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Case Study

Conservative versus surgical management of appendicitis during pregnancy

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Key Learning Points
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1. Women presenting with appendicitis in pregnancy have a higher risk of perforation
2. MRI scanning can reduce the number of negative appendicectomies by 50%
3. Surgery can now be safely performed in all trimesters, however, open surgery has lower miscarriage rates than laparoscopic
4. Conservative treatment with antibiotics may permit a safe interval appendicectomy post-partum thereby reducing risk to both mother and child

Abstract

Acute appendicitis is the most common non-obstetric surgical emergency during pregnancy. This report presents a case of conservative management of appendicitis during pregnancy. The aim is to discuss the role of conservative treatment for a condition that is routinely treated surgically. This is important because research on the management of appendicitis during pregnancy is limited compared to the general population. Conservative management can be a safe option for uncomplicated appendicitis. However, the increased risk of appendix perforation in pregnancy and implications for foetal health commonly make surgery a more attractive option. This risk is a key driver for higher rates of negative appendectomies during pregnancy. Conservative management was heavily utilised at the start of the COVID-19 pandemic. Following up pregnant patients in this cohort would provide valuable data into the risks and benefits of conservative versus surgical management.

Introduction

Acute appendicitis is the most common abdominal surgical emergency worldwide. In the UK, around 50 000 acute appendectomies are carried out each year[1]. During pregnancy it is one of the most common non-obstetric surgical interventions[2] and about 50% of cases present during the second trimester[3]. Surgical intervention is more common than conservative management, even in pregnancy, when diagnosis is more challenging and there are a greater range of surgical complications. Despite this, treatment outcomes for appendicitis are understudied in pregnancy compared with the general population. This article presents a case of conservative management during pregnancy and contrasts the benefits and risks of this approach compared with surgical intervention.

Case history

In 2016, a 23 year old patient presented with acute appendicitis while in her third trimester. She presented with diffuse abdominal pain, nausea, vomiting and anorexia. The diagnosis was confirmed by ultrasound. Due to the difficulty of operating at this stage of pregnancy and the risk to the foetus she was managed conservatively with antibiotics and analgesia. She had complete resolution of her symptoms and continued her pregnancy to term, delivering a healthy baby. She was informed of the risk of reoccurrence but experienced no further symptoms in the following 5 years.

She re-presented in February 2021, experiencing the similar symptoms as her previous appendicitis. She reported a one day history of progressively worsening abdominal pain, which migrated to the right iliac fossa. She also experienced loss of appetite, nausea, but no vomiting. She hadn't experienced any recent weight loss; she had no bowel or urinary symptoms. The patient didn't take any regular medication or have any allergies. Her only relevant medical history was her previous appendicitis.

On examination her abdomen was soft with marked percussion tenderness and localised guarding in the right iliac fossa. She had a NEWS score of 1 for tachycardia and the rest of her observations were normal. She had a negative pregnancy test, and her urine dip was negative for leukocytes and nitrites.

Blood tests showed a white cell count of 15.8 x109/L and a CRP of 2. The rest of her results were normal. Given her clinical presentation, combined with her history of appendicitis, she was taken to theatre for a laparoscopic appendicectomy and experienced no complications following discharge.

Overview of appendicitis

Appendicitis is an acute inflammation of the

appendix. Between 0.05% and 0.07% of women experience appendicitis during pregnancy[4]. Luminal obstruction of the appendix is thought to be the main cause. The obstruction causes appendix distention leading to increased mucus production, growth of bacteria and inflammation. Complex appendicitis with appendix perforation is more common in pregnancy. Up to 55% of pregnant women experience perforation compared to 4 – 19% of the general population[5].

Symptoms

Common symptoms of appendicitis include abdominal pain, nausea, vomiting, anorexia, diarrhoea, constipation and low grade fever. Appendicitis is more difficult to diagnose during pregnancy because many of the symptoms such as nausea and vomiting are similar to those experienced in pregnancy. Classically in the general population, pain starts as a dull peri-umbilical pain that later localises to the right iliac fossa.

Later in pregnancy, cases are less likely to present with classic appendicitis symptoms. For instance, as the uterus grows it pushes the appendix higher, so pain may occur in the upper abdomen instead of the right lower quadrant. Abdominal guarding is often less prevalent because as the uterus grows it lifts the anterior abdominal wall away from the inflamed appendix. The anatomical differences in pregnancy also make the classic signs of appendicitis such as Rovsing's sign and rebound tenderness less useful in making a diagnosis. These differences are illustrated in Fig 1[6].

