



Increased Comorbidity Burden Among Hip Fracture Patients During the COVID-19 Pandemic in New York City

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Abstract

Background: The coronavirus disease 19 (COVID-19) pandemic had a devastating effect on New York City in the spring of 2020. Several global reports suggested worse early outcomes among COVID-positive patients with hip fractures. However, there is limited data comparing baseline comorbidities among patients treated during the pandemic relative to those treated in non-pandemic conditions. **Materials and Methods:** A multicenter retrospective cohort study was performed at two Level I Trauma centers and one orthopedic specialty hospital to assess demographics, comorbidities, and outcomes among 67 hip fracture patients treated (OTA/AO 31, 32.1) during the peak of the COVID-19 pandemic in New York City (March 20, 2020 to April 24, 2020), including 9 who were diagnosed with COVID-19. These patients were compared to a cohort of 76 hip fracture patients treated 1 year prior (March 20, 2019 to April 24, 2019). Baseline demographics, comorbidities, treatment characteristics, and respiratory symptomatology were evaluated. The primary outcome was inpatient mortality. **Results:** Relative to patients treated in 2019, patients with hip fractures during the pandemic had worse Charlson Comorbidity Indices (median 5.0 vs 6.0, $P = .03$) and American Society of Anesthesiologists (ASA) scores (mean 2.4 vs 2.7, $P = .04$). Patients during the COVID-19 pandemic were more likely to have decreased ambulatory status ($P < .01$) and a smoking history ($P = .04$). Patients in 2020 had longer inpatient stays (median 5 vs 7 days, $P = .01$), and were more likely to be discharged home (61% vs 9%, $P < .01$). Inpatient mortality was significantly increased during the COVID-19 pandemic (12% vs 0%, $P = .002$). **Conclusions:** Patients with hip fractures during the COVID-19 pandemic had worse comorbidity profiles and decreased functional status compared to patients treated the year prior. This information may be relevant in negotiations regarding reimbursement for cost of care of hip fracture patients with COVID-19, as these patients may require more expensive care.

Keywords

COVID-19, SARS-CoV-2, geriatric hip fracture, New York, comorbidity

Introduction

During the coronavirus disease-19 (COVID-19) pandemic in New York City in spring of 2020, elderly patients with hip fractures posed a particular challenge given the urgency of hip fracture management and the high comorbidity burden of the patient population. Patients with

hip fractures commonly have multiple significant medical comorbidities, which have been associated with morbidity and mortality due to COVID-19.^{1,2} Additionally, patients with hip fractures are at increased risk of developing nosocomial infection while hospitalized given their limited ambulatory capacity in the perioperative period.^{3,4}



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Early studies from Asia and Europe highlighted the increased morbidity and mortality associated with COVID-positive (COVID+) patients treated for concomitant hip fracture.⁵⁻⁷ Two of these studies were case series without comparison groups, whereas 1 compared COVID+ to non-COVID patients and found increased mortality in the COVID+ group. Two studies from New York City^{8,9} similarly compared COVID+ and non-COVID patients and found increased inpatient mortality among hip fracture patients with concomitant confirmed or presumed COVID-19, as well as increased ventilator requirement and prolonged hospital stay relative to non-COVID patients. One of these studies⁸ also compared patients treated during the pandemic to those treated 1 year prior and found no demographic or clinical differences between the two groups, including no difference in Charlson Comorbidity Index. However, this study assessed patients presenting as early as February 1, 2020, even though the earliest confirmed diagnosis of COVID-19 in New York City was in mid-March.¹⁰ A similar study compared patients presenting in the months immediately preceding COVID-19 in Argentina to those presenting during the pandemic.¹¹ Given the need to better understand hip fracture management during the ongoing COVID-19 pandemic, the present multicenter study compared demographics, clinical characteristics, comorbidity burdens, fracture and treatment characteristics, and pulmonary symptomatology between patients treated for hip fractures during the COVID-19 pandemic (2020 cohort) and patients treated 1 year prior (2019 cohort). We hypothesized that patients treated during the COVID-19 pandemic would have a greater comorbidity burden and worse outcomes.

