Original Article

Computed tomography characteristics of isolated caecal ischaemia

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Keywords
Diseases of the cecum; Colitis ischaemia; Acute abdomen; Spiral computed tomography

Abstract
Objective: The aims of this review are to describe the main characteristics for the CT diagnosis of isolated caecal ischaemia (ICA) and give details of the differential diagnosis with other conditions with a similar clinical picture.

Material and methods: A retrospective study was conducted to review the CT findings of 4 patients diagnosed with ICA in our hospital. The parameters recorded to analyze their characteristics in the CT were: maximum thickness of the cecum wall, the appearance of the peri-cecum fat, presence of free fluid, signs of caecal or portal pneumatosis, the appearance of the caecal appendix, and general signs of the presence of vasculopathy.

Results: In all cases it was recorded that there was a thickening of the walls of the blind loop with an abrupt transition between the caecal wall and the walls of the ascending colon wall. In all cases the caecal thickening had a characteristic image in the central area. Signs of caecal pneumatosis were observed in two cases. All of them had an appendix with normal characteristics.

Conclusions: The combination of caecal wall thickening with oedematous characteristics, with no changes in the appendix, ileum and colon, suggests the diagnosis of caecal ischaemia, particularly with the presence of pneumatosis.

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Palabras clave
Isquemia cecal aislada; Colitis isquémica; Abdomen agudo; Tomografía computarizada helicoidal

Características en tomografía computarizada de la isquemia cecal aislada

Resumen
Objetivo: Los objetivos de esta revisión son describir las características de la isquemia cecal aislada (ICA) y detallar el diagnóstico diferencial con otras entidades con un cuadro clínico similar.

Material y métodos: Se trata de un estudio retrospectivo que revisa los hallazgos por TC de 4 pacientes que fueron diagnosticados de ICA en nuestro centro. Los parámetros escogidos para

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Introduction

Ischemic colitis is the commonest cause of colitis in elderly patients, especially if associated to cardiovascular risk factors.\(^1\)\(^2\) Contrariwise, ischaemia exclusively limited to the cecum is an infrequent entity, but not extremely rare, seldom described in medical bibliography,\(^3\)\(^-\)\(^7\) one that generally occurs with acute pain in the right iliac fossa. There are a large number of articles describing computed tomography (CT) characteristics of colon ischaemia, but only two of them have attempted to describe specifically the findings when it is limited to the cecum.\(^3\)\(^,\)\(^4\) The present series, though with only four patients, gains radiologic relevance for being the most extensive published so far.

The objectives of this revision are to describe the key characteristics to diagnose isolated caecal ischaemia (ICI) by means of CT from the retrospective revision of 4 cases studied in our center, and to detail differential diagnosis with other entities that present similar clinical characteristics.

Materials and methods

Subjects and image acquisition

It is a retrospective study that revises CT findings in four patients that had been diagnosed with ICI in our center between December 2006 and February 2011. They had all been examined by means of an abdominal CT performed urgently and indicated by an acute abdominal clinical.

Only the patients complying with Brandt and coworkers\(^8\) criteria for confirmed ischemic colitis were included in the study, and those with criteria for probable colon ischaemia by means of CT, but without histological confirmation, were excluded. Those patients with ischaemia affecting other colon segments in addition to the cecum were not included either.

The ICI confirmation diagnosis was obtained by means of the anatomopathological results in the 4 cases, three of them after a right hemicolectomy and one by means of an endoscopic biopsy performed in the first 72h.

Epidemiological data of all the patients were collected in relation to age, sex, relevant pathological antecedents and clinical evaluation upon admission.

Three of the CT studies were performed with a 64-crown multicut CT equipment and the other one with a simple helicoidal CT. The images were acquired in 60–80s (portal vein phase) after the intravenous injection of 3ml/s of 100–150ml of iodized contrast material with an iodine concentration of 300mg/ml. No images were obtained in the arterial phase, since in none of the cases the initial clinical suspicion was that of mesenteric ischaemia.

No statistical study was conducted since said analysis would have limited validity in our small studied population.

The study was performed in accordance with the ethics standards of the committee responsible for clinical research in our hospital.

Image analysis

The CT images of all the cases were recovered from our digital files and reviewed jointly by an abdominal radiologist and a resident. The images of 4 cases with definite histological diagnosis of isolated caecal colon ischaemia stored in the file and image communication system (PACS) were analyzed retrospectively. The parameters chosen to analyze the computed tomography characteristics of isolated caecal ischaemia were: maximum thickness of the caecal wall, taking into consideration that caecal wall in normal conditions must not surpass 3 mm, although with collapsed light it may reach 4mm\(^9\)\(^,\)\(^10\); a target concentric thickening; the appearance of pericecal fat; the presence of free fluids; the signs of caecal or portal pneumatosis; the appearance of the caecal appendix; circumscription of the affection to the cecum; and the general signs of vasculopathy that were assessed according to the signs of atheromatosis in the abdominal aorta, the common iliac arteries and main visceral arteries, on a scale of 1 (mild), to 3 (serious) in a subjective manner.

