

ACUTE PANCREATITIS

ALGORITHM

¹ Diagnosis of Acute Pancreatitis
if 2 of 3 criteria are met:

- Abdominal pain
- Serum lipase or amylase greater than or equal to 3 times upper limit of normal
- Imaging findings consistent with pancreatitis

Inclusion Criteria

- Patients greater than 6 months old, with diagnosis of acute pancreatitis¹

Exclusion Criteria

- Patients less than 6 months old
- Patients who develop acute pancreatitis during hospitalization for another cause

Patient diagnosed with acute pancreatitis¹

Begin simultaneously

Initial Pain / Nausea Management

- Goal: adequate pain / nausea control
- If mild pain and tolerating oral medication, can use sliding scale PO acetaminophen, PO oxycodone, IV morphine
- Use IV anti-emetics as needed

Initial Fluid Management

- Goal: Intravascular Euolemia (*refer to page 3*)
- 20 mg/kg (max 1L) bolus of Lactated Ringers, reassess fluid status, repeat as necessary

Continued Fluid Management

- Goal: Intravascular Euolemia
- After bolus(es), start lactated ringers at 1.5X maintenance (max 150 mL/hr)

Evaluate for Etiology

- Labs: CMP, CBC, triglycerides
- Imaging: Abdominal ultrasound (repeat if done at outside facility)
- If CT or MRI available from outside facility, upload to EPIC for over read instead of repeating ultrasound
- If history of trauma, discuss need for cross sectional imaging with Surgery and/or GI
- Consult GI and discuss if additional tests are needed

!
 Need for ICU is uncommon in pediatric pancreatitis, but discuss disposition with PICU and floor team if signs of severe pancreatitis

Is pain controlled?

Secondary Pain Management

- Goal: adequate pain control
- Use a low threshold for IV morphine or hydromorphone
- Use a low threshold for patient controlled anesthesia pump (PCA)
- If inadequate pain control, consult acute pain service

Does patient:

- Have persistent hypotension/ tachycardia after 40 ml/kg fluid resuscitation?
- Have progressive worsening respiratory distress/ hypoxia

Is ICU considered appropriate after discussion with PICU and/or Floor team?

Admit to ICU
(refer to page 6)

- Management per ICU with GI consult and/or surgical consult
- Early enteral nutrition if possible (*refer to Clinical Pathway, Nutrition for Patients with Acute Pancreatitis*)

² Pediatric Pancreas Center Follow Up:

- Email patient information to pancreascenter@childrenscolorado.org, and/or consult with GI fellow or GI attending.
- Typical timeframe is approximately 1 month.

Does patient have a biliary obstruction or pancreatic leak as determined by imaging?

Admit to Surgery Service
(refer to page 6)

- Fluid management
- Pain control
- GI consult for potential Endoscopic Retrograde Cholangiopancreatography
- Cholecystectomy prior to discharge and/or Intraoperative Cholangiogram for gallstone pancreatitis

Does patient:

- Have mild symptoms controlled with oral medications?
- Tolerate oral intake?
- Appear otherwise stable?

Discharge patient home with return precautions. Primary Care follow up in 2-4 days

Admit to Green Team (Anschutz) or General Medical Floor (COS)
(unless special circumstances³)

- Regular diet (*refer to Clinical Pathway, Nutrition for Patients with Acute Pancreatitis*)
- Fluid management
 - Lactated Ringers at 1.5X maintenance for 24-48 hours (max 150 mL/hr)
 - Monitor fluid status Q4H (heart rate, blood pressure, urine output greater than or equal to 1 mL/kg/hr)
 - Renal Function Panel at least daily until off intravenous fluids
 - Once euolemia achieved (*refer to page 3*), adjust fluid rate to maintain and account for oral intake
- Pain / Nausea control
 - If mild pain and tolerating oral medication, can use sliding scale PO acetaminophen, PO oxycodone, IV morphine
 - Use a low threshold for IV morphine or hydromorphone
 - Use IV anti-emetics as needed
 - Use a low threshold for patient controlled anesthesia pump (PCA)
 - If inadequate pain control in 24 hours, consult acute pain service
- Complete etiologic workup
- Follow up in Pediatric Pancreas Center² and with Primary Care

³ Special Circumstances:

- Kaiser Insurance – discuss with Kaiser hospitalist first
- Active malignancy – Discuss with Oncology
- Active multisystem diseases – Discuss with GI fellow
- If not admitted to Green Team, consult GI fellow

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TARGET POPULATION

Inclusion Criteria

Patients greater than 6 months of age with diagnosis of acute pancreatitis: i.e. if 2 of 3 criteria are met:

- Abdominal pain
- Serum lipase or amylase greater than or equal to 3 times upper limit of normal
- Imaging findings consistent with pancreatitis

Exclusion Criteria

- Patients who develop acute pancreatitis during hospitalization for another cause.
- Patients less than 6 months old.

