Coll. Antropol. **26** (2002) 2: 441–446
UDC 616.348-001.45(495.5)
Original scientific paper

War Injuries of Colon and Rectum – Results After 10 Years

Ž. Bušić[1], F. Rudman[2], I. Stipančić[1], E. Amić[3] and D. Bušić[4]

[1] Department of Abdominal Surgery II, University Hospital »Dubrava«, Zagreb, Croatia
[2] Department of Surgery, University Hospital »Dubrava«, Zagreb, Croatia
[3] Department of Traumatology, University Hospital »Dubrava«, Zagreb, Croatia
[4] Department of Dermatology, University Hospital »Dubrava«, Zagreb, Croatia

A B S T R A C T

The aim of our study is to evaluate results of treating war injuries of colon and rectum, after 10 years. During the war in Croatia, 21 wounded, with colon (19) and rectum (2) injuries, were treated in the Department of Surgery at Nova Gradiška General Hospital from August 1991 to April 1992. Bullet wounds accounted for 57% of the injuries. All patients had other associated injuries. Primary repair and proximal derivation was possible in 2 cases (9.5%), while primary resection with intraperitoneal anastomosis was performed in 3 (14.3%) patients. In 2 (9.5%) patients sustained intraperitoneal and extraperitoneal rectal penetrating injury rectum was resected and closed performing temporary sigmoidostomy. When multiple perforations or crush injury of the colon were found, in 8 (38.1%) injured persons resection of the involved segment was combined with proximal end colostomy and aboral mucous fistula. Exteriorization of injured segment of the colon and creating colostomy incorporating the injured colon as the stoma was performed in 6 (28.5%) wounded patients. Four of the wounded (19.0 %) died two of them during the operative procedure due to hemorrhagic shock. One injured died after eight days due to pulmonary embolism, and one patient died after thirty days due to sepsis. Reoperation was necessary in two (9.5%) injured due to bowel obstruction four days following initial surgery because of adhesions. Three (14.3%) of the injured had wound infection, one of them died 30 days after injury due to sepsis, and two (9.5%) consequently developed ventral hernia that was operated after 4 and 5 years respectively. Four (19.0%) of the injured are still occasionally experiencing occasional abdominal pain.

Received for publication April 25, 2002

Introduction

Wounds of the colon and rectum resulting from penetrating or blunt trauma are commonly encountered in civilan and war circumstances. Prior to the World War II, this type of injury was associated with significant mortality and morbidity. Injury to the colon and rectum are the most important factor in septic complications following abdominal trauma. Sepsis causes most of the delayed morbidity and mortality in war trauma.

As combat trauma differs from peacetime counterpart by involving different spectrum of injuries, occurring in austere environments, dealing with mass casualties, and embodying inherent treatment delays the surgical war doctrine mandated colostomy in dealing with colonic and rectal injuries. Despite military recommendation[1–4] for routine performance of colostomy, the management of colonic injuries has undergone radical change in the last fifty years[1,5–12].

More frequent performance of primary repair of civilian colonic injuries has been recommended in recent reports[6,13,14]. Some authors have discouraged the use of exteriorized repair as an alternative to loop colostomy[3,9,15]. Current management of rectal injuries mandates fecal diversion and presacral drainage, but throughout the last three decades other reports have suggested a more conservative approach[4,16,17]. Most of reports deal with civilian injuries from low-velocity missiles or combat experience, without pointing out the specific differences between shell fragments and bullets[2,18,19]. Within the context of this controversy we reviewed our experience with penetrating colon and rectum injuries under combat conditions during the war in Croatia[20] and late results after 10 years. The aim of our study is to evaluate results of treating war injuries of colon and rectum, after 10 years.

Material and Methods

During the war activities through 8 months period in northern part of Croatia from August 1991 to April 1992, 21 wounded persons sustained injury of colon and rectum. All were managed in the Department of Surgery at Nova Gradiška General Hospital that was like the whole town of Nova Gradiška under continuous daily artillery attacks.

