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# Acute pancreatitis: Pathophysiology, diagnosis and management

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## Abstract

From modest oedema to severe pancreatic necrosis, acute pancreatitis is a prevalent cause of acute abdominal pain. Morbidity, mortality, and financial burden are all significantly impacted. Pancreatitis has a significant worldwide incidence, with central and eastern Europe having the highest rates. Acute pancreatitis is diagnosed by taking into account the patient's clinical symptoms, high blood lipase and/or amylase levels, and distinctive imaging results. Obstructive conditions such gallstones and biliary sludge, alcoholism, smoking, drug-induced pancreatitis, metabolic problems, trauma, medical operations, infections, vascular diseases, and autoimmune pancreatitis are among the causes of acute pancreatitis. Determining the severity of the illness, offering supportive care, treating the underlying cause, and avoiding complications are all part of appropriate therapy of acute pancreatitis. Death rates have decreased as a result of improvements in goal-directed therapy and the classification of acute pancreatitis severity.

**Keywords:** Acute Pancreatitis; Disease Severity; Pain Management; Therapy

## 1. Introduction

Acute pancreatitis (AP), a frequent inflammatory disease of the exocrine pancreas, has a mortality rate of 1% to 5% and is characterized by intense stomach pain and multiple organ dysfunction that can result in pancreatic necrosis and organ failure [1, 2]. In total, there are 30 to 40 instances per 100,000 people worldwide each year [2] and more than twice as much in some areas [3]. Significant short- and long-term morbidity results from acute pancreatitis and in a sizable minority leads to recurrent illness, chronic debility, and pancreatic exocrine and/or endocrine insufficiency. Chronic pain can have a major, but sometimes disregarded, influence on quality of life, and extended hospital stays can have socioeconomic repercussions [4].

### 1.1. Epidemiology

Every year, there are roughly 5 to 80 occurrences of acute pancreatitis for every 100,000 persons [5]. Hospitalizations and expenses associated with acute pancreatitis grew substantially between 2001 and 2014, most likely as a result of an aging population, gallstone-related illnesses, and an increased prevalence of obesity [6].

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### 1.2. Causes of acute pancreatitis

**Table 1** Causes of acute pancreatitis [7-13]

| SL. No. | MORE COMMON | UNCOMMON |
|---|---|---|
| 1. | Choledocholithiasis (38% to 70%) | Abnormalities of the pancreas: annular pancreas, pancreas divisum, sphincter of Oddi dysfunction |
| 2. | Chronic alcohol use (25% to 41%) | Autoimmune disorders |
| 3. | Hypertriglyceridemia (10%) | Genetic factors: variation in CFTR, CTRC, PRSS1, SPINK1, or CASR gene |
| 4. | Endoscopic retrograde cholangiopan - creatography (4%) | Hypercalcemia: excessive vitamin D supplementation, hyperparathyroidism, total parenteral nutrition |
| 5. | Pancreatic ductal carcinoma (1% to 4%) | Infections: viral, bacterial, fungal, parasitic |
| 6. | Medication use (<2%): aminosalicylates, anti-convulsants, antimicrobials, hormone therapy, oral contraceptives, loop diuretics, nonsteroidal anti-inflammatory drugs, opiates, reverse transcriptase inhibitors, steroids, Glucagon - like peptide 1 antagonists | Surgical procedures and trauma<br>Toxins: scorpion and snake bites<br>Vascular abnormalities: ischemia, vasculitis |

### 1.3. Determination of disease severity

Determining the severity of the condition accurately helps, prevent delays in the right kind of care. While only a tiny proportion of individuals have severe AP upon presentation, a patient with mild AP at first may quickly decompensate and develop severe AP. In AP, there are two primary classification schemes used to assess the severity of the disease.

