



New Studies for Old Diseases

The advent of newer technology has made it easier to diagnose many abdominal disorders, but are they really all that helpful or even necessary? Should that older patient in whom you suspect mesenteric ischemia go to the operating room or to the angiography suite? Is pancreatitis a clinical, laboratory, or computed tomography (CT) diagnosis? The lecturer will discuss the indications, and contraindications, for such modalities as CT, ultrasonography, and angiography in the evaluation of aortic aneurysms, mesenteric ischemia, pancreatitis, and diverticulitis.

- List the indications and contraindications for newer diagnostic modalities.
- List the advantages and disadvantages of those modalities.
- Contrast the usefulness of well-established studies with that of newer studies.

WE-159
Wednesday, October 13, 1999
3:00 PM - 3:55 PM
Room # N236
Las Vegas Convention Center

FACULTY

Scott W Melanson, MD, FACEP

Assistant Clinical Professor,
Medicine, Temple University School
of Medicine, Philadelphia,
Pennsylvania; Associate Director,
Emergency Medicine Residency, St.
Luke's Hospital, Bethlehem,
Pennsylvania

New Studies For Old Diseases

Scott W. Melanson, M.D., FACEP

Course Description

This course will focus on new and established means of evaluating several conditions that have traditionally been challenging to diagnose, namely abdominal aortic aneurysm (AAA), pancreatitis, mesenteric ischemia and diverticulitis.

Course Outline

I. Abdominal Aortic Aneurysm

A. Clinical Issues

- ◆ AAA affects 11% of males over the age of 65 and accounts for 15,000 deaths/year in the U.S. (13th leading cause of death)
- ◆ 97% occur between the origin of the renal arteries (L1 level) and the aortic bifurcation (L4 level/umbilicus)
- ◆ Risk factors:
 - Age >60 Hypertension
 - Smoking COPD
 - Male gender Family history of AAA
 - Atherosclerotic vascular disease
- ◆ Misdiagnosis is common; up to 1/3 initially misdiagnosed
 - Pulsatile mass felt in <50%
 - Symptoms variable: syncope, shock/unresponsiveness, nausea/vomiting, limb ischemia and pain in the back, flank, abdomen, groin or testicle
 - Most common misdiagnosis = renal colic

B. Diagnostic Modalities

1. Abdominal Radiographs

- ◆ Finding = curvilinear calcification of aneurysmal wall
- ◆ AP, lateral and LPO views will demonstrate finding
- ◆ Calcified aneurysm can be seen in $\leq 60\%$ of patients, therefore absence does not exclude the diagnosis
- ◆ Radiographs should not delay definitive testing (i.e. CT or U/S)

2. Abdominal Ultrasound

- ◆ Finding = aortic diameter >3.0 cm
- ◆ Virtually 100% sensitive if technically adequate study performed

- ◆ As accurate as CT in measuring aortic diameter and more accurate than angiography
- ◆ Normal aortic ultrasound study rules out AAA
- ◆ Can be done at the bedside by trained emergency physician
- ◆ Limitations
 - Visualization of entire abdominal aorta may occasionally be difficult or impossible due to marked obesity or bowel gas
 - Most AAA's rupture into retroperitoneum which is difficult to visualize on U/S. Ultrasound is therefore not reliable in determining whether the AAA has ruptured. While U/S is accurate at identifying hemoperitoneum, free intraperitoneal rupture usually results in rapid exsanguination..

3. Computed Tomography

- ◆ Finding = aortic diameter >3.0 cm, evidence of hemorrhage
- ◆ Virtually 100% accurate, less subject to technical problems than U/S
- ◆ Spiral CT provides better vascular identification than standard CT, allowing accurate determination of aneurysm extent and branch vessel involvement
- ◆ Can determine if retroperitoneal or intraabdominal rupture has occurred
- ◆ Limitations
 - Takes longer than bedside ultrasound
 - Requires patient to leave ED; only appropriate for stable patients

4. MRI

- ◆ Images aneurysm as well as CT but CT better for detecting acute hemorrhage
- ◆ Given time and availability limitations, MRI not appropriate for suspected symptomatic AAA

5. Angiography

- ◆ Useful for preoperative determination of aortic anatomy and branch vessel involvement
- ◆ Most AAA's have significant intraluminal thrombus, making lumen much smaller than the aneurysm. As contrast will only fill the lumen, angiography will often markedly underestimate aneurysmal size
- ◆ *Not appropriate ED study to diagnose AAA*

