

*Emergency Radiology, 1st Nordic Course
Gothenburg, Sweden, May, 2007*

CT of Acute Ischemic Bowel Disease

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**Occlusion of the mesenteric vessels is apt to be regarded as one of those conditions of which the diagnosis is impossible, the prognosis is hopeless, and the treatment almost useless.*

*Cokkinis AJ. Mesenteric vascular occlusion.
London: Bailliere, Tindall and Cox, 1926

Today, modern imaging with CT has dramatically improved the diagnosis and treatment planning of patients with ischemic bowel disease

Acute Ischemic Bowel Disease Demographics

- Life-threatening vascular emergency
- Incidence: 1/1000 hospital admissions
- Cause of 1% of ED visits for an acute abdomen
- High mortality rate (50-90%), varying with cause and extent of ischemic bowel wall damage
- Higher mortality rate than colon cancer
- Occurs with highest frequency:
 - Elderly patients
 - Known cardiac disease (atrial fibrillation, CHF)
 - Known atherosclerotic disease

Acute Ischemic Bowel Disease Clinical Challenges

- One of the most serious acute abdominal conditions in elderly patients
- Wide range of clinical/pathological manifestations
- May involve small or large bowel, may be segmental or diffuse, or may be partial mural (only mucosa and submucosa) or transmural (necrosis all layers with bowel infarction)
- Need to differentiate cases of infarction requiring emergency surgery from those with reversible ischemia which can be treated conservatively

Acute Ischemic Bowel Disease Clinical Presentation

- Acute onset of diffuse abdominal pain
- Minimal abdominal tenderness
- Nausea and vomiting
- Sudden evacuation of the bowel
- Hematochezia or guaiac-positive stool
- Risk factors (atrial fibrillation, hypotension)

Acute Ischemic Bowel Disease

Anatomy and Physiology

- Arterial supply to bowel by celiac, superior mesenteric and inferior mesenteric arteries
- Superior and inferior mesenteric veins parallel their arteries and drain into the portal system
- Bowel receives 20% of resting cardiac output; this may increase to up to 35% after meals
- Tissue viability may be maintained even with a systemic blood pressure as low as 70mm Hg.
- However if pressure below 40mm Hg this level of hypoperfusion will result in bowel ischemia

Arterial Anatomy

- Arterial Supply
 - First part duodenum Celiac axis
 - Small bowel SMA
 - Colon SMA and IMA
 - Rectum IMA and internal iliac arteries

Acute Ischemic Bowel Disease Pathology

- Ischemic damage may result in mild/superficial necrosis of mucosa, or progress to life-threatening necrosis all bowel wall layers (transmural infarction)
- With ischemia, mucosal barrier of bowel breaks down resulting in bacterial invasion of wall, leading to systemic bacteremia and sepsis
- Bacterial invasion of the wall contributes to the development of necrosis within ischemic segments
- Ischemic complications include intestinal bleeding, perforation, abscess formation, and peritonitis

Acute Ischemic Bowel Disease Pathology

Three Stages of acute bowel ischemia:

1. Reversible Ischemic Enteritis/Colitis
 - Mucosal necrosis, erosions, hemorrhage
2. Necrosis of the Submucosal/Muscular Layers
 - May heal with fibrotic strictures
3. Transmural Bowel Wall Necrosis
 - Bowel infarction requiring immediate surgery

Causes of Acute Bowel Ischemia

- Arterial Occlusion (60-70%)
 - Mesenteric artery thrombosis, thromboembolism (atrial fibrillation), aortic/mesenteric artery dissection, atherosclerosis, aortic surgery, stent placement, fibromuscular dysplasia, vasculitis
- Venous Occlusion (5-10%)
 - Mesenteric venous thrombosis (neoplastic/inflammatory conditions), or hypercoagulability state (polycythemia, carcinomatosis, pregnancy, oral contraceptives)
- Mechanical
 - Bowel obstruction with compromise of the venous circulation
 - Bowel over-distension (pre-stenotic dilated colonic segment)
- Hypoperfusion (Low-Flow) Syndromes (20-30%)
 - Hemorrhagic, cardiogenic or septic shock
 - Cardiac failure, cardiac arrhythmia, dehydration, illegal drugs
- Other
 - Irradiation, trauma (vessel injury), neoplasms, chemotherapy
 - Vasospasm with pancreatitis, other inflammatory conditions

Acute Ischemic Bowel Disease CT Protocol

- Perform CT with IV and Oral contrast
- Rectal contrast may be required in some cases to evaluate the colon wall
- Perform two CT acquisitions:
 - Arterial phase (30 sec)
 - Parenchymal/portal venous phase (70 sec)
- Multiplanar (coronal/sagittal) reformations
- MIP/CTA of mesenteric arteries

CT Findings in Bowel Ischemia

- Bowel wall thickening
 - Mural edema, hemorrhage or superinfection
 - 26-96% of cases (94% of ischemic colitis)
- Bowel wall dilatation
 - Luminal dilatation and/or air-fluid levels
 - Interruption of intestinal peristalsis
- Stranding and ascites
 - Mesenteric fat stranding and fluid
- Bowel wall attenuation
 - Hypoattenuation due to bowel wall edema
- Abnormal enhancement
 - Often primarily involves mucosa and submucosa
- Pneumatosis and portomesenteric gas
 - Very specific sign
- Arterial or venous occlusion/thrombosis
 - Very specific sign

Ischemic Colitis

- Most common vascular disorder of intestines
- Most common cause of colitis after 50 years
- Usually self-limiting condition
- Ischemic injury may be either totally or partially reversible, does not often proceed to total infarction and gangrene
- Distribution often “watershed” colon segment

Differential Diagnosis of Colitis

Radiation colitis

Crohn colitis

Ulcerative colitis

Medication/drugs

Enemas

Laxatives

Local NSAIDs

Sulfasalazine

Penicillamine

Gold

Methyldopa

Eosinophilic gastroenteritis

Behçet's syndrome

Viral: CMV

Bacterial:

Salmonella, Shigella species

TB

Yersinia enterocolitica

Vibrio parahaemolyticus

Aeromonas hydrophila

Neisseria gonorrhoeae

Chlamydia trachomatis

Syphilis

Staphylococcus aureus

Escherichia coli

Clostridium difficile

Protozoan: Amebiasis, Schisto.

Fungal: Histoplasmosis, Candid.

CT of Acute Ischemic Bowel Disease Summary

1. CT can quickly and accurately identify findings of acute bowel ischemia
2. Most specific signs are pneumatosis of bowel wall, mesenteric and portal venous gas, SMA embolus/thrombus and SMV thrombus
3. With only findings of increased bowel wall thickness, bowel wall hyperemia, target sign or bowel wall dilatation, these should be correlated with the clinical presentation and distribution of involvement

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