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COVID-19 Lockdown Has No Significant Impact on Trauma Epidemiology and Outcomes in a Tertiary Trauma Center—Retrospective Cohort Study

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Abstract: Background: The aim of this study was to describe the impact of a COVID-19 lockdown on the variation in the volumes and types of injuries at a level one trauma center while focusing on preserving trauma care resources. Methods: A retrospective, descriptive study of prospectively collected data from the Trauma Registry. Data collection included patient demographics, injury mechanism, injury type and treatment required. The time periods studied corresponded with the lockdown period in Israel and a parallel period in 2019. Results: Overall, there was no reduction in all injury-related admissions. There was a significant reduction in pedestrian injuries ($p < 0.02$) and a non-significant increase in children admissions aged 0–2 years. Compared to the previous years, the severity of injuries during the March–April 2020 lockdown was unchanged. Hospital resources (number and percentage of trauma patients who required an operation, ICU stay and LOS) were not different between the lockdown period compared to the previous 5 years. Less trauma patients arrived with a Trauma Team Activation code during the lockdown period (58, 33% decrease compared to the control), but a significantly higher proportion of those patients required hospitalization (77.6%, $p < 0.0001$). Conclusions: During a lockdown period, road accidents were still the main cause for major trauma admissions, resulting in prolonged and complex surgeries, and hospitals should continue to provide full services until resource limitations are unavoidable. Maintenance of an effective full-staffed trauma service is vital throughout a COVID-19 lockdown.

Keywords: trauma admissions; COVID-19; hospital resources; lockdown

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1. Introduction

The COVID-19 pandemic is poised to challenge the volume and capability of acute care facilities. As the number of patients requiring hospital-level care due to COVID-19 escalates, it is likely that available resources will be relocated in favor of the growing number of COVID-19 patients. However, while this acute care is on the rise, injuries will continue to occur in our community. In this complex situation, hospital planners and trauma team leaders must simultaneously balance the needs of trauma patients with those of COVID-19 patients, as well as other medical and surgical emergencies [1].

On 11 March 2020, the World Health Organization (WHO) declared the outbreak of the SARS-CoV-2 (COVID-19) virus a global pandemic. The American College of Surgeons (ACS) warned of the possibility of the pandemic to impact on the care of critically injured patients, particularly of those patients who require immediate life-saving interventions and advanced critical care to support life and recovery [2]. Through the Israeli Surgical Association and Ministry of Health, trauma surgeons have expressed concerns that an unintended consequence of the pandemic may affect both trauma care and manpower resources. In parallel with ACS, the Israeli Trauma and Emergency Surgery Society came up with guidelines for trauma care during the pandemic [3]. In a national response to the pandemic,

a national state of emergency was declared on 19 March 2020, in order to reduce the spread of the virus. On 25 March, the government imposed stricter restrictions on citizens' movements. These included social distancing and advising people to avoid crowded public venues. For example, people could not venture more than 100 m (330 ft) from their homes, private vehicles could transport a maximum of two passengers, and taxis took only one passenger. Compulsory temperature testing was required for essential workers at their workplace, and anyone with a temperature above 38 °C (100 °F) was to be sent home.

To ensure optimal patient flow, reduce the risk of viral transmission and allow for healthcare workforce shortages due to viral infection, non-urgent elective surgical procedures were either reduced or postponed. Medical resource allocation was reorganized to enforce care for COVID patients, thus minimizing other services.

During the lockdown, it was supposed to have very few trauma or other emergency admissions not related to COVID-19. In order to strengthen the staff of departments caring for patients infected with coronavirus, first, trauma coordinators and, second, trauma residents were recruited. The same happened for ICU staff and a shortage of personnel lead to a shortage of ICU active beds. This restructuring was performed at most hospitals taking COVID patients and increased the workload on the non-COVID staff, mainly in surgical emergencies, trauma and non-COVID ICU.

Despite the overall decrease of patient's admissions to the emergency departments, trauma admissions continued to present [4,5]. The overall volume of injured patients in Israel significantly decreased during the lockdown period of the COVID-19 outbreak, with the greatest decrease registered for road traffic collisions (RTCs) [6]. However, this trend was not studied for tertiary trauma centers in Israel.

The aim of this study was to gain a clear understanding of the impact that a nationwide lockdown has on the demographics, mechanisms and severity of injuries compared to a parallel period and provide recommendations for trauma service practice in a tertiary trauma center during a pandemic lockdown. We hypothesized that trauma service is still immersed and that resources allocation during COVID pandemic should include trauma service maintenance at the same level of preparedness.

2. Materials and Methods

A retrospective, descriptive study was conducted on prospectively collected trauma registry data on injured patients of all age groups and injury severities hospitalized to a level one trauma center during the community lockdown in response to the COVID-19 pandemic.

