EVMS EM JC CRITICAL REVIEW FORM:

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Citation: Rud B et al. Computed tomography for diagnosis of acute appendicitis in adults. Cochrane Database Syst Rev. 2019 Nov 19;2019(11)

Background:
Abdominal pain is a common ED complaint and appendicitis is a common cause of abdominal pain with an overall lifetime risk of approximately 7.0%. There are classic set of symptoms and findings associated with appendicitis such as RLQ pain (LR= 7.3-8.4) but the diagnosis it isn't so straight forward particularly in women of child-bearing age. There are different practice patterns in regards to imaging especially depending on country of practice. For example, the UK has a pre-operative CT rate of 12% compared to over 90% in the US which likely reflects lower risk tolerance for missing intrabdominal pathology and higher laparoscopy rates in the UK. The use of different imaging modalities can affect time to diagnosis and ultimately, time to OR. Different imaging modalities are used internationally, including ultrasound and MRI with ultrasound considered a first line in children. In the United States, we most commonly use CT and most practitioners use contrast-enhanced CT's. With the advent of multi row CT scanners sensitivity of CT has improved dramatically bringing into question the need for contrast enhancement and its potential risks and inherent delays. More recently, a national shortage of IV contrast in the US prompts us to ask whether ED patients undergoing CT for suspected acute appendicitis are appropriate candidates for deferral of the use of IV contrast.

Study Objectives: To explore the following questions:
Primary: How accurate is CT abd/pelvis for diagnosis of appendicitis?
Secondary: to compare the accuracy of contrast-enhanced versus non-contrast-enhanced CT, to compare the accuracy of low-dose versus standard-dose CT, and to explore the influence of CT-scanner generation, radiologist experience, degree of clinical suspicion of appendicitis, and aspects of methodological quality on diagnostic accuracy

Study Methodology:
A systematic review compiles a large body of evidence meeting pre-determined eligibility criteria. This systematic review included prospective studies selected from MEDLINE and Embase databases that compared the sensitivity of using CT to diagnose/confirm diagnosis of suspected appendicitis measured against histological findings of appendicitis, laparoscopic intraoperative findings, or clinical follow-up in non-operative cases. The targeted population was patients above the age of 14. It excluded studies that had mixed adult-pediatric populations with pediatrics composing more than 10% of the mixed population. It also excluded studies including only pregnant women and patients with generalized findings/no specific concern for appendicitis. It also excluded studies that aimed to differentiate accuracy of CT in cases of simple versus complicated appendicitis. The authors adhered to the Quadas-2 tool for quality of systematic reviews.

Randomization and Blinding:
Studies were selected for inclusion by two individual reviewers and graded using a tool called the Quality Assessment of Studies of Diagnostic Accuracy (QUADAS-2). This looked at four different elements, which were patient selection, index test, reference standard, flow and timing. This tool was used to minimize bias and increase applicability.

What were the results:
The authors included 64 studies with a total of 10,280 participants. The methodological quality

was generally poor, particularly with respect to the index test which ranged from non-helical or single row detectors in 22 studies to multirow detectors in 35 (ranging from 2-265). Reference test standard such as appropriate follow-up period in those not undergoing surgery was not reported in 42 included studies.

Overall summary sensitivity/specificity of all CT modalities:
Sensitivity 0.95 (CI 0.93 to 0.96),
Specificity was 0.94 (CI 0.92 to 0.95)
Positive likelihood ratio was 15 (CI 12 to 19),
Summary negative likelihood ratio was 0.05 (CI 0.04 to 0.07)

CT with IVC enhancement vs no IVC
Sensitivity was 0.96 (CI 0.92 to 0.98) vs. 0.91 (95% 0.87 to 0.93)
Summary specificity was 0.93 (CI 0.90 to 0.95) vs. (0.94 (95 CI 0.90 to 0.96).

Non-helical CT-scanner or a helical CT-scanner with less than 16-detector row technology
Summary Sensitivity: Was statistically significantly higher for the 16 detector CT scans than for the non-helical (P =0.02).
Summary Specificity: There was no statistically significant difference between groups (P= 0.63)

Influence of Radiologists experience:
Senior radiologists: Sensitivity 0.97 (CI 0.95 to 0.98) and Specificity 0.95 (95% CI 0.93 to 0.97),
In-training radiologists: 0.92 (95% CI 0.80 to 0.97) and 0.91 (95% CI 0.86 to 0.94), respectively.

There is no statistically significant difference between low and standard dose CT.

Use of contrast does not affect specificity.

Applicability to my patient care:
Enhanced CT may be more sensitive (true positives) than unenhanced for appendicitis. This finding is something to keep in mind however when combined with clinical suspicion which was not measured in this systematic review is the sensitivity difference meaningful?

So theoretically, the absolute risk reduction (ARR) between the two modalities is 0.96 vs. 0.91=0.05 so the NNT= 1/ARR or 20 which means 20 patients would need to get IVC to detect an interpretable difference between the two modalities. So, does this add meaningful data to a patient-centered discussion regarding the use if IVC when ordering CT's in this patient population?

Low-dose CT (selectively imaging upper or lower abdomen) demonstrated NO difference in sensitivity or specificity and should be consider.

Strengths:
This study has the strengths of a systematic review, in that is has very specific inclusion criteria and compiles a large amount of evidence using a validated QUADAS-2 tool
It also considers a variety of relevant factors that may affect the sensitivity of CT for appendicitis and how those may be confounding variables. Retrospective studies were not included in the analysis, which may have helped to limit confirmation bias.

Weaknesses:
Many of the included studies were of poor methodological quality and there was a great deal of heterogeneity when comparing CT scanners, follow-up, seniority of interpreting radiologists predisposing to bias across the QUADAS-2 domains particularly with respect to the reference standard (histology of resected appendix/intraoperative findings/clinical follow-up) and flow and timing. There was a loose definition of clinical follow-up as defined for the reference standard across many of the studies included, which could lead to a falsely higher sensitivity.

My Clinical Bottom Line:
Contrast-enhanced CT for the diagnosis of acute appendicitis appears to provide a small (0.96 vs.0.91) but statistically significant advantage over non-contrast CT. In the context of a IVC contrast "crisis" and with adequate patient-centered decision making and close follow up, it may be reasonable to defer IVC in patients presenting to the ED with clinical evidence of acute appendicitis