

SZYMKOWICZ, Anna, PALUCHOWSKA, Julia, SAMBURA, Maria, ROSOŁOWSKA-ŻAK, Sara, PASCHKE, Patrycja and MICZEK, Igor. ERCP (endoscopic retrograde cholangiopancreatography) and EUS (endoscopic ultrasonography) in diagnosis of choledocholithiasis – battle or cooperation? *Journal of Education, Health and Sport*. 2024;70:49529. eISSN 2391-8306.

<https://dx.doi.org/10.12775/JEHS.2024.70.49529>

<https://apcz.umk.pl/JEHS/article/view/49529>

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences). Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu). © The Authors 2024; This article is published with open access at Licensee Open Journal Systems of Nicolaus Copernicus University in Torun, Poland Open Access. This article is distributed under the terms of the Creative Commons Attribution Noncommercial License which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author (s) and source are credited. This is an open access article licensed under the terms of the Creative Commons Attribution Non commercial license Share alike. (<http://creativecommons.org/licenses/by-nc-sa/4.0/>) which permits unrestricted, non commercial use, distribution and reproduction in any medium, provided the work is properly cited. The authors declare that there is no conflict of interests regarding the publication of this paper. Received: 19.03.2024. Revised: 10.05.2024. Accepted: 14.05.2024. Published: 17.05.2024.

ERCP (endoscopic retrograde cholangiopancreatography) and EUS (endoscopic ultrasonography) in diagnosis of choledocholithiasis – battle or cooperation?

Anna Szymkowicz, Julia Pałuchowska, Maria Sambura, Sara Rosołowska-Żak Patrycja Paschke, Igor Miczek

Anna Szymkowicz;

ORCID 0009-0009-2596-6593;

<https://orcid.org/0009-0009-2596-6593>; a.szymkowicz98@gmail.com;

ZOZ w Nysie ul. Bohaterów Warszawy 23,

48-300 Nysa, Polska.

Julia Pałuchowska;

ORCID 0009-0009-4163-2569;

<https://orcid.org/0009-0009-4163-2569>; Julia.paluchowska@o2.pl;

ZOZ w Nysie ul. Bohaterów Warszawy 23 ,

48-300 Nysa, Polska.

Maria Sambura;

ORCID 0009-0007-5518-1418;

<https://orcid.org/0009-0007-5518-1418> ; maria.e.sambura@gmail.com;

Wojewódzki Szpital Specjalistyczny nr 5 im. św. Barbary w Sosnowcu, Plac Medyków 1,

41-200 Sosnowiec, Polska.

Sara Rosołowska-Żak;

ORCID 0009-0003-6202-2475;

<https://orcid.org/0009-0003-6202-2475>; sararosolowska@gmail.com;

Wojewódzki Szpital Specjalistyczny nr 5 im. św. Barbary w Sosnowcu, Plac Medyków 1,
41-200 Sosnowiec, Polska.

Patrycja Paschke;

ORCID 0009-0006-0306-3332

<https://orcid.org/0009-0006-0306-3332>; paschke.patrycja@gmail.com;

SP ZOZ MSWiA w Katowicach im. Sierżanta Grzegorza Załogi

Ul. Wita Stwosza 41, 40-514 Katowice, Polska.

Igor Miczek

ORCID 0009-0000-8476-7943

<https://orcid.org/0009-0000-8476-7943>; miczekigor222@gmail.com;

SP ZOZ MSWiA w Katowicach im. Sierżanta Grzegorza Załogi

Ul. Wita Stwosza 41, 40-514 Katowice, Polska.

Autor do korespondencji:

Anna Szymkowicz;

ZOZ w Nysie ul. Bohaterów Warszawy 23 ,

48-300 Nysa.

