Diagnostic Accuracy of Multidetector CT in Acute Mesenteric Ischemia

NAGAT M. KHALIFA, M.D.; OMNIA M. NADA, M.D. and NOHA A. ELSAID, M.D.
The Department of Diagnostic Radiology, National Cancer Institute, Cairo University

Abstract

Purpose: To evaluate the role of MDCT in assessment of patients with suspected mesenteric ischemia.

Patients and Methods: MDCT study of 18 patients with acute mesenteric ischemia, their ages ranged from 14-82 years, 12 male and 6 female. MDCT was used, Triphasic study was performed (pre-contrast, arterial phase, porto-venous phase and delayed phase). Findings are matched with histopathological results, clinical and surgical data for operable cases.

Results: Study revealed arterial thrombosis in 8 cases, bowel wall enhancement at the arterial phase seen in 13 cases. Wall enhancement at porto venous phase in 16 cases. Portal vein air in one case. Bowel wall air in 6 cases other features of bowel ischemia as fluid collection within bowel and wall thickening was found in all cases.

Conclusion: An accurate and early diagnosis is essential for the appropriate and successful treatment of patients with acute mesenteric ischemia to improve their prognoses. With the advances in MDCT technology, CT has realized a high diagnostic performance and become an essential diagnostic tool in this clinical setting.

Key Words: MDCT – Mesenteric ischemia.

Introduction

ACUTE mesenteric ischemia is a life-threatening condition, with a reported mortality rate of 50-90% [1] that requires early diagnosis and treatment. Angiography has been the reference standard imaging examination; however, the role of CT in this setting has expanded with the advent of helical CT scanners [2]. In particular, MDCT technology has dramatically improved the performance of CT by allowing rapid volumetric data acquisition to provide increased longitudinal spatial resolution over a large anatomic volume. From the volume data, retrospective thin or thick sections; sagittal, coronal, or curved multiplanar reformatted images; and CT angiograms with 2D or 3D visualization can be obtained. The rapid scanning capability of this technique coupled with IV bolus contrast injection substantially optimizes scan timing to allow both the arterial and venous phases to be imaged. These advantages are helpful in identifying the site, level, and cause of bowel ischemia by showing abnormalities in the bowel wall, mesentery, and mesenteric vessels. With these developments, the ability of CT for diagnosing mesenteric ischemia has recently been reported to have a sensitivity of approximately 90% [1,3]. It can also provide alternative diagnoses for patients in whom mesenteric ischemia is suspected.

Acute mesenteric ischemia can be caused by various conditions such as arterial occlusion, venous occlusion, strangulating obstruction, and hypoperfusion associated with nonocclusive vascular disease, and the CT findings vary widely depending on the cause and underlying pathophysiology [1,4]. CT findings of acute mesenteric ischemia should be characterized on the basis of the cause. In addition, the severity of bowel ischemia (i.e., superficial mucosal or transmural bowel wall necrosis), the location (i.e., small or large bowel), and the presence and degree of hemorrhage or subsequent superinfections may affect the CT appearance.

Material and Methods

The study was carried out at Al Mana General Hospital, (KSA) from July 2011 to June 2012. It involved 18 patients (12 male and 6 female) with age range from 14 to 82 years with average age of 47 years. Complaining of acute abdomen and referred to the surgical department as a surgical cases with possible bowel pathology, Full history taking and plain X-ray was done for all cases. Gastrografin study was done in 6 cases. Then multidetector CT examination of the abdomen and pelvis was done for all cases.

CT protocol:

The patient was placed in supine position on CT table (General electric, Milwaukee, USA). In patient who did not put under the regimen of nothing per mouth the bowels were opacified with
diluted Omnipaque (50ml diluted in 1500 water). Drinking started at the night before examination. The stomach was distended on table using two cups of water or diluted Omnipaque. Series 1 of the examination was unenhanced CT started from lower chest and extending to 2cm below the symphysis pubis. For series 2, a bolus of intravenous non-ionic contrast medium 120ml (Omnipaque 300mg/ml) was injected using automated injector at a rate of 3ml/sec. Parameters were 120kV Auto mA was 230, time(sec)=1 FOV=500, matrix 512, slice thickness (mm)=5mm, the increment (mm) =5mm and pitch=2mm. For series, 2 arterial phase was done 36 sec from contrast injection, then portalvenous phase after 45 sec and finally delayed images were taken after 10 minutes so that the patient was evaluated completely for any pathological abnormalities. Soft tissue, lung, and sometimes bone windows were done. The images were viewed on a workstation as axial and coronal multiplaner reformatted images.

**Results**

The study involved 18 patients, their ages ranged from 14-82 years.

CT findings are shown in Table (1).

