The Impact of the COVID-19 2020 Pandemic on Hospital Length of Stay Following Fragility Hip Fracture Surgery

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ABSTRACT **Background:** Hip fractures in elderly patients are a major cause of morbidity and mortality. Variability in length of hospital stay (LOS) was evident in this population. The coronavirus disease-2019 (COVID-19) pandemic led to prompt discharge of effected patients in order to reduce contagion risk. LOS and discharge destination in COVID-19 negative patients has not been studied.

Objectives: To evaluate the LOS and discharge destination during the COVID-19 outbreak and compare it with a similar cohort in preceding years.

Methods: A retrospective study was conducted comparing a total of 182 consecutive fragility hip fracture patients operated on during the first COVID-19 outbreak to patients operated on in 2 preceding years. Data regarding demographic, co-morbidities, surgical management, hospitalization, as well as surgical and medical complications were retrieved from electronic charts.

Results: During the pandemic 67 fragility hip fracture patients were admitted (COVID group); 55 and 60 patients were admitted during the same time periods in 2017 and 2018, respectively (control groups). All groups were of similar age and gender. Patients in the COVID group had significantly shorter LOS (7.2 ± 3.3 vs. 8.9 ± 4.9 days, P = 0.008) and waiting time for a rehabilitation facility (7.2 ± 3.1 vs. 9.3 ± 4.9 days, P = 0.003), but greater prevalence of delirium (17.9% vs. 7% of patients, P = 0.028). In hospital mortality did not differ among groups.

Conclusions: LOS and time to rehabilitation were significantly shorter in the COVID group. Delirium was more common in this group, possibly due to negative effects of social distancing.

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Hip fractures are among the most common fragility fractures encountered by orthopedic surgeons and are regarded as a worldwide epidemic and a major public health concern [1]. It is projected that by 2050 there will be 6.3 million new cases annually with double hospital admissions [2,3]. Proximal femur fractures carry a high mortality rate [4], and the standard of care involves early surgery, within 48 hours [5].

Hospital costs are multiple and include surgery, laboratory and radiological investigations, and hospital stay fees [6]. Great variability in length of stay (LOS) is evident among countries, as some advocate for initiation of the rehabilitation process in-house while others provide only acute care [7]. These differences also influence hospitalization charges [8]. In Israel, the average duration of hospitalization after fragility hip fracture injuries in 2013 was 7.9 days in orthopedic departments and 9.2 days in medical wards [9].

The coronavirus disease-2019 (COVID-19) pandemic, caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), put strain on healthcare systems around the world. In Israel, elective surgical activity was prohibited during the first 2 months of the outbreak to reduce the exposure of patients to the affected population and to preserve available medical teams, mainly the anesthesiologists, in case the situation would escalate. As a result, the availability of operating rooms increased for emergent cases, such as fragility hip fractures.

Several guidelines suggesting surgical prioritization of orthopedic trauma patients during the COVID-19 pandemic have been published [10]. The independent influence of COVID-19 on morbidity and mortality of patients with a hip fracture has been studied and has showed that COVID-19 was independently associated with a sevenfold increase in risk of 30-day mortality for patients with hip fracture [11]. For COVID-19 positive patients, LOS following surgery was shown to increase [12]. However, the influence of the pandemic on LOS and discharge destination in COVID-19 negative patients has not been studied in detail. Therefore, we assessed the LOS and discharge destination during the COVID-19 outbreak and compared it to a similar patient cohort in preceding years. The primary outcomes were LOS and discharge destination.

PATIENTS AND METHODS

STUDY DESIGN

Following institutional review board approval, a retrospective study was conducted to compare fragility hip fracture patients age 65 years of age and older, who were operated on during the first COVID-19 outbreak to patients operated on in the two preceding years.

Patients were assigned to study groups according to the time period in which they were treated. Patients in the study group had undergone surgery between 01 March 2020 and 31 May 2020, whereas patients in the control groups were operated on during the same months in 2017 and 2018. Patients 65 years of age and older were included if they presented with fragility femoral fractures and underwent surgery, either closed or open reduction. The treatment was either partial or complete hip replacement. Patients presenting with a pathological or impending fracture, or a fracture sustained while hospitalized for a different medical reason, were excluded.

