

Surgical Strategies in Severe Acute Pancreatitis (SAP): Indications, Complications and Surgical Approaches

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Rezumat

Strategiile chirurgicale în pancreatita acută severă (PAS): indicații, complicații și aborduri chirurgicale

Context: Pancreatita acută severă (PAS) este legată de o rată înaltă a mortalității. Studiul prezent a evaluat mai multe strategii chirurgicale în tratamentul pancreatitei necrotice infectate confirmate sau suspectate (NPI).

Metodă: Studiul retrospectiv include 212 de pacienți cu PAS, și NPI tratate chirurgical la nivelul Clinicii Chirurgie I în intervalul 2000-2012. Abordul chirurgical a inclus laparotomia cu lavaj retroperitoneal postoperator continuu, metoda abdomenului deschis, laparotomia cu închiderea primară a laparotomiei asociată sau nu cu laparostomie (marsupializare), retroperiostomie cu lavaj retroperitoneal continuu.

Rezultate: Mortalitatea generală a fost de 34 %, cu 25% în laparostomia cu lavaj retroperitoneal continuu, 11% în retroperitoneostomie și lavaj retroperitoneal continuu, 71% pentru abdomen deschis, și 43% în laparostomia cu abdomen închis ($p < 0.001$). Intervențiile acute, originea alcoolică, scorul APACHE ≥ 10 la internare, insuficiența organică la internare au reprezentat factori independenți în predispoziția complicațiilor. Necroza de colon cu o mortalitate ridicată de 53% s-a dovedit a fi factor prognostic relevant.

Concluzii: Atitudinea conservatoare în PAS este un concept terapeutic ce promite. Intervenția chirurgicală întârziată până

după a 3-a săptămână de la debutul afecțiunii crește semnificativ șansa de supraviețuire a bolnavilor. Apariția complicațiilor în PAS este obișnuită, cu evoluție spre insuficiență organică, ce necesită intervenție de urgență. Necroza de colon reprezintă un factor de prognostic independent al supraviețuirii.

Cuvinte cheie: pancreatita acută, infecția necrozei, complicații septic

Abstract

Background: Severe acute pancreatitis (SAP) is still related to high mortality rates. This study evaluated the various surgical strategies for treatment of suspected infected necrotizing pancreatitis (INP).

Methods: This retrospective study included 212 patients with SAP and INP, who had surgical treatment during the period between January 2000 - December 2012 at the Ist Surgical Clinic. Surgical approaches included laparostomy with continuous postoperative retropancreatic lavage, open abdomen strategy, laparotomy with primary abdominal closure accompanied or not by laparostomy (marsupialization), retroperiostomy with retroperitoneal lavage.

Results: The overall mortality rate was 34.0 percent, with 24 percent in laparotomy with continuous retropancreatic lavage, 11 percent for retroperitoneostomy and retroperitoneal continuous lavage, 71 percent for the open abdomen strategy, and 43 percent for laparotomy with closed abdomen ($p < 0.001$). Acute operations, alcoholic origin, Apache II scores of ≥ 10 organ dysfunction on admission were independent factors that predisposed patients to complications. Colonic necrosis with high mortality rates (53 percent),

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however seemed to be of prognostic relevance.

Conclusions: The conservative approach in severe acute pancreatitis is a promising therapeutic concept. Delaying surgery up to the third week after onset of disease significantly improves the patients' survival. Complications are common in severe necrotizing pancreatitis leading to organ failure and need for acute operations. Colonic necrosis is an independent prognostic factor for survival.

Key words: acute pancreatitis, infected necrosis, septic complications

Introduction

Contemporary clinical guidelines provide a framework for the initial management of patients with acute pancreatitis (1-6). On the other hand, there is less agreement on patients with ongoing severe acute pancreatitis (PAS) (1, 7-10).

About 80% of cases of the disease are acute interstitial edematous pancreatitis. With HASA low morbidity and mortality rate (< 1 %), 20% of patients develop pancreatic and peripancreatic tissue necrosis (11-14). The Atlanta symposium classification (15) of SAP links it to organ failure, and or local complications, including necrosis, abscess or pseudocysts. Usually, pancreatic infection is linked to the development of pancreatic necrosis associated with peripancreatic fatty tissue necrosis.

