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Planned Reoperations and Open Management in Critical Intra-abdominal Infections: Prospective Experience in 52 Cases

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Open management and "planned relaparotomies" in the treatment of critical abdominal infections have recently generated interest and hope. Most studies which examine the value of these therapeutic modalities are retrospective and include poorly stratified groups of patients. Since 1985, we have consistently applied these aggressive methods of treatment in all patients presenting with intra-abdominal infections belonging to the following groups: I) diffuse postoperative peritonitis (29 cases); II) diffuse fecal peritonitis (14 cases); and III) infected pancreatic necrosis (9 cases). The overall mortality rate was 44%; it was 55%, 14% and 56%, respectively, in the 3 groups. The abdomen was closed between reoperations in 21 patients who required an average of 1.7 relaparotomies; the mortality in this group was 24%. Thirty-one patients, who required an average of 3.8 relaparotomies, were managed with the open method resulting in a mortality of 58%. Multiple organ failure was the cause of death in 87% of the patients. We conclude that "planned relaparotomies" may have been beneficial in group II. The value of open management in patients belonging to groups I and III remains unproven. The mechanical-surgical answers to severe forms of peritonitis may have reached their limit.

The outcome of an intra-abdominal infection (IAI) depends on the results of a struggle between 2 main forces: the patient's systemic and peritoneal defense mechanisms on the one hand and the volume, nature and duration of the contamination, on the other. Intra-abdominal infection is a term that encompasses a wide range of pathological and clinical conditions. At one end of the spectrum of severity is the previously healthy individual suffering from a localized perforation of the appendix. On the other side of the scale there are conditions which result in IAI that have exceeded the patient's ability to contain them, leading to diffuse and frequently lethal forms of peritonitis [1, 2]. The latter, which persist and do not localize despite conventional supportive and operative management, continue to challenge the abilities of the abdominal surgeon. This has stimulated the search for more aggressive modes of treatment. Initially promising methods, such as radical peritoneal debridement [3] or continuous postoperative peritoneal lavage [4] failed to gain wide acceptance. Poor results have been obtained with reoperations "on demand", subordinate to the appearance of clinical evidence of residual IAI or the development of remote organ failure [5, 6]. The open management of the abdominal cavity and "planned relaparotomies", consisting of electively staged re-explorations of the abdominal cavity until macroscopically clean, are other modern management concepts which have recently generated some hope and interest, reflected in a growing number of reports [6–26], editorials [27–29] and review articles [1, 2, 30–33]. Most previous studies reporting the results of planned relaparotomies [6–8] and the open management, with or without the addition of repeated re-explorations [7–19, 21, 24, 25], are retrospective and deal with patients suffering from a great variety of types of IAI and receiving multifaceted aspects of treatment.

Since 1985, we consistently applied these aggressive modalities of treatment in patients selected on the basis of the severity of their IAI; the early results were reported previously [34]. The complete experience, to date, is presented here.

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Material and Methods

Patient Selection

During a 54 month period (January 1985–July 1989), 52 patients treated by the author in the surgical unit of the J.G. Strijdom Hospital were selected to undergo the management modalities reported in this study. Thirty-three patients were men and 19 were women; their ages ranged from 23 to 84 years (mean 52 years).

These methods of treatment were consistently applied in all patients suffering from IAI according to the following categories.

Group I. Diffuse postoperative peritonitis (POP) included 29 patients with IAI following abdominal procedures. The original operations were upper gastrointestinal (8 patients), small bowel (3), colon (12), pancreatico-biliary (2), gynecologic (2), appendectomy (1), and an abdominal vascular procedure (1). Seventeen (59%) of these operations were of an elective nature. Seven of the patients were considered moribund and in established multi-organ failure on admission. In 21 (72%) patients the primary operations were performed elsewhere with a mean period before transfer of 11 days.

Group II. Diffuse fecal peritonitis (FP) included 14 patients with the operative finding of widespread peritoneal fecal contamination due to perforated sigmoid diverticular disease in 6 patients, perforated carcinoma of the sigmoid in 2, perforated gastrocolic fistulas in 2, and overlooked colonic trauma in 2. Strangulated colon in a diaphragmatic hernia and a spontaneous rectal perforation accounted for the peritonitis in 2 cases.

Group III. Infected pancreatic necrosis (IPN) included 9 patients with clinical, radiologic, operative and microbiologic evidence of infected pancreatic and peripancreatic necrosis.

Patients with localized forms of intra-abdominal infection and postoperative peritonitis (i.e., abscesses) as well as those with peritonitis originating from the upper gastrointestinal tract, the small bowel, biliary system, appendix and urogenital organs were treated conventionally and are therefore excluded from this study. Likewise, patients with diffuse nonfecal peritonitis originating from the colon (i.e., purulent peritonitis) and patients with other forms of pancreatic sepsis (i.e., localized pancreatic abscess, infected pseudocyst) were not included in this series. The APACHE II score [35] was determined for each patient before our first laparotomy for IAI.