Methods

Study Design

A multicenter retrospective cohort study was performed to evaluate patients treated for a hip fracture (OTA/AO 31, 32.1) at 1 of 3 hospitals during the peak of the COVID-19 pandemic in New York City (March 20, 2020 to April 24, 2020). These patients were compared to a cohort of hip fracture patients treated 1 year prior (March 20, 2019 to April 24, 2019). March 20, 2020 was the first date an orthopedic patient was tested for SARS-CoV-2 at 1 of the hospitals and was therefore chosen as the start date. Findings were reported per the Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) checklist for retrospective cohort studies.¹²

Study Sites

Two of the hospitals are Level 1 Trauma centers, and one of the hospitals is an orthopedic specialty hospital without an emergency department. During the pandemic, both Level I Trauma centers diverted many operative resources to fulfill critical care needs. As a result, most patients with urgent orthopedic injuries were routinely transferred from the emergency departments at the two Level I trauma centers (and other hospitals throughout New York) directly to the orthopedic specialty hospital, which was equipped to provide essential orthopedic care during the pandemic. Therefore, patients presenting with hip fractures to all 3 hospitals were included in this study. Patients were excluded for the following reasons: age less than 65 years, high-energy trauma, revision surgery for prior hip fracture, periprosthetic fracture, and pathologic fracture.

Outcomes

The primary outcome was inpatient mortality. Secondary outcomes included deep venous thrombosis (DVT), pulmonary embolus (PE), pneumonia from any cause, cerebral vascular accident (CVA), myocardial infarction, cardiac arrhythmia, urinary tract infection (UTI), blood transfusion, decubitus ulcer, admission to the intensive care unit, and respiratory distress requiring intubation.

Covariates

Demographic, clinical, and functional variables were extracted from the electronic medical record, including age at presentation, sex, body mass index (BMI), smoking status, baseline domicile, ambulatory status, comorbidities, American Society of Anesthesiologists (ASA) score,¹³ and the calculated Charlson Comorbidity Index.¹⁴ Data on treatment timing were also collected, including

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presentation delay (number of days from injury to first presentation to any hospital), treatment delay (number of hours from first presentation to any hospital to the time of surgery), and whether the patient required a transfer from a hospital or outpatient/urgent care center. Data on the injury and surgery were collected, including fracture type, mechanism of injury, laterality, fixation method, surgical duration (defined as time in room to time out of the operating room), and anesthesia type. Postoperative ambulation, length of stay, and discharge disposition were also assessed.

Patient Characteristics

The sample consisted of 67 patients (average age 86, range 65–100) treated during the COVID-19 pandemic (2020 cohort), including 9 who were COVID+ and 1 who was presumed positive due to documentation in the electronic medical record of COVID-related death despite a negative test earlier in their hospitalization. These patients were compared to a cohort of 76 hip fracture patients (average age 84, range 65–102) treated 1 year prior (2019 cohort).

Statistical Analysis

Patient characteristics between the 2020 and 2019 cohorts were compared using chi-square test or Fisher's exact test for categorical variables and t-test and or Wilcoxon rank-sum test for continuous parametric or non-parametric variables, respectively. Normality was assessed with the Shapiro–Wilk test. Data are presented as mean (SD) if they are normally distributed, as median (first quartile, third quartile) if they are not normally distributed, and as a count (percentage) if they are categorical. There was minimal missing data (<5%) for all demographic and clinical characteristics as all extracted data were routinely collected as the standard of care. A two-sided P -value of <.05 was used. STATA 15.0 statistical software (StataCorp, College Station, TX, USA) was used for statistical analysis.

