

Percutaneous cholangioscopy

Analysis of our own 13-year results

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Abstract. In the course of 13 years we performed 807 percutaneous cholangioscopies in 215 patients aged from 3 to 89. The indications included iatrogenic injuries of bile ducts (244 examinations), difficult bile duct stones (174 examinations), stenosis of hepatico-jejuno-anastomosis (147 examinations), carcinoma (105 examinations), extraction of detained bile duct stones through the T-drain channel (56 examinations), and inflammatory stenosis of bile ducts (46 examinations). Two examinations were performed for biliary fistula, traumatic injuries and sclerosing cholangitis. Cholangioscopy was successfully performed in 98 % of cases on the first attempt while the remaining cases were successful on the second trial after the dilatation of the access channel. In 746 cases, we introduced the endoscope through the channel of percutaneous transhepatic drainage (PTD), in 56 cases through the T-drain channel and in 5 cases the endoscope was introduced intraoperatively. There were no major complications during the interventions, only the creation of PTD may be considered risky. We have developed and described two new techniques. The reconstruction of iatrogenic interruption of bile ducts and the creation of transcutaneous enterostomy for the treatment of the stenosis of hepatico-jejuno-anastomosis, difficult hepaticolithiasis and the sclerosing cholangitis. Enhancing the method with laser lithotripsy helped to remove all difficult stones. We have thus detected an unpublished cause of relapsing cholelithiasis – a tissue bridge that deforms the bile duct – and we described its treatment. A timely performed percutaneous cholangioscopy of a non-specific finding revealed an early cholangiogenous cancer. The disadvantage of percutaneous cholangioscopy is its time consuming character and the need to frequently repeat the endoscopy. We consider the method a standard endoscopic intervention that combines certain procedures of mini-invasive surgery and gastrointestinal endoscopy.

Keywords: percutaneous cholangioscopy, bile duct reconstruction, percutaneous enterostomy, difficult cholelithiasis

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Souhrn. Během 13 let jsme uskutečnili 807 perkutánních cholangioskopií u 215 pacientů ve věku od 3 do 89 let. Mezi indikace patřily iatrogenní léze žlučovodů (244 vyšetření), obtížná litiáza (174 vyšetření), stenóza hepatiko-jejuno-anastomózy (147 vyšetření), karcinom (105 vyšetření), extrakce retinovaných kamenů kanálem po T drénu (56 vyšetření), zánětlivá stenóza žlučovodů (46 vyšetření). Po dvou vyšetřeních jsme provedli u biliární fistuly, traumatické léze a sklerozující cholangitidy. Cholangioskopii jsme úspěšně realizovali v 98 % na první pokus, ve zbývajících případech na druhý pokus po dilataci přístupového kanálu. 746-krát jsme zaváděli endoskop kanálem perkutánní transhepatální drenáže (PTD), 56-krát kanálem po T drénu a 5-krát intraoperačně. Závažnější komplikace výkonu jsme neměli, rizikové může být vytvoření PTD. Vypracovali jsme a popsali dvě nové techniky. Rekanalizaci u iatrogenního přerušení žlučovodů a vytvoření transkutánní enterostomie k ošetření stenózy hepatiko-jejuno-anastomózy, obtížné hepatikolitiázy nebo sklerozující cholangitidy. Doplněním metody o laserovou litotripsi byly odstraněny všechny obtížné kameny. Zjistili jsme dosud nepopsanou příčinu recidivu-

jící litiázy – tkáňový můstek deformující žlučovod – a způsob jeho ošetření. Včasným provedením perkutánní cholangioskopie u nejasného nálezu jsme objevili časný karcinom žlučovodu. Nevýhodou vyšetření je časová náročnost a potřeba častého opakování endoskopie. Metodu pokládáme za standardní endoskopický výkon, který v sobě spojuje některé postupy miniinvazivní chirurgie a gastrointestinální endoskopie.

Klíčová slova: perkutánní cholangioskopie, rekanalizace žlučovodů, perkutánní enterostomie, obtížná litiáza

Introduction

Percutaneous cholangioscopy is an endoscopic method for the diagnosis and treatment of biliary tract by means of a flexible endoscope that is introduced through the percutaneous transhepatic drainage (PTD) channel, T-drain channel or intraoperatively. The aim of this study is a retrospective analysis of our own results acquired over previous 13 years.

Patients & methods

Patients

Between 1990 and 2003 we performed 807 examinations in 215 patients, see detailed information in Tables 1 – 6. In 746 cases, we performed the cholangioscopy through the PTD channel, in 56 cases through T-drain channel and in 5 cases intraoperatively (see Table 7).

Table 1

Number of patients, age and examination of each patient

1990 - 2003	Number of patients	Number of examinations	Number of examined persons median	Number of examined persons average	Number of examined persons range	Age median	Age average	Age range
Total	215	807	2	3,8	1 - 30	61	59	3 - 89
Men	99	389	2	3,9	1 - 30	59	58	3 - 84
Women	116	418	2	3,6	1 - 25	61	60	24 - 89

Table 2

Diagnoses for which percutaneous cholangioscopy was performed (Part 1)

Iatrogenic lesion		Carcinoma		Difficult lithiasis	
Total number of patients	37	Total number of patients	59	Total number of patients	47
Men	11	Men	29	Men	21
Women	26	Women	30	Women	26
Age – median	51	Age – median	64	Age – median	66
Age – average	52	Age – average	64	Age – average	64,2
Total number of examinations	244	Total number of examinations	105	Total number of examinations	174
Median	4	Median	1	Median	3
Average	6,6	Average	1,8	Average	3,7
Age, men – median	51	Age, men – median	64	Age, men – median	66
Age, men – average	51	Age, men – average	64	Age, men – average	61,7
Age, women – median	51	Age, women – median	64,5	Age, women – median	67
Age, women – average	52,3	Age, women – average	63,7	Age, women – average	66,2
Total number of examined men	88	Total number of examined men	55	Total number of examined men	76
Men average	8	Men average	1,9	Men average	3,6
Men median	3	Men median	1	Men median	2
Total number of examined women	156	Total number of examined women	50	Total number of examined women	98
Women average	6	Women average	1,7	Women average	3,8
Women median	4,5	Women median	1,5	Women median	3

Methods

The examination was performed by cholangioscope Olympus CHF-P20. Except for intraoperative cholangioscopy, which was performed under general anaesthesia in the operating theatre within surgery, the examination is performed on an X-ray table under fluoroscopy control and fulfilling strict aseptic conditions. Usually, we administer conscious sedation, midazolam (Dormicum®) 1 – 3 mg i.v. combined with nalbuphin-hydrochloride (Nubain®) 10 – 20 mg i.v. The examination is done while fasting, and the patient's informed consent is obtained prior the examination. Simple, repeated interventions are well tolerated even without sedation. A detailed description of percutaneous cholangioscopy technique was given earlier elsewhere (8).

In case of difficult cholelithiasis, stones were extracted transcutaneously by means of a basket

while in other cases a preliminary mechanic or laser lithotripsy (19) was necessary. Sludge balls grasped into the basket are crushed by pulling the basket into the sheath or into the endoscope channel.