In 9 (42.9%) cases injuries were caused by shell or mine fragments and in remaining 12 (57.1%) by bullets of various calibers and high kinetic energy. Sixteen patients (76.2%), predominantly male and young, were soldiers, and 5 (23.8%) casualties were civilians. The mean age of the patients was 33.0 years (range 17–77). There was 1 woman (4.8%), and the others 20 (95.2%) were men.

Associated other abdominal and extra-abdominal injuries were presented in all patients and seventeen (81.0%) were admitted in shock (Table 1).

TABLE 1
ASSOCIATED INJURIES (n = 21)

Injuries	N	%
Small intestine	16	76.2
Omentum and/or mesentery	6	28.6
Lung	5	23.8
Liver and biliary system	5	23.8
Genitourinary system	5	23.8
Spleen	4	19.0
Extremities	4	19.0
Major vessels	3	14.3
CNS	3	14.3
Diaphragm	2	9.5
Vertebral	1	4.8

Following admission, appropriate resuscitation and X-ray examination, the patients were promptly taken to the operating theater for immediate surgery. Broad-spectrum antibiotics were admin-

TABLE 2
LOCALIZATION OF BOWEL INJURIES

Site of injured colon	N	%
Caecum	4	19.0
Ascendent	6	28.6
Transverse	3	14.3
Descendent	2	9.5
Sigmoid	8	38.1
Extraperitoneal rectum	2	9.5
Intraperitoneal rectum	1	4.8

istered intravenously at the beginning of operation (penicillin, gentamycin, and metronidazole). After an accurate assessment of the location and extent of the injury (colonic, rectal, as well as, associated intra-abdominal organs) and treating life threatening bleeding one of the following methods was applied:

1. Primary closure of colonic injury and proximal derivation by colostomy or ileostomy

2. Primary resection of injured colon with intraperitoneal anastomosis and proximal colostomy

3. Resection of injured colon followed by proximal derivation with end colostomy and mucus fistula or aboral occlusion

4. Primary colostomy using exteriorization of the injured segment incorporating the injured colon as the stoma

The sites of injured large bowel are shown in Table 2. Three injured had multiple colonic injuries, so there were a total of 26 colonic injuries.

At the end of the operation the peritoneal cavity was meticulously washed out from blood and intestinal contents and drains were placed. The laparotomy incision was sutured. The wounds caused by shell and mine fragments and bullets were excised and left open, except peritoneum that was primarily closed. Colostomies were never created in place of injuries to the abdominal wall. Parenteral antibiotics (penicillin, gentamicin and metronidazole) were continued for 5 days postoperatively.

All patients were called after 10 years for the evaluation of their condition, possible late complications, and health problems related to injuries.

Results

Primary closure with proximal derivation was done in 2 (9.5%) patients and both had transverse colon injury. In one case primary repair of the transverse colon was followed by protective cecostomy and in another ileostomy was constructed. The primary resection with intraperitoneal anastomosis was performed in 3 (14.3%) patients. In two (9.5%) patients sustained intraperitoneal and extraperitoneal rectal penetrating injury, rectum was resected and closed performing temporary sigmoidostomy similar as in Hartmann procedure.

When multiple perforations or crush injury of the ascendent, transverse, descendent or sigmoid colon were found, a resection of the involved segment was combined with proximal end colostomy and aboral mucous fistula or »blind« occlusion of the aboral parts of the colon. This type of surgery ended with temporary end colostomy was performed in 8 (38.1%) injured persons. End colostomy was performed after bowel resection, while bipolar colostomy was performed for proximal derivation. Exteriorization of injured segment of the colon and creating colostomy incorporating the injured colon as the bipolar stoma was performed in 6 (28.5%) wounded patients.

Elective closure of the colostomy was performed in all cases after 2–3 weeks except in two in whom closure of colostomy was delayed six and eight months respectively, due to health problems caused with other more complex injuries. We chosen such early colostomy closure, because most of the injured patients were

young without associated medical conditions that could jeopardize surgery. After 2–3 weeks patients were in good condition and colonic injuries were already healed.