Management Modalities

All patients were treated in the surgical intensive care unit until no further reoperation or organ support was necessary. Nutritional support was started usually on the first postoperative day in the form of total parenteral nutrition. In the absence of proximal gastrointestinal fistulas, enteral nutrition was substituted when bowel function returned. Broad-spectrum antibiotic therapy, a combination of penicillin, an aminoglycoside, and metronidazole, was started preoperatively and subsequently modified according to culture results and the clinical course. Combinations of recently introduced antibiotic drugs were frequently used.

Surgical Treatment

The indication for the policy of planned relaparotomies was determined at the time of our first operation in the individual patient, in accordance with the stated selection criteria. At the first laparotomy for peritonitis or the first re-exploration for postoperative peritonitis, the source of contamination was eradicated in the usual way. When bowel resection was required, ostomies were fashioned instead of anastomoses. In cases of postoperative, uncontrolled intestinal fistulas, the leaking segments were exteriorized or diverted by proximal enterostomies, if technically feasible.

Planned relaparotomies. These were performed every 2–3 days, under general anesthesia in the operating room, irrespective of the patient's clinical condition. At reoperation, all septic collections were evacuated by suction and gentle moist swabbing. Intraoperative peritoneal lavage with saline was performed in the early years of the study but was subsequently abandoned because its value has not been definitively established [36, 37]. No local antibiotics or antiseptics were used. The use of abdominal drains was obviated by the plan for early re-exploration and was limited to sites of pancreatic resection and intestinal leaks which could not be exteriorized (e.g., duodenum). Intra-abdominal packs were used only to control diffuse bleeding, or to "pack" the lesser sac following operations for infected pancreatic necrosis. Between reoperations the abdomen was closed "en masse" whenever possible and the skin left open with a povidone-iodine pack. The decision to discontinue the abdominal re-explorations was based on the amount and macroscopic appearance of the collections, the presence of residual pancreatic slough, and the bacteriologic results of the peritoneal fluids. When no more operations were deemed necessary, the patient's clinical course was followed carefully; deterioration or failure to improve was aggressively pursued with computed tomographic scanning and/or early reoperation.

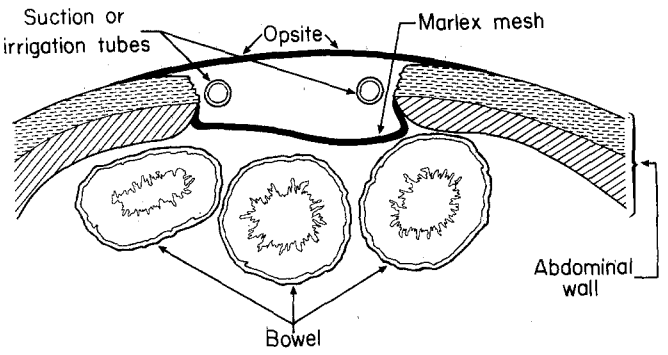

Fig. 1. The "sandwich technique" in the open management of the septic abdomen. Reprinted with permission of publisher [38].

Open management. Patients were treated by the closed method whenever possible. The decision to leave the abdomen open was made at the end of each laparotomy and was influenced by the build of the patient, the amount of abdominal distention, the degree of parietal inflammation, necrosis and scarring, and the expected number of further necessary re-explorations. When the abdomen was left open, we used the "sandwich technique" [38] consisting of a Marlex mesh (C.R. Bard Inc., Massachusetts, U.S.A.) applied over the exposed viscera or omentum and sutured to the edges of the fascia. An OpSite adhesive drape (Smith and Nephew Ltd, U.K.) covered the defect, and suction tubes were interposed between these two layers (Fig. 1). At every operation the adhesive drape was discarded and the abdomen was entered by incising the mesh in its center. At the end of the operation the mesh was repaired with a running suture and the "sandwich" reconstructed. After the last laparotomy and once the seepage through the mesh stopped, the "sandwich" was dismantled, and the mesh directly treated with moist, diluted, povidone-iodine packs.

The description of our method of reconstruction of the abdominal wall defect following the open management is beyond the scope of this manuscript and is discussed in detail elsewhere [34, 39].

