Real-time transabdominal ultrasound-guided ERCP is feasible and effective in pregnancy: a case series

Introduction

Gallstone disease in pregnancy is common, occurring in 3.2% to 12.2% of all pregnancies, with choledocholithiasis being the most common indication for endoscopic retrograde cholangiopancreatography (ERCP) [1,2]. The American Society for Gastrointestinal Endoscopy suggests that conventional ERCP is safe in pregnancy with appropriate implementation of techniques to minimize fetal radiation exposure. These recommendations are supported by studies that have shown the safety of conventional ERCP in pregnancy when completed by expert endoscopists with modified techniques [2]. Radiation exposure is most concerning in the first trimester during organogenesis, where radiation doses are recommended not to exceed 10 mGy [3]. Unfortunately, this threshold is occasionally exceeded as the dose of radiation in any one procedure is highly variable and dependent on operator experience, patient body habitus, fetal gestational age, and procedure duration/complexity [3].

Given these concerns, performing ERCP with radiation-free techniques is preferred [1,4]. Real-time transabdominal (TA) ultrasound (US)-guided ERCP is a radiation-free technique that facilitates confirmation of biliary cannulation, equipment exchange and stone clearance. Our article describes the largest

ABSTRACT

Background and study aims Endoscopic retrograde cholangiopancreatography (ERCP) is commonly required in pregnancy for choledocholithiasis, however, radiation exposure is a major concern for patients. Real-time transabdominal (TA) ultrasound (US)-guided ERCP is a radiation-free technique that facilitates confirmation of biliary cannulation, equipment exchange and stone clearance. We present the largest Western case series of this modality in pregnancy and a review of the literature. Four pregnant adult patients were referred to our tertiary center with suspected or documented choledocholithiasis and underwent real-time TA US-guided ERCP. US was successfully used to confirm positioning of the guidewire and ductal clearance. Procedures were successful in all patients with resolution of clinical symptoms and no immediate procedural complications. Two patients suffered adverse events later in their pregnancy.

Real-time TA US-guided ERCP is a technically feasible and effective modality that can be offered to obtain biliary access in a radiation-free fashion for specific subsets of pregnant patients with choledocholithiasis. Future studies are needed to confirm the safety of this technique.

* These authors contributed equally

Authors

Suqing Li¹·*, Callum Dargavel¹·*, Derek Muradali², Gary R. May¹, Jeffrey D. Mosko¹

Institutions

1 Division of Gastroenterology, Department of Medicine, The Center for Advanced Therapeutic Endoscopy and Endoscopic Oncology, St. Michael’s Hospital, Toronto, Canada
2 Department of Medical Imaging, St Michael’s Hospital, Toronto, Canada

submitted 4.1.2020
accepted after revision 20.4.2020

Bibliography

Endoscopy International Open 2020; 08: E1504–E1507
DOI 10.1055/a-1191-2680
ISSN 2364-3722
© 2020. The Author(s).

This is an open access article published by Thieme under the terms of the Creative Commons Attribution-NonDerivative-NonCommercial License, permitting copying and reproduction so long as the original work is given appropriate credit. Contents may not be used for commercial purposes, or adapted, remixed, transformed or built upon. (https://creativecommons.org/licenses/by-nc-nd/4.0/)

Corresponding author

Jeffrey D. Mosko MD, MSc, FRCP, Department of Medicine, Division of Gastroenterology, The Center for Advanced Therapeutic Endoscopy and Endoscopic Oncology, St. Michael’s Hospital, Room 16-034, Cardinal Carter Wing, 30 Bond Street, Toronto ON, M5B 1W8
Phone: +1-416-864-5684
moskoj@smh.ca
case series of US-guided, single-step ERCP during pregnancy in Western literature.

**Case reports**

Between May and August 2016, four pregnant patients were referred to our tertiary academic center and treated with TA US-assisted ERCP without fluoroscopy for symptomatic choledocholithiasis. Informed consent was obtained from all patients. ERCPs were performed by two expert endoscopists (GM, JM); Olympus (TJF-Q180V) duodenoscopes were used. The portable US (Philips iU22) was operated and interpreted in real-time by a radiologist (DM). Clinical details are shown in ▶Table 1.