**Table 2** Revised Atlanta Classification and Determinant Based Classification [14].

| Revised Atlanta Classification | Determinant Based Classification System |
|---|---|
| Mild AP:<br>No local or systemic complications<br>No organ failure | Mild AP:<br>No local complications<br>No organ failure |
| Moderately severe AP:<br>Local or systemic complications without persistent organ failure and/or transient organ failure (<48 h) | Moderate AP:<br>Sterile local complications and/or transient organ failure (<48 h) |
| Severe AP:<br>Persistent organ failure (>48 h) | Severe AP:<br>Infected local complications or persistent organ failure (>48 h) |
| | Critical AP:<br>Infected local complications and persistent organ failure (>48 h) |

## 2. Pathophysiology

According to recent research, AP develops across three stages. Acinar cell damage and the activation of intrapancreatic digesting enzymes like trypsin are characteristics of the first phase. It seems that lysosomal hydrolases, including

cathepsin B, which colocalize with digestive enzymes in intracellular organelles, are responsible for trypsin activation. Currently, trypsin activation is thought to result in acinar cell damage [15].

The activation, chemoattraction, sequestration of leukocytes and macrophages in the pancreas, which leads to an intensified inflammatory response, characterize the second phase [16]. Additionally, neutrophils are essential in mediating inflammation and damage to pancreatic tissue [17]. Preclinical evidence has shown that neutrophil depletion brought on by earlier antineutrophil serum injection reduced the severity of AP [18]. During the beginning of AP, trypsinogen activation may be the primary cause of neutrophil infiltration in the pancreas, and trypsinogen activation is further regulated by active neutrophils. Interestingly, as reported by Abdulla et al. [19], Trypsinogen is dynamically activated by intrapancreatic acinar cells, with an early neutrophil - independent phase and a late neutrophil - dependent phase. Additionally, a number of studies have linked platelet-activating factor (PAF) to the systemic inflammatory process of AP. As demonstrated by Wang et al. [20], platelet distribution width (PDW), a serum platelet index, may be a possible predictor of persistent organ failure (POF) in acute pancreatitis; individuals at risk for POF have greater serum PDW values at admission.