The study group consisted of admissions over the 25 days after the declaration of restrictions on 25 March 2020 of the lockdown period through to 19 April 2020 ('lockdown group').

In order to compare results, we chose a 25-day period from the previous years (1 to 25 April 2015–2019).

Patient data included age, gender, cause of injury, trauma team activation, injury severity (ISS) and injury outcome (need for operations, length of stay in hospital (LOS), ICU need and in-hospital mortality). The ISS was divided categorically according to severity as 1–8, 9–15, $\geq$16 and $\geq$25. The threshold for moderate to major injury was ISS > 15. All admitted patients were tested for COVID-19.

Only for hospitalized patient the ISS, ICU need and hospital length of stay (LOS) were recorded. Trauma team activations (TTA) were recorded for the same time periods and analyzed separately. TTA were driven by factors determining the immediate resource needs to deliver optimal care to the patient. TTA is based on a prehospital team request of emergency department (ED) triage and on recognized guidelines [7].

The mechanism of the injury was subcategorized into low energy falls (falls at the same level), high energy falls (including stairs and ladder), motor vehicle crashes (including bicycle and all-terrane vehicles), pedestrian trauma, burns, assault (including punching) and others (accidental laceration, crush injury and sports-related injury). Road accidents

included both motor vehicle crashes (MVC) and pedestrians hit by any vehicle. Self-inflicted injuries (any mechanism) were presented separately.

Hospital resources used to assess the trauma team activities were the number of TTAs, number of operations done for trauma patients, ICU needs and length of stay both in the hospital and in ICU.

Statistical Analysis

Categorical data are presented as total counts and percentages. Statistical significance was calculated using the chi-square test for categorical data. The Fisher's exact test was used to compare two groups of categorical data. The LOS is presented as the mean (plus minus standard deviation). The Pearson χ^2 was used to compare means. p-values < 0.05 were considered statistically significant, and 95% confidence intervals were used. The statistical analysis was performed using IBM SPSS Statistics (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. IBM Corp., Armonk, NY, USA).

3. Results

Table 1 presents the demographic and the incidental characteristics of the hospitalized injured patients over the periods studied. The overall number of hospitalized injured patients remained constant over both time periods and did not decrease in 2020 during the COVID-19 lockdown (152 vs. 162 ± 28). Pedestrian injuries were the only mechanism of injury that demonstrated a statistically significant change (<0.02), wih a decrease from 11 ± 5 patients in 2015–2019 to only 2 in the lockdown of 2020. The rate of admissions secondary to falls and MVC was similar between periods.

Table 1. Demographic, incidental and hospital resources utilization characteristics of the hospitalized injured patients during the lockdown period (March 25 2020 through to April 19 2020) and control periods (1 to 25 April 2015–2019).

	Lockdown		**2019**		**2018**		**2017**		**2016**		**2015**		**Average (±SD)**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	
N	152		157		134		145		205		172		162.6 ± 27.6
Male	103	67.8	103	65.6	83	62	96	66.2	131	64	100	58.1	102.6 ± 18
Mechanism of injury													
Low falls	56	36.8	55	35	45	33.6	42	29	61	29.8	59	34.3	52.4 ± 8.5
High falls	27	17.7	23	14.6	27	20.1	33	22.8	29	14.1	34	19.8	29.2 ± 4.5
Road accidents	30	19.7	41	26.1	31	23.1	32	22.1	64	31.2	49	28.5	43.4 ± 14
MVC	28	18.4	31	19.7	21	15.7	24	16.6	44	21.5	41	23.8	32.2 ± 10
Pedestrian *	2	1.3	10	6.4	10	7.5	8	5.5	20	9.6	8	4.7	11.2 ± 5
Penetrating	10	6.6	6	3.8	10	7.5	9	6.2	14	6.8	11	6.4	10 ± 3
Burns	10	6.6	8	5.1	9	6.7	9	6.2	12	5.9	8	4.7	9.2 ± 1.6
Assault	5	3.3	4	2.5	3	2.2	5	3.4	11	5.4	4	2.3	5.4 ± 3.2
Suicide	2	1.3	1	0.6	0		1	0.7	1	0.5	0		0.6 ± 0.5
Others	14	9.2	8	5.1	10	7.5	15	10.3	14	6.8	7	4.1	10.8 ± 3.5
ISS													
1–8	66	43.4	62	39.5	56	41.8	52	35.9	84	41	71	41.3	65.2 ± 13
9–15	62	40.8	69	44	54	40.3	63	43.4	75	36.6	72	41.9	66 ± 8.3
≥16	24	15.8	26	16.6	24	17.9	30	20.7	46	22.4	29	16.9	31 ± 8.7
≥25	7	4.6	8	5.1	9	6.7	10	6.9	19	9.2	9	5.2	11 ± 4.5

