

## Colon Traumatic Injuries – Factors that Influence Surgical Management

G. Jinescu, I. Lica, M. Beuran

Department of Surgery, Clinical Emergency Hospital, “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania

### Rezumat

#### *Leziuni traumatice ale colonului - factori ce influențează decizia chirurgicală*

*Introducere:* Acest studiu evaluează tendințele moderne de tratament chirurgical a leziunilor traumatice de colon într-un centru de traumă de nivel I, prin prisma creșterii încrederii în procedeele de reparare primară.

*Material și metodă:* Studiul nostru retrospectiv evaluează rezultatele obținute în cazul a 116 pacienți cu leziuni traumatice colonice operați în Spitalul Clinic de Urgență București, prin prisma unora din cei mai utilizați parametri care pot influența decizia chirurgului către unul din procedeele de reparare primară sau colostomie.

*Rezultate:* Leziunile colonice au survenit mai frecvent ca urmare a contuziilor abdominale (65%). Leziuni asociate intraabdominale au survenit în 85 de cazuri. Repararea primară a fost utilizată preponderent în 95 de cazuri (82%), iar colostomia în numai 21 de cazuri (18%). Parametrii care au influențat decizia chirurgicală au fost: prezența șocului, gradul contaminării peritoneale, gradul leziunii colonice (GLC) și valoarea Indicelui Traumatic Abdominal (ITA). Procedeele de reparare primară au avut o morbiditate de 7% comparativ cu 14% în cazul colostomiei, ITA având rol predictiv. Mortalitatea generală a fost de 19%.

*Concluzii:* Repararea primară, prin sutură primară sau rezecție și anastomoză, este o metodă sigură de rezolvare a majorității

leziunilor traumatice ale colonului. Colostomia este preferată la pacienții cu ITA  $\geq 30$  și GLC  $\geq 4$ . Judecata chirurgicală rămâne arbitrul final în luarea deciziei.

**Cuvinte cheie:** leziuni traumatice colonice, reparare primară, colostomie

### Abstract

*Background:* This study sought to evaluate current trends in surgical management of colon injuries in a level I urban trauma centre, in the light of our increasing confidence in primary repair.

*Methods:* Our retrospective study evaluates the results of 116 patients with colon injuries operated at Bucharest Clinical Emergency Hospital, in the light of some of the most commonly cited factors which could influence the surgeon decision-making process towards primary repair or colostomy.

*Results:* Blunt injuries were more common than penetrating injuries (65% vs. 31%). Significant other injuries occurred in 85 (73%) patients. Primary repair was performed in 95 patients (82%). Fecal diversion was used in 21 patients (18%). Multiple factors influence the decision-making process: shock, fecal contamination, associated injuries and higher scores on the Abdominal Trauma Index (ATI) and Colon Injury Scale (CIS). Colon related intra-abdominal complications occurred in 7% of patients in whom the colon injury was closed primarily and in 14% of patients in whom a stoma was created, ATI having a predictive role in their occurrence. The overall mortality rate was 19%.

*Conclusions:* Primary repair of colon injuries, either by primary suture or resection and anastomosis, is a safe method in the management of the majority of colonic injuries. Colostomy is

---

#### Corresponding author:

George Jinescu, MD, PhD  
Bucharest Clinical Emergency Hospital,  
8 Floreasca street, Bucharest, Romania  
E-mail: gjinescu@yahoo.com

preferred for patients with ATI  $\geq 30$  and CIS  $\geq 4$ . Surgical judgment remains the final arbiter in decision making.

**Key words:** colon trauma, primary repair, diversion

## Introduction

The recommended surgical treatment for colon trauma has undergone major changes in the last decades. There are various choices for colon injuries surgical repair but they can be grouped in two categories: primary repair (suture repair or resection and anastomosis) and diversion with colostomy formation at the time of injury. Surgeon's decision for one surgical procedure or another is influenced by a vast array of factors, yet there still are disagreements as to which of these factors is most significant. The dilemma over choosing the best medical procedure based on a series of parameters has been largely assessed in the specialized literature by means of retrospective and prospective analysis, meta-analysis and by literature review. Despite a relatively general consensus which stands for using primary repair procedures in colon injuries in civilian practice, there are yet authors warning against the dogmatic use of the latter mentioned ones (1). The present paper evaluates the results obtained in the case of 116 patients with traumatic colon injuries, operated in the Bucharest Clinical Emergency Hospital, and it is based on the most frequently used parameters that could influence the surgeon's decision towards one of the primary repair or colostomy procedures.

