

## Right Lower Quadrant (RLQ) Pain: Beyond The Boundaries Of Appendicitis

Dr. Nandita Goel\*, Dr. Dharita S. Shah\*\*

\*3<sup>rd</sup> year resident MD (Radio diagnosis), \*\* Professor and HOD, Department of Radiodiagnosis, N.H.L. Municipal Medical College, Sheth Vadilal Sarabhai General Hospital, Ellisbridge, Ahmedabad, Gujarat, India.

**Abstracts:** Right lower quadrant abdominal pain (RLQP) is one of the commonest causes for surgical emergencies. Beyond appendicitis and ileocecal (IC) tuberculosis; right iliac fossa pain indicates a varied list of differential diagnoses thus posing a challenge to surgeons. Causes of RLQP other than appendicitis and IC tuberculosis include inflammatory and infectious conditions involving the ileocecal region; diverticulitis; malignancies; pelvic cystic pathologies in women and miscellaneous conditions affecting omentum and mesentery. Multidetector computed tomography (MDCT) has seen a quantum leap since its introduction for bowel pathology and is now the modality of choice for evaluation of patients with right lower quadrant pain. MDCT is an extremely useful noninvasive method for diagnosis and management of not only the most common causes such as appendicitis, but also less common conditions.[Goel N NJIRM 2015; 6(5):125-133]

**Key Words:** Right lower quadrant pain, MDCT, appendicitis, ileo-cecal tuberculosis.

**Author for correspondence:** Dr. Nandita Goel, 3<sup>rd</sup> year resident MD (Radio diagnosis) P-2, Nirmal Apartments, Pritamnagar, Ellisbridge, Ahmedabad-380006 Gujarat, India. Pincode: 380006. Email:

**Introduction:** Abdominal pain is the most common cause next to chest pain as an emergency condition. RLQP lower quadrant pain in particular is the commonest among abdominal pain and has proved to be a great challenge to surgeons with a vast list of differential diagnoses, some of them requiring emergency surgery 1. In this article, we have tried to emphasize the importance of MDCT as a diagnostic tool for certain conditions which were unrecognized before the era of computed tomography.

MDCT a noninvasive technique is a modality of choice for patient's evaluation with acute RLQP as the symptomatology and physical examination findings are not always specific for diseases of right iliac fossa lesions. Even plain radiography and Barium findings are also not always corroborative 2

Scanning Protocols: To evaluate for causes of RLQP thin sections are acquired extending from domes of the diaphragm up to pubic symphysis in a single breath hold. This is mandatory as it will help identify alternative causes for the pain.3 MDCT with reduced acquisition time allows multiplanar reformation maintaining image resolution and post processing techniques, such as maximum intensity projection and volume rendering technique allows for perfect diagnosis and characterization of other causes of RLQP 4. Ideally oral, intravenous and rectal contrast material should be introduced to improve for evaluation of varied causes of RLQP. However there is no consensus agreement found in the literature with exception to presence of

contraindications such as abnormal renal function tests and allergic reaction to contrast material 5, 6.

Use of MDCT has reduced the rate of negative appendectomies and related morbidity. However, a normal or a nonvisualized appendix on CT virtually excludes appendicitis; an alternative diagnosis should be sought in patients of RLQP 8.

A varied list of differential diagnoses for RLQP and less awareness of it, accurate assessment of CT features is of utmost importance for management of patients to prevent unnecessary surgeries 1, 9.

### **Inflammatory and Infectious Conditions Involving the Ileocecal Region**

**Appendicitis:** Appendicitis is one of the most common causes of acute abdomen requiring surgical intervention and appendectomy may very well be the most common abdominal operation performed on an emergency basis.

Despite advances in clinical and diagnostic medicine, the diagnosis of acute appendicitis often remains elusive, with many patients undergoing unnecessary appendectomy<sup>10</sup>. The classic clinical triad of migrating abdominal pain, right lower quadrant tenderness, and leukocytosis is absent in half of the patients.

Due to limitations presented by ultrasound in diagnosing appendicitis CT has more reliability for assessing appendicitis. MDCT is the modality of choice in evaluation of appendicitis as it is highly

accurate in diagnosis along with its complications such as perforation and appendicular abscess requiring emergency surgery <sup>7</sup>. The CT findings are in form of an abnormally thickened (>6 mm), enhancing appendix with surrounding inflammatory changes or abscess formation with or without appendicolith [Fig1a].