Four (19.0%) of the injured died, and no one died as a direct result of the colorectal injury. All four were in shock on admission with multiple life threatening injuries. Two patients died during the operative procedure due to hemorrhagic shock caused by rupture of abdominal aorta and massive pulmonary injury. One patient died on the eighth postoperative day due to pulmonary embolism. This patient had associated spinal injury, small and large bowel injuries and pelvic injury with fracture. Sepsis caused death in the patient who sustained major hepatic and pulmonary trauma complicated with pulmonary abscess. He died thirty days after surgery.

Reoperation was necessary in two (9.5%) injured due to bowel obstruction four days following initial surgery. The cause of obstruction was adhesions. These patients had injured transverse and sigmoid colon that were primarily sutured. At reoperation colostomy was performed in both cases.

One of the injured was surgically treated for concomitant injuries of lumbar spine and spinal medulla contusion associated with paraparesis. He also developed deep vein thrombosis and underwent successful conservative treatment.

One of the injured underwent multiple reconstructive procedures for traumatic forearm amputation with extensive loss of soft tissue.

Three (14.3%) of the injured had wound infection. One of them died 30 days after injury due to sepsis, and two consequently developed a ventral hernia that was operated 4 and 5 years later, respectively. Four (19.0%) of the injured are still occasionally experiencing occasional abdominal pain ten years after injury. All other patients have no health related problems and conduct normal daily activities.

Discussion

At the turn of the century, penetrating abdominal injuries were treated conservatively with few survivors. In World War I[21,22], suture was the preferred treatment for wounds of the colon and rectum, with mortality rates of 60% to 75%. In the early 1940s, mortality remained 53% to 62% in both civilian[23] and military reports[24,25]. In 1943, the US Surgeon General[26], following the British lead, mandated exteriorization or proximal diversion for colon injuries, and by the mid 1940s mortality from wartime colon injuries dropped to 30% – 35%[27,28]. These recommendations were based on expert opinion, and none were the result of scientific, prospective study.

Ogilvie's[24] data did not show a decreased mortality with colostomy compared with primary repair, but he did cite cases where anastomotic failure led to sepsis and death. In many surgeons' minds, fear of breakdown of repair weighed more heavily as a cause of complications than did associated injuries. In an analysis of 1,155 wartime colostomy cases, Chunn[29] found that mortality was 19.5% with isolated colon or rectal injury and rose incrementally with additional organ damage to over 80% when four or more organs were injured. Among surgeons, the mandatory colostomy received credit for improved survival. But it must be remembered that in this period great advances in care occurred, including more rapid evacuation from the battlefield, improved surgical techniques, newer anesthetics and the use of endotracheal tubes, the appearance of penicillin and sulfadiazine, and widespread availability of blood and plasma transfusions.

After World War II, exteriorization or diversion became the accepted practice for civilian colon injuries. It was noted that most deaths in abdominal trauma cases were most likely related to shock and inadequate use of blood[30]. Improvements in mortality similar to the military experience were reported from civilian practices by the 1950s, crediting colostomy for the effect. A few voices of dissent argued against the colostomy dogma by pointing out differences between the civilian and military circumstances. Woodhall and Ochsner[31] in 1951 and Pontius et al.[32] in 1957 reported a mortality rate after primary colon repair half of that in the diverted group, but the more severe injuries had been exteriorized or diverted.

Murray et al.[33] analyzed 140 patients with colonic injuries that required resection. They suggested that while majority of patients can safely undergo colonic resection with primary colocolonic anastomosis even for severe injuries, there is a subgroup of critically injured patients at higher risk of anastomotic leakage who may be best treated by colostomy. Cornwell et al.[34] also postulate that there is a group of critically injured patients with high blood transfusion requirements and cardiovascular compromise in whom suboptimal gut perfusion and postoperative acidosis is likely to be prolonged and for whom colonic repair with anastomosis is unsafe. Behrman et al.[35] analyzed intestinal repairs after trauma and identified splanchnic hypoperfusion and hypoxemia as key factors affecting healing of those repairs. Bowley et al.[36] analyzed 127 patients with colonic injury and concluded that in 84% of colostomy could be avoided, but still there were critically injured patients requiring colostomy.