BACKGROUND | DEFINITIONS

Definition

Acute Pancreatitis: Condition diagnosed by meeting two of the following three elements: clinical symptoms such as abdominal pain, nausea/vomiting, or radiating back pain; serum levels of pancreatic amylase and/or lipase three times the upper limit of normal; and radiographic evidence of acute pancreatitis including pancreatic edema on ultrasound or computed tomography¹.

Background

Major considerations for management of acute pancreatitis are adequate fluid resuscitation, pain control, early enteral nutrition, evaluation for common etiologies, and monitoring/management of complications. Most cases of acute pancreatitis in children are mild, meaning little to no involvement of other organ systems, but there are some cases of severe pancreatitis which can lead to respiratory, renal, and circulatory compromise, as well as sequelae such as abdominal fluid collections and pancreatogenic diabetes type 3c.

Optimal management of pediatric pancreatitis is an area of ongoing research, but several paradigms of management have been found to be unnecessary or harmful, such as prolonged gut rest or avoidance of certain types of opioid medications². Standardization of initial management using best available evidence is an important step to improve patient care.

INITIAL EVALUATION

Once the diagnosis of acute pancreatitis has been made, next management steps should focus on:

Pain Control

- Use a low threshold for using IV opioids (no data to support one type vs another) for severe pain including early initiation of patient controlled analgesia pump (PCA).
- Consider scheduled oral acetaminophen (unless patient meets criteria for IV acetaminophen) 15 mg/kg Q6 hours, max 1000 mg and ketorolac IV 0.5 mg/kg Q6 hours max 30mg for 48 hours.
- If mild pain and tolerating oral intake, can use sliding scale of acetaminophen, oxycodone, and IV morphine. NSAIDS can be considered as well.
- If pain is unable to be adequately controlled, recommend escalating pain control to PCA, and consulting acute pain service if pain is not controlled within 24 hours.

Fluid Rehydration

Acute pancreatitis leads to intravascular hypovolemia via decreased intake, vomiting, and 3rd spacing of fluid. IV rehydration is critical for circulatory support, and may change disease course by decreasing pancreatic tissue ischemia. Optimal fluid type and amount are not known in pediatrics, but there is limited adult data that Lactated Ringers may be beneficial compared to normal saline if used early³. Volume goal is intravascular euvolemia, knowing that some 3rd spacing may occur. Recommendations for patients outside of the ICU are:

- Lactated Ringers preferred over normal saline **for first 24-48 hours** (unless patient with hyperkalemia or < 6 months old) bolus 20 ml/kg (max 1 L), repeat if necessary.
- Fluids at 1.5X maintenance (max 150 mL/hr) and assess fluid status Q4H (HR, BP, urine output goal ≥ 1 mL/kg/hr, BUN/Cr daily or Q12 hours until normal). If this is inadequate, can repeat bolus or increase rate to 2X maintenance.
- Euvolemia: Provider has determined that the patient is at their ideal volume status (neither dehydrated, nor volume overloaded). The patient therefore requires intravenous fluids to *maintain* their ideal volume status rather than for repletion purposes
- Once euvolemia achieved, adjust fluid rate to maintain and account for enteral intake, and switch to D5 NS + 20 mEq KCl with total fluids at maintenance.

Evaluate for etiologies which will guide initial management

Reasons to consider for pediatric pancreatitis:

- Cholelithiasis and other obstructive processes
- Abdominal Trauma
- Medications (reference Figure 1: UptoDate List of Medications for Drug-Induced Acute Pancreatitis)
- Toxins, alcohol in particular
- Ductal anatomic abnormality
- Genetic
- Autoimmune
- Idiopathic

Pancreatitis caused by gallstones or pancreaticobiliary obstruction or pancreatic duct disruption will be managed differently than pancreatitis from other causes.

