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Increased Incidence of COVID-19 Infections Amongst Interpersonal Violence Patients

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ABSTRACT

Objective: To investigate whether any specific acute care surgery patient populations are associated with a higher incidence of COVID-19 infection.

Background: Acute care providers may be exposed to an increased risk of contracting the COVID-19 infection since many patients present to the emergency department without complete screening measures. However, it is not known which patients present with the highest incidence.

Methods: All acute care surgery (ACS) patients who presented to our level I trauma center between March 19, 2020, and September 20, 2020 and were tested for COVID-19 were included in the study. The patients were divided into two cohorts: COVID positive (+) and COVID negative (-). Patient demographics, type of consultation (emergency general surgery consults [EGS], interpersonal violence trauma consults [IPV], and non-interpersonal violence trauma consults [NIPV]), clinical data and outcomes were analyzed. Univariate and multivariate analyses were used to compare differences between the groups.

Results: In total, 2177 patients met inclusion criteria. Of these, 116 were COVID+ (5.3%) and 2061 were COVID- (94.7%). COVID+ patients were more frequently Latinos (64.7% *versus* 61.7%, $P = 0.043$) and African Americans (18.1% *versus* 11.2%, $P < 0.001$) and less frequently Caucasian (6.0% *versus* 14.1%, $P < 0.001$). Asian/Filipino/Pacific Islander (7.8% *versus* 7.2%, $P = 0.059$) and Native American/Other/Unknown (3.4% *versus* 5.8%, $P = 0.078$) groups showed no statistical difference in COVID incidence. Mortality, hospital and ICU lengths of stay were similar between the groups and across patient populations stratified by the type of consultation. Logistic regression demonstrated higher odds of COVID+ infection amongst IPV patients (OR 2.33, 95% CI 1.62-7.56, $P < 0.001$) compared to other ACS consultation types.

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Conclusion: Our findings demonstrate that victims of interpersonal violence were more likely positive for COVID-19, while in hospital outcomes were similar between COVID-19 positive and negative patients.

Introduction

Cases of coronavirus disease 2019 (COVID-19) were first identified in the United States in January 2020 and attained widespread community transmission shortly thereafter.[1] The World Health Organization subsequently declared it a pandemic on March 11, 2020. Nearly ten months later, the exact pathophysiology remains largely unknown, however, it is widely believed that respiratory droplets are the primary mode of transmission.[2,3] Social distancing, in the form of restricting unnecessary activity outside of the home and closure of non-essential businesses, along with mask wearing guidelines and other public health policies, have been embraced as the chief means of limiting viral dissemination.[4,5] Several studies have since shown lower numbers of cases across multiple populations and decreased volume experienced by hospitals around the world.[6-8] The state of California enacted statewide stay-at-home mandates on March 19, 2020, although cases continued to rise, likely secondary to poor compliance.[9]

The relationship between trauma volume and COVID has now been studied by several groups, with a common finding of a decrease in total volume across several states following the implementation of social distancing measures.[10-15] An alarming finding, however, is the increase in percentage of penetrating trauma cases, most commonly due to gunshot wounds and particularly in areas where COVID density is highest.[16-19] While no solitary cause has been identified and proven, this may be an unfortunate consequence of prolonged societal isolation that is producing increased panic leading to arms purchases, unmasking of mental health conditions and compounding home violence.[13,18,20]

While the impact of the pandemic on the epidemiology of trauma has been previously described, its effect on patient outcomes has yet to be determined.[20] Due to its nature, interpersonal violence often requires close interpersonal interaction. When compared to other mechanisms of injury, interpersonal violence may therefore increase the likelihood of direct droplet transmission of COVID and subsequent infection. In the present study we examine the implications of the observed changes in trauma presentations and hypothesize that victims of interpersonal violence are more likely to present with incidental COVID-19 than any other type of acute care surgery patients.

Methods

We conducted a retrospective cohort study at the Los Angeles County + University of Southern California (LAC+USC) Medical Center from March 19, 2020 until September 20, 2020. The LAC+USC Medical Center is an acute care teaching facility and one of the largest county hospitals in the Unites States with more than 150,000 annual visits to the Emergency Department (ED). This study was approved by the Institutional Review Board at the University of Southern California. A waiver of informed consent was granted given the use of deidentified data.