II. Pancreatitis

A. Clinical Issues

- ◆ Clinical presentation can be quite variable, making the diagnosis elusive at times
- ◆ Most common causes= cholelithiasis and alcohol (80-90%)
- ◆ Most episodes are mild but mortality of acute pancreatitis remains 5-10% and may increase to $\geq 35\%$ if complications develop
- ◆ **Pathophysiology:** premature activation of pancreatic enzymes → autodigestion of pancreatic tissue and systemic effects from circulating enzymes (vasodilation, increased capillary permeability → 3rd spacing of fluid and DIC)
- ◆ Can be acute (reversible changes) or chronic (continuing inflammation and irreversible structural changes)

B. Diagnostic Modalities

1. Laboratory Tests

a. Serum Amylase

- ◆ Elevation begins within 2–12 hours of symptom onset, peaks at 12–72 hours and usually normalizes within 5 days
- ◆ Sensitivity = 79–95%
- ◆ Specificity = <70%; many false positives
- ◆ Degree of hyperamylasemia does not predict clinical course

b. Serum Lipase

- ◆ Level increases within 4–8 hours of symptom onset, peaks at 24 hours and returns to normal after 8–14 days
- ◆ Sensitivity similar to amylase during 1st 24 hours; sensitivity of lipase higher thereafter
- ◆ More specific than amylase
- ◆ Combining lipase with amylase increases sensitivity (81% with amylase alone, 94% with amylase and lipase)

2. Imaging in Acute Pancreatitis

a. Plain Abdominal Films

- ◆ May see pancreatic calcifications (chronic pancreatitis)
- ◆ Sentinel loop
- ◆ Limited usefulness; not recommended for routine use unless necessary to exclude other causes of abdominal pain (i.e. SBO, perforated ulcer)

b. Ultrasound

- ◆ Up to 40% of pancreas' cannot be visualized due to overlying bowel gas

- ◆ Test of choice for identifying common duct stones
- ◆ Sensitivity for pancreatitis 60–95%, specificity ~90%
- ◆ Identifies pseudocyst and abscess well but these don't develop until after hospitalization
- ◆ Most helpful in identifying complications of pancreatitis

c. CT Scan

- ◆ Normal in 15–30% patients with mild pancreatitis
- ◆ Most useful imaging study in patients with moderate or severe pancreatitis
- ◆ Findings: pancreatic necrosis, peripancreatic fluid collections, pseudocysts and abscess formation
- ◆ Contrast: CT performed both with and without contrast
 - Unenhanced: to identify hemorrhage
 - Enhanced: to assess extent of pancreatic necrosis
- ◆ Consider CT if:
 - Diagnosis in question
 - Complications suspected
 - Severely ill patients

d. MRI

- ◆ Contrast – enhanced MRI may be used as alternative to CT in patients with renal insufficiency or contrast allergy
- ◆ Similar findings as CT

III. Acute Mesenteric Ischemia

A. Clinical Issues

- ◆ Primarily disease of patients ≥ 50 years
- ◆ Accounts for ~1 of every 1000 hospitalizations. Incidence may increase with aging population
- ◆ Mortality as high as 70% after bowel infarction occurs. Early diagnosis is critical!
- ◆ Superior mesenteric artery (SMA) = most commonly involved vessel in arterial occlusion. Supplies jejunum, ileum and colon to the splenic flexure
- ◆ Presents with "pain out of proportion to the physical findings". Peritonitis develops only after bowel infarction has occurred.

B. Pathophysiology

- ◆ There are 4 distinct causes of acute mesenteric ischemia
 1. **Arterial Embolism**
 - ◆ Accounts for 50% of acute mesenteric ischemia

- ◆ Emboli usually originate from a mural thrombus associated with an MI or left atrium in the presence of atrial fibrillation
- ◆ Nearly always involves the SMA
- ◆ Emboli usually lodge 3–10 cm from the SMA origin in area of anatomic narrowing
- ◆ 20% are associated with concurrent emboli to other arterial beds

2. Arterial Thrombosis

- ◆ Accounts for 25% of acute mesenteric ischemia
- ◆ Most commonly involves SMA but can occur in celiac axis
- ◆ Occurs at site of atherosclerotic plaque – typically the origin of the SMA
- ◆ Patients will often have a history consistent with chronic mesenteric ischemia (postprandial pain, weight loss, "food fear" and early satiety)
- ◆ The more proximal occlusion occurring with thrombosis results in greater amount of viscera at risk than with arterial embolism

