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**Signs and syndromes in acute appendicitis: A pathophysiologic approach**

Yale SH *et al.* Signs and syndromes in acute appendicitis

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**Abstract**

Physical examination signs have not been well studied, and their accuracy and reliability in diagnosis remain unknown. The few studies available are limited in that the method of performing the sign was not stated, the technique used was not standardized, and the position of the appendix was not correlated with imaging or surgical findings. Some appendiceal signs were written in a non-English language and may not have been appropriately translated (*e.g.*, Blumberg-Shchetkin and Rovsing). In other cases, the sign described differs from the original report (*e.g.*, Rovsing, Blumberg-Shchetkin, and Cope sign, Murphy syndrome). Because of these studies limitations, gaps remain regarding the signs' utility in the bedside diagnosis of acute appendicitis. Based on the few studies available with these limitations in mind, the results suggest that a positive test is more likely to be found in acute appendicitis. However, a negative test does not exclude the diagnosis. Hence, these tests increase the likelihood of ruling in acute appendicitis when positive but are less helpful in ruling out disease when negative. Knowledge about the correct method of performing the sign may be a valuable adjunct to the surgeon in further increasing their pretest probability of disease. Furthermore, it may allow surgeons to study these signs further to better understand their role in clinical practice. In the interim, these signs should continue to be used as a tool to supplement the clinical diagnosis.

**Key Words:** Appendicitis; Signs and symptoms; Psoas; Rovsing; Signs and symptoms; Syndrome

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**Core Tip:** This paper describes the pathophysiologic mechanism of disease presentation and reports the signs of acute appendicitis as initially reported. Physical examination signs and syndromes have not been well studied in patients with acute appendicitis. Knowledge of how to appropriately perform these bedside maneuvers in diagnosing appendicitis may provide further knowledge about the likelihood of the disease. Understanding the mechanism of disease and these bedside maneuvers may further enhance the ability of surgeons to diagnose acute appendicitis.

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### **TO THE EDITOR**

We read with interest the paper by Teng *et al*<sup>[1]</sup> titled “Acute appendicitis-advances and controversies.” Several points regarding the physical examination require further clarification as they pertain to patient management and pathophysiologic mechanism of disease, which are critical in assessment. Additionally, we report information about the signs and syndromes as originally described, emphasizing how they are frequently incorrectly misused, accounting for their underreporting in clinical practice and cross-sectional designed clinical studies.

The presence of right lower quadrant abdominal pain in acute appendicitis is caused by viscerosomatic (visceromotor, viscerosensory) and somatic (somatosensory and somatomotor) segmental reflexes. This pathophysiologic mechanism differs entirely from the usual initial viscerosensory reflex, where the pain is deep-seated, poorly localized, more widespread, and bilaterally distributed at the T8-T10 dermatomes, primarily at the epigastric and umbilical regions. In cases of early appendicitis where

appendiceal distension is abrupt and severe, there may be “spill-over” of visceral to somatic afferent nerve impulses in the dorsal root ganglion, causing efferent activation of alpha-motor neurons and intercostal nerves in the right lower quadrant and abdominal spasm (guarding) in addition to pain at T10-T11 dermatomes (visceromotor and viscerosensory segmental reflexes)<sup>[2]</sup>. It is recognized that this phenomenon occurs in the absence of involvement of the parietal peritoneum. With rupture of the necrotic appendiceal wall, the inflammatory infiltrate may become localized to the parietal peritoneum on the anterior abdominal wall, most commonly at the site referred to as McBurney point located at the right T11-T12 dermatomes (somatosensory reflexes). Hence, these pathophysiologic processes represent entirely different mechanisms reflecting disease progression, not migration, shifting, or radiation; terms commonly used to describe the sequence of events in acute appendicitis and by which they all represent misnomers<sup>[3]</sup>. Although not discussed by the authors, McBurney point is the most important sign because it represents the site on the anterior abdominal wall where the pain is greatest and not the location of the appendix<sup>[4]</sup>. Its presence provides surgeons with reasonable assurance that this finding represents acute appendicitis with peritoneal inflammation.

Murphy syndrome ascribed to John B Murphy (1857-1916) did not involve, as stated by the authors, periumbilical pain radiating to the right iliac fossa associated with nausea or vomiting and fever. Murphy<sup>[5]</sup> described the symptoms of acute appendicitis in their order of occurrence as:

[f]irst, pain in the abdomen, sudden and severe, followed by (second) nausea or vomiting, even within a few hours, most commonly between three and four hours after the onset of pain; third, general abdominal sensitiveness most marked in the right side or more particularly over the appendix; fourth, elevation of temperature, beginning from two to twenty-four hours after the onset of pain (p.190)<sup>[5]</sup>.