Results

Mortality

The mortality rate in patients belonging to the postoperative peritonitis, fecal peritonitis and infected pancreatic necrosis groups was 55%, 14%, and 56%, respectively. Mean age and

Table 1. Age and APACHE II scores.[a]

	Postoperative peritonitis	Fecal peritonitis	Infected pancreatic necrosis	All patients
No. cases	29	14	9	52
Mean age (yrs)	50	61	45	52
Mean age survivors (yrs)	43	60	40	48
Mean age dead (yrs)	55.5	69.5	49	55
Mortality (%)	55	14	56	44
Mean APACHE II	14	14	12	14
Mean APACHE II survivors	11	13	11.5	11
Mean APACHE II dead	17	19	13	16

[a]APACHE II scores measured on admission.

mean APACHE II scores in the survivors and those who died are represented in Table 1. The mortality rate in the subgroups of APACHE II score is shown in Table 2. No patient with a score greater than 25 survived.

The mortality rate in patients suffering from postoperative peritonitis (Group I) who had their primary operation in our unit and those referred from elsewhere was 25% and 67%, respectively. The cause of death in this group was multiple organ failure in 15 patients and pulmonary emboli in 1 patient. In patients with fecal peritonitis (Group II), 1 critically ill patient (APACHE II score of 22) died prior to the planned re-exploration and another 1 succumbed to a pulmonary embolus one month following his last operation. Four patients with infected pancreatic necrosis (Group III) died from multiple organ failure, the 5th patient died from a massive intraperitoneal bleed 4 hours after her 4th reoperation for IPN.

Reoperations

One hundred and fifty four relaparotomies were performed. The required number of reoperations ranged from none, in a patient in the fecal peritonitis group, who died before re-exploration could be undertaken, to 10. There was on average 3 reoperations per patient. The mean reoperation rate in the 3 groups was 3.2, 1.8, and 4.1, respectively. The mortality in patients undergoing 1 to 4 reoperations was between 34% and 43%; it was 67% in patients who were subjected to more than 5 reoperations (Table 3). Eight of the reoperations were considered "unnecessary"; 4 in group I when no further peritoneal collections were found and 4 in group II in whom the residual fluid was sterile. In none of the patients were there macroscopic foci of infection at the time of death. This was confirmed during an abdominal exploration via the open abdomen just prior to death or at routine autopsy in patients in whom the abdomen was closed.

Treatment Modalities

The abdomen was closed in 21 patients who required an average of 1.7 relaparotomies. Five (24%) patients died in this group, 1 before her first reoperation. The abdomen was treated by the open method in 31 patients. The average number of relaparotomies in this group was 3.8; 18 (58%) patients died. In 17 patients the open management was started at the end of our first relaparotomy for IAI; 11 (65%) of these patients died; following the second re-exploration in 13 patients, 7 (54%) died and in 1 surviving patient the abdomen was left open at the end of his 3rd reoperation (Table 4).

Associated Gastrointestinal Fistulas

Gastrointestinal fistulas developed at some stage in 41 patients, of whom 21 (51%) died (Table 5). In 25 patients, all belonging to group I, the fistulas were present on entry into the study. Small bowel fistulas, solitary or multiple, occurred mainly in the POP group, while those originating from the colon (including colonic necrosis) developed in 6 patients belonging to the IPN group. Leakage from a Hartmann pouch developed in 7 patients. In only 2 patients could the direct pressure of the Marlex mesh on the exposed bowel be implicated in the cause of the fistulas. Both patients survived.

Other Complications

Intra-abdominal hemorrhage requiring surgical hemostasis and contributing to the death of the patients occurred in 2 patients of the POP group. Four patients in the IPN group had massive hemorrhage from the pancreatic bed; in 1 it was considered the direct cause of death and in 2 patients it probably contributed to the pre-existing multiple organ failure which eventually caused death. One patient survived 3 laparotomies to control the bleeding.

Abdominal wound dehiscence occurred in 2 patients from the FP group whose abdomens were closed after the second re-exploration. In both patients the abdomen was then closed with an absorbable synthetic mesh; 1 survived and the other succumbed to massive pulmonary embolism.

Pelvic abscesses developed after the cessation of planned reoperations in 2 of the patients belonging to the FP group; both drained spontaneously via the rectum.

Abdominal Wall Reconstruction Following Open Management

Thirteen patients treated with open management survived. In 1 patient, the abdomen could be formally closed after removal of the Marlex mesh at the end of the third reoperation for IPN. In 1 patient the mesh was excised and the defect contracted completely. Eleven patients underwent removal of their mesh and immediate skin grafting of the underlying omentum or viscera. Four patients were subjected subsequently to the repair of a large incisional hernia using bilateral, medial mobilization of the rectus abdominis. Seven patients refused reconstruction or were considered an excessive surgical risk; they are left with a large ventral hernia covered by a split-thickness skin graft.

