Classification and Nutrition Management of Acute Pancreatitis in the Pediatric Intensive Care Unit

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ABSTRACT

The aims of this retrospective cohort study were to classify the severity of patients admitted to the pediatric intensive care unit (PICU) with acute pancreatitis (AP) and to identify how many patients received appropriate nutritional management in accordance with more recent guidelines and the outcomes of those patients. Of the 54 children with AP, 12 (22.2%) had a primary diagnosis of AP (50% severe, 17% moderate) whereas 42 (77.8%) had a secondary diagnosis of AP (81% severe, 11.9% moderate). Just under half of the patients (48.1%) had enteral nutrition commenced before the third day of admission (50% with primary AP, 47.6% with secondary AP). The average time to initiation of enteral feeds was 2.3 days for those that received enteral nutrition. 51.8% of patients received parenteral nutrition (25% with primary AP, 59.5% with secondary AP). Most patients received enteral nutrition late and parenteral nutrition was overused in patients with AP admitted to the PICU.

Key Words: enteral nutrition, mortality, pancreatitis, parenteral nutrition, pediatric intensive care unit

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What Is Known

- Current recommendations categorize the severity of pancreatitis based on the presence of organ dysfunction/failure and time of symptom resolution.
- Children with mild acute pancreatitis may benefit from early enteral nutrition

What Is New

- Half of the cases of children admitted to the pediatric intensive care unit do not meet criteria for severe acute pancreatitis.
- Adherence to enteral feeding advancement in the pediatric intensive care unit is low in cases of severe pancreatitis and the percentage of patients with pancreatitis started on parenteral nutrition is high.

Severe acute pancreatitis (AP) in children can be a serious condition associated with significant morbidity and cost. Incidence has been increasing over the last 30 years (1–3) and occurs in is roughly 13/100,000 in the United States, with an estimated 11,000 children presenting with AP annually (2,4). It is unclear if the incidence is truly increasing or if it can be attributed to improved clinical awareness amongst physicians (5–7).

Recently published guidelines from the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN) criteria has classified AP into mild, moderate, and severe (8). Mild AP typically resolves within 1 week without local or systemic involvement. Moderate AP is associated with organ dysfunction lasting less than 48 hours. Severe AP is defined by multiorgan failure lasting more than 48 hours (8).

The management of children with AP has been derived from adult guidelines with recommendations including aggressive fluid management, pain control, and initiation of early enteral nutrition (EN)—even in cases of severe pancreatitis. Until 2017, there were no pediatric guidelines and thus, management strategies prior to these guidelines had to be extrapolated from adult guidelines. The patient population in this study was evaluated between 2008 and 2012 (before the guidelines were established). Current pediatric recommendations advocate early initiation of EN in all cases of AP; parenteral nutrition (PN) may be considered in more severe cases (ileus, compartmental syndrome, fistulae) after 5 to 7 days, if EN is not possible (9). In addition, PN is not recommended in most critically ill children in the first 7 days after a PICU admission (10). Again, this recommendation is new for children admitted to the PICU. Hence, our study may serve as a baseline for management of AP in the PICU before definitive pediatric guidelines and new recommendations suggesting deferral of PN in critically ill children.

A recent multicenter study demonstrated that about 1 in 200 children admitted to PICUs in the United States had AP (11). The study confirmed that severe AP is associated with significant morbidity. In that study, mortality was associated with multiorgan dysfunction and confined to children with a secondary diagnosis of AP (primary PICU admission diagnosis was not AP). That study was limited by the fact that all the data were obtained from a database and only general conclusions could be drawn about the patients. In addition, no data about patient management could be obtained (11). The aims of the present study were to further study patients with AP who were admitted to the PICU at the Children's Hospital of Wisconsin and to evaluate how many children with AP had mild, moderate, and severe AP. An additional aim was to determine if current NASPGHAN recommendations on enteral feeding advancement and EN were being followed in the PICU between 2008 and 2012—before the current pediatric guidelines.

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METHODS

This was a retrospective cohort study of patients with AP as a discharge diagnosis from a PICU admission. Data were obtained from the Virtual PICU Systems (VPS) database and through the electronic medical record (EMR) of the Children's Hospital and Health System. Institutional review board approval was obtained (IRB#: CHW 15/41).