Results

Epidemiologic characteristics

The epidemiologic and clinical data appear in Table 1.

CT characteristics of ICI

In all the ICI cases, it was possible to observe thickening of caecal walls, which represented thinning ranging from 12 to 17mm (mean 14mm) (Table 2). There was always an abrupt transition between the thickening of caecal wall and the ascending colon (Fig. 1).
Table 1  Epidemiological and clinical characteristics.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Sex</th>
<th>Pathological antecedents</th>
<th>Clinic</th>
<th>Diagnostic confirmation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>54</td>
<td>F</td>
<td>HBP, IRC</td>
<td>Pain in RIF Fever Leukocytosis</td>
<td>Pathological anatomy of right hemicolecction</td>
</tr>
<tr>
<td>2</td>
<td>42</td>
<td>F</td>
<td>–</td>
<td>Pain in RIF Leukocytosis</td>
<td>Pathological anatomy of right hemicolecction</td>
</tr>
<tr>
<td>3</td>
<td>67</td>
<td>F</td>
<td>HBP, DM2, DLP</td>
<td>Pain in RIF Fever Leukocytosis</td>
<td>Pathological anatomy of colonoscopy biopsy</td>
</tr>
<tr>
<td>4</td>
<td>83</td>
<td>F</td>
<td>HBP, antecedents of stroke</td>
<td>Pain in right hemiabdomen Fever Leukocytosis</td>
<td>Pathological anatomy of right hemicolecction</td>
</tr>
</tbody>
</table>

CVA: cerebrovascular accident; DLP: dislipemia; DM2: diabetes mellitus type 2; RIF: right iliac fossa; HBP: high blood pressure; CRF: chronic renal failure; F: female.

Table 2  Computed tomography characteristics of isolated caecal ischaemia.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Thickness of caecal wall (mm)</th>
<th>Free fluid</th>
<th>Pericecal fat stringiness</th>
<th>Signs of pneumatosis</th>
<th>Target thickening</th>
<th>Appearance of appendix</th>
<th>CT signs of vasculopathy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>No</td>
<td>No</td>
<td>–</td>
<td>Yes</td>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>Yes</td>
<td>No</td>
<td>–</td>
<td>Yes</td>
<td>Normal</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>Yes</td>
<td>Yes</td>
<td>–</td>
<td>Yes</td>
<td>Normal</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>17</td>
<td>Yes</td>
<td>No</td>
<td>+</td>
<td>Yes</td>
<td>Normal</td>
<td>1</td>
</tr>
</tbody>
</table>


In all the patients, caecal thickening presented a characteristic target image, with preserved mucosa uptake and submucous layer hypodensity. The increase of the latter layer was responsible for the wall thickening (Fig. 2).

Two of the patients presented free fluid (2/4) and only one pericecal fat stringiness (1/4). Signs of caecal pneumatosis were observed in two of the cases (2/4) and none presented portal pneumatosis signs. These two patients presented a transmural (gangrenous) necrosis in the anatomo-pathological study of the surgical piece. In all of them (4/4) the appendix had normal characteristics (Fig. 3). None of them had image evidence or other clinical data that would suggest that the caecal ischaemia were secondary to a caecal volvulus.11

Figure 1  (A) Axial section of abdominal CT (patient 2). An abrupt transition between the ischemic cecum mural thickening (arrow) and the ascending colon with preserved caliber walls is observed (heads of the three lower arrows). (B) Axial image of the same patient in which it is possible to observe parietal pneumatosis (arrow) located in the not inclined portion of the caecal fundus.
Of the 4 ICI patients, three presented signs of CT vasculopathy, two were moderate and one mild.

Discussion

Acute ischemic colitis is the commonest cause of colitis in the elderly and it is an important cause of morbidity in this age group. Ischaemia usually affects the colon in a segmentary manner, and some segments are affected more frequently than others. Brandt et al. analyzed ischemic colitis anatomical patterns in 313 cases. In said series, the exclusive affection of the cecum appeared only in 2.2% of the patients; therefore selective caecal affectation is rare in colon ischaemia.

Ischemic colitis is classified, according to its etiopathogenesis, into occlusive and non-occlusive, depending on whether it occurs due to a vascular obstruction, or due to a low blood flow condition. Ischaemia due to low output, the non-occlusive one, affects the right colon more frequently. This is due to the fact that it has a less developed network of collateral vessels than the left colon, and in addition, its vasa recta (with little collateral circulation among them) are longer and have an origin farther from the colon wall.

