# Original article

## Clinical experience of surgical intervention for severe acute pancreatitis

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***Keywords:*** *severe acute pancreatitis; surgical intervention; timing and procedure*

**Background** The controversy on the treatment strategy for severe acute pancreatitis (SAP) has never stopped for the past century. Even now surgical procedures play a decisive role in the treatment of SAP, especially in managing the related complications, but the rational indications, timing, and approaches of surgical intervention for SAP are still inconclusive.

**Methods** Clinical data of 308 SAP patients recruited during January 2000–January 2013, including 96 conservatively treated cases plus 212 surgically intervened cases, were comparatively analyzed. Based on the initial surgical intervention time, the surgical intervention group was split into two: early intervention group (within 2 weeks) 103 cases, and late intervention group (after 2 weeks) 109 cases.

**Results** In the conservative treatment group, the cure rate was 82.29% (79/96), the death rate was 13.54% (13/96), and 4 cases self-discharged, while in the surgical intervention group, the cure rate was 84.43% (179/212) and the death rate was 10.85% (23/212) with 10 cases self-discharged. The difference was of no statistical significance between these two groups ($P$ >0.05). In surgical intervention group, the death rate 15.53% (16/103) in the early surgical intervention group was higher than that of late surgical intervention group 6.42% (7/109), and the difference was statistically significant ($P$ <0.05).

**Conclusions** Both conservative treatment and surgical intervention play important roles in the treatment of SAP, and the indication, timing, and procedure should be strictly followed. Surgery earlier than 2 weeks after onset of the disease is not recommended in patients with necrotizing pancreatitis only when there are specific indications, such as multiple organ failure, which does not improve despite active treatment, and in those who develop abdominal compartment syndrome.

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Severe acute pancreatitis (SAP) is a huge threat to human health in spite of century-long persistent endeavors. The mortality is still as high as 10%–30%.[1] With the study of underlying mechanisms and rules, there has been a great improvement in the treatment of SAP and agreement has been reached on many issues, but it is still controversial where timing, indication, and procedure selection are concerned. The clinical data of 308 SAP patients recruited during January 2000–January 2013 in our hospital were analyzed retrospectively, and the individualized and standardized treatments of SAP are discussed.

## METHODS

### Patient selection

From January 2000 to January 2013, 308 SAP patients were recruited in the hospital. All 308 SAP cases presented with acute abdomen with variable levels of peritoneal irritation syndrome plus elevated amylase level in blood as well as in urine. The diagnosis was confirmed by intensified CT. All the patients met the inclusion criteria of the guidelines for diagnosis and treatment of SAP in China (2007).

### Treatment

A total of 308 SAP subjects were included in this study with 96 having received conservative treatment and 212 having received surgical intervention. Based on the initial surgical intervention time, the surgical intervention group was further split into two groups: early intervention group (within 2 weeks) 103 cases and late intervention group (after 2 weeks) 109 cases.

### Conservative treatment

Early intensive care strengthens the functional support for important organs. Those patients with APACHE II score of 10 or higher need to be sent to ICU when necessary; treated with fasting, gastrointestinal decompression, antacid, and somatostatin and its analogues to inhibit the secretion of pancreatic enzyme; have liquid resuscitation, maintenance of water and electrolyte balance, dynamic monitoring of central venous pressure (CVP) or pulmonary wedge capillary pressure (PWCP), with attention to the ratio of crystal and colloid liquid; monitored for intra-abdominal pressure as well as the function of the organs; and prevented and treated for infection with antibiotics against Gram-negative bacteria, and anaerobic bacteria that can pass through blood pancreatic barrier. Once the internal environmental disturbance has been corrected and gastrointestinal function restored, the nasojejunal tube is kept to maintain enteral nutrition.[2]

