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<tbody>
<tr>
<td>1. Cademartiri F, Raaijmakers RH, Kuiper JW, van Dijk LC, Pattynama PM, Krestin GP. Multi-detector row CT angiography in patients with abdominal angina. <em>Radiographics</em> 2004; 24(4):969-984.</td>
<td>12</td>
<td>N/A</td>
<td>Review role of MD-CTA in patients with abdominal angina.</td>
<td>MD-CTA with appropriate post-processing techniques is highly effective for the diagnosis, evaluation, and treatment of suspected abdominal angina. Additional studies will help further evaluate the performance and applications of this modality.</td>
<td>4</td>
</tr>
<tr>
<td>2. Kirkpatrick ID, Kroeker MA, Greenberg HM. Biphasic CT with mesenteric CT angiography in the evaluation of acute mesenteric ischemia: initial experience. <em>Radiology</em> 2003; 229(1):91-98.</td>
<td>10</td>
<td>62 patients 2 reviewers</td>
<td>To prospectively evaluate the sensitivity and specificity of biphasic CT with mesenteric CTA in the diagnosis of AMI.</td>
<td>AMI was diagnosed in 26 patients. The CT angiogram depicted arterial disease in 8 patients and altered care in 5. Biphasic CT with mesenteric CTA is a valuable method of diagnosing AMI, with a sensitivity of 96% and a specificity of 94% calculated by using outlined diagnostic criteria.</td>
<td>2</td>
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<tr>
<td>3. Stueckle CA, Haegele KF, Jendreck M, et al. Multislice computed tomography angiography of the abdominal arteries: comparison between computed tomography angiography and digital subtraction angiography findings in 52 cases. <em>Australas Radiol</em> 2004; 48(2):142-147.</td>
<td>9</td>
<td>52 patients had both multislice CTA and DSA 2 reviewers</td>
<td>Retrospective study to compare conventional angiography to CTA in the diagnosis of morphological changes in the abdominal aorta and its branches.</td>
<td>• All aneurysms, occlusions, stenoses and calcifications were diagnosed correctly by CTA in axial and multiplanar projections (sensitivity 1.0; specificity 1.0). • 3D volume-rendered CTA showed a sensitivity of 0.91 for aneurysms, 0.82 for stenoses, 0.75 for occlusions and 0.77 for calcifications. The specificity was 1.0 in all cases. • Multislice CTA seems to be similar to conventional DSA for abdominal vessels if multiplanar projections are used.</td>
<td>3</td>
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<tr>
<td>4. Ernst O, Asnar V, Sergent G, et al. Comparing contrast-enhanced breath-hold MR angiography and conventional angiography in the evaluation of mesenteric circulation. <em>AJR Am J Roentgenol</em> 2000; 174(2):433-439.</td>
<td>9</td>
<td>33 patients 2 reviewers</td>
<td>Prospective study to compare the results of gadolinium-enhanced breath-hold MRA with those of conventional angiography for the study of mesenteric circulation. Standard reference was selective conventional angiography.</td>
<td>• Agreement was good or excellent for the hepatic artery (kappa = 0.78), the SMA (kappa = 0.65), the splenic artery (kappa = 0.70), the portal vein (kappa = 1.0), the superior mesenteric vein (kappa = 0.88), and the splenic vein (kappa = 0.75). • Agreement was poor, and vessels were better shown by conventional angiography, for the intrahepatic arteries (kappa = 0.006) and the branches of the SMA (kappa = 0.14). • MRA and conventional angiography revealed 29 and 27 portosystemic collaterals, respectively. However, conventional angiography is still necessary to evaluate distal arteries.</td>
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| 5. Menke J. Diagnostic accuracy of multidetector CT in acute mesenteric ischemia: systematic review and meta-analysis. *Radiology* 2010; 256(1):93-101. | 11 | 142 patients with AMI and 477 without 6 studies: 3 studies prospective and 3 studies retrospective 2 reviewers | To use meta-analysis to determine the diagnostic accuracy of contrast agent-enhanced MDCT in primary AMI. | - Pooled sensitivity of 93.3% (95% CI: 82.8%, 97.6%) and a pooled specificity of 95.9% (95% CI: 91.2%, 98.2%).  
- Contrast-enhanced MDCT allows the diagnosis of primary AMI with high sensitivity and specificity. Thus, it may be used as the first-line imaging method. | 2 |
| 6. Harward TR, Smith S, Seeger JM. Detection of celiac axis and superior mesenteric artery occlusive disease with use of abdominal duplex scanning. *J Vasc Surg* 1993; 17(4):738-745. | 9 | 38 patients | Compare mesenteric duplex scanning with lateral aortography to define the accuracy of abdominal duplex scanning for detection of mesenteric arterial insufficiency. | - In the SMA a peak systolic frequency of 4.5 kHz was 96% sensitive (24/25), 92% specific (12/13), and 95% accurate (36/38) at predicting stenoses less than 50% or 50% or greater.  
- For arteries with stenoses 50% to 99%, regression analysis demonstrated excellent linear correlation between percent stenosis and peak systolic frequency \( r = 0.89 \).  
- In the celiac axis a peak systolic frequency of 4.0 kHz had a sensitivity of 100% (30/30), a specificity of 88% (7/8), and an accuracy of 97% (37/38). Again, for arteries with stenoses 50% to 99%, an excellent linear correlation existed between peak systolic frequency and percent stenosis \( r = 0.86 \). All total arterial occlusions (14) were correctly identified.  
- In all, mesenteric arterial duplex scanning was 96% accurate for predicting SMA and celiac axis stenoses/occlusions. | 3 |
| 7. Trompeter M, Brazda T, Remy CT, Vestring T, Reimer P. Non-occlusive mesenteric ischemia: etiology, diagnosis, and interventional therapy. *Eur Radiol* 2002; 12(5):1179-1187. | 12 | NA | Discussion of non-occlusive mesenteric ischemia. Includes, etiology, presentation, diagnosis, therapies. | Imaging modalities like CT, MRI, and US, are able to evaluate the aorta and the origins of splanchnic arteries. Despite the technical evolution of these methods, selective angiography of mesenteric arteries is still the gold standard in diagnosing peripheral splanchnic vessel disease. | 4 |
## Radiologic Management of Mesenteric Ischemia

