ENDOSCOPIC TREATMENT OF THE CHELEDOCOHOLITHIASIS –
EFFECTIVENESS, SAFETY AND LIMITATIONS OF THE METHOD

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Endoscopic Retrograde Cholangio-Pancreatography (ERCP) is accepted referred method of treatment of the cheledocholithiasis.

The aim of the study. Evaluation of efficacy and safety of the endoscopic treatment of the biliary tract stones.

Material and methods. Results of 3309 Endoscopic Retrograde Cholangio-Pancreatography (ERCP) carried out in Division of Endoscopy of the General Surgery Department in the period 2000 – 2010. The retrospective analysis of the indications, process, findings and final results of 1698 ERCP and Endoscopic Sphincterotomy (ES) was performed with intention to treat of the biliary tract stones.

Results. The 883 (52%) patients with coexisted gall-bladder and biliary tract stones were the principal group. The second group included 580 (34.2%) patients with residual cheledocholithiasis after cholecystectomy and biliary tract surgery. Moreover ERCP, ES and endoscopic evacuation of biliary stones have been urgently carried out in 159 (9.4%) cases with acute biliary pancreatitis. Lastly ERCP with re-sphincterotomy and removal of the stones was performed in 75 (4.4%) patients with recurrent cheledocholithiasis. The procedure was effective in 1561 (92%) patients. When removal of the stones was not possible, decompression of the biliary tract by implantation of the plastic stent was done in 63 (3.7%) cases. Ineffective procedure was noted in 74 (4.3%) patients. The most commonly observed complication was acute pancreatitis. Because of: post ES bleeding, acute haemorrhagic and necrotic pancreatitis, impacted Dormia basket and peripapillary duodenal perforation 10 patients (0.5%) had to be operated. Two patients (0.1%) died.

Conclusions. 1. Endoscopic treatment of cheledocholithiasis is highly effective but risk factors of complications with urgency an intensive conservative management and surgical intervention have to be considered. 2. After ES, if surgical evacuation of the stones have to be carry out, post operative biliary tract drainage (by T tube) is not necessary.

Key words: cheledocholithiasis, endoscopic retrograde cholangio-pancreatography, endoscopic sphincterotomy

The diagnosis of cheledocholithiasis, irrespective of the clinical picture, is associated with making the decision on removing the deposits from the biliary tract. The method of choice is endoscopic retrograde cholangiopancreatography (ERCP), combined with endoscopic sphincterotomy (ES) and deposit evacuation. The pioneering role in the implementation of those procedures in the 1970s should be attributed to Demling and Classen from Erlangen, Germany (1) and to Kawai and colleagues from Kyoto, Japan (2). Currently, it is accepted that the method efficacy is high and reaches at least 90%. However, the obtained results depend on the number and size of deposits, their possible lodging during evacuation, the width and course of biliary tract, the presence of periampillary diverticula, and the past procedures on the biliary tract, stomach and duodenum. The experience of the centre and physicians performing the procedures is also of significance. Cheledocholithiasis coex-
ists in 10-18% of cases with symptomatic cholelithiasis (3, 4) and currently it is recommended to perform endoscopic evacuation of stones from the biliary tract prior to elective cholecystectomy (4, 5). In addition, biliary tract endoscopy is of particular importance in choledocholithiasis complicated by acute gallstone pancreatitis and cholangitis.

In view of the significant extent of the problem in everyday clinical practice, the present study evaluated the efficacy, safety and limitations of endoscopic treatment of choledocholithiasis.

MATERIAL AND METHODS

The material in the present study encompassed the results of 3309 ERCP procedures performed at the Departmental Endoscopy Laboratory in the years 2000-2010. Patients undergoing endoscopy had previously been hospitalised at the Department or transferred from Surgery Departments of other hospitals. Thorough analysis was performed on the data from 1698 endoscopic procedures in the treatment of uncomplicated and complicated choledocholithiasis, and procedures undertaken in the early stages of acute gall-stone pancreatitis (AGP). Indications were set based on the clinical picture, imaging examinations (ultrasound) and laboratory tests. The vast majority, i.e. 81% (1375) of procedures were performed in females. Patient’s age ranged between 16 and 103. Conscious sedation was used in most of the cases, with intravenous administration of fentanyl and midazolam, pulse monitoring and pulse oximetry. General anaesthesia was used in 36 cases (2.1%), mainly due to the complete lack of patient’s cooperation. The procedures were performed at the hospital X-ray Laboratory, with the use of OLYMPUS devices (visual track OEV 203, light source CLE -145, duodenoscopy TJF 145) and accessories manufactured by Cook medical, Endo-Flex and Medwork (spirincterotomy, catheters, Dormia baskets, prostheses, etc.). An obvious and essential condition for performing the procedure was the obtaining of informed consent from the patient or their legal guardian.