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### Surgical intervention

The 212 subjects in this group were surgically treated and divided into two groups: early intervention group (within 2 weeks) and late intervention group (after 2 weeks). The indications and procedures for early intervention ($n$=103 cases) include the following: (1) biliary pancreatitis combined with bile duct obstruction ($n$=52 cases) and the patients who received endoscopic nasobiliary drainage by EPCP or open choledocholithotomy;[3] (2) SAP combined with abdominal compartment syndrome (ACS; $n$=37 cases) and the patients who received a CT or ultrasound-guided therapeutic percutaneous puncture catheter drainage, or debridement and decompression of pancreatic necrotic tissue; and (3) combination of the above two factors or other patients who received early surgical intervention ($n$=14 cases). The indications and procedures for late intervention ($n$=109 cases) include (1) biliary pancreatitis with no bile duct obstruction ($n$=38 cases), and those patients that received elective laparoscopic cholecystectomy; (2) pancreatitis combined with infection and pancreatic or peripancreatic abscess ($n$=46 cases), and those patients that received CT or ultrasound-guided therapeutic percutaneous puncture catheter drainage or debridement and decompression of pancreatic necrotic tissue; and (3) pancreatic pseudocyst or other local complications that caused obvious discomfort, and those patients that received cyst puncture drainage ($n$=25 cases).

Surgically, the therapeutic strategies include two options: "minimal invasive procedure" and "sequential procedure". The minimal invasive procedure was preferred for therapeutic purpose of debridement and decompression. For severe necrosis where a complete removal of necrotic tissue by debridement procedure was impossible or pus was not fully drained by CT or ultrasound-guided therapeutic percutaneous puncture catheter drainage, open debridement, tube placement, drainage, and rinse were indicated.

### Statistical analysis

All statistical analysis was performed with SPSS 19.0 (SPSS Inc., IL, USA). The quantitative data and categorical data were compared with $t$-test and $\chi^2$ test, respectively, with $P$ <0.05 denoting statistical significance.

## RESULTS

A total of 308 SAP patients were enrolled in the study, which included 146 males and 162 females, with age in the range from 26 to 78 years and average age of 52.6 years. The etiology was composed of biliary origin in 132 cases, hyperlipidemia in 43 cases, meal or alcohol induced in 72 cases, abrupt pancreatitis in 33 cases, and other causes in the remaining 28 cases.

In this study, no difference was identified between the conservative treatment group and the surgical intervention group regarding age, gender, amylase index, APACHE score, and so on ($P$ >0.05). CT severity index (CTSI) in the surgical intervention group was higher than that of the conservative treatment group ($P$ <0.05, Table 1).

In the conservative treatment group, the cure rate was 82.29% (79/96), the death rate was 13.54% (13/96), and 4 cases self-discharged for financial reason. In the surgical intervention group, the cure rate was 84.43% (179/212), the death rate was 10.85% (23/212), and 10 cases self-discharged. The difference was of no statistical significance ($P$ >0.05), as shown in Table 1.

In surgical intervention group, the cure rate was 81.55% (84/103) and the death rate 15.53% (16/103) in the early intervention group while the cure rate was 87.15% (95/109) and the death rate 6.42% (7/109) in the late intervention group, and the difference was statistically significant ($P$ <0.05) as shown in Table 2.

There were 13 cases of death in the conservative treatment group including five cases of adult respiratory distress syndrome (ARDS), three cases of renal failure, two cases of pancreatic encephalopathy, and three cases of shock. There were 23 cases of death in the surgical intervention group including six cases of ARDS, five cases of ACS, five cases of septicopyemia, four cases of renal failure, and three cases of upper GI bleeding.

## DISCUSSION

There are two death peaks in SAP with the first one

**Table 1.** Baseline characteristics of conservative group and surgical group

| Characteristics | Conservative group ($n$=96) | Surgical group ($n$=212) | $P$ values |
|---|---|---|---|
| Age (mean±SD, year) | 51.4±9.2 | 53.1±9.3 | 0.13 |
| Gender (male:female) | 52:44 | 118:94 | 0.81 |
| Blood amylase (U) | 1273.2±223.6 | 1345.2±244.9 | 0.07 |
| Balthazar CTSI | 7.5±1.2 | 8.7±1.0 | 0.00 |
| APACHE II | 12.4±3.2 | 13.1±3.8 | 0.14 |
| Hospital stay (day) | 42.3±8.8 | 50.4±8.4 | 0.00 |
| Curative rate (%) | 82.29 | 84.43 | 0.38 |
| Mortality (%) | 13.54 | 10.85 | 0.42 |

