Review on Common Non-Obstetric Acute Abdominal Conditions in Pregnancy: An Update of management

Abstract

Non-obstetric acute abdominal conditions account for admission to the surgical ward, and it involves management by the surgeon and gynecologists. The common conditions are acute appendicitis, acute cholecystitis and acute pancreatitis. Acute appendicitis in pregnancy requires prompt diagnosis and the management has moved towards laparoscopic appendectomy. Acute cholecystitis in pregnancy has seen a trend from conservative management to laparoscopic cholecystectomy being performed during pregnancy to prevent recurrence. Acute pancreatitis in pregnancy is usually managed conservatively with endoscopic retrograde cholangiopancreatography being performed for gallstone pancreatitis. We have conducted this review article to investigate the current management of these conditions.

Keywords: Non-obstetric acute abdomen, acute abdomen in pregnancy, conservative treatment of acute abdomen in pregnancy, laparoscopic appendectomy in pregnancy, laparoscopic cholecystectomy in pregnancy and acute pancreatitis in pregnancy.

Introduction

Acute abdomen in pregnancy is a clinical condition characterized by severe abdominal pain that occurs within 24 hours and it requires prompt diagnosis and management. It is seen in 5% to 10% of all emergency department admission and surgical intervention is required in 0.5% to 2% of cases. The anatomical and physiological changes that occur in pregnancy make diagnosis and treatment of this condition difficult. The most common non-obstetric surgical condition is acute appendicitis followed by acute cholecystitis and acute pancreatitis.(1,57,58,59)

The anatomical changes that occur in pregnancy include the growth of the gravid uterus, include its position being intra-pelvic during the first trimester, reaching the umbilicus during the second trimester and at the epigastric region during the third trimester. This makes clinical examination of the abdomen difficult as the gastrointestinal tract organs are displaced. The physiological changes that occur include the presence of nausea, vomiting, increase in temperature, increase in blood volume,

and tachypnea. Biochemical changes that occur include a slight drop in the hemoglobin level, presence of leukocytosis and an increased level of alkaline phosphatase.(2)

Radiological imaging that can normally be performed is hampered by the fetus, with its risk of teratogenic effect due to radiation exposure. This is more prevalent during the first trimester of pregnancy. The common imaging modalities that are used include ultrasonography and magnetic resonance imaging. Ultrasonography is effective due to its lack of radiation exposure and its ability to assess the solid organs in the abdomen and the gravid uterus. Magnetic resonance imaging can also be used to diagnose an acute abdominal condition in pregnancy as it is able to give a better diagnosis. Computerized tomography is not used due to the iodized contrast agents that are harmful to the fetus.(3)

The most common causes of non-obstetric acute abdominal conditions include acute appendicitis, followed by acute cholecystitis and acute pancreatitis. The other rare causes include choledocholithiasis and intestinal obstruction. The management of these conditions is influenced by the fetus and gravid uterus. These conditions are managed conservatively first, and this leads to recurrence and frequent admission to the hospital. Surgical management should be performed as deferment may lead to a higher risk of fetal loss.(4–6)

Laparoscopy was initially contraindicated in the management of acute abdominal conditions in pregnancy, but the Society of American gastrointestinal and endoscopic surgeons (SAGES) concluded that laparoscopy may be safely performed during any trimester of pregnancy when indicated. Additional measures include the position of the patient in the left lateral decubitus position, the placement of the ports and using a lower carbon dioxide pressure for insufflation. Intra-operative carbon dioxide monitoring should also be used during the surgery.(7)

As there is no current consensus on the management of non-obstetric acute abdominal conditions in pregnancy, The role of conservative treatment is not well defined, the role of surgical therapy is not defined with regards to which trimester of pregnancy is the best time to perform. The role of laparoscopy in the management of these conditions is not properly defined. We have conducted this review article looking for answers for all these factors in the management of acute abdominal conditions in pregnancy. We conducted a literature review using PUBMED, the Cochrane database of systemic reviews, Google scholar and semantic scholar looking for randomized control trials, non-randomized trials, observational and cohort studies, clinical reviews, systemic reviews, case write ups, and meta-analysis from 1990 to 2023.The following keywords were used, “Non-obstetric acute abdomen”, “Acute abdomen in pregnancy”, “Conservative treatment of acute abdomen in pregnancy”, “Laparoscopic cholecystectomy in pregnancy “, “Laparoscopic appendectomy in pregnancy” and “acute pancreatitis in pregnancy”. All articles were in English, and all articles were

assessed by manual cross referencing of the literature. Commentaries and editorials were excluded from this review. Only Pregnant patients with symptoms on non-obstetric abdominal pain were included in this study.

