

90141_Auto_Edited.docx

Value of prophylactic non-steroidal anti-inflammatory drugs before endoscopic ultrasound guided tissue acquisition to reduce the incidence of post procedural pancreatitis

de Jong M *et al* NSAIDs before EUS-TA to prevent post-EUS pancreatitis

Mike de Jong, Foke van Delft, Christine Roozen, Erwin-Jan van Geenen, Tanya Bisseling, Peter Siersema, Marco Bruno

Abstract

3 Endoscopic ultrasound (EUS) with fine needle aspiration (FNA) or fine needle biopsy (FNB) is gold standard for sampling tissue to diagnose pancreatic cancer and autoimmune pancreatitis or to analyze cyst fluid. The most common reported adverse event of FNA and/or FNB is acute pancreatitis which likely is induced by the same pathophysiological mechanisms as after endoscopic retrograde cholangio pancreatography (ERCP). According to the current European Society of Gastrointestinal Endoscopy guideline, non-steroidal anti-inflammatory drugs are administered prior to ERCP as a scientifically proven treatment to reduce post-ERCP pancreatitis incidence rate. A single suppository of diclofenac or indomethacin prior to EUS guided tissue-acquisition (TA) is harmless in healthy adults. Since it is associated with low costs and, most important, may prevent a dreadful complication, we strongly recommend the administration of 100 mg diclofenac rectally prior to EUS-TA. We will explain this recommendation in more detail in this review, as well as the risk and pathophysiology of post-EUS TA pancreatitis.

Key Words: Pancreatitis; Endoscopic ultrasound; Tissue acquisition; Nonsteroidal anti-inflammatory drugs; Pancreatic cancer

de Jong M, van Delft F, Roozen C, van Geenen EJ, Bisseling T, Siersema P, Bruno M. Value of prophylactic non-steroidal anti-inflammatory drugs before endoscopic

ultrasound guided tissue acquisition to reduce the incidence of post procedural pancreatitis. *World J Gastroenterol* 2024; In press

Core Tip: Post-endoscopic ultrasound (EUS) pancreatitis has an incidence of 1%-2%. Literature on the effectiveness of diclofenac in preventing a post EUS-tissue-acquisition (TA) pancreatitis is scarce. Based on the pathophysiological mechanism, which is nearly the same in both post-endoscopic retrograde cholangio pancreatography and post-EUS pancreatitis, diclofenac could be effective as prophylaxis of post-EUS-TA pancreatitis. There are several arguments in favor of administration, such as the cost-effective prevention of post-EUS-TA pancreatitis, which could have potentially disastrous consequences for the patient. In addition, a single suppository of diclofenac has limited side effects. In conclusion, administration of diclofenac prior to EUS-TA procedure should be strongly advised to prevent developing post-EUS-TA pancreatitis.

INTRODUCTION

Since its introduction in the early 1990s^[1], endoscopic ultrasound guided tissue acquisition (EUS-TA) by fine needle aspiration (FNA) or fine needle biopsy (FNB) is the gold standard for obtaining a tissue specimen for diagnosing pancreatic cancer, with a reported sensitivity and specificity of 77% and 98%, respectively^[2,3]. In order to confirm the diagnosis before deciding on further treatment, EUS-TA of the pancreatic lesion is often indicated^[4,5]. Besides being golden standard in obtaining cytology and histology of pancreatic solid masses, EUS-FNA/FNB is also used for cyst fluid analysis^[6] and evaluation of autoimmune pancreatitis^[7].

A variety of needles with different diameters and needle-tip designs are available. Most recent data about the efficacy of EUS-TA recommend the use of a 22-gauge FNB needle in solid masses. In case of an unfavorable position of the endoscope with a sharp angulation of the tip, the more flexible 25-gauge needle can be chosen. For aspiration of cystic fluid, the 22 gauge FNA needles are the preferred ones^[8].

