LAPAROSCOPIC EXPLORATION OF BILE DUCTS IN PATIENTS WITH CALCULUS. 
INDICATIONS, METHODS AND FIRST RESULTS

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ABSTRACT
INTRODUCTION: In the last few years there has been a resurgence of laparoscopic exploration of the common bile duct as an alternative to endoscopic retrograde cholangiopancreatography (ERCP), the primary method for diagnosis and treatment of biliary tract calculosis. 
AIM: The aim of this study was to clarify the indications and methods for performing laparoscopic bile duct exploration, based on our experience in the field and data from the literature.

PATIENTS AND METHODS: We recruited 12 patients who underwent laparoscopic exploration and stone extraction from the common bile duct (CBD) in the surgical ward of Kaspela Hospital, Plovdiv over the period January 2011 to January 2012.

The diagnostic and therapeutic modalities used in the study included laboratory tests, ultrasound study, CT, ERCP, digital cholangiography, clamp and balloon stone extraction, primary suture and choledochoduodenostomy.

RESULTS: Stone extraction was successfully performed in 8 patients using the transcystic approach through an incision used in the cholangiography. The procedure failed in the remaining four patients and we used here 2-cm longitudinal choledochotomy. In two patients the control cholangiography following the extraction of stones demonstrated complete clearance of the biliary tree and free passage of contrast agent from bile duct to duodenum (patent ampulla of Vater). In these two patients we performed a primary closure of the choledochotomy with a single interrupted suture (“ideal choledochotomy”). In two patients from the choledochotomy group, the control cholangiography showed the presence of residual stones or fragments trapped above the sphincter of Oddi with no contrast medium in the duodenum. In these cases we completed this procedure with latero-lateral choledochoduodenostomy by Flörken. All patients had a smooth postoperative course with no recorded complications. The average hospital stay was 5 days.

CONCLUSIONS: Laparoscopic exploration of the biliary ducts in calculus is an efficient, safe and reliable method to manage this serious complication of gall-stone disease in the hands of an experienced laparoscopic surgeon.

The results of its application are comparable and in some cases even better than those of ERCP used as a therapeutic procedure as regards clearance of the CBD and the complications involved in these two procedures.

Key words: laparoscopic exploration, choledochotomy, laparoscopic choledochoduodenostomy

INTRODUCTION
Recently, there has been a resurgence of the interest in the laparoscopic exploration of the common bile duct, as opposed to ERCP which has been accepted as a major method for diagnosis and treatment of biliary tract calculosis. ERCP can be difficult to perform, however, in patients with large stones, in emergency operations, and if there are certain technical difficulties in performing the procedure; in such cases intraoperative revision of the biliary ducts is the therapeutic modality of choice.1,2

Moreover, the complications encountered in ERCP are generally comparable and sometimes more
serious in comparison with those of intraoperative revision of the biliary tree.\textsuperscript{2}  
In the era of laparoscopic surgery there have been described various methods for common bile duct exploration. The main issues to be addressed by surgeons performing intraoperative laparoscopic exploration of the bile duct in cases of calculosis are as follows:

1. Approach to the common bile duct:
   - Transcystic approach
   - Choledochotomy

2. Assessment of the condition and patency of the biliary duct after stone clearance:
   - Intraoperative digital cholangiography
   - Intraoperative choledochoscopy

3. Completion of exploration:
   - Ideal choledochotomy (primary closure of choledochotomy)
   - Drainage of the common bile duct:
     - External: Kerr T-tube drainage, transcystic, endonasobiliary drainage.
     - Internal biliodigestive bypass: cholecoduo-denostomy, choledochojejunostomy

AIM

The aim of the present study was to clarify the indications and methods for performing laparoscopic bile duct exploration based on our experience in the field and data from the literature.

PATIENTS AND METHODS

The study enrolled 12 patients that had undergone laparoscopic exploration and stone extraction from the common bile duct (CBD) in the surgical ward of Kaspela Hospital, Plovdiv for a period of one year (01.01.2011 - 01.01.2012). Inclusion criteria for participation were:

1. Patients with preoperatively diagnosed common bile duct stones and ERCP performed with no therapeutic success.
2. Patients with no preoperative clinical and laboratory data for common bile duct obstruction, but with intraoperatively diagnosed calculosis found by routine digital cholangiography.

