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Review

Challenges encountered in the management of gall stones induced pancreatitis in pregnancy

Ahmad Al Samaraee*, Vish Bhattacharya

Department of General Surgery, Queen Elizabeth Hospital, Gateshead, UK

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ABSTRACT

Background: Though uncommon, acute biliary pancreatitis in pregnancy carries a potential of serious and life threatening complications to mother and foetus. The management of acute pancreatitis in pregnancy is challenging due to the complexity of physiological and anatomical changes. This becomes even more challenging when invasive interventions are urgently needed. Therefore, there have been various debates among clinicians on the type and timing of these interventions. We systematically reviewed the evidences that looked into these debates to formulate a list of recommendations for clinical practice.

Methods: An electronic literature search of the databases (Medline/Pubmed, EMBASE, Cochrane database, NICE guidelines and Google Scholar) using the keywords "pancreatitis, pancreatitis in pregnancy, biliary pancreatitis, laparoscopy in pregnancy, and gall stones in pregnancy" was conducted. The relevant studies were screened and full text versions were retrieved. The references to all the retrieved texts were searched for further relevant studies. All studies were systematically reviewed and critically analysed.

Conclusion: The available published literature on management of gall stones induced acute pancreatitis in pregnancy was solely based on retrospective studies and case series.

The management of biliary induced pancreatitis in pregnant patients is challenging and complex, and it should involve the input of highly skilled clinicians from different specialities. Each case should be individually and thoroughly assessed by weighing the risks against the benefits. The authors have formulated a list of recommendations for clinical practice that is based on this comprehensive review of the literature.

1. Background

Acute pancreatitis (AP) in pregnancy is uncommon. It has been estimated that 1/1000–1/12000 of pregnant women are affected by attacks of AP a year; the vast majority of these attacks are associated with gall stones disease. It is more frequently reported during the third trimester and the early postpartum period. Though infrequent, AP carries a potential of serious and life threatening complications to mother and foetus. Published works indicate that AP in pregnancy could be associated with maternal and foetal mortality figurers of about 3% or less [1–5].

In general, the management of AP in pregnancy is challenging, due to the complexity of the physiological and anatomical changes throughout pregnancy combined with the local and systemic effects of AP, and not forgetting its nutritional and psychological impacts. This becomes even more challenging when endoscopic or surgical intervention is urgently needed, since both interventions carry a potential of serious risks to mother and foetus.

Nevertheless, one large retrospective study showed that pregnant patients with gallstone induced AP; who received early surgical or endoscopic intervention, had lower rates of preterm delivery and recurrent attacks of AP when compared to those who were conservatively managed, though the difference was not statistically significant [2].

On the other hand, it seems that non-operative management of patients with symptomatic gall stones related disease during pregnancy would have a high chance of recurrent symptoms in the antepartum and early postpartum periods requiring repeat hospitalizations [6,7]. Conservative management approach had been reported to have a more than 50% chance of a recurrent attack of biliary pancreatitis in pregnant patients [8–10].

Currently, there is a lack of strong evidence in the form of randomized trials that has looked into the interventional management strategy of gall stones induced AP in pregnancy. This is not surprising due to the difficulties encountered in the emergency settings trials, and the complexity of the ethical approval protocols in trials involving pregnant patients [11].

* Corresponding author. Department of General Surgery, Queen Elizabeth Hospital, Queen Elizabeth Avenue, Gateshead, NE 9 6SX, UK.
E-mail address: ahmadas@doctors.org.uk (A. Al Samaraee).

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Furthermore, the long term foetal outcomes following exposure to surgery, anaesthetics, sedation and radiation associated with various imaging modalities are unknown. Therefore, there have been various opinions and debates among clinicians regarding the choices of the diagnostic radiological imaging and the type of intervention when indicated (endoscopic or surgical). Moreover, there is also an ongoing debate about the timing and the type of surgical intervention (open or laparoscopic cholecystectomy) because of the same reasons.