- Abdominal ultrasound is first line imaging test to assess for gallstones and biliary obstruction. If ultrasound was performed at an outside facility, it should be repeated at CHCO.
- If an outside CT or MRI was performed, these should be uploaded into EPIC and over read instead of a repeat ultrasound.
- Initial labs include CMP to monitor electrolytes, serum calcium, renal function, and assess for biliary obstruction, CBC for WBC, and triglycerides as a potential cause of pancreatitis

Disposition depends on clinical status

- For very mild pancreatitis (patients able to tolerate adequate oral intake and control symptoms with oral medications), home discharge from the ED with return precautions may be appropriate if the family is comfortable.
- Need for ICU is uncommon in pediatric pancreatitis, but can be considered if there are signs of multisystem dysfunction or clinical status is not suitable for the medical floor. Patients with severe pancreatitis can decompensate quickly. Respiratory compromise (progressive increased work of breathing, increasing oxygen requirement not accounted for by hypopnea from pain medication), persistent hypotension after 40 ml/kg (or 2 L) fluid resuscitation, or worsening clinical status (other than pain control) should prompt a discussion with the ICU team and the inpatient medical team for appropriate disposition.
- Patients with biliary obstruction/gallstone pancreatitis, or pancreatic duct disruption should be admitted to the surgical service.
- Typically, most patients with acute pancreatitis should be admitted to the Green Team if at Anschutz. Special considerations which may warrant admission to other teams are: Kaiser insurance (should discuss with Kaiser attending), active multi-system disease (discuss with GI fellow green vs. general medical team), or current malignancy (discuss with oncology). If the patient is at a satellite campus with inpatient services, there should be a discussion with the inpatient team if the patient is clinically appropriate for admission at that site, or if transfer to Anschutz campus is necessary.

Summary of drug-induced acute pancreatitis based on drug class

Class Ia	Class Ib	Class II	Class III	Class IV
α-methyl dopa	All-trans-retinoic acid	Acetaminophen	Alendronate	Adrenocorticotrophic hormone
Azodisalicylate	Amiodarone	Chlorothiazide	Atorvastatin	Ampicillin
Bezafibrate	Azathioprine	Clozapine	Carbamazepine	Bendroflumethiazide
Cannabis	Clomiphene	Didanosine	Captopril	Benazepril
Carbimazole	Dexamethasone	Erythromycin	Ceftriaxone	Betamethasone
Codeine	Ifosfamide	Estrogen	Chlorthalidone	Capecitabine
Cytosine	Lamivudine	L-asparaginase	Cimetidine	Cisplatin
Arabinoside	Losartan	Pegaspargase	Clarithromycin	Colchicine
Dapsone	Lynestrenol/methoxyethinylestradiol	Propofol	Cyclosporin	Cyclophosphamide
Enalapril	6-mercaptopurine	Tamoxifen	Gold	Cyproheptadine
Furosemide	Meglumine		Hydrochlorothiazide	Danazol
Isoniazid	Methimazole		Indomethacin	Diazoxide
Mesalamine	Nelfinavir		Interferon/ribavirin	Diclofenac
Metronidazole	Norethindronate/mestranol		Irbesartan	Diphenoxylate
Pentamidine	Omeprazole		Isotretinoin	Doxorubicin
Pravastatin	Premarin		Ketorolac	Ethacrynic acid
Procainamide	Trimethoprim-sulfamethazole		Lisinopril	Famciclovir
Pyritinol			Metolazone	Finasteride
Simvastatin			Metformin	5-fluorouracil
Stibogluconate			Minocycline	Fluvastatin
Sulfamethoxazole			Mirtazapine	Gemfibrozil
Sulindac			Naproxen	Interleukin-2
Tetracycline			Paclitaxel	Ketoprofen
Valproic acid			Ponatinib	Lovastatin
			Prednisone	Mefenamic acid
			Prednisolone	Nitrofurantoin
				Octreotide
				Oxyphenbutazone
				Penicillin
				Phenolphthalein
				Propoxyphene
				Ramipril
				Ranitidine
				Rifampin
				Risperidone
				Ritonavir
				Roxithromycin
				Rosuvastatin
				Sertraline
				Strychnine
				Tacrolimus
				Vigabatrin/lamotrigine
				Vincristine

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UpToDate®

Figure 1: UpToDate List of Medications for Drug-Induced Acute Pancreatitis¹⁴

CLINICAL MANAGEMENT

Management During Admission

General Management

- If there is a suspected pancreatic duct disruption, consider surgical consult.
- Cross-sectional imaging can be considered for clinical worsening such as new worsening pain unrelated to eating, new fevers, new hypotension, or new anemia (Abdominal MRI/MRCP preferred if stable and no sedation required, CT with IV contrast otherwise).
- Routine use of antibiotics has not been found to be beneficial, but can be considered on a case-by-case basis for high suspicion of infected fluid collections or infected necrotic pancreatic tissue.