Discussion

Acute appendicitis in pregnancy

Acute appendicitis is the most common cause of the non-obstetric acute abdomen in pregnancy. It is seen in 1 in 650 pregnancies per year and is most common in the second trimester. The classical presentation of pain over the right iliac fossa is rarely seen due to the presence of the gravid uterus with pain being felt over the flank or right hypochondrium. Tenderness over McBurney's point on clinical examination of the abdomen is less prominent due to stretching of the anterior abdominal wall by the gravid uterus.(8)

Blood investigations are not sensitive to use in the diagnosis of acute appendicitis in pregnancy with the physiological leukocytosis that occurs makes this not sensitive to diagnose acute appendicitis. The elevation of the C-reactive protein that progresses with pregnancy also hinders its role in the diagnosis of acute appendicitis. Other investigations like the neutrophil to lymphocyte ratio and the lymphocyte to C-reactive protein ratio are also not sensitive to make a diagnosis of acute appendicitis in pregnancy.(9–11)

There should be no delay in the diagnosis of acute appendicitis in pregnancy as the rate of complications like perforation is about 12%-40%. Prompt diagnosis and treatment is essential to prevent these complications like perforation and abscess formation.(12)

Imaging is often employed to help in the diagnosis of acute appendicitis in pregnancy but the risk of radiation exposure to the fetus has made ultrasonography the first line investigation of choice. The sensitivity of ultrasound in the diagnosis of acute appendicitis in pregnancy ranges from 60% to 80% and its specificity is from 80% to 100%. This often leads to a high false positive results hence further different imaging modalities may be required.(13–15)

Magnetic resonance imaging is the best nonionizing imaging modality that can be used to diagnose acute appendicitis in pregnancy and with a sensitivity and specificity of up to 95%, it is slowly becoming the first line imaging modality of choice in pregnant patients.(16,17)

A systemic review and meta-analysis on the diagnostic performance of magnetic resonance imaging for the detection of acute appendicitis in pregnancy by Motavaselian et al, showed that the pooled sensitivity and specificity were 92% and 98% and they concluded that magnetic resonance imaging could be used as a first line investigation to

diagnose acute appendicitis in pregnancy. This was also confirmed by a systemic review which was conducted by Cho et al.(18,19)

The treatment of acute appendicitis in pregnancy is appendectomy and it can be performed as an open or laparoscopic method. The World Society of Emergency Surgeons (WSES) has recommended laparoscopic appendectomy in acute appendicitis in pregnancy as it is associated with a shorter hospital stay and reduced surgical site infection.(20)

Laparoscopic appendectomy was compared to open appendectomy in the management of acute appendicitis in pregnancy and it was found to be safe, effective, associated with early mobilization and reduced hospital stay. There was a decreased risk of pre-term labor and no increased risk of abortion.(21–24)

There have been several systemic reviews and meta-analyses that compared laparoscopic appendectomy versus open appendectomy in the management of acute appendicitis in pregnancy. These studies concluded that although laparoscopic appendectomy was safe and effective, but it was associated with an increased risk of fetal loss when compared to open appendectomy, but this can be explained by the fact that almost all the cases in these studies were operated in the first trimester.(25–28)

There is insufficient evidence to recommend conservative treatment for acute appendicitis in pregnancy as there are very few studies and though their results are favorable, it is not recommended as a primary form of therapy.(29)

Table 1: The Odd’s ratio for fetal loss following laparoscopic appendectomy for acute appendicitis in pregnancy

Study	year	Study type	N=numbers	Odds Ratio
Wilasrusmee et al	2012	Meta-analysis	3415 Laparoscopic appendectomy-599, Open appendectomy-2816	1.91
Frountaz et al	2019	Meta-analysis	6276 Laparoscopic appendectomy-1963, open appendectomy-4313	2.11

Acute cholecystitis in pregnancy

Acute cholecystitis in pregnancy is the second most common cause of non – obstetric abdominal pain in pregnancy and its incidence is about 0.2 to 0.5 cases per 1,000 pregnancies. The elevated levels of estrogen and progesterone during pregnancy lead to stasis and supersaturation of bile as well as gallbladder stasis. The presence of these factors leads to cholelithiasis and subsequently cholecystitis.(30,31)