+48 504 099 700

email: a.szymkowicz98@gmail.com

Abstract

Introduction: Diagnosis of choledocholithiasis, a common manifestation of gallstone disease, is mainly based on advanced endoscopic techniques such as ERCP and EUS. Since the 1970s, ERCP has been a key method in the diagnosis and treatment of choledocholithiasis, allowing direct visualization and therapeutic interventions. However, technological developments have brought the emergence of EUS as a complementary tool, providing high-resolution imaging of the bile ducts. Understanding the diagnostic accuracy, therapeutic options and complications of both modalities is key to optimizing the care of patients with bile duct stones.

Aim of the study: The aim of our study is to review and compare various diagnostic methods of bile duct stones, as well as to assess their effectiveness, accuracy, and potential complications.

Materials and methods: Electronic sources, particularly PubMed and Google Scholar databases, were searched using keywords such as "endoscopic ultrasonography", "endoscopic retrograde cholangiopancreatography" and "choledocholithiasis".

Conclusions: With the use of modern technologies, such as endoscopic ultrasonography (EUS) and retrograde cholangiopancreatography (ERCP), it has become possible to diagnose bile duct stones more accurately and introduce more effective and less invasive therapies. The development of the availability of diagnostic tests, especially those that do not require invasive procedures, has helped reduce the risk of complications. EUS may be the preferred tool of choice for patients with gallstones, as it is associated with a lower risk of complications compared to ERCP alone. Decisions regarding the use of specific diagnostic and therapeutic modalities should be made on a case-by-case basis, taking into account medical and economic considerations.

Key words: Cholangiopancreatography, Endoscopic Retrograde; ERCP; Endosonography; Bile ducts; Choledocholithiasis.

Introduction

Biliary duct stones are a hallmark of almost every general surgery or gastroenterology department in today's hospitals. The prevalence of this condition in the general population is between 15 and 20%. The mechanism of this disease is the deposition of deposits in the extrahepatic or intrahepatic bile ducts. In patients with gallbladder stones, the presence of stones in the bile ducts is diagnosed in about 20% of patients, and in those who have undergone cholecystectomy 3-10%. Gallstones can enter the ducts by a secondary route, that is, from the gallbladder through the cystic duct, blocking the flow of bile through the papilla of Vater, and by a primary mechanism, most often caused by bile stasis, in which they form in the common bile duct. [1]

Clinical manifestations

The symptoms of choledocholithiasis can follow a highly variable individual course. In some patients the course can be quite asymptomatic for many years and in others it can occur in the form of very sudden, life-threatening symptoms such as acute cholangitis or pancreatitis. Biliary colic, which results from blockage of the bile duct, can also be a harbinger of the disease. It is characterized by constant pain, lasting from several minutes to several hours. Patients localize it most often in the epigastrium and right upper quadrant of the abdomen. A typical symptom found in cases of acute cholangitis is Charcot's triad. It can be observed in 50-75% of patients with this condition. It manifests as pain in the right upper quadrant of the abdomen, fever with chills and jaundice. A fulminant course of the disease with hemodynamic instability and encephalopathy also occurs in 10% of patients. [2]. In severe forms of cholangitis, cases of the so-called Reynolds pentad have been described, in which symptoms such as septic shock and impaired consciousness are additionally observed in addition to the symptoms of Charcot's triad. [3]

ERCP

Since the 1970s, retrograde choleangiopancreatography (ERCP) has been considered the gold standard in the diagnosis and treatment of pancreatic and biliary diseases. Despite its considerable prevalence in the medical world, it is fraught with numerous complications. The examination itself involves the administration of contrast through Vater's papilla and then X-rays, in which the width, shape and cavities of the biliary and pancreatic ducts are assessed. It is considered an invasive method and is considered one of the more difficult in the diagnosis and treatment of biliary diseases. The above examination is performed in patients with suspected choledocholithiasis, pictured in Fig.1 and 2, in chronic pancreatitis and pancreatic cysts, primary sclerosing cholangitis (forms with so-called predominant stenosis, as in Fig.3) and in suspected proliferative processes of the biliary and pancreatic ducts. [4,5,6,7]