VARIABLES AND MEASUREMENTS

Demographic data, living arrangement, and mobility level was retrieved from electronic medical records. Information regarding hospitalization such as mortality, laboratory values, surgery type, intraoperative medical and orthopedic complications was gathered, as well as discharge destination and LOS. The age-adjusted Charlson Comorbidity Index (ACCI) [13] was used to assess patient co-morbidities. Hospitalization characteristics such as LOS, time to surgery (TTS) (defined as time from admission to surgery), surgical procedure, blood loss, in-hospital medical and orthopedic complications and mortality, and pre- and post-surgical laboratory values (hemoglobin, platelets, creatinine, and international normalized ratio [INR]) were gathered.

PROCEDURES

All patients were clinically assessed by an orthopedic surgeon on arrival to the emergency department and imaging studies were conducted. According to guidelines, we started surgery within 48 hours, unless the patient was medically unfit for surgery at that time. Following surgery, all patients received daily respiratory physiotherapy. Early mobilization was encouraged, and patients participated in personal physical therapy sessions focused on range of motion, swelling reduction, gait, and balance, 5 days per week. For thromboprophylaxis, patients were treated with low molecular weight heparin, enoxaparin 40 mg once daily, which was initiated on postoperative day 1.

STATISTICAL ANALYSIS

Continuous variables are presented as mean and standard deviation. Quantitative variables are presented with absolute and relative frequencies. Fisher's exact test was used for comparison of quantitative variables and Student's *t*-test was used to compare continuous variables. All reported *P* values are two-tailed. Statistical significance was defined as $P < 0.05$.

Statistical analysis was performed using R Core Team (2018). R: A language and environment for statistical computing (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

A total of 182 patients who underwent surgery for fragility hip fractures were included in the study. Sixty-seven patients were admitted during the COVID-19 outbreak (COVID group), 55 and 60 patients were admitted during the same time periods in 2017 and 2018, respectively (control groups). Demographic characteristics are presented in Table 1. Both groups were of similar age, gender, and ACCI. Pre-operation walking ability was significantly different between the COVID and control groups; as a higher portion of patients from the control group could walk independently prior to the fracture, while a higher rate of patients from the COVID group required assistance (cane, walker, wheelchair) ($P = 0.003$). Among the laboratory values measured on admission, hemoglobin levels were found to be slightly higher in the COVID group, but as average values were higher than 12 gr/dl for all patients, the clinical significance is unclear (12.9 ± 1.7 for the COVID group vs. 12.1 ± 1.6 for the control groups, $P = 0.002$).

In all groups, the majority of patients had undergone surgery within 48 hours after admission, and no difference was noted in time to surgery [Table 2]. The type of surgery was also comparable between periods. For patients treated with hemiarthroplasty, the use of cement was similar between groups, with 86.4% of patients in the COVID group and 94.1% in the control group, undergoing cemented bipolar surgery ($P = 0.371$).

The prevalence of medical complications did not differ among the groups [Table 2]. However, the prevalence of delirium was significantly higher in the COVID group. Twelve patients (17.9%) were diagnosed with acute delirium in the COVID group compared to eight patients (7%) in the control group ($P = 0.028$). The rate of in-hospital orthopedic complications did not differ between study groups [Table 2]. Only one case of surgical site infection (SSI) was encountered in a patient from the control group ($P = 1$). In hospital mortality was also similar. Two patients in the COVID group and four patients in the control group died while hospitalized ($P = 1$).

LOS was significantly shorter in the COVID group (7.2 ± 3.3 days) compared with the control group (8.9 ± 4.9 days), $P = 0.008$ [Table 2]. The LOS for patients waiting for a rehabilitation facility was shorter for the COVID group (7.2 ± 3.1) compared with the control groups (9.3 ± 4.9), $P = 0.003$. Discharge destination did not defer among groups ($P = 0.208$) [Table 2].

