ORIGINAL ARTICLE

Bali Medical Journal (*Bali MedJ*) 2021, Volume 10, Number 3: 1061-1066
P-ISSN.2089-1180, E-ISSN: 2302-2914

Prevention of post-ERCP pancreatitis using pancreatic duct stenting in difficult cannulation patients with calcular biliary bbstruction

Ali Abdel Rahim[1*], Mohamed A. Elrefaiy[1], Shereif Ahmed Morsy[1], Mariam Mosaad El Saadany[2] and Ahmed R. Mashaal[1]

[1]Hepato-gastroenterology Department, Theodor Bilharz Research Institute (TBRI) Giza, Egypt;
[2]Hepato-gastroenterology Department Al Haram Hospital, Giza, Egypt;

*Corresponding author:
Ali Abdel Rahim;
Hepato-gastroenterology Department, Theodor Bilharz Research Institute (TBRI) Giza, Egypt;
ali_tbri_1982@yahoo.com

Received: 2021-08-23
Accepted: 2021-12-10
Published: 2021-12-30

ABSTRACT

Background: Post-ERCP pancreatitis (PEP) has been the most frequent complication of Endoscopic Retrograde Cholangiopancreatography (ERCP). It has been documented to happen after 5–30% of ERCP procedures. PEP is new or exacerbated abdominal pain associated with a serum lipase or amylase concentration which is more than three times the upper limit of normal at 24 hours post-ERCP, requiring at least two days of prolongation of the planned admission. Following pancreatic sphincterotomy, pancreatic stenting is commonly used with the objective of decreasing both early restenosis and post-ERCP pancreatitis. Aim of the work: Evaluation of the pancreatic stenting technique as a preventive measure against post ERCP pancreatitis in calcular obstructive jaundice patients with difficult cannulation.

Patients and methods: Forty Egyptian patients with calcular biliary obstruction with a difficult biliary cannulation who are at risk of developing PEP enrolled in a prospective randomized controlled comparative study. Group A: 20 patients with manipulation of pancreatic duct by guidewire without pancreatic stent insertion; Group B: 20 patients with manipulation of pancreatic duct by guidewire with pancreatic stent insertion.

Results: The pancreatic duct stenting technique had reduced the risk of PEP significantly in calcular biliary obstruction patients with difficult CBD cannulation to 20% (in group B) compared with 60% in (group A).

Conclusion: Prophylactic pancreatic stenting technique is a simple and easy procedure that showed to be efficient in decreasing cases of post ERCP pancreatitis in difficult cannulation patients. The endoscopists should be trained to practice the procedure safely.

Keywords: Endoscopic retrograde cholangiopancreatography (ERCP), pancreatic stenting and pancreatitis.
Cite This Article: Rahim, A.A., Elrefaiy, M.A., Morsy, S.A., Saadany, M.M.E., Mashaal, A.R. 2021. Prevention of post-ERCP pancreatitis using pancreatic duct stenting in difficult cannulation patients with calcular biliary bbstruction. *Bali Medical Journal* 10(3): 1061-1066. DOI: 10.15562/bmj.v10i3.2665

INTRODUCTION

One of the most frequent and expensive digestive diseases is Gallstone disease. The most frequent reason for extrahepatic biliary obstruction is choledocholithiasis, commonly present in biliary colic, pancreatitis, jaundice, or cholangitis. Bile duct stones are divided into two groups: primary & secondary. A) Primary choledocholithiasis (forming in the duct) occurs in about 15% of cases due to bile stasis and may be correlated with conditions like biliary strictures, sclerosing cholangitis, choledochal cysts, or periampullary diverticula. B) Secondary choledocholithiasis (forming somewhere and having traveled into the duct) represents about 85% of cases and originates from the gallbladder.[1]