The symptoms of acute cholecystitis are pain over the right hypochondrium, fever and on abdominal examination, Murphy's sign will be positive. In pregnancy due to the presence of the gravid uterus, the symptoms of abdominal pain may be present in the flank and Murphy's sign may not be present due to the displacement of the organs by the uterus.(32)

Elevated total white cell counts, and C. Reactive protein are all features of acute cholecystitis but in pregnancy the physiological elevation of these parameters makes the diagnosis of acute cholecystitis in pregnancy difficult. Ultrasound is the initial investigation of choice in acute cholecystitis in pregnancy and it can detect gallstones and inflammation of the gallbladder.(33–36)

The management of acute cholecystitis in pregnancy is initially conservative treatment with intravenous fluids, intravenous antibiotics and analgesics followed by an elective laparoscopic cholecystectomy in the post-partum period. But due to recurrent attacks and readmission it is now recommended that laparoscopic cholecystectomy be performed during pregnancy to reduce this.(37–41)

Laparoscopic cholecystectomy can be safely performed for acute cholecystitis in pregnancy. The best time to perform this operation is during the second trimester as the risk of fetal loss and pre-term labor are reduced during this period. The World Society of

Emergency Surgeons (WSES) also recommends laparoscopic cholecystectomy for acute cholecystitis in pregnancy.(42–44)

Several systemic reviews and meta-analyses have been done to compare laparoscopic cholecystectomy versus open cholecystectomy in pregnant patients with acute cholecystitis. These studies concluded that laparoscopic cholecystectomy was safe, effective, and associated with reduced complications. The rate of pre-term labor and fetal loss was low. The conversion rates were less than 5% but most of the cases were conducted during the first and second trimester.(45,46)

Acute pancreatitis in pregnancy

Acute Pancreatitis in pregnancy is the third most common cause of acute non-obstetric abdominal pain in pregnancy. It is seen in 1 in 5,000 cases and most seen in the first trimester. The etiology of acute pancreatitis in pregnancy are gallstones, alcohol, and hypertriglyceridemia. The clinical presentation is the presentation of severe upper abdominal pain, and the diagnosis is confirmed by the measurement of serum amylase or lipase with is elevated by more than three times the normal limit. Acute pancreatitis is classified by the revised Atlanta criteria into mild, moderate, and severe. The severity assessment is by The Ranson's or Glasgow criteria. Imaging is primarily by ultrasound with magnetic resonance imaging being considered when further imaging is required.(47–49)

The management of acute pancreatitis in pregnancy will depend on etiology, general management involves the use of intravenous fluids and monitoring of vital signs. For patients with hypertriglyceridemia includes lowering the serum triglycerides and control of lipid intake. Patients who present with gallstone pancreatitis will require the use of endoscopic retrograde cholangiopancreatography. There are modifications that need to be done to account for the pregnancy, which include positioning the patient in the lateral position, careful use of sedatives, to use bipolar current when performing a sphincterotomy, and to consider not using contrast and placement of a stent.(50–53) Endoscopic retrograde cholangiography is otherwise a safe and effective procedure that can be performed in gallstone pancreatitis and the best time to perform it is during the second trimester. To limit the risk of radiation exposure, measures like lead shielding to cover the patient, limiting fluoroscopy time and smallest possible field.(54–56)

Conclusion

Acute appendicitis and acute cholecystitis account for the most common non obstetric acute abdominal conditions which is seen by the surgeon. For acute appendicitis in pregnancy, the delay in diagnosis is often due to the difficulty in interpreting blood investigation and obtaining imaging modalities like ultrasound. The access to magnetic resonance imaging is a problem in certain hospitals. The decision to operate often falls on the treating surgeon with consultation with the gynecologist. Laparoscopic appendectomy should be performed, when possible, without delay as the risk of complications like perforation are higher in these patients.

Patients who present with acute cholecystitis during pregnancy are more likely to be managed conservatively and laparoscopic cholecystectomy being performed electively in the post-partum period. The recurrence rate is high, and this will account for frequent readmission to the hospital and may be detrimental to the fetus. Laparoscopic cholecystectomy should then be performed especially in the second trimester to treat this condition and prevent these complications.

Acute pancreatitis in pregnancy is often managed conservatively with endoscopic retrograde cholangiopancreatography being performed in gallstone pancreatitis. The etiology of acute pancreatitis is important, to prevent recurrence.