Infected pancreatic necrosis (IPN) remains the primary indication for surgery in patients with SAP (16). There are several indications for operative intervention in patients with SAP. Conventional indications include an intra-abdominal catastrophe, hemorrhage not amenable to angioembolization, or bowel infarction, or perforation are absolute indications for surgery. SAP is a risk factor for abdominal compartment syndrome due to visceral and retroperitoneal edema, and failure of nonoperative management mandates abdominal decompression (17-20).

Initial clinical presentation, laboratory findings, and scoring systems such as the Ranson criteria and APACHE II score, might help to differentiate mild versus severe pancreatitis, within use hours of hospital admission, but they do not accurately predict the prognosis of patients with acute pancreatitis (21,22). Pancreatic necrosis (PN), remains the most severe form in the evolution of acute pancreatitis. Usually death occurs only in necrotizing pancreatitis associated with failure of at least one organ system (23,24,25).

Contrast enhanced abdominal computed tomography (CT) is the current gold standard in the clinical diagnosis of pancreatic necrosis, indicating disruption of microcirculation (26).

The IPN occurs later in the clinical course, most commonly in the third to fourth week of the disease, but this is not exclusively the case. In our study of patients with IPN

infection was detected within the first 2 weeks of illness in almost 20% of patients (27). SAP is a risk factor for abdominal compartment syndrome due to visceral and retroperitoneal edema and abscess. Failure of nonoperative management mandates abdominal decompression with open abdomen (17,25).

The natural course of AP proceeds in two phases. In the first 24h after the onset of initial symptoms, about 20-30% of all patients are affected by a severe clinical course of their disease (28), with systemic toxic phase (SIRS). The second phase at the end of the second week after the onset is dominated by septic complications caused by infected pancreatic necrosis (29).

The incidence and risk of infected necrosis tends to peak in the third week of evolution of the disease, but infection might occur at any moment of disease (30,31,32).

Complications of laparostomy for necrectomy include enterocutaneous fistula and bleeding caused by injury during exploration as well as sepsis due to the incomplete removal of the infected necrotic tissue.

Material and Methods

From January 2000 - to December 2012 212 patients were operated for severe acute pancreatitis in our department. The diagnosis of pancreatic necrosis was established by computed tomography (CT). The diagnosis of infected pancreatic necrosis by CT shows air in the retroperitoneum or retroperitoneal collections (Fig. 1).

Although the presence of air is pathognomonic for infection, it is generally rare. All patients with infected necrosis were treated with antibiotics depending on the sensibility of the germ in the culture. Antibiotic prophylaxis was used in most patients in whom pancreatic or peripancreatic necrosis was detected, or suspected on CT image (Fig. 2).

The indication for surgical treatment was infection of pancreatic necrosis (IPN) with evidence of gas on CT scan, sus-

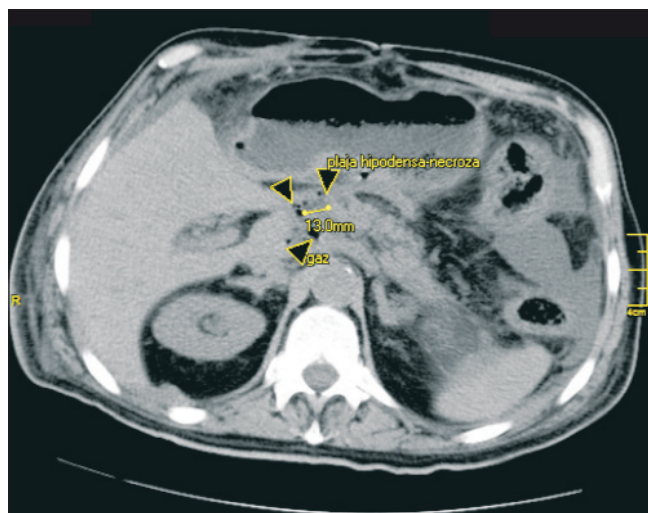


Figure 1. CT image of the presence of air in the retroperitoneum.

