Review

Suspected appendicitis in pregnancy

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ABSTRACT

Aim: Acute appendicitis is one of the most common acute surgical presentations. However investigation and management is sometimes confounded in a pregnant patient. Appendicitis in pregnancy is often managed jointly by both the surgical and obstetric teams, which can lead to discrepant pathways, which may be detrimental to the patient. This review sets out to identify the normal physiological changes of pregnancy that pose diagnostic and therapeutic difficulties to the clinician, assess the more common differential diagnoses and review the current evidence to assist achieving a swift diagnosis and appropriate treatment.

Methods: A literature review of the investigation and management of suspected appendicitis in pregnancy was undertaken. Guidelines by the relevant surgical, obstetric and radiological societies were also reviewed.

Results: There remains no consensus on the best diagnostic pathway for appendicitis in pregnancy; which is unsurprising given that appendicitis in non-pregnant patients can yield diagnostic conundrums. However this review identifies a role for MRI scanning as a useful adjunct in these patients. The increasing role of laparoscopy in these patients is also becoming more apparent.

Conclusion: Appendicitis in pregnancy remains a complex problem necessitating a close working relationship between various specialties to achieve the best outcome for mother and fetus.

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Introduction

Acute abdominal pain in pregnancy presents a diagnostic and therapeutic challenge to the clinician. A serious cause of acute abdominal pain in pregnancy is an acute appendicitis. These patients are often managed jointly by surgical and obstetric teams. However, depending on service provision they are usually admitted under a parent team which could either be surgical or obstetric; leading to discrepant investigative and management pathways.

The aim of this paper is to review the current literature on appendicitis during pregnancy and discuss investigative and management strategies.

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http://dx.doi.org/10.1016/j.surge.2013.11.022
Background

Acute appendicitis is seen in approximately 1 in 1700 pregnancies; and is most common in the second trimester of pregnancy. Appendectomy is the commonest non obstetric operation performed during pregnancy. Prompt diagnosis and appropriate management of acute appendicitis in pregnancy is vital to reduce the potential risks to both mother and fetus.

Maternal and fetal outcomes of appendicitis during pregnancy

Acute appendicitis in pregnancy has been proven to be associated with adverse pregnancy outcomes. A study of 908 women with an acute appendicitis during pregnancy reported an increased frequency of adverse outcomes for the fetus compared to healthy pregnant women. These included an increased frequency of; Small for Gestational Age (SGA), Low Birth Weight (LBW), preterm labor and major congenital anomalies of the fetus. Congenital abnormalities were only seen in women with acute appendicitis in the first trimester of pregnancy. SGA and LBW are significant as they are both associated with higher rates of infant mortality.

Appendicular perforation is a major risk factor related to both fetal morbidity and mortality. Literature suggests that perforation becomes more common in successive trimesters. Uberrueck et al. reported an overall perforation rate of appendicitis in pregnancy of 14.9%; with perforation rates of 8.7%, 12.5% and 26.1% during the three trimesters respectively. These findings suggest that diagnosis may become progressively more difficult during the length of pregnancy; also there may be reluctance for surgeons to operate on patients in the second and third trimesters of pregnancy, leading to delays in treatment and increasing the risk to both mother and fetus.

Diagnostic challenges

Acute appendicitis is traditionally a clinical diagnosis. However there is a broad list of differential diagnoses in non-pregnant pre-menopausal women presenting with acute abdominal pain; posing a diagnostic challenge. Clinical scoring systems such as the Alvarado scale have been designed to predict the likelihood of appendicitis in view of the relevant clinical and biochemical findings. However there is no validated score for use in pregnancy. Secondly the Alvarado score is not widely used and diagnostic uncertainty is commonplace.

The diagnostic challenges of an acute appendicitis are amplified in pregnancy due to the anatomical and physiological changes that occur. The gravid uterus displaces the normal position of the appendix making examination findings variable and minor complaints of normal pregnancy such as nausea, vomiting and anorexia cannot be distinguished from common symptoms of appendicitis. Biochemical findings are also unreliable with a leukocystosis often seen in normal pregnancy and a raised c-reactive protein not directly linked to inflammation.