The methods we used for the diagnosis and treatment of patients included laboratory tests, ultrasound study, CT, ERCP, digital cholangiography, clamp and balloon stone extraction, primary suture and choledochoduodenostomy.

RESULTS

The demographic characteristics of the study contin-
the intraoperative cholangiography to be used as an opening through which we can remove the stones by Dormia basket or balloon catheter (Figs 2, 3).

We have also used this approach twice as often as any others approaches, as is evident from the results we report here, which is consistent with the available data in the literature. There are, however, certain conditions that should be met to use it. First, the cystic duct has to be large enough (no less than 2.5-3 mm) and join the CBD at a visible site outside of the periampullary region.

Secondly, the stones should not exceed 5-6 mm in size, for even the best balloon dilatation and bladder perfusion catheters cannot provide space for extraction wider than 7-10 mm. In cases of a long and narrow bladder duct, running parallel to the common hepatic duct and joining it in the formation of the CBD somewhere in the periampullary region, revision of the entire biliary tree is impossible, which is a clear indication to use choledochotomy as a method of approach.

Regarding the type of choledochotomy, there are basically two types described in the literature: longitudinal and transverse. The general principle is that the length of incision in choledochotomy should be between 1.2 and 2 cm. We believe that longitudinal choledochotomy should be preferred over the transverse one so that the incision can be extended to more than 2 cm when dealing with very large stones. In this sense, we performed longitudinal choledochotomy in all the cases (Fig. 4).

Residual stones can be removed from the biliary tree mainly in two ways:

A. Using physiological serum under pressure to flush the duct in cases with freely mobile stones.

Figure 1. Transeptic approach – intraoperative.

Figure 2. Dormia basket extraction (as cited in Watson et al.13)

Figure 3. Balloon catheter extraction (as cited in Watson et al.13)
in the bile ducts.

B. Using a Dormia basket, clamp extraction or balloon catheter extraction with a 2-cm balloon.

Usually, stone flushing is combined with balloon extraction because the catheter itself is used as a conduit for the flushing fluid.

This method is highly efficient as complete bile duct clearance, with no residual stones, is achieved in 60-80% of all cases reported in the literature.8,9

In our study, in two out of four patients that underwent choledochotomy we achieved complete clearance which is actually 50% of cases. The second most efficient method of clearing stones from the CBD is the clamp extraction.10 The method is indicated for poorly mobile stones or stones entrapped in the narrow sections of the biliary tree (where the hepatic ducts merge with the common bile duct, at the papilla of Vater). With brittle gallstones the clamp extractor may crush the stones into two or three smaller parts which can be extracted more easily. The Dormia basket technique can be used almost to the same effect.

After stone extraction is completed, it is important to verify the clearance of the bile duct and the patency of the papilla of Vater through a diagnostic procedure.

The status of the biliary tract and bile drainage into the duodenum determine the end of the operative procedure, i.e. by restoring the integrity of the CBD with primary closure or by using a drainage procedure. Residual stones or inadequate patency of the papilla of Vater can be verified by intraoperative cholangiography or choledochoscopy. Cholangiography can show the whole biliary tree, including the small hepatic ducts, and significantly, the contrast medium in the duodenum confirming that the papilla is patent (Fig. 5).

Choledochoscopy, on the other hand, allows doctors to visualise the biliary tract and access the ducts to remove residual stones, should there be any left. A disadvantage of this technique is the inability to demonstrate the drainage of the bile into the duodenum to the full extent. Another drawback that should be mentioned in this respect is the need for additional equipment (camera and light source) that makes the technique rather costly.

The next step in conducting choledochotomy is to decide whether we should perform primary closure or biliary drainage. Two requirements should be met if we opt for the primary closure of the incision in the CBD - complete stone clearance of the biliary tract and effective patency of the papilla of Vater (Fig. 6).

Figure 4. Longitudinal choledochotomy (as cited by Watson et al.13).

Figure 5. Intraoperative cholangiography.

Figure 6. Ideal choledochotomy.
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papilla of Vater. These can be verified most often by performing intraoperative cholangiography. In the absence of defect(s) in the filling of the biliary tree and the presence of contrast medium in the duodenum, the choledochotomy is usually closed with a single interrupted suture with No 3/0 absorbable sutures (Fig. 6).

This surgical procedure has been proven to be highly efficient, causing a negligible percentage of complications and practically a zero mortality rate according to data from the literature over the last 5-6 years.

This is supported by the results we have in the treatment of our patients in the choledochotomy and primary suture group.

