

## Original Articles

# A COMPARATIVE STUDY OF THERAPEUTIC RESULTS OF RIGHT AND LEFT COLONIC INJURIES SUSTAINED BY IRANIAN SOLDIERS IN THE IRAN-IRAQ WAR

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### ABSTRACT

The treatment strategy of colonic injuries is a debatable and highly controversial subject worldwide in various medical centers. The method of treatment of left and right colonic injuries, diversity or similarity in their management and particularly differences between the treatment of war-associated injury from other types of colonic damage are among the unsettled issues.

The present study involves a review of 226 medical records belonging to male Iranian soldiers 15-54 years of age admitted to 3 hospitals affiliated to Shiraz University of Medical Sciences for injuries sustained during eight years of the Iran-Iraq war. Differences with respect to therapeutic results, symptoms and mortality rates were studied between the two groups of patients with left and right colonic injury with reference to the various surgical treatments employed. Ninety-two (40.7%) and 134 (59.3%) cases suffered from injuries of the right and left colon, respectively. The majority (91.6%) had undergone primary surgical treatment in field hospitals before being dispatched to our hospital for convalescence and continuation of therapy.

Our study indicates that in the presence of identical side-conditions and regardless of anatomical sites, both right and left colon injury can be treated similarly with no significant differences between the two groups ( $p=0.804$ ). The peculiarities relating to each case demanded a particular surgical therapy. As compared with the results obtained from other surgical therapies the best surgical management of war-associated colonic injuries with the least sequelae is

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exteriorization ( $p=0.0000002$ ) which is of first priority, whereas resection of the damaged segment accompanied by colostomy or ileostomy is of second preference. The use of antibiotics in the early phases of colonic injury is mandatory and a rapid diagnosis followed by expedient surgical therapy is of fundamental importance. Therefore, the most effective and convenient process for immediate treatment of wartime injuries is the establishment of reliable and equipped centers in the vicinity of battle zones.

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## INTRODUCTION

Colon and rectal injuries have been covered extensively in both religious<sup>1</sup> and scientific literatures. Despite many centuries of human life surgeons have not yet arrived at a unified decision on the subject and different opinions are expressed and various methods are applied. Hippocrates regarded these injuries as lethal and Socrates believed that in order for such injuries to resolve they should be left untreated.<sup>1</sup> With respect to war time injuries of the colon the diversity of opinions becomes even greater.

Based on the experience of Ogilvie during the second world war, resection of damaged colon can be easily achieved but colostomy for such injuries is essential and mandatory.<sup>9</sup> In recent years, however, surgeons have expressed tendencies to perform primary resection and colon anastomosis or even attempted to suture the damaged area of the colon. In this connection Morreels and colleagues were more in favour of primary repair of damaged colon than colostomy for the treatment of colonic injuries during the Cambodia war.<sup>6</sup> Despite numerous reports on the management of colonic wounds, few comparative studies have been performed on the injuries of right and left colons with reference to their distinct embryologic, anatomic, physiologic and microbiologic characteristics in particular to war time wounds.<sup>11</sup> The objective of the present study is to clarify the state of knowledge on the strategy of treatment of colon injuries with special reference to war-associated injuries.

## PATIENTS AND METHODS

The present investigation is retrospective and based on the examination of hospital records of patients admitted to our training hospitals (Nemazee, Shahid Dr. Faghihi and Shahid Dr. Beheshti) in Shiraz, Iran during eight years of the Iran-Iraq war.

## RESULTS

In this study the beginning of the colon to the midpoint of its transverse segment was regarded as the right colon,

and the rest to the end of the sigmoid was considered as the left colon.

The study included 226 selected cases out of which 92 (40.7%) suffered from right colon injuries and 134 (59.3%) sustained left colon injuries. The patients were all males and aged 15-54 years old. The majority had undergone surgical treatment in the hospitals of battle zones in the early hours of their injuries before being dispatched to the foregoing hospitals for continuation of therapy. Most injuries were penetrating (223 or 97.77% of cases) and resulting from bullets or shell fragments and missiles fired from aircrafts. In only two cases penetrating lesions were due to cuts by sharp objects and a nonpenetrating lesion in one patient resulted from shock wave. The last three cases suffered from injuries of the left colon.