Fig. 1. A deposit in the common bile duct (arrow).
(Source: Archives of the Endoscopy Laboratory of ZOZ Nysa)

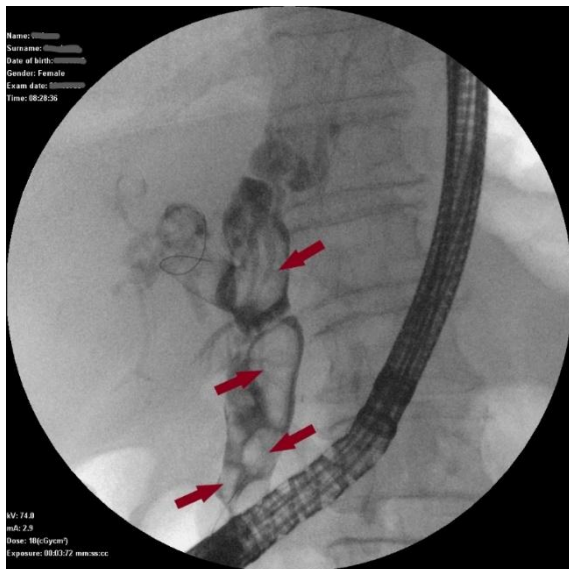


Fig. 2. Numerous biliary deposits in a patient with choledocholithiasis (arrow).
(Source: Archives of the Endoscopy Laboratory of ZOZ Nysa)

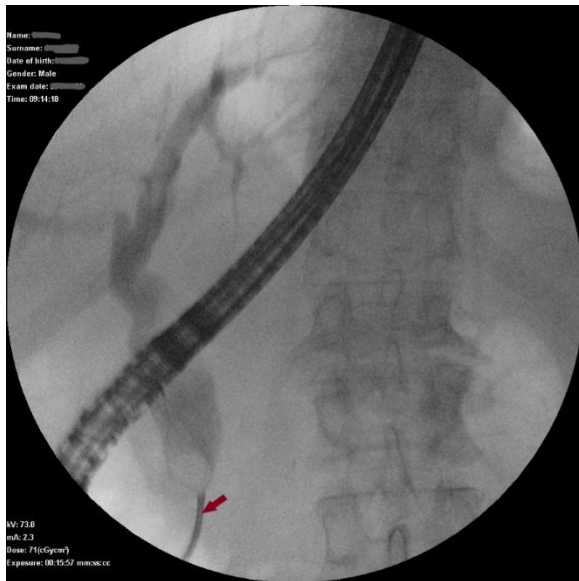


Fig. 3. Stenosis of the common bile duct (arrow).
(Source: Archives of the Endoscopy Laboratory of ZOZ Nysa)

The European Society of Gastrointestinal Endoscopy (ESGE) guidelines define the definitions and frequency of complications associated with ERCP. The most common complication of the study we describe is pancreatitis. ESGE defines it as the occurrence of a new or worsening of already existing abdominal pain accompanied by a threefold increase in blood amylase or lipase activity above the upper limit of normal >24 hours after the test, which was associated with hospital admission or prolonged hospitalization. The second most common complication is cholangitis, which is diagnosed in about 0.5-3% of patients. They are characterized by a fever of >38 degrees C for more than 24 hours as a new symptom along with associated cholestasis. Gallbladder inflammation after ERCP is as common as cholangitis. Patients may then show general systemic signs of inflammation, physical signs of inflammation in the right upper quadrant of the abdomen and, on imaging studies performed, typical features of cholecystitis. During the examination, there may also be perforation of the gastrointestinal tract examined, accompanied by the presence of gas or intestinal contents outside the gastrointestinal tract, and bleeding accompanied by vomiting of bloody contents, tarry stools and a decrease in hemoglobin of >2g/dl. [8]