Investigations

Diagnosis is often made based on clinical assessment, which as Fig 1 demonstrates can be misleading in pregnancy. Imagery and blood tests are available to aid diagnosis. In the general population leucocytosis greater than 10x109/L is an indicator of acute appendicitis. In pregnancy leucocytosis can be misleading because leucocytosis is normal in pregnancy and can exceed 17x109/L. During labour it may be as high as 29x109/L without any underlying health issues[6].

CT is the most accurate method of diagnosis. In the general population the accuracy is between 91 – 95% with a specificity of 90 – 95%[7]. However, due to the radiation exposure from CT, ultrasound is the preferred method in children and pregnant women. The ultrasound sensitivity for appendicitis in pregnancy has a wide range between 67-100% and a specificity between 83-96%[8]. The large variability in sensitivity is due to the increasing difficulty in visualising the appendix with increasing gestational age. Ultrasound confers the added benefit of providing information on foetal health and ruling out obstetric causes of abdominal pain. For inconclusive cases MRI should be used because it avoids ionizing radiation. The routine use of MRI reduces the negative appendectomy rate in pregnancy by almost 50%[6]. MRI also has excellent sensitivity (91%) and specificity (98%) for appendicitis in pregnancy[8].

Diagnosis & differentials

Making an accurate diagnosis is challenging in pregnancy because the typical clinical presentation is only seen in 50-60% of pregnancies[3] and there are a wider range of pregnancy specific differentials to exclude. In early pregnancy, ectopic pregnancy must be considered for all women with lower abdominal pain. Round ligament pain is common, although it's not associated with other symptoms and is not progressive.

Later in pregnancy preeclampsia and HELLP syndrome can present with abdominal pain, nausea and vomiting. However, unlike appendicitis, hypertension is usually present, and it would be unusual to have leucocytosis or fever[6]. Placental or uterine rupture can occur at any stage of pregnancy. This can be differentiated from appendicitis by the presence of vaginal bleeding, changes in foetal heart rate and increased uterine tone.

The wider range of differentials during pregnancy can increase the risk of delayed diagnosis, which can have serious implications for the foetus. The risk of foetal death increases from 4% in an uncomplicated appendectomy to 35% for perforated appendicitis[9]. There can also be serious complications of untreated complicated appendicitis for the mother, including peritonitis, sepsis, bowel obstruction, abscesses and intra-abdominal adhesions.

Management

Assessing whether conservative or surgical management delivers the best outcomes during pregnancy

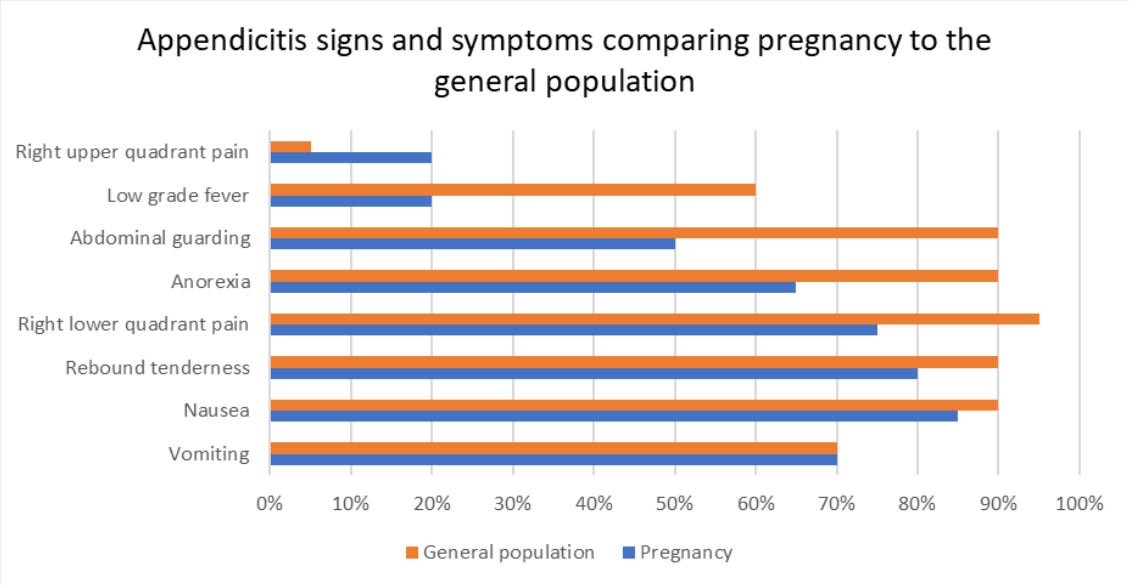

Figure 1: Comparison of appendicitis signs and symptoms in the general population and in pregnancy[8].

is important because research is typically sparse in pregnancy compared with the general population. It is known that there is a significant reoccurrence rate in the general population, around 39% in the 5 years following conservative management of appendicitis[10]. This is one of the reasons that laparoscopic appendectomy is considered the gold standard for acute appendicitis in the general population. However, the reoccurrence rate may be acceptable during pregnancy because it leaves the option for elective appendectomy post-partum or to wait until possible reoccurrence for surgical treatment when the surgical risk is lower. Insufficient research means the optimal surgical approach during pregnancy is still debated. Open surgery is often used in pregnancy due to concerns that there is a higher rate of foetal loss using a laparoscopic approach[11].