Results

Baseline demographics (age, sex, BMI) were similar between the 2020 and 2019 cohorts (Table 1). The majority of patients sustained their injury due to a ground level fall (138/143; 97%). Patients treated in 2020 had overall worse ambulatory status ($P<.01$), with 62% of patients in 2020 being community ambulators (with or without assistive device) compared to 83% of patients in 2019.

Patients in the 2020 cohort were more likely to have a history of myocardial infarction (16% vs 1%, $P<.01$) and diabetes (25% vs 11%, $P = .03$). Dementia was common in both cohorts (40% in 2020 vs 29% in 2019, $P = .16$). In

terms of comorbidity profile, patients in the 2020 cohort had worse Charlson Comorbidity Indices (median 5 vs 6, $P = .03$) and ASA scores (mean 2.4 vs 2.7, $P = .01$) compared to those treated in 2019. Current or former tobacco use was also more common in patients in the 2020 cohort (14% vs 28%, $P = .04$).

Patients in the 2020 cohort were more likely to require transfer between hospitals prior to undergoing surgical treatment (42% vs 3%, $P<.01$) (Table 2). Interestingly, surgical duration was significantly shorter among the 2020 cohort (median 111 minutes in 2019 vs 83 minutes in 2020, $P<.01$). This was driven primarily by shorter surgical duration among hip hemiarthroplasties (HHAs) (132 minutes in 2019 vs 102 minutes in 2020, $P<.01$) given that the duration of cephalomedullary nails (CMNs) was not significantly different between years (90 minutes in 2019 vs 78 minutes in 2020, $P = .16$). Inpatient stays among the 2020 cohort were longer (median 5 days vs 7 days, $P = .01$), and patients were much more likely to be discharged home (9% vs 61%) rather than a skilled nursing facility (91% vs 35%, $P<.01$).

Preoperative and postoperative symptomatology related to COVID-19 was also assessed (Table 3). Patients in 2020 were significantly more likely to be hypoxic preoperatively (15% vs 3%, $P = .01$) and have radiographic findings concerning for atypical pneumonia (15% vs 0%, $P<.01$). Similarly, patients in 2020 were significantly more likely to be hypoxic postoperatively (24% vs 11%, $P = .04$). In a subgroup analysis excluding COVID+ patients, there was no difference in the frequency of hypoxia requiring supplemental oxygen preoperatively (11% vs 3%, $P = .07$) or postoperatively (20% vs 11%, $P = .14$). After excluding COVID+ patients, the 2020 cohort was still more likely to have radiographic findings concerning for atypical pneumonia (11% vs 0%, $P = .02$).

Inpatient mortality was significantly elevated during the COVID-19 pandemic (12% vs 0%, $P<.01$) (Table 4). If patients diagnosed with confirmed COVID-19 based on nasopharyngeal swab or patients with presumed COVID-19 were excluded, there was no significant difference in inpatient mortality between the cohorts (2% vs 0%, $P = .38$). There were no differences in any other secondary outcomes between the two groups.

Discussion

The present study identified important differences in the comorbidity burdens and functional profiles of patients presenting to 3 New York City hospitals during the COVID-19 pandemic compared to the year prior. A prior study compared hip fracture patients with vs without COVID-19, relying on COVID-negative patients as a control group for comparison.⁹ The present study, in contrast, relies on patients treated outside of pandemic

Table 1. Clinical and Demographic Characteristics of the Study Sample.