In this review, we have systematically and critically analysed the published evidence that had looked into these challenges and debates, in order to list some recommendations for daily practice. We have not discussed the pathophysiology, clinical presentations, the initial diagnostic biochemical investigations or nutrition approach in AP during pregnancy. Nevertheless, we would like to highlight that pregnant women are more prone to have gall stones due to the increase of circulating oestrogen levels and the associated cholestasis.

2. Methods

Electronic literature search of the databases (Medline/Pubmed, EMBASE, Cochrane database, NICE guidelines and Google Scholar). The keywords used were pancreatitis, pancreatitis in pregnancy, biliary pancreatitis, laparoscopy in pregnancy, gall stones and gall stones in pregnancy. Searches were screened for relevant studies and the full text versions retrieved. The references to all retrieved texts were searched for further relevant studies. All studies were systematically reviewed and critically analysed.

3. Discussion

3.1. Pre-intervention imaging modalities

3.1.1. Abdominal ultrasound scan (AUSS)

AUSS is a well established primary imaging modality for any abdominal pain in pregnant patients. It is readily available, safe, non-invasive and cost effective. It has a high sensitivity and specificity in the diagnosis of cholelithiasis, with high accuracy of more than 90% in this context [12] It can also show dilated intrahepatic biliary tree and occasionally dilated extrahepatic biliary tree.

On the other hand, the sensitivity of AUSS in detecting common bile duct (CBD) stones has a wide range of 23%–80% in literature [13]. A recent Cochrane review reported that AUSS has an average sensitivity of 73% and specificity of 91% in detecting choledocolithiasis [14]. However, factors like operator's experience, patient's body habitus and the presence of gas in the bowels could interfere with the AUSS findings [15].

If AUSS failed to confirm choledocolithiasis despite clinical, biochemical or sonographic suspicions, then a different imaging modality should be used before attempting any type of invasive interventional procedures in pregnant patients. This is when the role of Magnetic Resonance Imaging (MRI) comes into consideration.

3.1.2. Magnetic resonance cholangio-pancreatography (MRCP)

MRCP doesn't involve the use of radiation or contrast. Moreover, it does have a high sensitivity and specificity in the diagnosis of choledocolithiasis with reported accuracy of more than 90% [13,16]. These facts make MRCP an appealing imaging modality in pregnant patients.

However, the safety profile of the use of MRI during pregnancy has always been a grey area with a controversy in literature due to the lack of strong evidence in this context. Some reports raised concerns about the heat effect of the magnetic field on the foetus, especially during the first trimester [11,17]. Other published works reported that a non-contrast MRI can be safely performed at any gestational age [18–20].

Therefore, there is no optimal answer to this controversy yet. In our opinion, if AUSS failed to demonstrate the presence of choledocolithiasis despite a clinical, biochemical or sonographic suspicion, then MRCP can save pregnant patients from having unnecessary invasive and risky interventions. Nevertheless, an experienced radiologist advice should always be sought before using MRI scans in pregnant patients.

3.1.3. Computerized tomography (CT) scan

Abdominal CT scan at the portal venous phase has been reported to have 72%–78% sensitivity and 96% specificity in identifying choledocolithiasis [21,22]. However, its role is limited in pregnant patients due to the potential effect of ionizing radiation and contrast on the foetus, in addition to the availability and superiority of MRCP in this context. On the other hand, CT scans are still used during pregnancy when there is diagnosis uncertainty and in trauma settings. In such scenarios, maternal benefit from early and accurate diagnosis clearly outweighs the small foetal risks [23].