**Fig1a: Appendicitis in a 24-year-old man with RLQP, nausea, and vomiting. Coronal CT image shows a retrocecal appendix (arrows) with a thick hyper enhancing wall and adjacent fat stranding.**



Current helical CT protocols recognize that diagnosis is greatly facilitated with the use of prospective thin-section (3- to 5-mm collimation) scanning through the right lower quadrant to maximize z-axis resolution and to improve identification of the appendix. The administration of IV contrast material aids in the diagnosis of appendicitis by detection of the inflamed appendix <sup>11</sup>. Administration of oral or rectal contrast material to opacify the cecum and terminal ileum is useful for differentiating the appendix from adjacent bowel. Performing data acquisition through the entire abdomen and pelvis facilitates identification of the appendix if it lies outside the right lower quadrant and also facilitates alternative diagnoses. Studies comparing the use of sonography with CT in patients suspected of having acute appendicitis have generally favored CT for providing greater diagnostic accuracy, superior detection and staging of complications, and higher accuracy for establishing alternative diagnoses <sup>12, 13</sup>

Ileocecal tuberculosis: Due to abundance of lymphoid tissue, the ileocecal region is the common site to be involved. Three forms are identified-ulcerative, hypertrophic or ulcerohypertrophic <sup>14</sup>. The clinical triad is of fever, weight loss and palpable lower quadrant mass. Even though barium studies are specific; MDCT

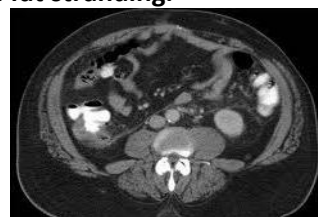
plays a significant role in detecting and characterizing it. CT findings are suggestive of asymmetric wall thickening particularly the medial wall of the cecum with thickening of the ileocecal valve and terminal ileum [Fig 1b].The cecum is shrunken and pulled up out of iliac fossa due to fibrosis of mesocolon. The lymphadenopathy with central areas of low attenuation is characteristic of ileocecal tuberculosis <sup>15</sup>. Ascitic fluid may be present.

**Fig1b: Ileocecal tuberculosis in a 54-year-old man with anorexia, RLQP and weight loss. Coronal CT image shows thickened IC junction with pulled up cecum.**



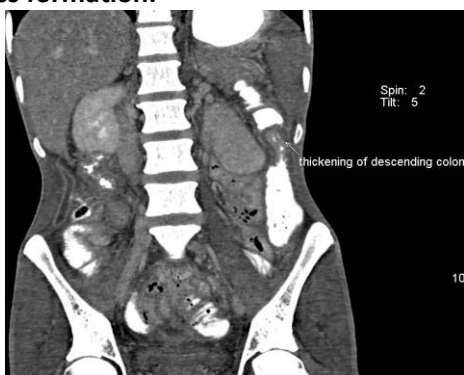
Typhlitis: It may commonly occur due to varied causes such as infection, ischemia, hemorrhage and neoplasms leading to intestinal mucosal damage and may progress to perforation. The typical clinical presentation being a triad of neutropenia, RLQP and fever. This being an emergency due to the risk of perforation, MDCT is the choice of study for its diagnosis <sup>16</sup>. Classical CT finding is distension of caecum with wall thickening and necrosis appearing as low attenuation areas along with mesenteric fat stranding <sup>17, 18</sup>. This finding in addition with peritoneal fluid and pneumoperitoneum warrants perforation requiring prompt surgical intervention <sup>17</sup>. The degree of bowel thickening is much more circumferential and symmetric and length of thickening is much greater in typhlitis as compared to secondary involvement of caecum in case of appendicitis [Fig 1c].