**Patient 1**

A 42-year-old in the first trimester of pregnancy was evaluated for epigastric pain and elevated liver biochemistries. US completed 3 days prior revealed a dilated common bile duct (CBD) with a distal CBD stone. Given persistent symptoms and increasing liver enzymes, ERCP was performed. Real-time TA US confirmed a dilated CBD; however, the distal CBD could not be visualized due to patient positioning, and a stone was not seen. Endoscopically, the ampulla was bulging, consistent with obstructing stone. After CBD cannulation, positioning of the guidewire within the proximal CBD was verified by TA US and aspiration of bile. A wire-guided sphincterotomy was performed. Biliary sweeps with an 8.5-mm extraction balloon, beginning at the hilum, and confirmed via TA US, were conducted. Two small stones were removed. No immediate procedure-related complications occurred and the patient improved clinically. Four weeks post-procedure, the patient had a spontaneous abortion deemed unrelated to the ERCP.

**Patient 2**

A 33-year-old in the first trimester of pregnancy with a previous cholecystectomy was referred with right upper quadrant abdominal pain and elevated liver biochemistries. US and magnetic resonance cholangiopancreatography revealed intrahepa-
tic duct and CBD dilatation to 1.2 cm without a definite stone. The patient was monitored in hospital for 3 days; however, her pain persistently worsened, and liver enzymes continued to rise. Given the clinical concern for cholecystolithiasis biliary obstruction, ERCP was performed. Real-time TA US demonstrated an 11-mm CBD without a definite stone. The ampulla was bulbous and erythematous suggestive of recent obstruction. After CBD cannulation with a sphincterotome, positioning of the guidewire within the CBD was verified by TA US, and a wire-guided sphincterotomy was performed. CBD was subsequently swept with a basket; however, no stones were extracted. Excellent biliary drainage was visualized, and the CBD had decreased to 5 mm on real-time TA US, suggesting an element of prior obstruction. We suspected a recently passed stone and development of papillitis. No procedure-related complications occurred, and the patient had improvement of symptoms and liver enzymes. The patient went on to an uncomplicated pregnancy to deliver a healthy baby at term.

Patient 3
A 31-year-old in the second trimester of pregnancy was referred with epigastric pain and elevated liver biochemistries. TA US revealed a dilated CBD stone. After cannulating the CBD with a sphincterotome, positioning of the guidewire within the CBD was verified by TA US, and a wire-guided sphincterotomy was performed. One stone was removed using a basket. No procedure-related complications occurred, and the patient improved clinically. A week post-ERCP, the patient ruptured her membranes at 26 + 5 weeks of gestation and delivered the baby at 27 weeks, who remains alive and well.

Patient 4
A 37-year-old in the first trimester of pregnancy was evaluated for epigastric pain and elevated liver biochemistries. TA US revealed multiple CBD stones. ERCP was thus performed, with real-time TA US confirming multiple CBD stones and a dilated CBD of 10 mm. After CBD cannulation was achieved with a sphincterotome and wire, positioning of the guidewire within the proximal CBD, extending to the common hepatic duct, was verified by TA US and aspiration of bile. A wire-guided sphincterotomy was performed. Balloon sweeps with an 8.5-mm extraction balloon beginning proximally at the common hepatic duct were performed with removal of eight small stones. Real-time TA US demonstrated complete clearance of stones, and excellent bile flow was visualized. No procedure-related complications occurred, and patient improved clinically. The patient went on to an uncomplicated pregnancy to deliver a healthy baby at term.

Discussion
Initially described in a case report in 1991, TA US was the first non-radiation imaging modality used to facilitate radiation-free ERCP [5]. Since that time, only a couple of case reports have described variations of this technique [1, 4]. Our case series demonstrates that real-time TA US-guided ERCP is feasible and effective in pregnancy.

Recent reviews have summarized the limited literature on radiation-free ERCP techniques in pregnancy. Described methods include empirical bile aspirate guided and imaging-guided techniques such as TA US, endoscopic US (EUS), and cholangioscopy [1, 4]. Use of TA US-guided ERCP has the advantage of allowing real-time visualization, confirmation of wire placement, and ascertainment of stone clearance [1]. Our series found TA US was able to accurately confirm guidewire placement within the CBD (Fig. 1) in all cases and is consistent with prior series [6]. Although TA US can have limited sensitivity in visualizing stones in the distal CBD, it is valuable in facilitating removal of stones when seen (Fig. 2), and in confirming placement of instruments proximally within the CBD to allow removal of distal stones.