Endoscopic retrograde cholangiopancreatography (ERCP) has many diagnostic and therapeutic indications with a detailed collection of techniques involving direct duct visualization, tissue interrogation and sampling, and therapy for a broad range of biliary and pancreatic disorders. In suspected obstructive jaundice patients with clinical and biochemical evidence and imaging evidence suggesting pancreatic or biliary tract disease, acute concomitant cholangitis biliary pancreatitis, or biliary obstruction, ERCP is indicated.[2]

The most prevalent complication of ERCP is post-ERCP pancreatitis (PEP). It has been documented after 5-30% of the ERCP procedures.[3] Post-ERCP pancreatitis is fresh or aggravated abdominal pain associated with a serum amylase concentration greater than three times the upper limit of normal at 24 hours post-ERCP, requiring prolongation of the scheduled admission to a minimum of two days.[4] Post ERCP pancreatitis with multi-organ failure and even death can vary from mild interstitial to extreme necrotizing. The intensity of post-ERCP pancreatitis is ranked by consensus on the length of hospitalization and the require for intervention.[5]

The risk factors for PEP could be classified into A) Patient's factors (which cannot be avoided) as female gender,

young age, suspected SOD, normal serum bilirubin and/or previous recurrent pancreatitis. B) Procedure's factors that greatly affect the outcome include difficult cannulation, number of cannulation attempts, cannulation of the pancreatic duct, injection of the pancreatic duct dye, precut sphincterotomy and pulpectomy. Many strategies have been postulated & investigated for reducing the risk of PEP. The current widely accepted and evidence-based approach includes the careful selection of patients, the use of certain techniques related to procedures and the use of pharmacological agents (rectal NSAIDs).[6] This study was aimed to evaluate the pancreatic stenting technique as a preventive measure against post ERCP pancreatitis in calcular obstructive jaundice patients with difficult cannulation.

METHODS

This prospective controlled comparative study was carried out on about 40 Egyptian calcular obstructive jaundice patients with difficult biliary cannulation who are at risk of developing post-ERCP pancreatitis. The study was held from May 2020 to October 2020 at Giza's Theodore Bilharz research institute (TBRI). Written consent was obtained from each participant after explanation of the study purpose.

Patients Classification

Group A) 20 patients manipulated pancreatic duct guidewire without pancreatic stent insertion. Group B) 20 patients manipulating pancreatic duct guidewire with pancreatic stent insertion.

Inclusion criteria

- Adult participant.
- There is evidence of calcular biliary obstruction by elevated serum bilirubin and abdominal imaging (abdominal ultrasound and/or Magnetic resonance cholangiopancreatography "MRCP").
- Difficult biliary cannulation.

Exclusion criteria

- Patients refuse to participate in the study.
- Patients with previous episode of pancreatitis.

All of the patients have been subjected to:

- Full Medical history and clinical examination.
- Pre-ERCP evaluation profile: complete blood count (CBC), liver function test (SGOT, SGPT, ALP, Total and direct bilirubin), renal function test (Creatinine), coagulation profile (PT, PC, INR) and imaging assessment in the form of abdominal ultrasound and/or MRCP.
- The procedure of ERCP: All ERCP procedures have been conducted by a high volume endoscopist (who conducts more than two sphincterotomies per week).[7] They were using the ED-3440T and ED-3485T lateral view endoscopes of Pentax. Using a double-lumen papillotomy Boston scientific ultratome with a short nose (5 mm) and a 20 mm cutting wire, selective cannulation of the common bile duct was performed and aided by a slippery guidewire in difficult instances. Urographin was the contrast material for cholangiopancreatography. Cannulation by a metal tip cannula can be attempted in the case of failed cannulation using papillotome and guidewire. A precut papillotomy was performed using a needle knife when cannulation failed. Using endo cut mixed current mode or Olympus PC 20 electrosurgical unit using 40-watt cutting and 25-watt coagulation current, papillotomy was performed using the Erbe ICC 200 electrosurgical unit. Trials for stone extraction were done using balloons, stone extraction baskets or lithotripsy. In case of failure of stone extraction, stent insertion was done for temporary drainage. The research team recorded all the vents of difficult cannulation, including duration of the whole procedure, duration of manipulation of the papilla, number of cannulation trials, number of pancreatic duct cannulation and number of pancreatography. Also, the data of stone extraction includes; the number and size of stones and the degree of difficulty of stone extraction.
- Post-ERCP assessment of the complications (e.g., pancreatitis, bleeding and/or perforation) and profile: complete blood count (CBC), liver function test (SGOT, SGPT, ALP, Total and direct bilirubin) and serum lipase.