DISCUSSION

The COVID-19 pandemic has put a significant strain on healthcare systems worldwide. One of the greatest challenges healthcare professionals had to face was the need to reduce the potential exposure of patients and medical teams to the affected population. Among the steps taken, medical wards were instructed to discharge patients as soon as possible to reduce in-hospital contagion, increase

Table 1. Patient demographics

Characteristic		Pre-Covid-19 pandemic (n=115)	During Covid-19 pandemic (n=67)	*P* value
Age (years), average ± SD		81.2 ± 8.2	82.3 ± 7.8	0.364
Gender, n (%)	Male	36 (31.3)	30 (44.8)	0.058
Living arrangement, n (%)*	Home	83 (72.1)	40 (59.7)	0.140
	Home with a professional caregiver	23 (20)	20 (29.9)	
	Nursing home	8 (7)	7 (10.4)	
Walking ability, n(%)	Independent walking	73 (63.4)	26 (38.8)	0.003
	Cane	11 (9.6)	13 (19.4)	
	Walker	29 (25.2)	23 (34.3)	
	Wheelchair	2 (1.7)	5 (7.5)	
Age adjusted Charlson Co-morbidity Index, average ± SD		5.8 ± 2.2	5.3 ± 1.9	0.093
Dementia, n (%)		12 (10.4)	13 (19.4)	0.118
Depression, n (%)		8 (7)	6 (9)	0.774
Hospitalization department	Orthopedics	59	34	0.712
	Geriatrics	54	33	
	Medicine	2	0	
Laterality, n (%)	Right	60 (52.2)	32 (48.7)	0.645
Laboratory in admission, average ± SD	Hemoglobin (gr/dl)	12.1 ± 1.6	12.9 ± 1.7	0.002
	Platelets (K/micl)	247.9 ± 86.8	231.5 ± 60.6	0.137
	Creatinine (mg/l	1.1 ± 0.5	1 ± 0.3	0.475
	International normalized ratio	1.1 ± 0.3	1.2 ± 0.2	0.040

*Data were not available for one patient from the pre-COVID-19 pandemic group.

hospital capacity, and allow redeployment of staff to the care of patients presenting with COVID-19 infection. We compared the LOS of fragility hip fracture patients during the COVID-19 outbreak to that of preceding years and found it to be significantly shorter, especially among patients awaiting rehabilitation. Our findings are consistent with the findings of a study by Turgut et al. [14], which showed that hospitalization time was significantly shorter in the pandemic period for patients with proximal femur fractures (4.5 ± 2.1 days in 2020 vs. 8.5 ± 5.9 and 7.2 ± 3.8 in 2018 and 2019, respectively). However, while Turgut's group considered that a trend toward a shorter time to surgery could explain the change, in our cohorts this timer period was not significantly shorter, despite a higher availability of morning trauma rooms for orthopedic surgeons, as elective procedures were minimized.

We think that two main forces influenced the briefer LOS. First, the concern for the well-being of these frail patients and the fear for in-hospital COVID-19 infection led to higher staff motivation to hasten initial rehabilitation. Second, as elective activity was cancelled, more rehabilitation beds were available for fragility hip fracture patients, explaining the even shorter LOS for patients awaiting rehabilitation. This finding is supported by a multilevel analysis of femoral hip fracture patients in Japan [15]. That study found the availability of long-term care beds in the community to significantly correlate with both shorter LOS and increased rate of discharge to other facilities.

Although the percentage of patients discharged to a rehabilitation facility did not differ among the groups, our study demonstrated a statistically significant decrease in the LOS for patients waiting for a rehabilitation facility, with a mean reduction of 2.1 days. In our experience, availability of beds in rehabilitation centers is considered to be the bottleneck preventing quicker discharge of patients in need of rehabilitation after orthopedic surgeries. During the COVID-19 outbreak, to preserve the availability of medical staff and hospital beds, some guidelines were published, which suggested surgical prioritization of orthopedic trauma patients and stoppage of the elective services [10]. We believe that this protocol contributed to the availability of rehabilitation beds and the resultant reduction in LOS.