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| 8. Mitsuyoshi A, Obama K, Shinkura N, Ito T, Zaima M. Survival in nonocclusive mesenteric ischemia: early diagnosis by multidetector row computed tomography and early treatment with continuous intravenous high-dose prostaglandin E(1). *Ann Surg* 2007; 246(2):229-235. | 4 | 22 patients | To establish a procedure for early diagnosis and treatment of nonocclusive mesenteric ischemia. | - 9 of the first 13 patients died of multiple organ failure associated with multiple intestinal necrosis. These cases suggested that nonocclusive mesenteric ischemia may develop when 3 of the following 4 criteria are met after cardiovascular surgery or maintenance dialysis in elderly patients:  
- symptoms of the ileus develop slowly from abdominal symptoms, such as an unpleasant abdominal feeling or pain;  
- a requirement for catecholamine treatment;  
- an episode of hypotension; and  
- slow elevation of the serum transaminase level.  
- Early diagnosis of nonocclusive mesenteric ischemia is possible using the above criteria and MDCT, and initiation of prostaglandin E treatment may increase survival in patients with nonocclusive mesenteric ischemia. | 3 |
| 9. Bjorck M, Wanhainen A. Nonocclusive mesenteric hypoperfusion syndromes: recognition and treatment. *Semin Vasc Surg* 2010; 23(1):54-64. | 7 | N/A | A review on mesenteric nonocclusive hypoperfusion syndromes. Three clinical entities reviewed are:  
- Intra-abdominal hypertension or abdominal compartment syndrome  
- Colonic ischemia after abdominal aortic surgery.  
- Nonocclusive mesenteric ischemia. | A multidisciplinary approach is one of the keys to treating patients successfully. The cardiologist or intensivist might not consider abdominal compartment syndrome or an arterial stenosis, the radiologist might not consider intravenous therapy, and the vascular surgeon might not consider drug therapy. | 4 |
| 10. Resch TA, Acosta S, Sonesson B. Endovascular techniques in acute arterial mesenteric ischemia. *Semin Vasc Surg* 2010; 23(1):29-35. | 7 | N/A | Review endovascular techniques in acute arterial mesenteric ischemia. | Access to excellent imaging facilities, preferably angio-equipped operating rooms, as well appropriate endovascular tools, is important for successfully treating sick patients. Care must be individually tailored. Laparotomy should be performed liberally, but is not mandatory for successful outcomes. | 4 |
1st group – 10 patients  
2ND group – 11 patients | To characterize the outcome of attempted endovascular intervention in patients with acute embolic or thrombotic SMA occlusion. | The in-hospital survival rate was 82% (9/11 patients). Endovascular therapy of acute SMA occlusion provides a good alternative to open surgery. | 3 |