## Materials and Methods

The study is based on the retrospective analysis of 116 patients with colon injuries admitted and surgically managed within the Bucharest Clinical Emergency Hospital. The colonic lesions have been solved either by primary repair (primary suture of the colon perforation, with/without wound's margin debridement and resection of the injured segment, followed by anastomosis) or by colostomy (exteriorization of the lesion, resection of the injured segment with proximal colostomy and closure of mucous fistula of the distal end, or perforations suture followed by proximal colostomy on continuous or terminal loop) (2,3,4).

In the comparative analysis on primary repair and colostomy procedures used for colonic injuries repair in cases registered for the current clinical study, the influence over the surgical decision has been investigated with respect to 11 clinical parameters: age, gender, mechanism of injury, polytrauma, presence of shock at admission (defined as systolic blood pressure  $< 90$  mmHg) and transfusion requirements, elapsed time between injury and surgical intervention, location and number of colon injuries, degree of fecal contamination (mild, moderate and severe), colon injury severity (graded using Colon Injury Scale), associated organ injuries and the Abdominal Trauma Index (ATI) (5,6)

The present research has tried to identify easily quantifiable parameters whose facile intra-surgical appreciation could

quickly direct surgeon's decision towards a certain surgical attitude.

The result of surgical intervention has been evaluated by means of postoperative morbidity and mortality rates.

The way the 11 evaluated parameters in the clinical study influence the choice of surgical intervention type has led to the following results which will be presented as follows:

## Results

Of 116 patients undergoing operation for colonic injury, 95 underwent primary repair, while for the rest of the 21 cases, colostomy has been chosen.

Primary repair methods have been mostly used (82%), colonic injuries of 84 patients (88.5%) being primary sutured, whereas for 11 cases (11.5%) colon resection followed by anastomosis was chosen.

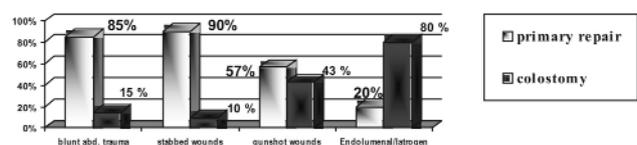
Methods of diversion of the faeces, generically registered as colostomy have been performed in only 18% of the cases - 21 patients. Most of the cases were represented by Hartmann colectomy (14 cases), followed by exteriorization of the colonic lesion as ostomy (4 cases) and primary suture with diverting Maydl colostomy (3 cases). Exteriorized repair was not used in our study.

The surgical attitude in Bucharest Clinical Emergency Hospital has been oriented towards primary repair methods for colon injuries. The method of surgical management was at the liberty of the operating surgeon.

- In the selected group, the male/female ratio was 5/1 while the mean patient age was 41 (with a range of 8 to 88 years), scarcely lower in cases of primary repair- 39 years old compared to the cases where colostomy has been used-46 years old. These differences are not statistically significant and have not influenced the surgical decision towards one method or another.
- The mechanism of injury has influenced the type of surgical intervention (Fig. 1).

In blunt abdominal trauma with colon injuries (75 cases), primary repair has been used in most of the cases (85.3%,  $p=0.0032$ ): primary suture in 55 cases and resection with anastomosis in 9 cases. Colostomy has been used in 14.7%: exteriorization of the lesion in 3 cases and Hartmann colectomy in 8 cases.

For penetrating abdominal wounds (36 cases) the primary repair/ colostomy ratio was 83.3%/16.7% and it is very similar to the one in blunt abdominal trauma; however, by looking



**Figure 1.** Relationship between mechanism of injury and method of repair

separately at stabbed abdominal wounds and gunshot wounds (using low velocity rifles) we notice significant differences in the surgical tactics; yet, the differences get blurred globally due to the low number of gunshot wounds.

Ninety per cent of stab wounds were treated by primary repair: 25 primary sutures and 1 colectomy with end to end anastomosis (p=0.001); colostomy has been used in 10% of the cases: 1 cecostomy and exteriorization of 2 transverse colon injuries. For gunshot wounds we notice a balance between primary repair (57% - 3 primary sutures and a right colectomy with end-to-side anastomosis) and colostomy (43% - 3 Hartmann colectomies).