Solid bile duct stones are fragmented by pulse dye laser (the dye is rhodamine 6G in pure ethanol) with an ignition lamp at emission wave length of 595 ± 5 nanometres. The laser beam is conducted through the lens in an optical fibre of 200 or 300 micrometres. The energy on the fibre tip has to be in contact with the stone so that a small plasma bubble is created for 2 – 3 microseconds. The oscillation of the bubble causes an impulse wave that leads to the destruction of the stone. The energy of the laser beam is absorbed on the boundary of the two environments and the process of plasma creation is triggered which is completed only on condition that the limit of 20 – 40 mJ on the fibre tip is exceeded. This reliable feedback

Table 3

Diagnoses for which transcutaneous cholangioscopy was performed (Part 2)

H-J-Stenosis		Bile duct stenosis		Stone extraction through the T-drain channel	
Total number of patients	18	Total number of patients	13	Total number of patients	35
Men	10	Men	10	Men	13
Women	8	Women	3	Women	22
Age – median	52	Age – median	53	Age – median	64
Age – average	50,7	Age – average	52,8	Age – average	58,7
Total number of examinations	147	Total number of examinations	46	Total number of examinations	56
Median	5	Median	2	Median	1
Average	8,2	Average	3,5	Average	1,6
Age, men – median	51	Age, men – median	47	Age, men – median	64
Age, men – average	48,9	Age, men – average	49,3	Age, men – average	61,6
Age, women – median	53	Age, women – median	69	Age, women – median	57
Age, women – average	53,4	Age, women – average	64,7	Age, women – average	57
Total number of examined men	78	Total number of examined men	33	Total number of examined men	25
Men average	7,8	Men average	3,3	Men average	1,9
Men median	5	Men median	2	Men median	1
Total number of examined women	69	Total number of examined women	13	Total number of examined women	31
Women average	8,6	Women average	4,3	Women average	1,4
Women median	4	Women median	3	Women median	1

Table 4

Diagnoses for which transcutaneous cholangioscopy was performed (Part 3)

Traumatic lesion		Biliary fistula		Sclerosing cholangitis	
Total number	2	Total number	2	Total number	2
man (1 examination)	22 years	man (6 examinations)	82 years	man (6 examinations)	63 years
man (17 examinations)	53 years	woman (1 examination)	42 years	man (4 examinations)	32 years

Table 5

Age of patients in repeated examinations and their total number (men)

Patient man	Age of patient on the first examination	Age of patient on the next examination	Age of patient on the next examination	Age of patient on the next examination	Age of patient on the next examination	Age of patient on the next examination	Age of patient on the next examination	Age of patient on the next examination	Total number of examinations
1	58	59							3
2	32	33							4
3	53				57				5
4	84		86						5
5	82				86				6
6	63	64							6
7	56	57							6
8	47			50					7
9	80	81							7
10	67	68							8
11	63					68			9
12	59				63				9
13	65	66							11
14	67	68	69		71				12
15	40					45			13
16	72	73							16
17	53	54	55		57	58			17
18	48			51					22
19	51	52	53		55	56	57		24
20	51	52	53	54	55	56	57		30

Table 6

Age of patients in repeated examinations and their total number (women)

Patient woman	Age of patient on the first examination	Age of patient on the next examination	Age of patient on the next examination	Age of patient on the next examination	Age of patient on the next examination	Age of patient on the next examination	Age of patient on the next examination	Age of patient on the next examination	Total number of examinations
1	62	63							2
2	56	57							2
3	51	52							3
4	49	50							3
5	53	54							5
6	50				54				5
7	47	48							7
8	35				39				8
9	50	51							9
10	68	69							9
11	44	45				49	50		9
12	53	54	55				59		9
13	59	60							10
14	67	70		72					10
15	76	77							12
16	45	46							16
17	47	48	49			52		54	18
18	60	61		63					20
19	39	40							25

ensures the differentiation of the solid material and the liquid material and cellular structures. The laser fibre is introduced through the cholangioscope channel and the lithotripsy is performed under visual control (9). The crushing is to be done in several sessions because the visibility inside bile ducts deteriorates rapidly. The interval is 1 – 7 days. After the removal of the last visible stone the 16 Fr drain is again applied. The treatment is considered successful after subsequent endoscopy, performed several days later, proving negative results (no detained bile duct stones are found) and the percutaneous transhepatic drainage can be removed. If the bile duct stones are impacted in the peripheral bile duct, we perform flushing using a saline solution of epinephrine (1 : 20,000) first. This helps to reduce the congestion of bile duct mucosa and the stone is more easily released. Antibiotics are administered only sporadically if there is no certainty that the bile duct drainage can be maintained between particular endoscopies. All treated patients are in dispensary care in our out-patient clinic and they come for examination every 3 months.

Percutaneous cholangioscopy is also indicated if the treatment of iatrogenic injury to the bile ducts requires the introduction of PTD (e. g. after failure or impossibility of transpapillary treatment). The PTD is created with respect to the future percutaneous cholangioscopy so that the damaged section of the bile duct can be evaluated and treated if necessary. We decide about access either into the right or the left hepatic duct, most often proximally from the iatrogenic injury. An acute angle between PTD channel and the bile ducts is undesirable. If the bile duct is interrupted, recanalization is performed and the natural passage of bile is reconstructed (7).

For tumours, percutaneous cholangioscopy is indicated to evaluate the extent of the tumour, to take specimens for histology, before planned brachytherapy or application of ethanol into the tumour. The procedure is similar to that in the above-mentioned cases. In brachytherapy, the emitter is introduced through the PTD channel in two sessions in the majority of cases and is completed with external radiation. Ethanol is applied into the tumour with an injector under visual control. We use 85% ethanol prepared *magistraliter* by the pharmacist into a 10 mL ampoule, two weeks before the intervention at the latest. This concentration fully complies with our intention to dehydrate the target tissue and to cause its necrosis

(100% alcohol cannot be achieved and concentrations over 85 % are very unstable and unnecessarily expensive). We administer no more than 5 mL per one session.

In case of stenosis of hepatico-jejuno-anastomosis the PTD is again targeted with respect to the endoscopic evaluation or the treatment of the stenosis. The creation of a safe external drainage of the right or left hepatic duct often requires additional enterostomy of the excluded small intestinal loop according to Roux. The enterostomy is performed percutaneously under favourable conditions or on the operating table in collaboration with a surgeon. Other steps are similar to difficult lithiasis and iatrogenic bile duct lesion.

When removing foreign bodies, the PTD channel is usually not dilated with more than 16 Fr drainage. This width is sufficient for the introduction of the endoscope and the extraction of the fragments or whole plastic prostheses. If larger objects, e. g. metal prostheses, are to be extracted dilatation over 18 – 20 Fr may be necessary. After the removal of bile incrustations and the release of the metallic stent, the prosthesis is extracted through the wide drain using a Dormia basket or a wire hook. A metallic guide wire needs to be put through the prosthesis before the extraction in order to avoid undesirable extrusion of the channel direction. According to the type of prosthesis removed the stent is extracted either as a whole or in pieces. It is necessary to administer sufficient analgesia during the intervention.

With traumatic injuries of bile ducts the procedure is the same as in the case of iatrogenic lesion. If reconstruction of interrupted bile ducts is performed, a standard needle-knife papilotome is inserted through the working channel of the cholangioscope. During repeated small incisions, the saline solution is continually applied through the papilotome to wash out the occurring bubbles. This way the operative

Table 7
Cholangioscopies according to bile duct access method

Access	Number of examinations
PTD channel (also enterostomy)	746 (84)
T-drain channel	56
Perioperatively	5
Total	807

field remains continuously well arranged. At the same time the direction of the incisions is repeatedly verified by fluoroscopy control in two planes. A necessary condition of this method is perfect X-ray visualization of the interrupted structures. The proximal part of the bile duct is shown through the PTD channel, the distal part over the introduced nasobiliary drain, in case of lesion in the area of the right hepatic duct the PTD into the left hepatic duct can be used. No more than 5 mm distance is gained in a single session. If a longer distance must be passed, the intervention is stopped, the external drainage is renewed and endoscopy is continued the next day. If the pause is longer, the incision rapidly heals and disappears. After the other part of the interrupted bile duct is reached, a metallic guide wire is introduced and telescopic dilatation is performed which is followed by internal catheter drainage. Some time later, the reconstructed section of the bile duct is checked up. While healing (scarring) the duct may become contracted (shortened). The treatment is finished after the introduction of a very small metallic Palmaz prosthesis (maximally dilated) and the removal of the external drainage. Patients continue to be checked on an ambulatory

basis every three months and laboratory indicators of cholestasis are monitored.