Multiple publications have reported the risk of developing post procedural pancreatitis after EUS-TA^[9-11]. Diagnosis of pancreatitis is usually based on the revised Atlanta criteria in which ¹two of the following three features ¹are required for the diagnosis of acute pancreatitis: hyperlipasemia (> 3 times the upper limit of normal), acute abdominal pain and/or signs of pancreatitis on computed tomography-scan^[12]. In some publications including EUS-FNA (not EUS-FNB) the reported post-EUS pancreatitis incidence was around 2%^[9,10]. To date the most comprehensive approximation of the post-EUS pancreatitis rate is provided by a systematic review and meta-analysis by Tian *et al*^[11]. They showed a pooled incidence of pancreatitis of 0.7%^[11]. However, this meta-analysis was mainly based on publications from before 2010 and only thirty publications after 2010 were analyzed in this meta-analysis. Table 1 shows seven retrospective and/or prospective trials that were all published after the screening period of the meta-analysis^[13-19]. Incidence of post-EUS-TA pancreatitis is comparable to the incidence described in the meta-analysis. Data about post-EUS pancreatitis in relation to the EUS-TA techniques are still scarce though.

The development of acute pancreatitis following a diagnostic EUS-TA may have major consequences for the patient, in particular when there is a suspicion of pancreatic cancer. Delay or even annulment of further diagnostic work-up or treatment reduces the chance of cure drastically, while the survival rate is already low in these patients^[20,21].

Acute pancreatitis is also a complication reported after endoscopic retrograde cholangio pancreatography (ERCP). Rectal non-steroidal anti-inflammatory drugs (NSAIDs) (*i.e.*, Diclofenac) are administered as prophylaxis to reduce the post procedural ERCP pancreatitis rate by 39%^[22]. Assuming a comparable pathophysiological mechanism with the activation of the same inflammatory cascade inside the pancreas as during an ERCP, the preventive effect of diclofenac in EUS-TA could be as relevant. Although the reported incidence of post-EUS-TA pancreatitis is lower compared to that after ERCP, the one-time administration of diclofenac post EUS-

TA may make it a worthwhile strategy as it has little to no side-effects and is associated with limited costs, while potentially avoiding a devastating complication.

Only limited literature is available on the preventive value of rectal administration of diclofenac prior to an EUS-TA procedure to protect against post-EUS pancreatitis. In this review we will focus on the clinical consequence of post-EUS pancreatitis and the potential role and impact of diclofenac in its prevention.

PATHOPHYSIOLOGY OF POST-EUS PANCREATITIS

Mechanical injury of the pancreas is multifactorial in origin. It can be caused by manipulation of the ampulla of Vater and pancreatic duct, possibly in combination with increased pressure and overfilling of the ductal system with contrast agents in case of ERCP or direct puncture of the pancreatic parenchyma in case of EUS-TA. In the latter, pancreatitis is most often the resultant of direct cell damage while in the former also the development of tissue edema may temporarily hamper the secretion of pancreatic enzymes causing increased ductal and intraparenchymal pressure. These events induce premature activation of pancreatic enzymes causing acute intracellular injury^[23]. Both prostaglandins and phospholipase A2 play a key role in the early phase of inflammation^[24].

THE ROLE OF DICLOFENAC IN PREVENTING POST-EUS PANCREATITIS

The use of NSAIDs, either once 100 mg diclofenac or 100 mg indomethacin rectally is recommended by the European Society of Gastrointestinal Endoscopy and American Society of Gastrointestinal Endoscopy as prophylaxis of a post-procedural pancreatitis in patients undergoing an ERCP^[25,26]. The most optimal timing for the administration of a rectal suppository of diclofenac or indomethacin is just prior to the ERCP^[27]. NSAIDs inhibit prostaglandins, phospholipase A2 and neutrophil-endothelial interaction, which will decrease the inflammatory reaction^[24]. Both diclofenac and indomethacin reach the maximum concentration between one and two hours after administration. Both these NSAIDs are mainly bound to albumin (90% *vs* 99% respectively)^[28] and subsequently

excreted *via* the hepatobiliary-fecal and kidney pathway. While after two hours after administration half of the level of diclofenac has been metabolized^[29], the biological half-life of indomethacin is five to ten hours. In addition, diclofenac is very cheap (\$0.19 per supp 100 mg)^[30] and a single dose is harmless in healthy adults^[31]. However, the use of NSAIDs has limitations. NSAIDs are contraindicated during pregnancy after a gestational age of 30 wk^[32], if the glomerular filtration rate is less than 30 mL/min/1.73 m² or in case of liver cirrhosis^[33,34]. Renal blood flow will be reduced by inhibition of prostaglandins, which can lead to a hepatorenal syndrome in patients with liver cirrhosis^[34]. If there is a documented allergy to NSAIDs, these should obviously be avoided.

