Original Article

The Therapeutic Use of Endoscopic Ultrasonography in Pediatric Patients is Safe: A Case Series

Yi Jia, Aldo Maspons[1], Mohammed O. Othman

Department of Gastroenterology, [1]Department of Pediatrics, Texas Tech University Health Sciences Center, Texas, USA

Address for correspondence:
Dr. Mohammed O. Othman, Assistant Professor of Medicine - Gastroenterology Section, Baylor College of Medicine, 7200 Cambridge Street, Suite 10C, Houston, Texas - 77030, USA.
E-mail: Mohamed.othman@bcm.edu

ABSTRACT

Background/Aim: Despite the safety and high diagnostic yield of endoscopic ultrasound guided fine needle aspiration (EUS FNA) for the evaluation of gastrointestinal diseases in adults, literature discussing the therapeutic use of EUS FNA in pediatrics remains limited. This study reports our experience with the use of EUS in children with pancreaticobiliary disorders. **Patients and Methods:** A retrospective study was conducted to evaluate safety, clinical utility, and impact of therapeutic EUS on the management of children (<18 years) at a tertiary referral center. Data were collected from January 1, 2011, to April 30, 2014. Patient demographics, clinical characteristics, and EUS procedure data were reviewed. Continuous variables were described using the mean and standard deviation. Categorical variables were described using frequencies and percentages. **Results:** A total of 6 therapeutic EUS procedures were performed in 5 children (3 F/2 M). The mean age was 13 years (range 6–17) with a mean body mass index of 28.2 (range 18.5–38.8). The indications for EUS procedures were abdominal pain with chronic pancreatitis (3) and management of symptomatic pancreaticobiliary cysts/pseudocysts observed on previous imaging (3). All procedures were performed under general anesthesia. The 6 therapeutic procedures performed were celiac plexus block (3), cyst gastrostomy with stents placement (2), and cyst aspiration using EUS FNA (1). A celiac plexus block effectively relieved abdominal pain in 2 patients with chronic pancreatitis. Cyst gastrostomy successfully resulted in pseudocyst resolution in the follow up imaging of 2 patients (up to 6 months after the procedure). Cyst aspiration with EUS guided FNA resulted in cyst resolution and confirmation of the benign nature of the cyst in 1 patient. All the procedures were successfully completed with no reported complications. **Conclusion:** The therapeutic use of endoscopic ultrasound in the pediatric population is safe and has a high success rate.

Key Words: Endoscopic ultrasound, fine-needle aspiration, pancreatobiliary, pediatric, therapeutic

Received: 15.12.2014, Accepted: 17.03.2015
How to cite this article: Jia Y, Maspons A, Othman MO. The therapeutic use of endoscopic ultrasonography in pediatric patients is safe: A case series. Saudi J Gastroenterol 2015;21:391-5.

Endoscopic ultrasound (EUS) is a valuable diagnostic tool for the evaluation of gastrointestinal diseases in adults. The combination of endoscopic visualization and high-frequency ultrasonographic images of the gastrointestinal tract enable advanced diagnostic and therapeutic EUS procedures.[1] The main diagnostic indications for EUS are well established in adults. These include evaluating pancreatobiliary lesions or masses, mediastinal diseases, submucosal lesions of the gastrointestinal wall, and luminal and extraluminal malignancies.[2] Therapeutic EUS applications are expanding. EUS-guided fine needle aspiration (FNA) and drainage of cystic lesions and fluid collections along the gastrointestinal tract, particularly in the pancreas, are the most common therapeutic procedures. Other innovative EUS therapeutic applications are celiac plexus block or neurolysis for abdominal pain resulting from chronic pancreatitis or pancreatic cancer. EUS-guided pancreatic and biliary drainage is gaining popularity.[2-5] The safety profile of EUS procedures is excellent. Adverse events associated with EUS-FNA include hemorrhage, infection, and pancreatitis. However, these are rare and occur in approximately 1%–2% of procedures.[6,7]

Despite established indications for therapeutic EUS in adults, literature discussing the therapeutic use of EUS in the pediatric population remains limited.[8-10] This scarcity is

Access this article online
Quick Response Code:
Website: www.saudijgastro.com
DOI: 10.4103/1319-3767.167191

mainly due to the relatively low incidence of pancreatobiliary and gastrointestinal disorders in children, limitation of equipment and trained pediatric gastroenterologists, and need for general anesthesia.[8-10] Most advanced diagnostic and therapeutic procedures in pediatric patients are performed by advanced endoscopists with extensive experience in adults.[8] This is a case series evaluating the clinical utility and outcomes of therapeutic EUS in the management of gastrointestinal disorders in pediatric populations.

