

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



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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.

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 direct confirmation of biliary cannulation, equipment exchange, and stone clearance. Our article describes the largest

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► **Table 1** Case series summary.

	Case 1	Case 2	Case 3	Case 4
Age (years)	42	33	31	37
Gestational Age (weeks)	5	9	25	10
	Initial Liver Enzymes			
ALT (10–45 U/L)	590	413	169	1268
ALP (35–125 U/L)	142	668	135	166
Total Bilirubin (0–23 µmol/L)/ Conjugated bilirubin (0–7 µmol/L)	11	27/18	35/16	34/25
Pre-ERCP imaging	US: CBD 10 mm; CBD stone	MRCP: CBD 12 mm; no stone	US: CBD 15 mm; 9 mm CBD Stone	US: No CBD dilation, multiple CBD stones
Antibiotic prophylaxis	No	No	No	No
Post-ERCP pancreatitis prophylaxis	Periprocedural hydration	Periprocedural hydration	Periprocedural hydration	Periprocedural hydration
Total procedure time ¹	22 minutes	10 minutes	Unable to obtain	22 minutes
Total sedation count (intravenous doses)	Fentanyl: 150 mcg Midazolam: 6 mg Dimenhydrinate: 50 mg	Fentanyl: 200 mcg Midazolam: 6 mg Dimenhydrinate: 50 mg	Unable to obtain	Fentanyl: 150 mcg Midazolam: 5 mg Dimenhydrinate: 50 mg
Successful ERCP	Yes	Yes	Yes	Yes
Clinical resolution	Yes	Yes	Yes	Yes
	Post-ERCP Liver Enzymes			
ALT (10–45 U/L)	34	13	13	19
ALP (35–125 U/L)	129	40	40	87
Total bilirubin (0–23 µmol/L)	8	9	9	3
ERCP-related complications	No	No	No	No
Fetal complications	Spontaneous abortion 4 weeks post-ERCP	No	Rupture of membranes 1-week post-ERCP	No
ALT, alanine aminotransferase; ALP, alkaline phosphatase; ERCP, endoscopy retrograde cholangiopancreatography; US, ultrasound; CBD, common bile duct ¹ Defined as time from endoscope insertion to withdrawal				

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 in-

creasing 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 choledocholithiasis/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

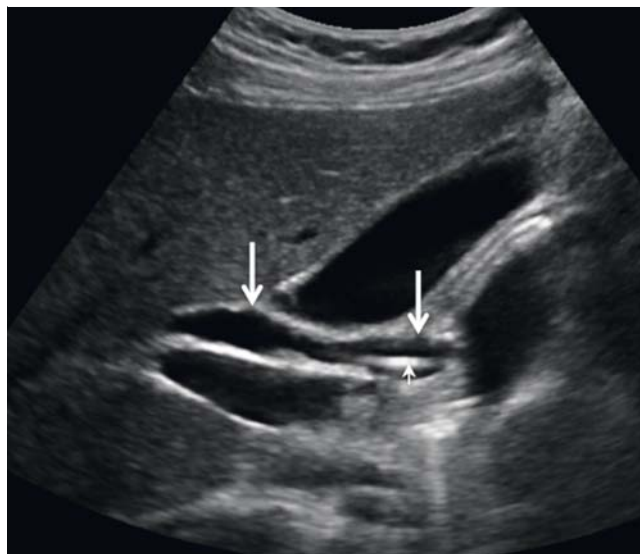
A 31-year-old in the second trimester of pregnancy with a previous cholecystectomy was referred with epigastric pain and elevated liver biochemistries. TA US revealed a dilated CBD and stone in the mid-CBD. Therefore, ERCP was performed. Real-time TA US confirmed a dilated CBD to 16 mm and a distal CBD 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



► **Fig. 1** Real-time trans-abdominal ultrasound showing guidewire (small arrow) cannulation in a dilated common bile duct (long arrows).

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



► **Fig. 2** Real-time transabdominal ultrasound showing retrieval basket (small arrows) with stone (broken arrow) capture in the common bile duct (long arrows).

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, its 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 confir-

mation, 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.

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