RESULTS

The main diagnoses posed after the performance of 3309 endoscopic retrograde cholangiopancreatography procedures in the period of 2000-2010 are presented in tab. 1.

In the above table, of note is the group of 522 patients (16%) post cholecystectomy with a stricture of ampulla of Vater and features of sphincter of Oddi dyskinesia.

The decision on performing the ERCP and ES procedures was made in cases where, apart from the symptoms of the so-called biliary colic, the imaging examination (ultrasound) revealed dilated common bile duct of above 12 mm, and the endoscopic examination – of above 10 mm, and there were found twice higher transaminase levels, which according to the so-called Milwaukee classification (5) allowed to diagnose type II and III of dyskinesia.

Following the ES performance, histopathological specimens were collected from the ampulla of Vater in cases with suspected neoplastic lesions.

Lists of groups of patients undergoing surgery due to choledocholithiasis and the evaluation of efficacy of those procedures and the occurring complications are presented in tab. 2, 3, 4.

Table 1. Principal diagnoses established after 3309 performed ERCP

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choledocholithiasis</td>
<td>1698</td>
<td>51</td>
</tr>
<tr>
<td>Neoplastic and benign strictures of the biliary tract</td>
<td>862</td>
<td>26</td>
</tr>
<tr>
<td>Strictures and dyskineses of Oddi sphincter*</td>
<td>522</td>
<td>16</td>
</tr>
<tr>
<td>Other**</td>
<td>131</td>
<td>4</td>
</tr>
<tr>
<td>Norm</td>
<td>96</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>3309</td>
<td>100</td>
</tr>
</tbody>
</table>

* symptoms of the dyskinesis of Oddi sphincter type II and III according to Milwaukee classification (5)

** eg. primary sclerosing cholangitis, postoperative lesions of biliary tract, unsuccessful procedures due to peripapillar duodenal diverticules, diversion of alimentary tract after Billroth II gastric resection, stricture of pylorus etc.
DISCUSSION

The most highly recommended therapeutic approach in choledocholithiasis is the performance of ERCP, ES and deposit evacuation prior to the elective laparoscopic cholecystectomy (4, 6) or following the above surgery if the choledocholithiasis diagnosis has not been posed based on the clinical picture, imaging examinations and laboratory tests (7). The performance of perioperative cholangiography during laparoscopy, and in particular perioperative ERCP (rendezvous technique), is believed to be technically difficult, time-consuming, costly and limited to centres having vast experience in this respect (4). Similar limitations concern only laparoscopic evacuation of stones from the biliary tract (8). It is also believed that the performance of ERCP only with the wait and see approach, and the postponing of decision on cholecystectomy increase the choledocholithiasis recurrence rate, and many patients may develop complications requiring surgical intervention (6, 7, 9).

The diagnosis of choledocholithiasis should be made by the least invasive methods (10-13), among of which the main ones are magnetic resonance cholangiopancreatography (MRCP) with sensitivity of 95% and specificity of 97%, and endoscopic ultrasound (EUS) with sensitivity of 93% and specificity of 93-97%, although, the latter is performed in rare cases due to the limited availability (11). It should also be noted that the above methods should be considered in patients with low or medium probability of choledocholithiasis. The value of the widely available percutaneous ultrasound examination is smaller in this respect and depends to a large extent on the experience of the technician. Obviously, the sensitivity and specificity of ERCP are high and reach 89-100%, but the diagnostic advantage of this examination is associated with its invasiveness, and this is why it should be performed only in patients with a potential requirement for intervention (4, 6, 8, 12).