EUS

EUS, or endoscopic ultrasonography, is another method used for patients with biliary complaints. It is now considered a very good and safe method for both diagnosis and treatment. EUS examination is technically similar to gastroscopy, being performed using a

suitable endoscope with an additional ultrasound transducer inside. It allows the operator to evaluate the walls of the gastrointestinal tract and adjacent structures. It also allows simultaneous cytological and histological biopsy, decompression of the biliary and pancreatic ducts, and drainage of cysts and abscesses. In addition, EUS provides the opportunity to administer substances that have a destructive effect on tumor tissue and to insert applicators after brachytherapy. [1,9] Studies have shown that endoscopic ultrasonography has a sensitivity of 94% and specificity of 95%. However, it is not possible to say unequivocally whether these parameters of ultrasound endoscopy depend on the dimensions of the deposits shown in Fig.4 and Fig.5. [10,11] Due to the use of ultrasound waves at a higher frequency than in standard ultrasound, the proximity of the transducer to the examined structures made it possible to obtain images with particularly high resolution.

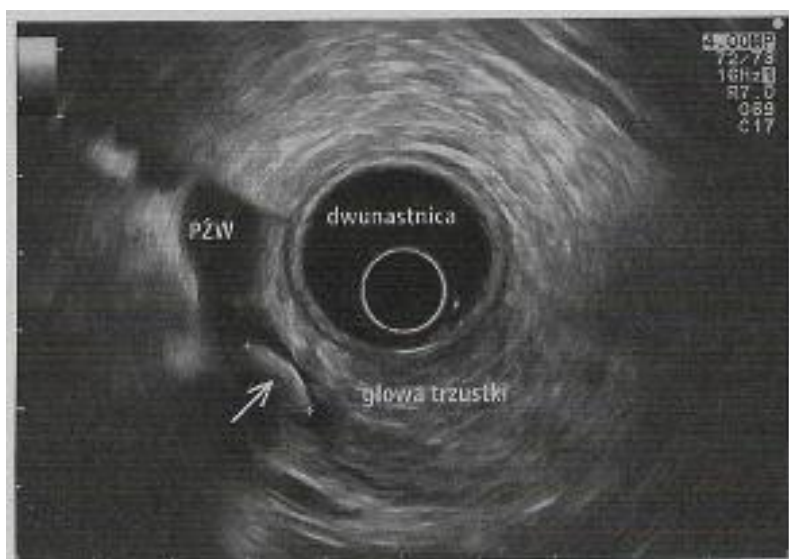


Fig. 4. A deposit in the terminal segment of the common bile duct (arrow).

(Source: Szczeklik A, Gajewski P. Interna Szczeklika. Medycyna Praktyczna. Krakow 2022; IIIB(4) 4:993-1005)

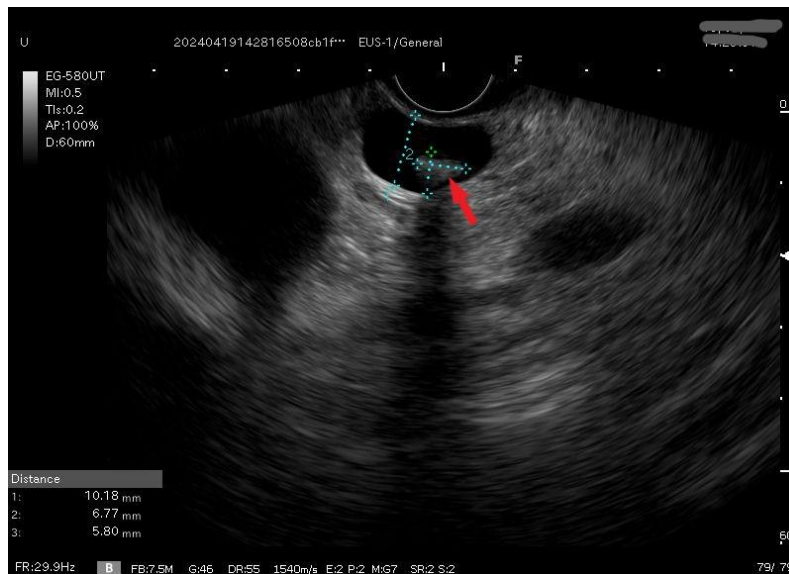


Fig. 5. Gallstone in a patient with choledocholithiasis (arrow).
(Source: Archives of the Endoscopy Laboratory of the Nysa ZOZ)