3.1.4. Endoscopic ultrasound scan (EUS)

EUS has been reported to have high accuracy in detecting microlithiasis and sludge in the bile duct [24–27]. However, its role in pregnant patients has not been largely explored in literature. Small published retrospective studies and case series have shown that EUS is effective and safe in pregnant patients at any gestational age. EUS doesn't involve radiation and can save pregnant patients from having an unnecessary invasive procedure like ERCP. Another important advantage of EUS is that ERCP could be done at the same setting if indicated. Nevertheless, EUS is operator dependent and can only be performed by highly skilled endoscopistis in centres with high expertise in this field. In addition, it involves the utilization of expensive equipments and the use of sedation. Currently, EUS seems to have a selective and complementary role in pregnant patients who are suspected to have choledocolithiasis (particularly micorlithiasis or sludge) that cannot be confirmed by AUSS or MRCP, or in cases where MRCP is contraindicated or not available [27–30].

3.1.5. Hepatobiliary iminodiacetic acid (HIDA) scan/cholescintigraphy

In the non - pregnant population, biliary obstruction is not a common indication for HIDA scan, but it can be helpful when other anatomical imaging modalities are non-diagnostic [31]. Due to the potential risks of the radioactive materials on the foetus, the use of radio-nuclear imaging in pregnancy is usually limited to exceptional cases, particularly when the benefits outweigh the small associated radiation risk. It is worth mentioning here that the usual radioactive material used in the setting of performing HIDA scan is Technetium–99 m. It is generally administered at doses of less than 5 mGy, which is within the known safe range of the whole foetal exposure. As far as we know, there are currently no published reports that looked into the use of HIDA scan for gall stones related disease in pregnancy. As a general rule, consultation with the nuclear medicine team should always be considered before performing these types of studies in any patient [23,32,33].

3.2. Treatment options

As we have discussed earlier in the text, conservative management of gall stones induced AP in pregnant patients is associated with a high chance of an early recurrent attack. This might result in catastrophic effects on the mother, foetus and their families. On the other hand, interventional procedures have their own risks and potential complications too.

Over the last few years, there has been a considerable amount of published literature in favour of performing early surgical or endoscopic intervention for gall stones induced mild AP. The current UK guidelines advice is to perform laparoscopic cholecystectomy for billiary induced mild AP within the indexed hospital admission, or within two weeks of the attack date. For patients who are not fit for surgical intervention or in those who have associated obstructive CBD stones, then the advice is to perform therapeutic ERCP and sphincterotomy.

This is to be followed by the definitive treatment in the form of early cholecystectomy in patients who are deemed to be fit for surgery. On the other hand, patients who have sever AP due to gall stones disease, should have conservative management in the form of organ and nutritional support. However, therapeutic ERCP and sphincterotomy is indicated when there are associated obstructive CBD stones. This is to be followed by delayed cholecystectomy (after full recovery) in patients who are fit to have surgery [34,35].

It is not surprising however, that the direct application of these guidelines to pregnant patients is challenging due to the associated maternal and foetal risks with any endoscopic or surgical interventions. We have discussed the interventional options in the next sections.

3.2.1. Endoscopic retrograde cholangio-pancreatography (ERCP)

The successful outcomes and acceptable safety profile of the ***therapeutic*** role of ERCP for choledocolithiasis in pregnancy have been well reported in retrospective published studies [36–40].

Nevertheless, ERCP is an invasive procedure that carries a potential for serious complications like pancreatitis, bleeding, cholangitis, perforation and mortality. These risks and complications seem to be more or less similar in rates to the non-pregnant patients, although one study reported higher rates of ERCP induced pancreatitis in pregnant patients [41].

In addition, the radiation effect of fluoroscopy used during ERCP might be associated with teratogenicity. Therefore, alternative methods aiming to visualize the biliary tree by using radiation free ERCP techniques have been described in literature, like cholangioscopy, bile aspiration and endosocopic sonography [29,42–45].

Although these reports were generally based on single centre experiences that involved small number of patients, they could perhaps pave the way for larger future studies.

On the other hand, radiation exposure of less than 50 mGy during pregnancy had not been reported to cause any foetal complications, keeping in mind that ERCP is associated with an estimated foetal radiation exposure at a much smaller value of 0.40 mGy [23,28,46]. A recently published systematic review has tabled a list of excellent recommendations to minimize the radiation effect of fluoroscopy during therapeutic ERCP in pregnant patients [47].