Gastrografin study detected arrest of dye in 4 cancer colon cases. Air fluid levels were detected in one case of arterial thrombosis.

Table (1): Features of bowel ischemia in 18 cases.

<table>
<thead>
<tr>
<th>Features of bowel ischemia</th>
<th>Arterial thrombosis</th>
<th>Bowel wall enhancement at arterial phase</th>
<th>Wall enhancement at porto venous phase</th>
<th>Portal vein air</th>
<th>Bowel wall air</th>
<th>Fluid collection within bowel-wall thickening</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ve</td>
<td>−ve</td>
<td>+ve</td>
<td>Homogenous</td>
<td>+ve</td>
<td>Homogenous</td>
<td>Patchy +ve</td>
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<tr>
<td>Patchy +ve</td>
<td>Homogenous</td>
<td>−ve</td>
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<td>Patchy −ve</td>
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<td>Patchy +ve</td>
</tr>
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</table>

Table (2): Pathology of patients with age distribution.

<table>
<thead>
<tr>
<th>Pathology</th>
<th>Intussusceptions</th>
<th>Complicated Crohn's</th>
<th>Vessels occlusion</th>
<th>Superior mesenteric artery syndrome</th>
<th>Adult type megacolon</th>
<th>Typhilitis</th>
<th>Panulitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of cases</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Age group</td>
<td>31-82</td>
<td>14-22-23</td>
<td>70-36-40</td>
<td>26</td>
<td>31</td>
<td>44</td>
<td></td>
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</table>

Operative data revealed ischemia in 12 cases and infarction in 2 cases, no surgery was done in 4 cases.

Fig. (1): 23 years old male presented with post appendicectomy bowel obstruction CT scan showed intussusception of small bowel segment at right lower abdomen: (A) Precontrast, (B) Arterial phase showed patchy wall enhancement consistent with ischemia, (C) Portal venous phase and (D) Delayed phase showed wall enhancement, bowel wall air is seen as well (arrow).
Fig. (2): 22 year old male presented with ileo-ileal intussusception (A) Precontrast, (B) Arterial phase, (C) Portal venous phase and (D) Delayed phase with evident patchy bowel wall enhancement consistent with ischamia.

Fig. (3): Male patient 70 years old diabetic heavy smoker presented with sever generalized acute abdominal pain 3 days back on top of vague abdominal pain since 2 months CT (A,B,C) show portal vein air, bowel wall air, multiple air fluid levels, no enhancement of proximal bowel wall at arterial and portovenous phase (infarction), CT angiography (D) showed filing defect of SMA athromtous plaques of caeliac trunk. Surgery pathology (E) show gangrenous jejunum two feet long.
Fig. (4): Female patient 26 years old post appendicetomy 1 year back presented with generalized abdominal pain and vomiting plain X-ray (A) showed multiple central abdominal air fluid levels CT (B,C,D) show ascites, effusion, distended bowels with fluids, bowel wall homogenous enhancement at arterial and portovenous phases (no ischemia) no definite cause seen by CT, laproscopy: Release of small bowel obstruction secondary to band adhesion (Caecum to terminal ilium and iliail constricting band).

Discussion

Mesenteric ischemia is a complex and devastating disease which still remains a diagnostic challenge to the clinicians due to non-specific clinical and laboratory findings. Mesenteric ischemia is characterized by inadequate blood flow to or from the involved mesenteric vessels supplying a particular segment of bowel [5]. The organs typically affected are the small bowel or colon. The source of blood that is lacking can be arterial or venous, and hemodynamically, the cause can be occlusive or nonocclusive. Mesenteric ischemia can be acute or chronic. Acute mesenteric ischemia etiology may be arterial occlusion, venous occlusion, strangulating obstruction or Hypo-perfusion associated with non-occlusive vascular disease [1].

Mortality related to acute mesenteric arterial occlusion remains very high. Patient survival is dependent on prompt recognition and revascularization before ischemia progresses to intestinal gangrene. MDCT angiography considered as the diagnostic tool of choice due to its ability to define the arterial anatomy and to evaluate secondary signs of mesenteric ischemia [6].

Our study included 18 cases presenting by manifestations of bowel ischemia. By CT Seven cases had small vessel occlusion and one case had large vessel occlusion.

Recognition of characteristic CT appearances and the variations associated with each cause helped in the accurate interpretation of CT in the diagnosis of mesenteric ischemia. Patients with inflammatory bowel disease and infectious colitis can present with similar physical signs and symptoms, including cramping abdominal pain, diarrhea, leukocytosis, and hematochezia. Bowel wall thickening is a finding common to all 3 types of disease; however, the pattern of vascular distribution can sometimes narrow the differential diagnosis [7].