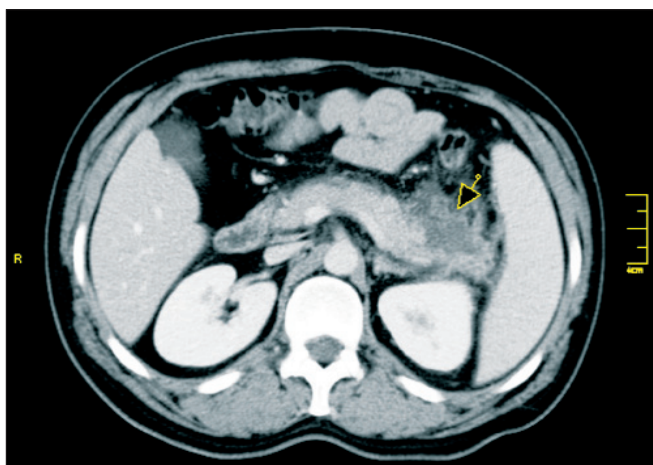


Figure 2. Ssuspected peripancreatic necrosis

pected or confirmed intra-abdominal catastrophe. Other indications were extensive pancreatic necrosis and persisting multiple organ failure (MOF), despite intensive care (30,34). Patients with extensive sterile necrosis, and persisting MOF benefit from surgical intervention, indication also observed in other sources (35). The rationale of necrosectomy was based on two principles. Necrotic tissue and pancreatogenic ascites is removed from the peritoneal cavity and the lesser sac to prevent absorption through the thoracic duct, which is accused of increasing the incidence of systematic complications as development of single or MOF, concept also accepted from other indications (36).

Secondly, as much as possible viable pancreatic tissue should be preserved to ensure a good quality of life after recovery (37).

Antibiotic prophylaxis was used in most patients, in whom pancreatic or peripancreatic necrosis was detected. Antibiotics were used in all patients with documented or clinical suspicion of infection of pancreatic or peripancreatic

necrosis.

145 patients required emergency operations within 10 days of the onset of pancreatitis, either because of IPN (n = 63,82%) or MOF (n = 14,18%). Details of patients are shown in Table 1.

All patients were treated in the surgical intensive care unit. The median range, APACHE II score on admission was 12 (6-26). In all patients at least one organ was not functioning (respiratory failure), and 42% (32 patients), had MOF defined as dysfunction of 3 or more organ systems. The mortality was 25 percent, but in the presence of severe complications the mortality is higher (30-50 percent).

In 22 patients the pancreatic necrosis was initially treated conservatively, and surgery was delayed for a median of 24 days from the onset of symptoms, concept accepted by other authors too (15-38).

These patients were operated for the late local complications of pancreatic necrosis with sepsis, pancreatic or peripancreatic abscesses. During the operation all necrotic material was debrided and the abdomen closed totally or partially (marsupialisation) after placement of drains (Fig. 3 A, B).

We used the open approach for severe acute pancreatitis, and laparostomy was used for drainage and access for revisions to further remove local debris. (Figs. 4, 5, 6, 7)

In our institution we use the surgical procedures with individual indications at the patients. (Fig. 8)

The necrotic cavity after the evacuation of pancreatic necrosis, can provide significant bleeding, and the hemostasis can be difficult and may require packing of the cavity. (Fig. 9)

In this retrospective study the patients predisposed to complications were evaluated as well as the time of surgery, cause of pancreatitis, APACHE II scores, incidence of MOF on admission, whether the pancreatic necrosis was infected, age, and coexisting conditions.

Out of 212 analysed patients we encountered 36 patients with retroperiotomy, 46 patients with open abdomen after severe acute pancreatitis for IPN.