Disclaimer (Artificial intelligence)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of manuscripts.

References

1. Alsadery, H. A., Bamalan, O. A., Aljubran, H. J., Albaish, L. J., & Al Ghanim, B. Z. (2023). Non-obstetric Acute Abdomen in Pregnancy: a Review of Literature. *Medical archives (Sarajevo, Bosnia and Herzegovina)*, *77*(4), 293–298. https://doi.org/10.5455/medarh.2023.77.293-298
2. Bouyou J, Gaujoux S, Marcellin L, Leconte M, Goffinet F, Chapron C, et al. Abdominal emergencies during pregnancy. Vol. 152, Journal of Visceral Surgery. Elsevier Masson s.r.l.; 2015. p. S105–15. https://doi.org/10.1016/j.jviscsurg.2015.09.017
3. Selzer DJ, Stefanidis D. Surgical Emergencies in the Pregnant Patient. Adv Surg. 2019 Sep;53:161-177. doi: 10.1016/j.yasu.2019.04.008. Epub 2019 May 18. PMID: 31327444.

4. Barber-Millet S, Bueno Lledó J, Granero Castro P, Gómez Gavara I, Ballester Pla N, García Domínguez R. Update on the management of non-obstetric acute abdomen in pregnant patients. Cir Esp. 2016 May;94(5):257-65. English, Spanish. doi: 10.1016/j.ciresp.2015.11.001. Epub 2016 Feb 11. PMID: 26875476.

5. Angelini DJ. Obstetric triage revisited: Update on non-obstetric surgical conditions in pregnancy. J Midwifery Womens Health. 2003;48(2):111–8. https://doi.org/10.1016/S1526-9523(02)00417-8

6. Angelini DJ. Obstetric triage: management of acute nonobstetric abdominal pain in pregnancy. J Nurse Midwifery. 1999 Nov-Dec;44(6):572-84. doi: 10.1016/s0091-2182(99)00106-8. PMID: 10634014.

7. Pearl J, Price R, Richardson W, Fanelli R; Society of American Gastrointestinal Endoscopic Surgeons. Guidelines for diagnosis, treatment, and use of laparoscopy for surgical problems during pregnancy. Surg Endosc. 2011 Nov;25(11):3479-92. doi: 10.1007/s00464-011-1927-3. Epub 2011 Sep 23. PMID: 21938570.

8. Franca Neto AH, Amorim MM, Nóbrega BM. Acute appendicitis in pregnancy: literature review. Rev Assoc Med Bras (1992). 2015 Mar-Apr;61(2):170-7. doi: 10.1590/1806-9282.61.02.170. PMID: 26107368.

9. Akbas A, Aydın Kasap Z, Hacım NA, Tokocin M, Altınel Y, Yiğitbaş H, Meriç S, Okumuş B. The value of inflammatory markers in diagnosing acute appendicitis in pregnant patients. Ulus Travma Acil Cerrahi Derg. 2020 Sep;26(5):769-776. English. doi: 10.14744/tjtes.2020.03456. PMID: 32946079.

10. Başkıran A, İnce V, Çiçek E, Şahin T, Dirican A, Balıkçı Çiçek İ, Işık B, Yılmaz S. Efficacy of laboratory tests and ultrasonography in the diagnosis of acute appendicitis in gravid patients according to the stages of pregnancy. Ulus Travma Acil Cerrahi Derg. 2018 Jul;24(4):333-336. doi: 10.5505/tjtes.2017.23693. PMID: 30028491.

11. Çınar H, Aygün A, Derebey M, Tarım İA, Akalın Ç, Büyükakıncak S, Erzurumlu K. Significance of hemogram on diagnosis of acute appendicitis during pregnancy. Ulus Travma Acil Cerrahi Derg. 2018 Sep;24(5):423-428. doi: 10.5505/tjtes.2018.62753. PMID: 30394495.

12. Aggenbach L, Zeeman GG, Cantineau AE, Gordijn SJ, Hofker HS. Impact of appendicitis during pregnancy: no delay in accurate diagnosis and treatment. Int J Surg. 2015 Mar;15:84-9. doi: 10.1016/j.ijsu.2015.01.025. Epub 2015 Jan 29. PMID: 25638737.