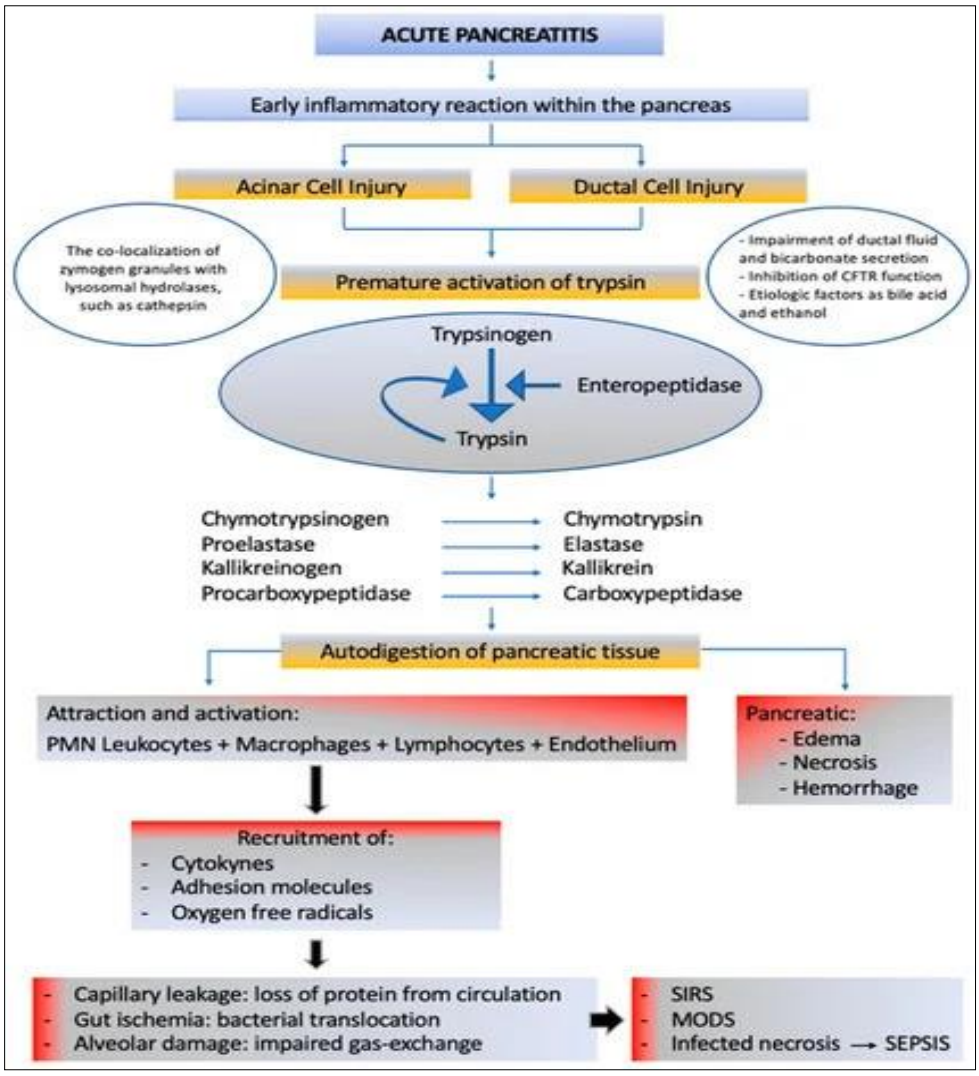


**Figure 1** A schematic overview of acute pancreatitis pathogenesis [24].

Extra pancreatic inflammation is a hallmark of the third stage of AP. When cytokines are released locally, activated granulocytes and macrophages sequester to the pancreas. Moreover, the immune cells release cytokines such as interleukin-1 (IL-1), IL-6, and tumor necrosis factor-alpha (TNF-α), which activate Kupffer cells in the liver and raise blood cytokine levels. Acute respiratory distress syndrome, multiorgan failure, and SIRS are examples of distant organ damage brought on by this. Enzymes like as phospholipase and elastase are also activated by activated proteolytic

enzymes, particularly trypsin. Following their breakdown of cellular membranes, the active enzymes and cytokines result in vascular damage, fat necrosis, parenchymal cell necrosis, edema, interstitial hemorrhage, and proteolysis [21].

Pancreatic autodigestion and parenchyma degradation result from the intracellular activation of pancreatic proenzymes. According to recent research, AP may be caused by lysosomal dysfunction-induced autophagy impairment, which can result in trypsin and vacuole accumulation in acinar cells, necrosis, and inflammation. Studies have also emphasized the significance of NF-κB, a ubiquitous nuclear transcription factor that mediates the expression of several genes involved in inflammation and may influence the early stages of AP. NF-κB triggers the release of cytokines from the pancreas and circulating immune cells after pancreatic acinar cell damage. These cytokines also cause surrounding immune cells to activate NF-κB, which in turn causes systemic inflammation [22].

A significant part of the pathophysiology of AP is also played by genetic alterations. Chymotrypsinogen C (CTRC), cystic fibrosis transmembrane conductance regulator (CFTR), calcium-sensing receptor (CASR), cationic trypsinogen (PRSS1), anionic trypsinogen (PRSS2), and serine protease inhibitor Kazal type 1 (SPINK1) have all been linked to an increased risk of AP. These genetic variables may impact the development of AP by blocking active trypsin in the pancreas or preventing trypsinogen from activating. According to studies, people with AP have these altered genes [23]. The impact of these genetic variants on the pathophysiology and/or severity of the disease may be better understood with additional analysis.

### 2.1. Diagnosis

Serum lipase or amylase levels at least three times above the upper limit of normal, abdominal pain consistent with AP, and distinctive AP features on cross-sectional imaging (computed tomography [CT] or magnetic resonance imaging [MRI]) are the three criteria that are used to diagnose AP. Every national and international society has approved these diagnostic standards. When using these criteria, there are a few important things to keep in mind. While AP is characterized by severe epigastric pain radiating to the back, patients' pain varies in intensity, location, and radiation. Lipase has a longer half-life and is recommended for patients who appear later after the beginning of pain, even though both lipase and amylase are employed in the diagnosis of AP [25]. Elevations of lipase and amylase can have a variety of gastrointestinal and non-gastrointestinal causes.