De-identified data from 54 discharges with the diagnosis of AP were provided by the VPS and confirmed through the EMR. Patients who had acute pancreatitis were identified by ICD-codes and confirmed by chart review. Patients included were less than 18 years of age and admitted to the PICU at the Children's Hospital of Wisconsin between August 28, 2008, through November 22, 2012. Children were included if they had been admitted to the PICU and met the Atlanta classification criteria for AP (12).

Data obtained included age, race, gender, PICU length of stay, primary diagnosis, chronic medical conditions, mechanical ventilation (MV), and nutrition intake. Diagnoses are classified as primary or secondary. Primary diagnosis is the principal reason for admission to the PICU. If primary cause for admission to the PICU was something other than AP, these patients are classified with secondary acute pancreatitis. Patients who developed pancreatitis after admission to the PICU were also classified as secondary pancreatitis. If lipase or imaging was not obtained on admission but discovered later on in their admission, they were classified with secondary pancreatitis. Patients were considered to have received delayed EN if they had not received EN within 72 hours.

RESULTS

Fifty-four patients were identified with AP with 57.4% of those patients being male (n = 31) The mean age at presentation was 9 years and 10 months with 57.4% (n = 31) being Caucasian, 14.8% (n = 8) African American, 16.7% (n = 9) Hispanic, and 11.1% other.

Primary vs. Secondary Pancreatitis

Of the 54 children with AP, 22.2% (N = 12) had primary AP. The remainder (N = 42, 77.8%) had secondary AP. A variety of causes were identified for primary AP (Table 1). In addition, 11/14 patients (78.6%) were found to have underlying illnesses—some related to but others not related to their AP (Table 1). Half of the patients (N = 6) that presented with primary AP met criteria for severe AP. The remainder had mild (33%) and moderate pancreatitis (17%). Two patients with primary AP required mechanical ventilation lasting 2 and 3 days each.

In the group diagnosed with secondary AP, 81% had severe AP whereas 11.9% had moderate AP and 7.1% had mild AP. In this group, the most common primary diagnoses were sepsis/bacteremia and respiratory failure (Table 1). As expected, 34/42 (81.0%) patients had chronic illnesses either related or unrelated to their AP. Of those patients who developed secondary pancreatitis while in the PICU, 69% required mechanical ventilation for a median of 18.5 days (interquartile range [IQR]: 6.3–36.8)

For all patients, the overall hospital length of stay in days (LOS) was a median of 24.0 (IQR: 8.3–45.3) with a median PICU LOS of 11.5 (IQR: 2.0–35.0). The hospital and PICU length of stay were significantly longer in the children with secondary AP (Table 2). The data on nutrition interventions in all patients is provided in Table 2.

The most common complication in patients with severe AP was renal failure, occurring in 16.7% of patients, exclusively in those with secondary AP. Those with secondary AP had a greater incidence of shock (0% with primary AP vs 5.6% [N = 3] with secondary AP), pulmonary insufficiency (5.6% [N = 3] with primary AP vs 11.1% [N = 6] with secondary AP), and pseudocyst formation (1.9% [N = 1] with primary AP vs 5.6% [N = 3] with secondary AP). Surgical interventions occurred in 2 children (3.7%) and was limited to those with primary AP. The surgical interventions were pseudocyst drainage and emergent transhepatic cholangiogram with internal and external biliary drain placement. No patient with secondary AP required surgical intervention. Rates of gastrointestinal bleeding were 7.1% (N = 1) in those with primary AP and 1.9% (N = 1) in those with secondary AP whereas rates of infected necrosis were also 7.1% (N = 1) in those with primary and 1.9% (N = 1) in those with secondary AP (both $P = 0.4$). The overall mortality rate in all patients with pancreatitis was 18.52% with deaths occurring exclusively in patients with secondary AP (mortality rate of 23.8% within this group).

DISCUSSION

We evaluated the characteristics of 54 patients in the PICU with AP admitted to the PICU. Our results show that primary AP tends to be associated with fewer complications, shorter PICU length of stay, better compliance with feeding guidelines, and a much lower rate of mortality.