13. Kazemini, A., Reza Keramati, M., Fazeli, M. S., Keshvari, A., Khaki, S., & Rahnemai-Azar, A. (2017). Accuracy of ultrasonography in diagnosing acute appendicitis during pregnancy based on surgical findings. *Medical journal of the Islamic Republic of Iran*, *31*, 48. https://doi.org/10.14196/mjiri.31.48

14. Rybkin AV, Thoeni RF. Current concepts in imaging of appendicitis. Radiol Clin North Am. 2007 May;45(3):411-22, vii. doi: 10.1016/j.rcl.2007.04.003. PMID: 17601500.

15. Segev L, Segev Y, Rayman S, Nissan A, Sadot E. The diagnostic performance of ultrasound for acute appendicitis in pregnant and young nonpregnant women: A case-

control study. Int J Surg. 2016 Oct;34:81-85. doi: 10.1016/j.ijsu.2016.08.021. Epub 2016 Aug 20. PMID: 27554180.

16. Burke LM, Bashir MR, Miller FH, Siegelman ES, Brown M, Alobaidy M, Jaffe TA, Hussain SM, Palmer SL, Garon BL, Oto A, Reinhold C, Ascher SM, Demulder DK, Thomas S, Best S, Borer J, Zhao K, Pinel-Giroux F, De Oliveira I, Resende D, Semelka RC. Magnetic resonance imaging of acute appendicitis in pregnancy: a 5-year multiinstitutional study. Am J Obstet Gynecol. 2015 Nov;213(5):693.e1-6. doi: 10.1016/j.ajog.2015.07.026. Epub 2015 Jul 26. PMID: 26215327.

17. Burns M, Hague CJ, Vos P, Tiwari P, Wiseman SM. Utility of Magnetic Resonance Imaging for the Diagnosis of Appendicitis During Pregnancy: A Canadian Experience. Can Assoc Radiol J. 2017 Nov;68(4):392-400. doi: 10.1016/j.carj.2017.02.004. Epub 2017 Jul 18. PMID: 28728903.

18. Motavaselian, M., Bayati, F., Amani-Beni, R., Khalaji, A., Haghverdi, S., Abdollahi, Z., Sarrafzadeh, A., Rafie Manzelat, A. M., Rigi, A., Arabzadeh Bahri, R., Nakhaee, Z., Fadaei, M., Ghasemi Falaverjani, H., Malekpour-Dehkordi, S., Hoseinpour, M., Bidares, M., Zandkarimi, S., Ahmadi, R., Beheshtiparvar, D., Ahadiat, S. A., … Farrokhi, M. (2022). Diagnostic Performance of Magnetic Resonance Imaging for Detection of Acute Appendicitis in Pregnant Women; a Systematic Review and Meta-Analysis. *Archives of academic emergency medicine*, *10*(1), e81. https://doi.org/10.22037/aaem.v10i1.1727

19. Cho SU, Oh SK. Diagnostic accuracy of magnetic resonance imaging for acute appendicitis during pregnancy: A systematic review. Ulus Travma Acil Cerrahi Derg. 2021 May;27(3):271-277. English. doi: 10.14744/tjtes.2020.02416. PMID: 33884591.

20. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, Boermeester M, Sartelli M, Coccolini F, Tarasconi A, De' Angelis N, Weber DG, Tolonen M, Birindelli A, Biffl W, Moore EE, Kelly M, Soreide K, Kashuk J, Ten Broek R, Gomes CA, Sugrue M, Davies RJ, Damaskos D, Leppäniemi A, Kirkpatrick A, Peitzman AB, Fraga GP, Maier RV, Coimbra R, Chiarugi M, Sganga G, Pisanu A, De' Angelis GL, Tan E, Van Goor H, Pata F, Di Carlo I, Chiara O, Litvin A, Campanile FC, Sakakushev B, Tomadze G, Demetrashvili Z, Latifi R, Abu-Zidan F, Romeo O, Segovia-Lohse H, Baiocchi G, Costa D, Rizoli S, Balogh ZJ, Bendinelli C, Scalea T, Ivatury R, Velmahos G, Andersson R, Kluger Y, Ansaloni L, Catena F. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. World J Emerg Surg. 2020 Apr 15;15(1):27. doi:

21. Yang, J., Wen, S. W., Krewski, D., Corsi, D. J., Walker, M., Mattison, D., Moog, R., McNair, D., Huang, H., & Zhuang, G. (2021). Association of treatments for acute appendicitis with pregnancy outcomes in the United States from 2000 to 2016: Results from a multi-level analysis. *PloS one*, *16*(12), e0260991. https://doi.org/10.1371/journal.pone.0260991

22. Eom JM, Hong JH, Jeon SW, Choi JS, Lee JH, Kim HO, Kim H, Choi PC, Han SK. Safety and clinical efficacy of laparoscopic appendectomy for pregnant women with acute appendicitis. Ann Acad Med Singap. 2012 Feb;41(2):82-6. PMID: 22498855.