The patients with endolumenal mechanism have been solved as follows: for the cases with trans-anal insufflation of compressed air, colostomy was performed (2 Hartmann colectomies), while primary suture of the cecum perforation and omentoplasty was performed in the singular case of endolumenal trauma by accidental swallow of a toothpick.

For two cases with iatrogenic etiology (two transverse colon injuries, one after laparoscopic suprarenalectomy and the other after therapeutic colonoscopic polypectomy), the attitude has been oriented towards colostomy as well, due to the long elapsed time between lesion appearance and its acknowledgement, both cases presenting severe fecal contamination with septic shock.

- 48 patients (41%) met the criteria for shock at admission. Patients with shock made up 39% (n=37) of those treated by primary repair and 52% (n=11) of those treated by colostomy. Overall, patients with shock tended to have higher ATI scores (ATI<sub>m</sub> = 22) than those without shock (ATI<sub>m</sub> = 16). A certain influence of the presence of shock at admission is seen in relation with the ATI, in choosing the type of surgical intervention.
- Identifying a colon lesion in a polytraumatized patient does not influence the surgical method. Half of the lesions solved by colostomy and 59% of the ones solved by primary repair have been performed in cases of polytraumas (Table 1).
- The mean time between injury and operative intervention has not registered significant differences between the two large surgical intervention groups (median time in primary repair - 91 min and colostomy - 63 min).
- The average transfusion requirements were 2.4 units /case for primary repair and 2.33 units /case in colostomy, very close figures. The number of packed red blood cells transfused has not influenced the

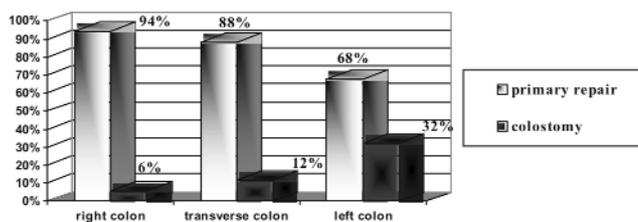


Figure 2. Relationship between colon injury location and method of repair

choice over the type of colon intervention.

- The location of the colon wounds were evenly distributed throughout the length of the intraperitoneal colon, with 47(40.5%) wounds located in the left colon, 35(30.2%) wounds located in the right colon, and 34(29.3%) wounds located in the transverse colon. The methods of primary repair have been used in a balanced way: right colon - 33 cases (34.7%), transverse colon - 30 cases (31.6%) and left colon - 32 cases (33.7%). Primary suture was used in 27 right colon injuries (32.1%), 27 transverse colon injuries (32.1%) and 30 left colon injuries (35.7%). There were 6 right colectomies, 3 transverse colectomies and 2 left colectomies. Out of the 21 cases of colostomy, 15 (71.4%) were for left colon injuries, 4 (19%) for transverse injuries and 2(9.5%) for right colon injuries. There were 14 Hartmann colectomies for 13 left colon injuries and 1 transverse injury. The exteriorization of the colon injury has been used in 4 cases: 2 caecum lesions as caecostomies, one transverse and one sigmoid injury. Suture repair with proximal colostomy was performed in 3 cases (2 transverse colon injuries and one sigmoid injury).

Comparing the surgical management based on the location of the colon injury it seems that there is an increased tendency for primary repair for right and transverse injuries (94% and 88%) compared to left colon injuries (68%) (Fig. 2).

- Fecal contamination of the peritoneal cavity can be an important influencing factor of the healing of the suture/anastomosis in emergency interventions on an unprepared colon. The degree of peritoneal contamination has been assessed by reviewing the detailed operative protocols. Out of the 116 cases, only 40% showed no fecal contamination, a situation met in grade I (27 cases) and grade II (19 cases) injuries, all solved by primary suture.

Fecal contamination was present in 70 patients (60%).