The management of colonic injuries in war conditions inaugurated some changes to the standard procedures[1,6,11,13–14]. Some principles have been changed concerning exteriorization versus primary repair[4,5,10], but controversy still continues.

The hospital conditions were improvised, with large number of injured persons needing urgent surgical management, involving not only abdominal surgeons, in a short time, and making postoperative care difficult. Evacuation of postoperative patients from the hospital under heavy artillery attacks burdens hospital capacity, and makes care and control problematic. All this demands good primary care and whenever possible definitive management of the injured at the first attempt with a low number of complications. The risk of complications was estimated intraoperatively, and method of surgical management was chosen individually in each case. Those conditions were principal reason that so many colostomies were performed and not primary repairs.

We believe that colon and rectum war injury should be managed with as few complications as possible using the safest procedure available. The late results after ten years are more than satisfying considering nature of injuries and there are no major health related problems due to sustained colorectal injuries as well as considering the type of surgical procedure.

REFERENCES

1. ADKINS, R. B., P. K. ZIRKILE, G. WATERHOUSE, J. Trauma, 24 (1984) 491. — 2. NALLATHAMBI, M. N., R. R. IVATURY, M. ROHMQN, W. M STAHL, J. Trauma, 27 (1987) 876. — 3. SHANNON, F. L., E. E. MOORE, F. A. MOORE, B. L. MCCROSKEY, J. Trauma, 28 (1988) 989. — 4. HAYWOOD, I., D. SKINNER, ABC Major Trauma, 301 (1990) 1040. — 5. ADAMS, D. B., Arch. Surg., 126 (1991) 115. — 6. ALEXANDER-WILLIAMS, J., Injury, 21 (1990) 294. — 7. CHAPPUIS, C. W., D. J FREY, C. D. DIETZEN, T. P. PANETTA, K. J. BUECHTER, I. COHN JR., Ann. Surg, 213 (1991) 492. — 8. FALCONE, R. E., S. R.

WANAMAKER, S. A. SANTANELLO, L. C. CAREY, Dis. Colon Rectum, 35 (1992) 957. — 9. LOU, M. A., A. P. JOHNSON, M. ATIK, A. K. MANDAL, J. L. ALEXANDER, T. L. SCHLATER, Arch. Surg, 116 (1981) 926. — 10. MOORE, E. E., E. L. DUNN, J. B. MOORE, J. S. THOMPSON, J. Trauma, 21 (1981) 439. — 11. SHANNON, F. L., E. E. MOORE, Surgery, 98 (1985) 851. — 12. THOMPSON, J. S., E. E. MOORE, J. B. MOORE, Ann. Surg., 193 (1981) 414. — 13. GEORGE, S. M. JR., T. C. FABIAN, G. R. VOELLER, K. A. KUDSK, E. C. MANGIANTE, L. G. BRITT, Ann. Surg., 209 (1989) 728. — 14. WIENER, I., P. ROJAS, F. J. WOLMA, Am. J. Surg., 142 (1981) 717. — 15. STONE, H. H., T. C. FABIAN, Ann. Surg., 190 (1979) 430. — 16. TUGGLE, D., P. J. HUBER JR., Am. J. Surg., 148 (1984) 806. — 17. GEORGI, B. A., M. MASSAD, M. OBEID, J. Trauma, 31 (1991) 711. — 18. FACKLER, M. L., JAMA, 259 (1988) 2730. — 19. PORET, H. A., T. C. FABIAN, M. A. CROCE, R. P. BYNOE, K. A. KUDSK, J. Trauma, 31 (1991) 1088. — 20. LACKOVIĆ, J., J. MARKELJEVIČ, M. MARUŠIĆ, Croat. Med. J., 33 (1992) 110. — 21. FRASER, J., H. DRUMMOND, Br. Med. J., 1 (1917) 321. — 22. POER, D. H., Arch. Surg., 61 (1950) 1058. — 23. ELKIN, D. C., W. C. WARD, Ann. Surg., 118 (1949) 780. — 24. OGILVIE, W. H., Surg. Gynecol. Obstet., 78 (1944) 225. — 25. GORDON-TAYLOR, G., Br. J. Surg., 32 (1944) 247. — 26. Office of the Surgeon General, Circular Letter No. 178, Oct. 23, 1943. — 27. HURT, L. E., Ann. Surg., 122 (1945) 398. — 28. IMES, P. R., Surg. Gynecol. Obstet., 81 (1945) 608. — 29. CHUNN, C. F., J. Florida MA. 34 (1947) 269. — 30. POER, D. H., Ann. Surg., 127 (1948) 1092. — 31. WOODHALL, J. P., A. OCHSNER, Surgery, 29 (1951) 305. — 32. PONTIUS, R. G., O. CREECH, M. E. DEBAKEY, Ann. Surg., 146 (1957) 291. — 33. MURRAY, J. A., D. DEMETRIADES, M. COLSON, Z. SONG, G. C. VELMAHOS, E. E. CORNWELL, J. A. ASENSIO, H. BELZBERG, T. V. BERNE, J. Trauma, 46 (1999) 250. — 34. CORNWELL, E. E., G. C. VELMAHOS, T. V. B ERNE, J. A. MURRAY, S. CHAHWAN, J. ASENSIO, D. DEMETRIADES, J. Am. Coll. Surg., 187 (1998) 58. — 35. BEHRMAN, S. W., K. A. BERTKEN, H. A. STEFANACCI, S. N. PARKS, J. Trauma, 45 (1998) 227. — 36.