All patients who required a consultation to the Acute Care Surgery (ACS) service were included in the study. Consultations were made at the discretion of the ED attending for patients who were deemed as needing trauma surgery intervention or admission or an emergency general surgical intervention. Patients in whom COVID testing was not performed were excluded. COVID testing was performed for all patients with respiratory symptoms such as fever, cough and shortness of breath, those who endorsed positive contacts or had recent international travel.[21] The patients were then divided into two cohorts: COVID+ and COVID-. Patient characteristics were compared including age, gender, race, frequency of emergency procedures (defined as requiring an operative or angioembolization procedure before 8 hour COVID testing results could be obtained), admission vitals, and type of consultation [emergency general surgery (EGS), interpersonal violence trauma consults (IPV), non-interpersonal violence trauma consults (NIPV)]. IPV consults were those defined as patients who sustained blunt assault, stab wound, or gunshot wound (GSW), excluding self-inflicted injuries. NIPV consults were the remaining consults to the trauma surgery service, including falls, self-inflicted trauma, motor vehicle accidents and other forms of blunt trauma. Subgroup analysis was performed among trauma patients, with comparison of mechanism and injury severity score.

Descriptive statistics were reported as either means and standard deviations or medians and interquartile ranges for continuous variables and as frequencies and proportions for categorical variables. Variables between groups were compared using univariate analysis. Chi-square or Fisher's exact test was used for categorical variables and Mann-Whitney U test was used for continuous variables as appropriate. A multivariate logistic regression model was then created to compare adjusted outcomes, such as mortality, hospital length of stay (HLOS) and intensive care unit length of stay (ICU LOS) among all patients and among trauma patient subgroups specifically. Variables included in the model were age >65 years, systolic blood pressure (SBP) < 90 mmHg, Glasgow Coma Scale (GCS) < 9, need for emergency procedures and type of consultation (NIPV, IPV or EGS). Dichotomized injury severity score (ISS)> 15 and mechanism were also included in the trauma subgroup model. A second multivariate logistic regression model was created to determine the odds of COVID infection accounting for age, gender, race, consultation and need for emergency procedures. We considered P values < 0.05 to be significant. Analysis was performed using

