

Primary repair versus diversion in penetrating colon injuries

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Abstract

Back ground: In Iraq, after 2003 had more accidents of the shell, bullet and stab abdominal wounds, more over colon injuries.

Objective: The aim of this study is to evaluate the most appropriate management of penetrating colon injuries, comparing the primary repair with the diversion.

Methods: Eighty patient series with shell, bullet and stab colonic injuries during 4.5 years period from June 2006-december 2010 at Al-Yarmouk teaching hospital. The study compared the use of primary repair versus diversion, analyzing variables such as sex, age, severity of injury and mortality rate.

Results: there were total 80 patients ,62 (77.5%) male and 18(22.5%) female .male :female ratio 3.4:1. the most affected age group was 21-30

years. 47 patients 58.75% were shell injuries.28 patients 35% were bullet injuries. 5 patients 6.25% were stab wounds. 46 patients 57.5% managed by primary repair ,one of them 1.25% died, while diversion in34patients 42.5% different grades of colon injuries ,5 of them 6.25% died ,this was due to different factors such as multiple organ injuries and post operative complications.

Conclusion: the primary repair is safe and effective regarding morbidity and mortality in the management of grade II, III penetrating colon injuries with minimal risk factors as compared to diversion.

Key words: primary repair, diversion, colon injuries, complications.

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Introduction

Colonic injury is still widely recognized as one of the most serious intra-abdominal injuries in practice because of lethal consequences of peritoneal contamination. In general, wartime series have a higher incidence of colon injuries¹. This injury has been associated with a high risk of septic complications and mortality². Traditionally colostomy remained the gold standard for treatment of colon injuries. It is still practiced in many centers and considered safe, conservative and acceptable; however with low risk penetrating injuries a prospective multicentre study demonstrated that surgically (primary closure versus diversion) they can be managed safely by primary repair³. Primary repair of colonic injuries has less morbidity and is less expensive as compared to colostomy and is ideal method of management for colonic injury⁴. Primary repair is a safe method of managing penetrating colon injuries in

carefully selected patients⁵. Colostomy is no longer a standard option because of its own complications and the need for subsequent surgery^{6, 7}. It seems, however, that there is a role for colostomy, particularly in high-risk patients. High risk cases include those with preoperative hypotension, intra-peritoneal hemorrhage exceeding one liter or patients who need more than four units of blood transfusion, significant fecal spillage and more than two associated organ injuries (hepatic, pancreatic and splenic)⁸, destructive injuries of the left colon, rectal injuries^{9, 10} and comorbid medical conditions. Colostomy and exteriorized repairs minimize the risk of leakage at the expense of requiring a second operation. Primary repairs are desirable provided they do not leak, and balancing the risks versus benefits of each type of repair can be controversial¹².

The colonic injuries were assessed by the Colon Injury Score (CIS)^{13, 14} as shown in Table I.

Table 1. colon injury score (CIS) According to American College of Surgery (ACS):

Grade I	Contusion or hematoma; partial-thickness laceration
Grade II	Small (< 50% of circumference) laceration
Grade III	Large (\geq 50% of circumference) laceration
Grade IV	Transection
Grade V	Transection with tissue loss; devascularized segment

It should be kept in mind, however, if there are risk factors, the retrospective data showed a higher incidence of suture line failure and a significant incidence of associated mortality, suggesting that resection and primary anastomosis may not be the optimal treatment for all colonic wounds especially destructive with risk factors.^{14, 15}

Methods

This is a case series of eighty patients whom were admitted to the emergency department of AL-Yarmouk teaching hospital from June 2006 – Dec. 2010, sustaining penetrating abdominal injury and underwent explorative laparotomy.