He did not however, specify the specific regions (epigastric and periumbilical) within the abdomen involved. We believe that the sequence of pain initially in the epigastrium and periumbilical regions followed by pain in the right lower quadrant was described

by Theodor Kocher (1841-1917), written by Albert Vogel, and attributed to Nikolay Markianovich Volkovitch (1858-1928) and thus named the Kocher-Volkovitch sign. According to Vogel<sup>[6]</sup>:

In our opinion, initial vomiting, and localization of pain in the epigastrium followed by the diffuse spread and gradual fixation in the classical place, McBurney point, occurs because of general peritoneal inflammation. This inflammation should not be confused with the serious type of peritonitis which develops later if the appendix becomes gangrenous or perforates. We can explain the diffuse pain, particularly at the umbilical and epigastric regions, because the appendix is not painful in the first stages of the disease, with the pulling on the peritoneum being the source of pain. Local pain develops if infiltration of the mesentery occurs (p.2-3)<sup>[6]</sup>.

The findings of “rebound tenderness” performed by Dimitri Sergeevich Shchetkin (1851-1923) in the late 1880s and reported by Jacob Moritz Blumberg (1873-1955) in 1907 (Blumberg-Shchetkin sign) also represents inflammation of the parietal peritoneum. Blumberg<sup>[7]</sup> described this maneuver in cases of appendicitis:

Very different results occur when pressure is applied compared to when the palpating hand is raised. In my opinion, it is always necessary to consider these two movements separately based on the type of pain they induce. For example, first, apply pressure on the area of the abdomen to be examined and ask the patient whether it is painful. After listening to the response, suddenly lift the palpating hand and ask the patient whether it was painful when the hand was removed and which of the two types of pain was greatest. (...) I noted an extremely violent pain, causing the patient to momentarily grimace, when the palpating hand was suddenly lifted. During an acute episode, the patient stated with certainty that the pain was greatest when the hand was suddenly lifted compared to when it was pressed. In cases of less severe inflammation involving the peritoneum, the pain when the hand was suddenly lifted was similar to when the hand was pressed. As the healing process progressed, the pain was less when the hand was lifted and finally remained only vaguely present, presumably caused by adhesion, when the hand was lifted. The pain completely disappeared when chronic

disease was present (p.1177)<sup>[7]</sup>. (...) The method can be applied accurately since it is not a matter of assessing the extent of the pain but comparing the intensity of the two pains. This information is reliably conveyed by the patient (p.1178)<sup>[7]</sup>.

Rovsing sign, initially described Niels Thorkild Rovsing (1862-1927), involves deep palpation at the left lower quadrant with a sliding motion directed proximally at the descending colon towards the splenic flexure. As described by Rovsing<sup>[8]</sup> in 1907:

I wondered whether I could elicit the typical <sup>5</sup> pain in the right iliac fossa by applying pressure at the left iliac fossa. This involves compressing the descending colon by pushing the fingers of <sup>2</sup> my right hand onto the fingers of the left hand placed flat against the abdomen in the left iliac fossa. Using this method, the hands slide upward toward the left colonic flexure (p.1258)<sup>[8]</sup>.

Thus, the maneuver involves more than simple palpation of the left iliac fossa as stated by the authors—it causes air within the colon to flow retrograde in response to compression, resulting in distension of the inflamed appendix and activation of a viscerosensory segmental reflex. Rovsing sign is frequently performed incorrectly, explaining the wide sensitivity and specificity reported.

Lastly, the iliopsoas sign described by Vincent Zachary Cope (1881-1974) in 1921 involved the following<sup>[9]</sup>:

<sup>1</sup> It is well known that if there is an inflamed focus in relation to the psoas muscle the corresponding thigh is often flexed by the patient to relieve the pain. A lesser degree of such contraction (and irritation) can be determined often by making the patient lie on the opposite side and extending the thigh on the affected side to the full extent. Pain will be caused by the maneuver if the psoas is rigid from either reflex or direct irritation (p.42)<sup>[9]</sup>.

It is recognized that Cope's original description did not involve having the patient flex the thigh against the examiner's hand in the supine position as stated the authors<sup>[9,10]</sup>. Cope recognized that this test was more likely to be found in cases where the appendix is in a retrocecal position<sup>[9,10]</sup>.

A sensitivity ranging from 0.16-0.27, specificity of 0.86-0.89, positive likelihood ratio 1.49-2.06, and negative likelihood ratio of 0.83-.94 has been reported for the psoas, obturator, and Rovsing sign in the diagnosis of acute appendicitis<sup>[11-15]</sup>. These findings show that a positive test suggests the diagnosis of acute appendicitis, but a negative test does not exclude the diagnosis. Hence, these tests increase the likelihood of ruling in acute appendicitis when positive but are less helpful in ruling out disease when negative. Awareness of the differences between the way these signs were originally reported and how they are currently used provides a better understanding of why gaps remain in the existing literature regarding these signs' effectiveness in the clinical diagnosis. It is imperative that the sign is accurately described in the literature and that the examination method is standardized so that surgeons fully understand and appreciate and further study their role in diagnosing acute appendicitis.

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