**Fig1c: Typhlitis in a 44-year-old female with RLQP and fever. Axial image shows distension of cecum with circumferential wall thickening and perilesional fat stranding.**



**Crohn Disease:** Inflammatory bowel disease has its peak onset at 15-30 years of age. Chron's disease with acute exacerbations leads to acute abdominal pain, although most patients have chronic symptoms commonly affects ileocecal region in contrast to ulcerative colitis predominantly affecting the descending colon<sup>19</sup>. Commonest CT scan findings are eccentric wall thickening with hyperattenuation of mucosa depicting extension of disease and its severity<sup>20</sup>. Segmental lesions with skip areas are typically indicative of Crohn disease from ulcerative colitis, in which bowel is affected more continuously<sup>20</sup>. Intramural edema indicates active disease while intramural fat is indicative of chronicity<sup>21</sup>. Certain extraenteric findings are characteristic for Crohn disease such as "comb sign" and "creeping fat sign"<sup>22</sup>. Reactive mesenteric lymphadenopathy is also known. Complications associated with Crohn disease such as obstruction, abscesses and enteric fistulas due to small bowel stricture are commonly diagnosed by CT scan [Fig 1d]. MDCT with multiplanar reformation using neutral contrast agents as used for CT enterography can better depict and characterize the fistulous tracts [Fig 1d] while abscess may be confined to bowel wall or may extend to adjacent structures<sup>23</sup>.

**Fig1d: Crohn's disease in a 35-year-old man with RLQP and fever. Coronal image shows thickening of descending and ascending colon with adjacent abscess formation.**



#### Infectious Enterocolitis

A common infectious condition caused by *Campylobacter jejuni*, *Salmonella enteritidis* and *Yersinia enterocolitica* with symptoms having resemblance to viral gastroenteritis requiring urgent attention because of the acute pain indistinguishable from that of appendicitis<sup>24</sup>.

Owing to self-limited nature of disease, CT scan is needed to differentiate from other diseases in patients with persistent pain which shows circumferential thickening with homogenous enhancement of terminal ileum and cecum along with adjacent lymphadenopathy, fat stranding, and minimal ascites may be associated<sup>23,24</sup>

#### Diverticulitis

##### Right Colonic and Cecal Diverticulitis

Lower abdominal pain is the common manifestation of the diverticulitis of the colon in elderly. It predominantly involves left and sigmoid colon, however, less commonly right colon and cecum may be involved thus often confused for appendicitis<sup>25</sup>. CT scan features include circumferential or asymmetric wall thickening of colon with pericolic fat stranding and presence of inflamed diverticula with normal appendix helps to differentiate from appendicitis<sup>26</sup> [Fig 2a].

**Fig2a: Cecal diverticula in a 58-year-old man with right iliac fossa pain and fever. Axial image shows asymmetric wall thickening of cecum with inflamed diverticulum**



The enhancement pattern of thickened colonic wall is preserved along with mesenteric fluid and increased mesenteric vasculature favors diverticulitis against malignancy of right colon or cecum. However, presence of pericolic lymph nodes suggest malignancy rather than diverticulitis<sup>27, 28</sup>.

**Ileal and Meckel Diverticulitis:** Ileal diverticula are less frequent than colonic diverticula, often are multiple and result from mucosal herniation of bowel at sites of vascular entry and thus located at mesenteric border of bowel about 7.5 cm away from ileocecal valve [Fig 2b]. Ileal diverticula

although asymptomatic mimics appendicitis when inflamed and have a tendency to perforate and bleed<sup>29</sup>.

**Fig2b: Ileal diverticula in a 37-year-old man. Coronal image shows normal cecum and inflamed ileal diverticula with mesenteric fat**



Meckel diverticulum commonly occurs due to non-obliteration of omphalomesenteric duct and is seen on anti-mesenteric border 100 cm away from ileocecal valve<sup>30</sup>. CT findings are those of a blind ending pouch having air or fluid with hyperattenuation, mural thickening and adjacent mesenteric fat stranding leading to inflammation [Fig 2c]. Inflammation usually results from enterolith or foreign body causing luminal obstruction mimicking appendicitis. Other complications are mucosal ulceration, bleeding and perforation.

**Fig2c: Meckel's diverticulum in a 24-year female with RLQP. Axial image shows a blind tubular structure with a thickened wall and adjacent fat stranding.**



Appendiceal Diverticulitis

Appendiceal diverticula are uncommon and acquired resulting from increased intraluminal pressure due to proximal obstruction<sup>31</sup>. These are pseudo diverticula due to herniation of mucosa through muscularis layer, perhaps single or multiple and located on mesenteric border of distal part of appendix. Usually seen in older patients and has insidious onset lacking characteristic pain, thus perforation is much more common due to thinner wall of the diverticulum. CT scan reveals outpouching from margin of appendix containing air, fluid or soft tissue. Hyperenhancement of diverticulum wall along with secondary inflammatory changes in appendix misleads the diagnosis of appendicitis<sup>32</sup>.

