

## Patterns and factors associated with complications of laparotomy for firearm and blast injuries in the Emergency Management Centre in Erbil city

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### Abstract

**Background and objective:** Laparotomy is the surgical opening of the abdomen and the important way to control and treat any problem and complication along pathway site of penetrating by a bullet or shell. This study aimed to identify the patterns and the factors associated with complications of laparotomy for firearm and blast injuries in Erbil City.

**Methods:** This retrospective study was carried out on 125 injured patients at the Emergency Management Centre in Erbil city. Data was collected from the Statistics Department of Emergency Management Centre from 1<sup>st</sup> January 2014 to 31<sup>st</sup> December 2016.

**Results:** The mean age of the included patients was  $26.2 \pm 11.0$ . The majority of patients were young (54.4%), male (80%), lived in the Erbil center (45.6%), and the injured place was mostly in the center of Erbil (45.6%). The mean and standard deviation time needed to arrive at the hospital was  $8.7 \pm 39.2$  hours. Most of them had a medium condition (53.6%), arrived within the first hour to the hospital (57.6%), had the first operation at the Emergency Management Centre (89.6%), did not have any other injury (64%) and had bullet injuries (88%). The post operative complications from laparotomy were significantly higher in those with poor condition at admission ( $P < 0.001$ ), not having the first operation at Emergency Management Centre ( $P = 0.003$ ) and higher number of internal organs injured ( $P = 0.010$ ). There was a significant association between postoperative complications from laparotomy with the time needed to arrive at the hospital ( $P = 0.028$ ) and having associated injuries ( $P = 0.028$ ).

**Conclusion:** Bullet injury was the most common penetrating abdominal trauma leading to one or more intra-abdominal organ injury and needing emergency laparotomy for treatment and prevention of complications. Postoperative complications from laparotomy were significantly associated with the condition of admission, the first operation of the Emergency Management Centre, the number of internal organs injured, the time needed to arrive at the hospital and presence of associated injuries.

**Keywords:** Patterns; Complications; Laparotomy; Firearm; Blast injury.

### Introduction

Laparotomy is a surgical incision into the abdominal cavity.<sup>1</sup> Penetrating wounds result from sharp object, bullets or shell injury or knives they might lead to severe hemorrhage, severe disturbances of various organ functions and shock during major internal bleeding.<sup>2,3</sup> A bullet can lead to damage at the site of penetration and along its pathway.<sup>4</sup> During emergency situations, abdominal injury such as bullet

injury might need exploratory surgery to determine the extent of intra-abdominal bleeding.<sup>5</sup> Kumar et al. reported in their study; Bullet injury is a leading cause of morbidity and mortality worldwide. When neglected, intra-abdominal injuries and concealed hemorrhage can lead to increased morbidity and mortality, particularly in the patients who might survive the initial phase after an injury.<sup>6</sup> A retrospective study conducted by

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Duchesne et al. in the United States; reported a total of 196 patients with a bullet and penetrating injuries who underwent damage control laparotomy. A total of 124 (63.2%) patients was managed during the laparotomy.<sup>7</sup> Also, Ball et al. reported in their retrospective study in Canada, during the 10-year study period, 7941 injured adult patients admitted at the Foothills Medical Centre, a total of 151 (2%) patients was admitted with equestrian injuries, (7%) patients died. The average respondent was male (60%) and 47 years of age (range, 20–78 years), with 54% and 48% of all patients experiencing chest and head injuries. Overall, 68 of 151 (45%) patients injured by a horse underwent a surgical procedure.<sup>8</sup> The incidence of injuries increased substantially during the last few years in Iraq and Kurdistan Region due to the war and insecurity in Iraq. Therefore, this study aimed to identify the patterns and the factors associated with complications of laparotomy for firearm and blast injuries in the Emergency Management Centre during the last three years.

## Methods

### Design and setting

This retrospective study was carried out at the Emergency Management Centre (EMC) in Erbil City. We received those data from the Statistics Department of EMC.

### Participants

Data was collected from the Statistics Department of EMC. We received the information of all patients that were admitted and remained at EMC in Erbil City during the last three years for receiving treatment and discharged between 1<sup>st</sup> January 2014 and 31<sup>st</sup> December 2016. A total of 3964 cases of injury were registered at EMC that was admitted and remained at EMC in Erbil City for receiving treatment. Among the 3963 cases of injury that were mentioned above, 3872 cases of them were injured by bullet and shell form deferent part of the body, only 150 cases of them had an abdominal injury, and only 125 cases of the 150

injured patients who had laparotomy at EMC hospital were included in this study.

