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Decision Making Pathways in Digestive Surgery

in the era of minimally invasive surgery

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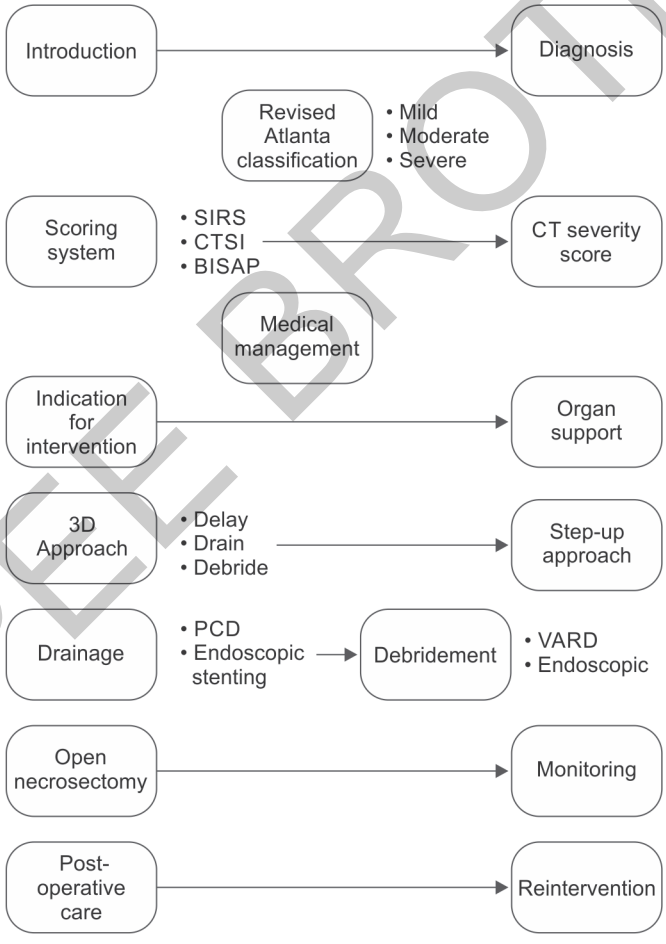
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CHAPTER

Acute Pancreatitis

Sanjiv Haribhakti

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Learning Objectives Algorithm



(BISAP: bedside index for severity in acute pancreatitis; CT: computed tomography; CTSI: computed tomography severity index; PCD: percutaneous catheter drainage; SIRS: systemic inflammatory response syndrome; VARD: video-assisted retroperitoneal debridement)

INTRODUCTION

Acute pancreatitis (AP) involves acute inflammation of the pancreas. The severity of AP varies widely from mild condition needing conservative treatment, to severe and complicated disease with high morbidity and mortality. The mortality of acute pancreas ranges from 3% with mild edematous pancreatitis to as high as 20% in patients with pancreatic necrosis.[1]

DIAGNOSIS

Two of the following three criteria are needed for diagnosis:

1. Abdominal pain consistent with AP (acute onset of a persistent, severe, and epigastric pain often radiating to the back)
2. Serum lipase activity (or amylase activity) at least three times greater than the upper limit of normal
3. Characteristic findings of AP on contrast-enhanced computed tomography (CECT) or on ultrasonography.

CLASSIFICATION

The revised Atlanta Classification 2012 for AP[2] overcame the limitation of the original Atlanta Classification 1992 and has since become the standard way of classifying AP.

Acute pancreatitis is classified as mild, moderate, or severe based on severity:

- *Mild:* No organ failure, no local or systemic complications
- *Moderate:* Severe transient organ failure (<48 hours) ± local or systemic complications
- *Severe:* Persistent organ failure (single or multiple)

This revised classification identifies two phases of AP:

1. *Early phase (first 1 or 2 weeks):* Where the complications are due to systemic inflammatory response syndrome (SIRS).
2. *Late phase (thereafter):* Where the complications may be due to SIRS or sepsis

Atlanta classification divides AP into two morphological subtypes:

1. Interstitial edematous pancreatitis (IEP)
2. *Necrotizing pancreatitis (NP) which is further subdivided into parenchymal necrosis, peripancreatic necrosis or combined type (peripancreatic and parenchymal necrosis):* Most common

All types of NP may be sterile or infected; gas formation is the best imaging feature to suggest infection.