The respective age spectra for the right and left colons were 15-42 (average 21.1) and 15-54 (average 20.8) years old. In 31 (13.72%) cases colonic injuries were not accompanied by other intra- or extra-abdominal injuries and the remaining 195 (86.28%) patients were found to have concurrent intra- and extra-abdominal injuries. Sixty-one (66.30%) right colon injuries and 99 (73.88%) cases of left colon damage were accompanied by intra-abdominal injuries and the organ most affected was the small intestine in both groups. In 90% of patients in both groups extra-abdominal injuries were found of which the most common were those of upper and lower extremities.

A combination of two or more antibiotics were used during the early hours of injury. The average period of hospitalization was 34 and 35.5 days for patients with colostomy involving the right and left colon respectively. The average time of hospitalization was 16.9 and 17.7 days for cases with primary repair of right and left colons respectively. The average time of hospitalization was 16.9 and 17.7 days for cases with primary repair of right and left colons respectively. The rate of fever did not vary considerably between the two groups.

## Complications

Eleven patients (8.20%) with left and 9 cases (9.78%) with right colon injury developed generalized peritonitis. Other complications are listed in Table I.

Table I. Complication rates in right and left colon injuries.

Complication	Left colon (%)	Right colon (%)
Generalized peritonitis	11 (8.20%)	9 (9.78%)
Shock:	7 (5.22%)	10 (10.86%)
Septic	6	10
Hemorrhagic	1	0
Gastrointestinal bleeding	3 (2.23%)	1 (1.08%)
Intraabdominal collections	11(8.20%)	4 (4.32%)
Fistula:	8 (5.97%)	6 (65.52%)
Colocutaneous	8	5
Enterocutaneous	0	1
Wound complications:	41 (30.5%)	38 (41.27%)
Wound infection	32 (23.7%)	29 (31.5 %)
Miscellaneous wound complications	9	9
Complications of colostomy	15 (11.1%)	11 (11.8%)
Complications of entrance or exit wounds	18 (13.4%)	5 (5.4%)
Miscellaneous complications	2 (1.48%)	2 (2.16%)
Late complications	1 (0.74%)	6 (6.48%)

Regarding the complications of colostomy at the right side, colon exteriorization was associated with the least sequelae (7.54%), while the highest complication rate was related to tube cecostomy (80%). Similarly, the lowest complication rate on the left side was attributed to exteriorization of the colon (5.74%). However, the highest complication rate on the same side belonged to Hartmann colostomy (71.42%).

### Surgical methods

In both groups the most common treatment was exteriorization (Table II). A repeat abdominal operation was performed on 39 (29.10%) and 30 (32.6%) of left and right colon injuries, respectively.

Mortality rates of 8.95% (12 patients) and 17.48% (16 patients) were associated with left and right colonic injuries respectively. The causes of death in both groups are shown in Table III.

### DISCUSSION

Various descriptions of microbiologic, physiologic, anatomic and embryologic origin of left and right colons

found in different textbooks may cause one to assume that separate and distinct therapeutic managements must be considered for the injuries in each case. The present study indicates that it is not logical to suggest a common guideline for the treatment of colonic lesions with 100% efficiency. Individual treatment of each patient must be performed with reference to all aspects including the severity of injuries, fecal contamination of the peritoneal cavity, the cause of injury, the time interval elapsed between the initiation of damage and surgical treatment, association of intra- and extra-abdominal injuries and the presence or absence of shock. Similar proposals have also been given in other reports.<sup>7</sup>

Taking into account the preceding aspects, both groups are in similar states from a statistical viewpoint and concerning the primary conditions included in the study such as sex, age, mechanism of damage, causative factors, simultaneous injury in other organs, prescription of antibiotics and the time interval between initiation of damage to surgical therapy.