**Malignancies:** Ileocecal malignancies as the result of complications such as perforation or abscess may present as RLQP. However it is not easy to differentiate between acute inflammation and malignancy at CT scan due to overlapping of findings. Malignancy usually appears as a focal concentric mass with shouldering sign and pericolic nodes while acute inflammation will show a target sign, disproportionate long segmental involvement and adjacent fat stranding more than the degree of wall thickening<sup>33</sup>.

**Adenocarcinoma:** Cecal masses are usually characterized as adenocarcinomas and present in elderly with rectal bleeding, palpable mass and anemia. CT scan shows asymmetric mural thickening of cecum. Perforation of bowel is due to increased pressure proximal to obstruction. Intraperitoneal abscesses are the result of perforation [Fig 3a].

**Fig3a: Cecal adenocarcinoma in a 62-year-old man with sub-acute RLQP and a palpable mass. Axial image shows asymmetric thickening of cecum with abscess as a result of perforation.**



**Lymphoma:** Ileocecal region is the commonest site for lymphomas. It is common in 6<sup>th</sup>-7<sup>th</sup> decade with main features of abdominal pain and weight loss. Four types are noted: circumferential, polypoid, ulcerative and aneurysmal. Commonest is circumferential with areas of thickening along with homogenous enhancement. Signs of obstruction are rarely noted even in presence of a large mass<sup>33</sup> [Fig 3b].

**Fig3b: Lymphoma of the ileocecal valve in a 46-year-old man with RLQP and weight loss. Axial image shows circumferential wall thickening with homogenous enhancement.**



Polypoidal form may lead to intussusception; ulcerative form is known for interbowel fistulas while aneurysmal form shows dilatation in the region of mass<sup>33, 34</sup>. Large retroperitoneal lymphnodes are associated findings.

### **Conditions Affecting the Epiploic Appendages, Omentum, and Mesentery**

#### **Mesenteric Adenitis**

It may be primary or secondary. Primary adenitis is commonly encountered in children who present with RLQP, fever and leukocytosis. A cluster of more than three lymphnodes larger than 5mm in absence of any inflammatory condition is considered the primary adenitis<sup>35-36</sup>. Secondary adenitis associated with many inflammatory conditions is a frequently seen in adults [Fig 4a].

#### **Omental Infarction**

Interrupted blood supply to omentum causes omental infarction, a rare cause of abdominal pain.

Coughing or straining precipitates primary infarction while vascular insufficiency due to trauma, surgery or other causes is responsible for secondary infarction<sup>37</sup>. On CT scan it shows a well-defined, solitary heterogenous fatty mass between anterior abdominal wall and transverse colon in absence of thickening of the adjacent bowel wall<sup>38</sup> [Fig4b].

**Fig4a: Primary mesenteric adenitis in a 30-year-old man. Coronal image shows multiple enlarged mesenteric lymph nodes (arrowheads) without abnormalities in the ileocecal region.**



#### **Epiploic Appendagitis:**

Epiploic appendages are uncommon and usually not seen at CT scan unless inflamed. It may manifests as lower quadrant pain and mimicks appendicitis. CT appearance is of a hypoattenuating pericolonic lesion with hyperenhanced rim<sup>9</sup>.

**Miscellaneous Conditions:** Endometriosis, a common cause of pelvic pain and infertility in women of childbearing age denotes the presence of endometrial tissue outside the uterine cavity. The genital organs are commonly affected. However rectosigmoid colon and ileum followed by jejunum or cecum may be affected<sup>33</sup>. Appendiceal endometriosis is very rare and usually asymptomatic; however, symptomatic patients have symptoms similar to that of appendicitis occurring during menstruation<sup>39</sup>. CT scan findings are of a nonspecific focal mass at tip of appendix in absence of inflammation<sup>40</sup>.

**Intussusception:** A common idiopathic condition of childhood rarely presents in adults as colocolic or ileocolic intussusception mostly secondary to

underlying pathologic condition serving as the leading point as for e.g., lipoma, polyp. Clinically the symptomatology relates to bowel obstruction. CT with multiplanar reformation manifests pathognomonic criteria of a target lesion having bowel-within-bowel appearance with a typical outer layer formed of intussusciens and an inner intussusceptum <sup>41</sup> along with identification of an underlying lead point [Fig 5a].