23. Cai YL, Yang SS, Peng DZ, Jia QB, Li FY, Ye H, Cheng NS. Laparoscopic appendectomy is safe and feasible in pregnant women during second trimester: A retrospective study in

a top-level Chinese center. Medicine (Baltimore). 2020 Aug 14;99(33):e21801. doi: 10.1097/MD.0000000000021801. PMID: 32872081; PMCID: PMC7437783.

24. Machado NO, Grant CS. Laparoscopic appendicectomy in all trimesters of pregnancy. JSLS. 2009 Jul-Sep;13(3):384-90. PMID: 19793481; PMCID: PMC3015967.

25. Wilasrusmee C, Sukrat B, McEvoy M, Attia J, Thakkinstian A. Systematic review and meta-analysis of safety of laparoscopic versus open appendicectomy for suspected appendicitis in pregnancy. Br J Surg. 2012 Nov;99(11):1470-8. doi: 10.1002/bjs.8889. Epub 2012 Sep 21. PMID: 23001791; PMCID: PMC3494303.

26. Walsh CA, Tang T, Walsh SR. Laparoscopic versus open appendicectomy in pregnancy: a systematic review. Int J Surg. 2008 Aug;6(4):339-44. doi: 10.1016/j.ijsu.2008.01.006. Epub 2008 Feb 1. PMID: 18342590.

27. Walker HG, Al Samaraee A, Mills SJ, Kalbassi MR. Laparoscopic appendicectomy in pregnancy: a systematic review of the published evidence. Int J Surg. 2014 Nov;12(11):1235-41. doi: 10.1016/j.ijsu.2014.08.406. Epub 2014 Sep 9. PMID: 25219891.

28. Frountzas M, Nikolaou C, Stergios K, Kontzoglou K, Toutouzas K, Pergialiotis V. Is the laparoscopic approach a safe choice for the management of acute appendicitis in pregnant women? A meta-analysis of observational studies. Ann R Coll Surg Engl. 2019;101(4):235–48. https://doi.org/10.1308/rcsann.2019.0011

29. Flexer SM, Tabib N, Peter MB. Suspected appendicitis in pregnancy. Surgeon. 2014 Apr;12(2):82-6. doi: 10.1016/j.surge.2013.11.022. Epub 2014 Jan 13. PMID: 24429161.

30. Tseng JY, Yang MJ, Yang CC, Chao KC, Li HY. Acute Cholecystitis During Pregnancy: What is the Best Approach? Taiwan J Obstet Gynecol. 2009 Sep;48(3):305-7. doi: 10.1016/S1028-4559(09)60311-9. PMID: 19797027.

31. Salari N, Hasheminezhad R, Heidarisharaf P, Khaleghi AA, Azizi AH, Shohaimi S, Mohammadi M. The global prevalence of gallstones in pregnancy: A systematic review and meta-analysis. Eur J Obstet Gynecol Reprod Biol X. 2023 Sep 6;19:100237. doi: 10.1016/j.eurox.2023.100237. PMID: 37711873; PMCID: PMC10497987.

32. Mahjoubi MF, Dhaou AB, Maatouk M, Essid N, Rezgui B, Karoui Y, Moussa MB. Acute cholecystitis in pregnant women: A therapeutic challenge in a developing country center. Ann Hepatobiliary Pancreat Surg. 2023 Nov 30;27(4):388-393. doi: 10.14701/ahbps.23-031. Epub 2023 Nov 2. PMID: 37915236; PMCID: PMC10700939.

33. Grigoriu C, Lutic C, Scurtu I, Calinescu G, Gheorghe CM, Balan AM, et al. Management of biliary lithiasis in pregnancy – an updated overview. Romanian Medical Journal. 2021;68(4):433–6. 10.37897/RMJ.2021.4.2

34. Gilo NB, Amini D, Landy HJ. Appendicitis and cholecystitis in pregnancy. Clin Obstet Gynecol. 2009 Dec;52(4):586-96. doi: 10.1097/GRF.0b013e3181c11d10. PMID: 20393411.