PATIENTS AND METHODS

We conducted a retrospective study to evaluate the safety, clinical utility, and outcomes of EUS in pediatric patients (<18 years old) in a tertiary referral center along the United States–Mexico border. The study was approved by the Texas Tech University Health Sciences Center Institutional Review Board. Data were collected from January 1, 2011 to April 30, 2014. Patient demographics, EUS indications, details of EUS procedures, pathological data, and radiographic data were obtained by reviewing existing electronic medical records.

Indications of EUS included celiac plexus block for pain control in chronic pancreatitis, cyst gastrostomy with stent placement and drainage for pancreatic pseudocyst, and EUS-guided FNA aspiration for simple pancreatic cysts. The patients were followed up for 6 months after the procedure. Descriptive statistics of the patient and procedure characteristics were reported using means and percentages. Continuous variables were described using mean and standard deviation. Categorical variables were described using frequency and percentages.

All procedures were performed by an adult gastroenterologist with advanced endoscopy training. GIF-HQ190 and GF-UC140P endoscopes (Olympus, Melville, NY, USA) were used to perform the procedures. All procedures were performed under general anesthesia. One dose of intravenous antibiotics was given immediately prior to all procedures. A celiac plexus block was performed by injection of bupivacaine (0.25%, 20 mL) and methylprednisolone (80 mg) on both sides of the celiac ganglia after identifying the celiac artery take off from the aorta. A cyst gastrostomy was performed by the technique described previously by Al-Rashdan *et al.*, and Jazrawi *et al.*[9,11] A Doppler examination was used to identify the intervening vascular structures along the anticipated needle path. The area of interest was punctured using a 19-gauge FNA needle under ultrasonographic and fluoroscopic guidance. Suction with a 10 cc syringe was applied. Aspiration of the pseudocyst contents was performed. Aspirated liquid material was sent for a gram stain, culture, and cytological evaluation. A 0.035 mm guide wire was advanced through the needle and was allowed to coil several times inside the pseudocyst under fluoroscopic guidance. The cyst gastrostomy tract was created using needle knife (Olympus America Inc, Center Valley, PA, USA) over the guide wire. The tract was then dilated with 10 mm with the endoscope balloon (CRE™, Boston Scientific, Natick, MA, USA). Two 7-French double pig tail plastic stents (Advanix®, Boston Scientific) were placed under endoscopic and fluoroscopic guidance for drainage. A repeat CT scan was performed within 1 week following the procedure. The stent was removed in a subsequent endoscopy session after confirmation of pseudocyst resolution.

All patients were monitored for complications throughout the procedures and for 6 months thereafter. The following complications were particularly monitored: Uncontrolled bleeding (defined as need for admission or blood transfusion), pancreatitis, gastrointestinal perforation, infection, abdominal pain, fever, nausea, and vomiting.

RESULTS

Six EUS procedures (all upper EUS) were performed in 5 children (3 females/2 males). The mean age was 13 years (range 6–17 years). Three Hispanic and 2 non-Hispanic white patients were included. The mean weight percentile was 58th (range 10th–99th), and the mean body mass index was 28.2 (range 18.5–38.8, percentile range 13th–99th) [Table 1]. The indications for EUS were abdominal pain with chronic pancreatitis (3 procedures) and management of symptomatic pancreatic cyst or pseudocysts (3 procedures) [Figures 1–3] [Table 2]. The three patients with pancreatic cysts or pseudocysts presented with abdominal pain. Fever was noted in one patient with pseudocyst. All EUS procedures

