of hospital admission and surgery during the pandemic against conservative management and early discharge, e.g. the Swansea Hip interrogation Fracture Tool or SHiFT [14]. Concerns have been raised regarding the lack of evidence supporting the non-operative management of hip fractures, even during the pandemic [15]. Subsequently, the SHiFT authors commented that since surgical capacity for hip fractures was never limited during the pandemic, therefore the scoring system was never implemented [16]. Ethical concerns remain regarding many surgical procedures during the pandemic and the evidence continues to evolve. It remains unclear what additional risk hip fracture patients are exposed to if they concomitantly contract COVID-19.

The World Health Organisation (WHO) China Joint Mission on Coronavirus disease 2019 reported an estimated COVID-19 mortality rate of 3.8% [17]. People aged over 60 years and with underlying medical conditions such as hypertension, diabetes, cardiovascular disease, chronic respiratory disease and cancer are considered to be at greatest risk for severe disease and mortality [18].

Evidence is emerging regarding the associated mortality of surgical patients undergoing procedures who are COVID-19 positive during the peri-operative period [19]. There is limited information available on the associated mortality following surgery for hip fracture during the pandemic. The COVID-19 pandemic is likely to affect healthcare systems worldwide for the foreseeable future and there is a need for evidence to understand the impact of COVID-19 infection on mortality following hip fractures in this high-risk group.

This prospective study aims to analyse the 30-day mortality for patients presenting with hip fracture across nine Hospitals and NHS Trusts in the South of the United Kingdom.

Methods

Systematic literature search

A systematic literature search across the EMBASE, MEDLINE and medRxiv databases was conducted combining search terms for hip fracture, COVID-19 and mortality. These were combined to find all those papers that either discuss hip fracture and COVID-19 or that discuss hip fracture and surgical mortality. It was observed that combining all three terms together made the search over-restrictive. The search reviewed studies from 2019 onwards, with no language, study type or population filters. The detailed search strategy, with search terms is described in Appendix. Our search identified two published reports looking at outcomes following management of hip fractures in COVID-19-affected patients during the pandemic, with one study on outcomes of 136 patients reported a 9.6% death rate at 14-day follow-up [20] while the second one had 121 patients and a death rate of 14.04% within 21 days of surgery [21].

Ethical approval

This study used data and information routinely collected as per standard clinical care, ergo formal ethical approval was not required.

Study design and participants

This is a multicentre prospective study conducted across. Collectively, these sites managed approximately 7% of hip fracture cases in England as reported in the National Hip Fracture Database (NHFD) for 2019 [22]. We prospectively recorded all cases of fragility hip fracture, eligible for inclusion on the NHFD admitted to these hospitals between 1st March and 30th of April 2020, at a time when cases of COVID-19 were increasingly being reported in these Trusts.

Cases from all hospitals, for the same time period in 2019, were analysed as a retrospective control group. ‘Time to theatre’ and crude mortality rates were compared between the 2019 and 2020 cohorts.

Data collection

Demographic and background information considered important variables for hip fracture patients undergoing surgical management were collected by independent chart review. Data on surgical factors included American Society of Anesthesiologists (ASA) score, time to theatre and Nottingham Hip fracture score (NHFS) and classification of fracture (extracapsular vs intracapsular).

The primary outcome was 30-day mortality. All data was extracted from the NHFD datasets routinely recorded by these Trusts. In addition, swab results for COVID-19 were recorded for patients receiving swab testing for COVID-19 antigen. During the duration of the study, any patient with symptoms and signs of COVID-19 including persistent new cough, dyspnoea, pyrexia, anosmia, hypoxia or with radiographic evidence of COVID-19 infection were tested with a combined oropharyngeal and nasal respiratory swab for COVID-19 antigen, as per national guidelines for COVID-19 testing Public Health England [23]. The data on COVID-19 status was extracted on an individual basis at hospitals and included any positive result during the duration of their admission.

Paired data was collected from a time-matched period in 2019 from the NHFD to compare baseline characteristics, 30-day mortality and operative delay (measured as a time to theatre of over 36 hours as per the Best Practice Tariff associated with Hip Fracture Care in the UK). Data was collected until the first of June 2020 when the 30-day mortality for all patients was confirmed.