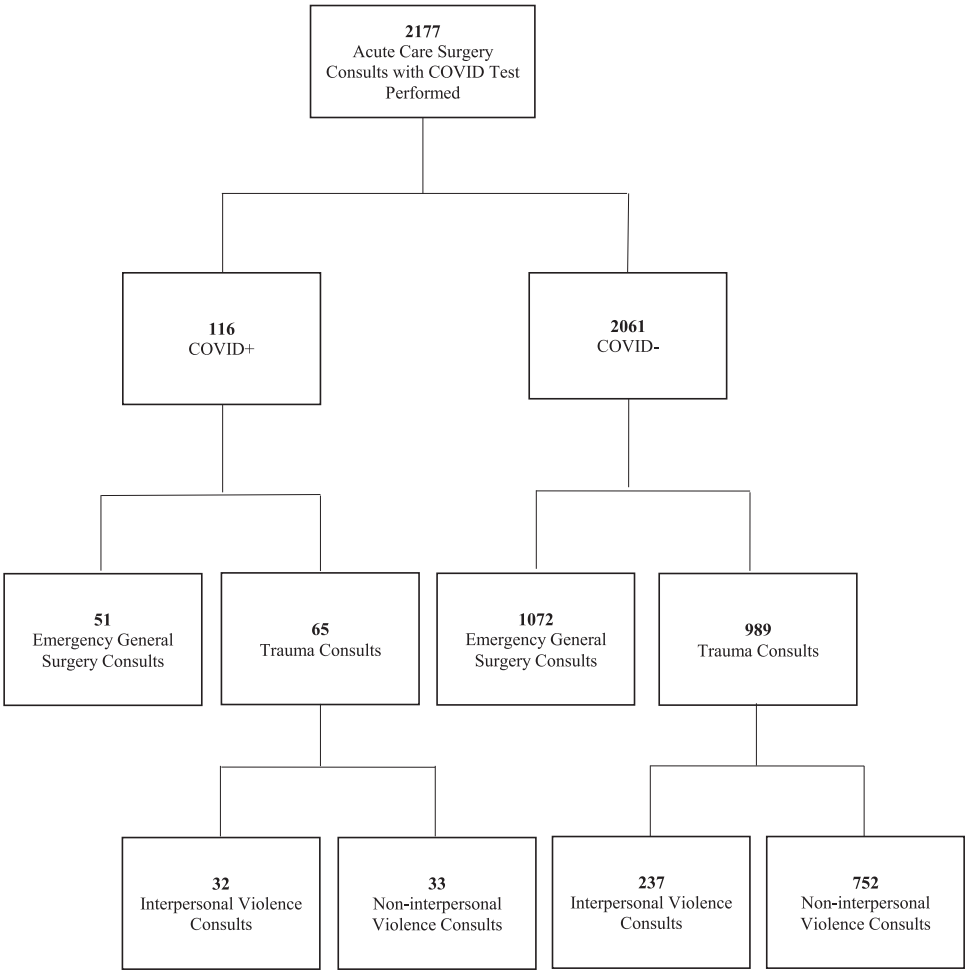

Fig. 1 – Patient inclusion flow diagram. Color version of figure is available online.

SAS Studio Software for Windows version 3.6 (Cary, North Carolina, USA) and R version 4.0.0.

Results

A total of 2177 patients met our inclusion criteria. Of these, 116 were COVID+ (5.3%) and 2061 were COVID- (94.7%) Of the total number of patients, 269 met IPV criteria (12.4%) (Fig. 1). Both cohorts were similar in age (49.6 *versus* 48.4, $P = 0.448$) and male gender (53.4 *versus* 51.9, $P = 0.153$). COVID+ patients were more frequently Latinos (64.7% *versus* 61.7%, $P = 0.043$) and African Americans (18.1% *versus* 11.2%, $P < 0.001$) and less frequently Caucasian (6.0% *versus* 14.1%, $P < 0.001$). Asian/Filipino/Pacific Islander (7.8% *versus* 7.2%, $P = 0.059$) and Native American/Other/Unknown (3.4% *versus* 5.8%, $P = 0.078$) groups showed no statistical difference in COVID incidence. (Table 1) After logistic regression analysis was performed, there was notable increased odds among African American (1.92, 95% CI 1.21-2.85, $P < 0.001$) and Latino patients (1.68, 95% CI 1.13-2.47, $P < 0.001$) when compared to Caucasian patients. Asian/Filipino/Pacific Islander and Native American/Other/Unknown groups did not demonstrate a statistically different odds of COVID positivity compared to Caucasian patients. (Table 4)

No difference was noted in admission vitals. Of note, COVID+ patients were slightly more likely to undergo emergency procedures (10.3% *versus* 8.3%, $P = 0.038$) with a higher incidence operative procedure in the COVID+ cohort (9.5% *versus* 8.0%, $P = 0.046$) Among the trauma subgroup, median ISS as well as the frequency of severe trauma (ISS > 15) were similar between COVID+ and COVID- patients (15.4% *versus* 16.9%, $P = 0.076$). Penetrating trauma was more likely in the COVID+ group (27.7% *versus* 21.0%, $P = 0.042$), with a significantly higher GSW (12.3% *versus* 8.4%, $P = 0.016$). (Table 1)

Unadjusted analyses of in hospital mortality, HLOS, and ICU LOS, revealed no differences between the cohorts. Similarly, no difference in outcomes was observed among trauma patients based on COVID status (Table 2). On logistic regression analysis, mortality, HLOS and ICU LOS were no different between both cohorts. Similarly, amongst the trauma subgroup after logistic regression, no differences in mortality, HLOS and ICU LOS were noted. (Table 3)

Finally, a separate logistic regression model using age, gender, race, type of ACS consultation and need for emergency procedures was performed to determine the odds ratio (OR) of COVID positivity. Analysis yielded an OR of 2.44 for IPV pa-

Table 1 – Univariate comparison based on COVID status.