Discussion

This study represents, to the best of our knowledge, the first attempt to evaluate these radical modalities of treatment in well defined and preselected subgroups of patients, with nonlocalizing intra-abdominal infection, presenting to 1 surgeon over a period of almost 5 years.

Table 2. Subgroups of patients according to APACHE II scores and the associated mortality rate.

	APACHE II score									
	0–10		11–15		16–20		21–25		26–30	
	No.	MR	No.	MR	No.	MR	No.	MR	No.	MR
Postoperative peritonitis	10	2	10	6	3	3	4	3	2	2
Fecal peritonitis	4	–	3	–	5	1	2	1	–	–
Infected pancreatic necrosis	4	1	3	3	1	1	1	–	–	–
Total (%)	18	3 (17)	16	9 (56)	9	5 (56)	7	4 (57)	2	2 (100)

MR = mortality rate.

Table 3. Number of reoperations and associated mortality rate.

	Operations									
	1		2		3		4		>5	
	No.	MR	No.	MR	No.	MR	No.	MR	No.	MR
Postoperative peritonitis	5	4	6	2	8	4	6	2	4	4
Fecal peritonitis[a]	8	1	3	–	1	–	–	–	1	–
Infected pancreatic necrosis	–	–	3	2	1	–	1	1	4	2
Total (%)	13	5 (39)	12	4 (34)	10	4 (40)	7	3 (43)	9	6 (67)

MR = mortality rate.
[a]The patient who died before planned re-operation was excluded.

Table 4. Treatment modalities.

	Planned reoperations			
	Abdominal closure		Open management	
	No.	Deaths (%)	No.	Deaths (%)
Postoperative peritonitis	8	3 (37.5)	21	13 (62)
Fecal peritonitis	13	2 (15)	1	– –
Infected pancreatic necrosis	–	– –	9	5 (56)
Total	21	5 (24)	31	18 (58)

Table 5. Associated gastrointestinal fistulas.

Source	Postoperative peritonitis	Fecal peritonitis	Infected pancreatic necrosis	Deaths
Small bowel				
Solitary	17	–	–	8
Multiple	7	–	1	7
Colonic	–	–	6	4
Hartmann pouch	4	1	1	1
Pancreatic	1	–	2	–
Biliary	1	–	–	1
Total	30	1	10	21 (51%)

Our cases were selected on the basis of the severity of their IAI. Diffuse fecal peritonitis and postoperative abdominal infections are known to carry the highest fatality [40]. Also, patients with infected pancreatic necrosis, in whom treatment is notoriously difficult because of the protracted nature of the necrotizing and purulent processes, were included. Electively planned reoperations constituted the cornerstone of our aggressive management in an attempt to anticipate the formation of septic collections and to preclude, before they became clinically apparent, their deleterious systemic effects. The open management of the septic abdomen has emerged as a corollary to the policy of repeated reoperations; if the abdomen is to be reopened frequently, why close it at all? Because of the problems associated with the practical implementation of this method and the need for subsequent reconstruction of the abdominal wall defect, the decision to leave the abdomen open was not taken lightly. When the build of the patient, the degree of abdominal distention, and the condition of the abdominal wall allowed it, the abdomen was closed between the re-explorations. The open management was necessary in 31 (60%) of the patients, reflecting the frequent impossibility and inadvisability of forcefully closing the abdomen in patients submitted to multiple laparotomies over a short period of time. The patients treated with the open method represented a sicker group than those whose abdomen was closed, as reflected by the mean number of relaparotomies (3.8 and 1.7, respectively) and the mortality rates (58% and 24%, respectively).

The three groups of patients, although subjected to a similar treatment protocol, differ in terms of the etiology and complexity of their IAI. They each pose specific therapeutic problems and should therefore be discussed separately.

Postoperative Peritonitis

Postoperative peritonitis carries high mortality and morbidity rates. Frequently the diagnosis is missed or delayed so that irreversible deterioration occurs [31, 41]. Why, then, did our management modalities, which involve aggressive search and evacuation of infection, fail to reduce the mortality rate from as high as 55%? It may be that radical mechanical solutions to

Table 6. Results of planned relaparotomies and open management: collective series.