Upon examination of various surgical treatments of left and right colon injuries in both groups, their rates of success, and complications, it becomes evident that despite superficial differences between the various surgical methods performed

## Therapy of Colonic War Injuries

**Table II. Complications of different procedures in colonic war injuries.**

Site of colonic injury Type of procedure	Left colon			Right colon		
	Without complication	With complication	Total	Without complication	With complication	Total
Exteriorization	69 (79.31%)	18 (20.69%)	87 (64.92%)	39 (68.42%)	18 (31.58%)	57 (61.95%)
Primary repair without proximal colostomy	2 (28.57%)	5 (71.43%)	7 (5.22%)	3 (21.43%)	11 (78.57%)	14 (15.21%)
Primary repair with proximal ileostomy, colostomy or tube cecostomy	5 (41.67%)	7 (58.33%)	12 (8.95%)	1 (14.28%)	6 (85.72%)	7 (7.60%)
Resection with primary anastomosis without proximal colostomy	0	4 (100%)	4 (2.92%)	1 (50%)	1 (50%)	2 (12.17%)
Resection and colostomy or ileostomy	18 (75%)	6 (25%)	24 (17.91%)	6 (50%)	6 (50%)	12 (13.04%)

**Table III. Causes of mortality in right and left colon war injuries.**

Cause	Left colon	Right colon
Missed perforation	5	4
Leakage of the anastomotic site	2	2
Colostomy complication	3	3
Inadequate debridement of necrotic tissue or inadequate irrigation	1	5
Abd. wall fasciitis	1	0
Extra-abdominal	0	2
Total	12	16

on both groups, the best procedure for right and left colon injury is exteriorization of the involved region. The latter was performed in the majority of surgical operations and had the lowest complication rate, as out of 87 (64.92%) exteriorizations of the left colon only 18 patients (20.69%) developed complications and the corresponding figure for the right colon was 18 (31.58%) out of 57 (61.95%) cases. Thus it must be remembered that irrespective of the sites of injury of the left or right colon, exteriorization (if feasible) of the injured part is the best surgical procedure. With respect to the rates of complications, statistical comparison of exteriorization with other surgical methods turned out to be highly significant ( $p=0.0000002$ ). Nevertheless the location of injuries in certain parts of the colon such as the rectum or rectosigmoid region and sometimes the hepatic

and splenic flexures does not allow exteriorization of the damaged part. In such cases the best treatment would be resection of the damaged part coupled with colostomy or ileostomy. The statistical comparison of various procedures between the right and left colon (Table III) did not show any significant differences and the corresponding results were as follows:

Exteriorization  $p=0.140$

Primary repair without proximal colostomy  $p=0.557$

Primary repair with proximal colostomy or ileostomy  $p=0.215$

Resection of damaged segment and primary anastomosis  $p=0.333$

Resection of damaged part coupled with colostomy or ileostomy  $p=0.487$

As mentioned previously a general agreement on the treatment of colonic injuries, particularly war-associated cases, does not exist and surgeons adopt their method of preference.

Morreels and co-workers were in favour of primary repair rather than colostomy for the treatment of 102 cases of Cambodia war injuries.<sup>6</sup> Starda, having treated 73 war-associated Afghan patients in Afghanistan's Red Cross Hospital stated that despite variable degrees of fecal contamination of the abdomen, 98.5% of surgical therapies, regardless of sites of damage, included resection plus primary anastomosis or primary repair of colonic lacerations.<sup>13</sup> Although he never resorted to colostomy or exteriorization of the colon, he achieved remarkable results. Resection plus early anastomosis has also been suggested provided the surgical operation is performed in less than 6 hours from the time of injury.<sup>5</sup> According to another report patients under certain conditions were randomly placed into three groups of surgical treatments (primary repair, exteriorization, and primary repair plus proximal colostomy) with no significant differences in mortality rates.<sup>12</sup> Similar results were obtained from a study relating to the right colon in the Afghanistan war.<sup>4,7</sup>