35. Katz DS, Klein MA, Ganson G, Hines JJ. Imaging of abdominal pain in pregnancy. Radiol Clin North Am. 2012 Jan;50(1):149-71. doi: 10.1016/j.rcl.2011.08.001. Epub 2011 Oct 13. PMID: 22099493.

36. Swisher SG, Schmit PJ, Hunt KK, Hiyama DT, Bennion RS, Swisher EM, Thompson JE. Biliary disease during pregnancy. Am J Surg. 1994 Dec;168(6):576-9; discussion 580-1. doi: 10.1016/s0002-9610(05)80125-4. PMID: 7977999.

37. Schwulst SJ, Son M. Management of Gallstone Disease During Pregnancy. JAMA Surg. 2020 Dec 1;155(12):1162-1163. doi: 10.1001/jamasurg.2020.3683. PMID: 32997134.

38. Ibiebele I, Schnitzler M, Nippita T, Ford JB. Outcomes of Gallstone Disease during Pregnancy: a Population-based Data Linkage Study. Paediatr Perinat Epidemiol. 2017 Nov;31(6):522-530. doi: 10.1111/ppe.12406. Epub 2017 Sep 7. PMID: 28881393.

39. Othman MO, Stone E, Hashimi M, Parasher G. Conservative management of cholelithiasis and its complications in pregnancy is associated with recurrent symptoms and more emergency department visits. Gastrointest Endosc. 2012 Sep;76(3):564-9. doi: 10.1016/j.gie.2012.04.475. Epub 2012 Jun 23. PMID: 22732875.

40. Rios-Diaz AJ, Oliver EA, Bevilacqua LA, Metcalfe D, Yeo CJ, Berghella V, Palazzo F. Is It Safe to Manage Acute Cholecystitis Nonoperatively During Pregnancy?: A Nationwide Analysis of Morbidity According to Management Strategy. Ann Surg. 2020 Sep 1;272(3):449-456. doi: 10.1097/SLA.0000000000004210. Erratum in: Ann Surg. 2021 May 1;273(5):e184-e187. PMID: 33759834.

41. Lu EJ, Curet MJ, El-Sayed YY, Kirkwood KS. Medical versus surgical management of biliary tract disease in pregnancy. Am J Surg. 2004 Dec;188(6):755-9. doi: 10.1016/j.amjsurg.2004.09.002. PMID: 15619495.

42. Itaimi A, Abbassi I, Baraket O, Kotti A, Triki W, Bouchoucha S. Safety of Laparoscopic Cholecystectomy for Cholecystitis during Pregnancy. Gynecol Minim Invasive Ther. 2023 Aug 10;12(3):166-169. doi: 10.4103/gmit.gmit_57_22. PMID: 37807993; PMCID: PMC10553592.

43. Palanivelu C, Rangarajan M, Senthilkumaran S, Parthasarathi R. Safety and efficacy of laparoscopic surgery in pregnancy: experience of a single institution. J Laparoendosc Adv Surg Tech A. 2007 Apr;17(2):186-90. doi: 10.1089/lap.2006.0037. PMID: 17484645.

44. Pisano M, Allievi N, Gurusamy K, Borzellino G, Cimbanassi S, Boerna D, Coccolini F, Tufo A, Di Martino M, Leung J, Sartelli M, Ceresoli M, Maier RV, Poiasina E, De Angelis N, Magnone S, Fugazzola P, Paolillo C, Coimbra R, Di Saverio S, De Simone B, Weber DG, Sakakushev BE, Lucianetti A, Kirkpatrick AW, Fraga GP, Wani I, Biffl WL, Chiara O, Abu-Zidan F, Moore EE, Leppäniemi A, Kluger Y, Catena F, Ansaloni L. 2020 World Society of Emergency Surgery updated guidelines for the diagnosis and treatment of acute calculus cholecystitis. World J Emerg Surg. 2020 Nov 5;15(1):61. doi: 10.1186/s13017-020-00336-x. PMID: 33153472; PMCID: PMC7643471.

45. Sedaghat N, Cao AM, Eslick GD, Cox MR. Laparoscopic versus open cholecystectomy in pregnancy: a systematic review and meta-analysis. Surg Endosc. 2017 Feb;31(2):673-679. doi: 10.1007/s00464-016-5019-2. Epub 2016 Jun 20. PMID: 27324332.