Moreover, the short and long term effects of the sedative drugs used during ERCP on the foetus are still unknown. Nevertheless, the regular use of midazolam and fentanyl in pregnancy may result in neonatal withdrawal symptoms and respiratory depression [40].

It is worth mentioning here that performing therapeutic ERCP during the first trimester had been reported to be associated with higher rates of foetal loss [29,41,48]. Therefore, and in order to minimize the associated risks in early pregnancy, some authors advised to perform a two stage ERCP procedure. Their approach was to perform a sole endoscopic biliary drainage (i.e. biliary stenting ± balloon sphincterotomy) in the early stages of pregnancy. This is to be followed by stent and CBD stones removal through another ERCP one week after delivery [49,50]. One should keep in mind that biliary stents occlusion remains a potential complication if it is performed without effectively clearing the CBD [29].

Over the last few years, new techniques had been described to tackle difficulties encountered during endoscopic CBD stones extraction, like large stones, multiple stones, barrel-shaped stones, and tortuous distal common bile duct. In such scenarios, authors reported successful CBD clearance by using a combination of extracorporeal shock wave lithotripsy (ESWL), cholangioscopy assisted lithotripsy and mechanical lithotripsy (ML). Also, single-operator holmium laser lithotripsy [51,52]. However, these techniques had involved non – pregnant population.

Although based on retrospective studies and case series, the available published evidence indicates that ***therapeutic*** ERCP seems to have an acceptable safety profile to both mother and foetus throughout pregnancy. Therefore, it is not advisable to delay its use in cases with gall stones induced AP pancreatitis and symptomatic choledocholithiasis. However, it should be only performed by highly experienced endoscopists with the implementation of the appropriate safety measures. There is currently no diagnostic role for ERCP in pregnancy and in the general population.

3.2.2. Surgical intervention

Our knowledge regarding the safety of surgery and general anaesthesia (GA) during pregnancy is primarily based on retrospective human studies and animal studies, in addition to personal experiences [53]. Moreover, the exact short and long term effects of GA on the foetus are still unknown, keeping in mind that the general anaesthetic drugs appear to have the ability to cross the placenta [11].

Any type of surgical intervention under GA in pregnancy is challenging due to its accompanying anatomical and physiological changes. These changes might require certain modifications to the anaesthetic and surgical techniques in order to maximise their safety profile. We have discussed some of these surgical modifications later in the text. The Royal College of Obstetricians and Gynaecologists had published a summary of guidelines to decrease the risk of thrombo-embolism in pregnant patients undergoing various surgical interventions under GA [54]. We have not explored the anaesthetic techniques' modifications in this review, but the general advice is to minimize the total anaesthetic time as possible in pregnant patients [11].

Despite the above challenges, clinicians' concerns about the foetus safety should not overshadow their decision to perform surgical intervention when it is needed. Unnecessary delays to diagnosis or treatment could have serious and life threatening complications to both mother and foetus [55].

3.2.3. Laparoscopic versus open cholecytectomy

Two main challenging issues would face any surgeon when cholecystectomy is needed in pregnant patients. These are the timing of surgery and the mode of surgery (i.e. laparoscopic or open).

The safety profile of the use of laparoscopy in pregnant patients has been a matter of debate among clinicians over the years. Sedagha and colleagues have categorized the potential limitations that could be associated with use of laparoscopy in pregnancy into technical and non-technical "*The technical limitations, particularly during the third trimester, include a risk of uterine manipulation through the umbilical port, poor vision obtained and limited laparoscopic access due to the gravid uterus. The non-technical limitation during any trimester is the uncertain physiological effects of a pneumoperitoneum on the foetus and hypercapnia*" [56].

Furthermore, there had been some concern about the higher rates of foetal loss associated with the use of laparoscopy in pregnant patients [57,58]. In addition, some reports showed that surgeons tend to avoid laparoscopic approach in the third trimester [11].