**Table 2.** Comparison of the clinical parameters in the early surgery group and the late surgery group

| Characteristics | Early surgery group ($n$=103) | Late surgery group ($n$=109) | $P$ values |
|---|---|---|---|
| Age (year) | 52.9±8.5 | 53.3±9.8 | 0.78 |
| Gender (male:female) | 58:45 | 60:49 | 0.85 |
| Balthazar CTSI | 8.6±0.9 | 8.7±1.0 | 0.32 |
| APACHE II | 12.8±3.8 | 13.4±3.9 | 0.29 |
| Blood amylase (U) | 1 323.7±235.9 | 1 366.4±264.7 | 0.69 |
| Surgical intervention for the first time (day) | 8.4±2.6 | 22.5±5.0 | 0.00 |
| Curative rate (%) | 81.55 | 87.15 | 0.04 |
| Mortality (%) | 15.53 | 6.42 | 0.02 |

usually being within the first 2 weeks of diagnosis and characterized by dysfunction of multi-organs such as hemodynamical instability caused by acute inflammation, shock, ARDS, and renal failure, and the second one usually falling in the period between the fourth and sixth weeks after onset of the disease, being associated with pancreatic or peripancreatic necrosis, or infection, septicopyemia, and bleeding, accounting for 30%–40% of overall mortality. Effective control of the two death peaks is key to reducing the mortality.

**Conservative treatment**

For SAP first death peak, early intensive care should be strengthened: oxygen therapy or mechanical ventilation support to avoid ARDS, improved blood oxygen saturation as well as nutrition metabolism, and close monitoring of organ and system functions. Those with critical conditions were sent to ICU. Pancreas rest therapy included fasting, gastrointestinal decompression, antacids, and somatostatin and its analogues inhibiting pancreatic enzyme secretion. Adequate fluid resuscitation, anti-shock treatment, and corrected electrolyte for acid-base balance disorders are also integral. Sensitive antibiotics are used to limit the acute inflammatory response, combined with antifungal agents when necessary. Enteral nutrition should be restored as soon as possible, and the nasal jejunal feeding tube to support enteral nutrition should be placed. Hospitals supplied with the necessary equipment had early regional arterial infusion therapy or short-term hemofiltration interventional treatment in the option list.

Those cases whose non-bacterial pancreatic necrosis was <50% (accounting for about 30%–60%) could usually be mitigated by exclusive conservative treatment, and the lesions could be self-limited and organized, without need for surgical intervention. On the contrary, surgery might artificially increase the possibility to transform non-bacterial necrosis into an infectious one, which would deteriorate the situation. In this study, 79 out of the total 96 SAP patients were cured with exclusive conservative treatment, which made it a promising option in the treatment of SAP.

**Timing and indication of surgical intervention**

Surgical intervention plays an important role in the treatment of SAP, especially the complications. Choice of timing and recognizing indications of surgical intervention are keys to improve cure rate.[4] We opine that indication of early surgical intervention mainly includes two aspects. One is focused on the removal of the causes of SAP. The curative effect of early surgery to reopen the bile duct in 52 patients with biliary obstruction in this group was definite and effective. The other aspect focuses on the treatment of fatal complications such as intra-abdominal hypertension (IAH) and ACS. In patients with SAP, the incidence rate of IAH is about 60%–80%, and the mortality of those complicated with ACS is as high as 50%–75%;[5] five patients died of ACS. Intra-abdominal or retroperitoneal peripancreatic necrotic exudates and intestinal distention may result in IAH or retroperitoneal hypertension; in addition, damage and leakage of capillary endothelia caused by absorption of toxins may further lead to refractory shock or even multiple organ dysfunction syndrome (MODS).[6] So if there is no evident improvement in such patients after 24 hours of conservative treatment, intra-abdominal pressure still >25 $mmH_2O$, or MODS may potentially occur or has already occurred, surgical intervention should be taken without any hesitation for the purpose of drainage and decompression.[7]