Patients were divided in two groups; *Group A* Primary Repair, and *Group B* Diversion. *Intraoperative management:* All the patients were assessed clinically resuscitated and were given prophylactic antibiotics. They were prepared for emergency exploration, which was done under general anesthesia. The patients were explored by mid line incision, homeostasis secured and hemodynamic stability established. Operative assessment including the degree of hemoperitoneum, site of colonic injuries, extent, grade and number of colonic injuries, degree of fecal contamination, associated intra and extra abdominal injuries. Mobilization of the retroperitoneal portions of the ascending and descending colon is performed when suspicion of injury is present. Retroperitoneal hematoma or air may be clues to retroperitoneal colonic injuries. The type of operations were either:

primary repair (primary closure of perforation or resection plus ileocolostomy, or resection and colocolostomy.), or diversion (exteriorization of colonic tear as a colostomy or proximal colostomy plus repair of the perforation or resection of the injured part and exteriorization of a colostomy). If simple suture of the colonic injury was selected as the treatment, the wound was debrided as necessary. An attempt was made to close all wounds in a transverse fashion to prevent narrowing of the lumen. Virtually all wound closures were performed in two layers, using 3-0 polyglycolic acid suture through all layers and interrupted 3-0 silk seromuscular sutures. At the completion of the operation, the abdomen was irrigated with large quantities of warmed saline until the effluent was clear. Drainage was routinely used for associated organ injuries (e.g. liver, pancreas, duodenum, and urologic injuries). Abdomen was closed in layers using a running no1 polypropylene suture, tension sutures were used selectively. The skin was closed primarily in most of the patients; delayed primary closure was performed rarely. The hospital stay was ranged 7-20 days. We exclude the following from this study: patients with rectal injury and grade I colon injury.

Results

Age & Gender:

Patients' age ranged between 2-68 years. The most common age group involved was 21-30 years. Male to female ratio was 3.4:1 (62 male & 18 female) as shown in table 2

Table-2 the age & gender numbers

Age	no. of cases	male	female
<10 yr.	5(6.25%)	4	1
11-20 yr.	13(16.25%)	10	3
21-30 yr.	29(36.25%)	23	6
31-40 yr.	15(18.75%)	11	4
41-50 yr.	8(10%)	6	2
51-60 yr.	6(7.5%)	5	1
>60 yr.	4(5%)	3	1
Total	80(100%)	62(77.5%)	18(22.5%)

Causes of Injury:

The most common cause of injuries was due to shells 47 patients (58.75%), followed by bullets 28 patients (35%), while stab injury occurred in 5 patient (6.25%) as in figure1.

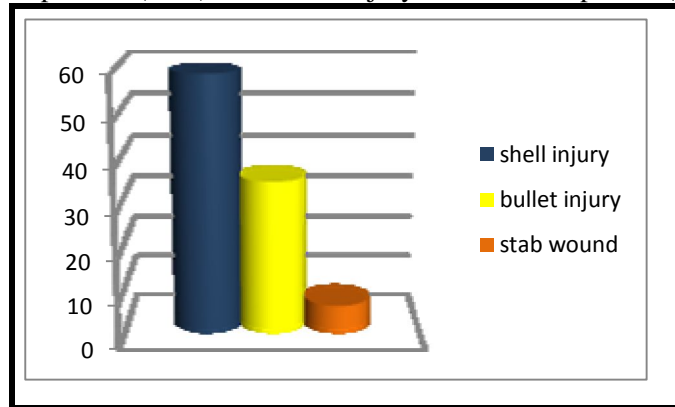


Figure-1 causes of penetrating colon injuries.

Site of Penetrating Colonic Injuries

For purposes of localization, the colon was grouped into the right, transverse, and left colon. The hepatic and splenic flexures were included with the right or left respectively. Most injuries were found in the transverse colon 46 cases 57.5%. These have been illustrated in table3.

Table -3 Sites of colon injuries.

Site	No. of patients	percentage
Caecum	17	21.25%
Ascending colon	21	26.25%
Transverse colon	46	57.5%
Descending colon	19	23.75%
Sigmoid colon	25	31.25%
Multiple sites	57	71.25%

Associated Injuries:

The isolated colonic injuries were 14 (17.5%) of cases. The associated intra and extra abdominal injuries were 66 (82.5%) of cases. The frequency of associated intra abdominal injuries were small bowel(48.75%) ,liver18(22.5%),

stomach12(15%), diaphragm11(13.75%), kidney9(11.25%), spleen7(8.75%), urinarybladder5(6.25%), Extra abdominal injuries occurred in extremities 14(17.5%), vascular 10(12.5%),chest was9 (11.25%), head6 (7.5%) and spinal cord2(2.5%). These results are shown in table -4