Our study reaffirms findings from other studies showing that pediatric mortality from primary severe AP is rare. Bai et al evaluated mortality rates from AP in children and reported a mortality rate between 0% and 21% as a result of multisystem organ failure (4,13). Fewer organ systems were compromised in the patients with primary severe AP—leading to improved outcomes and early feeding advancement. In our study, renal failure occurred exclusively in those with secondary AP, whereas shock, pulmonary insufficiency, and pseudocyst formation occurred more frequently in those with secondary AP). Surgical interventions, while uncommon, were, however, confined to those with primary AP. Rates of gastrointestinal bleeding and infected necrosis were the same in both groups. Finally, mortality was confined to those with secondary AP.

Recent data suggest that early initiation of EN may be beneficial in decreasing length of stay and complications associated with pancreatitis in adults and in children (9). Initiation of EN is the only treatment modality that has shown clear benefit in improving the outcome and length of stay in patients with severe AP by maintaining the mucosal border, preserving the microbiota, and possibly preventing bacterial translocation (14). Adult studies have also showed fewer infectious complications with early EN if initiated within 24 and 72 hours of admission with AP (15,16). Recent NASPGHAN guidelines also recommend that in the absence of ileus, fistulae, or abdominal compartment syndrome, enteral feeds should be started as soon as possible (9).

Secondary AP in the ICU is associated with higher morbidity and mortality when compared with primary pancreatitis. In our study, the mortality occurring exclusively in patients with secondary AP can be attributed to multisystemic disease. Our previous study showed that patients with secondary AP had higher severity of illness scores than patient with primary AP (11). Delayed EN with the majority receiving PN in this patient population with secondary AP is probably due to the higher severity of illness where providers may be reluctant to commence enteral feeds. It is unclear if earlier enteral feeding advancement would have averted poorer outcomes. There is, however, fairly strong evidence that PN should not be used early in most PICU patients (10) and data associating early EN in most patients being associated with better outcomes (17,18). There are also data suggesting that early EN and aggressive fluid resuscitation improve outcomes in pediatric AP (19).

TABLE 1. Diagnoses associated primary and secondary acute pancreatitis

Primary acute pancreatitis (n = 12)		Secondary acute pancreatitis (n = 42)		
Cause of acute pancreatitis	Other chronic disease present in these patients	Primary diagnostic category (n)	Individual diagnoses in each category (n)	Other diseases present in these patients
Post-ERCP (1)	Down syndrome with congenital heart disease	Infectious disease (10)	Bacteremia and fungemia (4)	Complex congenital heart disease (10)
Drug-induced (L-asparaginase) (1)	Acute lymphoblastic leukemia		Sepsis (3)	
? Viral (1)	Developmental delay; cerebral palsy; seizure disorder		Ruptured appendicitis (1)	Acute lymphoblastic leukemia (4)
Hypertriglyceridemia (1)	Lipoprotein lipase deficiency		Cellulitis (1)	
Post-colectomy for ulcerative colitis (1)	Down syndrome		Fever (1)	Post bone marrow transplantation (4)
Idiopathic (1)	Only 3 children otherwise completely healthy	Respiratory (8)	Respiratory failure (6)	Type 1 diabetes mellitus (4)
Pancreatitis was initial presentation of:			Respiratory insufficiency (2)	
Systematic lupus erythematosus (1)		Cardiovascular (6)	Cardiac arrest (1)	Cerebral palsy/global developmental delay (3)
Henoch-Schőnlein purpura (1)			Shock (1)	
Gallstones (1)			Heart failure (1)	
Choledochal cyst, gallstones (1)			Postcompleted aortic replacement (1)	Suspected or confirmed mitochondrial disorder (3)
Primary sclerosing cholangitis (1)			Hypoplastic left heart syndrome (1)	
Associated with osteomyelitis (1)			Hypertensive crisis (1)	T-cell lymphoma (1)
		Injury/poisoning (5)	Motor vehicle accident (2)	Gastrointestinal dysmotility (1)
			Traumatic brain injury (2)	
			Toxic ingestion (1)	Bronchial asthma (1)
		Endocrinologic (4)	Diabetic ketoacidosis (4)	Mixed connective tissue disease (1)
		Neurologic (3)	Seizure (2)	Severe pulmonary hypertension (1)
			Exacerbation of movement disorder (1)	
		Gastrointestinal (3)	Gastrointestinal bleeding (2)	Only 8 children otherwise completely healthy
			Acute liver failure (1)	
		Renal (2)	Hemolytic uremic syndrome (1)	
			Nephrotic syndrome with sepsis (1)	
		Rheumatologic (1)	Systemic lupus erythematosus (1)	

ERCP = endoscopic retrograde cholangio-pancreaticography.
The numbers do not always add up to the total numbers as some chronic diseases are reflected in the primary diagnosis.