New terminology for fluid collections associated with AP is introduced:

- *Fluid collections associated with IEP (i.e. minimal or no necrosis):*
  - Acute peripancreatic fluid collections (APFC): In the first 4 weeks; nonencapsulated peripancreatic fluid collections
  - Pseudocysts: Develop after 4 weeks; encapsulated peripancreatic or remote fluid collections
- *Fluid collections associated with NP:*
  - Acute necrotic collections (ANCs): In the first 4 weeks; nonencapsulated heterogeneous nonliquefied material
  - Walled-off (pancreatic) necrosis (WON or WOPN): Develop after 4 weeks; encapsulated heterogeneous nonliquefied material

Acute necrotic collections and WONs are collections that contain both fluid and necrotic material of various amounts (an important point to differentiate them from APFCs and pseudocysts, however, in indeterminate cases follow-up is recommended). The terms pancreatic abscess, phlegmon, and intrapancreatic pseudocyst are totally abandoned in this new classification.

SCORING SYSTEMS

Prediction of acute severe pancreatitis is done by several scoring systems as described below. Some of them need at least 24–48 hours and few of them have been validated. Some are single factor scoring, whereas most are multiple factors determining the severity score, which in turn determines the prognosis.

Predictive score	Cutoff for severity
APACHE II	>8 in first 24 hours
BISAP	>3 in first 24 hours
Modified Glasgow	>3 in first 48 hours
Ranson	>3 in first 48 hours
CRP	>150 U/L in first 72 hours

Out of many of these, a simple score such as Systemic Inflammatory Response (SIR) score helps to triage patients to ward or intensive care unit (ICU) based on severity of SIR. SIRS is defined by presence of two or more criteria: Heart rate >90 beats/min; core temperature 38°C; white blood count 12,000/mm; and respirations >20 breaths/min.

The most common multiorgan dysfunction score used in practice is the Modified Marshall scoring

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system for organ dysfunction score. This score has been recommended by the revised Atlanta Committee for AP. An online calculator of modified Marshall Score is available.[3]

COMPUTED TOMOGRAPHY SEVERITY SCORE[4]

Computed tomography (CT) severity grades the severity of AP on CECT scan. Typically, the first CT scan must be done at least 3–5 days after the initial pain of AP. Later, repeated CT scan will be needed based on clinical condition, especially before any intervention is planned to determine the approach of intervention. A CECT scan is done with three phases with pancreatic protocol, with an arterial phase to look for pseudoaneurysms, early venous phase for pancreatic uptake or absence of uptake which determines the necrosis, presence of collections, and late venous phase for venous complications such as portal vein or splenic vein thrombosis.

CT severity index		***Modified CT severity index***	
Prognostic indicator	***Points***	***Prognostic indicator***	***Points***
Pancreatic inflammation		*Pancreatic inflammation*	
Normal pancreas	0	Normal pancreas	0
Enlargement of pancreas	1	Pancreatic abnormalities with or without peripancreatic inflammation	2
Pancreatic abnormalities with peripancreatic inflammation	2	Pancreatic or peripancreatic fluid collection or fat necrosis	4
Single fluid collection	3		
Two or more collections or gas	4		
Pancreatic necrosis		*Pancreatic necrosis*	
None	0	None	0
<30%	2	<30%	2
30–50%	4	>30%	4
>50%	6	Extrapancreatic complications (pleural effusion, ascites, parenchymal complications. GI tract involvement)	2

Predicting morbidity and mortality with the CT severity index combining scores for pancreatic morphology and extent of pancreatic necrosis

Index	***Morbidity***	***Mortality***
0–3	8%	3%
4–6	35%	6%
7–10	92%	17%

MEDICAL MANAGEMENT

Medical management is very important, and various principles are:

- *Pain relief:* Pain is one of the most distressing symptoms of AP, requiring relief for patients. Also, pain stimulated the SIR further and therefore needs to be relieved. Pain will also cause shallow breathing, and more likely to cause basal atelectasis. Pain relief is achieved by opioids and paracetamol, whereas nonsteroidal anti-inflammatory drug (NSAID) should be used with caution as these patients are prone to acute kidney insufficiency (AKI). When patients are in ICU, we prefer to use fentanyl infusion for pain relief. A few patients with refractory pain may need an epidural catheter with ropivacaine or tramadol.
- *Fluid resuscitation* is another very important part of treatment. Currently goal-directed fluid therapy is preferred rather than too aggressive fluid resuscitation, due to the risk of developing pulmonary compromise or abdominal compartment syndrome (ACS). The target hematocrit (HCT) to be achieved is 35–45%, and the target urine output in the range of 0.5–1 mL/kg/h.
- *Role of prophylactic antibiotics:* Though there is a lot of controversy on this subject, most published literature shows no role of prophylactic antibiotics even in severe AP with necrosis and with early organ failure, as these are secondary to SIR rather than sepsis. In practice, when these patients are in ICU, with invasive lines, a prophylactic antibiotic is often used. One should start with a quinolone or a third-generation cephalosporin as their penetration into pancreas is good. Carbapenems and antifungals should be reserved for established sepsis and its complications in the third and fourth weeks.
- *Enteral nutrition preferred:* Early enteral nutrition (EN) is of paramount importance in these patients. As soon as the pain subsides, oral fluids are allowed and gradually increased to soft semisolid fat-free

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high-protein diet. Only when these patients do not tolerate oral feeds, a nasogastric (NG) tube feeding or an endoscopic placed nasojejunal (NJ) tube feeding is started. The authors group believes in early nasojejunal tube feeding, when patients do not tolerate oral feeds, as this preserves nutrition in the fourth week, when these patients may require intervention.

INDICATIONS FOR INTERVENTION

Patients with sterile necrosis do not require intervention and will be continued to be managed conservatively. When patients in the third week are showing signs of sepsis or persistent signs of SIR, then sepsis is suspected and intervention needs to be planned. Infection in the pancreatic bed can be proved by CT guided fine needle aspiration bacteriology (FNAB); however, in clinical practice, most of these patients can be diagnosed based on clinical criteria of sepsis rather than relying on FNAB. Commonly, a recent CECT scan of the abdomen is ordered to plan for the intervention. Following are the indications of intervention in AP:

- *Infected necrosis:* This is a definite indication for intervention in most patients, with a rare exception of a patient who is very stable, without clinical sepsis but with air in the pancreatic bed.
- *Extensive Sterile necrosis with persistent organ failure:* Some patients with extensive sterile necrosis will develop symptoms due to compression or failure to thrive due to low-grade sepsis and will require some intervention, at some point of time.
- *Abdominal compartment syndrome:* These are the only patients who may need intervention in the early phase of AP, i.e., first 2 weeks of AP. We routinely monitor intra-abdominal pressure (IAP) in all patients with AP in critical care units. This is done by measuring the intravesical pressure from the urinary catheter, technique of which is well described. IAP >12 mm Hg is termed as intra-abdominal hypertension (IAH), and these patients are more closely monitored for respiratory or renal compromise. Pressure persistently >20 mm Hg is termed as ACS and such patients having organ dysfunction such as renal or pulmonary compromise will need release of IAH. Some maneuvers to reduce IAH are restricting intravenous (IV) fluids, using diuretics if renal functions are normal, using percutaneous catheter drainage (PCD) for ascites or retroperitoneal collections and artificial ventilation for respiratory distress. Few patients may need release incisions on linea alba or on the abdominal wall to release their IAH. These patients are at risk of sepsis, fecal fistulas, and hernias in the future.
- *Bleeding* from pseudoaneurysms, postintervention PCD, or postoperative bleeding is a known complication in view of pancreatitis and the pancreatic enzymes causing erosion of vascular collagen leading to pseudoaneurysms.
- *Local complications* such as gastric outlet obstruction (GOO) due to compression of collections and necrosis or biliary obstruction due to bile duct stones or compression, colonic complications such as ischemia, bowel obstructions, fistulas, or colonic ischemia are some of the other major local complications that are not uncommon.