Conservative management during pregnancy

Antibiotic treatment can be used in uncomplicated appendicitis either definitively or as a bridging therapy delaying appendectomy to later in the pregnancy or post-partum. A 6 year prospective study demonstrated that conservative management can be an effective option. 25% of pregnant patients with uncomplicated appendicitis were treated conservatively. Although treatment failure occurred in a quarter of these patients, there were no foetal complications during pregnancy[12]. This evidence matches the experience of this case study, where antibiotic treatment was used successfully during pregnancy. However, the evidence is limited by the small study cohort of 20 patients; and the absence of comparative prospective studies on conservative management in pregnancy. When used appropriately for uncomplicated appendicitis, conservative management can reduce both foetal and maternal surgical mortality and morbidity risks[13]. However, due to the risk of serious complications of appendicitis such as bowel perforation and sepsis, these patients require close monitoring and escalation to surgery may be required.

Conservative management avoids the risk of unnecessary surgery. Given the difficulty in diagnosing appendicitis during pregnancy, there is a much higher rate of negative appendectomy in pregnancy (25-50%) compared to the general population (15-35%)[3]. This exposes a large proportion of pregnant women with suspected appendicitis to unnecessary surgery and the associated risks. These include wound infection, premature labour and foetal mortality. Premature labour is thought to result from manipulation of the uterus during surgery in order to locate or access the appendix. Appendectomy during pregnancy is associated with 15-45% premature labour and 4% foetal loss[3,6]. This is a considerable burden, especially given the high rates of negative appendectomies where surgery was unnecessary.

However, delaying surgery can be equally risky with rates of foetal loss between 1.5-4% in uncomplicated appendicitis and 21-35% in perforated appendicitis[3]. Around 20% of pregnant women experience peritonitis, which is higher than the general population[14]. The risk increases with gestational age as diagnosis becomes more challenging. The risk associated with perforation is why traditionally a high negative appendectomy rate is accepted.

Therefore, additional factors including the surgeon's skill and experience at operating on pregnant patients, gestational age and the patient's clinical status also need consideration when choosing between conservative vs surgical management.

For this case study, the surgeon explained that he would not be comfortable operating on a woman in her third trimester due to the increased difficulty in accessing the appendix. These factors may explain why there is a higher rate of conservative management of 5.8% during pregnancy compared to 4.3% in the non-pregnant population[14].

If MRI was utilised more frequently for suspected appendicitis during pregnancy, it could significantly reduce the negative appendectomy rate and associated surgical complications. It would also provide the added benefit of identifying the women most suitable for conservative management.

Surgical management during pregnancy

Surgery in pregnancy risks miscarriage and pre-term labour in later in pregnancy. A literature review of outcomes following surgery during the 1st trimester showed that 10.5% of women went on to miscarry. This is comparable to the background risk of miscarriage in first trimester of 8-16%[8]. Although historically it was considered best to avoid surgery in the 1st and 3rd trimesters, recent research shows that laparoscopic surgery can be done safely during any trimester[15]. This is especially true when the surgical risk is balanced against the increased risk of perforation during pregnancy.

It is important to note that maternal welfare is prioritised ahead of the foetus, regardless of gestation. If a pregnant patient is critically ill and requires urgent surgery, it should be done even if there is considerable risk to the foetus. Therefore, conservative management is only appropriate during pregnancy for uncomplicated appendicitis. However, surgery does convey different risks to conservative management, and these require careful consideration.

Surgical risks

There are many surgical risks unique to pregnancy, some of which are shown in Table 1. Most of the surgical risks in pregnancy are manageable to ensure both maternal and foetal safety. The Royal College of Obstetricians & Gynaecologists has published comprehensive evidence-based guidance on surgery during pregnancy[16]. The maternal risk generally increases the further advanced the pregnancy. For instance, during surgery, particularly at late gestation, women can experience a 30% drop in cardiac output due to uterine compression of the vena cava decreasing venous return. To alleviate this effect, it is advisable to position patients in a left lateral decubitus position[17].