Ref	Relap	OM	OM + Relap	POP		Other		PRS		Total	
				No.	MR	No.	MR	No.	MR	No.	MR (%)
6	+	–	–	11	?	31	?	–	–	42	12 (29)
7	+	–	–	27	6	34	8	–	–	61	14 (23)
8	+	–	–	13	8	21	13	–	–	34	21 (62)
9	–	+	–	2	–	11	1	1	–	14	1 (7)
10	–	+	–		?		?		?	18	7 (39)
11	–	+	–	10	2	3	–	–	–	13	2 (16)
12	–	–	+	10	?	10	?	–	–	20	12 (60)
13	–	+	–	20	11	5	2	1	–	26	13 (50)
14	–	+	–	19	?	8	?	3	?	30	14 (47)
16	–	–	+	12	6	13	2	8	4	33	12 (36)
17	–	+	–	16	4	–	–	2	1	18	5 (28)
18	–	+	–	5	11	15	3	–	–	20	4 (20)
19	–	–	+	8	3	6	–	7	3	21	6 (29)
20	–	–	+	–	–	–	–	28	3	28	3 (11)
21	–	–	+	–	–	–	–	36	7	36	7 (19)
22	–	–	+	–	–	–	–	17	3	17	3 (18)
23	–	–	+	–	–	–	–	10	2	10	2 (20)
24	–	–	+	?	?	?	?	49	13	64	18 (28)
26	–	–	+	–	–	–	–	11	5	11	5 (45)
present series			+	29	16	14	2	9	5	52	23 (44)
Total[a]				140	57	122	37	173	45	569	184 (32)

POP = postoperative peritonitis, PRS = pancreatic related sepsis, OM = open management, MR = mortality rate.
[a]Only where complete results available.

intractable IAI represent a futile effort when offered too late. Of the 29 patients in this group, 21 were referred from elsewhere; 67% of them died. Only 2 of the 8 patients who developed POP while in our hospital died. Multi-organ failure was the usual cause of death despite routine relaparotomies until death. Characteristically, many of these patients died following an ICU stay of more than 6 weeks during which their abdomens were left open and frequently re-explored. It is likely that with less aggressive modalities of treatment these patients would have succumbed earlier. At present however, patients with apparently clean abdomens and surgically diverted, previously uncontrolled, gastrointestinal fistulas often survive for prolonged periods to die from persistent organ failure triggered and sustained by immunoparesis, opportunistic infections of gut origin, and the ICU environment [42–45]. Norton [46] showed that in most patients organ failure leading to death persists despite surgical eradication of IAI. Fry's observation [47] that patients who develop organ failure within a week of their operation tend to harbor undrained sepsis while those whose organs fail later in the postoperative period usually represent cases of immunologic collapse, supports the concept that prompt definitive drainage of IAI is critical for survival, even though the mortality may still be high [48]. In a review of the literature (Table 6), the average mortality for patients suffering from POP and treated by planned reoperation and/or open management was 41% (range 20%–62%). Mortality rates from postoperative IAI treated by conventional methods are between 30 to 76% [5, 40, 46, 49, 50]. Thus, there is no strong evidence that these innovative methods of treatment drastically change the prognosis of POP.

Fecal Peritonitis

The lowest mortality (14%) was obtained in the FP group. Excluding a moribund patient who died before his first reoperation, the mortality was 7%. Patients belonging to this group obviously suffer from a less virulent form of IAI. All were operated primarily by the author so that their first relaparotomy was always within 48 hours; they required a smaller number of reoperations than the other 2 groups; in only 1 patient was open management necessary, reflecting the relatively good condition of the abdominal wall and the absence of gross distension.

Nonlocalized forms of fecal peritonitis are associated with the greatest mortality following colonic perforations. Unfortunately, there is little uniformity in the reporting of peritonitis from large bowel origin and most series are diluted by cases suffering from localized or seropurulent peritonitis. In a collected series of 262 patients with generalized forms of peritonitis (fecal and purulent) secondary to diverticular disease who were treated conventionally with resection (without anastomosis), the mortality was 12.2% [51]. Other recent single-center reports mention mortality rates as high as 37% after a Hartmann procedure for perforated diverticular disease of undescribed severity [52], and 21% following sigmoid resection for diffuse fecal peritonitis [53]. It is impossible to assess the results of others who used aggressive modalities of treatment since, in the great majority of the available series, patients with diffuse fecal peritonitis are grouped together with those suffering from IAI of different etiology and magnitude. Walsh and associates [16], however, reported a mortality of 11% in patients with fecal peritonitis treated with open management and planned relaparotomies. Our mortality (14%) with planned reoperations alone suggests that the open management in this group of patients probably represents an over aggressive treatment. Since none of our patients died from persistent or recurrent IAI and only 1 patient developed a spontaneously draining pelvic abscess, we believe that the policy of planned re-explorations in patients with diffuse fecal peritonitis is beneficial.