Characteristic	2019		2020		P-value
	n	%	N	%	
Age	84.2 (77.4, 90.6)		85.8 (79.8, 91.3)		.20
Sex					.42
Female	61	80%	50	75%	
Male	15	20%	17	25%	
BMI	22.7 (20.4, 26.2)		22.5 (19.5, 25.3)		.41
Mechanism of injury					.96
Ground level fall	72	95%	66	99%	
Fall from height	1	1%	0	0%	
Pedestrian struck	1	1%	0	0%	
Motor vehicle accident	1	1%	0	0%	
Twisting	1	1%	0	0%	
Bicycle	0	0%	1	1%	
Baseline domicile					.14
Home	70	92%	55	82%	
Nursing home	5	7%	6	9%	
Assisted living facility	1	1%	5	7%	
Unknown	0	0%	1	1%	
Ambulatory status					<.01
Community ambulator without assist	47	62%	29	43%	
Community ambulator with assist	16	21%	13	19%	
Household ambulator with assist	13	17%	17	25%	
Bedbound/Wheelchair bound	0	0%	6	9%	
Unknown	0	0%	2	3%	
History of myocardial infarction	1	1%	11	16%	<.01
Congestive heart failure	9	12%	6	9%	.79
Peripheral vascular disease	4	5%	8	12%	.14
Chronic obstructive pulmonary disease	7	9%	8	12%	.79
Dementia	22	29%	27	40%	.16
History of stroke	4	5%	8	12%	.14
Liver disease	3	4%	4	6%	.70
Diabetes mellitus	8	11%	17	25%	.03
Chronic kidney disease	7	9%	6	9%	1.00
Malignancy	13	16%	11	16%	1.00
Charlson Comorbidity Index	5 (4, 6)		6 (4, 7)		.03
ASA score	2.4 (.1)		2.7 (.1)		.01
Tobacco use					.04
Current smoker	2	3%	2	3%	
Former smoker	8	11%	17	25%	
Never smoker	61	80%	40	60%	
Unknown	5	7%	8	12%	

Categorical variables are reported as n (% of total). Continuous parametric variables are reported as mean (SD). Continuous nonparametric variables are reported as median (Q1, Q3).

conditions to better control confounding factors associated with being treated during the pandemic.

Of note, two studies have also evaluated patients with hip fractures treated during the pandemic compared to those treated the year before,^{8,15} while another compared patients presenting in the months immediately preceding COVID-19 to those presenting during the pandemic.¹¹

Interestingly, a study by Egol et al.⁸ of hip fracture patients treated in several New York City hospitals found no demographic or clinical differences between patients treated in 2020 vs 2019, including no differences in Charlson Comorbidity Index. However, this study assessed patients presenting as early as February 1, 2020, even though the earliest confirmed diagnosis of COVID-19

Table 2. Fracture and Treatment Characteristics of the Study Sample.

Characteristic	2019		2020		P-value
	n	%	N	%	
Laterality					.69
Right	32	40%	26	39%	
Left	49	60%	40	60%	
Bilateral	0	0%	1	1%	
Fracture classification					.32
Stable femoral neck fracture (31B1.1)	8	11%	5	7%	
Unstable femoral neck fracture (31B1, 31B2)	30	40%	17	25%	
Isolated greater trochanteric fracture (31A1.1)	0	0%	1	1%	
2- or 3-part intertrochanteric fracture with intact lateral wall (31A1.2, 31A1.3)	21	28%	30	45%	
Multifragmentary intertrochanteric fracture with incompetent lateral wall (31A2)	8	11%	6	9%	
Reverse obliquity intertrochanteric fracture (31A3)	4	5%	3	4%	
Basicervical femoral neck fracture (31B3)	1	1%	3	4%	
Subtrochanteric fracture (32.1)	3	4%	2	3%	
Other ^a	1	1%	0	0%	
Presentation delay (days)	0 (0,1)		0 (0,1)		.07
Treatment delay (hours)	25.7 (20.0, 41.2)		22.1 (17.8, 29.2)		.08
Transfer	2	3%	28	42%	<.01
Fixation					.09
CRPP	6	8%	5	7%	
HHA	22	29%	13	19%	
THA	7	9%	4	6%	
CMN	35	46%	42	63%	
ORIF	1	1%	1	1%	
Other ^b	5	7%	0	0%	
Nonoperative	0	0%	2	3%	
Anesthesia type					<.01
General	19	25%	13	20%	
Spinal	30	40%	48	74%	
Combined spinal/epidural	23	30%	4	6%	
Unknown	4	5%	0	0%	
Length of surgery (min)	111 (89, 134)		83 (65, 112)		<.01
Length of inpatient stay (days)	5 (4, 6)		7 (4, 12)		.01
Discharge disposition					<.01
Home	7	9%	38	61%	
Skilled nursing facility (SNF)	69	91%	22	35%	
Hospice	0	0%	2	3%	

