

Wire-guided Cannulation Versus Contrast-guided Cannulation In Pediatric Endoscopic Retrograde Cholangiopancreatography

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ABSTRACT

Background/Aim: Wire-guided cannulation (WGC) of the common bile duct may be associated with fewer complications and higher success rate compared with contrast-guided cannulation (CGC) in adults. Data in children are lacking. The aim of this study was to compare the successful cannulation and complication rate of WGC and CGC in pediatric endoscopic retrograde cholangiopancreatography (ERCP). **Patients and Methods:** We report a retrospective cohort study comparing WGC to CGC in a pediatric cohort. We reviewed the medical records of 167 children who underwent ERCP over a 10-year time period (CGC, 1999–2003, WGC, 2003–2009). Indications, findings, and success were analyzed. **Results:** A total of 93 patients (56% underwent WGC and 74 (44%) CGC. Children in the WGC group were younger (9.5 ± 4.7 vs. 11.5 ± 4.6 years in CGC; $P = 0.006$) and underwent more therapeutic ERCP interventions (70% vs. 40% in CGC), whereas diagnostic ERCP was more common in the CGC group (60%; $P < 0.005$). The overall success (96%) and complication rate (8%) were identical in both groups but a trend toward a reduction in the complication rate over time was noted in the WGC group. Post-ERCP pancreatitis (PEP) was documented in one patient in the WGC group (1.1%) and three patients (4.2%) in the CGC group (P-NS). **Conclusion:** The success and complication rate in both CGC and WGC are comparable in children but considering the patient and procedure complexity and the trend toward lower PEP in the WGC group, WGC may be the preferable cannulation technique for ERCP in children.

Key Words: Performance, pediatric endoscopy, pancreatobiliary, technical aspects and complications of ERCP

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Since the first report of successful cannulation of the ampulla of Vater in 1968, endoscopic retrograde cholangiopancreatography (ERCP) has been widely used in the diagnosis and management of pancreatic and hepatobiliary disorders in adults. The first successful pediatric ERCP in a 3.5-month-old child using an adult-size duodenoscope was reported in 1976^[1] and since then ERCP has evolved into a central diagnostic and therapeutic tool in pediatric gastroenterology.^[2-8] Following improvements in the technique and increased experience, ERCP is currently done safely and with excellent success rates of 86%–100%

in all pediatric age groups.^[2-7,9] The major risks and complications of ERCP in children are similar to adults and include pancreatitis, hemorrhage, infection, and perforation. Reported complication rates are similar to those reported for adults and vary between 3% and 10%.^[3,4,9,10]

Selective cannulation of the common bile duct by insertion of a guidewire (wire-guided cannulation, WGC) may be associated with fewer complications than other methods of cannulation with injection of contrast (contrast-guided cannulation, CGC) to access the bile duct. A prospective randomized controlled trial by Lee *et al.* concluded that WGC is associated with a lower rate of post-ERCP pancreatitis (PEP) in adults.^[11] Similarly, a systematic review and meta-analysis of WGC versus CGC for the prevention of PEP in adults demonstrated a reduced risk of PEP in WGC compared with the use of CGC in randomized non-crossover trials (3.2% in WGC vs. 8.7% in CGC; RR 0.38; 95% CI 0.19–0.76), whereas the rate of bleeding, perforation, or mortality was comparable.^[12,13] In addition, the success rate

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of primary cannulation was greater in the WGC group (RR 1.07, 95% CI 1–1.15) compared with the CGC group. No data on this topic is available for the pediatric population and it is unknown if WGC has an added benefit in pediatric ERCP. The aim of this retrospective cohort study is to evaluate the impact of WGC on the outcome of pediatric ERCP compared with CGC in terms of success rate and complication.

PATIENTS AND METHODS

The study was designed as a retrospective single-center cohort study comparing WGC with CGC in a pediatric cohort. The medical records of 167 patients, 18 years and younger, who underwent ERCP from January 1999 to December 2009 at the hospital for Sick Children, Toronto, Canada, were reviewed. The following data were retrieved from the medical records: Patient age at the time of procedure; gender; ERCP type; indication; findings; and interventions performed complications, and outcome. ERCP success was defined as successful deep cannulation of the desired duct based on the preprocedure ERCP indication listed. Failed ERCP was defined as a failure to cannulate the desired duct. Hospitalization was defined as admission to the hospital beyond the routine 24-h admission after ERCP. Complication was defined as the following: PEP, defined as pancreatic pain associated with elevation in pancreatic enzymes 3 times the upper limit of normal and associated with prolonged hospitalization of an inpatient or new-onset or increased abdominal pain lasting more than 24 h caused an unplanned admission for more than one night. Cholangitis was defined as an elevation in the temperature to more than 38°C because of a biliary cause without evidence of other concomitant infections; fever in the absence of cholangitis or pancreatitis, which prolonged inpatient stay; abdominal pain in the absence of cholangitis or pancreatitis, which prolonged inpatient stay. The study protocol was approved by the hospital ethics committee.