Endoscopic ultrasound, like any specialized examination, can carry negative consequences, which are mainly related to the use of the endoscopic tube. Listed are cardiopulmonary complications related to sedation and analgesia, infectious infections related to inadequate preparation of the equipment or the procedure itself, sometimes pain, bleeding and perforations, especially in anatomically altered sections of the upper gastrointestinal tract, such as Zenker's diverticulum, esophageal stricture or in a neoplastic lesion. [12]

Simultaneous performance of EUS-ECPW procedures for diagnostic and therapeutic purposes

In the past, when ERCP was the leading diagnostic method, when gallstones were found, the examination was converted. Then, in addition, removal of the deposits preceded by incision of the sphincter of Vater's papilla was performed. In the case of EUS examination, it is performed only for diagnostic purposes. It has begun to be considered to perform simultaneous EUS examination with surgical ERCP with removal of deposits, as shown in studies. [13,14] This strategy has now been adopted as the most desirable diagnostic and therapeutic method in bile duct stones. With such a procedure, the number of unnecessary ERCPs is reduced by more than half and, at the same time, the associated complications, the time of performing the examinations, as well as the time of hospitalization (by an average of 2.5 days in a comparison including separate procedures). At the same time, the cost of the procedure is reduced, as well as the dose of sedation to be used for premedication, which is particularly important in elderly patients. [15,16,17] Those who are qualified for this method

are patients at high risk of common bile duct stones, post-cholecystectomy patients, pregnant women and non-operative patients. Performing endoscopic ultrasound (EUS) before the retrograde cholangiopancreatography (ERCP) procedure makes it possible to predict the anticipated complexity of the ERCP procedure. As a result, physicians are able to plan in advance for the use of additional techniques, such as balloon plication, lithotripsy or cholangioscopy. [18,19]

Unfortunately, in addition to its disadvantages, the simultaneous EUS-ERCP procedure has numerous drawbacks. Not every physician performing EUS is simultaneously qualified and experienced in ERCP. The examination time may then be extended in favor of finding another specialist. There are some hospitals where the simultaneous EUS-ERCP method will turn out to be more expensive than the one using only ERCP, which is determined by the individual's method of calculating costs. [20,21]

Comparison of ERCP and EUS

EUS has a high sensitivity (94%) and specificity (95%) in detecting biliary tract stones (ERCP has a sensitivity of 90% and specificity of 98%). The use of EUS to isolate patients in need of therapeutic ERCP promises a lower risk of complications compared to the use of ERCP not only for the diagnosis, but also for the treatment of stones. There is a decrease in the risk of complications associated with ERCP, resulting from a two-thirds reduction in patients with simultaneous EUS-ERCP. [22,23,24] Although complications associated with ERCP are relatively rare, they can be life-threatening. Endoscopic ultrasound has lower direct costs compared to ERCP, but simultaneous EUS-ERCP requires significantly more endoscopic procedures than those based on ERCP alone. In addition to its excellent diagnostic efficacy, endoscopic ultrasonography may have additional benefits in identifying causes of biliary obstruction other than stones. [25,26,27]