There is a wide range of differential diagnoses for patients with lower abdominal pain in pregnancy (Table 1). Some require urgent intervention whereas others can be treated conservatively.

Diagnostic tools

History and examination are the foundations for clinical diagnosis of acute appendicitis. In addition an obstetric history should be sought and any concerns over the fetus should be fully investigated by the obstetric team. A detailed history and examination is vital to differentiate between the broad diagnoses in Table 1. Diagnostic tools including biochemical tests and radiological investigations can be useful adjuncts to history and examination.

In the general population the reported negative appendicectomy rate based on histological findings after clinical diagnosis alone is as high as 25%. Biochemical investigations are relatively cheap, non invasive and readily available. However as alluded to earlier in this article a leukocystosis and raised c-reactive protein are common findings in a healthy pregnancy. The trend in inflammatory markers is a more helpful guide when observing these patients. Urine analysis is imperative to exclude a urinary tract infection as the cause of acute abdominal pain.

In non-pregnant patients who have had computer tomography (CT) imaging prior to appendicectomy, the negative appendicectomy rate is reported to be as low as 4%. These findings highlight the benefit of radiological imaging in confirming a diagnosis of appendicitis and reducing the false positive rate. The different radiological investigations are discussed below.

Radiological — Ultrasound Sonography Scan (USS)

USS is a quick and safe imaging modality for use in pregnancy and can be used to help diagnose appendicitis and also diagnose other conditions that may present as acute abdominal pain. Findings such as an ovarian torsion or large ovarian cyst can then be treated appropriately.

As with the non-pregnant population, classic findings of appendicitis on USS are a dilated, aperistaltic, non-compressible, blind ending tubular structure arising from the caecum.
Traditionally USS has been used as the first line investigation for suspected appendicitis in pregnancy.\textsuperscript{18,19} However there are a number of more recent studies which show large proportions of USS reported as indeterminate as they cannot visualize the appendix. Studies vary significantly in the number of USS reported as indeterminate from 7% to 96%.\textsuperscript{16,18–20} This wide variation in indeterminate scans may be due to both operator dependent factors and also patient factors such as the trimester of pregnancy, obesity and anatomical variations of the appendix.

**Radiological – Computer Tomography (CT)**

CT scanning has been shown to dramatically improve negative appendectomy rates when used in the non-pregnant population. There has also been work evaluating its use in diagnosing appendicitis in pregnancy; one study reviewed the rates of negative appendectomy in pregnancy in three groups, the first had primary clinical diagnosis, the second had clinical plus USS and the third group had clinical, USS and CT scan. The negative appendicectomy rate was of 54%, 36%, and 8% respectively in the three groups (p value < 0.05). Following their findings they recommend a CT scan for all patients with a clinical suspicion of acute appendicitis during pregnancy in which USS has been inconclusive or normal.\textsuperscript{20}

However, although CT has been found to be reliable at diagnosing appendicitis in pregnancy the radiation exposure to the fetus is unacceptable. Radiation from an abdominal CT scan ranges from 10 to 20 mSv (sievert) which is comparable to 500–1000 chest radiographs and has been linked with a doubled risk to the fetus for the development of childhood cancer.\textsuperscript{21,22}

**Radiological – Magnetic Resonance Imaging (MRI)**

Recent studies have shown MRI to be safe in pregnancy and have a higher specificity and sensitivity for diagnosing appendicitis in pregnancy than USS.\textsuperscript{23,24} Specific MRI protocol for evaluation of the appendix is described by Dewhurst et al.\textsuperscript{25}

Available data reporting on the use of MRI for diagnosing appendicitis in pregnancy show sensitivity and specificity rates ranging from 50% to 95% and 93%–100% respectively.\textsuperscript{23,24,26,27}

A study reviewing the diagnostic accuracy of MRI in regards to the negative appendicectomy rate and perforation rate found 0% and 8% respectively.\textsuperscript{28}

The drawback of MRI is that it is complex to interpret and relies on radiologists that have undergone dedicated MRI training. Also many institutions do not have MRI scans available out of hours. Therefore the trend has been to USS pregnant women with lower abdominal pain in the first instance. USS can be useful to exclude differential diagnoses, however if inconclusive and clinical concern persists then MRI has a higher sensitivity and specificity to diagnose acute appendicitis.

