

## CLINICAL PRESENTATION AND RADIOLOGY QUIZ QUESTION

A 16 year old girl presents with abdominal pain. During a visit to urgent care, the patient states that the pain started around about four hours before presentation to urgent care. The pain was initially midline and in the upper abdomen. She had accompanying nausea. She has no fever, no cough, sore throat, headache, rash, or swelling, and no urinary symptoms or vaginal discharge. The patient underwent normal menses one week ago. She has had no sick contacts, and has consumed no unusual or suspicious foods. The patient has a remote history of pyloric stenosis repair as an infant and is obese with a BMI of 34 (98<sup>th</sup> percentile). The patient is afebrile and the abdomen is soft with tenderness in the upper quadrants. The white blood count is 7,900 with 67% neutrophils. The patient vomited for the first time during the visit. The patient was sent home with Zofran.

The patient came to the ED 8 hours later with worsening abdominal pain and vomiting. The patient's temperature was 98.3, her pulse 90, her respiratory rate 16, and her blood pressure 139/64. Her abdominal exam showed a soft abdomen with mild upper abdominal tenderness, and no guarding or rebound. There were normal bowel sounds. A complete metabolic panel was negative. The patient was treated with IV fluids, ketorolac, and a soap suds enema and felt better after a bowel movement. She was sent home with a laxative.

The patient returned to the ED 14 hours later with worsening abdominal pain which had become severe and constant, and which radiated into the right lower quadrant. The patient had continued vomiting with no diarrhea. Her temperature was 100, her pulse 109, her respiratory rate 15, and her blood pressure 134/75. The patient now had focal tenderness with palpation and percussion in the right lower quadrant, including referred pain in the right lower quadrant with palpation of the left lower quadrant.

Which imaging study is most appropriate for this patient?

- (a) supine and upright plain film examination of the abdomen
- (b) ultrasound of the right lower quadrant/pelvis
- (c) computed tomography of the abdomen and pelvis
- (d) magnetic resonance imaging of the abdomen and pelvis

<b>RADIOLOGY QUIZ QUESTION, ANSWER, AND EXPLANATION</b>
---

16 year old girl with persistent, worsening abdominal pain (see previous page).

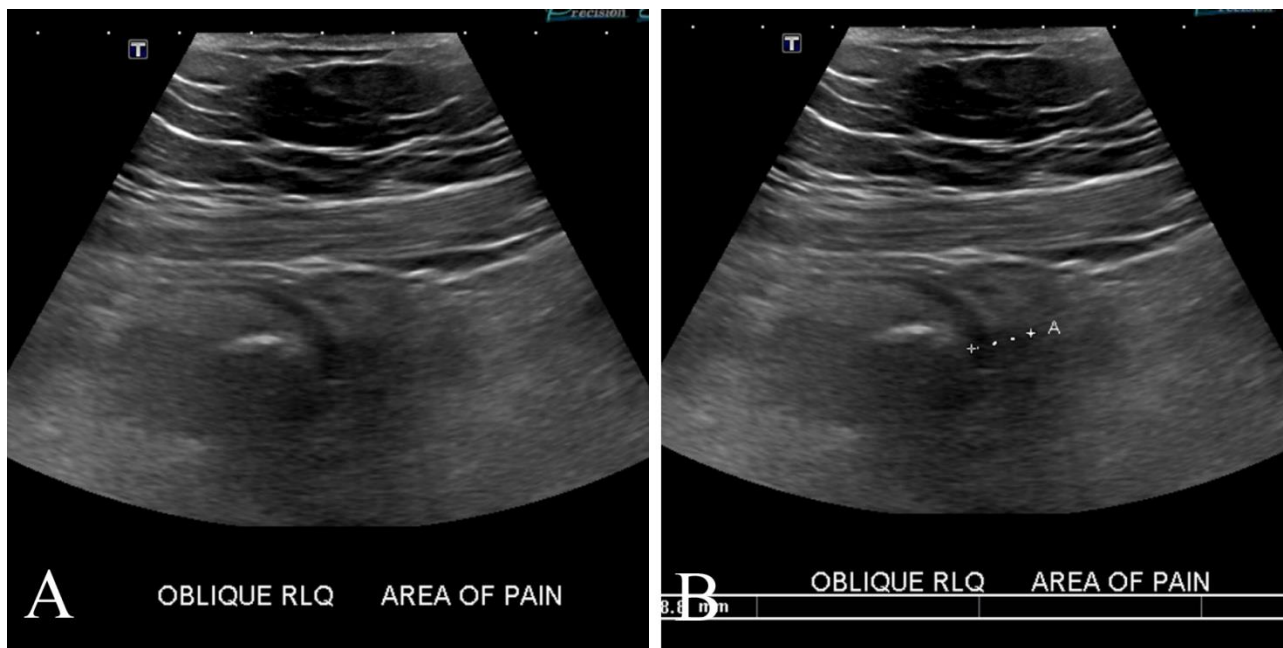
Which imaging study is most appropriate for this patient?