Table 1. Relationship between shock/trauma type and method of repair

Intervention type	Shock +	Shock -	Politrauma case
Primary repair (n = 95)	37 cases (39%) ATI <sub>m</sub> = 20	58 cases (61%) ATI <sub>m</sub> = 15	56 cases (59%)
Colostomy (n = 21)	11 cases (52%) ATI <sub>m</sub> = 26	10 cases (48%) ATI <sub>m</sub> = 16	10 cases (48%)

Among this subset, contamination was mild (confined to the immediate area of injury) in 42 patients (60%), moderate (involving one abdominal quadrant) in 12 (17%), and severe (extending beyond one abdominal quadrant) in 16 (23%). Thirty-six patients with mild contamination (85%) underwent primary suture repair, 2 (5%) were resected and anastomosed, and only 4 (10%) underwent diverting colostomy ( $p=0.001$ ). Six patients with moderate contamination (50%) received a diverting colostomy, 4 (33.3%) were resected and anastomosed, and only 2 (16.7%) underwent primary suture repair ( $p=1.0$ ). Patients with severe contamination were similarly distributed: eleven (68.7%) solved with a diverting colostomy and five (31.3%) were resected and anastomosed ( $p=0.0105$ ).

There is a significant relationship between extent of contamination and method of repair, as one can easily notice in Fig. 3. A severe fecal contamination favoured colostomy.

- Colon injuries were graded using Colon Injury Scale (CIS) (5) and as shown in Fig. 4, the treatment chosen differs substantially across CIS grades. Patients had 27 (23.3%) grade I colonic injuries (contusion, partial thickness, no perforation), 56 (48.3%) grade II (laceration < 50% of circumference), 16 (13.8%) grade III (laceration > 50% of circumference without transection), 5 (4.3%) grade IV (transection of the colon) and 12 patients (10.3%) had grade V injuries (transection of the colon with segmental tissue loss).

Primary repair was used for all CIS grade I and most of grade II injuries (90%). Patients with CIS grade III received primary repair in 10 cases (primary suture repair - 7 cases, resection and anastomosis - 3 cases) 62.5%; colostomy was used in 6 cases (37.5%). For patients with CIS grade IV and V colostomies were predominant - 60% of CIS grade IV and 60% of CIS grade V. For the rest of the cases (40%) colon resections and anastomosis have been used.

- Associated organ injuries were carefully evaluated and classified based on the Organ Injury Scale for each organ, which permitted the calculation of the Abdominal Trauma Index (ATI) for each case.

Seventy-one patients repaired primarily (75%) and 14 of those repaired by colostomy (66.7) sustained concomitant injuries. There were 101 lesions associated with primary repair and 22 lesions associated with the colostomy cases. 113 associated surgical interventions were performed, in a percentage that was almost identical both for the primary repair and for colostomy. The most frequent concomitant injury was to the small bowel (33% in PR and C).

- For the group of 116 patients the average overall ATI was 18. The average score for patients repaired primarily was 17, while for colostomies this was higher - 23 ( $p=0.0419$ ). For the 84 cases of primary suture repair, the average ATI was 16 compared to an average ATI of 26 for cases with resection and anastomosis and 23 for those where colostomy was used. Patients resected and diverted did not differ in terms of average ATI.

The average ATI score varies considerably with the colon injury scale, but keeps a moderate correlation degree, as one can notice in Fig. 5.

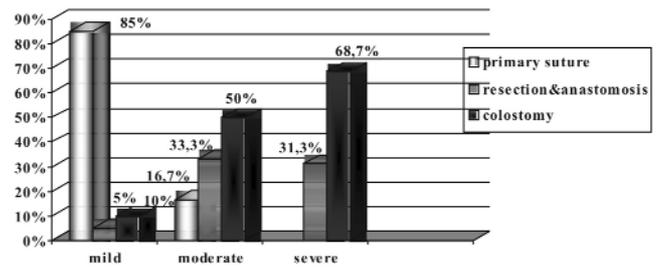


Figure 3. Relationship between fecal contamination and method of repair

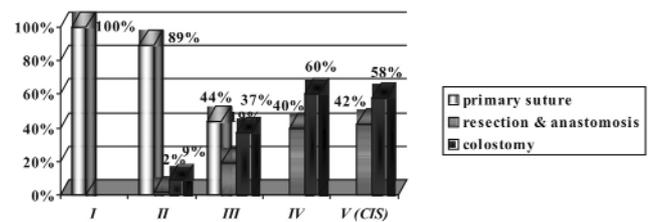


Figure 4. Distribution of primary suture repair, resection and anastomosis, and colostomy by CIS grade

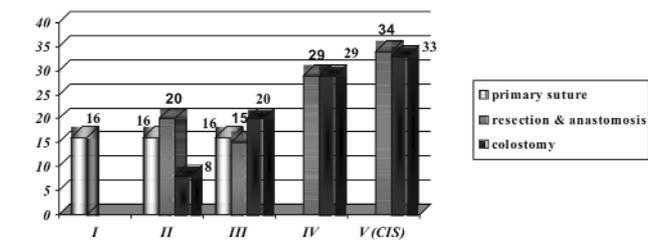


Figure 5. Relationship between the average abdominal trauma index (ATI), CIS grade and surgical intervention type

The overall morbidity was 22.4% (26 patients sustained complications), in the range of the literature data which shows figures between 7% - Bugis S.P. (7) and 51% - Fealk M. (8). Comparative analysis of the morbidity recorded for this study within the two large surgical interventions groups has shown a frequency of complications that is 2.5 times lower for primary repair procedures (18%) compared to colostomy (43%).