3. Mesenteric Venous Thrombosis

- ◆ Accounts for 5% of acute mesenteric ischemia
- ◆ Venous occlusion results in massive congestion. The resulting bowel wall edema, as well as the increased outflow resistance secondary to venous thrombosis, can impede arterial inflow, leading to submucosal hemorrhage, venous capillary congestion and bowel infarction
- ◆ Most cases are associated with underlying hypercoagulable state (i.e. protein C or antithrombin III deficiency, malignancy). Patients tend, therefore, to be younger than those with arterial disease

4. Nonocclusive Mesenteric Ischemia (NOMI)

- ◆ Accounts for 20% of acute mesenteric ischemia
- ◆ Occurs due to reactive vasoconstriction developing in response to periods of low cardiac output (most commonly hospitalized CHF patients) or to the administration of vasoactive medications

C. Diagnostic Modalities

1. Laboratory Tests

- ◆ A number of markers are associated with acute mesenteric ischemia:
 - Creatinine phosphokinase
 - Alkaline phosphatase
 - Lactate dehydrogenase
 - Oxidized glutathione
 - Hexosaminidase
 - D-lactate
 - Diamine oxidase
 - Malondialdehyde
- ◆ Most patients have WBC >15,000, many have metabolic acidosis
- ◆ No laboratory test has been found to be a reliable screening test for acute mesenteric ischemia

2. Imaging Modalities

a. Plain Abdominal Radiography

- ◆ >25% of patients with mesenteric ischemia will have completely normal X-rays
- ◆ Findings associated with acute mesenteric ischemia:
 - Ileus
 - Thickened bowel walls
 - Gasless abdomen
 - Pneumatosis intestinalis (gas in bowel wall)
 - Portal venous gas
- ◆ Most useful to exclude other possible causes of abdominal pain

b. Barium Studies

- ◆ Upper and lower barium studies are **contraindicated** in suspected mesenteric ischemia as residual contrast can limit visualization during angiography
- ◆ If performed searching for other diagnosis, may see thickening of bowel wall, strictures or ulcerations

- c. Duplex Ultrasonography
 - ◆ Visualizes flow in SMA and celiac axis
 - ◆ Can see proximal stenosis or occlusion of these vessels
 - ◆ Overlying dilated, air-filled loops of bowel may prevent adequate visualization
 - ◆ Not a first line study in mesenteric ischemia
- d. CT Scanning
 - ◆ May demonstrate focal bowel wall thickening or nonenhancement of arterial vasculature
 - ◆ **Test of choice for mesenteric vein thrombosis.** CT demonstrates thrombus. Arteriography not as accurate in MVT as in arterial occlusion
- e. Mesenteric Arteriography
 - ◆ **Definitive diagnostic study** in mesenteric arterial obstruction
 - ◆ Determines site and nature of ischemia (occlusive vs nonocclusive)
 - ◆ Provides direct vascular access for the infusion of vasodilatory agents
 - ◆ Permits evaluation of vascular bed distal to obstruction
- f. Magnetic Resonance Angiography (MRA)
 - ◆ Contrast enhanced MRA images the arterial and venous mesenteric vasculature
 - ◆ Several recent articles support accuracy
 - ◆ May be used in place of arteriography in the future

IV. Diverticulitis

A. Clinical Issues

- ◆ Diverticular disease common: 5–10% of those >45 years and 80% of those >85 years. 20% of those with diverticular disease will develop symptomatic diverticulitis
- ◆ 80% of patients with diverticulitis are >50 years old
- ◆ Classically presents with left lower quadrant (LLQ) pain, alterations in bowel habits and LLQ tenderness
- ◆ Peritoneal signs generally not present unless peridiverticular abscess ruptures
- ◆ 85% diverticulitis occurs in sigmoid and descending colon

B. Diagnostic Modalities

1. Barium Enema

- ◆ Demonstrates diverticula well but their presence does not secure the diagnosis of diverticulitis
- ◆ May demonstrate extravasation of contrast and/or segmental sigmoid narrowing
- ◆ Poor interrater reliability
- ◆ Insufflation can → perforation
- ◆ BE has been replaced by U/S or CT