The percutaneous enterostomy is indicated for the treatment of hepaticolithiasis or hepatic duct strictures after the dilatation of the hepatico-jejuno-anastomosis. It is performed in a similar way to percutaneous endoscopic gastrostomy, for details see Fig. 9. Three weeks later, the intestinal loop is already adhering to the abdominal wall and after the drain extraction the cholangioscope can be repeatedly introduced into the intestinal lumen and, retrogradely, to the bile ducts over the hepatico-jejuno-anastomosis. In this way, uncertain findings on intrahepatic bile ducts can be diagnosed, strictures can be dilated and the hepaticolithiasis extracted.

Results

Out of the 807 examinations (100 %) a total of 98 % were successful in that the bile ducts were reached with the cholangioscope. The introduction failed sixteen times because of a too narrow PTD channel. After its dilatation the intervention always succeeded. No major complications during the endoscopy itself were observed. However, some patients were not

Table 8

Application of ethanol into biliary tract carcinoma by means of percutaneous cholangioscopy

Patient	Age	Complications during alcohol application	Date of application	Date of decease	Length of survival
Woman	51 years	Moderate pain during application	9 Sept 1994	?	?
Woman	82 years	Moderate pain during application	27 Sept 1994	?	?
Man	76 years	0	18 Apr 1996	?	?
Man	48 years	0	9 Jul 1996	12 Mar 2002	68 months
Woman	66 years	Moderate pain during application	18 Feb 1997	?	?

Table 9

Reconstruction of interrupted bile ducts

Point of interruption	Number of patients	No problems	Relapse of problems 1 x (acceptable result)	Relapsing cholangitis (therapy failure)
Interrupted common hepatic duct	8	4	2	2
Interrupted right hepatic duct	4	4	0	0
Total	12 (100%)	8 (75%)	2	2

available for subsequent long-term follow-up. In handling difficult lithiasis, iatrogenic or traumatic injuries of bile ducts and the renewal of the way through inflammatory or tumorous stenoses we were always successful, although usually after several sessions (see also Tables 5 and 6). The results of ethanol application and the reconstruction of bile ducts are given in Tables 8 and 9. Details of some, especially complicated cases are included in the discussion. Photographs illustrating the cholangioscopy are given in Figs. 1 – 10.

Discussion

It was Bakeš who first performed choledochoscopies in the Czech Republic and published his observations in 1923. He introduced the rigid choledochos-

cope intraoperatively (1). First remarks on experience with percutaneous cholangioscopy using flexible instruments can be found in literature from the 1970s and 80s (15,18,25). The first studies by European and Japanese authors show that percutaneous cholangioscopy was originally intended for the extraction of retained bile duct stones through the T-drain channel. The well-mastered PTD technique, indicated for obstructive jaundice of uncertain aetiology, offers further possibilities for percutaneous cholangioscopy use. The introduction of the cholangioscope through a sufficiently wide and firm PTD channel is as safe as in the previous case.

Currently, besides indications for difficult common bile duct stones, hepaticolithiasis and tumorous or inflammatory bile duct stenosis (4,6,11,17,26) other



Figure 1 / Obr. 1

Cholangioscopy. Normal intrahepatic bile ducts. The lining is free of defects, white, light-yellow, sometimes slightly pink. The endoscope may reach deep into the periphery (sequence of pictures showing the forward movement of the endoscope from left to right). Cholangioskopie. Normální nitrožaterní žlučovody. Výstelka je bez defektů, bělavá, světle žlutá, jindy až mírně narůžovělé barvy. Endoskopem lze proniknout daleko do periferie (sekvence obrázků při pohybu endoskopu kupředu zleva doprava).

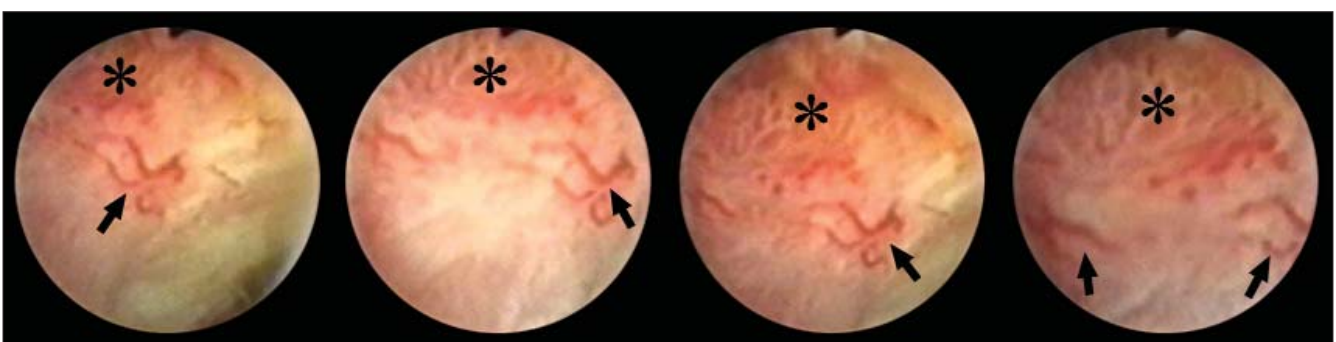


Figure 2 / Obr. 2

Bile duct tumour. Tumorous infiltration is shown in the upper part (marked with asterisks), below a pathological vascularization (arrows). A 69-year female was treated for 9 months elsewhere for iatrogenic stenosis after cholecystectomy by repeated transpapillary introduction of two duodenobiliary prosthesis. After this treatment failed she was referred to our department. We suspected a malign stenosis and recommended verification by cholangioscopy as well as further oncological treatment. The patient refused the suggestion and asked for the continuation transpapillary treatment. Three months later, she agreed to undergo PTD and subsequent cholangioscopy, which confirmed a Klatskin tumour localized in the bifurcation of both hepatic ducts. A complex oncological therapy including brachytherapy through the PTD channel was started.

Nádor žlučových cest. V horní části je patrná nádorová infiltrace (hvězdičky), pod ní patologická vaskularizace (šipky). 69-letá pacientka byla 9 měsíců léčena na jiném pracovišti jako iatrogenní stenóza po cholecystektomii opakovaným transpapilárním zavedením dvou duodenobiliárních protéz. Teprve po selhání této léčby byla odeslána na naše pracoviště. Bylo vysloveno podezření na maligní stenózu a doporučena verifikace cholangioskopií a další léčba onkologická. Tu nemocná odmítala a žádala další postup transpapilární cestou. Teprve po dalších třech měsících se rozhodla k provedení PTD a následně cholangioskopií, která potvrdila Klatskinův tumor lokalizovaný v bifurkaci obou hepatiků. Následovala komplexní onkologická terapie včetně brachyterapie kanálem PTD.

possibilities for the use of percutaneous cholangioscopy have been emerging, for instance intraductal ultrasonography, manometry of the sphincter of Oddi,

ethanol application into biliary tract tumours or its use for brachytherapy (10,12,14,22,23). Patients with tumorous bile ducts stenosis represented the largest

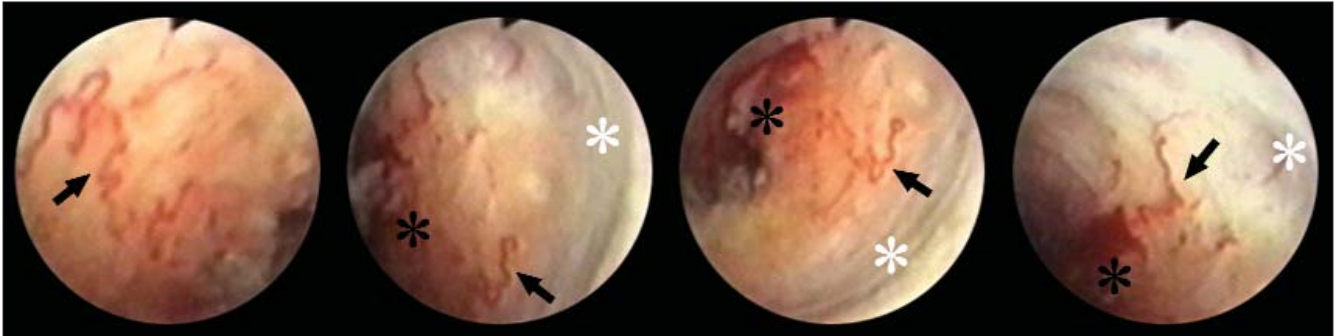


Figure 3 / Obr. 3

Pathological vascularization in the cholangioscopic picture (arrows). Distinct irregular fabric of blood vessels can be discerned in the macroscopically "normal" tissue (white asterisks) on the margins of the tumorous infiltration (black asterisks). The same patient as in Fig. 2.

