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Adverse role of aggressive fluid therapy in severe acute pancreatitis

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Abstract

Acute pancreatitis (AP) is a condition for which no specific treatment is currently available. Interventions such as early endoscopic sphincterotomy or prophylactic antibiotic therapy in severe cases have not demonstrated clear benefits in published meta-analyses. Consequently, both clinical practice guidelines and systematic reviews emphasize supportive care as the cornerstone of management, with particular focus on early and aggressive fluid resuscitation. This review aims to compile the most up-to-date evidence regarding severe acute pancreatitis, with an emphasis on accurate diagnosis and effective treatment strategies. Given the high incidence of this condition in emergency departments and its potential for significant morbidity and mortality, understanding optimal management approaches is essential to improve patient outcomes.

Keywords: Fluid Therapy; Acute Pancreatitis; Treatment; Fluids

1. Introduction

The pancreas is an abdominal organ with essential functions, including the secretion of digestive enzymes and key hormones. Anatomically, it is divided into two functional components endocrine and exocrine which correspond to its physiological roles. The endocrine pancreas, comprising less than 5% of the organ's total mass, consists of various cell types, each responsible for the secretion of specific hormones: α-cells (glucagon), β-cells (insulin), δ-cells (somatostatin), PP cells (pancreatic polypeptide), and ε-cells (ghrelin).

The exocrine pancreas is composed of acinar cells that produce pancreatic juice, which is secreted into the duodenum through the pancreatic ducts. This juice contains several digestive enzymes, some of which are initially synthesized in an inactive form. Once activated, these enzymes facilitate the breakdown of food components and enable nutrient absorption in the intestine. Conditions that impair the normal function of pancreatic enzymes, known as pancreatic insufficiency, can lead to poor fat digestion and steatorrhea (fatty stools).

Acute pancreatitis is a sudden inflammatory condition of the pancreas. In approximately 80% of cases, it remains mild and localized, without significant systemic impact or local complications. However, it is one of the most frequent gastrointestinal disorders requiring emergency evaluation. The disease is associated with systemic and metabolic disturbances caused by the release of hydrolytic enzymes, toxins, and cytokines, which can ultimately lead to multi-organ dysfunction.

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Severe acute pancreatitis is a condition with highly variable clinical presentation and is associated with significant morbidity and mortality in its more critical forms. The disease encompasses a broad clinical spectrum, ranging from mild forms accounting for approximately 80% of cases, where patients recover within a few days to severe forms (about 20% of cases), which often require prolonged hospitalization, intensive care management, and carry a mortality rate of 15–20%.

In most patients, the condition results in pancreatic edema alone. However, in around 20% of cases, the clinical course is unfavorable and may be complicated by substantial morbidity and notable mortality. Two major components contribute to poor prognosis in acute pancreatitis: local complications (such as acute fluid collections, pancreatic and peripancreatic fat necrosis) and systemic complications (including systemic inflammatory response syndrome [SIRS] and organ failure).

Given its dynamic and patient-specific nature, therapeutic approaches are often tailored according to individual clinical characteristics. Nevertheless, there remains no universally established and standardized management protocol for acute pancreatitis at a global level.

2. Materials and Methods

A comprehensive literature search was conducted for information published from 2015 onward, using databases such as PubMed, Elsevier, SciELO, UpToDate, Medline, and both national and international medical libraries. The following descriptors were used: fluid therapy and acute pancreatitis. Depending on the combination of search terms, between 5 and 15 relevant records were retrieved. Articles were reviewed in both Spanish and English, and the selection was limited by publication year, including only studies published from 2015 to the present.

3. Results

In recent years, there has been growing debate regarding whether early aggressive fluid therapy is beneficial or harmful in cases of severe sepsis. The intended goal of such an approach is to expand effective blood volume to counteract hypotension, improve peripheral and organ perfusion, and correct base deficit and elevated lactate levels [1].

However, current evidence does not support a definitive benefit of volume expansion in increasing cardiac output. Likewise, there is no conclusive data indicating that aggressive fluid therapy improves blood pressure or organ-specific perfusion [2].

Over the past decade, one of the most influential studies in the management of sepsis has been the landmark trial by Rivers et al., published in The New England Journal of Medicine, titled “Early Goal-Directed Therapy in the Treatment of Severe Sepsis and Septic Shock.” In this randomized controlled trial, patients with severe sepsis or septic shock were allocated to receive either standard care (targeting central venous pressure [CVP] ≥ 8–12 mmHg, mean arterial pressure [MAP] ≥ 65 mmHg, and urine output ≥ 0.5 mL/kg/h) or early goal-directed therapy (which added a target of central venous oxygen saturation ≥ 70%). Fluids were administered as 500 mL boluses of crystalloids every 30 minutes until achieving a CVP of 8–12 mmHg. If MAP remained below 65 mmHg, vasopressors were initiated. Vasodilators were used if MAP exceeded 90 mmHg. The study included 263 patients, and those in the goal-directed therapy group had a significantly lower mortality rate (30.5% vs. 46.5%, $p < 0.01$) [3].