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**Radiologic Management of Mesenteric Ischemia**

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<td>12. Schoots IG, Levi MM, Reekers JA, Lameris JS, van Gulik TM. Thrombolytic therapy for acute superior mesenteric artery occlusion. <em>J Vasc Interv Radiol</em> 2005; 16(3):317-329.</td>
<td>11</td>
<td>48 patients</td>
<td>Systematic analysis of literature to evaluate thrombolytic therapy for acute SMA occlusion as an alternative or adjunctive treatment modality to surgical therapy and to provide current knowledge for timely and informed decisions regarding treatment of AMI.</td>
<td>Technically feasible but few reports found. Insufficient data to judge safety and effectiveness. Thrombolytic therapy can be effective relatively quickly, may obviate surgery, and has the potential to resolve the clot completely. In some cases it can be used as an alternative or neo-adjunctive treatment modality to surgery.</td>
<td>4</td>
</tr>
<tr>
<td>13. Schermerhorn ML, Giles KA, Hamdan AD, Wyers MC, Pomposelli FB. Mesenteric revascularization: management and outcomes in the United States, 1988-2006. <em>J Vasc Surg</em> 2009; 50(2):341-348 e341.</td>
<td>3a</td>
<td>6,342 PTA/S and 16,071 open surgical repairs</td>
<td>To evaluate trends in management of CMI and AMI using either surgery or PTA/S over the time period 1988–2006 and compare in-hospital outcomes in the most recent years using a national hospital administrative database.</td>
<td>• PTA/S increased steadily over time surpassing all surgery for CMI in 2002. • PTA/S for AMI has also increased and surpassed bypass in 2002 but has not surpassed all surgical procedures for AMI even in 2006. • Mortality was lower after PTA/S than bypass for both CMI (3.7% vs 13%, P&lt;0.01) and AMI (16% vs 28%, P&lt;0.01). • Bowel resection was more common after bypass than PTA/S for CMI (7% vs 3%, P&lt;0.01) and this subgroup showed an increased in-hospital mortality for both repair types (54% and 25%).</td>
<td>3</td>
</tr>
<tr>
<td>14. van Petersen AS, Kolkman JJ, Beuk RJ, Huisman AB, Doelman CJ, Geelkerken RH. Open or percutaneous revascularization for chronic splanchic syndrome. <em>J Vasc Surg</em> 2010; 51(5):1309-1316.</td>
<td>11</td>
<td>412 patients open repair and 227 patients endovascular repair</td>
<td>To review the available evidence for endovascular repair or open repair of chronic splanchic syndrome.</td>
<td>Endovascular repair appears to be preferential in the treatment of elderly patients and in patients with comorbidity, severe cachexia, or hostile abdomen. Long-term results after open repair are excellent. Open repair can still be proposed as the preferred option for relatively young and fit patients.</td>
<td>3</td>
</tr>
<tr>
<td>15. Bergqvist D, Svensson PJ. Treatment of mesenteric vein thrombosis. <em>Semin Vasc Surg</em> 2010; 23(1):65-68.</td>
<td>7</td>
<td>N/A</td>
<td>Review treatment of MVT.</td>
<td>In most cases conventional anticoagulant treatment should be used and is often successful. The duration should be at least 6 months. Thrombolysis has been used, both systemic and local, although only in small series. Surgery is indicated when there is peritonitis, when often bowel resection is necessary.</td>
<td>4</td>
</tr>
<tr>
<td>16. Rhee RY, Gloviczki P. Mesenteric venous thrombosis. <em>Surg Clin North Am</em> 1997; 77(2):327-338.</td>
<td>12</td>
<td>N/A</td>
<td>Review management and diagnosis of MVT.</td>
<td>Simple, logical diagnostic algorithm can be used. CT or MRI appears to be the most sensitive diagnostic test and should be obtained early for any patient suspected of harboring MVT.</td>
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<td>17. Bradbury MS, Kavanagh PV, Bechtold RE, et al. Mesenteric venous thrombosis: diagnosis and noninvasive imaging. <em>Radiographics</em> 2002; 22(3):527-541.</td>
<td>12</td>
<td>N/A</td>
<td>Review the causes, clinical features, radiologic findings, and management of portal or MVT.</td>
<td>• Helical CT and CTA, especially when performed with multi-detector row scanners, and MRI, particularly gadolinium-enhanced MRA, enable volumetric acquisitions in a single breath hold, eliminating motion artifact and suppressing respiratory misregistration. • Helical CTA and 3D gadolinium-enhanced MRA should be considered the primary diagnostic modalities for patients with a high clinical suspicion of mesenteric ischemia.</td>
<td>4</td>
</tr>
<tr>
<td>18. Abu-Daff S, Abu-Daff N, Al-Shahed M. Mesenteric venous thrombosis and factors associated with mortality: a statistical analysis with five-year follow-up. <em>J Gastrointest Surg</em> 2009; 13(7):1245-1250.</td>
<td>3a</td>
<td>31 cases</td>
<td>To examine the factors associated with mortality in MVT.</td>
<td>30 day mortality for MVT is strongly associated with colonic involvement as well as “short-bowel” syndrome, while anticoagulation may be protective. 5-year survival was found to be strongly associated with “short-bowel” syndrome.</td>