Table 1. Analysis of patient details

		Emergency Surgery for IPN n=120	Emergency Surgery for Sterile Necrosis n=25	Delayed surgery n=69
Median age		52	46	45
Actiology	Biliary	39 (33)	3	12
	Alcohol	49 (41)	8	24
	Other	32 (27)	5	33
Organ failure	No	0	0	36
	1-3	78 (65)	10	53
	>3	42 (35)	13	0
Median interval between onset and surgery (days)	8	6	24	
Range	4-10	1-9	15-38	
Complications	Abscess	12	1	31
	Bleeding	16 (14)	2	2
	Fistula	10 (13)	2	2
	Colonic necrosis	7	3	0
Deaths		30 (25)	6	0



Figure 3. Necrotic material debrided with (A) or within marsupialisation (B)

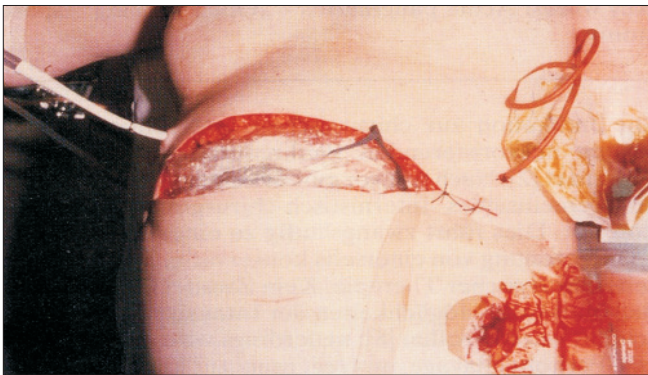


Figure 4. Open necrosectomy with closed continous lavage. Image continous lavage

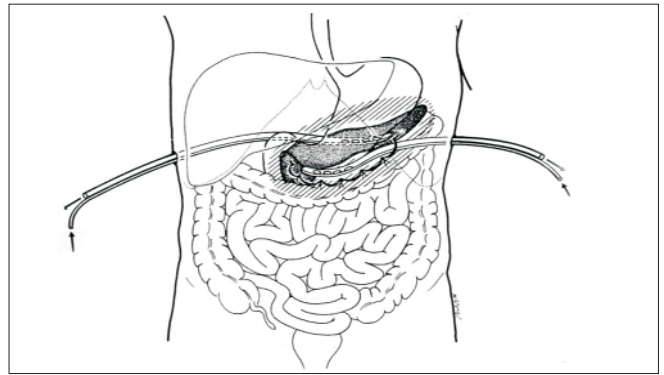


Figure 5. Open necrosectomy with drainage and relaparotomy on demand. Image open necrosectomy and drainage



Figure 6. Open necrosectomy with open abdomen, in acute compartment syndrome. Image Open abdomen

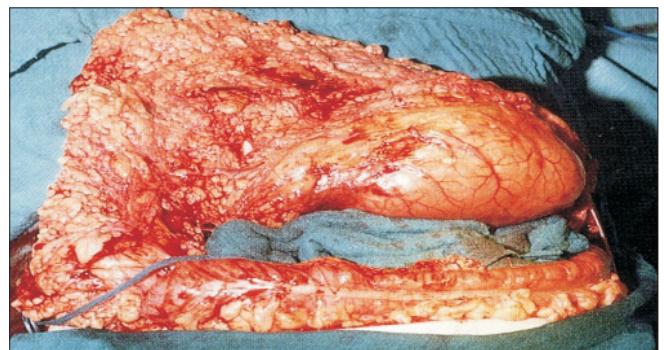


Figure 7. Open necrosectomy with retroperitoneostomy and continous lavage with drainage of all fluid collections in the pararenal and retrocolic spaces