All ERCPs were performed by dedicated staff gastroenterologists (PK, GM) specialized in interventional endoscopy with significant experience in both adult and pediatric ERCP. Adult endoscope (Olympus TJF 160; Center Valley, PA, USA) was typically used. For children younger than 1 year a smaller endoscope was used (Olympus PJF 160) since January 2003. CGC technique was routinely used at our center from 1999 until July 2003, whereas WGC was used thereafter. All ERCPs were performed under general anesthesia. For CGC, a small amount of contrast was injected by the endoscopist on each attempt at cannulation until the desired duct was opacified and then deep cannulation of that duct was attempted. Care was taken not to overfill the pancreatic duct. For WGC, a hydrophilic guidewire was gently advanced into the papilla and contrast was only

injected after the wire was felt to be positioned in the desired duct. The size of the guidewire used was at the discretion of the endoscopist, with wires ranging in size from 0.018 in. to 0.035 in. Although no optimal iodine concentration has been defined for ERCP, 65% iodinated contrast agent is injected manually using a 5 or 10 mL syringe. Dilution of the contrast material to 30% was used for optimal visualization if ducts are known to be dilated or if filling defects are anticipated.

Prophylactic pancreatic stents were not routinely placed. Post-procedure all patients were monitored in hospital for 24 h and discharged the next day if stable.

Patients were divided into two groups for statistical analysis—WGC and CGC. Continuous variables were analyzed with unpaired Student's *t*-test (age), whereas categorical variables were analyzed with Chi-square or Fisher's exact tests (reason, indication, findings, complications, and outcome). All analyses were conducted using inStat software.

RESULTS

One hundred sixty-seven pediatric patients underwent ERCP in our institute over the study period. Ninety-three children (55.7%) underwent WGC (August 2003–December 2009) and 74 (44.3%) CGC (January 1999–July 2003) of the common bile duct (CBD). The male-to-female ratio was similar among the groups (1.5:1 WGC vs. 1.7:1 CGC). The mean age at the time of ERCP has dropped significantly over the years and was 9.5 ± 4.7 years (range, 0.75–18 years) in the WGC group compared with 11.5 ± 4.6 years (range, 0.15–17.5 years) in the CGC group ($P = 0.006$).

A significantly larger proportion of patients in the WGC group underwent therapeutic ERCP (70% vs. 40% in CGC), whereas diagnostic ERCP was more common in the CGC group (60% of the patients; $P < 0.005$) [Table 1]. As a result of this shift in practice the indications for ERCP in the WGC group were mainly related to therapeutic interventions for conditions such as choledocholithiasis (29%), obstructive jaundice (18%), or repeated interventions (21%; stent removal or replacement, dilatation of stricture, etc). On the other hand, the main indications for ERCP in the CGC group were related to diagnostic dilemmas such as suspected primary sclerosing cholangitis (28%) or recurrent pancreatitis (20%) ($P < 0.005$ for ERCP indication).

ERCP findings were divided into four categories [Table 2] and were not significantly different when WGC and CGC groups were compared ($P = \text{NS}$). However, trends were observed that included extrahepatic bile duct disease (mainly bile duct stone or stricture) being more common in the WGC group (58%) compared with CGC (28%), whereas

Table 1: Indications for ERCP in the wire guided and contrast cannulation groups

	N (%)		P
	Wire guided cannulation	Contrast cannulation	
Number of patients	93	74	
Type of ERCP	Therapeutic	Therapeutic	<0.005
	65 (70)	30 (40)	
	Diagnostic	Diagnostic	<0.005
	28 (30)	44 (60)	
Indications			
Liver disease	12 (13)	29 (39)	<0.005
Suspected primary sclerosing cholangitis	6 (6)	21 (28)	<0.005
Cirrhosis/hepatitis (not yet diagnosed)	6 (6)	6 (8)	<0.005
Cholangitis	0	2 (3)	<0.005
Extrahepatic bile duct disease	48 (52)	22 (30)	<0.005
Choledocholithiasis	27 (29)	8 (11)	<0.005
Obstructive jaundice	17 (18)	10 (14)	<0.005
Other	4 (4)	4 (5)	<0.005
Pancreatic disease	13 (14)	15 (20)	<0.005
Recurrent pancreatitis	12 (13)	15 (20)	<0.005
Other	1 (1)	0	<0.005
Other	20 (21)	8 (11)	<0.005
Stent related procedure	8 (9)	6 (8)	<0.005
Pseudocyst drainage	5 (5)	1 (1)	<0.005
Dilatation of stricture/papilla	4 (4)	0	<0.005
Other	3 (3)	1 (1)	<0.005

ERCP: Endoscopic retrograde cholangiopancreatography

normal ERCP (26% vs. 14%) and PSC (18% vs. 7%) being more common in the CGC group.