Table- 4 Associated intra &extra abdominal injuries

Associated Injury	No.	%	Associated Injury	No.	%
<i>Intra abdominal</i>			<i>Extra abdominal</i>		
Small bowel	39	48.75%	Extremities	14	17.5%
Liver	18	22.5%	vascular	10	12.5%
Stomach	12	15%	Chest	9	11.25%
Diaphragm	11	13.75%	Head injury	6	7.5%
Kidney	9	11.25%	Spinal cord	2	2.5%
Spleen	7	8.75%			
Urinary bladder	5	6.25%			

According to ACS grading system of colonic injuries, most of the cases occurred in grade (II) 36(45%) of the cases, grade (III) 31 (38.75%) of the cases, Grade (IV) 5 (6.25%) of the cases and grade (V) 8 (10%) of the cases .figure-3

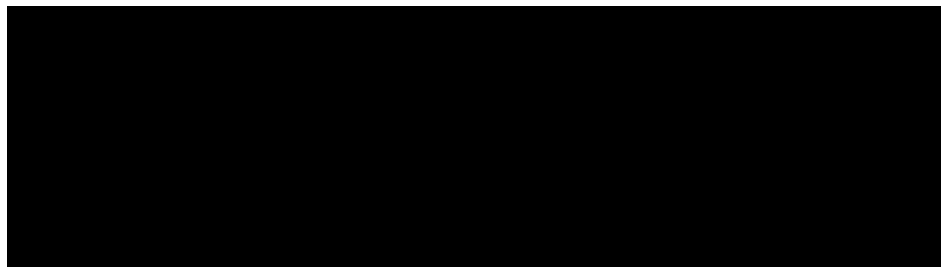


Figure 3- grades of col

Group A:

Primary repair was used in 46 (57.5%) of the patients, 27 of them were grade II injury, 17 of those patients treated by primary closure and the other 10 by resection with primary anastomosis.19(48.2%) patients of this group were grade III ,4 of them treated by primary closure and 15 cases were treated by resection and primary anastomosis.

Group B:

in managing 34(42.5%) patients, their operative treatment include: Grade II 9 cases, 4 of them by exteriorization of colonic tear and other 5 by proximal colostomy and repair of perforation. Grade III 12 cases, 9 of them treated by exteriorization of colonic tear and other 3 by proximal colostomy and repair of perforation. Grade IV 5 cases, one of them was treated by proximal colostomy and repair of the colonic injury and the

remaining 4 treated by resection and exteriorization of the ends as a colostomy. Grade V 8 cases, 5 of them treated by Colostomy (exteriorization of injury), the

remaining 3 were treated by resection of the colonic injury and exteriorization of the colonic end as a colostomy. Table 5

Table5 - Grades of colonic injury and types of surgical management.

Types of surgical management	No. of cases	%	G II	G III	GIV	GV
<i>Group A</i>						
Primary closure	21	26.25%	17	4	0	0
Resection(primary anastomosis)	25	31.25%	10	15	0	0
<i>Group B</i>						
Colostomy (exteriorization of injury)	18	22.5%	4	9	0	5
Proximal colostomy and repair	9	11.25%	5	3	1	0
resection of colonic injury and colostomy	7	8.75%	0	0	4	3
total	80	100%	36(45%)	31(38.75%)	5(6.25%)	8(10%)

Group

A: 32(40%) patients of this group recovered without complications, while 13(16.25%) of them were developed postoperative complications .One 1.25% patient died.

Group B: 14(17.5%) patients of this group recovered without complications, 15(18.75%) patients developed postoperative complications. 5 (6.25%) patients died. Table6

Table 6-Types of surgical management and outcome of the colonic injuries

Type of surgical management	Total No.	Smooth recovery	morbidity	Mortality
<i>Group A</i>				
Primary closure	21(26.25%)	15(18.75 %)	6(7.5%)	Nil
Resection and primary anastomosis	25(31.25%)	17(21.25%)	7(8.75%)	1(1.25%)
<i>Group B</i>				
Colostomy (exteriorization of injury)	18(22.5%)	9(11.25%)	8(10%)	1(1.25%)
Repair and Proximal colostomy	9(11.25)	3(3.75%)	4 (5%)	2(2.5%)
resection of colonic injury and colostomy	7(8.75%)	2(2.5)	3(3.75%)	2(2.5%)
Total	80(100%)	46(57.5%)	28(35%)	6(7.5%)