Statistical Analysis

Analysis of the data will be carried out using IBM© SPSS© Statistics version 23 (IBM© Corp., Armonk, NY, USA) and version 19.1 of MedCalc®. Quantitative variables will be described in mean, standard deviation (SD), minimum and maximum. Qualitative variables in numbers (N) and percentages (%) will be described.

Comparisons among quantitative variables will be conducted after normality data is examined using the Kolmogorov-Smirnov normality test. Whenever test results indicate that the data is normally distributed, the student t-test (parametric tests) will be used to compare means between groups; otherwise, when the data shows out to be non-normally distributed, comparisons will be carried out using Mann Whitney (non-parametric tests).

Chi-Square test ($\chi 2$) will be utilized to compare qualitative variables; Fisher's Exact Test will be utilized instead of Chi-square test when one or more cells are predicted to be ≤ 5. All results will be expressed in the form of P-values: P-value <0.05 is deemed to be significant, P-value <0.001 is deemed to be highly significant, and P-value >0.05 is deemed to be non-significant.

RESULTS

There was no substantial variation between both groups regarding the epidemiological and clinical parameters of the patients enrolled in the research (table 1).

Post ERCP measurement of lipase showed that there was a statistically substantial rise in lipase levels in group A (462.50 ± 455.36) compared to (162.15 ± 221.68) in group B (table 2) (figure 1).

Regarding post-ERCP complications, our results showed no statistically significant differences in bleeding or perforation between both groups (table 3) (figure 2). However, the results showed a statistically significant difference regarding pancreatitis (P-value = 0.0108). In group A (without pancreatic stent), 12 cases (60%) developed pancreatitis. On the other hand, in group B (those with

Table 1. **It showed no significant difference between both studied groups regarding age, gender or other history and clinical parameters.**

History	Group A [N=20]		Group B [N=20]		Total		X^2	P-Value
	N	%	N	%	N	%		
Age								
Mean ± SD	48.35 ± 14.26		48.050 ± 11.56		-0.0731			0.9421
Range	22 - 72		22 - 64					
Gender								
Male	9	45%	10	50%			0.098	0.7546
Female	11	55%	10	50%				
Diabetes Mellitus								
History of DM	8	40%	7	35%	15	37.5%	0.104	0.7471
No History of DM	12	60%	13	65%	25	62.5%		
Hypertension								
History of HTN	7	35%	6	30%	13	32.5%	0.111	0.7389
No History of HTN	13	65%	14	70%	27	67.5%		
Cardiac diseases								
History of cardiac diseases	0	0%	0	0%	0	0%	N/A	N/A
No History of cardiac diseases	20	100%	20	100%	40	100%		
Hepatic Diseases								
History of hepatic diseases	2	10%	1	5%	3	7.5%	0.351	0.5533
No History of hepatic diseases	18	90%	19	95%	37	92.5%		
Renal Diseases								
History of renal diseases	1	5%	0	0%	1	2.5%	1.000	0.3173
No History of renal diseases	19	95%	20	100%	39	97.5%		
Others								
Smoking	5	25%	6	30%	11	27.5%	0.091	0.7630
Obesity	4	20%	5	25%	9	22.5%	0.111	0.7389
Ascites	2	10%	0	0%	2	5%	N/A	N/A

SD: standard deviation, N: number, DM: Diabetes Mellitus, HTN: hypertension, p-value >0.05 NS; p-value <0.05 S; p-value <0.001 HS, N/A: not applicable

pancreatic stent), less number of cases developed pancreatitis 4 cases (20%) (table 3) (figure 2).