In our opinion primary repair coupled with proximal colostomy can be performed in the absence of contamination of the abdominal cavity and in the presence of other suitable conditions. 7 out of 12 (58.33%) and 6 out of 7 (85.72%) of our complications developed due to primary repair of left and right colons respectively. On the basis of foregoing statistics on war-associated injuries and particularly in cases with heavy contamination of the peritoneal cavity, it seems logical, as far as possible, to avoid primary repair of the right or left colon and apply more reliable therapeutic procedures. From a limited number of available reports expressing different results and viewpoints it can often be inferred that the prognosis of right colon trauma is more favorable with lower mortality rates than that of the left colon and apply more reliable therapeutic procedures. From a limited number of available reports expressing different results and viewpoints it can often be inferred that the prognosis of right colon trauma is more favorable with lower mortality rates than that of the left colon. The study of 145 cases of colonic injuries by Nicholas led him to believe that lacerations of the left colon carry higher risks than those of the right colon.<sup>8</sup>

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In order to compare right and left colon injuries Thompson and co-workers<sup>14</sup> reported that the same treatment can be performed on penetrating injuries of right and left colons provided the extent of trauma, contamination and other conditions are similar.

Demetriades and colleagues<sup>2</sup> stated that from a clinical point of view, the anatomic, physiologic and bacteriologic differences of the right and left colon have been overemphasized. They believed that unless preceding heavy

contamination of the peritoneal cavity exists, in most cases and regardless of the site of injury, primary repair of the damaged part could be performed with certainty. According to Parasad and his colleagues<sup>10</sup> if in cases of severe damage of the right colon resection is unavoidable and primary anastomosis is not possible, it is preferable to perform ileostomy along with a mucous fistula. Such treatment minimizes complications and facilitates later closure of the colon.

Whether war-associated injuries differ from other types of colonic injuries is another matter of importance. Flint and associates,<sup>3</sup> on the basis of information obtained during surgical treatment of colonic lacerations unlinked with war-time, proposed a guideline dividing such injuries into three distinct groups. Based on the experiences of Wiener and his colleagues<sup>15</sup> derived from 181 cases, war-linked colonic injuries must be dissociated from other types of colonic damage. They believed that the treatment of war injuries must be performed selectively and on an individual basis bearing in mind the possibility of performing primary repair (primary repair or anastomosis) under special circumstances. An accurate observation of the mortality ratio shows that although the number of deaths in cases of right colonic lacerations is twice that of the left colon, no significant difference was found between the two groups with respective mortality rates of 17.47% and 8.95% for the right and left colon ( $p=0.804$ ).

Further investigation on the cause of mortality revealed that deaths in both groups were due to infectious causes originating from hidden sites of lacerations and in later stages technical difficulties involving the colostomy and leakage from the site of anastomosis. Thus regardless of the site of colonic lacerations adequate and precise efforts must always be made during operation to find the sites of damage and clean the peritoneal cavity.

Study of the type and severity of complications in both groups led to the conclusion that most complications were associated with wounds, followed by intra-abdominal abscesses. Thus to prevent such sequelae similar steps must be taken for each group. These include rapid and adequate use of broad spectrum antibiotics, speedy diagnosis and immediate performance of surgical treatment with sufficient and careful attempts during surgery to find the sites of damage and persistence in cleansing the peritoneal cavity. In this connection, it has been noted that infectious complications are slightly more common in the right compared to the left colon. This may be ascribed to an easier flow of fecal matter in the former causing a faster spread of right colon contents compared to the left colon. Such an explanation cannot be applied to the left colon as in the latter intra-abdominal abscesses are more prevalent.

With respect to the period of hospitalization no significant differences were found between the two groups ( $p=0.60$  in the colostomy group and  $p=0.88$  in the primary repair

group).

Irrespective of the site of damage and in the presence of identical conditions, war-associated injuries of the right and left colon can be treated similarly. The best surgical procedure with the least complications is exteriorization of the damaged part, although resection of lesions coupled with colostomy or ileostomy would be the next preference. The prescription of appropriate antibiotics immediately after suspected colonic injury is mandatory but rapid diagnosis and performance of necessary surgical operations are the most important therapeutic processes. The most effective and convenient place for the treatment of war time injuries is the therapeutic centers in the vicinity of the battlefield.

Adequate and meticulous attempts made by the surgeon for the inspection of all intra-abdominal organs and adequate persistence in cleansing, debridement of necrotic tissues and suitable washing of the peritoneal cavity can reduce the postsurgical mortality rate.

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