Table 1: Patient characteristics

	Gender	Age (years)	Ethnicity	Weight (kg)/percentiles	BMI/percentiles	Indication
Pt 1	M	16	White	70/77th	22.5/74th	Pain control for chronic pancreatitis
Pt 2	F	15	Hispanic	69/90th	32.1/99th	Pain control for chronic pancreatitis
Pt 3	M	6	Hispanic	42/99th	25.6/99th	Walled off pancreatic necrosis on MRI
Pt 4	F	17	White	47/10th	18.5/13th	Pancreatic pseudocyst on CT
Pt 5	F	13	Hispanic	41/16th	38.8/99th	Pancreatic cyst on CT

MRI: Magnetic resonance imaging; CT: Computed tomography; BMI: Body mass index

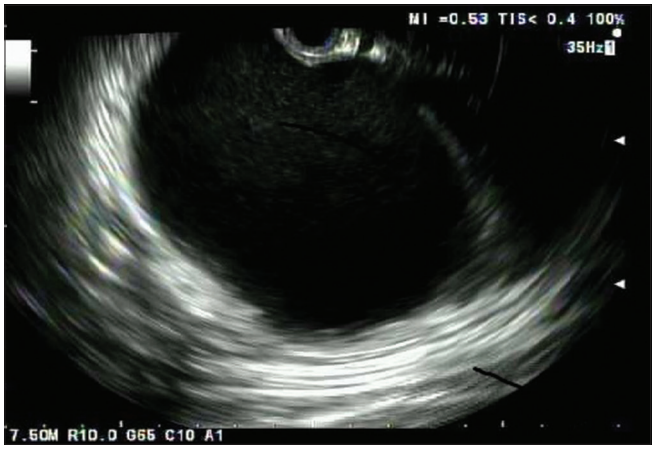

Figure 1: Pancreatic pseudocyst observed on endoscopic ultrasound

Figure 2: Cyst gastrostomy dilation with 10 mm balloon

Figure 3: Cyst gastrostomy stents

were performed under general anesthesia. The EUS findings included chronic pancreatitis in two patients, a pancreatic pseudocyst in two patients, and a simple pancreatic cyst in 1 patient. All patients with pancreatitis were diagnosed by clinical presentation, abnormal pancreatic enzymes, and characteristic imaging findings. The EUS findings in patients with chronic pancreatitis included hyperechoic strands, hyperechoic foci, and lobularity in the parenchyma of the pancreas. The pancreatic duct had hyperechoic walls, visible side branches, and a tortuous/ectatic appearance. The pancreatic duct measured up to 4 mm in diameter in the body of the pancreas. In patient 2, intraductal stones were also noted on the EUS examination. The etiology of chronic pancreatitis in our patients was not identified. Both patients tested negative for genetic mutations in protease, serine, 1(PRSS1), cystic fibrosis transmembrane conductance regulator (CFTR), or serine protease inhibitor Kazal-type 1 (SPINK1) genes. Absence of genetic mutation in these genes suggests the exclusion of common forms of hereditary pancreatitis as the cause of their chronic pancreatitis.

Therapeutic procedures included a celiac plexus block (3 procedures), cyst gastrostomy with stent placement (2 procedures), and cyst aspiration using EUS-FNA (1 procedure). All the procedures were completed successfully without any immediate or long-term complications during the follow-up period (up to 6 months after the procedure).

The celiac plexus block effectively provided relief of abdominal pain in the two chronic pancreatitis patients in the follow-up assessments over the 6-month period. One patient with multiple pancreatic duct stones received endoscopic retrograde cholangiopancreatography immediately after the EUS for stone removal.

EUS cyst gastrostomies with stent placement were successful in the two patients with walled-off pancreatic necrosis and pancreatic pseudocysts. The follow-up abdominal imaging after 6 months showed resolution of the previously observed fluid collection or necrosis. An EUS-FNA was performed in 1 patient with a simple pancreatic cyst. Two passes were attempted with a 22-gauge needle using the transgastric approach, and 3 mL of fluid were collected. The fluid was purulent, with a possible diagnosis of infected pseudocyst. Gram stain and culture of the cyst fluid was negative for any bacterial infection, and cytology did not identify any malignant cells. This result supported the diagnosis of a simple pancreatic cyst. The follow-up imaging showed complete resolution of the cyst after aspiration.