Calculation of expected mortality

Patients were split into three cohorts for the calculation of expected 30-day mortality;

2020 COVID-19 positive,

2020 COVID-19 negative.

2019 time-matched cohort.

Expected mortality for each cohort was calculated using the revised NHFS 30-day mortality for each risk-stratified cohort to provide overall expected mortality rates [13].

Statistical analysis

Statistical analysis was performed using SPSS v26 (IBM, Massachusetts, USA). Differences in baseline patient characteristic were assessed for 2020 COVID-19-positive and -negative cohorts, in addition to 2020 COVID-19-negative and 2019 patients.

Chi-squared was used for categorical data with a Student's *t* test used for continuous data; ASA grade and NHFS were assessed as continuous data. Differences between expected and actual 30-day mortality were assessed using a Chi-squared test. Relative risk of 30-day mortality for COVID-19 positive patients was calculated from actual mortality figures, compared against expected deaths calculated using the NHFS.

Kaplan-Meier curves were constructed to demonstrate 30-day mortality.

Statistical significance was accepted at 5%.

Results

A total of 682 patients were admitted with a confirmed hip fracture during the two month study period with 86 (12.6%) testing positive for COVID-19. COVID-19-positive patients' mean age was three years greater than those who were negative, in addition to having significantly higher ASA grades and NHFS ($p < 0.05$). COVID-19 patients were more likely to have their surgical intervention within 36 hours of presentation (77.9%) compared to COVID-19-negative patients (59.2%) ($p < 0.001$) and to have an extracapsular fracture ($p = 0.009$) (Table 1).

Crude 30-day mortality for COVID-19 patients was significantly higher at 34.9% (30/86) compared to 6.0% (36/596) COVID-19-negative patients ($p < 0.001$) (Fig. 1).

No difference in patient characteristics (age, gender, fracture type and NHFS) was demonstrated between 2020 COVID-19 negative and 2019 cohorts ($p > 0.05$). A significantly higher proportion of patients received their surgical treatment within the 36 hour limit in 2019; there was minimal change (+ 2.7%) in overall case load between 2019 and 2020 ($p < 0.001$) (Table 2). There was no difference in 30-day mortality rates between these cohorts ($p < 0.001$) (Fig. 2).

There was no significant difference between expected and actual mortality rates between 2020 COVID-19 negative and 2019 cohorts ($p = 0.950$). Actual 30-day mortality for cumulatively across all sites was 72.0% (36/50) and 74.6% (44/59) of expected, respectively, for 2020 COVID-19 negative and 2019 periods (Table 3).

Actual and expected 30-day mortality was found to be significantly different between 2020 COVID-19 positive (RR 3.00 95% CI 1.57–5.75, $p < 0.001$), 3× higher for COVID-19- positive patients with 30 deaths recorded within 30 days compared against the 10 expected from NHFS risk stratification (Table 4).

Discussion

This is the largest non-registry study of hip fracture mortality during the COVID-19 pandemic and highlights the excess mortality associated with concomitant COVID-19 infection in patients with hip fractures.

This study demonstrates a relative risk of death, within 30 days of hip fractures for COVID-19-positive patients, of 3.00 compared to COVID-negative patients. Current mortality prediction and scoring systems appear to significantly underestimate the mortality of these patients with the expected mortality exceeded by a factor of 3.

Table 1 Demographics, operative delay and crude mortality of the 2020 cohort 1st March 2020 to 31st April 2020 (all data available included; therefore, totals may not be equal)

		COVID-19 negative	COVID-19 positive	Test	*p* value
Patients		596 (87.4%)	86 (12.6%)		
Gender	Female	424 (71.5%)	53 (62.4%)	Chi-squared	0.084
	Male	169 (28.5%)	32 (37.6%)		
Mean age		83 years	86 years	*t* test	0.009
Mean ASA Grade		3.0	3.3	*t* test	0.003
Mean NHFS Score		5.0	5.9	*t* test	< 0.001
Fracture type	Intracapsular	351 (60.2%)	38 (45.2%)	Chi-squared	0.009
	Extracapsular	232 (39.8%)	46 (54.8%)		
Operative delay	No	344 (59.2%)	67 (77.9%)	Chi-squared	0.001
	Yes	237 (40.8%)	19 (22.1%)		
30-day mortality	No	560 (94.0%)	56 (65.1%)	Chi-squared	< 0.001
	Yes	36 (6.0%)	30 (34.9%)		

Despite the increase in 30-day mortality, surgical management remains the preferred treatment for hip fracture as non-operative management is known to be associated with poor outcomes [8]. Our findings that excess deaths were reported during the COVID-19 outbreak in UK can help guide the prognosis of hip fractures during the pandemic.