CRPP: closed reduction percutaneous pinning; HHA: hip hemiarthroplasty; THA: total hip arthroplasty; CMN: cephalomedullary nail; ORIF: open reduction internal fixation. Categorical variables are reported as n (% of total). Continuous parametric variables are reported as mean (SD). Continuous nonparametric variables are reported as median (Q1, Q3).

^aOne patient in the 2019 group had an unstable femoral neck fracture and fracture of the greater trochanter.

^bTwo patients underwent HHA and ORIF. Two patients underwent CMN and ORIF. One patient underwent a planned HHA which was aborted intraoperatively due a cardiac arrest immediately prior to cementing of the femoral canal and subsequently underwent HHA once stabilized 19 days later.

in New York City was in mid-March and the case load peaked in early April.¹⁰ Another study conducted in the United Kingdom also found no difference in ASA score, 30-day mortality, pulmonary complications, ICU admissions, or length of stay between patients treated during the

COVID-19 pandemic and those treated 1 year prior.¹⁵ These findings are in contrast to the data shown in the present study, which showed significant differences in comorbidity profiles and clinical outcomes, including inpatient mortality, between hip fracture patients treated

Table 3. Preoperative and Postoperative Signs, Symptoms, and Imaging Results.

Characteristic	2019		2020		P-value
	n	%	N	%	
Preoperative					
Any sign or symptom	8	11%	13	19%	.14
New onset cough	4	5%	2	3%	.69
Dyspnea	5	7%	1	1%	.21
Other symptoms	2	3%	4	6%	.42
Fever	1	1%	1	1%	1.00
Hypoxia	2	3%	10	15%	.01
Type of oxygen required					.02
None	74	97%	58	87%	
Nasal cannula	1	1%	7	10%	
Non-rebreather	0	0%	1	1%	
Intubation	1	1%	1	1%	
Chest radiograph					<.01
Normal	55	72%	36	54%	
Chronic changes, no acute findings	8	11%	12	18%	
Atypical pneumonia	0	0%	10	15%	
Organizing pneumonia	2	3%	1	1%	
Atelectasis	5	7%	2	3%	
Pulmonary edema	6	8%	2	3%	
Not performed	0	0%	4	6%	
Postoperative					
Any symptom	17	22%	22	33%	.11
New onset cough	2	3%	2	3%	1.00
Dyspnea	6	7%	1	2%	.12
Other symptoms	1	1%	5	8%	.07
Fever	5	7%	2	3%	.28
Hypoxia	8	11%	16	24%	.04
Type of oxygen required					.04
None	68	89%	50	76%	
Nasal cannula	6	8%	12	18%	
Non-rebreather	2	3%	1	2%	
Intubation	0	0%	3	5%	
Chest radiograph					.26
Not performed	54	71%	46	69%	
Normal	8	11%	9	13%	
Chronic changes, no acute findings	2	3%	2	3%	
Atypical pneumonia	0	0%	2	3%	
Organizing pneumonia	2	3%	5	7%	
Atelectasis	5	7%	3	4%	
Pulmonary edema	3	4%	0	0%	
Other	2	3%	0	0%	

Fever is defined as having 1+ temperature above 38°C preoperatively or having 2+ temperatures above 38°C postoperatively greater than 6 hours apart to account for the possibility of routine postoperative fever. Type of oxygenation refers to the most invasive form of oxygenation required. Other postoperative chest radiograph results for two patients in 2019 were atelectasis vs aspiration.