DISCUSSION

Compared with the established role of EUS in adult gastrointestinal and pancreatobiliary diseases, EUS experience in pediatric patients is rarely reported.[8-10] Although current guidelines indicate that EUS can be used in pediatric patients, published studies of pediatric EUS are limited to few patients and single-center trials. Moreover,

Table 2: Procedure details

	EUS finding	Therapy	Outcome	Complication
Pt 1	Chronic pancreatitis	Celiac plexus block	Pain controlled	No
Pt 2	Chronic pancreatitis with intraductal stones	Celiac plexus block twice	Pain controlled	No
Pt 3	50 mm × 55 mm pancreatic pseudocyst	Cystogastrostomy with 2 (7 F) stents placement	Resolution of walled off pancreatic necrosis in follow-up imaging	No
Pt 4	110 mm × 70 mm pancreatic pseudocyst	Cystogastrostomy with 3 (7 F) stents placement	Resolution of pseudocyst in follow-up imaging	No
Pt 5	40 mm × 30 mm Pancreatic head cystic lesion	Cyst aspiration with EUS-FNA	Cyst resolution and confirmation of benign nature of the cyst	No

EUS-FNA: Endoscopic ultrasound-guided fine-needle aspiration; F: French

most studies focus on diagnostic indications for EUS, and only a few provide information on its therapeutic role.[9-13] We demonstrated 6 successful pediatric therapeutic EUS procedures, including a celiac plexus block for pain control in chronic pancreatitis, cyst gastrostomy with stent placement, and drainage of a pancreatic pseudocyst and EUS-guided FNA aspiration for a simple pancreatic cyst. We found that standard EUS equipment and accessories can be used in pediatric patients to perform EUS therapeutic interventions. We demonstrated that therapeutic EUS procedures can be safely performed in pediatric patients as young as 6 year olds.

Pseudocysts are the most common pancreatic cysts in the pediatric population. Large pseudocysts have a higher risk of rupture.[11] A pseudocyst larger than 6 cm or one that persists for more than 6 weeks is less likely to resolve spontaneously. Therefore, all symptomatic pancreatic pseudocysts require therapeutic drainage. EUS-guided drainage of pancreatic pseudocysts is more common in adults because this approach has a higher efficacy than percutaneous drainage and similar efficacy with less morbidity compared with surgical intervention.[2] Jazrawi *et al*., reported their experience with EUS-guided cyst gastrostomy in 10 pediatric patients.[11] In all 10 cases, transgastric endoscopic drainage of pseudocysts was successfully achieved without any reported complications. Three other studies reported their experience in one or two cases with good success.[12-14] Despite the rare nature of cyst gastrostomy in children, there is a high success rate of the EUS-guided cyst gastrostomy in our data and other published data.[9,11,12]

An EUS-guided celiac plexus block is used for pain relief from chronic pancreatitis, whereas EUS-guided celiac plexus neurolysis is used for pain relief from pancreatic cancer.[4] An EUS-guided celiac plexus block in chronic pancreatitis is assumed to be a short-term intervention and results in less durable pain relief compared with a celiac plexus neurolysis for pancreatic cancer patients.[2] In our study, an EUS-guided celiac plexus block effectively provided temporary relief of abdominal pain up to 6 months after the procedure.

EUS-guided therapeutic interventions have a higher incidence of complications than other endoscopic procedures.[6] Most EUS complications are associated with performing therapeutic EUS procedures, including immediate perforation, bleeding, infection of the drained pseudocyst, and pancreatitis. However, the incidence of these complications is rare. EUS safety appears to be comparable with percutaneous or surgical approaches. Our series had no major complications 6 months after the procedure.

Antibiotic prophylaxis is indicated for adult EUS-guided FNA of cystic lesions but not for solid lesions or lymph nodes.[15] In our three EUS-guided interventions for pancreatic cysts and pseudocysts, antibiotics were provided prior to the procedures. None of the patients developed a fever or other infectious complications.