Unless the patient is unstable, imaging is the criterion standard for diagnosis. Upright and supine
plain abdominal radiographs typically should be requested first to evaluate for free air, obstruction, ileus, intussusception, or volvulus [7].

Eventually, a computed tomography (CT) scan using oral and intravenous contrast material is needed if the cause is not apparent on plain radiographs which is the case in our study. Plain abdominal radiographs are helpful initial screening tools for excluding certain manifestations of disease. Although plain radiographs may be sensitive, they are typically nonspecific. For instance, the presence of mucosal edema, small-bowel dilatation, and free air on plain radiographs are sensitive findings; however, these findings are not useful in localizing or determining the etiology of the event [8].

Several imaging features have been described with multidetector computed tomography which allows the diagnosis of mesenteric ischemia with high sensitivity and specificity, these are bowel wall thickening, bowel wall thinning (arterial ischemia), bowel wall attenuation (high attenuation in non-contrast phase means hemorrhage), Pneumatosisintestinalis, bowel dilatation and dilated mesenteric vessels to bowel. Other CT Findings that are clearly seen and looked out beyond the bowel include mesenteric vessel abnormalities (thrombus of artery or veins, dilatation of veins), stranding of the mesentery and air in portal or mesenteric veins [1].

However, there are imaging features which overlap with other pathologies including benign inflammation and infection. Knowledge of imaging findings in mesenteric ischemia and its potential mimics is important in early and definitive diagnosis. CT has been proven to be highly accurate with multidetector computed tomography which allows the diagnosis of mesenteric ischemia with high sensitivity and specificity, these are bowel wall thickening, bowel wall thinning (arterial ischemia), bowel wall attenuation (high attenuation in non-contrast phase means hemorrhage), Pneumatosisintestinalis, bowel dilatation and dilated mesenteric vessels to bowel. Other CT Findings that are clearly seen and looked out beyond the bowel include mesenteric vessel abnormalities (thrombus of artery or veins, dilatation of veins), stranding of the mesentery and air in portal or mesenteric veins [1].

Large-vessel disease (superior mesenteric artery occlusion seen in one case) was diffuse matching with previous studies done by Cademartiri F. et al., [10] and Akira Furukawa et al., [1]. In this case of our study large gangrenous segment removed at surgery, presence or absence of bowel wall enhancement at arterial and portovenous phase also seen clearly by CT In cases of Small-vessel arterial or venous thrombosis which seen in 7 out of 18 patients ischemic changes is more likely to be focal matching with previous results of [1,10].

With proper timing of the contrast-agent bolus, a thrombus in a large vessel is seen as a soft-tissue filling defect as in one of our cases. Small-bowel obstruction can cause vessel obstruction and lead to ischemia, which is apparent as dilated loops on CT scans.

In our study plain X-ray was done for all cases then gastrografin study in 6 cases and dynamic CT study was carried out for 18 patients. Bowel wall enhancement in the arterial phase was detected in 13 cases (9 homogenous and 4 patchy heterogenous) and in portovenous phase in 16 cases (11 homogenous and 5 patchy heterogenous).

With mucosal disruption and gas dissection, intramural air can be seen. This is often best appreciated by using lung window settings. This entity is called pneumatosisintestinalis seen in 6 out of our 18 cases.

Gas may enter the portal circulation, and it may be found in peripherally located portal vein branches, (usually in the nondependent left hepatic lobe) [1] this finding seen in one patient out of 2 patients with bowel infraction diagnosed by CT and confirmed at surgery.

Bowel wall necrosis with pneumatosis and pneumoporta are extremely specific late onset findings, but only observed in delayed diagnosis, rendering the framework irreversible, at this stage, urgent surgical resection is necessary, before perforation and sepsis occur [11-15].

A reliable method to differentiate arterial causes from venous causes is depiction of the characteristic bowel-wall enhancement pattern. Arterial occlusive disease demonstrates no enhancement of the involved segment, whereas venous occlusion reveals marked contrast enhancement and retention secondary to stagnant flow no cases included in our study with such findings.

A false-negative diagnosis of mesenteric ischemia can result from many causes. Focal wall
thickening, particularly of the cecum, can be confusing. Tumor infiltration especially that due to lymphoma and adenocarcinoma, can mimic focal ischemic colitis caused by small colic branches of the SMA. Local lymph node enlargement may be present in infectious and neoplastic processes, allowing them to be further differentiated from ischemia. Dedicated interpretation of CT images together with using other imaging such as ultrasound barium and gastrograffin studies may narrow these false diagnoses [1,5].

In our cases bowel thickening was detected in 3 intussusception cases. One case of panculitis and one case of crohn’s disease.

Conclusion:
On the basis of a thorough clinical examination, contrast enhanced multidetector CT may be used as the first line imaging method to differentiate patients with suspected acute mesenteric ischemia.

References
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