ICU Management

- ICU management is primarily on case-by-case basis by ICU team with GI consultation.
- Enteral nutrition compared to parenteral nutrition has been shown to improve outcomes in multiple prospective, randomized adult studies in patients with severe acute pancreatitis (patients with necrotizing pancreatitis and/or needing ICU-level care). Studies have shown early enteral nutrition to have lower mortality⁴, lower overall⁵ and septic complications⁴⁻⁶ as well as lower cost⁶ and improved inflammatory markers⁷ in patients with severe acute pancreatitis. The benefits have been confirmed in meta-analyses as well⁸. Unless patient condition prohibits (needing pressors, unable to attain enteral access), early enteral nutrition should be strongly considered.

Surgical team management of gallstone pancreatitis

- Fluid management with goal of intravascular euvolemia
- Adequate pain control (see initial management), consult acute pain service if pain not controlled in 24 hours
- GI consult if Endoscopic Retrograde Cholangiopancreatography (ERCP) is needed or other questions. Patients may need additional imaging to assess for choledocholithiasis prior to ERCP (such as a patient with mild LFT elevation or biliary dilation without definite choledocholithiasis seen on other imaging). This is typically MRCP or endoscopic ultrasound. ERCP is only available at Anschutz campus. If ERCP is needed, transfer will be required from satellite campuses.
- Cholecystectomy prior to discharge to decrease risk of recurrent biliary pancreatitis^{9,10}

Medical team management

- Pain control (see initial management). If pain not adequately controlled within 24 hours, consult acute pain service.
- Regular diet, no role for routine fat-restricted diet or prolonged NPO. Allowing children with mild pancreatitis to advance their diets as tolerated has been associated with shorter hospitalizations without increased complications¹¹.
- IV lactated ringers at 1.5X maintenance until euvolemia achieved, then can transition to standard IV fluids (D5 NS with 20 mEq KCl) for total fluids at 1X maintenance, accounting for oral intake.
- Monitor fluid status closely (strict Is and Os, HR, BP, UOP greater than or equal to 1 mL/kg/hr).
 - Renal function panel (RFP) daily or Q12 H until patient is tolerating fluid needs enterally.
- Complete etiologic workup (family or prior history of pancreatitis, trauma, medication/substance exposures). UpToDate has a useful summary table with medications to consider and strength of evidence for associations with acute pancreatitis. Obtain a Hereditary Pancreatitis panel if family history of pancreatitis or 2 or more episodes of pancreatitis with complete resolution of symptoms and/or normal lipase between episodes.
- Consider DVT prophylaxis as patients often have limited mobility during acute pancreatitis and it is an inflammatory state. Refer to [Venous Thromboembolism \(VTE\) Prevention](#) clinical pathway.

Discharge Readiness

- Tolerating adequate oral intake.
- Pain has resolved or well controlled by oral medications.

Follow Up

There is up to a 42% rate of repeat hospitalization for children discharged after acute pancreatitis¹².

- Children with uncomplicated / mild acute pancreatitis who do not require admission can follow up through primary care office in 2-4 days. If GI follow up is desired, this can be arranged by PCP office.
- Inpatients admitted with acute pancreatitis should have follow up with primary care office within 1-2 weeks to monitor symptoms and ensure adequate hydration.
- Inpatients admitted with acute pancreatitis should also have follow up in the Pediatric Pancreas Center approximately 1 month after discharge
- Exceptions:
 - Patients outside of Denver-metro-area (reviewed case-by-case basis; could follow up with general GI provider in Colorado Springs).
 - Primary oncology / bone marrow transplant.
 - Uncomplicated Gallstone (biliary) pancreatitis s/p cholecystectomy does not require routine GI follow up.
 - If sooner access in GI is required than can be accommodated in pancreas center, then GI clinic is reasonable.