Therapeutic interventions were done in both groups but their number was significantly higher in the WGC group (103 interventions in 64 patients vs. 35 in 27 patients in the CGC group; $P < 0.0001$) [Table 3]. The most common therapeutic intervention in the WGC were sphincterotomy ($n = 39$, 38%) combined with stone/sludge removal ($n = 43$, 42%), and stent-related interventions ($n = 16$, 16%). In many cases several interventions were performed in the same patient such as sphincterotomy followed almost always by stone removal or occasionally by stent placement.

Patient and ERCP outcome were similar in both groups [Table 4]. Ninety-six percent of the ERCPs were successfully completed in both groups and failure to cannulate the desired duct was mainly related to anatomical abnormalities of the duodenum. PEP was documented in 1 patient in the WGC group (1.1%) and 3 patients (4.2%) in the CGC group however this trend did not reach statistical difference. Seven (7.5%) patients in the WGC and 2 (2.7%) in the CGC group required prolonged hospitalization due to post-ERCP complications. The overall complication rate

was 8% in both groups and other complications included fever, abdominal pain, and cholangitis [Table 4]. Despite the lack of statistical difference in the rate of complication it is important to note that the last PEP occurred in 2004 and only one complication was reported over the last 3 years of the study (2007–2009) suggesting a trend toward reduced complication rate over time in the WGC group. One death was reported in the CGC group in a 17-year-old female with persistent hyperbilirubinemia who was referred for a diagnostic ERCP. The child developed PEP and died due to multiorgan failure 5 days after the ERCP.

DISCUSSION

Since the first descriptions of the guide-wire technique for bile duct cannulation in 1987,^[14] the use of a guide wire has become an important part of ERCP procedures. The guide wire can be used for achieving and maintaining access to the desired duct and facilitating the advancement of various accessories.^[15-17] The impact of WGC on the successful completion of ERCP and post procedure complications mainly PEP has been widely studied in adults but data in children is lacking. The current study is the first to compare WGC to CGC in the pediatric population. Our findings revealed a few trends and differences among the studied groups. Children in the WGC were younger and a larger proportion of patients in this group underwent therapeutic procedure (70%) compared with the CGC group (40%) where most of the indications for ERCP were diagnostic. Despite the younger age and the higher number of therapeutic procedures in the WGC group the success rate (96%) and the complication rate (8%) were similar among the groups. Although the prevalence of PEP was lower in the WGC group (1.1%) compared with the CGC group (4.2%) this trend did not reach statistical significance.

The indications for ERCP and the post procedure findings in our cohort are similar to previous reports on ERCP in children with bile duct disease and pancreatic pathologies as the leading indications and findings.^[3,4,9,18] Not surprisingly, the indication for ERCP as a diagnostic tool for anatomical abnormalities of the extrahepatic bile ducts and for intrahepatic pathologies such as primary sclerosing cholangitis has dropped over the years in our center. Diagnostic ERCP had shifted from 60% of the cases in the early days of the CGC group (1999–2003) to 30% in the WGC group. This change in practice can be explained by our increasing reliance on magnetic resonance cholangiopancreatography (MRCP) as a routine diagnostic tool for extra- and intrahepatic bile duct pathologies and has happened in parallel to the change in our ERCP technique from CGC to WGC. The use of MRCP as a reliable screening diagnostic tool is supported by recent publications in children.^[19,20]

Table 2: Findings at the time of ERCP in the wire guided and contrast cannulation groups

Findings	N (%)	
	Wire guided cannulation	Contrast cannulation*
Normal ERCP	13 (14)	19 (26)
Failed cannulation	3 (3)	3 (4)
Extrahepatic bile duct disease	54 (58)	21 (28)
CBD stone	32 (35)	9 (12)
Dilated CBD	13 (14)	4 (5)
Biliary stricture	4 (4)	4 (5)
Bile duct anomalies	2 (2)	3 (4)
Stone/dilated bile duct	1 (1)	1 (1)
Bile leak	2 (2)	0
Pancreatic disease	12 (13)	14 (19)
Pancreas divisum	3 (3)	6 (7)
Pseudocyst	4 (4)	2 (3)
Pancreatic duct anomalies/stone	5 (6)	4 (6)
Fibrosing pancreatitis	0	2 (3)
Liver disease	6 (7)	14 (19)
PSC	6 (7)	13 (18)
Caroli's disease	0	1 (1)
Other	5 (5)	3 (4)
Stricture of duodenal papilla	1 (1)	1 (1)
Duodenal papilla not identified	3 (3)	0
Tumor	0	2 (3)
Duodenal hematoma	1 (1)	0