The COVID-19 pandemic has posed significant challenges to healthcare, including access, infection complications and threat of iatrogenic transmission. Hip fractures occur most commonly in elderly people and preventing COVID-19 infection in this age group has unique challenges. Many patients are in residential or institutional care, thereby vulnerable to infection with close contact to care workers. The high caseload of COVID-19 in care homes, both in the UK and Europe, has highlighted the difficulties in containing outbreaks in the residential care environment. If the patients acquire COVID-19 infection during hospital admission, there is a potential risk of seeding a residential care outbreak as patients return back to nursing homes after their hospital episode. There is an urgent need to ensure mechanisms are in place for appropriate infection control to protect staff and other residents following hospital discharge.

There are several confounding factors which we have attempted to address. We have attempted to control for the significant heterogeneity of this patient population by matching the 2020 cohort to a 2019 cohort which has been shown to possess comparable demographics.

Operative delay Theatre productivity has anecdotally changed since the pandemic. Our findings show a significant increase in operative delay in 2020 compared to 2019. This decrease in productivity is likely to persist as theatre complexes continue to adapt to aerosol generating procedures (AGPs). As our data collection commenced from the onset of the outbreak in the UK, theatre efficiency has undoubtedly improved as pathways for managing unscreened emergency patients were established. It is unlikely that such a significant relative risk is entirely caused by a modest operative delay, especially as the literature supports surgery within 48 hours rather than 36 [8, 24]. Furthermore, this study demonstrates a lower operative delay for the COVID-19-positive patients (22.1%) when compared to the 2019 cohort (40.8%) thereby mitigating this.

Fracture type It is recognised that extracapsular fractures have a higher mortality than intracapsular fractures [25] and extracapsular fractures were more prevalent in the COVID-19-positive cohort from 2020 compared to the COVID-19-negative group. Given the magnitude of increase in relative risk observed in our COVID-19-positive group, fracture type is unlikely to be the sole explanation.

Table 2 2019 Cohort vs 2020 COVID-19-negative 2020 cohort

		2020 COVID-19 negative	2019	Test	*p* value
Patients		596	664		
Gender	Female	424 (71.5%)	455 (68.5%)	Chi-squared	0.251
	Male	169 (28.5%)	209 (31.5%)		
Mean age		83 years	84 years	*t* test	0.249
Mean ASA Grade		3.0	3.1	*t* test	0.039
Mean NHFS Score		5.0	5.1	*t* test	0.124
Fracture type	Intracapsular	351 (60.2%)	341 (58.9%)	Chi-squared	0.649
	Extracapsular	232 (39.8%)	238 (41.1%)		
Operative delay	No	344 (59.2%)	456 (69.4%)	Chi-squared	< 0.001
	Yes	237 (40.8%)	201 (30.6%)		
30-day mortality	No	560 (94.0%)	620 (93.4%)	Chi-squared	0.670
	Yes	36 (6.0%)	44 (6.6%)		