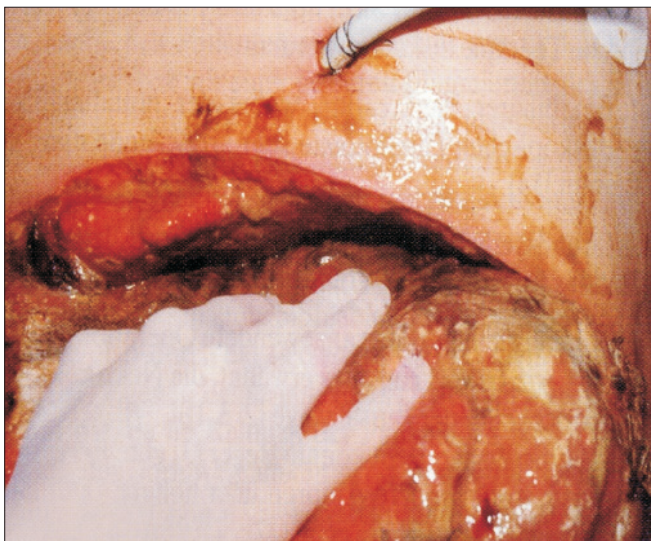


Figure 8. Retroperitoneostomy

Statistical analysis

The different surgical strategies were compared with mortality as the primary outcome. Fisher's exact test was used to compare categorical outcomes and the Kruskal-Wallis test for continuous outcomes. Model building by means of logistic regression was used to determine which factors contributed to death.

The patients' characteristics are summarized in Table 2.

In 68 patients the etiology of pancreatitis was biliary, idiopathic in 44 patients, alcoholic in 81 and of other causes 19.

The median time between admission and the first surgical interventions was approximately 3 weeks.

In severe cases with acute abdominal compartment syndrome or severe sepsis, patients treated by open abdomen surgery (OAS) were operated on earlier than those who had laparotomy and continuous postoperative lavage ($p = 0.028$). In Table 2 the indications for surgery are shown.

In suspected IPN (infected pancreatic necrosis) necrosectomy by laparotomy and continuous postoperative lavage of the retroperitoneum was the preferred strategy overall.

The need for surgical decompression for ACS (abdominal

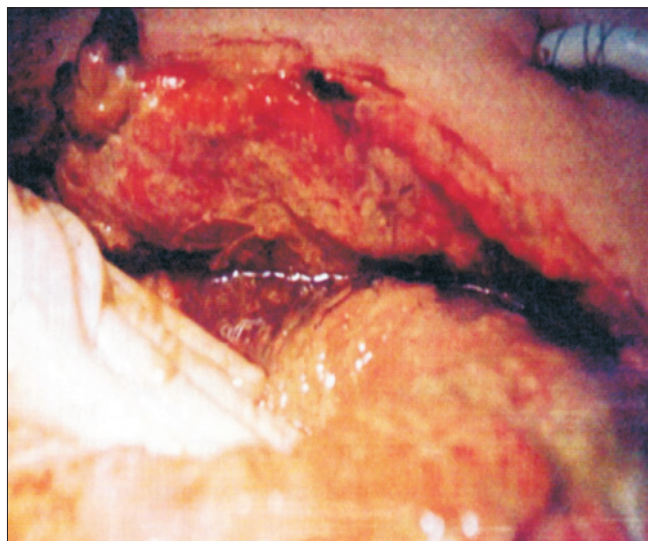


Figure 9. Hemostasis in the necrotic cavity

compartment syndrome) was more frequent in association with massive fluid resuscitation in the early stages of the disease. In these cases we use the vertical midline or transverse subcostal incision for open abdomen surgery.

Peroperative cultures from necrosis were positive in 152 patients (70 percent) and gram (+) positive and gram (-) negative bacteria were cultured in similar amounts (Table 4).

The patients with negative bacterial results were operated earlier than those with positive results (median range 7 days, versus 28 days, $p < 0.00011$). After delayed

Table 2. The preoperative characteristics of 212 patients operated for acute necrotizing pancreatitis

	Retroperitoneostomy No 36	Open abdomen No 46	Laparotomy and lavage No 106	Laparotomy and primary abdominal closure with or within laparostomy No 24	Total No 212	P
Age	52 (28-68)	68 (25-79)	59 (20-80)	59 (40-80)	59 (20-80)	0.176
Preop. ICU admission	20 (56)	26 (57)	54 (50)	10 (41)	110 (52)	0.835
Preop. ICU stay (days)	7 (2-106)	4 (1-37)	9 (2-78)	11 (3-20)	9 (2-106)	0.400
Referred patients	14 (38)	24 (52)	44 (43)	8 (33)	90 (43)	0.72