**Fig4b: Omental infarction in a 28-year-old female. Axial image shows heterogenous fatty mass between anterior abdominal wall and transverse colon.**



**Fig5a: Intussusception in a 29-year-old female with RLQP. Axial CT image shows bowel with in bowel appearance suggestive of ileo-ileal intussusception.**



Cecal Volvulus

Cecal volvulus a rare condition seen in patients having mobile cecum due to abnormal fixation of

posterior parietal peritoneum resulting in closed-loop obstruction. Clinically acute RLQP along with abdominal distension, nausea and vomiting are features suggestive of bowel obstruction <sup>42</sup>. There are three types of cecal volvulus known. In type-I (axial torsion type), cecum twists in axial plane, rotating along its long axis. In type II (loop type), distended cecum twists and inverts. In type III (cecal bascule), distended cecum folds anteriorly without torsion. Plain radiography makes diagnosis in less than 50% of cases while CT has definitive advantage of detecting it easily <sup>43</sup>. In type I and II, distended cecum with swirl of mesenteric vessels are seen while in type III, swirl of vessels is not seen. Circumferential wall thickening, pneumoperitoneum and pneumatosis intestinalis are seen with its complications [Fig 5b].

**Fig5b: Cecal volvulus in 25-year-old man. Coronal CT image shows a dilated cecum (straight arrows) that is twisted along its axis.**



Ischemic Colitis

Gastrointestinal ischemia often leads to ischemic colitis which may be either occlusive (80%) or non-occlusive (20%). However isolated involvement of right colon is uncommon as compared to left colon, mostly it is due to hypovolemic shock, sepsis, renal insufficiency or secondary to vasoconstrictor drugs. Patient's presents with mild to moderate RLQP. CT features in early stages are suggestive of mucosal hyperattenuation due to hyperemia and circumferential bowel thickening due to submucosal edema <sup>44</sup> [Fig 5c-1]. Later on followed by absent enhancement due to vasospasm and intramural gas, gas in portal and mesenteric vessels may be seen. Lastly, pneumoperitoneum presents due to bowel perforation. CT appearance of

vascular obstruction is seen as a focal area of absent opacification in artery or vein <sup>45</sup> [Fig 5c-2].

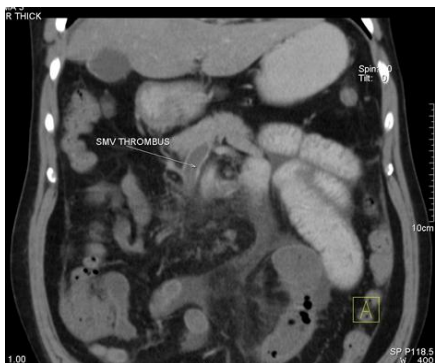
**Peritoneal Inclusion Cysts**

Peritoneal inclusion cysts maybe fairly common but are not well recognized entities on imaging of the female pelvis. Peritoneal inclusion cysts, also known as peritoneal pseudo cysts and inflammatory cysts of the pelvic peritoneum, present with a variety of imaging appearances, which can be confused with various adnexal masses of the female pelvis. Most patients with peritoneal inclusion cysts present with pelvic pain or a pelvic mass <sup>46</sup> and less commonly right lower quadrant pain. Peritoneal inclusion cysts occur mostly in premenopausal women with a history of previous abdominal or pelvic surgery, trauma, pelvic inflammatory disease, or endometriosis. MDCT shows cystic non enhancing lesion with occasional septations [Fig-6a and 6b]. Young women presenting to the emergency department with a right lower quadrant pain should be thoroughly worked up for pelvic pathologies including cystic conditions which may mimic appendicitis

**5c-1: Ischemic colitis in a 70-year-old man with hypovolemia. Axial image shows circumferential bowel thickening.**



**5c-2: Ischemic colitis in a 70-year-old man with hypovolemia. Coronal image shows superior mesenteric thrombosis.**



**Fig 6a & 6b: Peritoneal inclusion cyst in a 28 year old female presenting with chronic pain in the right lower quadrant. Axial images show large lobulated cystic lesion without solid component seen in pelvis on the right side displacing the uterus, rectum and ovaries without septations.**



**Fig 6a**



**Fig 6b**

**Conclusions:** MDCT is a noninvasive method which allows accurate diagnosis of common and uncommon conditions thus providing a new horizon beyond appendicitis and ileo-cecal tuberculosis in patients with RLQP and serves as a boon to surgeons.

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