All data available included; therefore, totals may not be equal

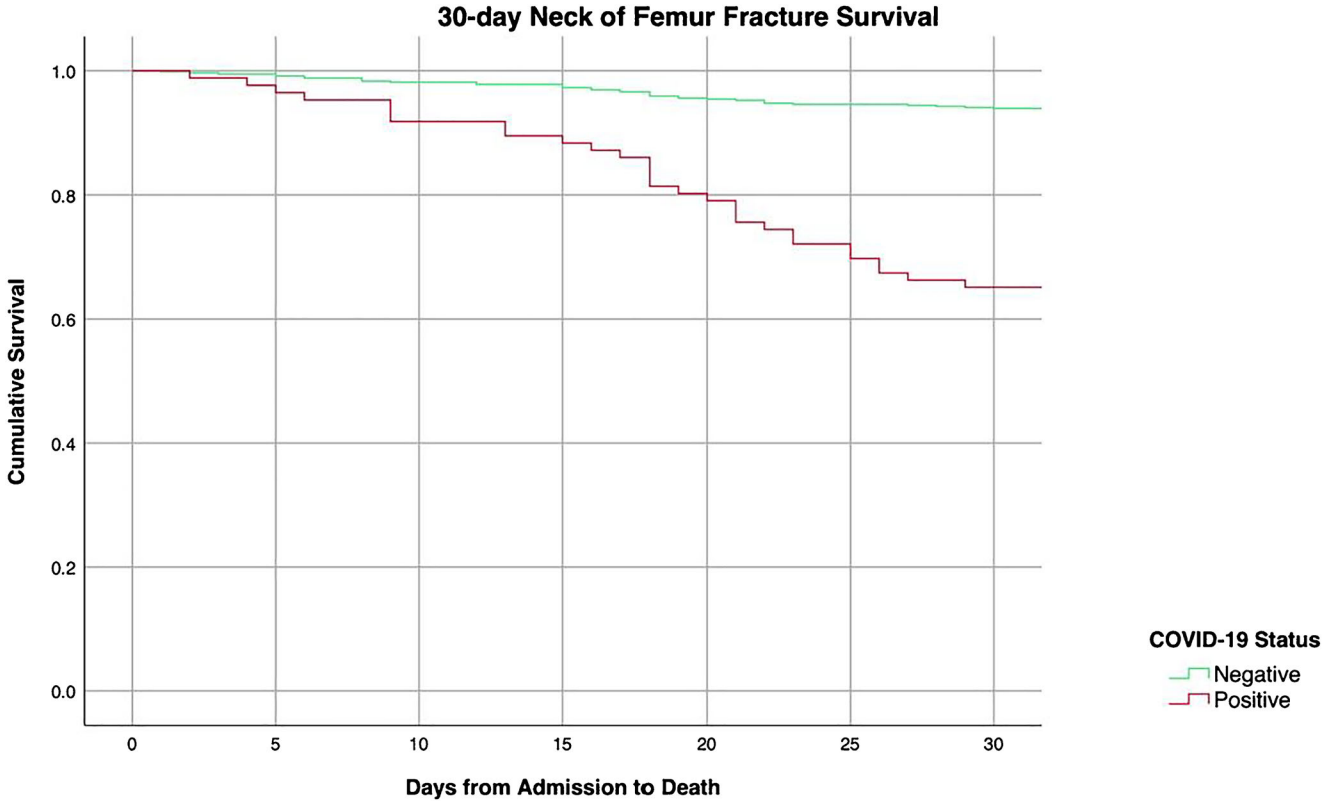

Fig. 1 Kaplan-Meier survival curve for 30-day survival for 2020 cohort COVID-19 positive vs COVID-19 negative

Data ascertainment Research which relies on a database is subject to the completion of data. Our data ascertainment was 97.6% which we consider sufficient to not have confounded our findings.

COVID-19 testing >No UK healthcare institution commenced blanket screening of all emergency-admitted patients from the beginning of the pandemic. This relates to availability of testing materials and also the laboratory processing capacity. We accept that there may be asymptomatic or pre-symptomatic patients who were COVID-19 positive and survived but equally there may be patients within the COVID-19-negative cohort who died within 30 days unexpectedly. What our data does confirm is the increased risk to patients with hip fracture who have *symptomatic COVID-19 infection*.

Anaesthetic type It is accepted that in-hospital mortality for hip fracture patients is higher with general anaesthetic than neuraxial anaesthesia, though this is not represented in 30-day figures [25]. Due to the lack of standardised anaesthetic protocols, the type of anaesthesia was not analysed and in addition was considered beyond the scope of this paper (Fig. 1).

Other confounding factors include potentially delayed presentation of patients due to apprehension regarding hospital attendance during the pandemic (which is likely to persist) and decreased availability of nursing and medical staff on the wards pre and post-operatively due to sickness levels amongst staff during the pandemic. These are very difficult to address and must be accepted as potentially confounding factors.