Other parameters that may influence the pancreatitis event (e.g., stones size and number) had been studied in both groups; no significant difference had been noticed between both groups (table 4).

DISCUSSION

Endoscopic retrograde cholangiopancreatography (ERCP) has become a key tool in diagnosing and treating biliary tree and gallbladder disease. With the progress of endoscopic sphincterotomy (independently stated by Kawai and Classen in 1974), ERCP progressed rapidly from a purely diagnostic technique into a therapeutic one, accompanied by the progress of large channel therapeutic duodenoscopes.[8] ERCP is the most hazardous procedure regularly conducted by endoscopists, as measured by the complication rate, and post-ERCP pancreatitis (PEP) is the most common ERCP complication.[9]

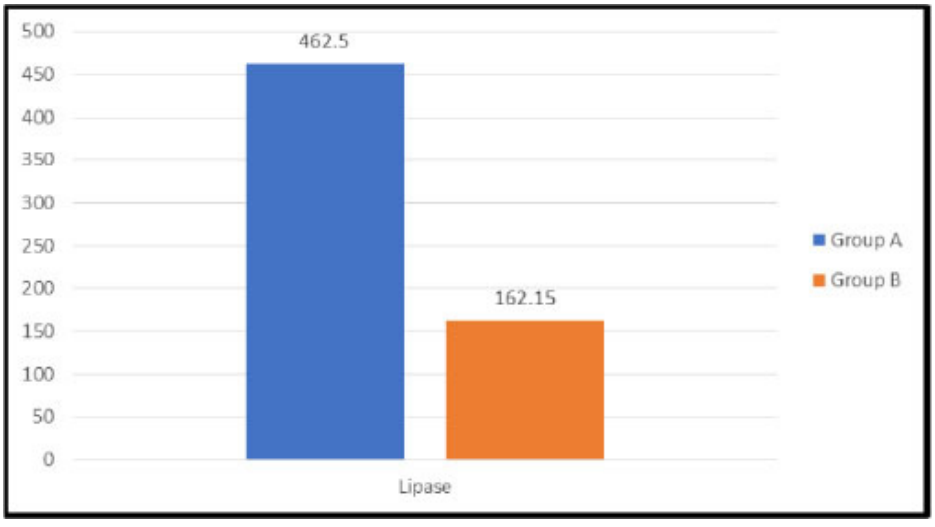

Figure 1. Post-ERCP lipase results in both groups by Bar chart.

Pancreatic stenting has been commonly used to minimize PEP and early restenosis after pancreatic sphincterotomy (e.g., in SOD cases). Pancreatic plastic stents are

mainly manufactured from polyethylene materials. The sizes of pancreatic stents vary from 2-25 cm in length to 3F-11.5F in diameter. Pancreatic stents have either been straight, curved, wedge-shaped or a single pigtail. To facilitate the draining of the pancreatic side ducts, many pancreatic stents include side holes throughout the stent length. A winged stent (ViaDuct, GI Supply) makes it possible to drain pancreatic juice around the stent instead of from the lumen of the stent. Many pancreatic stents involve a mechanism (e.g., distal flange, pigtail) to avoid internal migration. Due to pancreatic stents' smaller diameter, most are typically deployed with just a guidewire and pushing catheter. Migration and stent-induced pancreatic ductal shifts are among the major side effects of pancreatic stents.[10]

In our work, we enrolled 40 calcular biliary obstruction patients with difficult biliary cannulation in the prospective controlled comparative study. Patients were classified into 2 groups: Group A (20 patients) with manipulation of the pancreatic duct without pancreatic stenting and Group B (20 patients) with manipulation of the pancreatic duct with pancreatic stent insertion.