Open vs laprascopic surgery

The surgical options for appendectomy are laparoscopic and open techniques. Making an appropriate choice depends on the clinical status of the patient, the gestational age and the surgeon's experience. Reviews in recent years provide conflicting results comparing laparoscopic with open appendectomy in pregnancy. There are no randomised controlled trials on the topic, therefore information is drawn from systematic reviews of observational studies. A 2020 meta-analysis of 4 systematic reviews found that foetal loss is widely reported as significantly worse in laparoscopic procedures compared to open[18]. However, this conclusion is dominated by a large 2007 study by McGory et al. When this study is excluded, there is no significant difference in operative technique for foetal loss.

Some of the downsides to laparoscopic surgery

	Surgical Risk
Maternal Safety	**Hypoxia:** Pregnant women desaturate faster than nonpregnant women (3 mins compared to 9 mins).
	Failed intubation: Due to pregnancy related oedema & engorged breasts.
	Aspiration of gastric contents: gravid uterus increases gastric pressure and there is reduced lower oesophageal sphincter tone.
	Thromboembolic risk: Pregnancy is a hypercoagulable state to reduce the risk of haemorrhage during delivery. However, venous stasis during surgery can increase the risk of clotting events.
Foetal Safety	**Maternal hypercapnia:** This causes foetal respiratory acidosis and uterine vasoconstriction.
	Drug teratogenicity: Most modern anaesthetic drugs are considered safe in pregnancy, guidance on drug choice is provided by the RCOG.
	Decreased uterine blood flow: Occurring secondary to the increase in intraabdominal pressure and/or reduced maternal cardiac output.
	Injury to the uterus: This risk is considered higher in laparoscopic surgery during trocar insertion than open surgery.
	Placental transfer of drugs: Most anaesthetic drugs, with the exception of neuromuscular blocking agents are poorly ionized in the blood and readily cross the placenta.

Table 1: Surgical risks in pregnancy[16,19,20].

are pneumoperitoneum reducing uterine blood flow, uterine injury during trocar insertion, CO2 causing foetal acidosis and the increased technical difficulty compared to open surgery, particularly in late stage pregnancy[21]. To mitigate these risks, the Royal College of Obstetricians and Gynaecologists has produced guidelines on laparoscopy in pregnancy. For instance, pneumoperitoneal pressure should not exceed 12mmHg to reduce foetal acidosis, hypoxia and premature labour. To avoid uterine perforation, the primary port location should be selected based on fundus location, assessed using ultrasound if necessary[16].

Balanced against the risks, are several advantages of laparoscopic compared to open surgery. Firstly, laparoscopic surgery is associated with shorter hospital stays, lower incidence of surgical site infection and reduced post-operative pain. Reduced need for maternal pain medication helps to reduce foetal depression. Thromboembolic events are also reduced to due early mobilisation compared to open surgery. Once the appendix is localised, additional incisions can be planned to minimise uterine irritability due to manipulation and traction, which can lead to premature labour. An added benefit of the laparoscopic approach is that it enables good visualisation of the other abdominal organs, providing a greater opportunity to identify a differential diagnosis[22]. The growing acceptance of laparoscopic surgery as a safe option in pregnancy led the Society of American Gastrointestinal and Endoscopic surgeons to publish guidelines in 2017 on surgical management in pregnancy, which focuses on laparoscopy[23].

Overall, given the inadequacy of data on open vs laparoscopic surgery, timely intervention should be the key consideration to reduce the risk of perforation and sepsis. Therefore, open surgery with a surgeon who is experienced in this technique is superior to delayed laparoscopic treatment.

Conclusion

Conservative management during pregnancy is acceptable for uncomplicated appendicitis. However, the consequences of perforation and peritonitis are high rates of foetal death, up to 35%[3]. The increased risks of surgery during pregnancy are likely to explain why conservative management is more common in pregnancy than the general population by around 1.5%. However, conservative management still only occurs in the minority of cases. Given the high rates of reoccurrence, it is unsurprising that the patient in this case study required an appendectomy 5 years later.

One of the key reasons that surgery is the most common method of managing appendicitis in pregnancy is because surgery is now widely considered safe at all gestations. However, equipoise remains over open versus laparoscopic approaches. Overall, a higher rate of negative appendectomy is accepted in pregnancy compared to non-pregnant women given the potential for worse outcomes with progression to perforation.

The high rate of negative appendectomies is largely due to the difficulties in diagnosis during pregnancy. Greater utilisation of MRI as a diagnostic tool during pregnancy could reduce the rates of unnecessary surgery. Research into better diagnostic pathways in pregnancy has potential to significantly improve outcomes for both mother and foetus.

A recurrent theme is the paucity of research during pregnancy. While this case did not occur in the initial phase of the COVID-19 pandemic, there were far higher rates of conservative management at the start of the pandemic[24]. Analysing data from this time would enable a better assessment of conservative versus surgical management of acute appendicitis in pregnancy.

Conflicts of interest
None.

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Consent
The patient has consented to the publication of this case study.

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