In the recent past most of the authors recommended that any choledochotomy end with conventional Kerr T-tube drainage. The purpose of this drainage is to release the tension from the CBD due to edema of the sphincter of Oddi, to prevent the occurrence of acute cholangitis or cholangio-hepatitis and to enable us to assess the state of the postoperative biliary tract by using transdrainage cholangiography. Some authors reported successful extraction of residual transdrainage concretion in the CBD.

The disadvantages of the method include a considerably prolonged hospital stay, the discomfort for the patient caused by the need to attend to the drainage, which is kept until mature scar tissue is formed around it within a minimum of 15-20 days, as well as the risk of possible complications occurring after the T-tube is removed (e.g. biliary peritonitis, CBD strictures, rupture of drain with parts of it remaining as foreign bodies).

Therefore, recently, along with the accumulation of more and more experience in laparoscopic surgery, many authors prefer primary closure of choledochotomy in strict compliance with the above conditions.

Drainage procedures remain the method of choice in patients with proven residual stones and/or inadequate patency of the bile ducts. The experience gained and the increased dexterity in laparoscopic suture skills allows the performance of one-step choledochoduodenostomy which is essentially an internal drainage in patients with residual stones and/or obstruction of the papilla of Vater.

A major drawback of choledochoduodenostomy is the occurrence of chronic cholangitis as a late complication in approximately 3-5% of the patients.

An advantage of the method of internal drainage is a shorter hospital stay, faster recovery of patients, lack of multi-stage surgical procedures. This has made it a favourite recently for surgeons with enough knowledge and experience for its implementation.

Two of our patients underwent laparoscopic choledochoduodenostomy after the control intraoperative cholangiography showed the presence of residual stones in the CBD lumen and complete obstruction of the papilla of Vater.

The recovery of both patients proceeded smoothly, without any complications registered in the observed period.

CONCLUSIONS

Laparoscopic exploration of the biliary ducts in calculus is an efficient, safe and reliable method for the treatment of this serious complication of gall-stone disease in the hands of an experienced laparoscopic surgeon.

The results of its application are comparable and in some cases even better than those of ERCP used as a therapeutic procedure as regards clearance of the CBD and the complications involved in these two procedures.

REFERENCES

ЛАПАРОСКОПИЧЕСКАЯ ЭКСПЛОРАЦИЯ ЖЕЛЧНЫХ ПУТЕЙ ПО ПОВОДУ КАЛЬКУЛЕЗА. ИНДИКАЦИИ, МЕТОДЫ И ПЕРВЫЕ РЕЗУЛЬТАТЫ

Пациенты и методы: Исследовано 12 больных с лапароскопической экскрерцией и экстракцией конкрементов из общего желчного протока /ОЖП/ на фоне эндоскопической ретроградной холангио-панкреатографии /ЭРХПГ/, утвержденной как основной метод диагностики и лечения калькулеза билиарного тракта.

Цель: Выяснить индикации и методы проведения экскрерции желчных протоков в связи с данными литературы и с результатами опыта авторов.

Результаты: У 8 больных экстракция конкрементов успешно проведена трансназально через шпицерию, примененную в целях холангиографии. В других 4 случаях этот метод оказался неуспешным из-за чего применина продольная холедохотомия размером в 2.0 см. После экстракции конкрементов и контрольной холангиографии у двух пациентов установили полное очищение билиарного дерева и свободный переход контрастной массы в двенадцатиперстную кишку. В этих случаях осуществили полное закрытие холедохотомии единичным непрерывным швом /идеальная холедохотомия/. У двух других пациентов с холедохотомией контрольная холангиография показала наличие конкрементов и/или их осколков над сфинктером Оди и невозможность перехода контрастной массы в двенадцатиперстную кишку. Из-за чего процедуру закончили латеро-латеральной холедохудуodenostomей по Флеркину. Во всех случаях постоперационный период прошел гладко без осложнений. Средний больничный промежуток – 5 дней.

Выводы: Авторы пришли к выводу, что лапароскопическая экскрерция желчных протоков при калькулезе представляет эффективный, безопасный и надежный метод лечения этого тяжелого осложнения желчно-каменной болезни в руках опытного хирурга.

Результаты его применения сравнимы и в некоторых случаях даже более хорошие по сравнению с применением ЭРХПГ как леченная процедура по отношению к очищению ОЖП и по отношению к осложнениям этих двух процедур.