However, other published works including recent systematic reviews and meta-analysis (that were based on retrospective studies), concluded that laparoscopic cholecystectomy in pregnant patients is associated with a superior outcome when compared to open surgery, and appears to be safe to perform in all of the three trimesters [56,59–63]. To maximise its safety profile, Date et al. had listed some vital recommendations to use in the settings of laparoscopic cholecystectomy in pregnant patients (like open insertion technique for the umbilical port, avoidance of high intra-peritoneal pressure, left lateral positioning of the patients to minimize aortocaval compression, and extra-careful use of diathermy to avoid injuring the gravid uterus) [64].

When compared to open surgery, the laparoscopic approach in pregnant patients is associated with significant decrease in the operative time, length of stay, wound and other complications, post operative pain, thromboembolism rates, post operative ileus and in a quicker return to normal activities [65,66].

3.2.4. Combined cholecystectomy and surgical CBD exploration

Occasionally, a combined cholecystectomy and surgical CBD exploration (open or laparoscopic) is needed in pregnant patients. This is

usually the case when the preoperative endoscopic methods fail to clear the CBD form obstructing stones. The associated longer operative time needed in such scenarios might have negative physiological impacts on mother and foetus. Moreover, visualization of the CBD by intra-operative cholangiogram would be another issue due to the radiation risks. Ideally, choledocoscope assessment of the CBD should be used.

The choice between open and laparoscopic approach in this context mainly depends on the surgeons' preference and experience. In the general population, laparoscopic exploration of the CBD seems to have good success rates with minimal morbidity and mortality in experienced hands [67–72]. On the other hand; the available evidence that looked into to the role and safety profile of a combined laparoscopic cholecytectomy and CBD exploration in pregnant patients is currently limited to few published case reports [73–78].

We would also like to highlight that our literature search did not identify any published reports that had looked into performing cholecytectomy and ERCP at the same GA settings in pregnant patients.

3.2.5. Intra-operative diagnostic modalities

Because of the risks of radiation, and with the significant advancement in the preoperative imaging modalities and techniques, the role of intra-operative cholangiogram in pregnancy is currently limited to selective cases only. The lower abdomen should be shielded when performing cholangiography during pregnancy to decrease the radiation exposure to the foetus [32].

The diagnostic accuracy of laparoscopic ultrasonography in the setting of intra-operative detection of CBD has been reported in studies involving non - pregnant population [79,80]. To our knowledge, this approach has not been reported in pregnant patients.

3.2.6. Other interventions

Occasionally; other interventions are also needed in cases with gall stones induced sever AP complicated by infected pancreatic necrosis and organs failure, like radiological guided drainage or surgical drainage/necrosectomy. Fortunately, such scenarios are rare in pregnancy [81].

In summary, our review of literature indicates that surgery should not be delayed when it is needed in pregnant patients. The surgical approach (open or laparoscopic) and the timing of surgical intervention for bilary induced mild AP in pregnancy are determined by multiple factors like the surgeon's experience, the physiological status of the patient, stage of pregnancy, the patients choice and the availability of resources. In this review; we have not discussed other aspects of surgical intervention for acute biliary disease in pregnancy, like perioperative foetal monitoring and Tocolytics use.

4. Conclusion & recommendations

Gall stones induced pancreatitis in pregnancy is uncommon. However, it carries a potential of serious risks and complications to mother and foetus. Conservative management is associated with a high chance of an early recurrent attack which might result in catastrophic effects on the patients and their families. On the other hand, invasive endoscpic or surgical interventions have their own serious risks too. This controversy had led into various debates among clinicians about the diagnostic and treatment options in this context.

The available published literature that had looked into the management of biliary induced AP in pregnancy is solely based on retrospective studies (level – III evidence) and case series (level – IV evidence). This is not surprising since performing randomized trials in the settings of urgent/emergency interventions in pregnancy is challenging. We refer to (Table-1) for the level of the evidence ranking.