The post-operative complications in group A were 7.5% wound infection, 5%prolonged ileus, 5% respiratory complications, 3.75% anastomotic leak and fistula formation, 2.5% intra abdominal abscess, and 2.5% wound dehiscence, 1.25% hemorrhage. In group B, the complications were 16.25% wound infection, 7.5% respiratory complications, 8.75% prolonged

ileus, no anastomotic leak and fistula formation, 8.8% intra abdominal abscess, 3.75% septicemia, 5% burst abdomen and wound dehiscence, 2.5% hemorrhage. Table 7

Table 7-the postoperative complication following the types of surgery

Complications	Group A		Group B	
	No.	%	No.	%
Wound infection	6	7.5%	13	16.25%
Intra abdominal abscess	2	2.5%	5	6.25%
Burst abdomen or wound dehiscence	2	2.5%	4	5%
Anastomotic leak and fistula formation	3	3.75%	0	0
Septicemia	0	0	3	3.75%
Respiratory complications	4	5%	6	7.5%
Prolonged ileus	4	5%	7	8.75%
Hemorrhage	1	1.25%	2	2.5%

$X^2=6.447$, D.F.:1, P-Value = 0.011

Discussion

Nowadays, there is a definite trend toward increased use of primary repair in management of all penetrating colon injuries, independently of their localisation¹⁶. Numerous prospective randomized trials compared primary repair to diversion procedure, and demonstrated no significant difference in complication rates between groups^{17, 18}.

Regarding the age and gender of our 80 patients, we have found that more than one third of the patients 27(33.75%) were in the 21-30 years age group and 62(78%) of the patients were under the age of 40 years. This result is in accordance with that of *Bowley DMG et al*¹⁷ who also concluded a mean age of 26.6 years. *Khumair Asif et al*¹⁹ and *Robles-castillo j et al*²⁰ also found similar result. This could be attributed to the fact that most of the individuals affected by explosions and bullets were the young employees National guards, Police men and Hawkers.

We have found that males were 62(77.5%) and females were 18 (22.5%) with male/female ratio 3.4:1, this result goes with that of *Ahmad Uraiqat et al*²¹ who found the

ratio was 3:1, *Foster K*¹⁸ found male predominance but in a higher ratio 6.5:1.

Considering mechanism of injury, we found shell injury 47(58.75%) cases followed by bullets 28(35%) cases and stab 5 (6.25%) cases. *Douglas M.G. Bowley et al*¹⁷ and *Robles-castillo j et al*²⁰ found that the majority of cases due to bullet injury. *Ahmad Uraiqat et al*²¹ found that most injuries 50% due to shell. While *Afsar Ali Bhatti*²² stated that stab was the commonest cause of injury.

Considering the site of colonic injury the most common site found to be injured was the transverse colon 57.5% followed by sigmoid colon 31.25%, descending ascending 26.25% colon 23.75%, caecum 21.25%. *Jerzy Kumza et al*²³ also found the transverse colon was the most injured site. *Ahmad Uraiqat et al*²¹ found similar result. This could be attributed to that these parts of colon are the mobile segments, thus they are more prone to be injured.

In our study, patients had associated organ injuries 82.5%, the small bowel was the most common 48.75% followed by the liver 22.5%. Extra abdominal associated organ injuries including: extremities 17.5% ,

haemopneumo thorax 11.25%. This result is in accordance with that of *Bowely DMG et al*¹⁷, who found that the main associated organ injury was small bowel 42%, but main associated extraabdominal organ injury was hemopneumothorax 12%. *Ahmad Uraiqat et al*²¹ found associated intra abdominal injuries occurred in the small bowel (75 %), liver (33.3 %) and the extra abdominal injury was the upper limb 58%. While *Afsar Ali Bhatti*²² found the commonest associated Injury was liver (33%).

According to ACS grading system, in our study, the injuries account Grade II 45%, Grade III 38.75%, Grade IV 6.25% and Grade V 10%. This result goes with that of *Salinas et al*²⁴, who found that the majority of cases were of Grade II 60% of cases & Grade III 22% of cases. *A.M. Angelici et al*²⁵ *Ahmad Uraiqat et al*²¹ found that grade II was the most common 37.5% and 58.7% respectively. *F Cengiz and his colleagues*²⁶ in their study of 34 patients with colonic injury found that most injuries 64.8% is grade II.