Patologická vaskularizace v cholangioskopickém obraze (šipky). Na okrajích nádorové infiltrace (černé hvězdičky) jsou patrné v makroskopicky „normální“ tkáni (bílé hvězdičky) výrazné nepravidelně se vinoucí cévy (šipky). Stejná nemocná jako na obrázku 2.

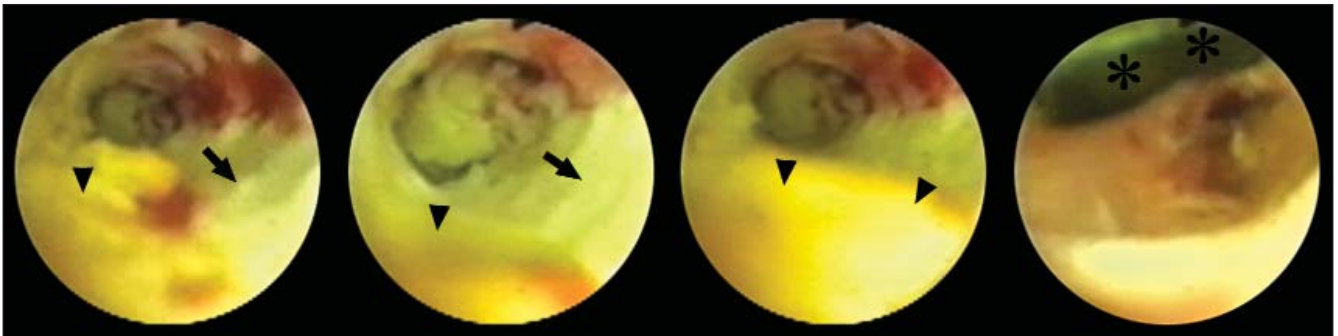


Figure 4 / Obr. 4

Severe inflammatory changes. The bile duct mucosa is fragile and bleeds when touched, the surface is covered with fibrin coating (arrows). The visualisation is for the most part a difficult one due to the turbid content of the bile ducts, bile sludge (arrowheads) or tough bile duct stones (black asterisks) are often found. A patient suffering from iatrogenic stenosis of the common hepatic duct and from difficult hepaticolithiasis. After removal of the stones and dilation the stenosis the cholangitis receded.

Těžké zánětlivé změny. Výstelka žlučovýchodů je fragilní, na dotek snadno krvácí, povrch je pokryt fibrinovými povlaky (šipky). Vizualizace je většinou obtížná pro zakalení obsahu žlučovýchodů, často nacházíme i žlučové bláto (hroty) nebo tvrdé žlučové kameny (černé hvězdičky). Nemocná s iatrogenní stenózou společného hepatiku a obtížnou hepatikolitiázou. Po odstranění kamenů a dilataci stenózy cholangioitida odezněla.

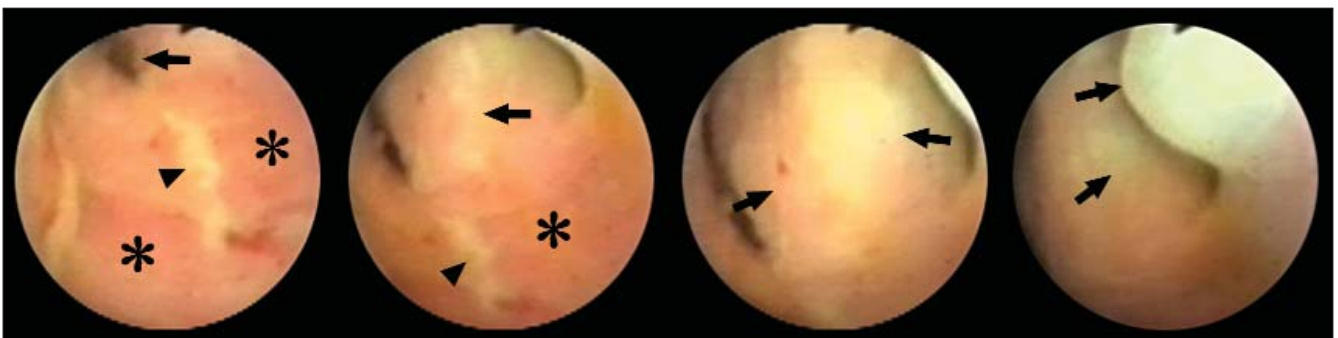


Figure 5 / Obr. 5

Congestion of biliary mucosa and varices. Reddening (asterisks) with whitish fibrin coating (arrowheads) can be seen from left to right, hardly visible blue varices (arrows) are bulging into the lumen. A patient with a transplanted kidney and distinct dilatation of the left hepatic duct over the stenosis and multiple hepaticolithiasis. After removal of the lithiasis large varices in left-side bile ducts were discovered. The drainage was finished. The patient's condition has been stabilized for the next 6 years, no cholangitis, and no symptoms of cholestasis.

Kongesce žlučového endotelu a varixy. Zleva doprava je vidět zarudnutí (hvězdičky) s bělavými povlaky fibrinu (hroty) a do lumen se vyklenují varixy modravě prosvítající (šipky). Nemocný po transplantaci ledviny s výraznou dilatací levého hepatiku nad stenózou a mnohočetnou hepatikolitiázou. Po odstranění litiázy byly nalezeny velké varixy v levostranných žlučovýchodech. Drenáž byla zrušena. Další průběh je 6 let stabilizovaný, bez cholangioitidy a bez známek cholestázy.

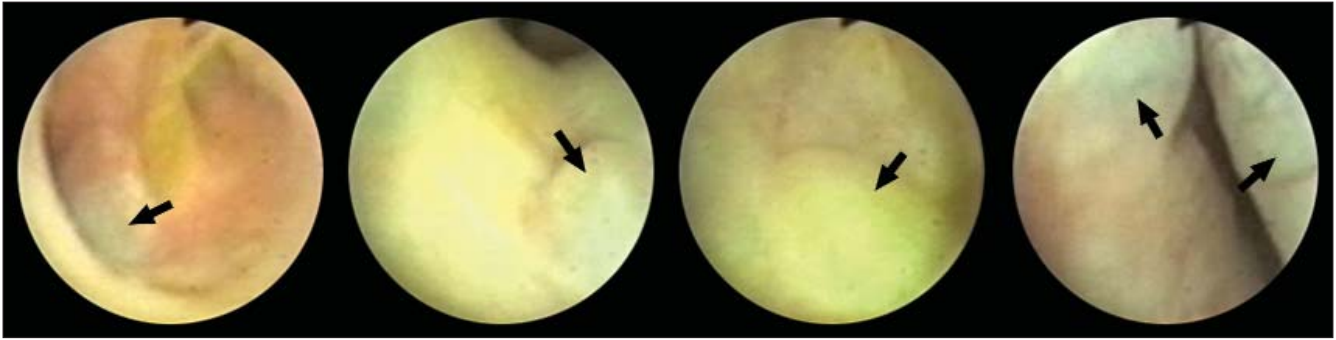


Figure 6 / Obr. 6

Varices of different sizes bulging into the bile duct lumen. Hardly visible blue bulges of different size (arrows) can be seen which may completely obstruct the lumen and evade the attention of an inexperienced observer. The same patient as in Fig. 5.