The median rate of post-ERCP pancreatitis in both groups was 40%, comparable to the reported rates of PEP in previous studies ranging from 1% to as high as 40%.[11,12,13,14]

The main result concluded from work that pancreatic duct stenting technique had reduced the risk of PEP in calcular biliary obstruction patients with difficult CBD cannulation to 20% (in group B) compared with 60% in the control group (group B) A), which was a significant difference. These data provide strong evidence supporting the recommendation that, after any accidental cannulation of the pancreatic duct during the ERCP, pancreatic duct stenting must be conducted. Our results were in accordance with several other prospective studies that concluded that stent placement of prophylactic PD reduces the risk of

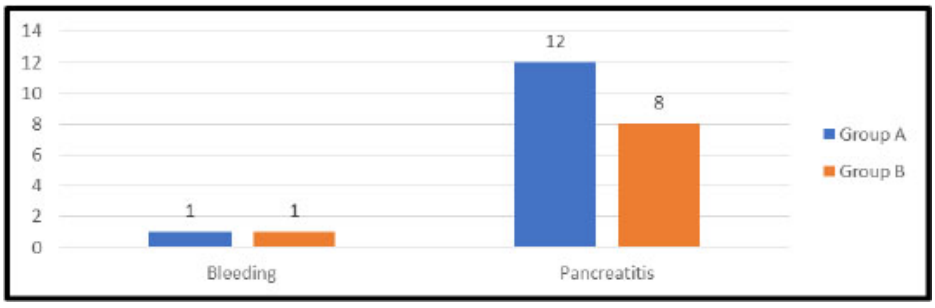

Figure 2. Bar chart showing post-ERCP complication among the groups.

Table 2. Post-ERCP lipase results in both groups.

	Group A [N=20]	Group B [N=20]	T	P - Value
Lipase				
Mean ± SD	462.50 ± 455.36	162.15 ± 221.68	2.652	0.0116*
Range	14 - 1532	14 - 830		

SD: standard deviation, N: number, T: Independent Sample t-test, p-value >0.05 NS; p-value <0.05 S; p-value <0.001 HS.

Table 3. Post-ERCP complication among the groups.

Post-ERCP Complications	Group A [N=20]		Group B [N=20]		X^2	P - Value
	N	%	N	%		
Bleeding						
Yes	1	5	1	5%	0.000	1.000
No	19	95%	19	95%		
Perforation						
Yes	0	0%	0	0%	N/A	N/A
No	20	100%	20	100%		
Pancreatitis						
Yes	12	60%	4	20%	6.500	0.0108*
No	8	40%	16	80%		

ERCP: endoscopic retrograde cholangiopancreatography, N: Number, %: percentage, X^2:Chi-square test, N/A: not applicable, p-value >0.05 NS; p-value <0.05 S; p-value <0.001 HS

Table 4. Number & size of stones in both groups.

	Group A [N=20]	Group B [N=20]	Total	X^2	P - Value
Number of stones					
One stone	3	0			
Two stones	1	2		3.957	0.2661
Three stones	2	1			
Multiple stones	14	17			
Size of stones					
Mean ± SD	3.18 ± 2.68	2.24 ± 0.91	2.79		0.146
Range	0.5 - 9	0.5 - 5			

N: Number, SD: standard deviation, T: Independent Sample t-test, X^2:Chi-square test, p-value >0.05 NS; p-value <0.05 S; p-value <0.00

pancreatitis.[15,11,13,14,16]

In contrast, Smithline et al. concluded in 1993 that pancreatitis occurred in 18% of sufferers in the no-stent group relative to 14% of stent group patients, with moderate to extreme pancreatitis occurring with an elevated frequency in sufferers in the no-stent group (8%) relative to sufferers in the stent group (2%), The average number of hospital days needed for the treatment of pancreatitis was 9.5 days in the no-stent group opposed to 2.8 days in the stent group; nevertheless, none of these discrepancies was statistically significance. The different results may be attributed to the multiple variables of the study, including the study population, the procedure and/or the accessories used.[17]