46. Nasioudis D, Tsilimigras D, Economopoulos KP. Laparoscopic cholecystectomy during pregnancy: A systematic review of 590 patients. Int J Surg. 2016 Mar;27:165-175. doi: 10.1016/j.ijsu.2016.01.070. Epub 2016 Jan 28. PMID: 26826612.

47. Mądro A. Pancreatitis in Pregnancy-Comprehensive Review. Int J Environ Res Public Health. 2022 Dec 3;19(23):16179. doi: 10.3390/ijerph192316179. PMID: 36498253; PMCID: PMC9737239.

48. Papadakis EP, Sarigianni M, Mikhailidis DP, Mamopoulos A, Karagiannis V. Acute pancreatitis in pregnancy: an overview. Eur J Obstet Gynecol Reprod Biol. 2011 Dec;159(2):261-6. doi: 10.1016/j.ejogrb.2011.07.037. Epub 2011 Aug 12. PMID: 21840110.

49. Maringhini A, Dardanoni G, Fantaci G, Patti R, Maringhini M. Acute Pancreatitis During and After Pregnancy: Incidence, Risk Factors, and Prognosis. Dig Dis Sci. 2021 Sep 1;66(9):3164–70. https://doi.org/10.3390/jcm13072028

50. Cappell MS, Stavropoulos SN, Friedel D. Systematic review of safety and efficacy of therapeutic endoscopic-retrograde-cholangiopancreatography during pregnancy including studies of radiation-free therapeutic endoscopic-retrograde-cholangiopancreatography. World J Gastrointest Endosc. 2018 Oct 16;10(10):308-321. doi: 10.4253/wjge.v10.i10.308. PMID: 30364767; PMCID: PMC6198312.

51. Menees S, Elta G. Endoscopic retrograde cholangiopancreatography during pregnancy. Gastrointest Endosc Clin N Am. 2006 Jan;16(1):41-57. doi: 10.1016/j.giec.2006.01.004. PMID: 16546022.

52. Ersoz G, Turan I, Tekin F, Ozutemiz O, Tekesin O. Nonradiation ERCP with endoscopic biliary sphincterotomy plus papillary balloon dilation for the treatment of choledocholithiasis during pregnancy. Surg Endosc. 2016 Jan;30(1):222-8. doi: 10.1007/s00464-015-4190-1. Epub 2015 Apr 4. PMID: 25840897.

53. Sarıcı İŞ, Kalaycı MU. Management of Gallstone-Induced Acute Pancreatitis in Pregnancy: A Tertiary-Center Experience. Sisli Etfal Hastan Tip Bul. 2018 May 21;52(2):92-96. doi: 10.14744/SEMB.2017.60490. PMID: 32595379; PMCID: PMC7315056.

54. Bani Hani MN, Bani-Hani KE, Rashdan A, Alwaqfi NR, Heis HA, Al-Manasra ARA. Safety of endoscopic retrograde cholangiopancreatography during pregnancy. ANZ J Surg. 2009 Jan;79(1–2):23–6. https://doi.org/10.1111/j.1445-2197.2008.04792.x

55. Fine S, Beirne J, Delgi-Esposti S, Habr F. Continued evidence for safety of endoscopic retrograde cholangiopancreatography during pregnancy. World J Gastrointest Endosc. 2014 Aug 16;6(8):352-8. doi: 10.4253/wjge.v6.i8.352. PMID: 25132918; PMCID: PMC4133414.

56. Daas AY, Agha A, Pinkas H, Mamel J, Brady PG. ERCP in pregnancy: is it safe? Gastroenterol Hepatol (N Y). 2009 Dec;5(12):851-5. PMID: 20567530; PMCID: PMC2886384.

57 Kingsley, Oriji Vaduneme, Nyeche Solomon, and Ibe Vitalis. 2017. “Cornual Twin Ectopic Pregnancy: A Case Report”. Journal of Advances in Medicine and Medical Research 22 (9):1-5. https://doi.org/10.9734/JAMMR/2017/34186.

58 Singh, Meenakshi, Pikee Saxena, Kavita Choudhary, . Soni, and Abha Singh. 2020. “Advanced Tubal Ectopic Pregnacy-A Rare Case”. International Journal of

Research and Reports in Gynaecology 3 (1):119-22. https://journalijrrgy.com/index.php/IJRRGY/article/view/24.

59 Augustin G, Majerovic M. Non-obstetrical acute abdomen during pregnancy. European Journal of Obstetrics & Gynecology and Reproductive Biology. 2007 Mar 1;131(1):4-12.