ORGAN SUPPORT FOR ORGAN DYSFUNCTION

For patients with persistent paralytic ileus may need parenteral nutrition. For cardiovascular support, adequate fluids and vasopressor support may be needed. For pulmonary support, many patients need supplemental oxygen and may need ventilation for respiratory distress. We prefer to avoid noninvasive ventilation in severe AP due to the risk of developing ACS. For renal support, rarely hemodialysis may be needed.

3D APPROACH TO ACUTE PANCREATITIS

- *Delay:* The guiding principle currently is that one should delay the intervention as far as possible into the third or preferably the fourth week. After 4 weeks are over, if the patient is stable and eating well, interventions should be further delayed.
- *Timing of intervention:* Studies have shown that postponing surgical interventions ≥4 weeks after the onset of the disease results in less mortality by better demarcation of necrosis from vital tissues, leading to more complete necrosectomy and less chances of intraoperative hemorrhage. All these lead to more effective necrosectomy and reduce the number of reinterventions, leading to better postoperative outcomes.
- *Drain:* When the patients need intervention, initially one should attempt to drain the collections by percutaneous or endoscopic route, whichever is suitable. For more peripherally located collections,

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which have a percutaneous access, we prefer the percutaneous route to drainage; whereas for the more centrally placed collections in the retrogastric location, an endoscopic route is preferable. The percutaneous drainage is done by large bore catheters >12 Fr and later can be up scaled to even 28 Fr. For more centrally placed collections, an endoscopic stent placement is used as a preferred approach. Plastic stents are less effective, and therefore a short fully covered metallic stent is preferable.

- *Debride:* After the initial drainage, these patients are regularly followed and reviewed every 3 days. If they do not improve, or the clinical condition worsens, these patients need a "step-up approach" to debridement of the necrotic tissue.

STEP-UP APPROACH

In this approach [minimally invasive surgery (MIS) to open), one starts with minimally invasive approach upscaled gradually to necrosectomy if patient does not respond. This has been shown to be effective in a majority of patients and also leads to reduced morbidity and mortality in patients with severe AP.[5] Even long-term results have been consistently better with this approach.[6]

If the previous approach has been percutaneous catheter placement (PCD), then one will likely use a minimally invasive percutaneous approach to necrosectomy termed as video-assisted retroperitoneal debridement (VARD). A recent CT scan is done to review the location of the pockets of necrosis and the amount of necrosum. Based on this, either a single or multiple small incisions are done to perform the necrosectomy. When the patients do not respond to the minimally invasive approach, then either a laparoscopic or open approach is utilized.

DRAINAGE AS FIRST STEP

- *Percutaneous drainage (PCD)* is indicated for patients who are deteriorating preferably after third week, or earlier if patient is having abdominal compartment syndrome. A CT/US guidance is used for PCD and a large bore 12–16 Fr catheter is placed based on recent CT location and access route defined, that can be later used for VARD. Multiple PCD can also be placed based on CT location to access percutaneous route available.
- *Endoscopic drainage by stenting* is indicated when there is a matured wall which takes 4 weeks, when the cyst is <1.5 cm from the stomach wall and when collections are central in location. Endoscopic approach is not a good approach for diffuse or multicystic collections or when there is a predominant necrosis rather than fluid collection. Endoscopic ultrasound (EUS)-guided drainage and stenting is preferred with the puncture site from avascular route with absent or minimal collaterals to reduce the chances of bleeding. Several types of stents are used including plastic stents such as double pigtail stent; however, better drainage is obtained with using metal stents such as fully covered self-expandable metal stent (FC-SEMS), a bi-flanged stent such as a NAGI™ stent or lumen apposing metal stent (LAMS) such as AXIOS & Spaxus stent. These metallic stents will need to be removed in 14 days, due to the risk of bleeding in the pancreatic bed by the metallic flanges when the cyst is decompressed.