### Tool

A questionnaire consisting of two parts was developed according to the information of the file of the patients. Part 1 included four questions about the socio-demographic characteristics; gender, age, residential area, and place of injury. Part 2 included nine questions about the condition at admission, the time needed to arrive at the hospital, fist operation at EMC, outcome, death or alive, associated injury, postoperative complications from laparotomy and the number of internal organs injured.

### Data collection

Data was collected from the statistical department of EMC through reviewing the file of the patients from 2<sup>nd</sup> July to 2<sup>nd</sup> August 2017.

### Ethical aspects

The study protocol was approved by the Research Ethics Committee at the College of Medicine, Hawler Medical University. Institutional permission was obtained from the EMC to getting information from the Statistics Department of EMC.

### Data analysis

Data were analyzed by the statistical package for the social sciences (version 20). Both descriptive and inferential statistics were used. Descriptive statistics involved calculating frequencies and percentages. For inferential statistics, the participants were categorized into those having postoperative complications from laparotomy and not having any complications. The association between the different social-demographic and clinical characteristics with the development of postoperative complications from laparotomy of the participants was assessed using the Chi-square test. A *P* value of  $\leq 0.05$  was considered statistically significant.

**Results**

Table 1 explored the socio-demographic characteristics of the patients. Most patients were young with the age of 18-30 years (54.4%). The mean age (SD) of the patients was  $26.2 \pm 11.0$  years (range 12-64 years). Most of the patients were

male (80%) and lived in the center of Erbil city (45.6%). Regarding the place of injury, 45.6% of them were injured in center of Erbil city, 30.4% from the suburbs of Erbil city (Dashti Hawler, Makhmur), 12.8% from remote areas of Erbil governorate and 11.2% from outside of Erbil Governorate.

**Table 1:** Socio-demographic characteristics.

Variable		*n= 125	
		F	%
<b>Age group (years)</b>	<17	23	(18.4)
	18-30	68	(54.4)
	>30	34	(27.2)
	<b>M <math>\pm</math> SD</b>	<b>26.216 <math>\pm</math> 11.045</b>	
<b>Gender</b>	Male	100	(80)
	Female	25	(20)
<b>Residential area</b>	Erbil	57	(45.6)
	Dashti Hawler	22	(17.6)
	Makhmur	16	(12.8)
	Outside governorate	14	(11.2)
	Shaqława	5	(4)
	Koya	5	(4)
	Soran	4	(3.2)
	Mergasoor	1	(0.8)
	Bardarash	1	(0.8)
<b>Place of injury</b>	Erbil city	57	(45.6)
	Erbil city suburbs (Dashti Hawler, Makhmur)	38	(30.4)
	Erbil remote	16	(12.8)
	Out of Erbil Governorate	14	(11.2)
<b>Total</b>		125	(100)

\* Number of samples

Table 2 shows the clinical information and condition of the injured patients. The condition of the majority of the patients at the time of admission was medium (53.6%). Most patients arrived at the hospital within the first hour (57.6%). The mean time (SD) needed for arrival at the hospital was  $8.7 \pm 39.2$ . Majority of the injured patients (89.6%) had the first operation in EMC, while only 10.4% of them had done the first operation at another hospital. Most injured patients did not have any other injury (64%), but 36% had another injury in another area of the body. The cause of injury of the majority of patients was bullet

injury (88%). Most of the sample (45.6%) had one internal organ injured, and 28.8% of them had two internal organs injured. The majority of participants (61.6%) did not have any complications from laparotomy. Regarding the end outcome of the patients, 68.8% had a good health condition, 11.2% died, 8.8% remained under follow up (unstable), 5.6% developed some complications, 4% left the hospital on their responsibilities, and 1.6% were transferred to another hospital. Majority of patients (88.8%) were alive after laparotomy while 11.2% died.

**Table 2:** Clinical characteristics of the injured patients.

Variable		*n= 125	
		F	(%)
<b>Condition at admission</b>	Missing	11	(8.8)
	Poor	26	(20.8)
	Medium	67	(53.6)
	Good	21	(16.8)
<b>The time arrived at hospital</b>	within 1 hour	72	(57.6)
	1 - 3 hours	37	(29.6)
	>3 hours	16	(12.8)
	<b>M ± SD</b>	<b>8.7 ± 39.2</b>	
<b>First operation at EMC</b>	No	13	(10.4)
	Yes	112	(89.6)
<b>Associated injury</b>	No	80	(64)
	Yes	45	(36)
<b>Cause of injury</b>	Bullet	110	(88)
	Shell	15	(12)
<b>Number of internal organs injured</b>	0 (Negative)	8	(6.4)
	1	57	(45.6)
	2	36	(28.8)
	3 and more	24	(19.2)
<b>Postoperative complications from laparotomy</b>	No	77	(61.6)
	Yes	48	(38.4)
<b>Outcome</b>	Good health	86	(68.8)
	Died	14	(11.2)
	Follow up	11	(8.8)
	Complications	7	(5.6)
	Left the hospital on their responsibility	5	(4)
	Transfer	2	(1.6)
<b>Death or Alive</b>	Alive	111	(88.8)
	Died	14	(11.2)