Another concern of invasive EUS in pediatric patients is the route of anesthesia. The current guidelines indicate no preference for moderate sedation over general anesthesia in pediatric patients.[9] In our study, general anesthesia provided significant sedation and maintenance of airway with adequate safety and no adverse events in all the pediatric patients.

Our limitations include a small number of patients, single center study, and limitations associated with a retrospective review. It is noteworthy that we had no infant patients in our study. In conclusion, the therapeutic use of EUS in pediatric patients is safe and effective and has a significant impact on the management of pediatric patients with pancreatic diseases. It should be considered as part of the therapeutic plan in pediatric gastroenterology.

REFERENCES

1. Fusaroli P, Caletti G. Endoscopic ultrasonography. Endoscopy 2003;35:127-35.
2. Gan SI, Rajan E, Adler DG, Baron TH, Anderson MA, Cash BD, *et al*.; ASGE Standards of Practice Committee Role of EUS. Gastrointest Endosc 2007;66:425-34.
3. Gan SI, Thompson CC, Lauwers GY, Bounds BC, Brugge WR. Ethanol

lavage of pancreatic cystic lesions: Initial pilot study. Gastrointest Endosc 2005;61:746-52.
4. Levy MJ, Wiersema MJ. EUS-guided celiac plexus neurolysis and celiac plexus block. Gastrointest Endosc 2003;57:923-30.
5. Mallery S, Matlock J, Freeman ML. EUS-guided rendezvous drainage of obstructed biliary and pancreatic ducts: Report of 6 cases. Gastrointest Endosc 2004;59:100-7.
6. Adler DG, Jacobson BC, Davila RE, Hirota WK, Leighton JA, Qureshi WA, *et al*.; ASGE. ASGE guideline: Complications of EUS. Gastrointest Endosc 2005;61:8-12.
7. Wiersema MJ, Vilmann P, Giovannini M, Chang KJ, Wiersema LM. Endosonography-guided fine-needle aspiration biopsy: Diagnostic accuracy and complication assessment. Gastroenterology 1997;112:1087-95.
8. Lee KK, Anderson MA, Baron TH, Banerjee S, Cash BD, Dominitz JA, *et al*.; ASGE Standards of Practice Committee. Modifications in endoscopic practice for pediatric patients. Gastrointest Endosc 2008;67:1-9.
9. Al-Rashdan A, LeBlanc J, Sherman S, McHenry L, DeWitt J, Al-Haddad M. Role of endoscopic ultrasound for evaluating gastrointestinal tract disorders in pediatrics: A tertiary care center experience. J Pediatr Gastroenterol Nutr 2010;51:718-22.
10. Attila T, Adler DG, Hilden K, Faigel DO. EUS in pediatric patients. Gastrointest Endosc 2009;70:892-8.
11. Jazrawi SF, Barth BA, Sreenarasimhaiah J. Efficacy of endoscopic ultrasound-guided drainage of pancreatic pseudocysts in a pediatric population. Dig Dis Sci 2011;56:902-8.
12. Cohen S, Kalinin M, Yaron A, Givony S, Reif S, Santo E. Endoscopic ultrasonography in pediatric patients with gastrointestinal disorders. J Pediatr Gastroenterol Nutr 2008;46:551-4.
13. Varadarajulu S, Wilcox CM, Eloubeidi MA. Impact of EUS in the evaluation of pancreaticobiliary disorders in children. Gastrointest Endosc 2005;62:239-44.
14. Theodoros D, Nikolaides P, Petousis G. Ultrasound-guided endoscopic transgastric drainage of a post-traumatic pancreatic pseudocyst in a child. Afr J Paediatr Surg 2010;7:194-6.
15. Hirota WK, Petersen K, Baron TH, Goldstein JL, Jacobson BC, Leighton JA, *et al*.; Standards of Practice Committee of the American Society for Gastrointestinal Endoscopy. Guidelines for antibiotic prophylaxis for GI endoscopy. Gastrointest Endosc 2003;58:475-82.

Source of Support: Nil, **Conflict of Interest:** All authors disclosed no conflict of interest pertaining to this publication.