We believe that management of biliary induced pancreatitis in pregnant patients is challenging and complex. Each case should be individually and thoroughly assessed by weighing the risks against the benefits. Therefore, it should involve the input of highly skilled and experienced surgeons, endoscopists, anaesthetists, radiologists and obstetricians. Moreover, the patients' choice is important in the setting of the management plan. The patients should be fully informed about the available imaging modalities and the treatment options. They should also be made fully aware of the intended benefits versus the associated maternal/foetal risks and complications.

One of the main limitations of applying a universal management approach in the management of biliary induced pancreatitis in pregnancy is the uncertainty and unknown effects of the invasive procedures, anaesthetics, sedation and radiation associated with various

Table 1
Level of evidence and grades of recommendation.

Level of Evidence
Level - I: multiple randomised controlled trials (RCT) or meta-analysis **Level - II:** adequately powered single RCT **Level - III:** non-randomized designs **Level - IV:** case series **Level - V:** expert opinion
Grades of Recommendation
Grade A treatment options are supported by strong evidence (consistent with Level I or II studies) **Grade B** treatment options are supported by fair evidence (consistent with Level III studies) **Grade C** treatment options are supported by either conflicting or poor quality evidence (Level IV studies) **Grade I** when insufficient evidence exists to make a recommendation.

Table 2
(Graded recommendations for practice).

Graded Recommendations for Practice
• Each case should be individually and thoroughly assessed by weighing the risks against the intended benefits. (Grade B) • Management plan should involve the input of highly experienced surgeons, endoscopists, anaesthetists, radiologists and obstetricians. (Grade B) • The patients should be actively involved in the setting of their management plan. (Grade C) • Conservative management is associated with a high chance of an early recurrent attack. (Grade B) • Concerns about the foetus safety should not overshadow any decision to perform invasive intervention when it is needed. (Grade B) • Unnecessary delays to diagnosis or treatment could result in serious and life threatening complications to both mother and foetus. (Grade B) • Non – contrast MRI scans have been reported to be safe at any gestational age. MRCP could save pregnant patients from having unnecessary invasive interventions. Nevertheless, an expert radiologist opinion should always be sought before its use in pregnant patients. (Grade B) • Currently, EUS has a selective role in pregnant patients who are suspected to have choledocolithiasis that cannot be confirmed by AUSS or MRCP or in cases where MRCP is contraindicated or not available. (Grade I) • The available evidence indicates that ***therapeutic*** ERCP seems to have an acceptable safety profile to both mother and foetus throughout pregnancy in highly experienced hands. (Grade B) • The choice between laparoscopic or open cholecystectomy is determined by factors like the surgeon's experience, the physiological status of the patient, stage of pregnancy, the patients choice and the availability of resources. • Laparoscopic cholecystectomy in highly experienced hands; with some intra-operative modifications, seems to have a superior outcome and safety profile throughout pregnancy when compared to open surgery in the reported studies. Nevertheless, both open and laparoscopic approaches seem to be viable in this context. (Grade B) • Clinicians seem to have the preference to perform invasive intervention in pregnant women during the second trimester when possible in order to minimize the chances of inducing miscarriage or premature labour respectively (Grade I). • The successful role of laparoscopic CBD exploration in pregnancy is limited to few published case reports. (Grade I) • Performing randomized trials in the settings of urgent/emergency interventions in pregnancy is challenging.

Table 3
(Summary of the relevant invasive intervention studies).