DEBRIDEMENT

Debridement of the necrosis is the next step in the step-up approach. If the previous approach is percutaneous drainage, and the patient is unresponsive, then the logical next step is to perform minimally invasive VARD through a small incision (3–5 cm) along the catheter tract and entering the infected cavity to remove necrosum by blunt technique and do a thorough lavage followed by drainage. A single incision port can be utilized to perform endoscopic visualization to confirm the completeness of necrosectomy and to perform blunt debridement from the deeper cavities. This is a retroperitoneal approach which avoids contamination of the peritoneal cavity and does not add much to the SIRS of a major surgery, especially in patients who have organ failure.

Direct endoscopic necrosectomy (DEN) is a technique utilized when the previous drainage technique is an endoscopic stenting. After a few days, endoscopic visualization of the pancreatic bed is achieved through the stent, and DEN is performed by snare and other blunt instruments. Finally, a nasocystic catheter can be placed for postoperative lavage if needed.

OPEN NECROSECTOMY

Open necrosectomy is needed as a final step in the step-up approach when patients do not respond to the minimally invasive approaches and continue to deteriorate with residual collections and infection. Infected necrosis with clinical deterioration is the prime indication for open

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necrosectomy as a continuum in a step-up approach after percutaneous/endoscopic procedure with the same indications. Other indications are acute on-going bleeding when endovascular approach is unsuccessful, colonic ischemia or acute necrotizing cholecystitis during AP, bowel fistula extending into a peripancreatic collection, ACS as a last resort and persistent extensive sterile necrosis with recurring symptoms. There are two approaches to open necrosectomy: Retroperitoneal and the transperitoneal. The transperitoneal approach can be performed by several approaches such as the gastrocolic, transmesocolic, retrocolic, gastrohepatic, and the mesenteric routes depending on the location of necrosis. Recently transgastric necrosectomy has also been advocated to minimize the contamination of the peritoneal cavity and to achieve an internal drainage.[7] Concomitant colonic ischemia is assessed and a loop stoma or a subtotal colectomy and end stoma may be needed to tackle such complications. Cholecystectomy and a feeding jejunostomy may be needed as per the situation.

Occasionally in some patients, an open laparotomy may be chosen as an initial therapy in a step-down approach. Patients who are later in their timeline beyond 6 weeks, who have multiple pockets of necrosis and collections in both supracolic and infracolic compartments, occasionally extending into the pelvis, and those who are nutritional well preserved without organ dysfunction are best suited for a one-step laparotomy to clear all the necrosis and giving them an early recovery. Some studies have shown equally good results and a low mortality in good risk patients, with one-step necrosectomy by laparotomy or laparoscopy when compared to step-up approach.[8]

MONITORING

Close monitoring of these patients is necessary to determine response to the intervention and also to decide whether the next step is necessary. We regularly follow these patients with vital charts, local examination, organ failure scores, and inflammatory makers such as C-reactive protein (CRP), serial WBC counts, and S. procalcitonin.

POSTOPERATIVE CARE

Patients with acute severe pancreatitis often need prolonged intensive care unit due to persistent SIRS, leading to multisystem organ dysfunction syndrome (MODS). These patients need thromboprophylaxis to prevent deep vein thrombosis (DVT) but need careful monitoring for bleeding complications. Clinician needs to careful look for signs of sepsis, organ failure, and bleeding. Wound assessment for likely wound infections and dehiscence needs to be looked into. Adequate nutrition is of paramount importance starting from partial parenteral to enteral nutrition as soon as possible. Some patients need postoperative lavage with large amount of adequate irrigation till the effluent fluid becomes clear. Judicious use of antibiotics and antifungals is encouraged rather than multiple cocktail therapies.

