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Incidence of Gunshot Wounds: Before and After Implementation of a Shall Issue Conceal Carry Law

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ABSTRACT

Introduction. This study examined the incidence of gunshot wounds before and after enacting a conceal carry (CC) law in a predominately rural state.

Methods. A retrospective review was conducted of all patients who were admitted with a gunshot injury to a Level I trauma center. Patient data collected included demographics, injury details, hospital course, and discharge destination.

Results. Among the 238 patients included, 44.6% (n = 107) were admitted during the pre-CC period and 55.4% (n = 131) in the post-CC period. No demographic differences were noted between the two periods except for an increase in uninsured patients from 43.0% vs 61.1% (p = 0.020). Compared to pre-CC patients, post-CC patients experienced a trend toward increased abdominal injury (11.2% vs 20.6%, p = 0.051) and increased vascular injuries (11.2% vs 22.1%, p = 0.026) while lower extremity injuries decreased significantly (38.3% vs 26.0%, p = 0.041). Positive focused assessment with sonography in trauma (FAST) exams (2.2% vs 16.8, p < 0.001), intensive care unit admission (26.2% vs 42.0%, p = 0.011) and need for ventilator support (11.2% vs 22.1%, p = 0.026) all increased during the post-CC period. In-hospital mortality more than doubled (8.4% vs 18.3%, p = 0.028) across the pre- and post-CC time periods.

Conclusion. Implementation of a CC law was not associated with a decrease in the overall number of penetrating injuries or a decrease in mortality. ***Kans J Med 2020;13:38-42.***

INTRODUCTION

United States (U.S.) civilians own more than 393 million firearms or 88.8 weapons per 100 people, nearly twice as many as the nearest leading nation.[1] The Federal Bureau of Investigation (FBI) reported in 2010 that firearms were used in 67.5% of U.S. murders.[2] The same year in Kansas, 10,531 violent crimes involving firearms were reported[2]; 63 resulted in murder.[3] According to the Centers for Disease Control (CDC), 73,505 non-fatal emergency room visits for firearm-related injuries occurred in 2010,[4] with associated costs of over half a billion dollars.[5]

It has been well established that increased gun ownership, access to gun dealers, or handgun purchase is associated with increased mortality from firearm injury.[6-11] Siegel et al.[6] reported gun ownership was a significant predictor of firearm homicides rates and that for each 1% increase in the gun ownership proxy, the firearm homicide rate increased by 0.9%. Likewise, in major cities where federal firearms licensees were more prevalent, Wiebe et al.[10] found gun homicide rates were also higher. Many states have passed firearm laws to regulate private citizens ownership or access to firearms[12] and states with a higher number of firearm laws have been shown to experience lower rates of firearm-related fatalities.[8]

Conceal Carry (CC) laws are state-based laws that regulate how private citizens can carry a firearm. These laws range from restrictive to unrestricted, and regulations vary by state and within state counties.[13] In 2006, Kansas enacted Senate Bill 418, the Personal and Family Protection Act, allowing approved applicants to conceal carry with a permit.[14] With an estimated population of 2,911,505, Kansas issued 116,649 permits by the end of 2013, or approximately 1 for every 35 citizens.[15,16]

In their landmark 1977 study, Lott and Mustard hypothesized an increased presence of law-abiding gun owners would prove to be a deterrent to crime.[17] The authors reported that CC laws lowered violent crimes and saved lives. The findings sparked wide debate regarding the studies robustness and reliability resulting in numerous researchers to re-examining Lott's findings.[18-26]

Previous studies largely have been limited to crime statistics from regional or national databases, seeking evidence to establish relationships between passage of concealed carry laws, crime rates, and homicide rates. However, study results are varied and inconsistent about whether passage of CC decreases[17,25-28] or increases[12,29-32] crime and homicide rates. Additional studies have shown mixed results noting that the impact of CC on crime and homicide rates vary.[13,22-24] Yet, other studies indicated that it is impossible to conclude that CC impacts crime and homicide rates[18-21] or that no association exists.[7,11,33-35]

Little clinical evidence is available regarding the effect CC legislation may have on the severity of traumatic gunshot wound (GSW) injuries. One barrier to understanding possible associations between firearm injury, weapon type, and owner intent is many states protect the identities of those who purchase CC permits. In addition, trauma registry data often lack GSW details related to the mechanism of injury, intent, location, and type of weapon. The purpose of this study was to describe the incidence of GSW-related injuries, type of weapon used, and hospital course and outcomes.