RISK FACTORS FOR POST-EUS PANCREATITIS

Several risk factors are associated with the development of post-EUS pancreatitis. A study of Lee *et al*^[35] showed that performing more EUS-guided punctures within one procedure increases the risk of adverse events [odd ratio (OR): 1.24 (1.02-1.50)]. This also applies to performing more than fifteen to-and-fro movements per puncture [OR: 2.25 (1.07-4.73)]. Performing an ERCP on the same day as EUS-guided TA was the greatest risk factor for a post procedural pancreatitis [OR: 2.82 (1.31-6.10)]. The excess risk of doing both procedures successively on the same day rather than on separate days however was not discerned. A history of recent acute pancreatitis was also found to be a risk factor for post-EUS-pancreatitis (26.6% *vs* 3.3%)^[17]. Additionally, the location of the biopsy contributes to the risk of developing post procedural pancreatitis. Pancreatitis is more common after needle biopsies taken from the uncinate process or the pancreatic head as compared to the body or tail, possibly due to the fact that in some cases the needle passes a thicker layer of healthy pancreatic parenchyma^[36]. Tissue sampling through normal pancreatic parenchyma or through the wall of the main pancreatic duct also increases the risk of post-EUS-pancreatitis compared to passage through minimal parenchyma (9.20% *vs* 0.18%). Lastly, patients with pancreatic cancer are less likely to develop post-EUS pancreatitis compared to patients with benign

pancreatic diseases, while puncture of solid lesions had a higher overall rate of pancreatitis compared to puncture of cystic lesions (60% of the pancreatitis occurred after puncture of a solid lesion)^[17]. In conclusion, both patients with solid lesions and patients with cystic lesions of the pancreas are susceptible to post-EUS pancreatitis. In both cases, there is a similar risk of puncturing through normal parenchyma and/or damaging the pancreatic duct.

FNA VS FNB IN RELATION TO PANCREATITIS

Currently, new advances in FNB techniques and increased yield compared to FNA gradually phase out the use of FNA needles. The advantage of FNB is that fewer needle passes are required to obtain a representative specimen^[37,38]. Despite the fact that greater tissue cores are obtained, which could cause hypothetically more damage, a meta-analysis showed that adverse events between FNA and FNB is not significantly different^[37]. Rapid on-site evaluation (ROSE) has been advised during a FNA-procedure to increase the diagnostic adequacy and thereby reduce the number of repeat procedures^[39]. In order to perform ROSE however, cytopathological evaluation needs to be immediately available, is time consuming and adds to the cost of the procedure. Meta-analysis shows that FNB without ROSE has a similar diagnostic adequacy compared to FNA with ROSE^[38].

FUTURE PERSPECTIVE

The only way to answer the question whether diclofenac is useful as a prophylaxis against the development of post-EUS pancreatitis is to conduct a randomized controlled trial (RCT). Ideally, this should be a double-blind, placebo-controlled trial in which one arm receives an NSAID suppository and the other arm receives a rectal placebo prior to the EUS-TA procedure. Patient, researcher, endoscopist and nurse should be blinded.

Conducting such an RCT has several limitations. Since the incidence of post-EUS pancreatitis is probably in between 1% and 2%, many patients need to be included. Aiming to reduce the incidence of PEP by 50% from 2% to 1%, with a significance of 5%,

a power of 80% and a 10% drop-out, 2550 patients are required in each arm. Suppose this hypothetically designed trial shows that administration of diclofenac can halve the incidence of PEP, then the number needed to treat is 1/100. In other words, one hundred patients must receive diclofenac to prevent one PEP case. For risk analysis, all of the known risk factors should be noted and registered.