Varixy různé velikosti, vyklenující se do lumen žlučového. Jsou patrná modravě prosvítající vyklenutí různé velikosti (šipky), která mohou zcela obturovat lumen a uniknout nezkušenému pozorovateli. Stejný nemocný jako na obrázku 5.

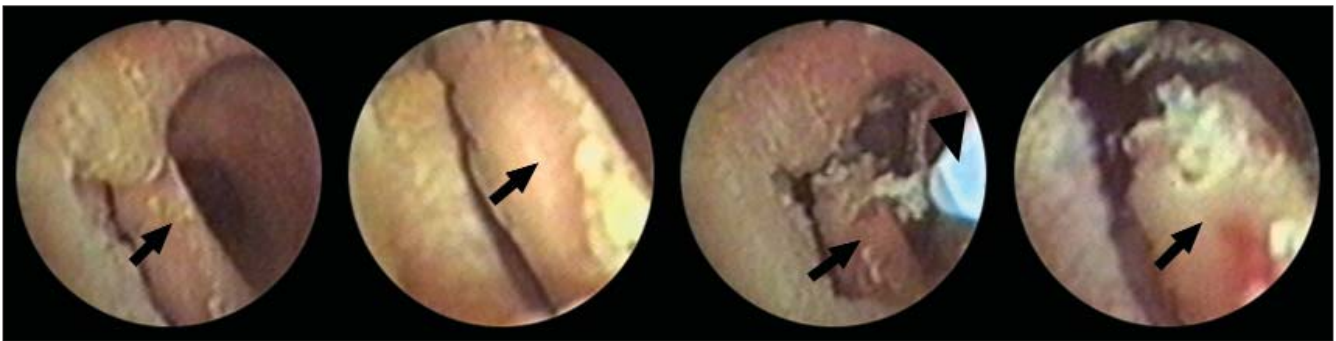


Figure 7 / Obr. 7

Tissue bridge (arrows) that caused the difficult lithiasis in a 55-year old patient. A formation can be seen from left to right that divides the bile duct lumen in two parts. On both ends it was cut off from the bile duct wall with a needle-knife papilotome (arrowhead). After having been cut off on only one side it grew together with the wall again. After its complete removal the patient has been 8 years without cholangitis, bile duct stones and without signs of cholestasis.

Tkáňový můstek (šipky), který byl příčinou obtížné litiázy u 55-leté pacientky. Zleva doprava je vidět útvar, který rozděluje lumen žlučového na dvě části. Na obou koncích musel být odříznut od stěny žlučového jehlovým papilotomem (hrot). Při odříznutí jen na jedné straně opět přirostl. Po jeho odstranění je pacientka 8 let bez cholangitid, žlučových kamenů či známek cholestázy.

section of our group of treated patients. Nevertheless, the majority of percutaneous cholangioscopies were performed for iatrogenic bile ducts stenosis, followed by difficult lithiasis and the stenosis of hepatico-jejuno-anastomosis. As there were also combinations of the stenosis of hepatico-jejuno-anastomosis, iatrogenic lesions and bilio-cutaneous fistulae with hepaticolithiasis or common bile duct stones, the most frequent pathologic finding in cholangioscopy was difficult cholelithiasis.

While for most tumorous stenoses, percutaneous cholangioscopy was performed only once in one patient, the examinations for the stenosis of hepatico-jejuno-anastomosis, iatrogenic stenosis and difficult cholelithiasis had to be repeated much more often.

Palliative endoscopic treatment of cholangiogenic cancer (application of ethanol into the tumorous tissue) was attempted with only 5 patients. As it was not possible to keep those patients in our dispensary

care (see Table 8) routine use of the method was discontinued. The only one patient who attended regular examinations survived for 68 months in a relatively good state of health with a continuous external catheter drainage, which is considered a very positive result on our part. No assumption can be made as to the favourable contribution of applied ethanol in combination with brachytherapy and other adjuvant treatment to the long-term survival of the patient or whether it was only a coincidence of circumstances. The patient soon got accustomed to the PTD drain exchanges and did not consider them as exceedingly stressful. The patient always came on time for the necessary exchange of the drain, which helped to avoid cholangitis and the need for antibiotic treatment. In the last year of his life the patient suffered from two attacks of upper gastrointestinal bleeding. Once he was bleeding from the duodenal ulcer, the other time he was bleeding from oesophageal vari-

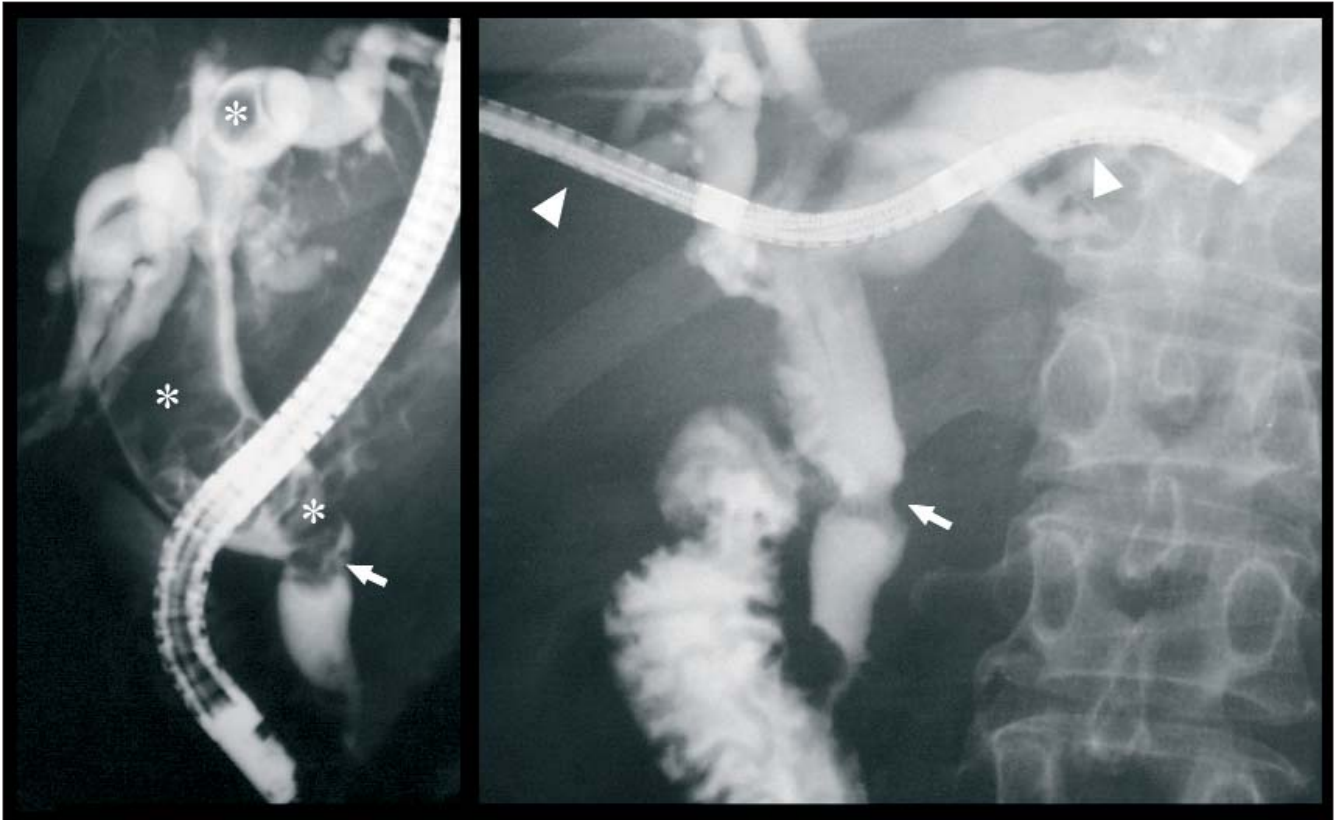


Figure 8 / Obr. 8

Biliary tissue bridge. On the left: X-ray picture taken at admission to our department, the asterisks point to difficult stones. On the right: after the removal of the stones by means of the transcutaneously introduced cholangioscope (arrowheads). An atypical shade persists in the bile duct, which corresponds to the tissue bridge (the bridge is marked on both sides by an arrow). The same patient as in Fig. 7.