REINTERVENTION

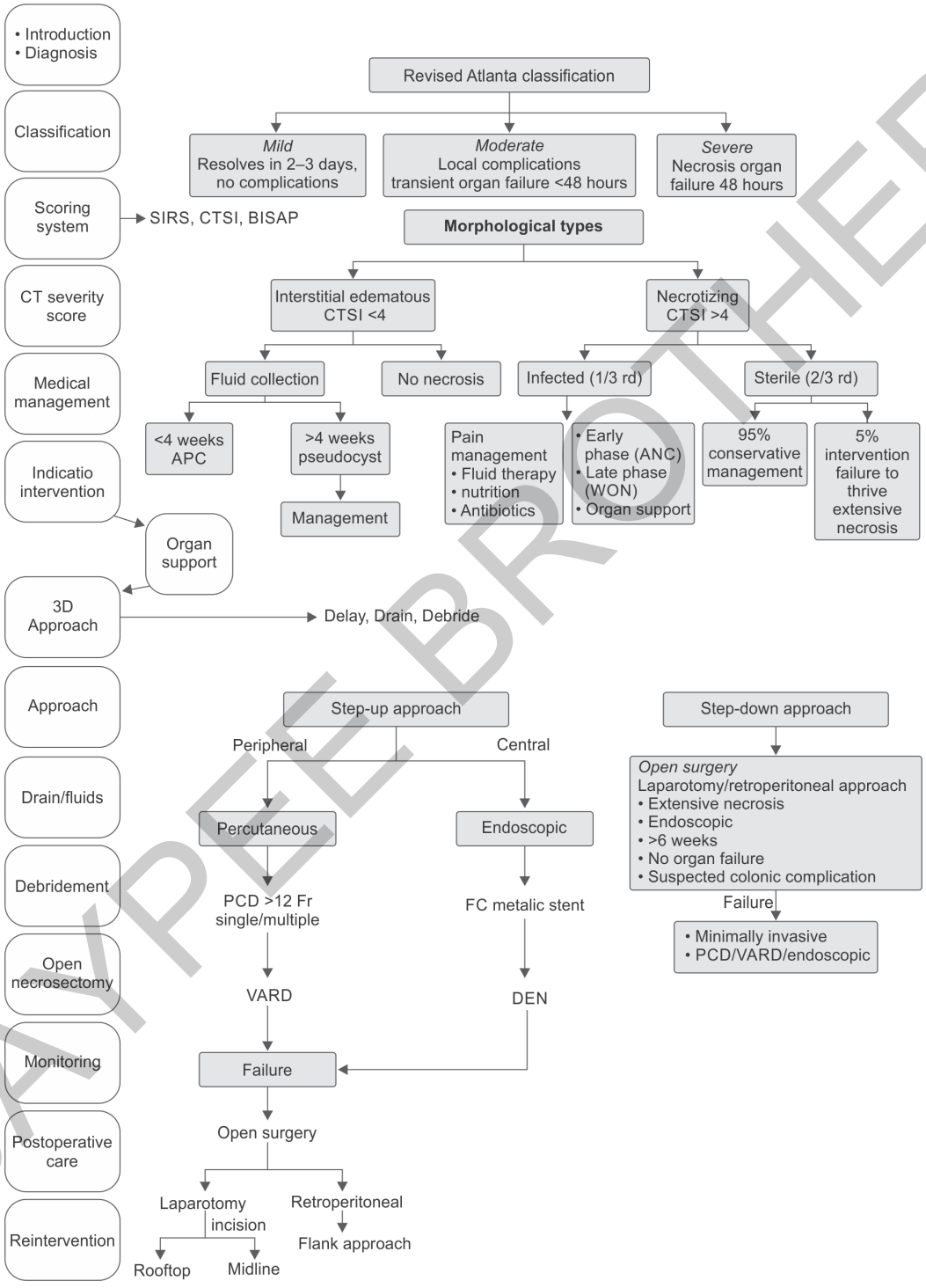
Reintervention may be needed in some patients who do not improve after interventions beyond 5–7 days and have persistent SIRS and MODS with intra-abdominal persistent sepsis. With a prior minimally invasive intervention, a laparotomy may be needed; while after a laparotomy, a minimally invasive intervention may be possible.