\* Number of samples

Table 3 shows the association between different demographic and clinical characteristics with the development of postoperative complications from laparotomy. There was a significant association between postoperative complications from laparotomy and the time needed to arrive at hospital (33.3% for within 1 hours, 35.1% for 1 - 3 hours, 68.8% for >3 hours,  $P = 0.028$ ) and associated injury (51.1% for yes vs. 31.3% for no,  $P = 0.028$ ). A highly significant relationship was found between postoperative complications from laparotomy with the condition at admission

(65.4% for poor, 35.8% for medium and 4.8% for good,  $P < 0.001$ ), having the 1st operation at EMC (76.9% for no and 33.9% for yes,  $P = 0.003$ ). Postoperative complications from laparotomy were significantly higher among those who had three and more internal organs injured, two internal organs injured, one internal organ injured and no any internal organs injured (62.5%, 44.4%, 28.1%, and 12.5%, respectively,  $P = 0.010$ ). There was no statistically significant association between the postoperative complications from laparotomy and the other socio-demographic and clinical characteristics.

**Table 4:** Association between different demographic and clinical characteristics with the development of complications from laparotomy.

Variable		Complications				Total	P value
		No		Yes			
		No.	%	No.	%		
Age group	≤17	14	(60.9)	9	(39.1)	23	0.431
	18-30	45	(66.2)	23	(33.8)	68	
	>30	18	(52.9)	16	(47.1)	34	
Gender	Male	62	(62)	38	(38)	100	0.854
	Female	15	(60)	10	(40)	25	
Place of injury	Erbil city	40	(70.2)	17	(29.8)	57	0.234
	Erbil city suburbs (Dashti Hawler, Makhmur)	22	(57.9)	16	(42.1)	38	
	Erbil remote	7	(43.8)	9	(56.3)	16	
	Out of Erbil Governorate	8	(57.1)	6	(42.9)	14	
The time arrived at the hospital	within 1 hour	48	(66.7)	24	(33.3)	72	0.028
	1 - 3 hours	24	(64.9)	13	(35.1)	37	
	>3 hours	5	(31.3)	11	(68.8)	16	
Associated injury	No	55	(68.8)	25	(31.3)	80	0.028
	Yes	22	(48.9)	23	(51.1)	45	
Cause of injury	Bullet	70	(63.6)	40	(36.4)	110	0.205
	Shell	7	(46.7)	8	(53.3)	15	
Condition at admission	Poor	9	(34.6)	17	(65.4)	26	<0.001
	Medium	43	(64.2)	24	(35.8)	67	
	Good	20	(95.2)	1	(4.8)	21	
1 <sup>st</sup> Operation at EMC	No	3	(23.1)	10	(76.9)	13	0.003
	Yes	74	(66.1)	38	(33.9)	112	
Number of internal organs injured	0	7	(87.5)	1	(12.5)	8	0.010
	1	41	(71.9)	16	(28.1)	57	
	2	20	(55.6)	16	(44.4)	36	
	3 and more	9	(37.5)	15	(62.5)	24	
	<b>Total</b>	<b>77</b>		<b>48</b>		<b>125</b>	

## Discussion

Erbil is the capital city of the Kurdistan region and was the chief center for fighting against terrorism, especially at the Daesh war. Most of the countries that fought Daesh started the plan and initiated the war against Daesh with Peshmarga from Erbil. Daesh related war in Iraq was from 2014 to 2017. Our retrospective study provides the incidence and outcomes of laparotomy among injured patients by the bullet and shell trauma in the Emergency Management Centre in Erbil City for the last three years. In most previous studies, the penetrating abdominal trauma by bullet commonly cause the major problem and majority of them need for laparotomy.<sup>3,9-14</sup> There are four emergency hospitals in Erbil city for receiving and treating emergency patients, but only EMC hospital receive patients complaining of bullet and shell injuries. Majority of the cases were young (18-30 years), and the majority of them were male because of the nature of war in any area involving these type of people. The results of our study are supported by many other studies.<sup>3,15-18</sup> The majority of the victims were living at Erbil, but the injury occurred around Erbil because the war with the Daesh was primarily in Mosel and around of Erbil and the nearest place to treat the victims was Erbil City. The condition of the most of the victims during admission was medium, which may be due to having most of the cases receiving first aid at the point of injury by the first aid teams. Majority of the injured patients did not have any associated injuries. Our study disagreed with a prospective study involving 68 consecutive cases of bullet trauma to the abdomen that conducted by Kulkarni et al. at Kolhapur, Maharashtra State, India where the majority of the of abdominal bullet trauma had associated injuries.<sup>19</sup> Our study also disagrees with the routinely and prospectively database study of Hildebrand et al. that showed significant association with primarily extra-abdominal injuries.<sup>20</sup> In our study, the majority of the injured