2. Ultrasonography

- ◆ Positive findings include:
 - Hypoechoic, thickened colonic segment
 - Presence of diverticula
 - Pain on compression of affected region
 - Zone of ↑ echogenicity surrounding the diseased colon
- ◆ Accuracy:
 - Zielke, et al, prospectively studies 143 consecutive patients suspected of having diverticulitis with ultrasound
 - Sensitivity = 84%
 - Specificity = 93%
 - Accuracy = 88%
 - PPV = 93%
 - NPV = 84%
 - Attributes: inexpensive, widely available
 - Disadvantages: operator-dependent, abdominal tenderness may preclude ability to scan the area and can be difficult/impossible in obese patients

3. CT Scan

- ◆ **Test of choice** for diverticulitis
- ◆ Findings: inflammation of pericolic fat, presence of single or multiple diverticula, thickening of bowel wall >4mm, peridiverticular abscess
- ◆ Can exclude other abdominal conditions (i.e. AAA, urolithiasis, appendicitis)
- ◆ Can have occasional false negative in early disease

- ◆ CT Very accurate test for diverticulitis. Rao, et al prospectively studied 150 consecutive ED patients with clinically suspected diverticulitis. All had CT with rectal contrast.
 - Sensitivity = 97%
 - Specificity = 100%
 - Accuracy = 99%
 - PPV = 100%
 - NPV = 98%
 - Alternative diagnoses made in 58% of those who did not have diverticulitis

4. Indicators for Imaging

- ◆ Evidence of severe disease (identify complications)
- ◆ Equivocal diagnosis
- ◆ Not necessary in mild disease being treated as outpatient

Selected References

1. Akkersdijk GJ, Puylaert JB, Coerkamp EG, de Vries AC. Accuracy of ultrasonographic measurement of infrarenal abdominal aortic aneurysm. *British Journal of Surgery*. 1994;81:376.
2. Ambrosetti P, Grossholz M, Becker C, Terrier F, Morel P. Computed tomography in acute left colonic diverticulitis. *British Journal of Surgery*. 1997;84:532-4.
3. Bearcroft PW, Lomas DJ. Magnetic resonance cholangiopancreatography. *Gut*. 1997;41:135-7.
4. Bergamaschi R. Uncomplicated diverticulitis of the sigmoid: old challenges. *Scandinavian Journal of Gastroenterology*. 1997;32:1187-9.
5. Brengman ML, Otchy DP. Timing of computed tomography in acute diverticulitis. *Diseases of the Colon & Rectum*. 1998;41:1023-8.
6. Chalmers AG. The role of imaging in acute pancreatitis. *European Journal of Gastroenterology & Hepatology*. 1997;9:106-16.
7. Chase CW, Barker DE, Russell WL, Burns RP. Serum amylase and lipase in the evaluation of acute abdominal pain. *American Surgeon*. 1996;62:1028-33.
8. Danse EM, Van Beers BE, Goffette P, Dardenne AN, Laterre PF, Pringot J. Diagnosis of acute intestinal ischemia by color Doppler sonography. Color Doppler sonography and acute intestinal ischemia. *Acta Gastroenterologica Belgica*. 1996;59:140-2.
9. Eggesbo HB, Jacobsen T, Kolmannskog F, Bay D, Nygaard K. Diagnosis of acute left-sided colonic diverticulitis by three radiological modalities. *Acta Radiologica*. 1998;39:315-21.
10. Errington ML, Ferguson JM, Gillespie IN, Connell HM, Ruckley CV, Wright AR. Complete pre-operative imaging assessment of abdominal aortic aneurysm with spiral CT angiography. *Clin Radiol*. 1997;52:369-77.
11. Gupta PK, al-Kawas FH. Acute pancreatitis: diagnosis and management. *American Family Physician*. 1995;52:435-43.
12. Heiss SG, Li KC. Magnetic resonance angiography of mesenteric arteries. A review. *Investigative Radiology*. 1998;33:670-81.
13. Hojer J. Diagnosis of acute symptomatic aortic aneurysm--ultrasonography an important tool. *Journal of Internal Medicine*. 1992;232:427-31.
14. Kahn CE, Jr., Quiroz FA. Positive predictive value of clinical suspicion for abdominal aortic aneurysm. Implications for use of ultrasonography. *Journal of General Internal Medicine*. 1996;11:756-8.
15. Keim V, Teich N, Fiedler F, Hartig W, Thiele G, Mossner J. A comparison of lipase and amylase in the diagnosis of acute pancreatitis in patients with abdominal pain. *Pancreas*. 1998;16:45-9.
16. Kempainen EA, Hedstrom JI, Puolakkainen PA, Haapiainen RK, Stenman UH. Advances in the laboratory diagnostics of acute pancreatitis. *Annals of Medicine*. 1998;30:169-75.
17. Kempainen E. Early phase of acute pancreatitis, screening, diagnosis and severity grading with new laboratory markers and imaging techniques. *Annales Chirurgiae et Gynaecologiae*. 1998;87:75-6.
18. Kempainen E, Puolakkainen P, Leppaniemi A, Hietaranta A, Gronroos J, Haapiainen R. Diagnosis of acute pancreatitis. *Annales Chirurgiae et Gynaecologiae*. 1998;87:191-4.
19. Kolkman JJ, Groeneveld AB. Occlusive and non-occlusive gastrointestinal ischaemia: a clinical review with special emphasis on the diagnostic value of tonometry. *Scandinavian Journal*