Later on, in 2004 & 2007, two independent meta-analyses had demonstrated a reduction in post-ERCP pancreatitis incidence in high-risk pancreatic duct stenting sufferers.[11,18] The European Society of Gastrointestinal Endoscopy guidelines recommends placing prophylactic pancreatic stents to avoid post-ERCP pancreatitis in high-risk patients depending on these data.[19]

A similar result was concluded by another -more recent- meta-analysis of RCTs. However, the meta-analysis raised many questions, including the pancreatic stents efficacy for severe PEP, the design of stents, the material, placement and removal timing, and the need to compare with pharmacoprophylaxis.[20]

The indicated patient's selection is so critical. The prophylactic pancreatic duct stenting was cost-effective if used for high-risk patients, not for average-risk patients. The use of pancreatic stent should be limited to endoscopists with an expected success rate of stent placement above 75%.[21,22] It was confirmed that failed instances were at higher risk of pancreatitis. All the studies had used 3 Fr and 5 Fr diameter pancreatic stents regarding the stent diameter. For placing 3-4 Fr stents, a small-caliber guidewire (0.018-0.025 inch), a hard procedure and needs a high level of expertise, is required. The 0.035-inch guidewire utilized for 5 Fr stents, on the other hand, is relatively easy to be used for stent placing. Luckily, Two RCTs was concluded that 5 Fr stents are equal to 3 Fr stents.[23,24] Based on these data and the available literature, we used 5 Fr diameters and very short (3cm) stents in our study, and we recommend its usage in routine practice. Long stents can be harder to insert and may have higher spontaneous dislodgement rates.

This study successfully placed the pancreatic duct stent in all patients without any complications (such as migration and/or occlusion). A 5%-10% failure rate and a low rate of complications were recorded in prior studies (2%).[25,26] The expected spontaneous migration of the stent out of the PD is about 5-10 days post-ERCP. Due to the elevated risk of post-ERCP pancreatitis (relative risk 5.2 at 2 weeks) and the possibility of stent-induced PD damage, if the migration of the stent is delayed beyond 10 days, endoscopic stent removal is recommended.[24,27]

The unflanged duodenal pigtail stent was confirmed to have spontaneously dislodged at a higher rate regarding the optimal stent design. On the other hand, due to the sudden forward movement of the stent at release, it can be complicated to handle the short duodenal pigtail stent, which requires close attention and experience. Furthermore, an internal flange can make it difficult to dislodge PD stents 13 spontaneously.

Just a small percentage of endoscopists use prophylactic pancreatic stenting, as per survey results.[27,28,19] The primary reason was the lack of experience in this technique. Many ERCP endoscopists remain unaware of the basic techniques needed to achieve secure and efficient access to PD guidewire and stent placement.[27] It is recommended that, for all endoscopists conducting ERCP, it is critically important to be competent in secure and efficient pancreatic stent placement techniques.

CONCLUSION

Prophylactic pancreatic stenting technique is a simple and easy procedure that has proven efficient in minimizing cases of post ERCP pancreatitis in difficult cannulation patients. The endoscopists should be trained to practice the procedure safely.

CONFLICT OF INTEREST

All authors declared that there is no conflict of interest regarding this article

AUTHORS CONTRIBUTION

All authors contributed equally in the writing of this article

ETHICS APPROVAL

Medical Research Ethical Committee has ethically approved this study of the National Research Centre, reference number (16-369).

FUNDING

This research was self-funded.