CONCLUSION

- Acute pancreatitis must be suspected in all acute upper abdominal or back pains, and serum amylase and/or serum lipase must be ordered.
- AP is a varied disease ranging from mild-to-severe AP, based on revised Atlanta classification.
- CECT scan of the pancreas is the most important prognostic test and should be done within 3–7 days of pancreatitis. CT severity score is useful for determining the severity of AP.
- Severity of pancreatitis is assessed by multiple scoring systems; out of which SIRS score, Marshall score, and CT severity score are most useful clinically.
- Most patients with moderate pancreatitis and many patients with sterile necrosis will be managed conservatively and will eventually recover.
- Infected pancreatic necrosis, patients with extensive sterile necrosis with complications will require invasive interventions.
- Interventions should be delayed by 3–4 weeks and even beyond wherever possible with aggressive medical management. Surgical interventions done after 4–6 weeks have better outcome.
- Step-up approach has better results and should be preferred whenever possible for intervention.
- The initial treatment in step-up approach is drainage of fluid collections either by percutaneous or endoscopic methods.
- Patients with treatment failure after percutaneous or endoscopic drainage should be considered for open

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Decision-making Pathway Algorithm



(ANC: acute necrotic collection; BISAP: bedside index for severity in acute pancreatitis; CTSI: computed tomography severity index; FC: Fully covered; PCD: percutaneous catheter drainage; SIRS: systemic inflammatory response syndrome; VARD: video-assisted retroperitoneal debridement; WON: Walled-off necrosis)

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surgical necrosectomy. Surgical decision should incorporate timing of disease process, anatomical orientations on recent CT, and individual clinical scenarios—organ failures, skill sets, and local expertise.

- It is paramount that treatment should be individualized to select optimal method of intervention at the most optimal time for a successful outcome. These patients should preferably be managed by multidisciplinary teams in specialized centers.

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Sanjiv Haribhakti MS DNB MCh is the Chairman, Department of Surgical Gastroenterology, Kaizen Hospital, Institute of Gastroenterology (GE), Ahmedabad, Gujarat, India, has an illustrious academic and professional journey marked by excellence. A passionate academician, Dr Sanjiv Haribhakti has organized over 20 conferences in Surgical Gastroenterology. His expertise has been sought as an invited Faculty at more than 100 national and 10 international medical conferences, and he has published 45 papers in indexed journals. Renowned for his surgical innovations, Dr Sanjiv Haribhakti developed the indigenous *Haribhakti's Abdominal Self-Retaining Retractor System* and the *Hammock Retractor* for scarless liver retraction. His patented inventions also include ports for transoral upper gastrointestinal (UGI) surgery, transanal surgery, single-incision laparoscopic surgery (SILS), and the video-assisted retroperitoneal debridement (VARD) port for retroperitoneal necrosectomy. As an Editor, he has enriched the medical community with the third edition of the *Textbook of Surgical Gastroenterology* and the *Textbook of Colorectal Surgery,* complemented by an Online *Video Atlas in Minimally Invasive Gastrointestinal (GI) Surgery*. His virtual initiative *Gisurgery.info*, serves as a repository of cutting-edge GI surgical techniques and patient's education resources. Beyond his surgical pursuits, he explores spiritual dimensions. He has authored a beginner-friendly guide to the teachings of the *Shreemad Bhagavad Geeta* and actively conducts online group learning sessions. Dr Sanjiv Haribhakti continues to inspire and contribute to the fields of medicine and spirituality alike.

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"Algorithms transform practice by breaking down complex problems into systematic steps, reducing cognitive biases and ensuring consistent, and evidence-based decision-making. Dr Sanjiv Haribhakti's book provides algorithm-driven guidance for managing gastrointestinal diseases, offering clear, and evidence-based pathways that improve precision and patient's outcomes. It will earn widespread acclaim and is a critical resource for surgeons."

Adarsh Chaudhary *MS FICS FRCS*

"Sanjiv Haribhakti presents a collection of insights from esteemed experts, offering a structured and algorithmic approach to understanding gastrointestinal (GI) diseases. This handbook is focused on evidence-based and algorithm-driven learning. While rooted in global practice, it emphasizes the Asian context, making it locally, regionally, and internationally valuable. Serving as an essential reference for surgeons at all stages, it consolidates current treatment practices and highlights ongoing innovations. Endorsed by the Society for Surgery of the Alimentary Tract (SSAT), this book is a significant contribution to the field."

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