of Gastroenterology - Supplement. 1998;225:3-12.

20. Kumar P, Mukhopadhyay S, Sandhu M, Berry M. Ultrasonography, computed tomography and percutaneous intervention in acute pancreatitis: a serial study. *Australasian Radiology*. 1995;39:145-52.
21. Lederle FA, Simel DL. Does this patient have abdominal aortic aneurysm? *Jama*. 1999;281:77-82.
22. Li KC. Mesenteric occlusive disease. *Magnetic Resonance Imaging Clinics of North America*. 1998;6:331-50.
23. Nasim A, Thompson MM, Sayers RD, et al. Role of magnetic resonance angiography for assessment of abdominal aortic aneurysm before endoluminal repair. *Br J Surg*. 1998;85:641-4.
24. Pradel JA, Adell JF, Taourel P, Djafari M, Monnin-Delhom E, Bruel JM. Acute colonic diverticulitis: prospective comparative evaluation with US and CT. *Radiology*. 1997;205:503-12.
25. Rao PM, Rhea JT, Novelline RA, et al. Helical CT with only colonic contrast material for diagnosing diverticulitis: prospective evaluation of 150 patients. *AJR. American Journal of Roentgenology*. 1998;170:1445-9.
26. Regent D, Delfau F, Blum A, et al. The role of computed tomography in acute bowel ischemia. *Acta Gastroenterologica Belgica*. 1996;59:143-5.
27. Rhee RY, Gloviczki P. Mesenteric venous thrombosis. *Surgical Clinics of North America*. 1997;77:327-38.
28. Rose WM, 3rd, Ernst CB. Abdominal aortic aneurysm. *Comprehensive Therapy*. 1995;21:339-43.
29. Schwerk WB, Schwarz S, Rothmund M. Sonography in acute colonic diverticulitis. A prospective study. *Diseases of the Colon & Rectum*. 1992;35:1077-84.
30. Shirkhoda A, Konez O, Shetty AN, Bis KG, Ellwood RA, Kirsch MJ. Contrast-enhanced MR angiography of the mesenteric circulation: a pictorial essay. *Radiographics*. 1998;18:851-61; discussion 862-5.
31. Simoni G, Perrone R, Cittadini G, Jr., De Caro G, Baiardi A, Civalleri D. Helical CT for the study of abdominal aortic aneurysms in patients undergoing conventional surgical repair. *Eur J Vasc Endovasc Surg*. 1996;12:354-8.
32. Stefansson T, Nyman R, Nilsson S, Ekbom A, Pahlman L. Diverticulitis of the sigmoid colon. A comparison of CT, colonic enema and laparoscopy. *Acta Radiologica*. 1997;38:313-9.
33. Sternby B, O'Brien JF, Zinsmeister AR, DiMagno EP. What is the best biochemical test to diagnose acute pancreatitis? A prospective clinical study. *Mayo Clinic Proceedings*. 1996;71:1138-44.
34. Tietz NW. Support of the diagnosis of pancreatitis by enzyme tests--old problems, new techniques. *Clinica Chimica Acta*. 1997;257:85-98.
35. Zielke A, Hasse C, Bandorski T, et al. Diagnostic ultrasound of acute colonic diverticulitis by surgical residents. *Surgical Endoscopy*. 1997;11:1194-7.
36. Zielke A, Hasse C, Nies C, et al. Prospective evaluation of ultrasonography in acute colonic diverticulitis. *British Journal of Surgery*. 1997;84:385-8.