**Surgical**

Surgery can be both diagnostic and therapeutic; especially with the increasing role of laparoscopy and laparoscopic appendectomy. If the diagnosis is made of an acute appendicitis or if the diagnosis is still inconclusive but the patient requires acute intervention then proceeding to surgery is the next step.

Historically surgery was often delayed until the second trimester in order to reduce the rates of spontaneous abortion and preterm labor.\textsuperscript{29} However, recent literature suggests that pregnant patients may undergo laparoscopic surgery safely during any trimester without undue risk to the mother or fetus.\textsuperscript{30–33}

It is imperative that the patient and partner are briefed in detail by the parent team regarding the diagnosis. If the plan is to observe or to operate then clear information on the risks associated to both the mother and the fetus must be given. The patient and their partner need to make an informed decision regarding their treatment. Confounding variables such as it being an IVF pregnancy may influence the patient decision. It is also paramount that there is comprehensive communication between the surgical and obstetric teams. Both teams need to be available to intervene if required.

**Conservative management**

Although the majority of the surgical community would use surgery as a definitive treatment for acute appendicitis there are a growing number of studies in the non-pregnant patient suggesting a place for primary conservative management.\textsuperscript{34,35} A meta-analysis of patients with acute uncomplicated appendicitis treated conservatively with antibiotics alone showed a relative risk reduction of 31% for antibiotic treatment compared with appendicectomy. No significant differences were seen for treatment efficacy, length of stay or risk of developing complicated appendicitis. The risk of a recurrent appendicitis was 30% within 1 year.\textsuperscript{34}

There is limited evidence regarding primary conservative management of appendicitis in pregnancy, with only a handful of cases currently available in the literature. One report by Fulton et al. in 2010 described a patient at 32 weeks gestation treated with CT guided drainage and IV antibiotics for a perforated appendix following a lengthy symptom course. The patient later went into preterm labor and delivered at 33 weeks. Although the report’s conclusion offers support for the role of conservative management in cases of complicated appendicitis in pregnancy, there is still insufficient evidence to go alongside this for recommending conservative treatment as a primary consideration in appendicitis during pregnancy.\textsuperscript{36}

Therefore the treatment plan currently for pregnant patients with suspected appendicitis is to proceed to appendicectomy; open or laparoscopic. The major benefit of laparoscopy over open procedures is the ability to perform a diagnostic laparoscopy and diagnose possible differentials. In addition to the conclusions made by recent studies, guidance from the Society of American Gastrointestinal Endoscopic Surgeons (SAGES) now fully supports the use of laparoscopy in pregnancy; reporting it as safe to perform during all trimesters of pregnancy.\textsuperscript{37,38}

**Suggested pathway for pregnant patients with a possible appendicitis**

History, examination and biochemical investigations are always the first line investigations for any patient with abdominal pain. In pregnant women they should all be
reviewed by an obstetrician at the earliest opportunity. If appendicitis is suspected, the flow diagram (Fig. 1) demonstrates a suggested management pathway.

**Conclusion**

Acute appendicitis in pregnancy poses risks to both the mother and fetus. It is imperative that as clinicians we promptly diagnose and treat these patients to prevent adverse outcomes. The challenges presented by the anatomy and physiology of pregnancy can lead to delays in diagnosis and treatment. Delay in diagnosis of acute appendicitis can lead to perforation and worse outcomes. Radiological imaging can provide useful information for the clinician to help diagnosis. This review highlights the use of USS as a primary imaging technique as it is inexpensive, readily available and useful at visualizing pelvic organs to exclude differential diagnoses. However the rate of indeterminate scans for diagnosis of appendicitis is high therefore MRI has become more popular.

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**Fig. 1 – Flow diagram for investigation and management of suspected appendicitis in pregnancy.**
and provides a safe and reliable alternative for diagnosing acute appendicitis in pregnancy. A good working relationship between surgical and obstetric teams is paramount in ensuring that the patient and fetus receive optimal care. Effective communication throughout the admission is imperative to ensure the mother and partner are well informed and the appropriate surgical and obstetric teams are kept up to date with developments.

REFERENCES