*P values are not significant. CBD: Common bile duct, PSC: Primary sclerosing cholangitis, ERCP: Endoscopic retrograde cholangiopancreatography

Table 3: Therapeutic procedures performed during ERCP

Intervention	Wire guided cannulation*	Contrast cannulation
Stone/sludge retrieval	43	16
Sphincterotomy	39	11
Stent placement/revision	16	7
Drainage of pseudo cyst	4	1
Stricture/papilla dilatation	1	0

*P value <0.0001. ERCP: Endoscopic retrograde cholangiopancreatography

The utilization of ERCP as a therapeutic tool has evolved over time, and previous reports in children have demonstrated its importance in the treatment of pancreaticobiliary pathologies. Sphincterotomy, stone and sludge retrieval, and stent-related procedures (placement, revision, and removal) were the most common therapeutic interventions in our cohort. Additional and less common interventions included drainage of pancreatic pseudocysts, treatment of pancreatic strictures, and pancreas divisum. As already stated, therapeutic procedures were more common in the WGC group despite the fact that patients in this group were younger and smaller in number. Moreover, WGC was not technically more difficult in this pediatric population compared with

Table 4: Outcome and complications in the wire guided and contrast cannulation groups

	Wire guided cannulation of CBD*	Contrast cannulation of CBD
Number of Pt.	93	74
Outcome		
Successful cannulation	90 (96.8%)	71 (96%)
Failed cannulation	3 (3.2%)	3 (4%)
Hospitalization	7 (7.5%)	2 (2.7%)
Complications	7 (7.5%)	6 (8.1%)
Death	0	1 (1.3%)
Pancreatitis	1 (1.1%)	3 (4%)
Fever	3 (3.2%)	0
Abdominal pain	2 (2.1%)	2 (2.7%)
Cholangitis	1 (1.1%)	0

*P values are not significant

CGC. The increasing use of therapeutic ERCP over time was probably driven by accumulated endoscopic experience in our center and occurred at the same time that we changed our cannulation technique from CGC to WGC.

Post-ERCP complications mainly PEP can lead to significant morbidity and occasional mortality. The overall complication rate in our study was 8% in both groups, although a reduction in the number of complications was noted over time in the WGC group with only one complication over the last 3 years of the study. Previous pediatric series have reported similar complication rates, ranging between 2.5% and 10% and therapeutic ERCP was found as a leading risk factor for post-ERCP complications including pancreatitis.^[4,9,10] The incidence of PEP in adult population varies from 1% to 40% partly as a result of the definition of PEP.^[21] But figures of 1%–7% are typical in large prospective adult studies. Similar incidence of PEP was reported in children ranging between 2.5% and 9.4% of the cases.^[3,10,22] In our study, the incidence of PEP was 4.2% in the CGC group and 1.1% in the WGC with no episode of PEP since 2004 in the WGC group (P-NS). Accessing the bile duct with the aid of a guidewire may limit mechanical trauma to the papilla or pancreatic sphincter and avoid hydrostatic pressure associated with contrast injection, thereby reducing the likelihood of PEP.^[23] We report the first post-ERCP mortality case. One death was reported in the CGC group in a 17-year-old female with persistent hyperbilirubinemia who was referred for a diagnostic ERCP. The child developed PEP and died due to multiorgan failure 5 days after the ERCP. This case should pay attention to all ERCP Endoscopist dealing with the pediatric age group, that a nonpredictable outcome can easily be developed. To date, four randomized controlled trials have been conducted in adults to evaluate the effect of WGC in the prevention of PEP compared with CGC.^[11,24-26] Of the four, three showed that WGC can reduce the risk of PEP^[11,24,26] whereas the remaining study showed no difference in the risk of PEP with

WGC. Conflicting results were also reported in four recent meta-analyses, where the first showed only non significant reductions in the rate of PEP with the use of GWC,^[23] whereas the other three^[12,13,27] concluded that the wire-guided technique increases the primary cannulation rate and reduces the risk of PEP compared with the standard contrast-injection method. The impact of WGC on complication and PEP incidence and ERCP success rate in children was not reported until now. The trend toward PEP reduction in the WGC group in our cohort despite the fact that these children were smaller and underwent more therapeutic interventions that increases the risk for PEP,^[10,28] might suggest that WGC offers an outcome benefit in pediatric ERCP. The retrospective nature of our study and lack of real-time randomization precludes a final answer to this observation. It is likely that more robust findings could have been found in a larger, prospectively followed cohort, although this nature of follow up in pediatric ERCP is very challenging due to the small number of patients in each center.

In conclusion, the current study demonstrates that diagnostic and therapeutic ERCP is safe and effective in children and infants. The success rate, complication rate, and PEP in both CGC and WGC are comparable in children but considering the patient profile, procedure complexity, and the trend toward lower PEP in the WGC group, WGC may be the preferable cannulation technique for ERCP in children.

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