Summary

Recent years have brought significant advances in the medical field, particularly in the context of diagnosis and treatment of biliary disorders. The use of advanced technologies, such as endoscopic ultrasonography (EUS) and endoscopic retrograde cholangiopancreatography (ERCP), has not only enabled precise diagnosis of bile duct stones, but also opened the door to more effective and less invasive therapeutic procedures. The trend of increasing availability of diagnostic tests, especially non-invasive ones, is

characterized by minimal risk of adverse effects, which is noticeable in contrast to invasive procedures. EUS may be a more beneficial tool in selecting patients with gallstones than ERCP alone, offering a lower risk of complications. [28,29] In light of the principle "salus aegroti suprema lex esto - the welfare of the patient is paramount," decisions regarding the use of specific diagnostic and therapeutic methods should be made on a case-by-case basis, taking into account both medical and economic aspects. Advances in the field of endoscopy offer hope for improving the quality of life of patients with biliary diseases, representing an important step in improving health care. [1,9,30,31,32]

Author's contribution

Conceptualization: Anna Szymkowicz, Julia Pałuchowska

Methodology: Anna Szymkowicz, Julia Pałuchowska

Software: Maria Sambura, Sara Rosołowska-Żak

Check: Igor Miczek, Patrycja Paschke

Formal analysis: Maria Sambura, Julia Pałuchowska

Investigation: Anna Szymkowicz, Igor Miczek

Resources: Patrycja Paschke, Sara Rosołowska-Żak

Data curation: Maria Sambura, Igor Miczek

Writing - rough preparation: : Anna Szymkowicz, Igor Miczek

Writing - review and editing: Sara Rosołowska-Żak, Julia Pałuchowska

Visualization: Julia Pałuchowska, Patrycja Paschke

Supervision:, Igor Miczek, Maria Sambura

Project administration: Anna Szymkowicz

Receiving funding: no funding was received.

All authors have read and agreed with the published version of the manuscript.

Disclosures: No disclosures.

Financial support: No financial support was received.

Conflict of interest: The authors declare no conflict of interest.

References

1. Kiełtucki J. [Endoscopic Ultrasonography (EUS) in Diagnostics and Treatment of Bile Duct Stones. The Current Role of ERCP]. *Ann. Acad. Med. Siles.* 2017; 71: 326–330. Polish. doi: 10.18794/aams/63508. eISSN 1734-025X.
2. Tadataka Y, Hasler WL, Inadomi JM, Anderson MA, Brown RS Jr, red.pol Małecka-Panas E. [Manual of Gastroenterology]. Wydawnictwo Czelej Sp. Z o.o., Lublin 2006. Polish. ISBN-10: 83-89309-92-0.
3. Szczeklik A. [Internal diseases]. *Medycyna Praktyczna*, Kraków 2005. Polish ISBN 978-83-7430-668-0.
4. Boduła A, Pazurek M, Woźniak B, Biernacki R, Antosik-Biernacka A, Winter K, Małecka-Panas E. [Comparison of magnetic resonance cholangiopancreatography and endoscopic retrograde cholangiopancreatography in the diagnosis of pancreatobiliary diseases]. [*Gastroenterology Review*] 2011; 6(3): 187–194. Polish. doi: 10.5114/pg.2011.22803. eISSN: 1897-4317.
5. Zidi SH, Prat F, Le Guen O, et al. Use of magnetic resonance cholangiography in the diagnosis of choledocholithiasis: prospective comparison with a reference imaging method. *Gut* 1999; 44(1): 118-122. doi: 10.1136/gut.44.1.118. PMCID: PMC1760072.
6. Soto JA, Barish MA, Yucel EK, et al. Magnetic resonance cholangiography: comparison with endoscopic retrograde cholangiopancreatography. *Gastroenterology* 1996 Feb; 110(2): 589-597. doi: 10.1053/gast.1996.v110.pm8566608. PMID 8566608.
7. Venu RP, Brown RD, Halline AG. The role of endoscopic retrograde cholangiopancreatography in acute and chronic pancreatitis. *J Clin Gastroenterol* 2002; 34(5): 560-568. doi: 10.1097/00004836-200205000-00017. PMID 11960071.
8. Dumonceau J.M, Kapral C, Aabakken L, Papanikolaou I.S, Tringali A, Vanbiervliet G, Beyna T, Dinis-Ribeiro M, Hritz I, Mariani A, Paspatis G, Radaelli F, Lakhtakia S, Veitch A.M, van Hooft J.E. ERCP-related adverse events: European Society of Gastrointestinal Endoscopy (ESGE) Guideline Endoscopy, 2020; 52(2): 127–149. doi: 10.1055/a-1075-4080. PMID: 31863440.
9. Butani M.S. Endoscopic ultrasonography. *Endoscopy*; 2002; 34(11): 888–895. doi: 10.1055/s-2007-966982 PMID: 18008207.