Study	Study Type/Level of evidence	Intervention	Patients Number	Mean Gestational Age (weeks)	Maternal Complications/Mortality Other	Foetal Complications/Foetal loss Other
Lee *et al* 2015 [36]	Retrospective Level - III	ERCP	10	16.8 (6–32)	- Hyperamylasemia **X1** - Pulmonary Oedema **X1**	none
Fine *et al* 2014 [37]	Retrospective Level - III	ERCP	20	Not available	- Bleeding **X4** - Pancreatitis **X3**	Cleft palate **X1**
Smith *et al., 2013* [35]	Retrospective Level - III	ERCP	35	18.9 (4–35)	- Bleeding **X2** - Pancreatitis **X2** - Mortality due to ARDS **X1**	- Resolved Preterm contractions **X2** - Induced labour, with no complications **X2**
Tang *et al., 2009* [41]	Retrospective Level - III	ERCP	65	Not available	- Pancreatitis **X11**	- Preterm with no complications **X5** -Induced abortion**X1** - Low birth weight **X4**
Kahaleh *et al.*, 2004 [39]	Retrospective Level - III	ERCP	17	18.6 (5–33)	- Bleeding **X1** - Pancreatitis **X1** - Preeclampsia **X2**	- Induced labour, with no complications **X2**
Tham *et al.*, 2003 [40]	Retrospective Level - III	ERCP	15	25 (12–33)	- Pancreatitis **X1**	None
Sedagha *et al* 2017 [56]	Systematic Review and Meta-analysis (based or retrospective studies) Level - II	Laparoscopic (Lap.) and Open Cholecystec- omy	- **otal** (10632) - Lap. (9413) - Open (1219)	**Lap.** (17.9) **Open** (23.6)	- Lap. approach was associated with statistically less maternal and surgical complications. - **91%** of the total patients were in the first or second trimester at the time of surgery	- Lap. approach was associated with statistically less foetal complications - No foetal loss
Nasioudis *et al.*, 2016 [60]	Systematic Review (based or retrospective studies) Level –II	Laparoscopic Cholecystec- omy	**590**	- **70.7%** of the cases were performed during the second trimester	- Conversion to open Surgery: **2.2%** - Perioperative morbidity: about **4%** - Uterine Injury **X1** - No Mortality	- Foetal loss: **0.4%** - Preterm delivery: **5.7%**
Paramanthan *et al,* 2015 [61]	Retrospective Level - III	Laparoscopic Cholecystec- omy	**22**	**19.5** (16.5–23.5).	- Conversion to open Surgery: **13%** - Perioperative morbidity: about **10%** - No Mortality	- Preterm delivery: **12%** - No foetal loss reported - **23%** lost to follow up

imaging modalities. We do know however that teratogenicity, miscarriage and premature labour are well recognized associated risks. Nevertheless, the long term effects are still unknown. We have discussed the potential associated effects on the foetus in details in the relevant diagnostic and intervention sections earlier in the text.

Clinicians should have a flexible; yet multidisciplinary, approach in the setting of management plan. As we have discussed in depth throughout the text, the choice of the diagnostic imaging modality, the type and timing of any invasive intervention should take into account the stage of pregnancy, surgeon's experience, the patients choice and the availability of resources. In order to avoid miscarriage or premature labour during the first or third trimesters respectively, clinicians seem to have the preference to perform invasive intervention in pregnant women during the second trimester when possible. However, this is not based on strong evidence. It should be kept in mind that any concerns about the foetus safety should not overshadow any decision to perform invasive intervention when it is indicated to avoid catastrophic complications on the patients and their families.

The application of the current UK guidelines of the management of mild or sever biliary induced pancreatitis; which we have discussed earlier in the text, to pregnant patients is challenging due to complex nature of this condition in pregnancy. Therefore, each case should be individually managed according to the multiple relevant factors above.

We have summarized our recommendations for practice in (Table −2). These recommendations are based on our comprehensive review of the published retrospective and case series studies. We refer to (Table-1) for the grading level of the recommendations. We have also summarized the reviewed studies that looked specifically into the outcome of the relevant invasive interventions in this context (Table-3).

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Author contribution

Mr Ahmad Al Samaraee (Design, literature search, analysis, writing, submission process).

Mr Vish Bhattacharya (Analysis, writing, final checks).

Conflicts of interest

None.

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