The intra-abdominal colon-related complications have been double for colostomies (14.3%) compared to primary repair (7.4%), wound infection was 4 times more frequent (38% in colostomies versus 8.5% in primary repair) and extra-abdominal complications had relatively close values (14.3% in colostomies and 9.5% in primary repair).

By comparing the incidence of leaks and intraperitoneal abscesses (1%/2.1% in primary repair and 4.7%/4.7% in colostomy) one notices that primary repair is much less accompanied by such complications. All this data support the current trend of using primary repair in colon wounds. The frequency of complications has been influenced by the severity of associated lesions, and ATI value.

Out of 27 patients with ATI > 25, 12 had complications (44.5%): colon-related intra-abdominal complications (7

patients - 26%), wound infection (8 patients - 30%) and extra-abdominal complications (6 patients - 22%). Among the 89 patients with ATI < 25, 14 suffered complications (15.7%): colon-related intra-abdominal complications (3 patients - 3.5%), wound infection (8 patients - 9%) and extra-abdominal complications (6 patients - 6.7%).

By interpreting the results of our study one can conclude that ATI may represent a predictive feature for morbidity, as patients with ATI values > 25 have a three times higher risk for complication occurrence, compared to patients with an ATI < 25. Moreover, considering complications for cases with CIS grade IV or V and ATI > 30, the colon resection must be followed by colostomy, not by anastomosis.

Overall mortality was 19.6% close to literature data, which varies between 2% and 16% (9, 10). Mortality rate was double for colostomy (31.2%) compared to primary repair (17.4%) but the conclusion must be carefully evaluated considering the fact that diversion was applied to politraumatized patients with colon injuries grade IV or V, with severe fecal contamination, factors with negative consequences. Half of the politraumatized patients with hospital in-take shock died. The number of deaths was extremely high for grade IV and V colon injuries, irrespective of the surgical solution (primary repair - 75%, colostomy - 83%), as a result of exsanguination or severe neurologic trauma, all within the first 24 hours. The analysis of deaths based on ATI values shows a 2.5 times higher mortality in cases with ATI > 25 (55.5%) compared to ATI < 25 (21.3%).

## Discussion

The high number of studies analysing surgical treatment options in colon trauma shows present controversies on this issue. It was in 1998 when Curran and Borzotta (10) analysed 27 retrospective studies with a total number of 2964 cases of traumatic colon injury; in the same year, Eshragi (11) quotes seven prospective studies which analyse primary repair procedures compared to colostomy. Even though there is no absolute consensus, most of the research papers which approach the topic conclude that primary repair should be used in traumatic colon injuries.

It was during World War II when colostomy was chosen as the standard method for solving colon wounds (12). Thus, the only options were - exteriorization of the injured segment as a stoma, resection and colostomy or repair of the injury with proximal colostomy. Primary repair gained popularity as surgeons began to understand the differences between military and civilian injuries. (13).

The policy of mandatory colostomy applied to the end of the '70s, was challenged in 1979 when Stone H.H. and Fabian T.C. (14) published the first prospective randomized trial involving 268 patients. Mandatory colostomy was performed in patients who had: preoperative shock, hemorrhage > 1000 ml blood, more than two intra-abdominal organs injured, severe fecal contamination, delay of more than 8 hours to operation, colonic injury requiring resection, massive loss of soft tissue. The remaining patients were randomized to either

primary closure -67, or to colostomy - 72. Even though performed on a low number of selected cases (67 cases-25%), the primary suture proved to have fewer complications than colostomy. Stone and Fabian have shown that, given certain criteria, primary repair of colon injuries could be safely performed.