Therefore, it does not seem to be practically feasible to conduct such a trial. The question is whether such proof is necessary, as the indirect evidence for the protection of post-ERCP pancreatitis is strong and the mechanism of how post-EUS-TA pancreatitis develops seems identical to post-ERCP pancreatitis. Even though post-EUS-TA pancreatitis is a relatively rare event, a cheap and relatively safe diclofenac suppository can lower the incidence and prevent a potentially dreadful complication that may cause a serious delay in the further work-up and treatment of a patient with a pancreatic mass. Therefore, in our opinion, the associated costs of managing preventable post-EUS-TA pancreatitis are disproportionate compared to standardized prophylactic diclofenac administration prior to EUS-TA.

CONCLUSION

Post-EUS pancreatitis is a rare complication of EUS-FNA/FNB with an incidence of 1%-2%. Despite its low incidence, it may have a significant clinical impact as pancreatitis may run a severe disease course causing delay in further diagnostics or therapy or even worse. Diclofenac suppository is effective as prophylaxis against pancreatitis after an ERCP. Literature on the effectiveness of diclofenac in preventing a post EUS-TA pancreatitis is scarce. Based on the pathophysiological mechanism, which is nearly the same in both types of pancreatitis, diclofenac could be effective as prophylaxis of a post-EUS-TA pancreatitis. Unfortunately, an RCT with unfeasible numbers of patients is the only way to answer the question whether there is a significant benefit to the administration of diclofenac. In our opinion, further attempts to investigate the use of NSAIDs in post-EUS-TA pancreatitis prevention has limited added value. There are several arguments in favor of administration, such as the cost-effective prevention of

post-EUS-TA pancreatitis, which could have potentially disastrous consequences for the patient. In addition, a single suppository of diclofenac has limited side effects. In conclusion, administration of diclofenac prior to the EUS-TA procedure of a solid or cystic pancreatic lesion should be strongly advised to prevent developing post-EUS-TA pancreatitis.

REFERENCES

- 1 **Vilman P**, Jacobsen GK, Henriksen FW, Hancke S. Endoscopic ultrasonography with guided fine needle aspiration biopsy in pancreatic disease. *Gastrointest Endosc* 1992; **38**: 172-173 [PMID: 1568614 DOI: 10.1016/s0016-5107(92)70385-x]
- 2 **Lisotti A**, Frazzoni L, Fuccio L, Serrani M, Cominardi A, Bazzoli F, Fusaroli P. Repeat EUS-FNA of pancreatic masses after nondiagnostic or inconclusive results: systematic review and meta-analysis. *Gastrointest Endosc* 2020; **91**: 1234-1241.e4 [PMID: 32006546 DOI: 10.1016/j.gie.2020.01.034]
- 3 **O'Reilly D**, Fou L, Hasler E, Hawkins J, O'Connell S, Pelone F, Callaway M, Campbell F, Capel M, Charnley R, Corrie P, Elliot D, Goodburn L, Jewell A, Joharchi S, McGeeney L, Mukherjee S, Oppong K, Whelan P, Primrose J, Neoptolemos J. Diagnosis and management of pancreatic cancer in adults: A summary of guidelines from the UK National Institute for Health and Care Excellence. *Pancreatology* 2018; **18**: 962-970 [PMID: 30292643 DOI: 10.1016/j.pan.2018.09.012]
- 4 **Specialisten FM**. Richtlijn Pancreascarcinoom 2019. 2020. [cited 10 December 2023]. Available from: <https://richtlijndatabase.nl/richtlijn/pancreascarcinoom/startpagina.html>
- 5 **Springfeld C**, Jäger D, Büchler MW, Strobel O, Hackert T, Palmer DH, Neoptolemos JP. Chemotherapy for pancreatic cancer. *Presse Med* 2019; **48**: e159-e174 [PMID: 30879894 DOI: 10.1016/j.lpm.2019.02.025]
- 6 **European Study Group on Cystic Tumours of the Pancreas**. European evidence-based guidelines on pancreatic cystic neoplasms. *Gut* 2018; **67**: 789-804 [PMID: 29574408 DOI: 10.1136/gutjnl-2018-316027]