<td>3</td>
</tr>
<tr>
<td>19. Amitrano L, Guardascione MA, Scaglione M, et al. Prognostic factors in noncirrhotic patients with splanchnic vein thromboses. <em>Am J Gastroenterol</em> 2007; 102(11):2464-2470.</td>
<td>15</td>
<td>121 patients 104 patients had screening for thrombophili c factors</td>
<td>To examine prognostic factors in noncirrhotic patients with splanchnic vein thromboses.</td>
<td>Anticoagulant therapy was effective to obtain recanalization of acute splanchnic vein thromboses in 45.4% of patients and preserved patients from recurrent thrombosis when given lifelong.</td>
<td>2</td>
</tr>
<tr>
<td>20. Di Minno MN, Milone F, Milone M, et al. Endovascular Thrombolysis in Acute Mesenteric Vein Thrombosis: a 3-year follow-up with the rate of short and long-term sequelae in 32 patients. <em>Thromb Res</em> 2010; 126(4):295-298.</td>
<td>3c</td>
<td>32 patients 18 in treated group and 14 controls</td>
<td>Study makes the argument that when administered promptly, percutaneous transhepatic thrombolysis and mechanical thrombectomy is a significant means of preventing short and long-term sequelae of MVT.</td>
<td>Clinical symptoms rapidly improved (reduction of abdominal pain, fever, nausea and progressive reduction of leukocytosis) after the procedure in all patients treated with successful thrombolysis. Early endovascular thrombolytic treatment in MVT is recommended.</td>
<td>3</td>
</tr>
<tr>
<td>21. Liu FY, Wang MQ, Fan QS, Duan F, Wang ZJ, Song P. Interventional treatment for symptomatic acute-subacute portal and superior mesenteric vein thrombosis. <em>World J Gastroenterol</em> 2009; 15(40):5028-5034.</td>
<td>4</td>
<td>46 patients</td>
<td>To summarize methods and experience with interventional treatment for symptomatic acute-subacute portal vein and superior mesenteric vein thrombosis.</td>
<td>Blood reperfusion of portal vein and superior mesenteric vein thrombosis was achieved completely or partially in 34 patients 3-13 days after thrombolysis. Interventional treatment, including direct or indirect portal vein and superior mesenteric vein thrombosis, is a safe and effective method for patients with symptomatic acute-subacute portal vein and superior mesenteric vein thrombosis.</td>
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<tr>
<td>22. Hollingshead M, Burke CT, Mauro MA, Wecks SM, Dixon RG, Jaques PF. Transcatheter thrombolytic therapy for acute mesenteric and portal vein thrombosis. <em>J Vasc Interv Radiol</em> 2005; 16(5):651-661.</td>
<td>3a</td>
<td>20 patients</td>
<td>Retrospective study to evaluate the utility of transcatheter thrombolytic therapy in patients with acute or subacute (symptoms &lt;40 days) portal and/or MVT with severe symptoms, deteriorating clinical condition, and/or persistent symptoms despite anticoagulation.</td>
<td>• 15/20 patients showed some degree of lysis of the thrombus. 3 patients had complete resolution, 12 had partial resolution, and 5 patients had no resolution. 85% of patients (n = 17) had resolution of symptoms, 60% of patients (n = 12) developed a major complication. • Transcatheter thrombolysis was beneficial in avoiding patient death, resolving thrombus, improving symptoms, and avoiding bowel resection. However, there was a high complication rate, indicating that this therapy should be reserved for patients with severe disease. Further evaluation of these techniques and outcomes should continue to be pursued.</td>
<td>4</td>
</tr>
<tr>
<td>23. Lee VS, Morgan JN, Tan AG, et al. Celiac artery compression by the median arcuate ligament: a pitfall of end-expiratory MR imaging. <em>Radiology</em> 2003; 228(2):437-442.</td>
<td>10</td>
<td>97 patients 2 blinded reviewers</td>
<td>To measure the prevalence and degree of celiac artery compression during breath-hold imaging at end inspiration and end expiration in patients referred to undergo MRI of the abdomen for reasons unrelated to intestinal ischemia.</td>
<td>Average percentage of stenosis at end expiration (21% +/- 16) was significantly higher than that at end inspiration (11% +/- 11; P&lt;.001). Authors recommended end inspiration imaging to minimize false positive celiac compression.</td>
<td>2</td>
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<td>24. Reilly LM, Ammar AD, Stoney RJ, Ehrenfeld WK. Late results following operative repair for celiac artery compression syndrome. <em>J Vasc Surg</em> 1985; 2(1):79-91.</td>
<td>3a</td>
<td>44 patients</td>
<td>Retrospective review of outcomes after operative treatment for celiac artery compression.</td>
<td>Celiac revascularization in addition to decompression provided better symptom relief than decompression alone. Authors identified indicators of favorable and unfavorable outcomes. • Favorable; postprandial pain, age 40-60, weight loss of ≥ 20lbs. • Unfavorable; atypical pain, history of psychiatric disorder or alcohol abuse, age &gt;60, weight loss &lt;20lbs.</td>
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### Evidence Table Key