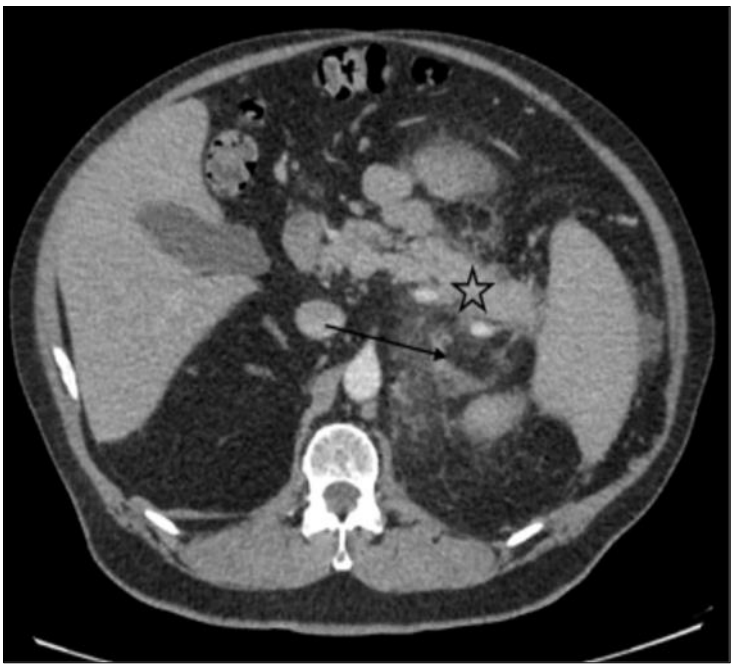

**Figure 2** A CT image of milder or interstitial pancreatitis. The pancreas (star) opacifies with intravenous contrast, so it is not necrotic. The arrow delineates peripancreatic fluid and inflammation.

Although it is not necessary, cross-sectional imaging (CT or MRI) is the most accurate way to diagnose AP and can reveal the extent of pancreatic and peri-pancreatic necrosis (Figures 2 and 3). The degree of necrosis may be overestimated

upon presentation because the imaging characteristics that determine severity might not be completely visible. For stable patients with a clear diagnosis, an early diagnostic CT scan is not necessary. Nonetheless, cross-sectional imaging is frequently carried out and is especially crucial in cases where there is doubt in the diagnosis [26].

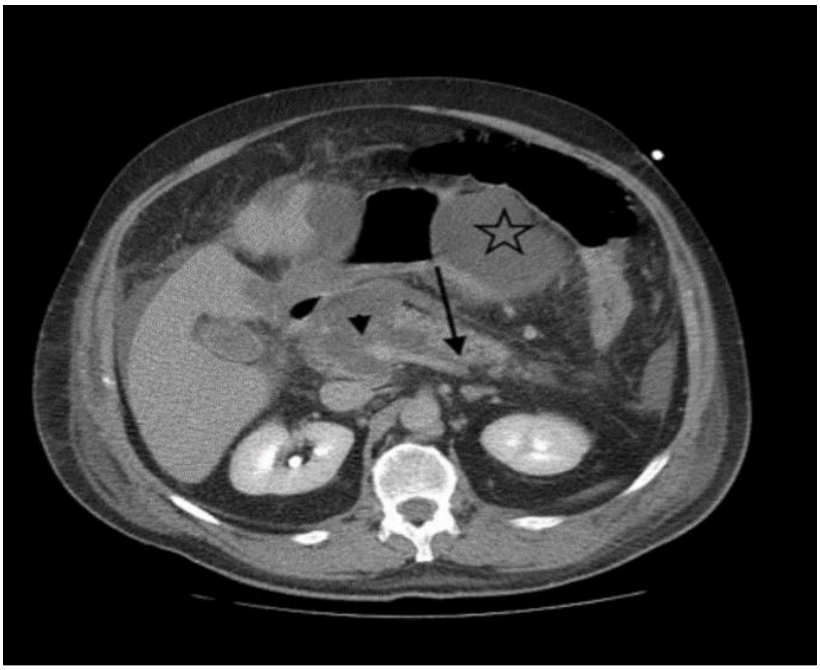

**Figure 3** A CT of NP. The pancreas in the tail of the gland (long arrow) still opacifies with intravenous contrast, whereas the gland in the head (short arrow) does not, indicating necrosis. Several fluid collections are also present on the scan (star)

### 2.2. Management

Aggressive early intravenous hydration, proper nutrition, required therapies, and pain management are the hallmarks of AP care. We go over the newest and most effective AP therapy methods below.