- (a) supine and upright plain film examination of the abdomen
- (b) ultrasound of the right lower quadrant/pelvis
- (c) computed tomography of the abdomen and pelvis
- (d) magnetic resonance imaging of the abdomen and pelvis

Answer: (b), ultrasound of the right lower quadrant, is the correct answer, *if there is local expertise available in pediatric US performed for evaluation of appendicitis*. US examination is currently the study of choice according to the American College of Radiology's Appropriateness Criteria (see Smith et al), and is listed first in current review sites (see, for example, Taylor and Wesson).

Supine and upright plain films examination of the abdomen may be helpful in evaluation of obstruction and free air, but plain films are neither sensitive nor specific in the evaluation of appendicitis and typically add little (other than expense and radiation) to the evaluation of pediatric patients with suspected appendicitis. Therefore, (a) is incorrect. Computed tomography of the abdomen and pelvis is a very helpful exam and is actually marginally superior (in terms of diagnostic efficacy as measured by sensitivity, specificity, and accuracy) than ultrasound. In locations where local expertise in pediatric US is *not* available, CT is a reasonable option. However, because of the radiation exposure associated with CT studies, CT is generally not the first study done on pediatric patients with suspected appendicitis. Therefore, (c) is not the correct answer if you are in an environment that offers pediatric US, but is the correct answer if you are not. MR is also a very helpful examination (it is, like CT, marginally superior to US) and does *not* use radiation, but because of the additional expense, time, and necessity for having the patient remain in a single position for several minutes, MR is generally performed only after US has been performed. Therefore, (d) is incorrect.