In the presented material (tab. 2), the majority of individuals qualified for endoscopy

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Choledocholithiasis + coexisted gall-bladder</td>
<td>883</td>
<td>52</td>
</tr>
<tr>
<td>Choledocholithiasis after cholecystectomy</td>
<td>581</td>
<td>34.2</td>
</tr>
<tr>
<td>Acute biliary pancreatitis</td>
<td>159</td>
<td>9.4</td>
</tr>
<tr>
<td>Recurrent choledocholithiasis after endoscopic treatment</td>
<td>75</td>
<td>4.4</td>
</tr>
<tr>
<td>Total</td>
<td>1698</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effectiveness</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate efficiency of the ERCP, ES and evacuation of stones</td>
<td>1561</td>
<td>92</td>
</tr>
<tr>
<td>Temporary stents implantation after ERCP and ES</td>
<td>63</td>
<td>3.7</td>
</tr>
<tr>
<td>Unsuccessful procedures</td>
<td>74</td>
<td>4.3</td>
</tr>
<tr>
<td>Total</td>
<td>1698</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of complication</th>
<th>%</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>0.1</td>
<td>2 due to haemorrhagic-necrotic pancreatitis</td>
</tr>
<tr>
<td>Acute pancreatitis</td>
<td>3.35</td>
<td>58</td>
</tr>
<tr>
<td>Bleeding required surgery</td>
<td>0.15</td>
<td>3</td>
</tr>
<tr>
<td>Peripapillary duodenal perforation</td>
<td>0.1</td>
<td>2</td>
</tr>
<tr>
<td>Impacted Dormia basket required surgery</td>
<td>0.1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>3.8</td>
<td>67</td>
</tr>
</tbody>
</table>
were the patients with choledocholithiasis and retained gall-bladder – 883 (52%). In those patients, the endoscopic procedure was performed first, with cholecystectomy planned for the next day or in 4-8 weeks. There were 581 endoscopic procedures (34.2%) performed in patients with choledocholithiasis post cholecystectomy. The above figure included 384 endoscopic interventions (22.6%) post classic cholecystectomy, 122 (7.2%) post laparoscopic procedure, and 75 (4.4%) in recurrent choledocholithiasis post endoscopic treatment. A significant group of 159 patients (9.4%) with cholelithiasis and choledocholithiasis was admitted for emergency endoscopic intervention due to symptoms of AGP.

Data from publications indicate cholelithiasis as the leading cause of pancreatitis (14). The combination of data from the clinical picture, laboratory test results and imaging examination results (ultrasound mainly) allow to verify with high probability this group of patients (15), although, as it is known, ultrasound sensitivity depends to a large extent on the experience of the technician (14). Endoscopic intervention aimed at releasing the mechanical obstruction in the pancreatic juice and bile outflow to the duodenum should be performed as early as possible, similarly to the early initiation of conservative treatment aimed at reducing the pancreatic exocrine secretion and inhibiting the inflammation (14). Similarly to the reports by other authors, in the present study, those qualified for endoscopy were the patients with the time from disease symptom (mainly pain) occurrence not exceeding 72 hours (15, 16).

The role of decision on undertaking endoscopic treatment within the first 24 hours from admission to the hospital is emphasised (17, 18). According to the frequently quoted publication by Nowak and colleagues (18), prompt making of the decision on undertaking endoscopic treatment should take place in all cases of AGP, even the mild ones. In the presented material, a favourable change in the disease course was observed in 144 patients (91%). A particularly clear improvement was seen post the evacuation of stones lodged in the ampulla of Vater, with rapid normalisation of bilirubin, amylase and lipase levels, and leukocytosis and CRP level reduction observed. In cases of massive mucosal oedema and unsuccessful biliary tract catheterisation, endoscopic intervention was limited to the ampullary pre-cutting. The observed improvement in patient’s condition and retreat of hyperbilirubinemia and hyperamylasemia post the procedure may be explained by a reduction in the intra-ampullary pressure and, in consequence, also the pressures in the biliary tract and pancreatic duct.

The analysis of data on the procedure efficacy (tab. 3) indicated that complete evacuation of stones from the biliary tract was achieved in 1561 cases (92%). However, in 63 cases (3.7%), despite the performance of total sphincterotomy, the evacuation of hard deposits exceeding 15 mm had to be abandoned due to the lodging in the biliary tract, which hindered their removal despite the attempts at their fragmentation.