#### *2.2.1. Pain management*

In the treatment of AP, pain control is still crucial. Uncontrolled pain can worsen results by causing hemodynamic instability. The first-choice painkiller for AP patients is still opioids. Recent research comparing various opioids and delivery routes revealed no differences in the likelihood of adverse events or pancreatitis-related complications [27].

#### *2.2.2. Role of antibiotics*

Prophylactic antibiotics have no place in the treatment of AP patients. According to recent research, people with inflamed pancreatitis do benefit greatly from antibiotics demonstrated no correlation between the start of antibiotic treatment in AP and serious consequences as death, necrosis, or organ failure [28].

The patient should be evaluated for infected necrosis if they do not improve within a week. A CT scan guidance fine-needle aspiration for gram stain or the presence of gas on the CT scan should be obtained as soon as possible to evaluate this [29]. The following frequent pathogens should be effectively treated empirically in these patients: Streptococcus faecalis, Staphylococcus aureus, Bacteroides species, Enterobacter species, Klebsiella species, Escherichia coli, and Staphylococcus epidermidis [29]. Carbapenems, quinolones, and metronidazole are all suitable antibiotic options because they are known to target these bacteria and penetrate pancreatic necrosis. For these patients, regular antifungal use is not advised. Antibiotics may help, avoid the need for surgical necrosectomy and should be started early in patients with infected pancreatitis. Poor results for these patients could arise from postponing intervention [30].

#### *2.2.3. Nutrition*

As contrast to complete parenteral nutrition, enteral feeding by nasogastric/nasojejunal channels should be evaluated early in patients who are incapable of eating [31]. When comparing nasogastric and nasojejunal feeding, no differences in results have been seen.

#### *2.2.4. Surgery*

Indications for surgical intervention include the presence of gallstones in the gallbladder or biliary tree, infected necrosis preferably for more than 4 weeks after antibiotics if stable, and necrosectomy in symptomatic patients [32].

#### *2.2.5. Alcohol cessation*

Alcohol cessation counseling should be provided to all patients admitted with AP [32]. Alcohol cessation counseling at the time of AP reduces the incidence of recurrent AP over a 2-year period, according to a single randomized controlled experiment [33].

#### *2.2.6. Fluid resuscitation*

The current recommendations for fluid resuscitation in AP management are changing. There is still agreement regarding the necessity and significance of intensive early fluid resuscitation in spite of these developments. It has been demonstrated that early goal-directed fluid resuscitation lowers mortality in individuals suffering from severe sepsis. However, it has been found that giving too much liquids has severe effects 24 hours later. We recommend that the requirement for vigorous fluid resuscitation be assessed six and twenty-four hours after admission, and that the fluid rate be modified in response to variations in respiratory status, mean arterial pressure, urine output, and BUN. Two recent studies demonstrated the value of aggressive intravenous fluids in accelerating the clinical recovery of AP patients. They also found that large volume fluid resuscitation within the first 24 hours of severe AP is linked to a lower death rate [34].

#### *2.2.7. Endoscopy*

Patients with AP who also have cholangitis or biliary blockage should have endoscopic intervention. Persistent choledocholithiasis can develop obstructive and cause obstruction of the pancreas or biliary tree in a small proportion of patients. Eventually, this will result in severe AP, which may be exacerbated by cholangitis. According to guidelines, cholangitis patients should get an ERCP within 24 hours of being admitted. According to earlier studies, individuals who underwent ERCP within 24 hours experienced less problems than those who received conservative care. Furthermore, it has been demonstrated that patients with AP complicated by biliary sepsis or cholangitis who have early ERCP have reduced rates of morbidity and mortality [35].

## 3. Conclusion

Gallstones and alcohol use are the most prevalent causes. Morbidity, mortality, and the use of healthcare resources are all significantly impacted. From moderate illness to severe illness with systemic implications, there are many different types of sickness. Aggressive early fluid resuscitation, suitable nutritional supplementation, and problem-solving are the cornerstones of theory.

## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest

## References

[1] Sohail Z, Shaikh H, Iqbal N, Parkash O. Acute pancreatitis: A narrative review. J Pak Med Assoc. 2024 May; 74(5): 953-958. doi: 10.47391/JPMA.9280. PMID: 38783446.