during the pandemic and those treated 1 year prior.^{16,17} The present data corroborate prior findings by Slullitel et al. in Argentina, which found that patients presenting during the pandemic were frailer and less active compared to those presenting immediately before. The reasons for this could

be multifactorial. Possibly, sicker patients and lower demand patients may fall at home more often in the setting of self-isolation and social distancing, whereas more functional people became less active (eg, less shopping, fewer walks, more social distancing, etc.), thereby leading to

Table 4. Inpatient Outcomes Among the Study Sample.

Characteristic	2019		2020		P-value
	n	%	n	%	
Inpatient mortality	0	0%	7	12%	.002
Deep venous thrombosis	0	0%	1	2%	.43
Pulmonary embolus	1	1%	0	0%	1.00
Pneumonia	4	5%	10	17%	.04
Myocardial infarction	1	1%	1	2%	1.00
Arrhythmia	5	7%	1	2%	.23
Urinary tract infection	8	11%	11	19%	.21
Decubitus ulcer	0	0%	2	3%	.19
Transfusion	11	14%	15	26%	.12
Intensive care unit admission	2	3%	5	9%	.13
Intubation	1	1%	4	7%	.16

Patients managed nonoperatively and those who expired prior to surgery were not included in the counts for neurovascular injury, hematoma, superficial infection, deep infection, and wound dehiscence. Pneumonia includes any pneumonia diagnosed on chest radiographs that necessitated treatment with antibiotics and/or supportive care. These include organizing pneumonia, atypical pneumonia, and aspiration pneumonia. Categorical variables are reported as n (% of total).

fewer falls in the functional group without a significant change in the less functional patients.¹⁸

The findings from this study highlight the challenges of treating geriatric hip fracture patients during the COVID-19 pandemic. For example, although the 2020 cohort was sicker than the 2019 cohort, patients in 2020 were more likely to be discharged home after longer hospital stays. This reflected, in part, the difficulty of discharging patients to subacute and acute rehabilitation facilities during the height of the pandemic in New York City.¹⁹ This reflected a challenging situation as patients were at risk of contracting COVID-19 in the hospital as well as in a nursing home, while nursing homes and patients and families both pushed for discharge directly home to avoid being in nursing homes. This commonly led to longer hospital stays as patients required more in-hospital rehabilitation before being able to be safely discharged home. This was compounded by the fact that patients in 2020 had lower baseline functional status compared to the 2019 cohort.

There are limitations to the present study. One of the principal findings of this study was the difference in comorbidity profiles between patients treated in 2020 vs 2019. Summary comorbidity indices such as the CCI and ASA have inherent limitations, including generalizability in unique populations and inability to capture comorbidities not included in the indices' definitions. A frailty score would have been a helpful adjunctive measure to assess the association of frailty on mortality and to explore the association between comorbidity burden and frailty; however, this was not done prospectively and cannot be assigned retrospectively.^{20,21} Additionally, although this

study evaluated conditions during the peak of the COVID-19 pandemic in New York (late March to late April 2020), it did not include patients treated before or after this window, during which the pandemic was still ongoing. The small sample size is another limitation of this study, which limits the power of the study. As a result of the small sample size, patients were not matched on confounding factors such as age or location.

In conclusion, this study found that patients with hip fractures treated during the COVID-19 pandemic had more severe comorbidity profiles and decreased functional status compared to patients treated in the year prior. In the setting of the ongoing COVID-19 pandemic, this information may be helpful to clinicians caring for patients with hip fractures to allow for more informed risk stratification and preoperative planning. Furthermore, this information may be relevant in negotiations regarding reimbursement for cost of care of hip fracture patients with COVID-19, as patients with more comorbidities may require more expensive care.

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Ethical approval

The study was approved by the Institutional Review Boards of all hospitals under study.

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