- 7 **Akshintala VS**, Singh VK. Management of Autoimmune Pancreatitis. *Clin Gastroenterol Hepatol* 2019; **17**: 1937-1939 [PMID: 31042584 DOI: 10.1016/j.cgh.2019.04.052]
- 8 **Kovacevic B**, Karstensen JG, Vilmann P. EUS-FNA vs EUS-FNB for Pancreatic Lesions: Which Needle When to Use? *Curr Treat Options Gastro* 2021; **19**: 295–307 [DOI: 10.1007/s11938-021-00340-3]
- 9 **Mizuide M**, Ryozaawa S, Fujita A, Ogawa T, Katsuda H, Suzuki M, Noguchi T, Tanisaka Y. Complications of Endoscopic Ultrasound-Guided Fine Needle Aspiration: A Narrative Review. *Diagnostics (Basel)* 2020; **10** [PMID: 33213103 DOI: 10.3390/diagnostics10110964]
- 10 **Gress F**, Michael H, Gelrud D, Patel P, Gottlieb K, Singh F, Grendell J. EUS-guided fine-needle aspiration of the pancreas: evaluation of pancreatitis as a complication. *Gastrointest Endosc* 2002; **56**: 864-867 [PMID: 12447299 DOI: 10.1067/mge.2002.129602]
- 11 **Tian G**, Ye Z, Zhao Q, Jiang T. Complication incidence of EUS-guided pancreas biopsy: A systematic review and meta-analysis of 11 thousand population from 78 cohort studies. *Asian J Surg* 2020; **43**: 1049-1055 [PMID: 31974051 DOI: 10.1016/j.asjsur.2019.12.011]
- 12 **Banks PA**, Bollen TL, Dervenis C, Gooszen HG, Johnson CD, Sarr MG, Tsiotos GG, Vege SS; Acute Pancreatitis Classification Working Group. Classification of acute pancreatitis--2012: revision of the Atlanta classification and definitions by international consensus. *Gut* 2013; **62**: 102-111 [PMID: 23100216 DOI: 10.1136/gutjnl-2012-302779]
- 13 **Chen YI**, Chatterjee A, Berger R, Kanber Y, Wyse J, Lam E, Gan I, Auger M, Kenshil S, Telford J, Donnellan F, Quinlan J, Lutzak G, Alshamsi F, Parent J, Waschke K, Alghamdi A, Barkun J, Metrakos P, Chaudhury P, Martel M, Dorreen A, Candido K, Miller C, Adam V, Barkun A, Zogopoulos G, Wong C. Endoscopic ultrasound (EUS)-guided fine needle biopsy alone vs. EUS-guided fine needle aspiration with rapid onsite evaluation in pancreatic lesions: a multicenter randomized trial. *Endoscopy* 2022; **54**: 4-12 [PMID: 33506455 DOI: 10.1055/a-1375-9775]

- 14 **Gonzalez A**, Wadhwa V, Singh H, Khan S, Gupta K, Liang H, Hussain I, Vargo J, Jang S, Chahal P, Bhatt A, Siddiki H, Erim T, Sanaka MR. Endoscopic ultrasound with combined fine needle aspiration plus biopsy improves diagnostic yield in solid pancreatic masses. *Scand J Gastroenterol* 2022; **57**: 610-617 [PMID: 34991430 DOI: 10.1080/00365521.2021.2024249]
- 15 **Ishigaki K**, Nakai Y, Oyama H, Kanai S, Suzuki T, Nakamura T, Sato T, Hakuta R, Saito K, Saito T, Takahara N, Hamada T, Mizuno S, Kogure H, Tada M, Isayama H, Koike K. Endoscopic Ultrasound-Guided Tissue Acquisition by 22-Gauge Franseen and Standard Needles for Solid Pancreatic Lesions. *Gut Liver* 2020; **14**: 817-825 [PMID: 32457276 DOI: 10.5009/gnl19171]
- 16 **Kandel P**, Nassar A, Gomez V, Raimondo M, Woodward TA, Crook JE, Fares NS, Wallace MB. Comparison of endoscopic ultrasound-guided fine-needle biopsy versus fine-needle aspiration for genomic profiling and DNA yield in pancreatic cancer: a randomized crossover trial. *Endoscopy* 2021; **53**: 376-382 [PMID: 32767288 DOI: 10.1055/a-1223-2171]
- 17 **Ribeiro A**, Goel A. The Risk Factors for Acute Pancreatitis after Endoscopic Ultrasound Guided Biopsy. *Korean J Gastroenterol* 2018; **72**: 135-140 [PMID: 30270595 DOI: 10.4166/kjg.2018.72.3.135]
- 18 **Thomsen MM**, Larsen MH, Di Caterino T, Hedegaard Jensen G, Mortensen MB, Detlefsen S. Accuracy and clinical outcomes of pancreatic EUS-guided fine-needle biopsy in a consecutive series of 852 specimens. *Endosc Ultrasound* 2022; **11**: 306-318 [PMID: 35708361 DOI: 10.4103/EUS-D-21-00180]
- 19 **van Riet PA**, Larghi A, Attili F, Rindi G, Nguyen NQ, Ruszkiewicz A, Kitano M, Chikugo T, Aslanian H, Farrell J, Robert M, Adeniran A, Van Der Merwe S, Roskams T, Chang K, Lin F, Lee JG, Arcidiacono PG, Petrone M, Doglioni C, Iglesias-Garcia J, Abdulkader I, Giovannini M, Bories E, Poizat F, Santo E, Scapa E, Marmor S, Bucobo JC, Buscaglia JM, Heimann A, Wu M, Baldaque-Silva F, Moro CF, Erler NS, Biermann K, Poley JW, Cahen DL, Bruno MJ. A multicenter randomized trial comparing a 25-gauge