METHODS

A retrospective review of all trauma patients admitted for GSW at an American College of Surgeons verified Level I trauma center between April 1, 2004 and September 30, 2009 (33 months before and 33 months after the adoption of the Kansas Senate Bill 418) was performed. Data collection included demographics (age, gender, race, insurance status), injury details (Injury Severity Score [ISS], Glasgow Coma Scare score [GCS], admitting SBP [systolic blood pressure],

admitting DBP [diastolic blood pressure], arrived intubated), and hospital outcomes (mechanical ventilation, days on mechanical ventilation, intensive care unit [ICU] admission and length of stay, hospital length of stay, discharge destination, and in-hospital mortality). Determination of the type of weapon used (handgun, shotgun, rifle, or unspecified), as well as information related to the nature of the GSW (intentional vs accidental), were obtained from online patient medical records.

Patients were grouped according to admission date into either the pre-CC group (April 1, 2004 to December 31, 2006) or the post-CC group (January 1, 2007 to September 30, 2009). A focus was placed on those patients injured during accidental or criminal activity, rather than those who used a firearm to inflict an intentional GSW. Self-inflicted GSWs, therefore, were exclusionary. Patients also were excluded if they died during or immediately following resuscitation on arrival to the trauma center, the injury resulted from a gun which did not qualify for a concealed carry permit (tranquilizer, air, pellet), or the circumstances of the shooting were unknown.

Descriptive analyses were presented as frequencies with percentages for categorical variables and means with standard deviations for continuous variables. Data initially were summarized, and all data were presented as mean (SD) and percentage. Primary analyses were conducted comparing patients' demographics, injury characteristics, and outcomes by time of injury (pre- vs post-CC). All analyses were conducted using 2-tailed tests, and analyses were considered significant if the resultant p value was < 0.05. All analyses were conducted using SPSS release 19.0 (IBM Corp, Somers, New York). This study was approved for implementation by the Institutional Review Board of Via Christi Hospitals, Wichita, Inc.

RESULTS

During the study period, a total of 353 patients were treated for GSWs at the trauma center. Of these, 57 patients were found to have a self-inflicted GSW and 58 patients reported unknown circumstances surrounding their GSWs and were excluded. Among the remaining cohort of 238 patients, 44.6% (n = 107) were admitted during the pre-CC period and 55.4% (n = 131) in the post-CC period.

Among demographic and injury severity data, statistically significant differences were noted for insurance status and admitting systolic and diastolic blood pressure (Table 1). The number of patients with no insurance increased by approximately 20% in the post-CC group, while the number of patients with public or private insurance both decreased by 9% (p = 0.020). The average admitting systolic and diastolic blood pressure values were 9 to 12 points lower in the post-CC group (p = 0.021 and 0.011, respectively). No other demographic or injury severity differences were found.

During the post-CC period, the percentage of handgun injuries increased from 80.4% (n = 86) to 86.3% (n = 113; Table 2). The number of weapons used in the other categories (shotgun, rifle, unspecified) decreased during the post-CC period, however, none of the changes involving weapon type were statistically significant (p = 0.529). There was a slight increase in the frequency of intentional injuries when comparing the pre- and post-CC periods (82.2% vs 85.5%) and the percentage of injuries that were accidental decreased (17.8% vs 14.5%). However, these changes were not statistically significant (p = 0.496).

Table 1. Patient demographics and injury severity pre- and post-conceal carry.

Parameter*	Pre-Conceal Carry	Post-Conceal Carry	p value
Number of patients	107 (44.6%)	131 (55.4%)	---
Age (years)	28.0 ± 12.3	29.0 ± 10.9	0.505
Male sex	94 (87.9%)	116 (88.5%)	0.868
Race			0.805
White	48 (44.9%)	56 (42.7%)	
Black	37 (34.6%)	41 (31.3%)	
Hispanic	17 (15.9%)	26 (19.8%)	
Other	5 (4.7%)	8 (6.1%)	
Insurance status			0.020
None	46 (43.0%)	80 (61.1%)	
Public	26 (24.3%)	20 (15.3%)	
Private	35 (32.7%)	31 (23.7%)	
Injury Severity Score (ISS)	9.8 ± 13.6	29.0 ± 10.9	0.079
Glasgow Coma Scale score (GCS)	14.2 ± 2.6	13.8 ± 3.4	0.348
Systolic blood pressure (mmHg)	132.7 ± 34.6	120.5 ± 44.0	0.021
Diastolic blood pressure (mmHg)	88.9 ± 26.7	79.1 ± 31.4	0.011
Arrived intubated	10 (9.3%)	19 (14.5%)	0.226

*Presented as number (%) or mean ± standard deviation.