Burch et al. (15) in a retrospective analysis of 1006 patients with colon injuries managed over a 10-year period (1980-1989), showed the fact that a rigorous surgical selection according to exclusion criteria can identify patients favouring primary repair, and they can sometimes even be the majority (61%). The chance of an adverse outcome was twice as great for both exteriorized repair or colostomy and for primary repair. Primary repair frequency has risen from 55% in the first 5 years of the study to 70% in the second part while the morbidity rate has dropped from 12 to 9.3 %.

George et al. have conducted a prospective analysis for a number of 102 cases with colon injuries for which primary repair has been used in an incredible percentage of 93% of the cases, without considering the shock severity, the fecal contamination or number of associated organs injured, with no primary repair suture fistula. Colon injuries requiring resection were followed by colostomy in the first half of the study (7 cases), and later by primary anastomosis (12 cases) with only one suture-line leak. They suggested that the classic contraindications to primary repair are unfounded, and primary repair should be the standard procedure in civilian colon injuries. Colostomy will thus be further considered as a backup method for cases with an injury-operation delay > 24 hours as well as for those with massive blood loss and consecutive coagulation disturbances. (16)

In a landmark paper on colon injuries published in 1991, Chappuis et al. publishes the first randomized prospective study on a number of 56 patients, where he compares primary repair (28 cases-50%) and colostomy (28 cases- 50%), without using the exclusionary criteria. For the group of patients solved by simple suture (17 cases) or resection with anastomosis (11 cases) no fistula or deaths were registered while the incidence of the intraperitoneal abscesses was similar to the group where colostomy was practiced (10.1% compared to 14.2%). Even though the number of the analysed patients was relatively small, the study was the first to show that primary repair is a safe method even in cases which had not been previously selected. Based on these results, it was suggested that primary repair be considered the treatment of preference for nearly all penetrating colon injuries. (17)

Moore et al. developed for patients with penetrated stabbed abdominal wounds, shot ones or with other traumatic nature origin the Colon Organ Injury Scale (CIS) which measures the severity of the colon injury and Abdominal Trauma Index (ATI) used to assess the severity of colon and other organ injuries, that can be used to evaluate and quantify the risk of complications after abdominal trauma. (5,6) ATI was calculated by assigning a risk factor (1-5) to each organ injured and then multiplying this by a severity of injury estimate (1-5). The sum of the individual organ scores comprised the final abdominal trauma index. The article

showed a significant increase in patient morbidity for those with ATI score greater than 25. Moore et al. suggested that ATI score is a reliable basis for prediction of complications and a measure for comparison of colon injury management. Also, Moore stated that ATI can be used intraoperatively for choosing the type of surgical intervention, all based on the predictive value in terms of morbidity and mortality.

In 1995, Sasaki et al. prospectively randomized 71 patients with colon injuries to either primary repair or diversion with no exclusionary criteria. Forty-three patients were treated with primary repair suture or resection and anastomosis (61% of cases), with no fistula or deaths registered and 28 patients were treated with diversion. The overall incidence of colon- and non-colon-related complications was 19% in the primary repair group and 36% in the diversion group. Intraoperative abscesses have been registered in 2.3% of primary repair cases and in 17.8% of colostomies. Authors have concluded that „primary repair or resection with anastomosis is the method of choice for treatment of all penetrating colon injuries in the civilian population despite any associated risk factors for adverse outcomes”. (18)

The largest study analysing exclusively destructive colonic injuries was a retrospective analysis by Murray et al. The study included 140 patients requiring colon resection for traumatic injuries, 80% managed by primary anastomosis and 20% by diversion. The authors appreciated that in most cases resection and anastomosis can be safely performed both in left colon injuries as well as in right ones, while for the right colon injuries ileocolic anastomosis had a lower incidence of fistula than the colocolic one. Authors recommended the use of colostomy for destructive left colon injuries in patients with abdominal trauma index > 25 or hypotension in the emergency room, as they noticed a higher risk for anastomotic leak in these cases. (19)

Demetriades D. et al. evaluated in a multicenter prospective study the management of colon injuries that require resection. Two hundred ninety-seven patients fulfilled the criteria for inclusion and analysis. Overall, 197 patients (66.3%) were managed by resection and primary anastomosis and 100 (33.7%) by colostomy. The overall colon-related morbidity was 24% (primary repair, 22%; colostomy, 27%), and overall colon-related mortality was 1.3% (four deaths in the colostomy group and no deaths in the primary group). Multivariate analysis identified three independent risk factors for abdominal complications: severe fecal contamination, transfusion of more than 4 units of blood within the first 24 hours and single-agent antibiotic prophylaxis. Historically, fecal contamination was considered an overt indication for colostomy. This study showed that the degree of fecal contamination did not affect the outcome of patients treated by diversion versus primary repair and supported primary repair even in cases of massive fecal contamination. The surgical method of colon management after resection for penetrating trauma did not affect the incidence of abdominal complications, irrespective of associated risk factors. In view of these findings, primary anastomosis should be considered in all such patients. (20)

