Journal of Pediatric Surgery (2013) **48**, 418–424

ELSEVIER

Journal of Pediatric Surgery

www.elsevier.com/locate/jpedsurg

Endoscopic management of biliary complications after partial liver resection in children

Mette W. Steen [a], Roel Bakx [a,*], Merit M. Tabbers [b], Jim C.H. Wilde [a], Krijn P. van Lienden [c], Marc A. Benninga [b], Hugo A. Heij [a], Erik A.J. Rauws [d]

[a]*Paediatric Surgical Centre of Amsterdam, Meibergdreef 9, 1105 AZ Amsterdam, the Netherlands*
[b]*Department of Paediatric Gastroenterology and Nutrition, Emma's children's Hospital Academic Medical Centre, Meibergdreef 9, 1105 AZ Amsterdam, the Netherlands*
[c]*Department of Radiology, Academic Medical Centre, Meibergdreef 9, 1105 AZ Amsterdam, the Netherlands*
[d]*Department of Gastroenterology and Hepatology, Academic Medical Centre, Meibergdreef 9, 1105 AZ Amsterdam, the Netherlands*

Received 13 April 2012; revised 24 August 2012; accepted 1 October 2012

Key words:
Endoscopic retrograde cholangiopancreatography;
Liver surgery;
Complications;
Bile leakage;
Biliary stricture;
Children

Abstract

Background: Biliary complications after liver surgery are difficult to manage. Endoscopic retrograde cholangiopancreatography (ERCP) with stenting of the common bile duct is not commonly practiced in children for this purpose. The aim of this retrospective review is to evaluate the role of ERCP as both a diagnostic and a therapeutic tool in the management of biliary complications after liver resection in children.

Patients and Methods: The charts of all patients from 0 to 18 years old who underwent partial liver resection in a tertiary children's hospital in Amsterdam, the Netherlands, between 2000 and 2010 were retrospectively reviewed.

Results: Forty-five children (median age: 3.6 years, range: 2 months–17 years) underwent partial liver resection. Post-operative biliary complications occurred in 13 children. Ten patients were suffering from bile leakage. Eight of them underwent ERCP with stent placement after which leakage stopped in 5 patients. Three patients presented with a post-operative biliary tract stricture. ERCP with dilation and stent placement was performed in 2 of them, which solved the problem in one patient. ERCP demonstrated the nature (bile leak and/or biliary tract stricture(s)), extent, and location of the lesion in 8 of 10 children. There were no serious procedure related complications. Rescue procedures in the other patients included hepaticojejunostomy and liver transplant.

Conclusion: ERCP with stenting of the common bile duct has a diagnostic and therapeutic role in the management of bile leaks after partial liver resection in children. The value of ERCP in the management of a stricture of the biliary tract is less conclusive.

Indications for partial liver resection in children are malignant primary and secondary tumors, and benign tumors. Biliary complications after liver resection comprise bile leakage and strictures of the biliary tract. They

* Corresponding author. Tel.: +31 20 5665693; fax: +31 20 5669287.
E-mail address: r.bakx@amc.uva.nl (R. Bakx).

0022-3468/$ – see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jpedsurg.2012.10.075

occur in 5%-12.5% of children [1–3] and in 1%–7% of adults [4–6]. They are difficult to treat and re-operation after liver resection is complex and may lead to additional complications. Furthermore, these complications frequently lead to delay in starting post-operative chemotherapy.

Endoscopic retrograde cholangiopancreatography (ERCP) is a relatively new modality in the diagnosis and treatment of biliary disease (e.g. biliary atresia, bile duct stones, choledochal cyst) and pancreatic disease (e.g. pancreatitis, traumatic pancreatic duct disruption, pseudocyst) in children [7,8]. Currently ERCP is not a standard procedure in most children's hospitals, mainly due to the low incidence of biliopancreatic disease among children and the fact that ERCP in young children has to be performed by an expert endoscopist.

Little is known about the role of endoscopic management of post-operative biliary complications in children. In adults, the treatment of post-operative bile leakage switched from surgical therapy to stenting of the papilla of Vater via ERCP with low morbidity and mortality [9–13].

The aim of this study is to evaluate the role of ERCP as a diagnostic and therapeutic tool in the management of biliary complications after partial liver resection in children.

Table 1 Patients, surgical procedures and indications for surgery.

	Total	Biliary complications
Patients		
Total number of patients	45	13
Male	26	9
Female	19	4
Median age during surgery	3.6 years (range: 2 months–17 years)	
Surgical procedures		
Resection of 1–2 segment(s)	5	2
Resection of 3–4 segments	19	4
Resection of 5 segments	12	7
Extra-anatomical resection	9	0
Indications for surgery		
Hepatoblastoma	22	7
Hepatocellular carcinoma	4	1
Nephroblastoma	4	1
Neuroblastoma	3	0
Rhabdomyosarcoma	2	0
Pure yolk sac tumor	1	0
Metastases	2	0
Benign disorders	7	4

1. Patients and methods

The case records of all patients from 0 to 18 years old who underwent partial liver resection in a tertiary children's hospital in Amsterdam, the Netherlands from 2000 to 2010 were retrospectively reviewed.

Partial liver resection was defined as resection of one up to five segments or an extra-anatomical resection of liver parenchyma without removal of a complete segment. All patients with signs of post-operative biliary complications were evaluated. Biliary complications were categorized as bile leakage or stricture of the bile duct. Bile leakage was defined as persistent drain output of bile (>50 ml/day) from the surgical drain with no decrease of the drainage within 7 days. A stricture of the biliary tract was defined as a caliber narrowing as seen on cholangiogram either by ERCP or PTC, based on expert opinion. The following data were collected: sex, age, surgical procedures, indications for liver resection (all are listed in Table 1), post-operative biliary complications and their management and complications after ERCP. Complications after ERCP were classified according to the Clavien–Dindo classification system of surgical complications [14].

Liver resections were performed by three different surgeons according to a standardized protocol. The parenchyma was divided using the Cavitron Ultrasonic Surgical Aspirator (CUSA®). After liver resection a percutaneous drain was left close to the resection surface. All ERCP procedures were executed by the same endoscopist (E.A.J.R.). They were all performed under antibiotic prophylaxis of ciproxin. During the procedure all children were under general anesthesia. In 2004 all ERCP procedures in children younger than 1 year were performed with the Olympus PJF-160 duodenoscope (Olympus, Hamburg, Germany). Before 2004 the instrument used was the Olympus PJF-7.5 duodenoscope (Olympus, Hamburg, Germany). All ERCP procedures in children older than 1 year were performed with a conventional adult Olympus TJF-160R duodenoscope (Olympus, Hamburg, Germany). Sphincterotomy was performed if indicated. Strictures were dilated by hydrostatic balloon (4, 6 or 8 mm). The stents used were polyethylene straight Amsterdam-type stents (5, 7 or 10 Fr).

Before removing or changing a stent, an abdominal radiograph was performed to verify that the stent was still present.

Of 45 children who underwent partial liver resection 13 patients suffered from post-operative biliary complications (Fig. 1). Ten patients had signs of bile leakage, manifesting as persistent output via a drain left at the operation, abdominal pain, fever and abdominal distension. The first presentation of post-operative bile leakage was not reliable to determine retrospectively, but the first abdominal ultrasound was after a median of 6 days (range: 6–26 days) after surgery. Three patients had signs of a biliary tract stricture: jaundice, discolored stools and/or cholestatic laboratory findings. Patients with extra-anatomical liver resections did not suffer from biliary complications. The extent of the anatomic liver resection was not clearly