Ž. Bušić

Department of Abdominal Surgery II, Clinical Hospital »Dubrava«, Avenija G. Šuška 6, 10000 Zagreb, Croatia

RATNE OZLJEDE KOLONA: REZULTATI NAKON 10 GODINA

S A Ž E T A K

Cilj naše studije jest ocjena rezultata liječenja ratnih ozljeda debelog i ravnog crijeva nakon 10 godina. Za vrijeme rata u Hrvatskoj na Odjelu kirurgije u Općoj bolnici Nova Gradiška, od kolovoza 1991. do travnja 1992. liječen je 21 ozlijeđenik s ozlijedama debelog (19) i ravnog (2) crijeva. Ozljeda mecima bile su uzrok u 57% ozlijeđenika. Svi bolesnici bili su politraumatizirani. Primarno zatvaranje mjesta ozljede s proksimalnom derivacijom crijevnog sadržaja bilo je moguće u 2 bolesnika (9.5%), dok je resekcija ozlijeđenog dijela crijeva s intaperitonealnom anastomozom učinjena kod 3 (14.3%) ranjenika. U 2 (9.5%) ozlijeđenika s intraperitonealnim i ekstraperitonealnom penetrantnom ozljedom rektuma, rektum je reseciran, te je učinjena temporerna sigmoidostoma. Kod multiplih ozlijeda debelog crijeva, u 8 (38.1%) bolesnika učinjena je resekcija ozlijeđenog segmenta s proksimalnom kolostomom i aboralnom mukus fistulom. Eksteriorizacija ozlijeđenog segmenta s kreiranjem kolostomije na mjestu ozlijede debelog crijeva učinjeno je kod 6 (28.5%) bolesnika. Četiri ozlijeđenika (19.0%) su umrla. Dvoje bolesnika je umrlo za vrijeme operacijskog zahvata zbog hemoragičnog šoka. Jedan bolesnik je preminuo nakon osam dana zbog embolije pluća, a jedan je umro trideset dana nakon ozljede zbog sepse. Dva ozlijeđenika (9.5%) su reoperirana zbog opstrukcije crijeva uzrokovanog adhezijama četri dana nakon prve operacije. Troje ozlijeđenika (14.3%) imalo je infekciju rane, od kojih je jedan preminuo nakon 30 dana zbog sepse, a preostalo dvoje (9.5%) razvilo je ventralnu kilu koja je operirana nakon 4, odnosno, 5 godina. Četiri bolesnika (19.0%) povremeno se žale na grčevitu bol.

BOWLEY, D. M. G., K. D. BOFFARD, J. GOOSEN, B. D. BEBINGTON, F. PLANI, Injury, 32 (2001) 435.