In scientific papers which evaluate colonic injuries there are still concerns about the safety of mechanical anastomosis with stapling devices. Although in elective colon surgery the mechanical anastomosis proved as safe as the handsewn one, there are still doubts if this is valid for emergency trauma surgery as well, as there are some concerns on associating mechanical suture with a higher risk of fistula and intra-peritoneal abscesses. A prospective multicenter project by Demetriades D., Murray J. et al. (21), performed in 19 participating trauma centers, analysed the outcomes between stapled and handsewn repairs. The study included a number of 207 patients who underwent colon resection with primary anastomosis following penetrating trauma. In 128 patients (61.8%) the anastomosis was performed by handsewing, while in 79 cases (38.2%) with stapling devices. No colon-dependent deaths were registered, while the intra-abdominal colon-related complications were 22.7% (26.6% for mechanical anastomosis and 20.3% for the handsewn ones). The incidence of anastomotic leak was 6.3% in the stapled group and 7.8% in the handsewn group. The results of this study have shown that the method of anastomosis for colon injuries requiring resection does not influence intraabdominal complications and the choice should depend on the surgeon's preference and on hospital capability to provide surgical staplers.

Primary suture repair or resection and anastomosis of colon wounds have been advocated in many studies, but the number of surgeons applying these recommendations is unknown.

Eshraghi et al. evaluated the answers of 449 trauma surgeons, members of AAST (American Association for Surgery of Trauma) on the choice of management for colon injuries repair. The preferred management of eight types of colon wounds was recorded, among three options: primary suture, resection and anastomosis and diverting colostomy. 98% of the surgeons have indicated primary repair for at least 1 type of colon injury, 30% have never chosen colostomy and only 0.9% would always divert for any colon injury, a largely spread attitude before the 1979 report of Stone and Fabian (14). High-velocity gunshot wound was the only injury for which the majority (54%) would perform colostomy. More than half (55%) of the surgeons preferred resection and anastomosis for colon contusion with possible devascularisation, laceration greater than 50% of the diameter or transection. Analysing surgeons' preferences based on their experience, it was shown that surgeons with less than 5 interventions a year for colon injuries chose colostomy more frequently than primary repair compared to surgeons who managed six or more colon wounds per year. The conclusion of the study was that the US trauma surgeons favors primary repair procedures even in an unprepared bowel (11). For a low number of destructive colon injuries, the selection of the treatment method is a personal choice for each surgeon called to solve such an issue, and this is valid until some significant statistical studies will be performed to analyse factors that predispose to anastomotic leak.

## Conclusions

Surgery of trauma has permanently evolved during centuries, reorganising itself in our days in order to cope with the modern injuries. (22) The goal of this study was to determine the preferences regarding the management of colon injuries of the surgeons from a level I trauma center – Bucharest Clinical Emergency Hospital. Factors that can influence intraoperative decision towards primary repair or diversion were evaluated as well as the influence of the surgical procedure on the patient's prognostic. The results of this study suggested that the surgical choice in colon injuries should be:

Colostomy, when:

- the mechanism of injury is a gunshot wound, endoluminal or iatrogenic;
- shock at hospital admission;
- severe fecal contamination;
- CIS grade IV or V with ATI > 30.

Primary repair, when:

- the mechanism of injury is a blunt or stabbed abdominal wound;
- the patient is hemodynamically stable, with no shock at admission;
- mild or moderate fecal contamination;
- CIS grade I, II or III with ATI < 25;
- CIS grade IV, V with ATI < 30 (Resection and anastomosis).

Thus, the information provided by the awareness of injury mechanism, shock presence, peritoneal contamination level, colon injury severity (CIS) in association with the complexity of abdominal trauma (ATI), can represent objective criteria for choosing the surgical solution.