Our cohort demonstrated a 16% increase in the incidence of FHFs during the COVID-19 pandemic compared with preceding year. This finding could be explained by the restrictions imposed, such as forbidding visitation of the elderly, as they are more vulnerable to the COVID-19 infection [19–22]. As less assistance was available for the elderly, who frequently rely on

Table 2. Results

Characteristic		Pre-COVID-19 pandemic (n=115)	During COVID-19 pandemic (n=67)	*P* value
In hospital mortality, n (%)		4 (3.5)	2 (3)	1
Surgery within 48 hours, n (%)		103 (89.6)	62 (92.5)	0.604
Time to surgery (hours), mean ± SD		23.7 ± 24.8	27.5 ± 21.3	0.139
Length of surgery (hours), mean ± SD		1:06 ± 00:25	1:07 ± 00:30	0.881
Implant type, n (%)	Dynamic hip screw	52 (45.2)	18 (26.9)	0.151
	proximal femoral nail anti-rotation	20 (17.4)	20 (29.9)	
	Bipolar hemiarthroplasty	34 (29.6)	22 (32.8)	
	Total hip replacement	5 (4.3)	4 (6)	
	Cannulated screws	3 (2.6)	3 (4.5)	
	Targon femoral nail	1 (0.9)	0	
Length of stay (days), mean ± SD		8.9 ± 4.9	7.2 ± 3.3	0.008
Length of stay for patients waiting for a rehabilitation facility (days), mean ± SD		9.3 ± 4.9	7.2 ± 3.1	0.003
Discharge destination, n (%)*	Home	20 (17.4)	14 (20.9)	0.208
	Rehabilitation facility	90 (78.3)	48 (71.6)	
	Nursing home	1 (0.9)	3 (4.5)	
Patients requiring blood transfusions, n (%)		44 (38.3)	23 (34.3)	0.635
In hospital medical complications, n (%)	Myocardial infraction	1 (0.9)	0	1
	Atrial fibrillation**	4 (3.5)	3 (4.5)	0.703
	Pulmonary congestion	6 (5.2)	3 (4.5)	1
	Cerebrovascular event	2 (1.7)	2 (3)	0.626
	Delirium	8 (7)	12 (17.9)	0.028
	Urinary retention	13 (11.3)	8 (11.9)	1
	Urinary tract infection	2 (1.7)	1 (1.5)	1
	Pneumonia	8 (7)	7 (10.4)	0.416
	COPD exacerbation	1 (0.9)	0	1
	Decubitus ulcer	2 (1.7)	2 (3)	0.626
	Systemic inflammatory response syndrome	1 (0.9)	1 (1.5)	1
	Acute renal failure	31 (27)	15 (22.4)	0.596
	Gastrointestinal bleeding	0	1 (1.5)	0.368
	Deep vein thrombosis	0	0	1
	Pulmonary emboli	0	0	1
In-hospital orthopedic complications, n (%)	Surgical site infection		1 (0.9)	0
	Implant dislocation	0	1 (1.5)	0.386
	Intraoperative periprosthetic fracture***	1 (0.9)	0	1

*Deceased patients were not included in the calculation; therefore, the total number of patients is lower
**Either a new condition or an exacerbation of a known one
***The fracture was noted during surgery and stabilized with a cerclage wire

family members to help, we speculate that these patients were forced to perform more demanding tasks by themselves. In turn, this may have resulted in an increased frequency of falling accidents and hip fractures.

Delirium is a frequent complication among hospitalized elderly individuals with hip fractures. A meta-analysis by Yang et al. [20] demonstrated an accumulated delirium incidence of 24.0% in patients hospitalized for hip fractures. Among risk factors for developing a dementia during hospitalization, age greater than 80 years, living in a care institution pre-admission, and pre-admission diagnosis of dementia were found to be most significant [21]. Delirium was found to be associated with cognitive and functional deficits, and increased the LOS and mortality [22]. Our results showed an increased occurrence of delirium in the COVID group compared with the control group. This finding might be explained by two main hypotheses. First, there were restrictions on visits, which were enforced. While previously limits on the number of visitors and visiting hours were not strictly enforced, during the COVID-19 pandemic, only one visitor was allowed, and only for restricted periods. As delirium is associated with reduced social support [23], this could explain the increased incidence of delirium during the COVID-19 pandemic. Second, for patients and staff protection, medical staff contact with the patients was reduced, and physicians wore protective gear, which reduced the sense of interpersonal interaction (facial expressions were masked and physical contact was barred by gloves). This change was found to be frightening for older adults, especially for those with underlying dementia or cognitive impairment [24], and could have also contributed to the development of postoperative delirium. Since delirium is related to worse patient outcomes, it is of the utmost importance to diagnose, treat, and prevent it. Family video calls, family-centered care, and reorientation are techniques suggested for the COVID-19 time period [25].