The relationship between fluid administration aggressiveness and clinical outcomes remains controversial. In a retrospective study of 39 patients admitted with a hematocrit ≥ 44%, no significant differences in fluid volume were observed between those who developed interstitial versus necrotizing severe acute pancreatitis, suggesting that fluid volume alone may not be a determining factor in pancreatic necrosis. Additionally, a retrospective analysis involving 99 patients revealed that those receiving more than 4 liters of fluids within the first 24 hours experienced more respiratory complications compared to those who received lower volumes. This may reflect not only the direct effects of fluid overload but also the fact that patients with more severe acute pancreatitis—often associated with respiratory failure—tend to retain more fluids [4

In another retrospective study, fluid therapy administration was analyzed in 340 patients [5]. Those who received less than one-third of their total 72-hour fluid volume during the first day of admission had worse outcomes, including a higher incidence of systemic inflammatory response syndrome (SIRS), organ failure, and longer hospital and ICU stays. The authors suggest that these patients received relatively insufficient fluid therapy early in the disease course.

Interestingly, the total volume of fluids administered over the initial days of evolution was not associated with patient prognosis [6].

More recently, an excellent systematic review with meta-analysis was published, evaluating the most relevant studies on fluid therapy in acute pancreatitis [10]. The review included four randomized controlled trials [58], and concluded—with moderate-quality evidence that a non-aggressive fluid administration strategy was associated with lower rates of organ failure and mortality. The authors also highlighted the scarcity and inconsistent quality of studies on fluid therapy in severe acute pancreatitis [7].

4. Discussion

Intensive fluid therapy is frequently recommended in the management of severe acute pancreatitis (SAP). However, its potential impact on clinical complications and the need for surgical intervention remains controversial. Adequate hydration is a fundamental aspect of treatment, yet one of the main challenges lies in the absence of standardized terminology or protocols regarding intravenous fluid administration referred to in literature using various terms such as replacement, resuscitation, or fluid reanimation, and often described as "aggressive" or "vigorous" IV hydration. Other common descriptors include fluid therapy or fluid management [8].

Significant uncertainty persists regarding the safety and efficacy of currently recommended fluid administration strategies. Both excessive and insufficient fluid volumes have been associated with increased risk of complications [9]. Supportive care through fluid resuscitation, analgesia, and continuous monitoring remains the cornerstone of SAP treatment [10]. Early and adequate fluid resuscitation is crucial to maintain effective circulating volume and perfusion pressure, ensuring proper pancreatic microcirculation. Ideally, fluid strategies should be individualized according to body weight, height, age, and disease severity. However, no universally accepted or proven-safe protocol currently exists [11].

One common complication of aggressive hydration in SAP is fluid overload and retention [12]. Nevertheless, studies have not shown a significant association between fluid volume administered within 48 hours and mortality or systemic complications. This raises questions about the "critical volume" of fluids potentially linked to such adverse outcomes [13].

Early aggressive IV hydration particularly within the first 6 to 12 hours—appears to offer the greatest benefit, with diminishing returns beyond 24 hours. This approach is supported by moderate-quality evidence and strong clinical recommendations [14]. On the other hand, exceeding 4 liters of fluid in the first 24 hours may worsen disease progression and increase the risk of pulmonary complications. Some studies show that early aggressive hydration with lactated Ringer's solution may accelerate clinical improvement in patients with mild acute pancreatitis [15].

Patient-specific characteristics must also be considered. Individuals with renal impairment or cardiac conditions may not tolerate high-volume hydration and may require a standard rehydration approach to avoid further harm [16]. Lactated Ringer’s solution is often preferred, yet controversies persist due to the lack of consensus on optimal fluid composition, rate, and volume. Patient variability such as obesity, hypertension, or organ dysfunction further complicates fluid requirements, emphasizing the need for clear clinical protocols to guide both physicians and nursing staff [17].

Another important factor influencing fluid therapy decisions is the initial severity of the disease upon emergency admission. For this reason, most studies reviewed rely on clinical scoring systems like APACHE II, Ranson, Glasgow, BISAP, and HAPS to stratify severity. While a majority of studies favor early aggressive hydration over conservative strategies, this approach carries more potential risks, especially when applied late. In fact, in populations such as overweight or obese patients, aggressive fluid therapy may increase morbidity or lead to respiratory complications, warranting special caution [18].

5. Conclusion

Severe acute pancreatitis, as an inflammatory condition with high prevalence in emergency settings, represents a significant public health concern. Intravenous hydration is frequently emphasized as a key therapeutic intervention in its management. Therefore, it is essential to promote case analyses and clinical research focusing on the role of fluid therapy whether aggressive or standard in patients with acute pancreatitis. The goal is to define therapeutic regimens that could be safely and effectively applied to most patients meeting clinical criteria for such treatment. Based on the

current literature reviewed, it remains evident that there are more disadvantages than benefits in the current approach to managing severe acute pancreatitis, highlighting the urgent need for more robust evidence and standardized protocols.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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