Table 3. Surgical indication in 212 patients operated on for acute necrotizing pancreatitis

	Laparotomy and closed abdomen No 24	Open abdomen surgery No 46	Laparotomy and lavage No 106	Retroperitoneostomy No 36	Total No 212	P
Air on CT	2	6	8	2	18 (8.6)	0.832
Sepsis or deterioration of patients	12	28	68	20	128 (60.5)	0.793
Suspected peritonitis	6	6	10	0	22 (10.4)	0.119
Bleeding	0	0	2	0	2 (9.4)	0.799

Table 4. Perioperative cultures in 212 severe pancreatitis

Culture	Number of patients
Positive	152 (72%)
Gram +	32 (15%)
Gram –	40 (19%)
Gram ±	46 (13%)
Candida	6 (2.9%)
Candida and bacteria	28 (13.1%)

operations the complication rate was 9.4%. The complications after acute surgery were 66/154, compared with 4/46 after delayed surgery ($p=0.001$).

Postoperative complications are shown in Table 5.

The mortality rate was highest in acute open abdomen surgery for acute compartment syndrome (70 percent), and the overall postoperative mortality rate was 34 percent (73/212).

Colonic necrosis, intestinal fistula, intraabdominal bleeding, pancreatic fistula were the most common complications (Table 6).

In 34 patients with colonic necrosis 30 had IPN. In these cases the interval between the surgery and the development of large bowel lesions was 5 days. In these cases, the surgical approach was aggressive, with bowel resection. After large

bowel lesions the mortality rate was 53%, 16 patients of fulminant septic shock within 24 hours of the operation, and two patients due to myocardial infarction. The surviving 18 patients left hospital after a median of 105 days.

A majority of patients (71%) had a reintervention either for further necrosectomy, to remove surgical threads or for inspection, evacuation of residual or present collections.

The risk of developing complications depended on the time of the operation, the causes of the pancreatitis, incidence of MOF, APACHE II scores.

Acute surgery, postoperative pancreatitis, alcoholic, idiopathic pancreatitis, APACHE II score of 11 or more, and MOF syndrome on admission, significantly influenced morbidity, while infection of pancreatic necrosis, age and comorbidity of patients had a predictive value (Table 6).

The prognostic effect of complications was caused by the high mortality after colonic necrosis, retroperitoneal diffuse infections, ARDS-syndrome.

Discussion

The aim of any intervention technique is to maximize debridement, preserve as much vital pancreatic parenchyma as possible and to secure postoperative drainage of debris and exudates (38-42). Several open and minimally invasive

Table 5. Complications in 212 patients with acute necrotizing pancreatitis

	Open abdomen surgery No 46	Laparotomy with continuous lavage No 106	Retro-peritoneostomy No 36	Laparotomy with closed abdomen No 24	Total No 212	P
No. of reinterventions	10	4	4	2	20	0.001
Reinterventions	46 (100%)	78 (75%)	24 (68%)	4 (16.5%)	152 (71%)	0.001
Postop. ICU stay (days)	17	11	3	3	9	0.046
Postop. hospital stay (days)	71	88	36	13	59	0.001
Postoperative deaths	32 (70%)	27 (25%)	4 (11%)	10 (43%)	73 (34%)	0.001
Postoperative bleeding	23 (49%)	33 (31%)	6 (17%)	4 (18%)	66 (31%)	0.140
Other complications with and without bowel perforations	14 (40%)	21 (20%)	8 (17%)	0 (0%)	43 (19.1%)	0.180
Colonic necrosis	Total: - 36 (16%) with 18 deaths (50%) - 18 patients had a medium hospital stay 105 days (67-200)					
Pancreatic fistula	16 – with 0% mortality					

Table 6. Risk factors for complications

APACHE II score at admission	No %	P value
0-10	14 (45)	< 0.0001
11 +	60 (56)	< 0.0001
Organ dysfunction at admission	No	< 0.0001
	1-2	< 0.0001
	3 +	< 0.0001