For the second death peak, effective control of pancreatic necrotic infection is the key. SAP patients with pancreatic non-bacterial necrosis <50% usually respond well to the conservative treatment; generally no surgical intervention is indicated for such patients. While pancreatic necrosis is complicated by infection, pancreatic and peripancreatic abscess are the absolute indications for SAP patients. However, intervention timing is very important to determine prognosis. Early intervention may be able to release biliary obstruction and remove necrotic or infectious tissue, but cannot completely block the pathologenetic process of pancreatitis. Also, SAP patients usually present with organ failure during the first week of admission; respiratory failure is most common followed by shock, renal failure, hypocalcemia, gastrointestinal bleeding, and such.[8] The strike of anesthesia and early surgical trauma may aggravate stress response in those patients and deteriorate the systemic inflammatory response syndrome contributing to increased mortality. So we suggest that it may not be suitable to perform early surgery in those patients, and preoperative stabilization of organ dysfunction by improved treatment in the intensive care unit is recommended.[9] On the other hand, at the early stage of the disease, the pancreatic infectious necrotic tissues have not been fully liquefied or limited, leading to ambiguous boundary between normal and necrotic tissues. Also the blood vessels to the affected parts of pancreas have not occluded; it is hard to completely remove infected necrotic tissues, and the patients become susceptible to complications such as leakage and bleeding, increasing the risk of intra-abdominal infection and the need of another surgery.[10,11] Therefore, early surgical intervention is only applicable to SAP combined with ACS and biliary pancreatitis with bile duct obstruction. For pancreatic necrosis associated with infection or peripancreatic abscess, if patients are stable, surgery should be delayed while receiving conservative treatment, and the opportunity of surgical intervention is roughly after 2 weeks or even after 1 month.[12-14] When the boundary between live and necrotic tissues is clear, it is easier to remove necrotic tissue, keeping as much normal tissue as possible.[15] Simultaneously, as they are close to adjacent loops and blood vessels, the formed granulation and fibrous tissue may help to reduce the incidence of postoperative hemorrhage and intestinal leakage.[16]

**Selection of surgical procedure**

With development and maturation of ultrasound and CT-guided percutaneous puncture catheter drainage, ERCP, endoscopic duodenal papilla sphincter incision (EST), laparoscopy, renoscopy, and choledochoscopy, minimally invasive surgery has overcome the disadvantages of

traditional surgery such as stress response and surgical trauma. It has been reported that CT-guided puncture drainage and laparoscopic technique have similar curative effect, but are safer and less traumatic compared with traditional open debridement and drainage.[19] However, minimally invasive surgical intervention emphasizes on removing while necrotizing, and its indication is relatively narrow with some drawbacks remaining, and sometimes it has to be done multiple times to achieve a satisfactory curative effect, which on the contrary will increase the rate of complications. Simultaneously minimally invasive interventions prove more difficult to achieve the desired effect for some complicated cases.

For now, the traditional laparotomy is still the major procedure for SAP, especially SAP with pancreatic abscess, including two modes, closed and open, with the latter mainly being used in severe ACS. Because of its frequent secondary complications such as infection, intestinal leakage, incision hernia, and high requirement level of nursing, its indication has to be strictly limited. Debridement and drainage are usually applied in closed mode to release intra-abdominal and retroperitoneal pressure, drainage of the exudates, removal of necrotic tissue, and a reduction in the absorption of toxins. The procedure of pancreatic necrotic tissue debridement is still the golden standard in the surgical intervention of secondary infection of SAP, and its principles are to remove necrotic inactivated tissue and try to reduce the rate of complications such ash intra or extra pancreatic dysfunction, hemorrhage, and intestinal leakage while limiting the release of inflammatory factors.

Finally, both conservative treatment and surgical intervention play important roles in the treatment of SAP and should be chosen according to the condition of the patients and different stages of disease development. The indication, timing, and procedure should be strictly followed. Therapeutic strategies such as minimally invasive procedure and sequential procedure should be utilized when needed.[20] A comprehensive individualized therapeutic strategy should be chosen based on each patient's condition to achieve the best curative effect.

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