Infected Pancreatic Necrosis

Theoretically, the potential use of these techniques in patients with an infected, necrotizing pancreatic process is promising. Inspection, debridement and removal of peripancreatic slough is possible on a frequent basis. Bradley [20], the originator of the open management–packing–frequent re–exploration treatment of IPN, reported a mortality rate of 11% in 28 consecutive patients. Although similarly good results were achieved by some groups [21–24], we and others [16, 19, 26], using similar approaches in a relatively small number of patients, failed to reproduce such success (Table 6). Not all studies, however, accurately stratify patients and it is possible that the inclusion of cases with noninfected or localized forms of peripancreatic necrosis or pancreatic abscesses accounts for the wide differences in outcome [54]. Reduced mortality rates were also reported in recent years by groups using closed debridement methods [55, 56] or closed debridement followed by local lavage [57–59]. It is probable, therefore, that adequate debridement is essential and the way one deals with the abdominal wall is of lesser importance [60, 61].

The scheduled debridement combined with open packing caused a significant number of complications in this series. Six (67%) patients developed segmental colonic necrosis. The pathogenesis proposed by most authors is ischemia caused by extension of the necrotizing process into the mesocolon [62–65]. We believe, however, that aggressive surgical debridement of necrotic mesenteric fat, injury to the colon during abdominal re–entries, and pressure from adjacent packs and the overlying mesh are all contributing factors. Such iatrogenic etiology is supported by the high incidence of colonic complications reported by other groups using open packing techniques [19, 22]. Massive hemorrhage from the pancreatic bed was another common complication in our patients, contributing to 3 deaths. One patient survived after 3 operations for bleeding, originating from the splenic vessels in the depth of the marsupialized, granulating cavity. Probably, injury during the changes of packs and exposure were the responsible factors. In a collected series of 173 patients suffering from various forms of pancreatic infection treated by open techniques, the mortality rate was 26% (range 11–55%) (Table 6). Since similar mortality rates were also achieved by closed management modalities [55–59], it is impossible to conclude that open packing and frequent re–explorations are the treatment of choice for infected pancreatic necrosis [61].

Many advantages are attributed to the open management of the septic abdomen, usually based, at least theoretically, upon sound physiologic principles [33]. The emphasis on maximal drainage of the peritoneal cavity is underlined by the term "laparostomy" which has permeated from the French [66] into the English language literature [17]. However, contrary to early claims, it appears that leaving the abdomen open does not obviate the need for thorough re–explorations, searching for deep pockets of pus. Avoiding forceful closure of the abdomen, which after multiple laparotomy procedures for intra–abdominal infection is commonly accomplished under significant tension, prevents necrosis and infection of the abdominal wall. Our observations support this concept. The clinical benefits of the reduced intra–abdominal pressure resulting from open management, such as better diaphragmatic excursion [13, 18], enhanced renal perfusion [67], and reduced absorption of bacterial products via the diaphragmatic stomata [68] has not yet been proven by clinical and experimental studies. Likewise, there is no evidence that exposure of the peritoneal cavity to air promotes the control of intra–abdominal infection. In a recent study in rats, we failed to improve the outcome of intra–abdominal infection using an open management technique (manuscript in preparation).

Complications of open management do occur. Evisceration, massive fluid losses, spontaneous fistulas in exposed intestinal loops, and potential contamination of the open wound have been reported [33]. In our experience, the use of our technique (Fig. 1) has almost eliminated these complications. Intestinal fistulas commonly occur in the patients suffering from postoperative peritonitis and infected pancreatic necrosis who are treated by open management (Table 5). Although some authors are uncertain about the etiology of this complication [69], we are convinced that it results from exposure injury, dehiscence of pre–existing suture lines, and the trauma to the obliterated intestine of re–exploration. In this series, only 2 fistulas could be attributed solely to exposure injury. Fistulas developing in the midst of a large abdominal wall defect carry a prohibitive mortality [70, 71] and special consideration should be given to their treatment. The distance of the fistulous opening in the bowel from the surface of the abdominal wall defect and the condition of the peritoneal cavity have bearing on the management modalities [17, 70, 71]. When the intestinal perforation is located in the depth of the infected abdominal defect, prolonged contact of the fistula's effluents with large peritoneal surfaces allows increased absorption of toxic products, perpetuating the septic state and organ failure. In such a situation the only surgical option to salvage the patient seems to be the diversion of the intestinal contents away from the defect with a proximal enterostomy. In patients who develop fistulas in the exposed bowel at the surface of the defect and in whom the peritoneal cavity remains clean and sealed away from the intestinal contents, an expectant approach is indicated. Gastrointestinal continuity is re–established a few months after the recovery from intra–abdominal infection in a well nourished patient after resolution of the peritoneal obliterative process. Usually, reconstruction of the abdominal wall defect is also technically feasible.