patients had only one internal organ injured. This result is supported by Abri et al. study from Imam Reza Hospital, Tabriz, Iran where 290 patients (83.3%) out of 332 patients with abdominal bullet trauma did not have any damage to any organ.<sup>21</sup> Another main point that focused in this study was the end outcome of the patients and postoperative complications from laparotomy. Majority of the patients had a good health outcome and did not have any complication. This may be because most of them arrived at the hospital within the first hour. It can also be due to having most of them not having another injury in another part of the body. Another reason may be due to having most of the injured persons having only one internal organ injured. These reasons mentioned above are possibly the main cause of having the majority of the patients alive, and only a few of them died. Our study agrees with the study of Karamercan et al. on 144 abdominal bullet trauma at Ankara, Turkey that revealed an overall mortality rate of only 16%, and the postoperative mortality rate concerning the operated patients was 14.3%.<sup>22</sup> The mortality rate in our study agrees with the retrospective study that was conducted by RaviKanth et al. at Karnataka, India on 65 bullet trauma patients where the mortality rate was only 20%.<sup>23</sup> However, our study disagrees with the retrospective study conducted by Wang et al. from January 2002 to June 2012, at Taiwan, with most of the penetrating abdominal injury after damage control laparotomy had died.<sup>24</sup> Regarding complications in our study, the result was supported by the retrospective study of Georgi et al. that conducted on two groups; 133 patients with shell fragment injuries and of 166 patients with bullet injuries. The major postoperative complications that occurred in both group was only 7.5% and 8.4% of the patients in Group A and Group B, respectively.<sup>25</sup> Another fact that appeared in our study was the association between different demographic and clinical characteristics with the development of

complication from laparotomy. There was no significant relationship between complication and place of injury, which may be due to the majority of our cases inside of Erbil City. The results of our study disagreed with a retrospective study of all trauma patients over the age of 18 years from Suez Canal University Hospital, Ismailia, Egypt that was conducted by Gad et al. that revealed a positive association between abdominal trauma and place of injury.<sup>26</sup> In our study, a significant relationship was founded between the postoperative complications from laparotomy with the time arrived at the hospital. Our result agrees with the retrospective study of Ertel et al. on 311 consecutive patients with severe abdominal and pelvic trauma after “damage-control” laparotomy at Zurich, Switzerland; in their study, a significant improvement was found between emergency laparotomy of all studied organ functions within a few hours.<sup>3</sup> It also agrees with the two-year prospective study of abdominal trauma patients who presented to the Accident and Emergency at Bugando Medical Centre Mwanza, Tanzania, that was conducted by Chalya and Mabula and revealed that injury-arrival time significantly influenced the outcome with the length of hospital stay ( $P = 0.015$ ).<sup>27</sup> Our study disagrees with the retrospective study of Iflazoglu et al. in Turkey that was conducted on 120 patients over 15 years, which reported no significant difference between developing complications and duration of hospital stay and the elapsed time until surgery.<sup>28</sup> The postoperative complications from laparotomy were also significantly related to the associated injury, which agrees with the previous study of Karamercan et al., which revealed that abdominal bullet trauma was not associated with significant extra-abdominal injuries.<sup>22</sup> In our study, postoperative complications from laparotomy were significantly associated with the condition at admission. The result was similar to the study of Costa et al. from Roma, Italy that

reported a significant association between the average injury severity score of patients with complications ( $P < 0.05$ ).<sup>12</sup> Another fact that appear in this study that the postoperative complications from laparotomy were also significantly higher in those not having the first operation at EMC, which may be because EMC was the familiar hospital at Erbil City for receiving and treating injury cases. The postoperative complications from laparotomy were also significantly higher in those having more internal organs injured. This finding was supported by a previous study conducted by Iflazoglu et al. that reported his complications, mortality, and shock were the most significant factors for the development of the high number of injured organs. Also, the number of injured organs was found to be significantly higher than those in the non-complication cases.<sup>28</sup>

### Conclusion

Abdominal trauma by bullet injury was more common in young aged and male patients. Majority of patients arrived at the EMC within the first hour of injury. The condition of the majority of patients during admission was medium and more than one internal organ was injured, but the outcome of most of them was good. Having postoperative complications from laparotomy was significantly associated with the condition at admission, the number of internal organs injured, the time needed to arrive at the hospital and having associated injury.

### Competing interests

The author declares no competing interests.

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