#### Study Type Key

*Numbers 1-7 are for studies of therapies while numbers 8-15 are used to describe studies of diagnostics.*

1. Randomized Controlled Trial — Treatment  
2. Controlled Trial  
3. Observation Study  
   a. Cohort  
   b. Cross-sectional  
   c. Case-control  
4. Clinical Series  
5. Case reviews  
6. Anecdotes  
7. Reviews  
8. Randomized Controlled Trial — Diagnostic  
9. Comparative Assessment  
10. Clinical Assessment  
11. Quantitative Review  
12. Qualitative Review  
13. Descriptive Study  
14. Case Report  
15. Other (Described in text)

#### Strength of Evidence Key

- **Category 1** - The conclusions of the study are valid and strongly supported by study design, analysis and results.
- **Category 2** - The conclusions of the study are likely valid, but study design does not permit certainty.
- **Category 3** - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.
- **Category 4** - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.

### Abbreviations Key

- AMI = Acute mesenteric ischemia  
- CI = Confidence interval  
- CMI = Chronic mesenteric ischemia  
- CT = Computed tomography  
- CTA = Computed tomography angiography  
- DSA = Digital-subtraction angiography  
- MDCT = Multidetector computed tomography  
- MD-CTA = Multidetector computed tomography angiography  
- MRI = Magnetic resonance imaging  
- MRA = Magnetic resonance angiography  
- MVT = Mesenteric vein thrombosis  
- PTA/S = Percutaneous transarterial angioplasty or stenting  
- SMA = Superior mesenteric artery  
- US = Ultrasound