10. Tse F, Liu L, Barkun AN, Armstrong D, Moayyedi P. EUS: a meta-analysis of test performance in suspected choledocholithiasis. *Gastrointest Endoscopy*. 2008; 67(2): 235–244. doi: 10.1016/j.gie.2007.09.047. PMID: 18226685.
11. Dietrich CF. *Endoscopy Ultrasound*. Thieme. Stuttgart 2011. ISBN 978-3-13-143152-3.
12. Eisen G.M, Baron T.H, Dominitz J.A, Faigel D.O, Goldstein J.L, Johanson J.F, et al. Complications of upper GI endoscopy. *Gastrointestinal Endoscopy* 2002; 55(7): 784-793. doi: 10.1016/s0016-5107(02)70404-5. PMID: 12024128.
13. Fusaroli P, Kypraios D, Eloubeidi, MA, Caletti G. Levels of Evidence in Endoscopic Ultrasonography: A Systematic Review. *Digestive Diseases and Sciences* 2011; 57: 602–609. doi: 10.1007/s10620-011-1961-y. PMID: 22057240.
14. Manes G, Paspatis G, Aabakken L, Anderloni A, Arvanitakis M, Ah-Soune P, et al. Endoscopic management of common bile duct stones: European Society of Gastrointestinal Endoscopy (ESGE) guideline. *Endoscopy* 2019; 51: 472–491. doi: 10.1055/a-0862-0346. PMID: 30943551.
15. Benjaminov F, Stein A, Lichtman G, Pomeranz I, Konikoff FM. Consecutive versus separate sessions of endoscopic ultrasound (EUS) and endoscopic retrograde cholangiopancreatography (ERCP) for symptomatic choledocholithiasis. *Surgical Endoscopy* 2013; 27(6): 2117–2121. doi: 10.1007/s00464-012-2720-7. PMCID: PMC3661077.
16. Kawai KY, Akasaka Y, Murakami K, Tada M, Koli Y. Endoscopic sphincterotomy of the ampulla of Vater. *Gastrointestinal Endoscopy* 1974; 20(4): 148–150. doi: 10.1016/s0016-5107(74)73914-1. PMID: 4825160.
17. Iles-Shih L, Hilden K, Adler DG.. Combined ERCP and EUS in One Session Is Safe in Elderly Patients When Compared to Non-elderly Patients: Outcomes in 206 Combined Procedures. *Digestive Diseases and Sciences* 2012; 57(7): 1949–1953. doi: 10.1007/s10620-012-2135-2. PMID: 22453997.
18. Cotton PB, Eisen G, Romagnuolo J, Vargo J, Baron T, Tarnasky P, et al. Grading the complexity of endoscopic procedures: results of an ASGE working party. *Gastrointestinal Endoscopy*, 2011; 73(5): 868–874. doi: 10.1016/j.gie.2010.12.036. PMID: 21377673.
19. Borgosz J, Kupczak-Wiśniowska B, Podsiadło B, Serzysko B. [Role of Endoscopic retrograde cholangiopancreatography in the diagnosis of choledocholithiasis].