The COVID-19-positive cohort had significantly higher NHFSs and also a higher mean ASA grade. Whilst these parameters are suboptimal measures of general health [26], undoubtedly the cohort who became COVID-19 positive had more comorbidities. Whether infection is more prevalent in patients with more comorbidities or these patients are more likely to be symptomatic remains unclear. We do not propose the use of the NHFS as a predictive scoring system for patients contracting severe or symptomatic COVID-19.

Whilst elective surgical procedures are often proposed for a healthier cohort of patients, compared to hip fractures, there is

Table 3 2019 vs 2020 (COVID-19-negative patients) cohort mortality as measured using NHFS

	Expected	Actual
2019	59	44
2020 (COVID-19 negative)	50	36

Chi-squared $p = 0.905$

Table 4 2020 COVID-19-positive cohort expected and actual 30-day mortality. Chi-squared $p < 0.001$. RR 3.00 (95% CI 1.57–5.75)

	Dead at 30 days	Alive at 30 days
Expected from NHFS	10	76
Actual	30	56

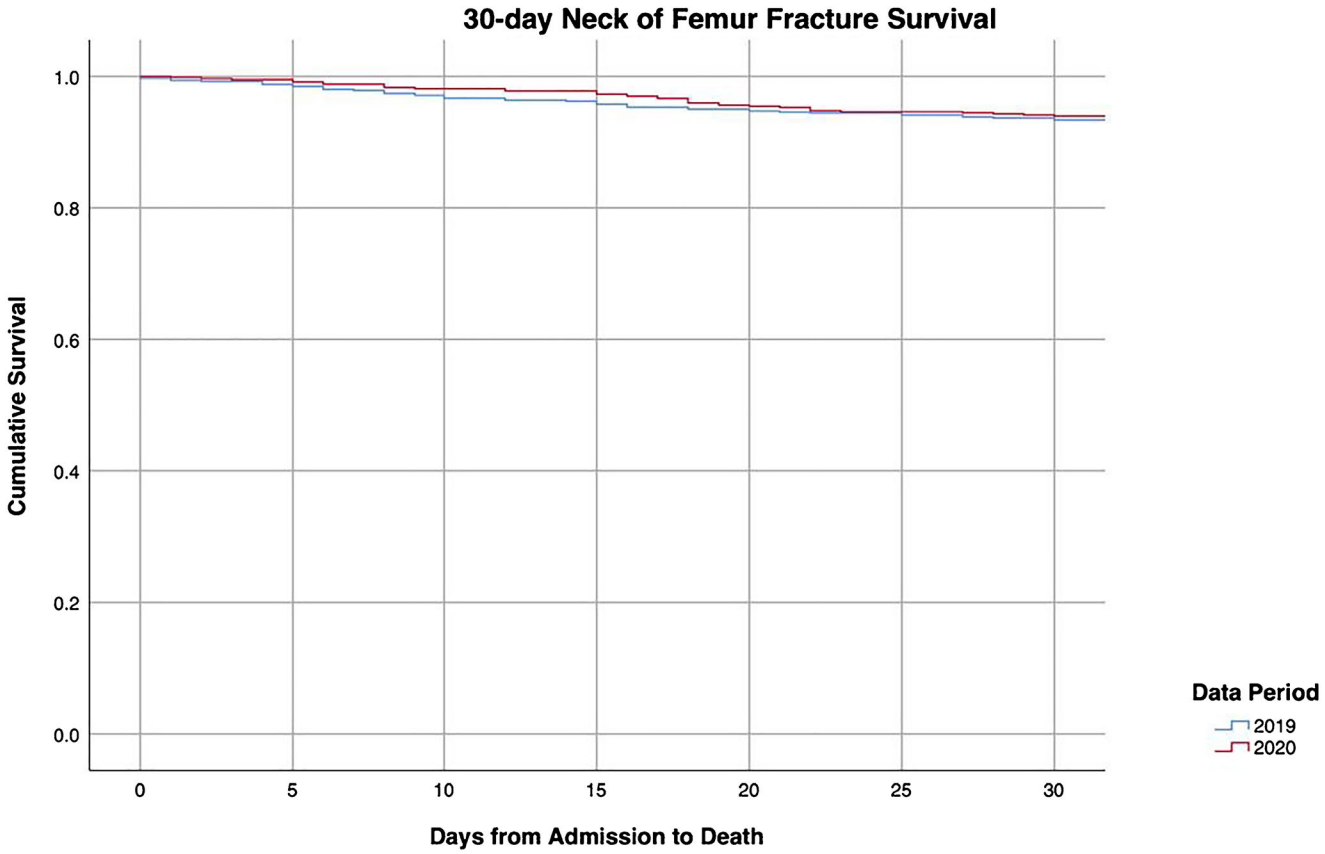

Fig. 2 Kaplan-Meier survival curve for 30-day survival 2020 COVID-19 negative group vs 2019 cohort

definitive evidence that elderly patients with comorbidities have significantly increased mortality both with and without COVID-19 infection [19, 27]. All patients who are to undergo surgery, whether on an emergent or planned basis, should be informed of the risks and potentially defer surgery where possible.

Conclusions

Our results show that the increase in mortality for patients with hip fractures who are COVID-19 positive is approximately three times higher when compared to a validated mortality prediction score. COVID-19 infection appears to be an independent risk factor for increased mortality in hip fracture patients.

Whilst non-operative management of these fractures is not suggested due to the documented increased risks and mortality, this study provides evidence to the emerging literature of the severity of COVID-19 infection in surgical patients. This evidence can be used to guide staff, patients and their next of kin as to the severity of the situation and the absolute requirement for appropriate measures to shield these patients from potential COVID-19 infection in the peri-operative period.

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Joe Riall – Hip Fracture Data Entry Clerk, Western Sussex Hospitals NHS Foundation Trust

Authors' contributions All authors contributed to either data collection, analysis or writing the manuscript.