[2] Petrov MS, Yadav D. Global epidemiology and holistic prevention of pancreatitis. Nat Rev Gastroenterol Hepatol. 2019 Mar; 16(3): 175-184. doi: 10.1038/s41575-018-0087-5. PMID: 30482911; PMCID: PMC6597260.

[3] Iannuzzi JP, King JA, Leong JH, Quan J, Windsor JW, Tanyingoh D, Coward S, Forbes N, Heitman SJ, Shaheen AA, Swain M, Buie M, Underwood FE, Kaplan GG. Global Incidence of Acute Pancreatitis Is Increasing Over Time: A Systematic Review and Meta-Analysis. Gastroenterology. 2022 Jan; 162(1): 122-134. doi: 10.1053/j.gastro.2021.09.043. Epub 2021 Sep 25. PMID: 34571026.

[4] Szatmary P, Grammatikopoulos T, Cai W, Huang W, Mukherjee R, Halloran C, Beyer G, Sutton R. Acute Pancreatitis: Diagnosis and Treatment. Drugs. 2022 Aug; 82(12): 1251-1276. doi: 10.1007/s40265-022-01766-4. Epub 2022 Sep 8. PMID: 36074322; PMCID: PMC9454414.

[5] Garg SK, Sarvepalli S, Campbell JP, Obaitan I, Singh D, Bazerbachi F, Singh R, Sanaka MR. Incidence, Admission Rates, and Predictors, and Economic Burden of Adult Emergency Visits for Acute Pancreatitis: Data From the National Emergency Department Sample, 2006 to 2012. J Clin Gastroenterol. 2019 Mar; 53(3): 220-225. doi: 10.1097/MCG.0000000000001030. PMID: 29629907.

[6] Rakesh Premkumar, Anthony R.J. Phillips, Maxim S. Petrov, John A. Windsor, The clinical relevance of obesity in acute pancreatitis: Targeted systematic reviews, Pancreatology, 2015, Volume 15, Issue 1, Pages 25-33, ISSN 1424-3903, https://doi.org/10.1016/j.pan.2014.10.007.

[7] Wang GJ, Gao CF, Wei D, Wang C, Ding SQ. Acute pancreatitis: etiology and common pathogenesis. World J Gastroenterol. 2009 Mar 28; 15(12): 1427-30. doi: 10.3748/wjg.15.1427. PMID: 19322914; PMCID: PMC2665136.

[8] Waller A, Long B, Koyfman A, Gottlieb M. Acute Pancreatitis: Updates for Emergency Clinicians. J Emerg Med. 2018 Dec; 55(6): 769-779. doi: 10.1016/j.jemermed.2018.08.009. Epub 2018 Sep 26. PMID: 30268599.

[9] de Pretis N, Amodio A, Frulloni L. Hypertriglyceridemic pancreatitis: Epidemiology, pathophysiology and clinical management. United European Gastroenterol J. 2018 Jun; 6(5): 649-655. doi: 10.1177/2050640618755002. Epub 2018 Jan 22. PMID: 30083325; PMCID: PMC6068776.

[10] Gerhardt RT, Nelson BK, Keenan S, Kernan L, MacKersie A, Lane MS. Derivation of a clinical guideline for the assessment of nonspecific abdominal pain: the Guideline for Abdominal Pain in the ED Setting (GAPEDS) Phase 1 Study. Am J Emerg Med. 2005 Oct; 23(6): 709-17. doi: 10.1016/j.ajem.2005.01.010. PMID: 16182976.

[11] Weissman S, Aziz M, Perumpail RB, Mehta TI, Patel R, Tabibian JH. Ever-increasing diversity of drug-induced pancreatitis. World J Gastroenterol. 2020 Jun 14;26(22):2902-2915. doi: 10.3748/wjg.v26.i22.2902. PMID: 32587438; PMCID: PMC7304112.

[12] Minato Y, Kamisawa T, Tabata T, Hara S, Kuruma S, Chiba K, Kuwata G, Fujiwara T, Egashira H, Koizumi K, Saito I, Endo Y, Koizumi S, Fujiwara J, Arakawa T, Momma K, Kurata M, Honda G. Pancreatic cancer causing acute pancreatitis: a comparative study with cancer patients without pancreatitis and pancreatitis patients without cancer. J Hepatobiliary Pancreat Sci. 2013 Aug; 20(6): 628-33. doi: 10.1007/s00534-013-0598-y. PMID: 23494612.