Any electively staged re–exploration is justified, in retrospect, on the finding of infected collections or tissue in need of further debridement. Such a re–look may be termed "unnecessary" when the displayed peritoneal cavity is found to be relatively clean or to contain bacteria–free fluid. This occurred in 4 (4%) reoperations in the POP group and 4 (16%) reoperations in the FP group. Others [6] reported a negative rate of relaparotomy as high as 29%. The decision to discontinue the re–explorations is not easy and rigid guidelines cannot be offered. It is the author's impression that surgeons with limited experience with such management modalities tend to over–treat such patients with an excessive number of "unnecessary" procedures. As more experience is gained, the clinician learns how much, and what sort of intraperitoneal fluid can be left to the host defense mechanisms. It must be stressed that the decision to stop planned reoperation is never final. If, subsequently, suspicion of residual intra–abdominal infection arises on clinical or radiological grounds, prompt surgery is indicated.

A close look at our results and those reported by others employing planned relaparotomies and/or open management

features a constant pattern which explains the wide variability in outcome reported in the various series (Table 6). On one side, there is a group composed of relatively fit patients suffering from an illness of lesser severity, in whom, probably, these aggressive surgical modalities represent an over treatment. The inclusion of such patients, who perhaps would have responded to conventional treatment, is responsible for the excellent results reported by some investigators [9, 11, 18]. At the other end of the spectrum are patients with established multi-organ system failure representing an end-stage and irreversible disease [67]. In such cases, even the most aggressive mechanical strategies of surgical therapy are doomed to fail and their inclusion in studies, such as ours, obviously leads to excessive mortality rates. An intermediate group between these two extremes may constitute the ideal population in which novel therapeutic regimens could be beneficial. Unfortunately, the accurate definition of such a group is at present beyond our means.

The complex nature of surgical infections and the multifaceted aspects of treatment make evaluation of new therapeutic advances very difficult [73]. Even in the present study which includes patients with well defined disease processes and homogenous therapeutic strategies, the complexity of intra-abdominal infection and of the host response make the evaluation of results almost impossible. Physiologic scores, such as the APACHE II, which measure the severity of the acute disease and take into account the chronic health status of the patients and their age [35], were found useful in the prediction of outcome and accurate stratification of patients with intra-abdominal infection [74, 75]. Others used acute physiologic scores to prove the critical illness of patients subjected to planned relaparotomies or open management [7, 8, 15–17, 24, 26]. We found the APACHE II of great value in milder forms of intra-abdominal infection, such as perforated peptic ulcers, which usually require one laparatomy [76]. However, our experience with this scoring system in subgroups of patients in need of multiple surgical procedures is less satisfactory (Table 2). It confirms the results of others [16], that no patient with a score greater than 25 survives, but also demonstrates that patients with low scores may die. Like others [73], we did not find serial measurements of APACHE II scores between the reoperations to be of any clinical value (unpublished data).

The concept of the critical importance of early treatment of intra-abdominal infection [41] was stressed by Walsh and coworkers [16] who suggested that an early resort to open management may improve survival. Our figures do not support this view. The mortality rates were similar in patients in whom the open management was started during the first, second or third reoperations.

Multiple organ failure was responsible for the death of 20 of 23 patients in our study. It seems that even the most aggressive treatment of intra-abdominal infection is not sufficient to reverse established multiple organ failure [48]. Furthermore, it is possible, but not proven, that these aggressive modalities which induce surgical stress, tissue trauma, inflammation and require prolonged stay in the invasive ICU environment may contribute to and perpetuate the organ-system damage via various pathways [77–80]. The value of this surgical strategy rests on the clinical observation that the conventional treatment of severe intra-abdominal infection is bound to fail, in at least a proportion of patients, mainly because of residual or recurrent sepsis. In this study, as in the collected series from the literature, more than one-third of the patients succumbed to severe intra-abdominal infection despite aggressive surgical management. It seems, therefore, that even if these novel techniques have indeed even marginally improved the outcome of patients with certain forms of intra-abdominal infection (i.e., fecal peritonitis), mechanical-surgical answers to others forms of IAI (i.e., postoperative peritonitis) may have reached their limit.

Résumé

La technique de ventre ouvert avec des laparotomies répétées dans le traitement des infections abdominales graves est une méthode thérapeutique d'intérêt et d'espoir récent. La plupart des études concernant cette modalité thérapeutique souffrent d'être rétrospectives et d'être inhomogènes quant aux type de patients inclus. Depuis 1985, l'auteur a appliqué cette technique chez tous les patients ayant une infection abdominale qui se répartissaient dans les groupes suivants: I - péritonite diffuse postopératoire (29 cas), II - péritonite diffuse fécale (14 cas), III - nécrose pancréatite infectée (9 cas). La mortalité globale a été de 44%; elle a été de 55%, 14% et 56%, respectivement, dans les groupes I, II et III. Chez 21 patients qui ont nécessaité une moyenne de 1.7 relaparotomies, l'abdomen était fermé entre les réopérations (''réouverture planifiée''). La mortalité dans ce groupe a été de 24%. Chez les 31 patients qui ont nécessité une moyenne de 3.8 relaparotomies, l'abdomen a été laissé ouvert entre les explorations successives avec une mortalité de 58%. La défaillance polyviscérale était la cause de mortalité dans 87% des cas. La ''réouverture planifiée'' a pu être bénéfique dans le groupe II, mais sa valeur reste à démontrer dans les groupes I et III. Les moyens mécaniques ont peut-être atteint leur apogée dans le traitement des péritonites sévères.