In our study, no primary repair was done to grade IV and V but mainly to grade II and III colonic injuries this can be explained by the higher levels of fecal contamination & the poor general condition of patients with higher grade injuries.

In our study, post operative morbidity was recorded in 35% of cases. There is a higher rate of post operative morbidity in group B 18.75% while in group A 16.25%. More than half of the patients 57.5% had smooth postoperative recovery, 40.25% of them group A, 17.25% group B. In this study the most common morbidity in the group A and B was wound infection which occurred in 7.5% and 16.25% respectively. So the incidence of wound infection in group B is twice group A probably due to the contamination severity in group B. prolonged ileus and respiratory complications were the second most common complication 5% for group A, while prolonged ileus was the second complication for group B 8.75% followed by the respiratory complication 7.5%. Intra abdominal abscess complicated 2.5% of group A while 3.75% of group B. Anastomotic leak and fistula formation was 3.75% in group A while no case in group B.

Burst abdomen and wound dehiscence was 2.5% in group A while 5% in the group B, septicemia occurred in 3.75% of group B. These results conform to the results found by *Bowely DMG et al*¹⁷ and *Cornwell EE et al*²⁷ which show a better outcome regarding postoperative recovery in cases managed by primary repair than with colostomy, *Chavarria-Aguilar et al*²⁸ who found that there were no differences in abdominal abscess or leak rates between groups, Abdominal abscess formation was the most frequent complication, and rates were essentially equivalent between patients with an anastomosis (21.1%) and patients with a stoma (20.0%). *Demetriades and colleagues*²⁹ 2001, having undertaken a multi-center prospective study, concluded that all colon injuries could be managed without fecal diversion without influencing morbidity or mortality, with no difference in colon-related complications (22% vs. 27%). The authors found that although the presence of severe fecal contamination, transfusion of greater than 4 units of packed red cells within the first 24 hours, and single agent antibiotic prophylaxis were all independently associated with increased complications, this was irrespective of the management of the colonic injury. Thus, if patients developed complications, it was not dependent on whether or not they were diverted or repaired primarily. *Gonzales RP et al*³⁰ 2000 drew similar conclusions. *Adesanya and Ekanem*³¹ 2004 similarly found no difference in outcome in the two methods in their retrospective review of 60 penetrating colonic injuries over a ten-year period. However, the primary repair group experienced a significantly lower rate of complications (0.39 to 0.76). *Eileen M. Bulger et al*³² conclude that the development of septic complications is related to the injury severity and hemodynamic status of the patient, not the type of operation performed. However, *Miller, 2002*³³ still raised a cautionary note for high risk patients, those with high trauma scores, destructive colon injuries, need for multiple blood transfusions, etc. *Singer et al*³⁴, 2002 clearly favoured primary repair

without diversion for all risk categories.

Our study showed that post operative mortality was recorded in 7.5% of cases. The mortality rate of the primary repair group was 1.25% due to extra colonic complications (vascular injuries), While in the diversion group a higher rate of mortality was recorded (6.25%), among the causes of death were pulmonary embolism, multiple organ failure due to septicemia, myocardial infarction, and duodenal fistula. The cause of lower mortality rate in the primary repair group was multi factorial including the risk factors which were lower in the primary group in comparison with those of the diversion group, also there is no trial of primary repair in grades IV & V where there was more destructive colonic injury, beside more of the associated injuries whether intra or extra abdominal occurred in patients with those grades. *Demetriades and colleague*²⁹, in their study colon-related mortality were significantly lower in the primary repair group (0% versus 4%). The results of *Nelson R et al*⁷ 2003 conclude that the mortality was not significantly different between groups, which was low in both the primary repair (1.94%) and the diverted groups (1.74%). While *Musa et al*³⁵ in their study of 55 case, There was 1 mortality in colostomy group and no death in primary repair group. The overall mortality rate in *kandil*³⁶ study of 264 patients was 7.4 %. In the study of *Ahmad Uraiqat*²¹, the mortality rate was 50%.

Conclusion:

The primary repair of penetrating colon injuries is safe.

The post operative complications were lower in primary repair group

The mortality rate was less in primary repair.

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