[13] LaRusch J, Whitcomb DC. Genetics of pancreatitis. Curr Opin Gastroenterol. 2011 Sep; 27(5): 467-74. doi: 10.1097/MOG.0b013e328349e2f8. PMID: 21844754; PMCID: PMC3704192.

[14] Trikudanathan G, Yazici C, Evans Phillips A, Forsmark CE. Diagnosis and Management of Acute Pancreatitis. Gastroenterology. 2024 Sep; 167(4): 673-688. doi: 10.1053/j.gastro.2024.02.052. Epub 2024 May 15. PMID: 38759844.

[15] Hey-Hadavi J, Velisetty P, Mhatre S. Trends and recent developments in pharmacotherapy of acute pancreatitis. Postgrad Med. 2023 May; 135(4): 334-344. doi: 10.1080/00325481.2022.2136390. Epub 2022 Oct 31. PMID: 36305300.

[16] Lee WS, Huang JF, Chuang WL. Outcome assessment in acute pancreatitis patients. Kaohsiung J Med Sci. 2013 Sep; 29(9): 469-77. doi: 10.1016/j.kjms.2012.10.007. Epub 2013 Jan 12. PMID: 24018149.

[17] Yang ZW, Meng XX, Xu P. Central role of neutrophil in the pathogenesis of severe acute pancreatitis. J Cell Mol Med. 2015 Nov; 19(11): 2513-20. doi: 10.1111/jcmm.12639. Epub 2015 Aug 7. PMID: 26249268; PMCID: PMC4627557.

[18] Chen G, Xu F, Li J, Lu S. Depletion of neutrophils protects against L-arginine-induced acute pancreatitis in mice. Cell Physiol Biochem. 2015; 35(6): 2111-20. doi: 10.1159/000374017. Epub 2015 Apr 7. PMID: 25895924.

[19] Abdulla A, Awla D, Thorlacius H, Regnér S. Role of neutrophils in the activation of trypsinogen in severe acute pancreatitis. J Leukoc Biol. 2011 Nov; 90(5): 975-82. doi: 10.1189/jlb.0411195. Epub 2011 Aug 2. PMID: 21810937.

[20] Wang F, Meng Z, Li S, Zhang Y, Wu H. Platelet Distribution Width Levels Can Be a Predictor in the Diagnosis of Persistent Organ Failure in Acute Pancreatitis. Gastroenterol Res Pract. 2017; 2017: 8374215. doi: 10.1155/2017/8374215. Epub 2017 Dec 27. PMID: 29445395; PMCID: PMC5763119.

[21] Kumar Shetty BS, Naik R, S. A, Rai S, G. R, Kanch T. Acute Pancreatitis - The Current Concept in Ethiopathogenesis, Morphology and Complications [Internet]. Pancreatitis - Treatment and Complications. InTech; 2012. Available from: http://dx.doi.org/10.5772/27459.

[22] Habtezion A. Inflammation in acute and chronic pancreatitis. Curr Opin Gastroenterol. 2015 Sep;31(5):395-9. doi: 10.1097/MOG.0000000000000195. PMID: 26107390; PMCID: PMC4618697.

[23] Koziel D, Gluszek S, Kowalik A, Chlopek M, Pieciak L. Genetic mutations in SPINK1, CFTR, CTRC genes in acute pancreatitis. BMC Gastroenterol. 2015 Jun 23; 15: 70. doi: 10.1186/s12876-015-0302-6. PMID: 26100556; PMCID: PMC4476205.

[24] Banks PA, Bollen TL, Dervenis C, Gooszen HG, Johnson CD, Sarr MG, Tsiotos GG, Vege SS; Acute Pancreatitis Classification Working Group. Classification of acute pancreatitis--2012: revision of the Atlanta classification and definitions by international consensus. Gut. 2013 Jan; 62(1): 102-11. doi: 10.1136/gutjnl-2012-302779. Epub 2012 Oct 25. PMID: 23100216.