Resumen

El manejo de abdomen abierto (laparostomía) con ''relaparotomías planeadas'' en el tratamiento de infecciones abdominales críticas ha generado reciente interés y esperanza. La mayoría de los estudios destinados a valorar estas modalidades terapéuticas han sido de carácter retrospectivo y basados en grupos de pacientes pobremente estratificados. A partir de 1985 el autor ha aplicado en forma consistente estos agresivos métodos de terapia en la totalidad de los pacientes con infecciones intra-abdominales, clasificados en los siguientes grupos: I - Peritonitis postoperatoria difusa (29 casos); II - Peritonitis fecal difusa (14 casos); y III - necrosis pancréatica infectada (9 casos). La tasa global de mortalidad fue 44%; correspondió a 55%, 14% y 56%, respectivamente, en los 3 grupos. El abdomen fue cerrado entre reoperaciones en 21 pacientes que requirieron un promedio de 1.7 relaparotomías; la mortalidad en este grupo fue de 24%. Treinta y un pacientes que requirieron un promedio de 3.8 relapatomías fueron manejados mediante el método abierto, con una mortalidad de 58%. La falla orgánica múltiple fue la causa de muerte en 87% de las muertes. Nuestra conclusión es que las ''relaparotomías planeadas'' pueden ser beneficiosas en el grupo II; su valor no queda demostrado en pacientes de los grupos I y III. Las soluciones de tipo quirúrgico mecánico pueden haber llegado a su límite de beneficio en las formas severas de peritonitis.

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Invited Commentary

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This paper by Schein is an honest attempt to examine a radical treatment modality for a highly lethal intra-abdominal disease process. It examines the value of planned reoperation in critical intra-abdominal infections but does not examine the role of the "packed open abdomen" approach in the treatment of diffuse suppurative pancreatitis. The author shows, as have many others, that aggressive, planned re-explorations do not reduce the high incidence of mortality of diffuse suppurative peritonitis. The role of the "packed open abdomen" approach in this condition has not been answered by this paper. To do so, a prospective randomized study is needed that includes patients with diffuse suppurative peritonitis. In this proposed study, the initial procedure should be clinically dictated with treatment of the underlying pathology and broad spectrum antibiotic coverage with a carbapenem, to achieve high therapeutic antibiotic levels and eliminate the concern of antibiotic induced renal failure. The abdomen should be closed if possible. If the patient deteriorates according to pre-defined criteria, then randomization should be performed with the control arm being standard, accepted treatment and the study arm being a laparotomy, treatment of the intra-abdominal pathology and subsequently, using a mesh-zipper system, a "packed open abdomen" approach. Daily laparotomies (up to 3 per day) would be performed in the intensive care unit, if possible, or in the operating room to reduce the bacterial contamination in the peritoneal cavity.

Whether such a study can be performed in this decade is questionable. I am more skeptical, and agree with the author, that such a study would not show a reduction in mortality. We now know that intra-abdominal infection (bacteria invading normally sterile host tissues) can be eliminated, as indeed was done in this paper, yet the septic response of the patient (a host response to infection or other "triggers" such as necrotizing pancreatitis) persists in most patients, leading to multiple organ failure and death. In some few others this is not apparent, even with failure to control the infection. We must understand the pathophysiology of the host response to conditions such as intra-abdominal infections and how to control the response and turn it off after the infection is cleared. It would appear, and this was shown very clearly by the author, that once this host response reaches a certain level it has a life of its own and is irreversible. Whether we can control it by monoclonal antibodies directed against the as yet unknown cytokines proposed in the pathophysiology of this response remains to be proven.

What then should be the management of critical intra-abdominal infections? First, operate as quickly as possible and eliminate the "trigger" as completely as possible. Use broad spectrum empiric antibiotic therapy in the form of a carbapenem in high dose. Observe the patient in an intensive care area. The data to date would suggest that a planned reoperation should not be performed. If there is no improvement, or indeed the patient deteriorates, a computed tomography scan with contrast should be done and appropriate treatment instituted, with the principle aim being to restore "normality" as soon as possible. "Normality" does not imply a peritoneal cavity open to the environment.