Variable	COVID+ ($n = 116$)	%, SD or IQR	COVID- ($n = 2061$)	%, SD or IQR	*P* value
Age (years, mean, SD)	49.6	20.1	48.4	21.2	0.448
Gender (male, *n*, %)	62	53.4	1069	51.9	0.153
Race (*n*, %)					
Caucasian	7	6.0	291	14.1	< 0.001
African American	21	18.1	230	11.2	< 0.001
Asian /Filipino/Pacific Islander	9	7.8	148	7.2	0.059
Latino	75	64.7	1273	61.7	0.043
Native American/ Other/Unknown	4	3.4	119	5.8	0.078
Emergency Procedures (*n*, %)	12	10.3	171	8.3	0.038
Operating Room	11	9.5	165	8.0	0.046
Angioembolization	1	0.9	6	0.3	0.573
Admission Vitals					
HR (mean, SD)	88	13.3	90	14.1	0.117
SBP < 90, (*n*, %)	4	3.5	62	3.0	0.095
RR (mean, SD)	19	4.1	18	4.6	0.263
SpO2 (mean, SD)	94	2.7	95	1.9	0.562
GCS < 9, (*n*, %)	4	3.4	82	4.0	0.081
Consultation Type (*n*, %)					
EGS	51	44.0	1072	52.0	0.008
IPV	32	27.6	237	11.5	< 0.001
NIPV	33	28.4	752	36.5	0.035
Penetrating Mechanism (*n*, % trauma)	18	27.7	208	21.0	0.042
GSW (*n*, % trauma)	8	12.3	83	8.4	0.016
ISS (Trauma Consults, Median, IQR)	9	8-10	9	8-11	0.873
ISS ≤ 15 (*n*, % trauma)	55	84.6	822	83.1	0.076
ISS > 15 (*n*, % trauma)	10	15.4	167	16.9	0.076

COVID = Coronavirus Disease; EGS = Emergency General Surgery; GCS = Glasgow Coma Scale; GSW = Gunshot Wound; HR = Heart Rate; IPV = Interpersonal violence trauma consultation; ISS = Injury Severity Score; NIPV = non-interpersonal violence trauma consultation; RR = respiratory rate; SBP = systolic blood pressure; SpO2 = oxygen saturation.

Table 2 – Outcomes based on COVID status.

Variable	COVID+	% or SD	COVID-	% or SD	*P* value
All Patients	$n = 116$		$n = 2061$		
Mortality Rate	2	1.7	38	1.8	0.628
HLOS, d (median)	1	0-2	1	0-3	0.215
ICU LOS d (median)	1	0-2	1	0-2	0.999
Trauma Patients	$n = 65$		$n = 989$		
Mortality Rate	1	1.5	21	2.1	0.132
HLOS, d (median)	2	2-3	2	2-3	0.999
ICU LOS d (median)	1	0-2	1	0-2	0.874

COVID = Coronavirus Disease; HLOS, Hospital Length of Stay; ICU LOS, Intensive Care Unit Length of Stay

tients (95% CI 1.62-7.56, $P < 0.001$) while there was no significant difference in likelihood among EGS and NIPV patients. Patients requiring emergency interventions such as an urgent operation or interventional radiology demonstrated a higher OR as well (1.18, 95% CI 1.04-2.16, $P < 0.045$). (Table 4).

Discussion

In this study at a high-volume, urban Level 1 trauma center, our findings demonstrate that amongst victims of IPV, the odds of a positive COVID screen at the time of admission was

Table 3 – Adjusted outcomes based on COVID status.

Variable	Odds Ratio	95% CI	P value
All Patients			
Mortality	1.03	0.74-1.31	0.776
HLOS > 1day	1.06	0.63-1.81	0.721
ICU LOS > 1 day	1.01	0.86-1.12	0.910
Trauma Patients			
Mortality	0.98	0.66-1.49	0.573
HLOS > 1day	0.99	0.97-1.01	0.649
ICU LOS > 1 day	1.00	0.98-1.01	0.805

HLOS = Hospital Length of Stay; ICU LOS = Intensive Care Unit Length of Stay

nearly 2.5 times that of other ACS patient populations. Additionally, racial subgroups such as African Americans and Latino patients were noted to have higher odds of presenting with a COVID infection at the time of arrival. We also demonstrate that outcomes, such as mortality and length of stay, do not appear to be affected by COVID status among ACS patients. To our knowledge, this is the first study of its kind. Our results suggest that vigilance should be exercised by healthcare providers in the care of patients who present secondary to interpersonal violence until testing can be performed and the disease ruled out. Additionally, since patients requiring emergency procedures were notably more likely to have COVID, possibly due to increased rates of penetrating trauma, operating room precautions in rule-out cases should be consistently applied.

