

Feasibility of Emergency MRI for Suspected Appendicitis in Pregnant Women

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The diagnosis of acute appendicitis is especially challenging in pregnancy due to the non-specific clinical presentation and the anatomic displacement by the gravid uterus. There is no substitute for sound clinical judgment in the management of patients with an acute presentation. Despite improvements in clinical and laboratory diagnostic tools [1,2], medical imaging is crucial for the diagnosis of appendicitis in pregnancy [3]. In the pediatric population and during pregnancy, ultrasound is the initial modality of choice due to its availability, ease of performance, and absence of ionizing radiation [4]. However, especially in pregnant women, ultrasound lacks the requisite sensitivity and accuracy due to its inability to locate the appendix in many cases [5].

In view of safety considerations, MRI for pregnant women should be performed without gadolinium injection. The use of MRI in pregnant patients at field strengths higher than 1.5 Tesla is somewhat controversial. Although there are no known risks of non-contrast MRI at either 1.5T or 3T in pregnancy, a high level of caution suggests that pregnant patients be scanned at 1.5T due to concerns of greater deposition of radiofrequency energy (specific absorption rate) at 3T [6].

MRI has been shown to be highly accurate in diagnosing acute appendicitis [7,8] and is therefore associated with a signifi-

cant decrease in both length of hospital stay and negative laparotomies [9,10]. It was also proved to be cost-effective [11]. The major drawbacks of MRI are the limited availability of MRI scanners, long scanning time, and limited availability of abdominal MRI radiologists around the clock.

In this issue of *IMAJ*, Amitai et al. [12] present their institutional experience in the workup of suspected appendicitis in pregnancy in order to determine the appropriate selection of imaging studies. They attempted to address the limitations of MRI utilization using a diagnostic pathway that ensures the availability of MRI performance and interpretation around the clock for pregnant women suspected of having acute appendicitis. In order to overcome the shortage of abdominal MRI specialists, some of the cases were initially interpreted by a general radiologist with limited training, and only later confirmed by an abdominal MRI specialist.

This retrospective study included 49 consecutive pregnant women with clinically suspected appendicitis who initially underwent an ultrasound scan to detect signs of appendicitis. If the ultrasound was negative but the case still highly suspicious, or, in most patients, if the ultrasound was positive, the patient proceeded to the MRI scan.

The scanning protocol used in the study included T2, SSFP and FSPGR at multiple planes, as well as T2 with and without fat saturation. In a few cases MR venography was used to differentiate between the appendix and adjacent vascular structures, particularly the ovarian vein. However, this approach was subsequently abandoned due to the impression that the addition of MR venography to the protocol did not improve the accuracy for detecting acute

appendicitis. In some cases, oral contrast (mannitol) was given prior to the scan. The impression of the authors was that oral contrast facilitated recognition of the right lower quadrant anatomy and detection of the appendix. However, there are no data indicating improvement in the accuracy of the scan, nor was this tested in this study. The use of oral contrast should be weighed against the potential delay in diagnosis and the potential discomfort/compliance limitations.

Diffusion weighted imaging (DWI) was not used in this study. DWI has been shown to have potential benefit when scanning the pediatric and general population with suspected appendicitis [13,14]. As of this writing, no studies have been conducted on DWI utilization in the pregnant population.

How reliable are the results? The reference standard was operative findings or clinical follow-up. The time between the ultrasound and the MRI ranged between 2.5 and 13 hours, thereby achieving the authors' desired goal of up to 12 hours interval. The reports of the non-abdominal radiologists were concordant with those of the abdominal MRI specialists and with the final diagnosis.

Of 49 women included in the study, 5 were positive. All five were detected by the MRI. One borderline case was negative at surgery and there were no false negative cases, indicating excellent performance with 100% negative predictive value and 87% positive predictive value. These results are concordant with previous reports and reinforce the recommendation to use MRI more liberally for this indication [8-11,15].

During the course of the study, the management policy changed in favor of performing MRI also for patients with positive

ultrasound results, despite the reported high specificity of ultrasound for this indication [16]. The authors do not explain the added value of ultrasound in this management pathway.

In this study five women had ultrasound findings that suggested appendicitis, but only one of them was positive (at surgery); the others were negative (on MRI and with clinical follow-up) thereby preventing unnecessary surgery. These results are surprising since ultrasound is usually very specific for the diagnosis of acute appendicitis [16].

The one caveat regarding false positive cases on ultrasound is that appendicitis may resolve spontaneously. Among the five patients with appendicitis suspected on ultrasound, three had negative MRI scans for appendicitis and resolution on follow-up, and one case with equivocal MRI findings showed clinical improvement on observation. Because the MRI and ultrasound were discrepant, conclusions from these five cases might be questioned.

The results of this study suggest that ultrasound does not influence the diagnostic outcome. The authors could conclude from their results that ultrasound does not allow triage and that MR may be performed as the first imaging modality in pregnant women with suspected appendicitis. Other studies suggest that ultrasonography has a better specificity and positive predictive value than what is reported here [5,9,15].

Four of the five positive cases were not detected on ultrasound. These results are concordant with previous reports showing very low sensitivity of ultrasound in this patient group due to displacement by the gravid uterus especially in the third trimester. This finding suggests that MRI rather than ultrasound should be the first imaging study for pregnant women with suspected appendicitis.

This study has limitations including the relatively small sample size of 49 cases and the heterogeneous MRI protocols that were followed. Although the enrolment was consecutive, the 49 cases should probably be stratified by gestational age, or perhaps by trimester as the degree of difficulty in diagnosis increases as pregnancy progresses toward term. The equipment, technique as well as the diagnostic criteria of the ultrasound study were not reported.

CONCLUSIONS

This study validates the feasibility of the suggested clinical/imaging algorithm providing around-the-clock MRI scanning and interpretation. It demonstrates that the performance of MRI is highly accurate, consistent with peer-reviewed medical literature. The low sensitivity of the ultrasonography shown in this and previous studies may justify more liberal use of MRI; and the low specificity and high false positive rate of ultrasound in this study support recommendations to use MRI as the first imaging modality for pregnant women suspected of having appendicitis [17,18].

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“If you want to know what a man’s like, take a good look at how he treats his inferiors, not his equals”

J.K. Rowling (born 1965), British novelist, screenwriter and film producer best known as the author of the *Harry Potter* fantasy series. The books have gained worldwide attention, won multiple awards, sold more than 400 million copies, and are the best-selling book series in history