Table 7. Surgical treatment of severe acute pancreatitis

	Patients' No.	APACHE II score	Reoperation %	Hospital stay (day)	Mortality %
Buchler (30)	86	166 (5-28)	22	44 (11-209)	10
Fernandez del Castillo (35)	64	9 (9-24)	17	41 (7-82)	6,2
Gottinger (44)	240	16 (8-35)	74	39 (11-215)	39
Rau (43)	140	11 (0-27)	51	64 (1-238)	23
Connor (45)	88	9 (1-21)	-	93 (8-300)	28
Tzovaras (46)	44	11 (5-21)	32	55 (11-126)	18

techniques have been described, but an ideal method has not yet been defined.

Many studies have shown comparable mortality rates after many surgical procedures (Table 7).

However morbidity with intestinal fistula, bleeding pancreatic fistula, gastric stenosis is higher in patients undergoing multiple reinterventions (80%) (30,35,47,48).

In our institution we use the open approach for the surgical treatment of acute necrotizing pancreatitis.

The mortality rate in this series (34.0 percent) is slightly higher than the rate of 28 percent reported in a single recent series of 88 patients from Liverpool (48).

In a recent systematic review a mortality rate of 27 percent for an open abdominal surgery was reported (49). In this series the early intervention (median 11 days), may have contributed to the poor evolution of patients, and these results are supported by the finding that delayed surgery after at least 12 days may reduce mortality (50-53).

In the present study, postoperative bleeding and bowel perforation were less often observed in laparotomy with primary abdominal closure comprising laparotomy and blunt debridement of necrosis, followed by abdominal closure with no postoperative lavage system in place.

The repeated pattern of an open abdomen surgery, and the associated risk of iatrogenic complications contributed to the poor results (54,55,56). The use of laparotomy and continuous lavage of the retroperitoneum first described by Beger et al (57) has been reported with a mortality rate of 15-25 percent (40,48). In the present series the mortality rate was 25 percent with this procedure. Hemorrhage and large bowel necrosis developed early in the course of pancreatitis as a result of spread of intra and peripancreatic necrosis, while fistulas usually develop later, often as complications of reinterventions.

Colonic necrosis is a serious event, with a 50 percent mortality rate in this study, and with long hospital stay,

particularly median hospital stay 105 days in our study. Early diagnosis is difficult, in our experience colonic involvement should be treated by emergency resection and stoma, to prevent development of perforation. In our patients with emergency operations colonic necrosis was high, 16 percent (Table 4). The activated pancreatic fluid and bacteria results in erosive vasculitis and predisposes to bleeding, with the reported incidence of major hemorrhage after surgical debridement being 20% (58,59), (31 percent in our series).

Intestinal fistulas may develop as complications of pancreatic necrosis or as results of operative treatment in 12 percent to 70 percent of patients (57, 60-65).

Any patients with SAP are admitted to the intensive care unit (66).

Infection of pancreatic necrosis develops during the second or third week in 40-70 percent patients, only patients who develop IPN might need debridement or drainage, because debridement or drainage increase the risk to infect sterile tissues (67). To keep the consequences of serial laparotomies to a minimum in critically ill patients, and decrease the ensuing increased mortality, several minimally invasive techniques are used (68,69). However these techniques are still being developed and are indicated only in some patients (70).

In abdominal compartment syndrome abdominal decompression through midline laparotomy is another surgical procedure for SAP (71). The consequences of surgical decompression in present study on the outcome remain unclear.

Conclusions

Sterile necrosis should be managed nonoperatively unless there is progressive deterioration from sepsis or organ dysfunction syndrome. Although there is a consensus that it is best to delay surgery if possible, there is no consensus on the exact indications for and timing of any intervention.

Complications develop significantly more often in severe necrotizing pancreatitis with organ dysfunction and need of emergency operations.

Their prognostic relevance is caused by the adverse effects of colonic necrosis, while bleeding and interventional fistulas do not affect survival.

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