Real-time visualization of cannulation may also decrease the rate of post-ERCP pancreatitis that is significantly higher in the pregnancy population compared to controls (12% vs. 5%) [4]. This has been shown in a recent study demonstrating increased rates of stone clearance and decreased complication rates of US-guided techniques compared to bile aspirate guided radiation-free ERCP in pregnancy [6]. However, unlike our study, Huang et al. performed a two-stage ERCP: US-guided cannulation and stent placement, followed by stent and stone removal via conventional ERCP 2 weeks post-delivery [6]. Two recent case reports have also presented use of contrast-enhanced US-guided ERCP in pregnancy [7, 8]. However, a non-contrast approach may be preferable, given the lack of safety data for the use of US contrast agents in pregnancy [1]. Although there were no immediate procedural complications, two patients experienced adverse outcomes during their pregnancy. Based on the limited case series, we are unable to
conclude whether the procedure itself was a contributing factor to these outcomes. Although data suggest a potentially increased risk of preterm birth and small for gestational age in pregnant patients undergoing endoscopy, it is difficult to distinguish if this is related to the underlying gastrointestinal disease that prompted endoscopic evaluation. Notably, for hepatobiliary disease, the illness itself may be the primary driver of poor fetal outcomes rather than the procedure [9].

Concerns of increased procedural time and sedation can arise with this modified technique. Experts recommend that procedural time and sedation be minimized in pregnant patients undergoing endoscopy [2]. In our series, the average procedural time was relatively short at 18 minutes [10]. As such, it is unlikely that the use of TA US resulted in additional procedural time, and may have potentially shortened procedural times by facilitating CBD cannulation. Conscious sedation was used in amounts similar to doses given for conventional ERCP at our institution. Given our relatively short procedure time, TA US-guided ERCP does not likely require excess sedation compared to traditional ERCP.

Lastly, TA US is portable and widely available. However, it’s widespread use to guide radiation-free ERCP in pregnancy may be limited by the requirement for a second operator, additional equipment and staff training, as well as coordination between radiology and gastroenterology departments. Nevertheless, in subsets of pregnant patients, particularly those in the first trimester of pregnancy who require ERCP and have significant objections to any degree of radiation, or in whom successful biliary cannulation is difficult without direct radiographic confirmation, real-time TA US-guided ERCP may be a potential option. Larger prospective cohort studies are necessary to establish the efficacy and safety of this technique.

Conclusion

Real-time single-step TA US-guided ERCP is a technically feasible and effective modality to obtain biliary access without the need for radiation. Unlike other radiation-free techniques, US-guided ERCP allows for real-time confirmation of biliary cannulation and facilitation of equipment exchange. In pregnant patients with suspected or documented choledocholithiasis, this technique should be considered as a potential modality to avoid all radiation exposure during ERCP.

Competing interests

The authors declare that they have no conflict of interest.

References

[1] Wu W, Faigel DO, Sun G et al. Non-radiation endoscopic retrograde cholangiopancreatography in the management of choledocholithiasis during pregnancy. Dig Endosc 2014; 26: 691–700
[2] Shergill AK, Ben-Menachem T, Chandrasekhara V et al. Guidelines for endoscopy in pregnant and lactating women. Gastrointest Endosc 2012; 76: 18–24
[3] Samara ET, Stratakis J, Enele Melono JM et al. Therapeutic ERCP and pregnancy: is the radiation risk for the conceptus trivial? Gastrointest Endosc 2009; 69: 824–831
[4] 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; 10: 308–321
[5] Parada AA, Goncalves MO, Tafner E et al. Endoscopic papillotomy under ultra-sonographic control. Int Surg 1991; 76: 75–76
[6] Huang P, Zhang H, Zhang X et al. Comparison of endoscopic retrograde cholangiopancreatography performed without radiography and with ultrasound-guidance in the management of acute pancreatobiliary disease in pregnant patients. Chin Med J (Engl) 2013; 126: 46–50
[7] Gotzberger M, Pichler M, Gulberg V. Contrast-enhanced US-guided ERCP for treatment of common bile duct stones in pregnancy. Gastrointest Endosc 2012; 76: 1069–1070
[8] Meves V, Pohl J. Trans-Abdominal ultrasound guided erc in a pregnant woman with bile duct stones. Video J Encycl GI Endosc 2014; 2: 9–11
[9] Tang S-J, Mayo MJ, Rodriguez-Frias E et al. Safety and utility of ERCP during pregnancy. Gastrointest Endosc 2009; 69: 453–461
[10] Mehta PP, Sanaka MR, Parsi MA et al. Association of procedure length on outcomes and adverse events of endoscopic retrograde cholangiopancreatography. Gastroenterol Rep 2014; 2: 140–144