The breaking of stones may to a significant extent improve the procedure efficacy (19), however, multiple attempts may increase the risk of cholangitis and pancreatitis by 10-20%, as well as delayed haemobilia by approx. 15% (21). Following unsuccessful fragmentation, a decision was made on the temporary insertion into the biliary tract of prostheses of 8.5-10 F in diameter, which contributed to the retreat of cholestasis and enabled the removal of deposits by elective laparotomy and choledochotomy. In such cases, in line with the tactics adopted at the Department, T tube retention was abandoned and the biliary duct primary suture was placed, since the previous ES procedure had ensured effective bile outflow to the duodenum. In 2 cases, upon the prosthesis insertion, it was possible to evacuate the stones during the subsequent endoscopic procedure owing to the reduction in their size. It was of particular importance for persons at high operative risk. Similar observations have been reported in previous publications (21, 22). However, with prosthesis insertion, its blockage and, in consequence, cholangitis should be taken into account. The risk of prosthesis blockage by the so-called bile sludge increases with time and may occur in over 40% of cases after 24 months (21). Meanwhile, the use of ursodeoxycholic acid as an agent dissolving non-calcified gallstones is dubious (22). In the presented material, there were observed three incidents of early spontaneous evacuation of a prosthesis inserted near the stone. It was associated with the need for emergency repeat endoscopic examination for new stent
Endoscopic treatment of the choledocholithiasis – effectiveness, safety and limitations of the method

insertion. Following the prosthesis insertion, there were also observed cases of acute cholecystitis. The above forced the performance of emergency cholecystectomy with bile tract clearing of stones.

In the presented material, no problems with deposits lodged in a swollen ampulla of Vater were seen. In line with the adopted tactics (23, 24), the ampulla was incised with the use of sphincterotomic needle knife. In most cases, the above enabled spontaneous stone evacuation. In the remaining cases, deposits were evacuated only following the bile tract catheterisation with the use of a guide and the total sphincterotomy. In most cases, there exists the possibility of using the classic sphincterotomic needle knife to cut the ampulla at its opening (23), however, if the above is not possible due to marked oedema, fistulotomy may be performed by incising the ampulla at 5 mm above its opening and continuing the incision upwards at between 11 and 13 hours. However, the access to the bile tract obtained in the above manner is usually smaller, and thus lithotripsy of larger deposits is required in more cases (24).

Cholangitis accompanying choledocholithiasis with the full picture of the so-called Charcot’s triad was observed in 32 cases (1.9%). Total sphincterotomy or re-sphincterotomy with emergency stone evacuation and/or prosthesis insertion enabled the outflow of infected bile. The persisting symptoms of inflammation post-prosthesis insertion were considered an unsuccessful drainage of the biliary tract, which prompted emergency stent change or drainage supplementation with a second prosthesis. In such cases, a rapid improvement in patient’s status was achieved, with a positive response to the used antibiotics and possibility of shortening the hospitalisation time.

The quoted decisive factors for emergency endoscopic intervention include elevated body temperature, bilirubin level of above 5 mg%, significant leukocytosis, pulse of over 100/min, increase in the prothrombin time to above 14 seconds and decrease in the albumin level to below 3 g/L (25, 26). The importance of early intervention following the inflammation diagnosis has also been emphasised in the multicentre study by Cleveland hospitals (27), with the authors also analysing the bile tract structure of neoplastic and post-inflammatory origin, primary sclerosing cholangitis (PSC) and duodeno-biliary fistula obstruction.

EXAMINATION SAFETY AND LIMITATIONS

The performance of endoscopic procedures may be associated with a risk of complications which, according to published reports, ranges between 4% and 15.9%, and with mortality at 0-1%, with the risk of serious complications being estimated at 4-5%. It is also emphasised that the comparison of the extent of complications between individual publications is not fully reliable in view of the diversity of research projects and structures of studied patients (4, 6, 12, 13, 28-31).

Table 4 presents serious adverse reactions and complications associated with the performed endoscopic intervention. They were observed in 67 patients post such procedures (3.8%). The most common and serious complication was acute pancreatitis (AP), occurring in 58 cases (3.35%). It should be noted that cases of mild, transient, 1-2-day hyperamylasemia were not included in the above figure. In 55 patients, the implemented conservative treatment proved effective. According to the data from published reports, AP post ERCP has occurred in 1-40% of cases, and in only 10% of them it has been moderate or serious, with mortality rate reaching 0.2% (6, 12 28, 32). In the presented material, two patients developed haemorrhagic pancreatic necrosis which, despite intensive conservative treatment, led to patients’ death (0.1% of the entire presented material).