- [Nursing of the 21st Century] 2016; Vol.15, No. 4(57): 48-52. doi: 10.1515/pielxxiw-2016-0037.
20. Petrov MS, Savides TJ. Systematic review of endoscopic ultrasonography versus endoscopic retrograde cholangiopancreatography for suspected choledocholithiasis. *British Journal of Surgery*, 2009; 96: 967–974. doi: 10.1002/bjs.6667. PMID: 19644975.
 21. Deutsch L, Matalon S, Phillips A, Leshno M, Shibolet O, Santo E. Older age, longer procedures and tandem endoscopic-ultrasound as risk factors for post-endoscopic retrograde cholangiopancreatography bacteremia. *World Journal of Gastroenterology* 2020; 26(41): 6402-6413. doi: 10.3748/wjg.v26.i41.6402. PMCID: PMC7656206.
 22. Chapman CG, Siddiqui UD. New Scopes, New Accessories, New Stents for Interventional Endoscopic Ultrasound. *Clinical Endoscopy* 2016; 49(1): 41-46. doi: 10.5946/ce.2016.49.1.41. PMCID:PMC4743728.
 23. Lee T. Endoscopic prevention of post-endoscopic retrograde cholangiopancreatography pancreatitis. *World Journal of Gastroenterology* 2014; 20(44): 16582. doi: 10.3748/wjg.v20.i44.16582. PMCID: PMC4248201.
 24. Safari MT, Miri MB, Ebadi S, Shahrokh S, Alizadeh AHM. Comparing the Roles of EUS, ERCP and MRCP in Idiopathic Acute Recurrent Pancreatitis. *Clinical Medicine Insights: Gastroenterology* 2016; 9(6): 35-39. doi: 10.4137/CGast.S37927. PMCID: PMC4915784.
 25. Krawczyk M. [Hepatobiliary Surgery]. PZWL. Warszawa 2013. ISBN: 9788320046489.
 26. Johnson G, Webster G, Boškoski I, Campos S, Gölder SK, Schlag C, et al. Curriculum for ERCP and endoscopic ultrasound training in Europe: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement. *Endoscopy* 2021; 53: 1071–1087. doi: 10.1055/a-1537-8999. PMID: 34311472.
 27. Prat F, Amouyal G, Amouyal P, Pelletier G, Fritsch J, Choury Ae al. Prospective controlled study of endoscopic ultrasonography and endoscopic retrograde cholangiography in patients with suspected common-bileduct lithiasis. *The Lancet* 1996; 347(8994): 75–79. doi: 10.1016/s0140-6736(96)90208-1. PMID: 8538344.
 28. Krupa Ł, Staroń R, Gutkowski K. [Biliary duct drainage under endosonography guidance - evidence-based medicine]. [Clinical Gastroenterology] 2019; 11(1):29-32.

29. Fusaroli P, Lisotti A. EUS and ERCP in the Same Session for Biliary Stones: From Risk Stratification to Treatment Strategy in Different Clinical Conditions. *Medicina* 2021; 57(10):1019. doi: 10.1016/S0016-5107(74)73914-1. PMCID: PMC8539296.
30. Nowakowska-Duława E, Nowak A. [Advances in the Diagnosis and Treatment of Hepatobiliary Diseases]. [Borgis - Advances in Medical Sciences] 2001; 2: 3-13. [Online]. Available: www.czytelniamedyczna.pl/2868,postpy-w-diagnostyce-i-leczeniu-chorlb-drlg-zlciowych.html.
31. Polkowski M, Regula J, Tilszer A, Butruk E. Endoscopic ultrasound versus endoscopic retrograde cholangiography for patients with intermediate probability of bile duct stones: a randomized trial comparing two management strategies. *Endoscopy* 2007; 39: 296–303. doi: 10.1055/s-2007-966264. PMID: 17427065.
32. Edmundowicz S, Aliperti G, Middleton W. Preliminary experience using endoscopic ultrasonography in the diagnosis of choledocholithiasis. *Endoscopy* 1992; 24(9): 774–778. doi: 10.1055/s-2007-1010581. PMID: 1468395.