## References

1. Curran TJ, Borzotta PA. Complications of primary repair of colon injury: literature review of 2964 cases. *Am J Surg.* 1999; 177(1):42-7.
2. Jinescu G, Ionescu Gh, Murgu C, Ene B, Tanase C, Lica I, et al. Plăgi abdominale penetrante cu leziuni de colon. *Chirurgia (Bucur).* 2004; 99(2) Supl 264.
3. Jinescu G, Ionescu Gh, Murgu C, Ene B, Lica I, Beuran M. Sutura primară sau colostomie în traumatismele abdominale deschise cu leziuni colonice?. *Chirurgia (Bucur).* 2006;101 Supl:82-3.
4. Jinescu G, Ionescu Gh, Murgu C, Lica I, Beuran M. Surgical attitude in penetrating abdominal trauma with colon injuries. *International Journal of Disaster Medicine.* 2006;4(1-2):9-10.
5. Moore EE, Cogbill TH, Malangoni MA, Jurkovich GJ, Champion HR, Gennarelli TA, et al. Organ injury scaling II: pancreas, duodenum, small bowel, colon, and rectum. *J Trauma.* 1990;30(11):1427-9.
6. Moore EE, Dunn EL, Moore JB, Thompson JS. Penetrating abdominal trauma index. *J Trauma.* 1981;21(6):439-45.
7. Bugis SP, Blair NP, Letwin ER. Management of blunt and penetrating colon injuries. *Am J Surg.* 1992;163(5):547-50.
8. Fealk M, Osipov R, Foster K, Caruso D, Kassir A. The conundrum of traumatic colon injury. *Am J Surg.* 2004;188(6):663-70.
9. Taheri PA, Ferrara JJ, Johnson CE, Lamberson KA, Flint LM. A convincing case for primary repair of penetrating colon injuries. *Am. J. Surg.* 1993;166(1):39-44.
10. Flint LM, Vitale GC, Richardson JD, Polk HC. The injured colon: relationships of management to complications. *Ann Surg.* 1981;193(5):619-23.
11. Eshraghi N, Mullins R, Mayberry JC, Brand DM, Crass RA, Trunkey DD. Surveyed opinion of American trauma surgeons in management of colon injuries. *J Trauma.* 1998; 44(1):93-7.
12. Ogilvie WH. Abdominal wounds in the Western Desert. *Surg Gynecol Obstet.* 1944;78:225-238.
13. Woodhall JP, Ochsner A. The management of perforating injuries of the colon and rectum in civilian practice. *Surgery.* 1951;29(2):305-20.
14. Stone HH, Fabian TC. Management of perforating colon trauma. Randomization between primary closure and exteriorization. *Ann Surg.* 1979;190(4):430-6.
15. Burch JM, Martin RR, Richardson RJ, Muldowny DS, Mattox KL, Jordan GL Jr. Evolution of the treatment of the injured colon in the 1980s. *Arch Surg.* 1991;126(8):979-83; discussion 983-4.
16. George SM, Fabian TC, Voeller GR, Kudsk KA, Mangiante EC, Britt LG. Primary repair of colon wounds. A prospective trial in nonselected patients. *Ann Surg.* 1989;209(6):728-34.
17. Chappuis CW, Frey DL, Dietzen CD, Panetta TP, Buechter KJ, Cohn IJr. Management of penetrating colon injuries. A prospective randomized trial. *Ann Surg.* 1991;213(5):492-8.
18. Sasaki LS, Allaben RD, Golwala R, Mittal VK. Primary repair of colon injuries: a prospective randomized study. *J Trauma.* 1995;39(5):895-901.
19. Murray JA, Demetriades D, Colson M, Song Z, Velmahos GC, Cornwell EE 3rd, et al. Colonic resection in trauma: colostomy versus anastomosis. *J Trauma.* 1999; 46(2):250-4.
20. Demetriades D, Murray JA, Chan L, Ordoñez C, Bowley D, Nagy KK, et al. Penetrating colon injuries requiring resection: diversion or primary anastomosis? An AAST Prospective multicenter study. *J Trauma.* 2001;50(5):765-75.
21. Demetriades D, Murray JA, Chan LS, Ordoñez C, Bowley D, Nagy KK. Handsewn versus stapled anastomosis in penetrating colon injuries requiring resection: a multicenter study. 2002; 52(1):117-21.
22. Beuran M, Negoii I, Paun S, Runcanu A, Gaspar B. History of trauma care. *Chirurgia (Bucur).* 2011;106(5):573-80. Romanian