LIMITATIONS

First, due to its retrospective nature, some of the data may not be accurate. Second, our findings were based on the data collected from a single center, which limited the number of patients included. Last, as the design relates to immediate patient outcomes, long-term follow-up was unavailable and some intriguing questions were not addressed, such as the medium-duration effect, the excessive implementation of protective equipment, and reduced LOS on postoperative surgical site infections.

CONCLUSIONS

The COVID-19 pandemic was associated with reduced length of stay following fragility hip fractures surgery, for those who tested negative for COVID-19. Hospitalization constrains during the pandemic period were associated with reduced human contact and subjected patients to increased delirium risk. As delirium is associated with increased morbidity and mortality, decisive steps must be taken to prevent, promptly diagnose, and treat in-hospital acquired delirium utilizing approaches adjusted to the COVID-19 pandemic.

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Capsule

Nasal delivery of an IgM offers broad protection from SARS-CoV-2 variants

Resistance represents a major challenge for antibody-based therapy for COVID-19. **Ku** et al. engineered an immunoglobulin M (IgM) neutralizing antibody (IgM-14) to overcome the resistance encountered by immunoglobulin G (IgG)-based therapeutics. IgM-14 is over 230-fold more potent than its parental IgG-14 in neutralizing SARS-CoV-2. IgM-14 potently neutralizes the resistant virus raised by its corresponding IgG-14. These include three variants of concern: B.1.1.7 (Alpha, which first emerged in the UK), P.1 (Gamma, which first emerged in Brazil), and B.1.351 (Beta, which first emerged in South Africa). In addition, 21 other receptor-binding domain mutants are included, many of which are resistant to the IgG antibodies that have been authorized for emergency use. Although engineering IgG into IgM enhances antibody potency in general, selection of an optimal epitope is critical for identifying the most effective IgM that can overcome resistance. In mice, a single intranasal dose of IgM-14 at 0.044 mg per kg body weight confers prophylactic efficacy and a single dose at 0.4 mg per kg confers therapeutic efficacy against severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). IgM-14, but not IgG-14, also confers potent therapeutic protection against the P.1 and B.1.351 variants. IgM-14 exhibits desirable pharmacokinetics and safety profiles when administered intranasally in rodents. These results show that intranasal administration of an engineered IgM can improve efficacy, reduce resistance and simplify the prophylactic and therapeutic treatment of coronavirus disease-2019 (COVID-19).

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Eitan Israeli

Capsule

Spread of a SARS-CoV-2 variant through Europe in the summer of 2020

Following its emergence in late 2019, the spread of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) has been tracked by phylogenetic analysis of viral genome sequences in unprecedented detail. Although the virus spread globally in early 2020 before borders closed, intercontinental travel has since been greatly reduced. However, travel within Europe resumed in the summer of 2020. **Hodcroft** and colleagues reported on a SARS-CoV-2 variant, 20E (EU1), which was identified in Spain in early summer 2020 and subsequently spread across Europe. They find no evidence that this variant increased transmissibility, but instead demonstrated how rising incidence in Spain, resumption of travel, and lack of effective screening and containment may have explained the variant's success. Despite travel restrictions, the authors estimated that 20E (EU1) was introduced hundreds of times to European countries by summertime travelers, which is likely to have undermined local efforts to minimize infection with SARS-CoV-2. These results illustrate how a variant can rapidly become dominant even in the absence of a substantial transmission advantage in favorable epidemiological settings. Genomic surveillance is critical for understanding how travel can affect transmission of SARS-CoV-2 and thus for informing future containment strategies as travel resumes.

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