The COVID-19 pandemic remains novel in many aspects, even as nearly a full year has passed since its outbreak. The impact of this type of public health crisis has not been observed in over a century and has led to massive societal changes. The world's understanding of the pathophysiology behind the virus and the means to mitigate its spread are still under development. However, social distancing has been proven repeatedly as an effective means of preventing transmission.[22-24] Stay-at-home orders have also had a secondary effect of reducing the incidence of trauma nationwide, although its overall impact on trauma is an area of evolving study. The pandemic has also unfortunately led to an unprecedented increase in the percentage of interpersonal violence and penetrating trauma in various cities.[13,14,20]

There are several theories as to the etiology of this observation, such as unmasking of underlying depression resulting in increased homicide and suicide due to prolonged isolation, increased panic driven firearms purchases and the rise of unemployment indirectly leading to increased domestic violence.[14,20] Additionally, discrepancies in the incidence of COVID as it pertains to race is now being readily observed.[25] Our observations regarding race between the various ACS patient cohorts is consistent with institutional historical controls, as IPV is noted to be higher amongst African American patients.[26] As reported in population level literature, COVID+ patients in our study were more likely to be African American or Latino and the incidence amongst Caucasians was significantly lower than those of any other race.[25,27,28] These findings, while not surprising, demonstrate that socioeconomic disparities that are partially responsible for higher rates of IPV and penetrating trauma may be equally as relevant in the spread of COVID amongst trauma patients.[29]

Table 4 – Multivariate logistic regression for likelihood of COVID infection.

Variable	Odds Ratio	95% CI	P value
Age			
< 65 years	1	-	-
≥ 65 years	0.97	0.73-1.20	0.428
Gender			
Male	1	-	-
Female	0.95	0.79-1.14	0.626
Race			
Caucasian	1	-	-
African American	1.92	1.21-2.85	< 0.001
Asian /Filipino/Pacific Islander	1.06	0.23-1.18	0.243
Latino	1.68	1.13-2.47	< 0.001
Native American/ Other/Unknown	0.85	0.57-1.14	0.580
Consultation Type			
EGS	1	-	-
IPV	2.44	1.62-7.56	< 0.001
NIPV	0.94	0.59-2.21	0.971
Procedures			
Emergency Procedure Not Required	1	-	-
Emergency Procedure Required	1.18	1.04-2.16	0.045

EGS = Emergency General Surgery; IPV = Interpersonal violence trauma consultation; NIPV = non-interpersonal violence trauma consultation

Encouragingly, our results demonstrated no major difference between cohorts in primary outcomes, such as mortality, HLOS and ICU LOS. However, the medium to long-term effect COVID has on trauma patients at this time is unclear. Additionally, while our data does not explicitly analyze the change in trauma volume or percentage of penetrating trauma, it does demonstrate that the disease is indirectly linked to an increase incidence of suffering from penetrating trauma, particularly gunshot wounds, which is consistent with studies from other major academic centers.[13,20]

We readily acknowledge several limitations in this study. A limitation includes the retrospective nature and as such, several hundreds of patients were eliminated from analysis due to the lack of COVID testing. A majority of these eliminated patients came from the earliest months of the lockdown (March and April) when there was an extreme dearth in the availability of testing in Los Angeles County. Many patients were only tested when noted to have respiratory symptoms or prior to inpatient admission. It is very likely several COVID+ patients were eliminated from the analysis, which can result in selection bias. Second, it is well known that interpersonal violence skews heavily towards racial minorities. This reflects the emerging evidence that COVID is clustered in areas predominantly inhabited by underserved members of the population (many from minority races), where socioeconomic conditions predispose to an inability to effectively social distance and where there exists a significant disparity in access to healthcare which predates the pandemic.[19,30] Ultimately, we believe public health efforts should focus in particular on these lower socioeconomic areas – ameliorating overall health conditions may allow an improvement in the ability to social distance, thus reducing the burden of COVID-19, and may also address factors that contribute to IPV. Finally, only 65 COVID+ patients were identified amongst the trauma patients and no long-term follow up could be performed. It is possible this small value makes this study underpowered to show a difference between the two groups if it exists, such as with regards to mortality, HLOS and ICU LOS. Additionally, the lack of follow up prevents a deeper understanding of the long-term consequences of this disease on trauma patients.

Conclusions

The results of this study show that while there may be minimal direct short- to medium-term consequences in regard to outcomes, the disease may frequently co-present in IPV trauma patients. Additionally, COVID-19 infections amongst African American and Latino trauma patients are considerably higher than in other members of the population. To this end, public health efforts must continue to mitigate risk factors for violent crime and, by extension, the disparities that may contribute to it in this population. Finally, healthcare providers should remain vigilant when treating this subset of patients to prevent inadvertent transmission to themselves.

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Disclosure statement

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Conflict of interest

None

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