Table 1. *Cont.*

	Lockdown		2019		2018		2017		2016		2015		Average (±SD)
	N	%	N	%	N	%	N	%	N	%	N	%	
Age groups													
0–2	19	12.5	12	7.6	14	10.4	14	9.7	19	9.2	12	7	14.2 ± 2.9
≤16	47	31	42	26.7	46	34.3	44	30.3	63	30.7	43	25	47.6 ± 8.7
≥65	34	22.3	38	24.2	33	24.6	38	26.2	40	19.5	44	25.6	38.6 ± 4
≥80	22	14.5	21	13.4	14	10.4	14	9.7	14	6.8	21	12.2	16.8 ± 3.8
Outcomes													
Trauma Team Activation	45	29.6	42	26.8	40	29.9	45	31	78	38	52	30.2	51.4 ± 15.5
OR	61	40	69	43.9	62	46.2	62	42.8	95	46.3	86	50	74.8 ± 15
ICU	24	15.8	27	17.2	27	20.1	31	21.4	42	20.5	29	16.9	31.2 ± 6
LOS †	4.7 ± 6.8		5.8 ± 7.8		5.5 ± 6.0		7.4 ± 9.2		7.1 ± 8.6		7.5 ± 11.7		6.6 ± 9
Mortality	2	1.3	1	0.6	5	3.7	0		4	2	0		2 ± 2.3

ISS—Injury severity score; OR—number of patients that required operations: ICU—number of patients that required an intensive care unit stay; LOS—hospital length of stay (in mean ± standard deviation); * $p = 0.02$; † $p = 0.03$.

In terms of age composition, there was a non-significant increase in the number of injured children aged 0–2 years old during the 2020 lockdown. We recorded a stable number of injuries among citizens older than 65.

Compared to the previous years, the severity of injuries during the Marc–April 2020 lockdown was unchanged (Table 1). Hospital resources (number and percentage of trauma patients who required an operation and ICU stay and hospital LOS) were not different between the groups.

Table 2 shows the utilization of trauma resources (TTA) and the clinical outcomes in each studied period. Fewer trauma patients arrived with a TTA code during the lockdown period ($n = 58$, 33% decrease compared to control), but a significantly higher proportion of those patients required hospitalization (77.6% during the lockdown period compared to 44.5 ± 3.4% during the control period; $p < 0.0001$). Absolutely less road accident victims sought trauma care during the lockdown period (24 vs. 54.6 ± 16). Only two patients required TTA following pedestrian trauma (3.4%) during the lockdown period, significantly less than the control group (13.4 ± 5.7, $p = 0.05$). The number of burns requiring TTA was significantly higher during the lockdown period (9 patients vs. 4.2 ± 2.4; $p = 0.008$). The number of TTA for children (age ≤ 16) was higher ($p = 0.03$) during the lockdown period ($n = 21$, 36.2%) compared with the control period ($n = 29$, 32.5%)

Table 2. The utilization of trauma team resources and outcomes of the injured patients presented to the emergency department during the lockdown period (25 March 2020 through to 19 April 2020) and control periods (1 to 25 April 2015–2019).

TTA	Lockdown		2019		2018		2017		2016		2015		Average (±SD)
	N	%	N	%	N	%	N	%	N	%	N	%	
N	58		89		85		116		143		114		109 ± 24
Male	47	81	68	76.4	55	64.7	87	75	107	74.8	82	72	80 ± 20
HOSP *	45	77.6	42	47.2	40	47	45	38.8	65	45.5	52	43.9	49 ± 10

Table 2. *Cont.*

TTA	Lockdown		2019		2018		2017		2016		2015		Average (±SD)
	N	%	N	%	N	%	N	%	N	%	N	%	
Mechanism of injury													
Low falls	5	8.6	9	10.1	3	3.5	9	7.8	6	4.2	6	5.3	6.6 ± 2.5
High falls	12	20.7	15	16.9	16	18.8	30	25.9	26	18.2	16	14	20.6 ± 7
Road accidents	24	41.3	53	59.6	49	57.6	57	49.1	79	55.2	35	30.7	54.6 ± 16
MVC	22	38	43	48.3	36	42.3	44	38	56	39.2	27	23.7	41 ± 10.7
Pedestrian *	2	3.4	10	11.2	13	15.3	13	11.2	23	16.1	8	7	13.4 ± 5.7
Burns *	9	15.5	5	5.6	3	3.5	2	1.7	8	5.6	3	2.6	4.2 ± 2.4
Assault	2	3.4	2	2.2	1	1.2	6	5.2	9	6.3	5	4.4	4.6 ± 3.2
Age groups													
0–2	5	8.6	7	7.8	7	8.2	8	6.9	5	3.5	5	4.4	6.4 ± 1.3
≤16	21	36.2	29	32.5	27	31.8	35	30.2	46	32.2	26	22.8	32.6 ± 8.2
≥65	3	5.2	6	6.7	3	3.5	15	13	9	6.3	4	3.5	7.4 ± 4.8
≥80	3	5.2	2	2.2	0		2	1.7	1	0.7	1	0.9	1.2 ± 0.8

TTA—trauma team activation; HOSP—patients hospitalized following assessment in the emergency department by the trauma team; * $p < 0.05$.