REFERENCES

1. Cai J-S, Qiang S, Bao-Bing Y (2016) .Advances of recurrent risk factors and management of choledocholithiasis. Scand J Gastroenterol. 2017 Jan;52(1):34-43.doi: 10.1080/00365521.2016. 1224382. Epub 2016 Sep 9.
2. ASGE Standards of Practice Committee. Buxbaum JL, Abbas Fehmi SM, Sultan S, Fishman DS, Qumseya BJ, Cortessis VK, Schilperoort H, Kysh L, Matsuoka L, Yachimski P, Agrawal D, Gurudu SR, Jamil LH, Jue TL, Khashab MA, Law JK, Lee JK, Naveed M, Sawhney MS, Thosani N, Yang J, Wani SB. ASGE guideline on the role of endoscopy in the evaluation and management of choledocholithiasis. Gastrointest Endosc. 2019 Jun;89(6):1075-1105.e15.
3. Guda NM and Freeman ML (2015). Overview of ERCP complications: prevention and management. In ERCP and EUS (pp. 37-56). Springer, New York, NY.
4. Cotton PB, Lehman G, Vennes J, Geenen JE, Russell RC, Meyers WC, Liguory C, Nickl N. Endoscopic sphincterotomy complications and their management: an attempt at consensus. Gastrointest Endosc. 1991 May-Jun; 37(3):383-93.
5. Banks PA, Bollen TL, Dervenis C, (2013). Classification of acute pancreatitis-2012: revision of Atlanta classification and definitions by international consensus. Gut, 62:102-11.
6. Adarsh M. Thaker, Jeffrey D. Mosko, and Tyler M. Berzin. Post-endoscopic retrograde cholangiopancreatography pancreatitis. . Gastroenterol Rep (Oxf). 2015 Feb; 3(1): 32–40.
7. Cooper ST and Slivka A (2007). Incidence, Risk Factors, and Prevention of Post-ERCP Pancreatitis. Gastroenterol Clin N Am, 36:259-276
8. Adler DG, Baron TH, Davila RE, Egan J, Hirota WK, Leighton JA, Qureshi W, Rajan