LABORATORY STUDIES | IMAGING

Imaging

- Abdominal ultrasound is first line imaging test to assess for gallstones and biliary obstruction. If ultrasound was performed at an outside facility, it should be repeated at CHCO.
- If an outside CT or MRI was performed, these should be uploaded into EPIC and over read instead of an ultrasound.
- Cross-sectional imaging can be considered for clinical worsening such as new worsening pain unrelated to eating, new fevers, new hypotension, or new anemia (Abdominal MRI/MRCP preferred if stable and no sedation required, CT with IV contrast otherwise).
- Patients may need additional imaging to assess for choledocholithiasis prior to ERCP (such as a patient with mild LFT elevation or biliary dilation without definite choledocholithiasis seen on other imaging). This is typically MRCP or endoscopic ultrasound.

Labs

- For diagnosis: serum lipase or amylase (lipase generally more reliable)
- Initial labs include CMP to monitor electrolytes, serum calcium, renal function, and assess for biliary obstruction, CBC for WBC, and triglycerides as a potential cause of pancreatitis
- Monitoring labs:
 - Daily Renal Function Panel while receiving IV fluids.
- Obtain a Hereditary Pancreatitis panel if family history of pancreatitis or 2 or more episodes of pancreatitis with complete resolution of symptoms and/or normal lipase between episodes.

THERAPEUTICS

Antibiotics

- Routine use of antibiotics has not been found to be beneficial in multiple adult studies, but can be considered on a case-by-case basis for high suspicion of infected fluid collections or infected necrotic pancreatic tissue. Consult GI before administering any antibiotics.

Pain Control

- Low threshold for using IV opioids (no data to support one type vs another) for severe pain including early initiation of patient controlled analgesia pump (PCA).
- Consider scheduled oral acetaminophen (unless patient meets criteria for IV acetaminophen) 15 mg/kg Q6 hours, max 1000 mg and ketorolac IV 0.5 mg/kg Q6 hours max 30mg for 48 hours.
- If mild pain and tolerating oral intake, can use sliding scale of acetaminophen, oxycodone, and IV morphine. NSAIDS can be considered as well.
- If pain is unable to be adequately controlled, recommend escalating pain control to PCA, and consulting acute pain service if pain is not controlled within 24 hours.

Fluid Management

- Lactated Ringers preferred over normal saline **for first 24-48 hours** (unless patient with hyperkalemia or less than 6 months old) bolus 20 ml/kg (max 1 L), repeat if necessary for initial resuscitation.
- Fluids at 1.5X maintenance (max 150 mL/hr) and assess fluid status Q4H (HR, BP, urine output goal greater than or equal to 1 mL/kg/hr, BUN/Cr daily or Q12 hours until normal). If this is inadequate, can repeat bolus or increase rate to 2X maintenance (max 200 mL/hr).
- Once euvolemia achieved, adjust fluid rate to maintain and account for enteral intake, and after 24-48 hours can switch to D5 NS with 20 mEq KCl with total fluids at maintenance.

Nutrition

- Regular diet, no role for routine fat-restricted diet or prolonged NPO. Allowing children with mild pancreatitis to advance their diets as tolerated has been associated with shorter hospitalizations without increased complications¹¹.
- Enteral nutrition compared to parenteral nutrition has been shown to improve outcomes in multiple prospective, randomized adult studies in patients with severe acute pancreatitis (patients with necrotizing pancreatitis and/or needing ICU-level care). Studies have shown early enteral nutrition to have lower mortality⁴, lower overall⁵ and septic complications⁴⁻⁶ as well as lower cost⁶ and improved inflammatory markers⁷ in patients with severe acute pancreatitis. The benefits have been confirmed in meta-analyses as well⁸. Unless patient condition prohibits (needing pressors, unable to attain enteral access), early enteral nutrition should be strongly considered.

PARENT | CAREGIVER EDUCATION

Discharge Instructions

Activity as tolerated. No need to restrict exercise or contact sports except in some cases of pancreatitis from trauma to the pancreas.

Regular Diet

Typically dietary fat restriction is not necessary. In some cases, children may feel abdominal pain and/or nausea if they eat high fat foods. In these cases, a low fat diet may help control symptoms.

Second-hand Smoke

Cigarette smoking is known to contribute to pancreatitis in adults. In children, second-hand smoke has been associated with more episodes of pancreatitis¹³. If there are members of the family who smoke, we recommend cutting back or quitting to help your child's pancreas. You can discuss ways to do this with your primary care physician or contact the Colorado quitline at www.coquitline.org or 1-800-QUIT-NOW.

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REVIEW | REVISION SCHEDULE

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