4. Discussion

Despite the overall decrease in emergency department visits [8], this study did not reveal significant reductions in the overall volume of all injury admissions during the COVID-19 lockdown period. However, trauma-related admissions to the ED which required TTA reduced significantly (by 33%), together with the increased need for hospital admission in this group of patients during the lockdown period ($p < 0.0001$). Hence, looking at hospital resources allocated for trauma patients, no change could be observed. During the lockdown period, only two injured pedestrians required hospitalization compared with a similar period in the previous 5 years. Furthermore, the number of burn-related admissions was higher during the lockdown period, both from domestic and accidental events ($p < 0.008$). The remaining epidemiology of trauma activations was similar between the groups. Only one patient had a positive COVID-19 test. Expectedly, the rate of MVCs fell during the lockdown period, as road use was limited to essential driving; we would actually have expected them to be negligible. In fact, according to the Israel National Trauma Registry, the number of MVCs in Israel with casualties decreased by 50% during March–May 2020 compared to the same period in 2019 [9].

Fewer visits to the ED following trauma were reported in the UK [10], New Zealand [11] and Italy [12]. However, these data are localized, and no firm trends and analyses are currently publicly available. In our study, the number of patients arriving following MVCs was constant. A possible explanation is non-adherence to lockdown rules and an increasing number of speeding drivers, as the streets were empty.

During a lockdown period, some trauma leaders reported increases in domestic, recreational, and pediatric trauma [13,14]. We can hypothesize that when people spend more time at home, it may increase the rate of burn injuries as a result of increased cooking or barbecuing. Domestic injuries in children also increased, as they spent more time at home instead being at school and organized activities. In fact, we saw a 10% but not significant increase in ED admissions which required TTA in the group of kids (age < 16). The incidence of domestic traumas (fall from ladder) was the same during both periods.

The elderly population is always at an increased risk for falls. During the lockdown period, there were more rigid social distancing recommendations for this group because of the obvious increased risk of contracting COVID-19 with the potential for devastating

outcomes. As less time was spent outside, we expected to see a decline in the number of falls in this population. Our data did not show any change in the number and pattern of elderly trauma cases, irrespective of age. It seems that regular activity for this group did not change considerably with the strict restrictions during lockdown.

Interestingly, the number of major trauma admissions also remained at the same level. Neither ISS > 15 nor the number of patients who required ICU care decreased despite driving restrictions. The same constant rate of trauma cases which required surgical procedures was observed in our study. The group of patients who arrived by ambulances during the lockdown period and required TTA had a higher admission rate (77%, $p < 0.0001$). It appears that people suffering from minor injuries refused to be evacuated to hospitals. "Fear" of being hospitalized during the COVID spread also was a part of public behavior during the whole study period. This also could explain the fact that the hospital LOS was shorter in the study group. Some hospitals employed a conscious policy of sending the patients home into lockdown as fast as possible, in order to reduce the risks of the virus spreading in a hospital environment and to make more hospital resources available.

An increased unemployment rate and significant decline in income can trigger an increase in criminal behaviors [15]. We did not observe an increase in violence (both penetrating and other types of assaults) during the lockdown period compared to the control period. Albeit, the number of casualties of violence in Israel is small, and comparisons cannot be made.

Important limitations to this study should be noted, including the focus on a single center's population. Trauma care in the area is divided between two trauma centers. In order to decrease this bias, we performed the analysis of the trauma admissions during the previous 5 years. A short 25-day period was chosen, but it reflected the only one strict lockdown that happened in Israel, when many emergency services were rescued to fight the COVID-19 pandemic. Although this is an important study, it is the first report on the effect of social distancing on trauma care at a single level 1 Trauma center in Israel. Trauma, by its nature, varies from month to month, so it is possible that there were other factors influencing the trauma volume in March and April 2020 compared to the 5 previous years (there was a major military conflict in 2016, which caused an increase in the number of trauma-related admissions).

5. Conclusions

This expected reduction of trauma volume in a major trauma center caused the redeployment of trauma service staff to help hospital departments struggling with COVID-19. A reduction of the elective workload did not influence the trauma-related workload. The appropriate provision in operating theaters and ICU beds should remain in place to ensure trauma patients can be managed as a surgical priority. The maintenance of an effective full-staffed trauma service is vital throughout the COVID-19 lockdown.

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