Table 2. Patient incident information pre- and post-conceal carry.

Parameter*	Pre-Conceal Carry	Post-Conceal Carry	p value
Number of patients	107 (44.6%)	131 (55.4%)	
Type of weapon			0.529
Handgun	86 (80.4%)	113 (86.3%)	
Shotgun	10 (9.3%)	11 (8.4%)	
Rifle	5 (4.7%)	3 (2.3%)	
Unspecified	6 (5.6%)	4 (3.1%)	
Nature of gunshot wound			0.496
Intentional	88 (82.2%)	112 (85.5%)	
Accidental	19 (17.8%)	19 (14.5%)	

*Presented as number (%).

Comparison of patient injuries pre- and post-CC are presented in Table 3. Incidence of vascular injuries (11.2% vs 22.1%, p = 0.026) significantly increased and a trend toward increased abdominal injury (11.2% vs 20.6%, p = 0.051) was noted during the post-CC period. However, lower extremity injuries decreased (38.3% to 26.1%, p = 0.041). No statistical differences were noted for the remaining injury types.

Table 3. Patient injuries pre- and post-conceal carry.

Parameter*	Pre-Conceal Carry	Post-Conceal Carry	p value
Number of patients	107 (44.6%)	131 (55.4%)	
Head	12 (11.2%)	17 (13.0%)	0.679
Neurologic deficit	12 (11.2%)	23 (17.6%)	0.169
Thoracic	21 (19.6%)	35 (26.7%)	0.200
Spine	4 (3.7%)	5 (3.8%)	0.975
Spinal cord	1 (0.9%)	3 (2.3%)	0.630
Abdominal	12 (11.2%)	27 (20.6%)	0.051
Pelvic	9 (8.4%)	10 (7.6%)	0.826
Upper extremity	21 (19.6%)	28 (21.4%)	0.740
Lower extremity	41 (38.3%)	34 (26.0%)	0.041
Vascular	12 (11.2%)	29 (22.1%)	0.026

*Presented as number (%).

On analysis, the frequency of positive FAST exams increased for post-CC patients from 2.2% to 16.8% (p < 0.001; Table 4). A significant change in overall trauma discharge destinations also was noted between the groups with increased operative management (20.6% vs 29.8%), ICU admission (15.0% vs 19.1%), and death in the trauma bay (2.8% vs 10.7%; p = 0.005) occurring during the post-CC period. No difference was demonstrated in the number of ICU days or ventilator days, however, the number of post-CC patients who required ICU admission (26.2% vs 42.0%, p = 0.011) and ventilator support (11.2% vs 22.1%, p = 0.026) did increase. In-hospital mortality increased significantly from 8.4% (n = 9) to 18.3% (n = 24) across the pre- and post-CC time periods (p = 0.028).

DISCUSSION

Since state firearm laws are passed to decrease crime and protect personal safety, it is incumbent on policymakers to carefully analyze the effect of any legislation to ensure that it does not produce the opposite effect. CC weapons laws are implemented to deter crime based on the theory that criminals have no way to know whether a potential victim is or is not carrying a firearm.[17] However, passage of such laws also may result in increased crime rates due to increased gun theft,[20,23,39] or due to more criminals carrying firearms.[19,29,33,34]

Numerous studies have attempted to address the impact CC law implementation has on crime and homicide rates, however, study findings are inconsistent.[7,11,12,13,17,18-35] In addition, several studies noted that the effect of concealed handgun laws is not fixed.[13,22-24] For instance, Dezhbakhsh et al.[23] demonstrated that the direction and magnitude of any change depends on county-specific characteristics, such as demographic, social, and economic factors. Study findings from Olson et al.[22] indicated that results can vary based on weapon type, victim characteristics, and victim-offender relationships.

Table 4. Patient hospital outcomes pre- and post-conceal carry.

Parameter*	Pre-Conceal Carry	Post-Conceal Carry	p value
Number of patients	107 (44.6%)	131 (55.4%)	
FAST exam			<0.001
Negative	88 (95.7%)	98 (82.4%)	
Positive	2 (2.2%)	20 (16.8%)	
Trauma discharge destination			0.005
Floor	51 (47.7%)	46 (35.1%)	
Operating room	22 (20.6%)	39 (29.8%)	
Intensive care unit (ICU)	16 (15.0%)	25 (19.1%)	
Death	3 (2.8%)	14 (10.7%)	
Intensive care unit (ICU) admission	28 (26.2%)	55 (42.0%)	0.011
ICU days	1.1 ± 4.8	1.9 ± 6.5	0.312
Mechanical ventilation	12 (11.2%)	29 (22.1%)	0.026
Ventilator days	0.7 ± 4.7	1.2 ± 5.8	0.500
Hospital length of stay (days)	3.8 ± 6.5	4.9 ± 10.4	0.369
Hospital discharge destination			0.071
Home/jail	93 (86.9%)	103 (78.6%)	
Rehab/acute care	5 (4.7%)	4 (3.1%)	
Mortality	9 (8.4%)	24 (18.3%)	0.028

*Presented as number (%) or mean ± standard deviation.