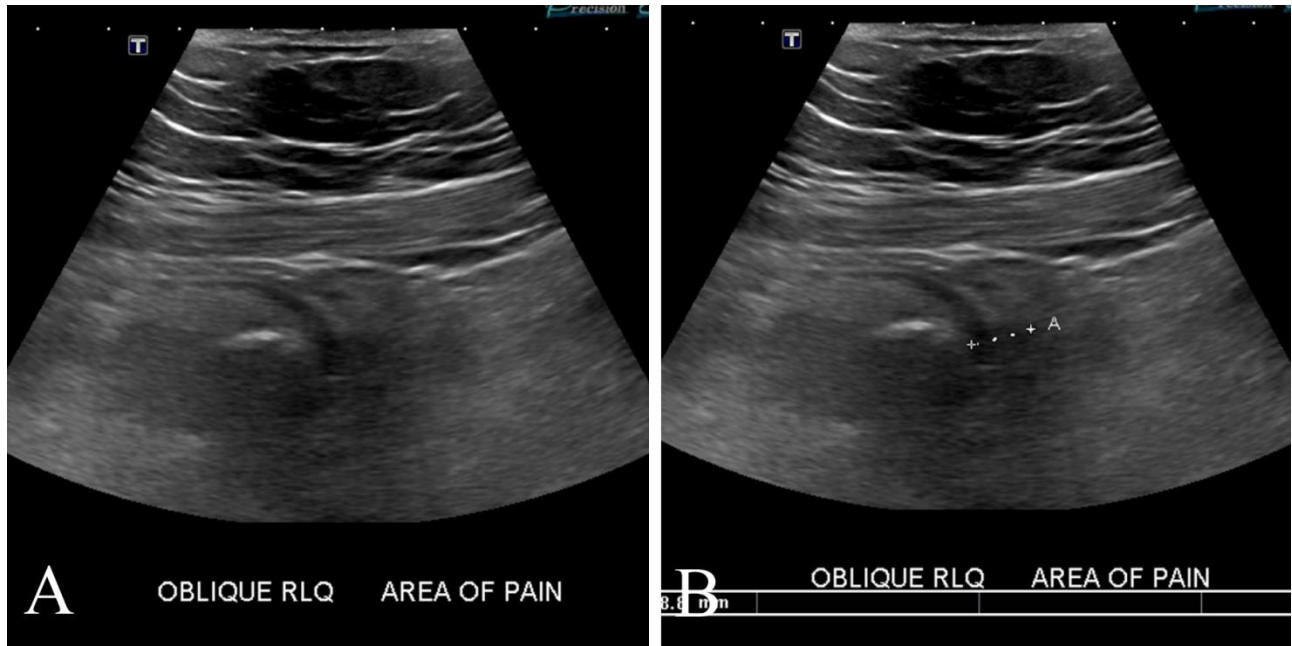
## IMAGING STUDY AND QUESTIONS



Imaging questions:

- 1) What type of study is shown in the figures?
- 2) Are there any abnormalities?
- 3) What is the most likely diagnosis?
- 4) What is the next step in management?

## IMAGING STUDY QUESTIONS AND ANSWERS



### Imaging questions:

- 1) What type of study is shown in the figures? Ultrasound of the appendix, although, as is often the situation with ultrasound studies, if you didn't know that already it would be hard to say.
- 2) Are there any abnormalities? Yes. There is a blind-ending, tubular structure measuring up to 9 mm in diameter (measured in panel B).
- 3) What is the most likely diagnosis? Acute appendicitis.
- 4) What is the next step in management? Surgical referral for likely appendectomy.

<b>PATIENT DISPOSITION, DIAGNOSIS, AND FOLLOW-UP</b>
--

Surgical consultation was obtained and the patient was taken emergently to the operating room where a laparoscopic appendectomy was performed. The resected specimen was interpreted as gangrenous acute appendicitis. The patient made an uneventful recovery.

## SUMMARY

**Presenting symptom:** Abdominal pain, nausea, and vomiting have several causes, including viral gastroenteritis and other self-limited benign causes. In cases when the pain persists (especially if it worsens), becomes localized to the right lower quadrant, and is associated with rebound tenderness, appendicitis must be considered.

**Imaging work-up:** In many cases and when the presentation is classic, it may not be necessary to perform any imaging prior to appendectomy. However, because of the concern to reduce the rate of negative appendectomies, imaging has been more frequently used recently, and preoperative CT has been shown to decrease the negative appendectomy rate (Krajewski et al). Interest in reducing the rate of radiation exposure, in turn, has resulted in use of ultrasound as the initial examination of choice at those locations with local expertise in imaging for appendicitis (as discussed on Page 2). In cases where such expertise is not available or the US study is equivocal, CT or MR are typically definitive.

**Establishing the diagnosis:** The diagnosis is secured by evaluation of the resected appendix. In those cases where the appendix is not resected and the pain resolves, it is usually assumed that the patient did *not* have appendicitis, although there is controversy regarding this issue.

**Take-home message:** US is currently the initial study of choice for imaging pediatric patients with suspected appendicitis, although CT is an excellent alternative in those locations where expertise in abdominal US performed for appendicitis is lacking, and as a back-up examination when US is nondiagnostic.

## REFERENCES

Krajewski S, Brown J, Phang PT, Raval M, Brown CJ. Impact of computed tomography of the abdomen on clinical outcomes in patients with acute right lower quadrant pain: a meta-analysis. *Can J Surg.* 2011;54(1):43-53.

Smith MP, Katz DS, Rosen MP et al. Right lower quadrant pain – suspected appendicitis. ACR Appropriateness Criteria, available through [www.acr.org](http://www.acr.org), accessed 5/17/2014

Taylor GA, Wesson DE. Acute appendicitis in children: diagnostic imaging. UpToDate, accessed 2/21/14.