Vlevo rtg snímek při přijetí na naše pracoviště, hvězdičkami jsou označeny obtížné kameny. Vpravo po odstranění kamenů za pomoci cholangioskopu, který byl zaváděn transkutánně (hroty). Přetrvává netypický stín ve žlučovodech, odpovídající tkáňovému můstku (můstek je označen na obou snímcích šipkou). Stejná nemocná jako na obrázku 7.

ces. In both cases the condition was solved non-operatively. The histology before the start of the therapy and at postmortem study proved a small cholangio-genous carcinoma in the common hepatic duct. Any early complication of this treatment (besides tolerably painful application of ethanol into tumorous tissue) was not observed. A valuable finding in the macroscopic diagnosis of the bile duct tumours is the pathological vascularization, exophytic growth into the bile duct lumen and fragility of the tissue (see Figs. 2 and 3). In one case we even discovered an early carcinoma of the biliary tract, which was confirmed in the subsequent curative surgery. Histological examination of biopsy specimens showed tumorous tissue only in the macroscopically distinct pathological vascularizations. The surrounding tissue was normal and microscopic samples were negative. The results of histological examination were not always unambiguous, the same as can be found in literature (20,24). The pathologist often warned us that the volume of tissue samples was not sufficient for a proper evaluation.

From the endoscopic view the manipulation with the endoscope in the narrow space is very limited and the small fine forceps often slip in vain on the rigid tissue. That is why we take as many biopsy specimens as possible.

The high number of repeated percutaneous cholangioscopies in our group of patients with iatrogenic injuries of bile ducts is also connected with the non-surgical treatment of these diseases (3), with gradual healing of the injuries, removal of difficult stones from hepatic ducts and also with our new method of reconstruction of interrupted bile ducts after complicated surgery. The renewal of clearness of one or more branches of the closed bile duct was sometimes successful in one session, sometimes the treatment had to be repeated. The introduction of a metallic prosthesis into the bile duct was considered as final solution for this serious complication (13). It was successful in 8 cases (75 %). Another two patients had to have the newly developed stones extracted by standard transpapillary approach. Further long-term

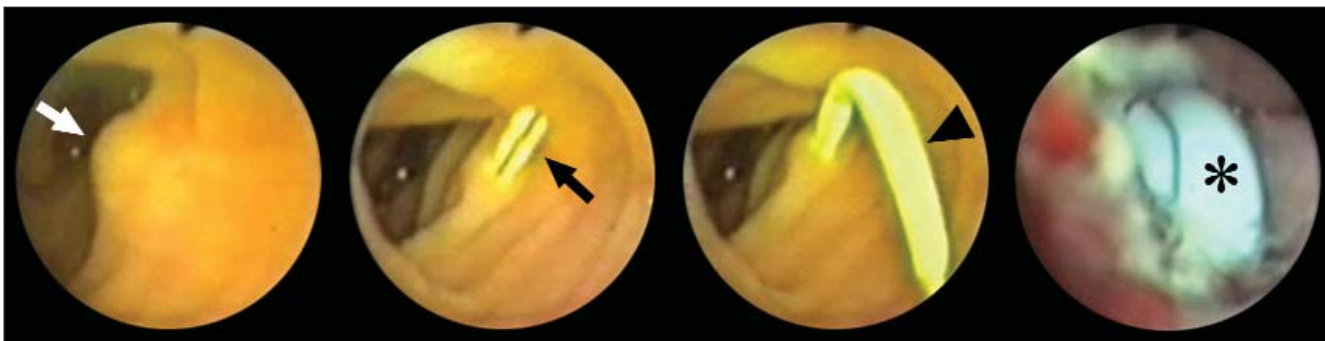


Figure 9 / Obr. 9

Creation of percutaneous enterostomy (from left to right). The method is similar to that in percutaneous endoscopic gastrostomy (PEG). If the interstinal and abdominal wall is illuminated we palpate the abdominal wall with a blunt cannule and see a typical intestinal wall impression (white arrow). Then we penetrate both the abdominal and the intestinal wall with a cannule to reach the intestinal lumen (black arrow) and a metallic guide wire is introduced through the cannule (arrowhead). A drain is then introduced into the intestine and fixed in the intestinal lumen. By pulling the thread we create a tough pig-tail (asterisk). After pulling the intestinal loop to the abdominal wall the catheter is fixed to the skin. A 39-year female after cholecystectomy at the age of 26, after the creation of hepatico-jejuno-anastomosis for iatrogenic lesion of bile ducts and after repeated surgery for the anastomosis stenosis, was admitted to our Department with an obstructive jaundice, multiple stenoses of hepatic ducts and hepaticolithiasis. The treatment was possible only after the enterostomy was created. The patient survived a critical period after the dilatation of the stenoses, the extraction of stones from the hepatic ducts and the introduction of three plastic endoprotheses over hepatico-jejuno-anastomosis into the hepatic ducts, and one year later her livers were transplanted. She had no problems for the next three years.

Vytvoření transkutánní enterostomie (zleva doprava). Postup je podobný jako při perkutánní endoskopické gastrostomii (PEG). Pokud se podaří prosvítit stěnu střevní a břišní, palpujeme tupou jehlou stěnu břišní a pozorujeme typickou impresi na stěně střevní klíčky (bílá šipka). Pak pronikneme kanylou přes stěnu břišní i střevní do lumen střeva (černá šipka). Následně provlečeme kanylou kovový vodič (hrot). Pak zavedeme do střeva drén, který fixujeme ve střevním lumen. Tahem za nit vytvoříme spolehlivý pig-tail (hvězdička). A po přitážení střevní klíčky ke stěně břišní katétr fixujeme ke kůži. 39-letá nemocná po cholecystektomii ve 26 letech, po vytvoření hepatico-jejuno-anastomózy pro iatrogenní lézi žlučového ústí a po reoperaci pro stenózu anastomózy, byla přijata na naše pracoviště pro obstrukční ikterus, mnohočetné stenózy hepatiků a hepatikolitiázu. Ošetření bylo možné jen po vytvoření enterostomie. Dilataci stenóz, extrakci kamenů z hepatiků a zavedení celkem tří plastických endoprotéz přes hepatico-jejuno-anastomózu do hepatiků nemocná přečkala kritické období a dočkala se po roce úspěšné transplantace jater. Nyní je již třetím rokem bez obtíží.

