J Gastrointest Surg (2007) 11:1294–1297
DOI 10.1007/s11605-006-0078-7

Behavior of the Common Bile Duct Diameter Before and 12 Years after Choledochostomy for Cholecystolithiasis and Choledocholithiasis. A Prospective Study

Attila Csendes · Paula Csendes · Patricio Burdiles · Juan Carlos Diaz · Fernando Maluenda · Ana Maria Burgos

Published online: 8 August 2007

Abstract

Introduction In patients with common bile duct (CBD) stones, the diameter of the CBD is usually dilated. After surgery, the behavior of CBD diameter is not clearly known.

Objective To determine at a late follow-up the width of CBD before and after choledochostomy for CBD stones.

Material and Methods In this prospective study, 39 patients with gallstones and CBD stones were included. They were 30 women and 9 men with a mean age of 52.6 years. In all ultrasound, determination of the CBD caliber before and 12 years after surgery was performed.

Results The mean value of the inner diameter of the CBD before surgery was 11.6 and 12.3 mm in patients below or above 60 years, respectively. Measurement 12 years after surgery showed a mean decrease of nearly 50% of preoperative values, which was highly significant ($p<0.0001$). However, either below or above 60 years, only 75% of the patients showed this decrease, whereas 25% remained unchanged.

Conclusion The dilated preoperative CBD returns to normal or near normal values in 3/4 of the patients after surgical exploration of the CBD and extraction of the stones.

Keywords Common bile duct diameter · Choledochostomy · Ultrasound

The effect of cholecystectomy on the diameter of the common bile duct (CBD) after cholecystolithiasis has been a matter of controversy over many years. There are at least 19 published reports concerning this topic with some conflictive results. On the contrary, there are very few reports dealing with the behavior of the CBD in patients with CBD stones submitted to surgery. We have found, after an extensive review, only four publications[7,8,10,11,15] mentioning very few patients in whom measurements of the diameter of the CBD were performed, before and after choledochostomy for choledocholithiasis.

The purpose of the present prospective study was to determine the changes in the diameter of the CBD before and late after choledochostomy and cholecystectomy for CBD stones.

Material and Methods

Patients studied The present prospective evaluation started on January 1987, when a complete protocol for several histological, manometric bacteriological, and radiological studies was planned in patients with gallstones or CBD stones.[1,3,4] As part of this protocol, the measurement of the CBD diameter before 12 years after surgery was defined.

The protocol was closed on December 1991, when a large number of patients were evaluated. A total of 39 patients submitted to choledochostomy for CBD stones were randomly selected for a late follow-up 12 years after surgery. They were 9 men and 30 women with a mean age

A. Csendes (✉) · P. Csendes · P. Burdiles · J. C. Diaz · F. Maluenda · A. M. Burgos
Department of Surgery, Clinical Hospital University of Chile, Santos Dumont # 999, Santiago, Chile
e-mail: acsendes@machi.med.uchile.cl

A. Csendes · P. Csendes · P. Burdiles · J. C. Diaz · F. Maluenda · A. M. Burgos
Department of Radiology, Clinical Hospital University of Chile, Santos Dumont # 999, Santiago, Chile

Table 1 Mean Diameter of the Common Bile Duct before and 12 Years After Choledochostomy for Choledocholithiasis

	Before surgery (mm)	12 years after surgery (mm)	*p* value
≤60 years of age			
Mean[a]	11.6±4	6.2±2	<0.001
Range	(5–30)	(2–10)	
Increase	1		
Unchanged	6		
Decrease(%)	20(74%)		
≥61 years of age			
Mean[b]	12.3±3	5.75±2	<0.001
Range	(5–19)	(3–11)	
Increase	0		
Unchanged	3		
Decrease(%)	9(75%)		

[a] $n=27$
[b] $n=12$

at the initial operation of 52.6 years (range 22–77). There were 27 patients below 60 years of age and 12 above 61 years. Only patients submitted to cholecystectomy and choledochostomy were included in the present investigation, excluding patients with cholecystectomy or choledochostomy alone, patients with strictures of the CBD, pancreatitis, and biliodigestive fistulas. All of them had an intraoperative cholangiogram that was normal at the end of the surgical procedure.[3]

Ultrasonographic evaluation In all patients 2 to 7 days before surgery, an ultrasound evaluation of the CBD, measuring its internal diameter, was performed by a real time equipment (Aloka, Japan) with a 3.5 MH_2 probe. This test was repeated by a single experienced radiologist 12 years after surgery. After an overnight fast, patients were examined in deep inspiration, lying supine or in a left lateral oblique position with a right subcostal approach.