Data availability Data stored on secure device and submitted to National Database.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval This study used data and information routinely collected as per standard clinical care, ergo formal ethical approval was not required.

Consent to participate Not applicable.

Consent for publication All authors give their consent to publish if accepted by the Editorial Board.

Code availability Not applicable.

Appendix: Evidence search

COVID-related surgical mortality
Date of search: 27th May, 2020
Sources searched
EMBASE (6)
MEDLINE (9)
medRxiv (0)
Date range used (5 years, 10 years): 2019 onwards
Limits used (gender, article/study type, etc.): None
Search terms and notes (full search strategy for database searches below):

B. Search History

	Source	Criteria	Results
1.	MEDLINE	exp coronavirus/	14646
2.	MEDLINE	exp Coronavirus Infections/	13506
3.	MEDLINE	((corona* or corono*) adj1 (virus* or viral* or virinae*)).ti,ab,kw,kf.	1093
4.	MEDLINE	(coronavirus* or coronovirus* or coronavirinae* or CoV).ti,ab,kw,kf.	21594
5.	MEDLINE	("2019-nCoV*" or 2019nCoV* or "19-nCoV*" or 19nCoV* or nCoV2019* or "nCoV-2019*" or nCoV19* or "nCoV-19*" or "COVID-19*" or COVID19* or "COVID-2019*" or COVID2019* or "HCoV-19*" or HCoV19* or "HCoV-2019*" or HCoV2019* or "2019 novel*" or Ncov* or "n-cov" or "SARS-CoV-2*" or "SARSCoV-2*" or "SARSCoV2*" or "SARS-CoV2*" or SARSCov19* or "SARS-Cov19*" or "SARSCov-19*" or "SARS-Cov-19*" or SARSCov2019* or "SARS-Cov2019*" or "SARSCov-2019*" or "SARS-Cov-2019*" or SARS2* or "SARS-2*" or SARScoronavirus2* or "SARS-coronavirus-2*" or "SARScoronavirus 2*" or "SARS coronavirus2*" or SARScoronovirus2* or "SARS-coronovirus-2*" or "SARScoronovirus 2*" or "SARS coronovirus2*" or covid).ti,ab,kw,kf.	16690
6.	MEDLINE	(respiratory* adj2 (symptom* or disease* or illness* or condition*) adj5 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw,kf.	260
7.	MEDLINE	(("seafood market*" or "food market*") adj10 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw,kf.	61
8.	MEDLINE	(pneumonia* adj3 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw,kf.	411
9.	MEDLINE	((outbreak* or wildlife* or pandemic* or epidemic*) adj1 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw,kf.	236
10.	MEDLINE	"severe acute respiratory syndrome*".ti,ab,kw,kf.	6411
11.	MEDLINE	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10	38607
12.	MEDLINE	exp Hip Fractures/	23748
13.	MEDLINE	((hip or femur* or femor*) adj3 fracture*).ti,ab.	37937
14.	MEDLINE	12 or 13	44430