The results of this study demonstrated that age and race of GSW victims were unchanged. However, insurance patterns changed with the passage of a CC law, with more uninsured patients in the post-CC group. This may be attributable to an increased number of patients losing the financial ability to afford health insurance during the Great Recession (2004 - 2009). This finding also could represent that more criminals and less private citizens became the victim of GSWs. However, due to the retrospective nature of this study, this was hard to determine.

Findings from the current study indicated that there was no difference in injury severity across the study periods. In contrast, more post-CC patients went directly to the ICU or operating room from the trauma bay, and more patients died in the trauma bay. These patients also experienced an increase in positive FAST exams, and more frequent ICU admissions and mechanical ventilation than the pre-CC group. These findings may be a result of the increased number of vascular injuries, as well as the more frequent trend of abdominal injuries in the post-CC group.

Interestingly, the type of weapon used did not change significantly. One might expect that more GSWs would be the result of handguns since more people would be carrying and subsequently using handguns. A study conducted by Siegel et al.[31] noted that if CC laws

increase homicide rates, this effect should be observed only in handgun-related homicides and not long gun-related homicides. If the law deters crime, then the impact should involve both handgun and long gun-related homicides. Siegel et al.[31], however, demonstrated that shall-issue CC law was associated significantly with a 10.6% increase in handgun homicide rates (IRR = 1.11; 95% CI = 1.04,1.18) and that no association existed between CC and long gun-related homicides.

In 2014, Ginwalla et al.[30] investigated whether a 2010 Arizona law allowing adults to carry concealed weapons without permits and without completion of a training course increased GSW-related injuries and death. Like the current study, they assessed pre- and post-law periods of 24 months each. The authors reported the risk of gun-related injuries and deaths increased by 11.0% (p = 0.036) between the two periods.[30]

These results demonstrated that while the proportion of GSW-related injury and death remained static between the pre- and post-repeal periods (9.7% law in place vs 10.4% post-repeal, RR, 1.06; 95% CI, 0.96-1.17), the proportion of GSW-related homicides increased 27% (RR, 1.27; 95% confidence interval, 1.02-1.58) among the entire at risk population following implementation of the new law.[18] As evidenced by this study, similar increases occurred pre- and post-implementation of a conceal carry law. Overall mortality increased from 8.4% to 18.3%, an increase of 9.9%. The results of these two studies suggested that conceal carry laws may not have had the desired effect in terms of the number of in-hospital deaths and clinical outcomes.

This study was subject to limitations. Although differences in critical clinical outcomes such as ISS, need for operative management, hospital length of stay, and death were analyzed, an associated risk for each was not provided. Such data would be valuable to policymakers who may be considering changes to existing laws. Another significant limitation was the nature of using a convenience sample which did not include all victims of gun-related accidents. Patients who died prior to the arrival of emergency personnel or who died in route to the hospital were unable to be assessed.

Furthermore, the lexicon used by the ICD-9-CM does not provide sufficient granularity to allow for a robust analysis of the details related to each GSW-related injury included in the cohort. It is difficult to differentiate the patient as either a victim of a violent crime or a perpetrator who was shot during the commission of a crime. Data revealed only if the wound was made accidentally (cleaning gun, mishandling gun) or intentionally during the commission of a crime. Finally, as with all administrative trauma registry data, our data set was subject to all the known imperfections inherent with the process of retrieving trauma data, including variation in accuracy of the data, diagnosis, and operative management of individual cases. These variations may have introduced some degree of surveillance bias into the study. With more recent studies noting a trend in states implementing less restrictive concealed carry laws,[11,31,35] future research should focus on the potential impact changing these laws may have on crime.

CONCLUSIONS

Overall, the number of gunshot victims appears to have increased, as has overall in-hospital mortality. Meanwhile, injury severity has remained static. Implementation of a CC law was not associated with a decrease in the overall number of penetrating injuries or a decrease in mortality, making it difficult to conclude the overall risk to benefit ratio of Kansas Senate Bill 418.

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