The extrahepatic bile duct was easily identified at the level of the porta hepatis, where the hepatic artery crosses perpendicularly between them. The CBD diameter was measured at its midportion (suprapancreatic part of the CBD), from its inner border to inner border in an anteroposterior examination.[5,9]

All measurements were expressed in mm and the measurement error for ultrasonography of the CBD was defined as 1± mm.[5,9,10]

Surgical technique The details of our procedure for CBD exploration and T-tube placement have been extensively discussed in detail in a previous publication.[2] Briefly, it starts with a complete Kocher's maneuver. Two lifting sutures are placed transversally at the most distal portion of the choledochus. The anterior wall is opened parallel to the axis of the choledochus. The exploration of the CBD is first done proximally and then distally with a Randall forceps. Then the CBD is irrigated with saline through a soft catheter. This catheter is gently passed into the duodenum. Then, Bakes' dilators up to 6 mm are employed, and the top of the dilator can be easily felt inside the duodenal lumen. A no. 14 T-tube is placed inside the CBD with arms no longer than 3 cm on each side. The choledochal wall is closed with absorbable stitches. An operative cholangiogram is always obtained to exclude the presence of residual stones.

Statistical evaluation For statistical analysis, the exact Fisher test and the chi square test were employed, taking a $p<0.05$ as significant.

Results

The mean values of the internal diameter of CBD before and 12 years after surgery according to age distribution are shown in Table 1. Among patients below 60 years, there was a significant decrease of 46% of mean preoperative values. However, the behavior of each individual patient was not uniform.

Table 2 Diameter of the Common Bile Duct Before and After Choledochostomy for Choledocholithiasis

Author	Year	No. of patients	Diagnostic method	Follow-up (months)	Preoperative (mm)	Postoperative (mm)	Change (mm)	Change (%)	Significance
Le Quesne [7]	1959	18	IC	19.5 (13–33)	15.6 (6–26)	13.6 (6–26)	−2.0	13	No
Longo [8]	1967	8	IC	43–69	13.75 (7–18)	12.7 (8.5–16.2)	−1.0	7	No
Mueller [11]	1981	18	US	10.8	Normal	Normal	–	–	No
Mueller [10]	1982	5	US	7 day	9	5	−4	44	Yes
Wedmann [15]	1988	13	US	36	7.5	5	−2.5	33	<0.05
Csendes	2004	39	US	144	≤60 years, 11.6	6.2	−5.4	46	<0.001
					≥61 years, 12.3	5.7	−6.6	54	<0.001

IC: intravenous cholangiography, *US*: ultrasound

Only one patient showed an increase, whereas six patients remained with an unchanged diameter (variations of 1 mm are included in this group). Twenty patients (74%) demonstrated decrease of the diameter of CBD. Among patients over 61 years, there was also a significant decrease of mean CBD inner diameter, approaching 54% of preoperative value ($p<0.001$). However nine patients (75%) showed this decrease, whereas three patients demonstrated no change. In this group, the decrease of CBD diameter was more pronounced compared to patients below 60 years. One patient from the entire group (2.6%) presented with an asymptomatic residual stone at the CBD. She had an age of 66 years at the first operation with a CBD diameter of 10 mm and an intraoperative cholangiography was interpreted as normal. Twelve years later, she had this single stone with a CBD of 9 mm of diameter. She refused any further endoscopic or surgical removal. Patients who remained with abnormal dilatation of the CBD were asymptomatic, but we did not measure liver function tests among them. There was no simple case with strictures at the T-tube site.

Discussion

The evolution and behavior of the CBD diameter after biliary tract surgery has been a matter of considerable scientific debate in the surgical, anatomical, radiologic, and ultrasonographic literature for several decades. The main focus of interest was directed toward the behavior of the CBD diameter before and after cholecystectomy alone. We have found 19 published reports in English literature concerning this topic, which is extensively analyzed in another study of our group and it is not the purpose to repeat all comments again.

However, it is surprising how few mentions are published concerning the behavior of the CBD diameter in patients will CBD stones submitted to choledochostomy with surgical exploration of the CBD and placement of a T-tube for some weeks. The common surgical belief is that probably the dilated duct diminishes its size, although there is no precise scientific published data on this topic. Table 2 summarizes the reports that we have found after an extensive research in surgical literature that mention the present point of discussion. The first authors performing some measurements of the CBD diameter in patients with choledocholithiasis were Le Quesne et al. who evaluated 18 patients with intravenous cholangiography almost 20 months after surgery.[7] They found no evidence that a dilated CBD diminishes significantly its caliber after cholecystectomy and removal of the stones from the duct. Later, Longo et al. evaluated eight patients almost 4 to 5 years after surgery, finding no significant changes in the diameter of CBD after operation.[8] Mueller et al. in two publications[10,11] evaluated a few patients before and after surgery. In one publication,[11] they only mention "normal values" after surgical clearance of the CBD in 18 patients, mentioning that the 2 cases with dilated ducts could return to normal values, demonstrating for the first time that acutely dilated duct before surgery may return to normal values because of the fact that sparse oblique-oriented muscle fibers and a vast network of elastic fibers throughout its course are present. Therefore, there is a potential for distensibility when an acute obstruction occurs and if the elastic tissue has not been chronically stretched, it may return to normal. In the other publication,[10] they mention five patients with an acute dilatation of the CBD because of stones, which may collapse to normal values if either the obstruction passed or was removed. However, in none of these two reports, a clear measurement of the CBD is mentioned. Finally, Wedmann et al. performed measurements of CBD diameter by ultrasound in 13 patients before and 36 months after surgery.[15] For the first time, a significant decrease was demonstrated. The present report is the largest prospective evaluation with a long-term follow-up, demonstrating a significant decrease of CBD diameter, independent of the age. This decrease is nearly 50% of the preoperative value, reaching almost normal values. It is possible that any patient with abnormal dilatation of the CBD could have some residual or recurrent stone, because the only patient that clearly had a CBD stone was asymptomatic. In our group, the ultrasound detection of CBD stones is 70%. Probably, a closer follow-up with magnetic resonance cholangiopancreatography would answer this question. We have incorporated this radiological technique in our university hospital only since 3 years ago, and therefore none of our patients was evaluated by this technique.