15.	MEDLINE	11 and 14	10
16.	MEDLINE	exp Mortality/	378693
17.	MEDLINE	exp Postoperative Complications/	542270
18.	MEDLINE	16 and 17	25711
19.	MEDLINE	((surgery or surgical) adj3 (mortality or death*) OR ((postoperative or post-operative) adj3 (mortality or death)).ti,ab.	18087
20.	MEDLINE	18 or 19	41858
21.	MEDLINE	11 and 20	3
22.	MEDLINE	15 or 21	13
23.	MEDLINE	15 or 21	13
24.	MEDLINE	limit 23 to yr="2019 -Current"	9
1.	EMBASE	exp Coronavirinae/	14195
2.	EMBASE	exp Coronavirus infection/	13494
3.	EMBASE	("coronavirus disease 2019" or "severe acute respiratory syndrome coronavirus 2").sh,dj.	7809
4.	EMBASE	((corona* or corono*) adj1 (virus* or viral* or virinae*)).ti,ab,kw.	764
5.	EMBASE	(coronavirus* or coronovirus* or coronavirinae* or CoV).ti,ab,kw.	20773
6.	EMBASE	("2019-nCoV*" or 2019nCoV* or "19-nCoV*" or 19nCoV* or nCoV2019* or "nCoV-2019*" or nCoV19* or "nCoV-19*" or "COVID-19*" or COVID19* or "COVID-2019*" or COVID2019* or "HCoV-19*" or HCoV19* or "HCoV-2019*" or HCoV2019* or "2019 novel*" or Ncov* or "n-cov" or "SARS-CoV-2*" or "SARSCoV-2*" or "SARSCoV2*" or "SARS-CoV2*" or SARSCov19* or "SARS-Cov19*" or "SARSCov-19*" or "SARS-Cov-19*" or SARSCov2019* or "SARS-Cov2019*" or "SARSCov-2019*" or "SARS-Cov-2019*" or SARS2* or "SARS-2*" or SARScoronavirus2* or "SARS-coronavirus-2*" or "SARScoronavirus 2*" or "SARS coronavirus2*" or SARScoronovirus2* or "SARS-coronovirus-2*" or "SARScoronovirus 2*" or "SARS coronovirus2*" or covid).ti,ab,kw.	11378
7.	EMBASE	(respiratory* adj2 (symptom* or disease* or illness* or condition*) adj5 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.	311
8.	EMBASE	(("seafood market*" or "food market*") adj10 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.	61
9.	EMBASE	(pneumonia* adj3 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.	421
10.	EMBASE	((outbreak* or wildlife* or pandemic* or epidemic*) adj1 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.	106
11.	EMBASE	"severe acute respiratory syndrome*".ti,ab,kw.	6192
12.	EMBASE	or/1-11	37695
13.	EMBASE	exp hip fracture/	37474
14.	EMBASE	((hip or femur* or femor*) adj3 fracture*).ti,ab.	48366
15.	EMBASE	13 or 14	61035
16.	EMBASE	12 and 15	8
17.	EMBASE	surgical mortality/	53640
18.	EMBASE	((postoperative or post-operative) adj3 (mortality or death)).ti,ab.	26450
19.	EMBASE	((surgery or surgical) adj3 (mortality or death*)).ti,ab.	23272
20.	EMBASE	17 or 18 or 19	87137
21.	EMBASE	12 and 20	6
22.	EMBASE	16 or 21	14
23.	EMBASE	limit 22 to yr="2019 -Current"	6

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