Moreover, in the case of the cecum, there are anatomical vascular variants that may increase its vulnerability to ischaemia (Fig. 5). The cecum receives its blood contribution from the anterior and posterior caecal arteries, which frequently originate from a vascular arcade between the
iliac and colic branches of the ileocolic artery. However, on occasion, the caecal arteries originate directly from the ileal or colic branch and, consequently, the cecum does not benefit from the collateral contribution provided by said vascular arcade. Hence, some authors consider the cecum as a vascular border area (such as the splenic or the rectum-sigmoid region).

Some ICI cases have been published as associated to several diseases such as chronic heart disease, cardiopulmonary bypass surgery, diabetes, systemic chemotherapy, aortitis, oral contraceptives and cocaine abuse, and in hemodialysis patients. The possible multifactor origin of isolated caecal ischaemia results in its final cause not being explained in many cases. In our series, most of the patients (3/4) presented cardiovascular risk factors as it has been evidenced in the results. In addition, three of them already presented signs of CT vasculopathy; in two of the cases it was moderate.

Isolated caecal ischaemia is presented clinically with pain in the right iliac fossa, or in the right hemi-abdomen, accompanied by a septic leucocytic formula, findings present in all the patients in our series. The findings in the physical examination are often not very evident until transmural necrosis occurs with the subsequent peritoneal inflammation. Given the unspecificity of clinics, the radiologist must know what the signs of CT isolated caecal ischaemia are. Thickening of caecal wall has been described as an ever-present sign, but one that is unspecific. On occasion, it has been described with a target image, formed by the stratification produced by the uptake of the inflamed mucosa (hyperdense), the submucosa responsible of the mural thickening with edema (hypodense), and the muscular one in the most external area (hyperdense). The target sign is an unequivocal evidence of intestinal lesion, which is often acute. It is an unspecific sign that may be produced by several colon diseases, both inflammatory and ischemic ones, but not the neoplastic ones. In the concrete case of ischaemia, the target sign is observed when the affection is not transmural and there is reperfusion after the ischaemia. Contrariwise, oclusive ischaemia, with total vascular occlusion, occur with a thinning of the wall and absence of uptake. In our series, thickening of the caecal wall with target image was present in all the cases.

Other important signs to recognize isolated caecal ischaemia are the abrupt transition between the ischemic cecum mural thickening and the ascending colon, which presents walls of normal thickness. The ascending colon, the ileum and the appendix have an irrigation that comes from different vessels, with multiple collaterals, unlike what occurs in the cecum. Therefore, they have more protection in conditions of low blood irrigation. That is why the ascending colon, the appendix and the ileum did not present alterations in any of the cases in our series. The most specific ICI sign described in the bibliography is pneumatosis of the caecal wall, especially on the fundus of the cecum, but it is not present in all the cases. In our series, only two of the patients presented it. It is important to mention how difficult it sometimes is to identify the cecum adequately due to its variable position, as it happened with one of our patients (Fig. 4) in whom the pathological segment was wrongly interpreted as the terminal ileum (Fig. 5).

Other findings were discrete pericecal fat stringiness and the presence of mild intraperitoneal free fluid, although all of them are completely unspecific signs.

It has been described that ICI rarely occurs with specific signs such as caecal fundus pneumatosis, and that its CT findings are usually unspecific. However, in our opinion, even in the absence of caecal pneumatosis, although the rest of the findings may be common to other affections, the combination of several of them can lead us to the correct diagnosis of ICI.

Other entities may occur with acute abdominal pain in the right iliac fossa and thickening of the caecal walls. The affection limited to the cecum allows us to rule out diseases such as appendicitis, infectious colitis, Crohn’s disease and ileocecal tuberculosis. Typhilitis, which may present an appearance similar to that of ICI and even occur in serious cases with intestinal pneumatosis, only occur in immune-depressed and neutropenic patients. Caecal diverticulitis may lead to differential diagnosis with ICI when it is not possible to identify the pathological diverticulum. Complicated caecal neoplasia will not present a target sign, since we will be facing a solid mural thickening, not an edematous one. Complicated mucinous neoplasia may debut with acute abdomen clinic and peritonism and pose greater diagnostic problems, since the mucin accumulated in the sinus of the mural thickening is hypodense.

Figure 5 In variant (A), the caecal arteries originate in an arcade formed by the ileal artery and the colic artery. In this case, vascular anastomosis maintains caecal irrigation. In variant (B), the caecal arteries originate in the colic artery and the absence of the arcade facilitates the development of ischaemia in low output situations (with permission of Netter FH14).
Taking into account the limitation presupposed by the small number of cases presented, the fact of observing a target-looking caecal thickening, along with an appendix, ileum and ascending colon of normal characteristics, suggests the diagnosis of caecal ischaemia, especially in the presence of pneumatosis.

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Conflict of interest

The authors declare that they do not have any conflict of interests.

References