[25] Tenner S, Baillie J, DeWitt J, Vege SS; American College of Gastroenterology. American College of Gastroenterology guideline: management of acute pancreatitis. Am J Gastroenterol. 2013 Sep; 108(9): 1400-15; 1416. doi: 10.1038/ajg.2013.218. Epub 2013 Jul 30. Erratum in: Am J Gastroenterol. 2014 Feb;109(2):302. PMID: 23896955.

[26] Banks PA, Bollen TL, Dervenis C, Gooszen HG, Johnson CD, Sarr MG, Tsiotos GG, Vege SS; Acute Pancreatitis Classification Working Group. Classification of acute pancreatitis--2012: revision of the Atlanta classification and definitions by international consensus. Gut. 2013 Jan; 62(1): 102-11. doi: 10.1136/gutjnl-2012-302779. Epub 2012 Oct 25. PMID: 23100216.

[27] Basurto Ona X, Rigau Comas D, Urrútia G. Opioids for acute pancreatitis pain. Cochrane Database Syst Rev. 2013 Jul 26; 2013(7): CD009179. doi: 10.1002/14651858.CD009179.pub2. PMID: 23888429; PMCID: PMC11841764.

[28] Vege SS, DiMagno MJ, Forsmark CE, Martel M, Barkun AN. Initial Medical Treatment of Acute Pancreatitis: American Gastroenterological Association Institute Technical Review. Gastroenterology. 2018 Mar; 154(4): 1103-1139. doi: 10.1053/j.gastro.2018.01.031. Epub 2018 Feb 6. PMID: 29421596.

[29] Sainio V, Kemppainen E, Puolakkainen P, Taavitsainen M, Kivisaari L, Valtonen V, Haapiainen R, Schröder T, Kivilaakso E. Early antibiotic treatment in acute necrotising pancreatitis. Lancet. 1995 Sep 9; 346(8976): 663-7. doi: 10.1016/s0140-6736(95)92280-6. PMID: 7658819.

[30] Mouli VP, Sreenivas V, Garg PK. Efficacy of conservative treatment, without necrosectomy, for infected pancreatic necrosis: a systematic review and meta-analysis. Gastroenterology. 2013 Feb; 144(2): 333-340.e2. doi: 10.1053/j.gastro.2012.10.004. Epub 2012 Oct 12. PMID: 23063972.

[31] Banks PA, Freeman ML; Practice Parameters Committee of the American College of Gastroenterology. Practice guidelines in acute pancreatitis. Am J Gastroenterol. 2006 Oct; 101(10): 2379-400. doi: 10.1111/j.1572-0241.2006.00856.x. PMID: 17032204.

[32] Crockett SD, Wani S, Gardner TB, Falck-Ytter Y, Barkun AN; American Gastroenterological Association Institute Clinical Guidelines Committee. American Gastroenterological Association Institute Guideline on Initial Management of Acute Pancreatitis. Gastroenterology. 2018 Mar; 154(4): 1096-1101. doi: 10.1053/j.gastro.2018.01.032. Epub 2018 Feb 3. PMID: 29409760.

[33] Nordback I, Pelli H, Lappalainen-Lehto R, Järvinen S, Räty S, Sand J. The recurrence of acute alcohol-associated pancreatitis can be reduced: a randomized controlled trial. Gastroenterology. 2009 Mar;136(3):848-55. doi: 10.1053/j.gastro.2008.11.044. Epub 2008 Nov 27. PMID: 19162029.

[34] Buxbaum JL, Quezada M, Da B, Jani N, Lane C, Mwengela D, Kelly T, Jhun P, Dhanireddy K, Laine L. Early Aggressive Hydration Hastens Clinical Improvement in Mild Acute Pancreatitis. Am J Gastroenterol. 2017 May; 112(5): 797-803. doi: 10.1038/ajg.2017.40. Epub 2017 Mar 7. PMID: 28266591.

[35] Moretti A, Papi C, Aratari A, Festa V, Tanga M, Koch M, Capurso L. Is early endoscopic retrograde cholangiopancreatography useful in the management of acute biliary pancreatitis? A meta-analysis of randomized controlled trials. Dig Liver Dis. 2008 May; 40(5): 379-85. doi: 10.1016/j.dld.2007.12.001. Epub 2008 Feb 19. PMID: 18243826.