E, Zuckerman MJ, Fanelli R and Wheeler-Harbaugh J (2005). ASGE guideline: the role of ERCP in diseases of the biliary tract and the pancreas. Gastrointestinal endoscopy, 62(1), pp.1-8.
9. McGrath K, Horwhat JD, Paulson EK, Branch MS, Baillie J, Tyler D, Pappas T, Enns R, Robuck G, Stiffler H and Jowell P (2006). A randomized comparison of EUS-guided FNA versus CT or US-guided FNA for the evaluation of pancreatic mass lesions. Gastrointestinal endoscopy, 63(7), pp.966-975.
10. Pfau PR, Pleskow DK, Banerjee S, Barth BA, Bhat YM, Desilets DJ and Rodriguez SA (2013). Pancreatic and biliary stents. Gastrointestinal Endoscopy, 77(3), 319–327.
11. Singh P, Das A, Isenberg G, Wong RC, Sivak MV, Agrawal D, Chak A (2004). Does prophylactic pancreatic stent placement reduce the risk of post-ERCP acute pancreatitis? A meta-analysis of controlled trials. Gastrointest Endosc. 60:544–550.
12. Cheng CL, Sherman S, Watkins JL, Barnett J, Freeman M, Geenen J, Ryan M, Parker H, Frakes JT and Fogel EL (2006). Risk factors for post-ERCP pancreatitis: a prospective multicenter study. Am J Gastroenterol, 101:139–147.
13. Sofuni A, Maguchi H, Itoi T, Katanuma A, Hisai H, Niido T, Toyota M, Fujii T, Harada Y, Takada T (2007). Prophylaxis of post-endoscopic retrograde cholangiopancreatography pancreatitis by an endoscopic pancreatic spontaneous dislodgement stent. Clin Gastroenterol Hepatol. 5:1339–1346.
14. Tsuchiya T, Itoi T, Sofuni A, Itokawa F, Kurihara T, Ishii K, Tsuji S, Kawai T, Moriyasu F (2007). Temporary pancreatic stent to prevent post endoscopic retrograde cholangiopancreatography pancreatitis: a preliminary, single-center, randomized controlled trial. J Hepatobiliary Pancreat Surg. 14:302–307.
15. Fazel A, Quadri A, Catalano MF, Meyerson SM and Geenen JE (2003). Does a pancreatic duct stent prevent post-ERCP pancreatitis? A prospective randomized study. Gastrointest Endosc. 57:291–294.
16. Kennedy PT, Russo E, Kumar N, Powell N, Bansi D, Thillainayagam A, Vlavianos P, Westaby D (2010). The safety and utility of prophylactic pancreatic duct stents in the prevention of post-ERCP pancreatitis: an analysis of practice in a single UK tertiary referral center. Surg Endosc. 24:1923–1928.
17. Smithline A, Silverman W, Rogers D, Nisi R, Wiersema M, Jamidar P, Hawes R, Lehman G (1993). Effect of prophylactic main pancreatic duct stenting on the incidence of biliary endoscopic sphincterotomy-induced pancreatitis in high-risk patients. Gastrointest Endosc. 39:652–657.
18. Andriulli A, Forlano R, Napolitano G, Conoscitore P, Caruso N, Pilotto A, Di Sebastiano PL and Leandro G (2007). Pancreatic duct stents in the prophylaxis of pancreatic damage after endoscopic retrograde cholangiopancreatography: a systematic analysis of benefits and associated risks. Digestion, 75:156–163.
19. Dumonceau JM, Andriulli A, Deviere J, Mariani A, Rigaux J, Baron TH and Testoni PA (2010). European Society of Gastrointestinal Endoscopy (ESGE) Guideline: prophylaxis of post-ERCP pancreatitis. Endoscopy, 42:503–515.
20. Mazaki T, Masuda H and Takayama T (2010). Prophylactic pancreatic stent placement and post-ERCP pancreatitis: a systematic review and meta-analysis. Endoscopy. 42:842–853.
21. Das A, Singh P, Sivak MV and Chak A (2007). Pancreatic-stent placement for prevention of post-ERCP pancreatitis: a cost-effectiveness analysis. Gastrointest Endosc, 65:960–968.
22. Freeman ML (2007). Pancreatic stents for prevention of post-endoscopic retrograde cholangiopancreatography pancreatitis. Clin Gastroenterol Hepatol.5:1354–1365.
23. Chahal P, Tarnasky PR, Petersen BT, et al., (2009). Short 5Fr vs long 3Fr pancreatic stents in patients at risk for post-endoscopic retrograde cholangiopancreatography pancreatitis. Clin Gastroenterol Hepatol, 7:834– 839. 20.
24. Fehmi SMA, Schoenfeld PS, Scheiman JM, et al., (2008). 5Fr prophylactic pancreatic stents are easier to place and require fewer guide wires than 3Fr stents. Gastrointest Endosc. 67: AB328–AB329.
25. Tarnasky PR, Palesch YY, Cunningham JT, Mauldin PD, Cotton PB, Hawes RH (1998). Pancreatic stenting prevents pancreatitis after biliary sphincterotomy in patients with sphincter of Oddi dysfunction. Gastroenterology. 115:1518–1524.
26. Fazel A, Quadri A, Catalano MF, Meyerson SM and Geenen JE (2003). Does a pancreatic duct stent prevent post-ERCP pancreatitis? A prospective randomized study. Gastrointest Endosc. 57:291–294.
27. Brackbill S, Young S, Schoenfeld P and Elta G (2006). A survey of physician practices on prophylactic pancreatic stents. Gastrointest Endosc, 64:45–52.
28. Freeman ML (2010). Pancreatic stents for prevention of post-ERCP pancreatitis: for everyday practice or for experts only? Gastrointest Endosc. 71:940–944.