According to literature, significant risk factors associated with the patient include the history of AP, narrow biliary tract, young age, and symptoms of sphincter of Oddi dysfunction, particularly suspicious in females post cholecystectomy. On the other hand, the risk factors associated with the procedure include the use of sphincterotomic needle knife, multiple (traumatic) attempts at catheterisation of the ampulla of Vater, attempts at dilating the sphincter of Oddi with the use of balloon catheter, and inadvertent administration of contrast agent to the pancreatic duct (4, 8, 12, 13, 28, 30). The experience of the centre at which the examinations and endoscopic procedures are performed are of significance in
Multiple attempts at catheterisation of the ampulla and its thermal injury during sphincterotomy may cause ampullary oedema and spastic reaction of the remaining sphincter. This leads to transient disturbances in pancreatic juice outflow and to elevated pressure in the pancreatic duct. Inadvertent administration of contrast agent to the pancreatic duct increases the risk of damaging the walls of pancreatic ducts. Bile or duodenal contents may also activate the proteolytic enzymes present in ductal content, in consequence leading to autolysis of surrounding tissues (37).

In view of the above, after each procedure with inadvertent catheterisation and contrast agent administration to the pancreatic duct, we administer intravenous bolus somatostatin. A beneficial prophylactic approach may be the temporary insertion of prosthesis of 3-5 F in diameter into the pancreatic duct (12, 13). Haemorrhaging post the performed ES procedure is observed in 10-30% of cases, with the rate of its marked intensity not exceeding 0.3-2% (4, 12, 13, 28, 31). In the presented material, in cases of haemorrhaging post ES, there was observed high efficacy of argon plasma coagulation (APC), supplemented with adrenaline solution injection in isolated cases.

The above-described approach was also used several times in check-up duodenoscopy, and in cases of incomplete haemostasis or recurrent haemorrhaging. However, three patients (0.15%) were required to undergo surgery, with duodenotomy and haemostatic suture placement on the edges of incised ampulla, which is in line with the surgical technique of transduodenal sphincteroplasty performed at Surgery Departments before the era of endoscopy. It should also be borne in mind that delayed haemorrhaging may occur up to 10 days post the performed procedure (13).

One of significant complications is also periampullary perforation, observed in 0.1-0.3% of cases (4, 12, 13, 28, 31). Obviously, the rate of perforations of intestinal loops connected with the biliary tract is many-times higher in patients post gastrectomy by Billroth’s operation II and post pancreaticoduodenectomy by Whipple procedure, due to the technical difficulties of the procedure (12, 13). In the presented material, periampullary perforation was found in two cases (0.1%). In one case, due to peritoneal symptoms, surgical treatment by drainage of peritoneal cavity and retroperitoneal space was applied. In the second case, with no peritoneal symptoms, intensive 7-day conservative treatment proved effective, during which there was observed in X-ray examinations a rapid absorption of contrast agent and gas present in the retroperitoneal space.

In the presented material, among the complications associated with stone evacuation, there were also found 2 cases (0.1%) of lodging of the Dormia basket with a large stone in the biliary tract. Such patients underwent emergency surgery, although, according to literature, mechanical lithotripsy and/or extracorporeal shock wave lithotripsy may be successful. Unsuccessful examinations were observed in 74 cases (4.3%). The above were caused by the localisation of ampulla of Vater in deep periampullary diverticula, the deformations or strictures of the pylorus and duodenum, or the abandoning of examination in patients post gastrectomy by Billroth’s operation II.

In published reports, examination failure do to the lack of access to the ampulla of Vater or the inability to catheterise the biliary tract has been observed in 5.1% of cases (28). It should also be noted that the remains of gastrointestinal contrast examination (X-ray infusion and intestinal passage) obscured the picture, requiring the postponing of elective endoscopic procedure. The postponing of examinations was also prompted by drug-induced coagulation disorders. Usually, the above required a 3-day discontinuation of anticoagulant administration and temporary use of low molecular weight heparins at prophylactic doses. In emergency cases, normalisation of coagulation factors was achieved by frozen plasma transfusion and intravenous vitamin K administration.

**CONCLUSIONS**

1. Endoscopic treatment of choledocholithiasis is highly effective, however, at patient qualification, the risk factors for complications potentially requiring intensive conservative treatment and emergency surgical intervention should be taken into account.
2. Post ES performance, in the event of need for surgical evacuation of deposits, postoperative drainage of the biliary tract may be abandoned.
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