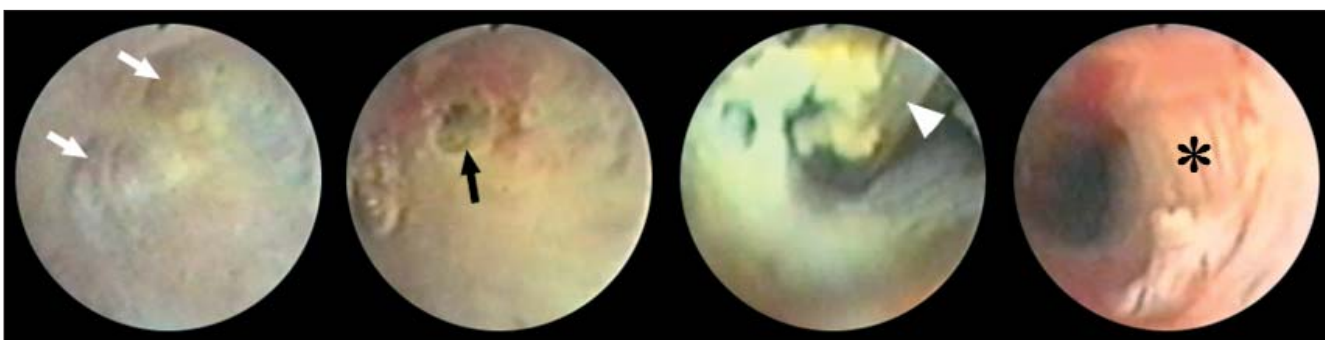


Figure 10 / Obr. 10

Reconstruction of iatrogenically interrupted bile duct. A scar is seen from left to right (white arrows), the result of the first section of needle-knife papillotomy (black arrow), unexpectedly released surgical clamp (arrowhead) and scarring channel after reconstruction (asterisk). The intervention was completed by the introduction of a metallic prosthesis in September 1998. Four years later, the patient suffered a period of cholangitis, in March 2002 a stone above the prosthesis, acting as a valve, was removed. Since that time the patient has been without any problems and without symptoms of cholestasis.

Rekanalizace iatrogenně přerušeno žlučového ústí. Zleva doprava je patrná pevná jizva (bílé šipky), výsledek prvního řezu jehlovým nožem (černá šipka), neplánovaně uvolněná chirurgická svorka (hrot) a jizvící se kanál po rekanalizaci (hvězdička). Výkon byl ukončen zavedením kovové protézy v září 1998. Po 4 letech měla pacientka epizodu cholangitidy, v březnu 2002 byl odstraněn ventilový kámen nad protézou. Od té doby je bez obtíží a bez známek cholestázy.

development (several years) has shown no new complications and no cholangitis until now. The last two patients from the group suffered from repeated cholangitis and cholelithiasis every 1 – 2 years. These cases are regarded as unsuccessful treatment.

In case of difficult cholelithiasis, the treatment focuses on multiple hepaticolithiasis or big stones addressed that could not be removed primarily with other

method. In some cases the difficult lithiasis was proved to be caused by a foreign body, broken remnants of incrustated duodenobiliary prosthesis, omitted suture or drain. A peculiarity was discovered in three cases as a tissue bridge dividing the bile duct to two channels and deforming its lumen (see Figs. 7 and 8). The bridge caused repeated lithiasis even after repeated surgical and transpapillary endoscopic treat-

ment. It was probably created as a response to operative injury of the bile duct. After its detection and removal by cholangioscopy the patients have been without complication for a number of years. The use of a laser lithotripter is advantageous especially for cast lithiasis, for larger stones that do not go to the extraction basket. It also helps for small bile ducts with swollen mucosa due to cholangitis where the basket cannot penetrate due to a small bile duct diameter or due to an acute bending. The crushing of the stones using this technique proceeds gradually and is accompanied by severe turbidity of bile duct fluid and a temporary invisibility. The extraction of stone fragments by a basket through the PTD channel is time consuming and painful. For this reason the wash-out of the crushed material with saline solution through the PTD channel over the papilla is preferred or it is left as a spontaneous process and the session is repeated several days later. In case of difficult bile duct stones the cause of the lithiasis must be searched for and possibly eliminated. An interesting indication for laser lithotripsy of big stones was established with an 89-year female. The cause of otherwise untreatable icterus was Mirizzi syndrome. Four big stones in the gallbladder pushed through a broad cystic duct into the common bile duct and hindered the bile flow. The stone were gradually crushed in the opposite direction.

A specific group of patients are young people after surgery of the biliary tract for congenital anomalies during childhood who suffer from atypical bilio-enteral anastomosis. Bile ducts are deformed, badly visible, hepatic ducts are usually full of stones. They may only be treated transcutaneously using percutaneous cholangioscopy. After the removal of the last stone the problems receded, the cholangitis healed, nevertheless long-term results are still unavailable. The reflux from the small intestine to the bile ducts as the main reason persists in most cases. The patients need to be monitored over the long term. In some cases, serious reflux of intestinal content was proved over the papilla of Vater, in some cases over hepatico-jejuno-anastomosis. In such cases, the bile ducts contained remnants of food, peel, fruit seeds or even droplets of fat. In one case, a submucosal angiolipoma of 11 mm in diameter prolapsed through the broad opening of the papilla of Vater into the bile duct and imitated a stone wedged in the papilla. It was only through percutaneous cholangioscopy that the

mechanism of intermittent cholestasis and an inconstant non-specific finding during the ERCP were discovered. The removal of a multiple hepaticolithiasis in a young man after a liver transplantation and the dilatation of the anastomosis solved the relapsing cholangitis.

Stones retained during an introduced T-drain are the most frequent cause of endoscopic intervention after biliary tract surgery. The method of choice is transpapillary extraction combined with endoscopic papillotomy. The T-drain clogs basket introduction and is usually taken out. The stone extracted through the T-drain channel was described for the first time by Mandet in 1962 and the method was later developed by Mazzariello (1,089 patients) and Burhenne (661 patients), Blažek in the Czech Republic published his experience in 1980 and 1987 (2,5,16). Nowadays, the extraction of stones through the T-drain channel is an obsolete method whereas the introduction of cholangioscope to the bile duct through the T-drain channel is becoming a very successful method that is less stressing in comparison with ERCP and the endoscopic papillotomy. For that reason, this method is preferred in our Department. A broader channel after a larger T-drain is mandatory. Otherwise the channel requires initial dilatation up to 16 Fr. Patients are mostly treated on an ambulatory basis. The only consideration is a potential occurrence of a serious pancreatitis after the passing of the narrow papilla of Vater. Our results show that in most cases the first trial is successful. A few patients with subsided obstructive jaundice, cholecystolithiasis and multiple difficult hepaticolithiasis were recommended for an elective cholecystectomy by standard open surgery and simultaneous introduction of the T-drain into the fine bile duct. In the subsequent post-operative period, small-sized multiple hepaticolithiasis and/or cast hepaticolithiasis accompanying intrahepatic bile ducts stenosis was repeatedly extracted through the T-drain channel.

The percutaneous cholangioscopy is technically very demanding in the treatment of cholangitis of the stenosis of hepatico-jejuno-anastomosis. The PTD of peripheral bile ducts itself means a higher risk of serious arterial bleeding, injury to the pleural cavity and the development of empyema due to communication between the thoracic cavity and infected bile ducts. Also, maintaining working drainage is a technical issue. The manipulation with the endoscope in a nar-

row space requires substantial experience. In the treatment of difficult to access stenoses of intrahepatic bile ducts, hepaticolithiasis, stenosis of hepatico-jejuno-anastomosis, we used enterostomy created in collaboration with a surgeon, or the treatment was performed endoscopically as described above.

The percutaneous cholangioscopy in traumatic lesions is similar to iatrogenic injury. A bile duct injury is indicated by biliary fistula or by growing obstructive jaundice and/or sepsis. The endoscopist's and surgeon's approach is complementary and collaborative. The introduction of PTD before surgery, keeping well-known indication criteria, would control an acute situation. An introduced 16 Fr drain may facilitate the surgeon's orientation in the subhepatic area, alleviate high pressure in the bile ducts and reduce the risk of other biliary complications of the trauma, especially biliary peritonitis. Subsequent percutaneous cholangioscopy through the PTD channel helps to evaluate and precisely localize the injury and to establish prognosis. In revision of the abdominal cavity, the traumatologist may facilitate subsequent expected therapeutic percutaneous cholangioscopy. The fixation of the excluded jejunal loop to the abdominal wall at a marked place in case of hepatico-jejuno-anastomosis may facilitate the later creation of enterostomy by simple puncture. Also, the introduction of a temporary drain or of the T-drain to a bile duct that cannot be treated by surgery or for a bile duct that is interrupted, may facilitate the passage of the endoscope to the biliary tree. In our opinion, this results in the reduction of liver resections caused by serious injury to bile ducts.