TABLE 2. Length of stay and nutrition interventions: comparison between primary and secondary acute pancreatitis

	Primary pancreatitis	Secondary pancreatitis	*P*
Hospital LOS in days (median, IQR)	9.0 (6.8–15.3)	32.0 (12.8–59.5)	0.03*
PICU LOS in days (median, IQR)	2.0 (1.0–3.5)	23.0 (4.3–43.3)	0.03*
NPO time in days (median, IQR)	2.0 (0.9–3.0)	2.5 (0.5–7.0)	0.28*
Commencement of enteral nutrition in days (median, IQR)	2.5 (1.8–3.3)	1.5 (0.8–3.3)	0.34*
Number (%) started on enteral nutrition (oral, nasogastric, nasojejunal feeds) before day 3 of admission	6 (50%) (1 fed at the time of diagnosis)	20 (47.6%) (7 fed at the time of diagnosis)	
Number started on parenteral nutrition during the first week of admission	Day 1: 1	Day 1: 16	
	Day 2: 1	Day 2: 2	
	Day 3: 1	Day 3: 1	
		Day 4: 3	
		Day 5: 2	
		Day 6: 1	
Number (%) given nasogastric feeds in the first week	2 (16.7)	2 (4.8)	
Day on which nasogastric feeds were commenced	Day 0: 1	Day 0: 1	
	Day 1: 1	Day 1: 1	
Number (%) given nasojejunal feeds in the first week	5 (41.7)	7 (16.7)	
Day on which nasojejunal feeds were started	Day 1: 1	Day 1: 1	
	Day 2: 1	Day 2: 4	
	Day 3: 2	Day 4: 2	
	Day 5: 1		
Number (%) eating/allowed to eat by mouth at the time of diagnosis	1 (8.3)	6 (14.3)	
Number started on oral feeds during the first week of admission	Day 0: 1	Day 0: 4	
	Day 1: 1	Day 1: 3	
	Day 2: 2	Day 3: 1	
	Day 4: 1	Day 4: 2	
Number (%) NPO for 7 days	0 (0)	12 (28.6)	
Number (%) on Parenteral Nutrition	3 (25)	25 (59.5)	

NPO = nil per os; LOS = length of stay; IQR = interquartile range.
NPO time was calculated for all patients while average day of advancement was just for the patients who were commenced on enteral feeds.
*t test.

Limitations of this study include small sample size and not capturing all patients with AP as pain may not have been recognized and laboratory studies and/or radiographic imaging not being ordered. Depending on when investigations were done patients with primary AP may have been erroneously classified as having secondary AP. Another limitation is that our study examines a time when the present pediatric recommendations for EN were not yet extant. Before the presence of pediatric guidelines, adult guidelines dating back to 2006, however, recommended the use of EN over PN and pediatric providers mostly followed adult guidelines because of the lack of studies and guidelines in children (20,21).

Two important things have changed since these patients were in the PICU. First, we now have pediatric guidelines on the management of AP and secondly, we have PICU guidelines that emphasize enteral nutrition (EN) over PN overall. Gradually, most PICUs have developed EN protocols and are switching over to an enteral-nutrition-first approach for most patients. It is vital that patients with AP also be managed using the EN protocols. Future research considerations would involve evaluation of a larger multicenter cohort admitted with AP after initiation of the guidelines to ensure that these patients are being optimally managed.

In conclusion, only half the patients admitted to the PICU with primary AP had severe AP while 80% with secondary AP had severe AP. In this single-PICU study, nutrition recommendations for AP were not followed with patients more likely to receive early PN and delayed EN.

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