Our preoperative values for CBD diameter are similar to the first report by ultrasound measurements performed by Parulekar.[12] It is important to note that there are discrepancies between the measurements by intravenous cholangiography versus ultrasound determinations, as shown by Mueller et al.[10] The other factor that is very important when determining the diameter of the CBD is the influence of age.[13] This is specially relevant when measurements of the CBD before and after cholecystectomy alone are performed. In these patients with normal CBD diameter in the majority of cases before surgery, it has been shown that some of the "physiological" dilatation seen among these patients is because of the effect of age. It is accepted that above 60 years of age, nearly 1 mm should be added to CBD diameter each decade.[6,13] However, in the present investigation, the age-dependent factor seems to be unimportant because of preoperative CBD dilatation and its decrease after surgery. This decrease seems to be very early and fast

after surgery. Mueller et al. showed that acute dilatation of the CBD returned to normal values 7 days after surgery.[10] Presumably, the stretch potential of the elastic tissue permits dilatation in the presence of obstruction or acute elevations of intraductal pressure. Schein and Beneventano demonstrated that duct caliber could increase up to 2.5 times baseline with increasing intraductal pressure.[14] When obstruction is relieved, the elastic recoil of the duct walls causes prompt return to normal caliber.

In conclusion, the dilatation of the CBD seen in patients with CBD stones returns to normal values after surgery and remains in these values for at least 12 years after surgery. However, this decrease in the width of CBD is seen in only 75% of the patients, whereas the rest show no significant variation.

References

1. Burdiles P, Csendes A, Díaz JC, Smok G, Bastias J, Palominos G, Braghetto I, Maluenda F. Histological analysis of liver parenchyma and choledochal wall, and external diameter and intraluminal pressure of the common bile duct in controls and patients with common bile duct stones with and without acute suppurative cholangitis. Hepatogastroenterology 1989;36:143–146.
2. Csendes A, Burdiles P, Díaz JC. Present role of classic open choledochostomy in the surgical treatment of patients with common bile duct stones. World J Surg 1998;22:1167–1170.
3. Csendes A, Burdiles P, Díaz JC, Maluenda F, Korn O, Vallejo E, Csendes P. Prevalence of common bile duct stones according to the increasing number of risk factors present. A prospective study employing routinely intraoperative cholangiography in 477 cases. Hepatogastroenterology 1998;45:1415–1421.
4. Csendes A, Burdiles P, Maluenda F, Díaz JC, Csendes P, Mitru N. Simultaneous bacteriologic assessment of bile from gallbladder and common bile duct in control subjects and patients with gallstones and common bile duct stones. Arch Surg 1996;131:384–394.
5. Feng B, Song Q. Does the common bile duct dilate after cholecystectomy? Sonographic evaluation in 234 patients. Am J Roentgenol 1995;165:859–861.
6. Hammarstiröm LE. Is there a significant increase in bile duct width after cholecystectomy? Scand J Gastroenterol 1997;32:961–964.
7. Le Quesne LP, Whiteside CG, Hand BH. The common bile duct after cholecystectomy. Br Med J 1959;1:329–332.
8. Longo MF, Hodgson DR, Ferris DO. The size of the common bile duct following cholecystectomy. Ann Surg 1967;165:250–253.
9. Majeed AW, Ross B, Johnsson AG. The preoperative normal bile duct does not dilate after cholecystectomy: Results of a five year study. Gut 1999;45:741–743.
10. Mueller PR, Ferrucci JT Jr, Simeone JF, Wittenberg J, vanSonnenberg E, Polansky A, Isler RJ. Postcholecystectomy bile duct dilatation: Myth or reality? Am J Roentgenol 1981; 136:355–358.
11. Mueller PR, Ferrucci JT Jr, Simeone JF, vanSonnenberg E, Hall DA, Wittenberg J. Observations on the distensibility of the common bile duct. Radiology 1982;142:467–472.
12. Parulekar SG. Ultrasound evaluation of common bile duct size. Radiology 1979;133:703–707.
13. Perrett RS, Sloop GD, Borne JA. Common bile duct measurements in an elderly population. J Ultrasound Med 2000;19:727–730.
14. Schein CJ, Beneventano TC. Choledochal dynamics in man. Surg Gynecol Obstet 1968;126:59–595.
15. Wedmann D, Börsch G, Coenen C, Paassen A. Effect of cholecystectomy on common bile duct diameter: A longitudinal prospective ultrasonographic study. J Clin Ultrasound 1988;16:619–624.