Sclerosing cholangitis is not a frequent indication for percutaneous cholangioscopy. The endoscopy may help in differential diagnostics, for the exclusion of a primary tumour of the bile ducts. The percutaneous cholangioscopy is also useful for a therapeutic purpose. The PTD channel or T-drain channel may serve as a way for the dilatation of intrahepatic ste-

noses. The creation of choledocho-entero-anastomosis side-to-side with the excluded small intestinal loop fixed in a marked place to the abdominal wall is a similar solution. Repeated creation of enterostomy through transcutaneous puncture and subsequent percutaneous cholangioscopy with the dilatation of bile ducts stenosis is then relatively safe and easy.

Conclusions

Percutaneous cholangioscopy is a safe method, which is technically demanding for the physician and well-tolerated by the patient. It requires perfect mastery of the transcutaneous access in diagnostics and treatment of the biliary tract on the part of the medical staff. A disadvantage may be the relatively high time consumption and the necessity of frequent repetition of the endoscopy. The method proved competent for diagnostics and treatment of iatrogenic lesions of the biliary tract. In combination with laser lithotripsy, any bile duct stone may be treated. It is successful in the diagnosis of the causes of relapsing lithiasis. We have described a tissue bridge dividing the bile duct into two channels and deforming its lumen. Such a tissue bridge was probably created after an earlier bile duct injury. Its removal by means of endoscopy healed the patient from relapsing lithiasis. The extraction of foreign bodies from the biliary tract has become a common practice. The treatment of stenoses of hepatico-jejuno-anastomosis complicated by hepaticolithiasis or secondary sclerosing cholangitis, especially with the help of percutaneously or intraoperatively created enterostomy is very efficient. Percutaneous cholangioscopy is useful for the diagnostics of non-specific cholangiographic findings in the area of the papilla of Vater and intrahepatic bile ducts. It is able to show small intestinal reflux to the biliary tract. It is also a boost for the therapy of bile ducts tumours and traumatic lesions. The method is promising in that it combines digestive endoscopy with certain characters of mini-invasive surgery.

REFERENCES

1. Bakeš J. Choledochopapilloskopie, nebst Bemerkungen über Hepaticusdrainage und Dilatation der Papille. Arch Klin Chir 1923; 126: 473 – 483.
2. Blažek O. Neoperační odstraňování zbylých žlučových kamenů za RTG kontroly. Prakt Lék 1987; 67: 608 – 610.
3. Born P, Rösch T, Bruhl K, Sandschin W, Allescher HD, Frimberger E, Classen M. Long term results of endoscopic and percutaneous transhepatic treatment of benign biliary strictures. Endoscopy 1999; 31: 725 – 731.
4. Brambs HJ. Perkutane transhepatische Cholangioskopie. Schweiz Rundsch Med Prax 1994; 83: 1288 – 1291.
5. Burhenne HJ. Percutaneous extraction of retained biliary tract stones: 661 patients. Am J Roentgenol 1980; 134: 888 – 898.
6. Classen M, Neuhaus H. Diagnostic and therapeutic peroral and percutaneous cholangioscopy. J Gastroenterol 1994; 29, Suppl 7: 143 – 147.

7. Černoch J. Nová indikace transkutánní cholangioskopie. *Vnitř Lék* 2002; 48: 575 – 577.
8. Černoch J. Perkutánní transhepatální cholangioskopie (p 193 – 200). In: P Dítě a kolektiv. *Základy digestivní endoskopie*. Praha: Grada Publishing, 1996.
9. Černoch J. Laserová litotrypse žlučových kamenů. *Minimální invazivní terapie* 1997; 2: 42 – 48.
10. Gorich J, Rillinger N, Brado M, Huppert P, Vogel J, Siech M, Sokiranski R, Ganzauge F, Begger HG, Brambs H. Non-operative management of arterial liver hemorrhages. *Eur Radiol* 1999; 9: 85 – 88.
11. Hwang MH, Tsai CC, Mo LR, Yang CT, Yeh YH, Yau MP, Yueh SK. Percutaneous choledochoscopic biliary tract stone removal: experience in 645 consecutive patients. *Eur J Radiol* 1993; 17: 184 – 190.
12. Izuishi K, Tajiri H, Ryu M, Furuse J, Maru Y, Inoue K, Konishi M, Kinoshita T. Detection of biliary duct cancer by autofluorescence cholangioscopy: a pilot study. *Hepatogastroenterology* 1999; 46: 804 – 807.
13. Jeng KS, Sheen IS, Yang FS, Cheng SJ, Ohta I. Percutaneous transhepatic placement of metallic stents in the treatment of complicated intrahepatic biliary stricture with hepatolithiasis: A preliminary report. *Am J Roentgenol* 1999; 94: 3507 – 3512.
14. Lee SK, Kim MH, Kim HJ, Seo DS, Yoo KS, Joo YH, Min YI, Kim JH, Min BI. Electroacupuncture may relax the sphincter of Oddi in humans. *Gastrointest Endosc* 2001; 53: 211 – 216.
15. Longland CJ. Choledochoscopy in choledocholithiasis. *Brit J Surg* 1973; 60: 626 – 628.
16. Mazzariello RM. A fourteen-year experience with nonoperative instrument extraction of retained bile duct stones. *World J Surg* 1978; 2: 447 – 455.
17. Meier M, Kohler B, Benz C, Körber H, Riemann JF. Die perkutane transhepatische Cholangioskopie (PTCS) – eine wichtige Ergänzung in der Diagnostik und Therapie von Gallenwegserkrankungen. *Indikationen, Technik und Ergebnisse*. *Z Gastroenterol* 1995; 33: 435 – 439.
18. Nakamura M. Choledochoscopy (p 123 – 140). In: T Takemoto, T Kasugai. *Endoscopic retrograde cholangiopancreatography*. Tokyo: Igaku-Shoin, 1979.
19. Petrář J, Brůha R. Transhepatální cholangioskopie v léčbě choledocholithiázy. *Čas Lék čes* 2003; 142: 603 – 605.
20. Seo DW, Lee SK, Yoo KS, Kang GH, Kim MH, Suh DJ, Min YI. Cholangioscopic findings in bile duct tumors. *Gastrointest Endosc* 2000; 52: 630 – 634.
21. Simon T, Fink AS, Zuckerman AM. Experience with percutaneous transhepatic cholangioscopy (PTCS) in the management of biliary tract disease. *Surg Endosc* 1999; 13: 1199 – 1202.
22. Tamada K, Tomiyama T, Ohashi A, Wada S, Satoh Y, Higashizawa T, Gotoh Y, Ido K, Sugano K. Intraductal ultrasonography for evaluating the patency of biliary metallic stents: correlation with cholangioscopic findings. *Abdom Imaging* 2001; 26: 210 – 214.
23. Tamada K, Yasuda Y, Tomiyama T, Ohashi A, Kanai N, Aizawa T, Wada S, Tano S, Miyata T, Satoh Y, Ido K, Kimura K. Preoperative assessment of congenital bile duct dilatation using intraductal US. *Gastrointest Endosc* 1999; 49: 488 – 492.
24. Wang HP, Chen JH, Wu MS, Wang HH, Chou AL, Chang YS, Yang CS, Shun CT, Lin JT. Application of peroral cholangioscopy in an endemic area with prevalence of hepatocellular carcinoma and choledocholithiasis. *Hepato-Gastroenterology* 2000; 47: 1555 – 1559.
25. Yamakawa T, Mieno K, Shikata J. Improved choledochofiberscopes and non-surgical removal of retained biliary calculi under direct visual control. *Gastrointest Endosc* 1976; 22: 160 – 164.
26. Yeh YH, Huang MH, Yang JC, Mo LR, Lin J, Yueh SK. Percutaneous transhepatic cholangioscopy and lithotripsy in the treatment of intrahepatic stones: a study 5 year follow-up. *Gastrointest Endosc* 1995; 42: 13 – 18.

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