EUS fine-needle aspiration device with a 20-gauge EUS fine-needle biopsy device. *Gastrointest Endosc* 2019; **89**: 329-339 [PMID: 30367877 DOI: 10.1016/j.gie.2018.10.026]

20 **IntegraalKankercentrumNederland. NKR-cijfers**, datasetselectie alvleesklierkanker. 2020

21 **Puckett Y**, Garfield K. Pancreatic Cancer. 2022 Sep 26. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan- [PMID: 30085538]

22 **Lyu Y**, Cheng Y, Wang B, Xu Y, Du W. What is impact of nonsteroidal anti-inflammatory drugs in the prevention of post-endoscopic retrograde cholangiopancreatography pancreatitis: a meta-analysis of randomized controlled trials. *BMC Gastroenterol* 2018; **18**: 106 [PMID: 29973142 DOI: 10.1186/s12876-018-0837-4]

23 **Pezzilli R**, Romboli E, Campana D, Corinaldesi R. Mechanisms involved in the onset of post-ERCP pancreatitis. *JOP* 2002; **3**: 162-168 [PMID: 12432182]

24 **Pezzilli R**, Morselli-Labate AM, Corinaldesi R. NSAIDs and Acute Pancreatitis: A Systematic Review. *Pharmaceuticals (Basel)* 2010; **3**: 558-571 [PMID: 27713268 DOI: 10.3390/ph3030558]

25 **Dumonceau JM**, Kapral C, Aabakken L, Papanikolaou IS, Tringali A, Vanbiervliet G, Beyna T, Dinis-Ribeiro M, Hritz I, Mariani A, Paspatis G, Radaelli F, Lakhtakia S, Veitch AM, van Hooft JE. ERCP-related adverse events: European Society of Gastrointestinal Endoscopy (ESGE) Guideline. *Endoscopy* 2020; **52**: 127-149 [PMID: 31863440 DOI: 10.1055/a-1075-4080]

26 **ASGE Standards of Practice Committee**, Chandrasekhara V, Khashab MA, Muthusamy VR, Acosta RD, Agrawal D, Bruining DH, Eloubeidi MA, Fanelli RD, Faulx AL, Gurudu SR, Kothari S, Lightdale JR, Qumseya BJ, Shaikat A, Wang A, Wani SB, Yang J, DeWitt JM. Adverse events associated with ERCP. *Gastrointest Endosc* 2017; **85**: 32-47 [PMID: 27546389 DOI: 10.1016/j.gie.2016.06.051]

27 **Sperna Weiland CJ**, Smeets XJNM, Verdonk RC, Poen AC, Bhalla A, Venneman NG, Kievit W, Timmerhuis HC, Umans DS, van Hooft JE, Besselink MG, van Santvoort HC, Fockens P, Bruno MJ, Drenth JPH, van Geenen EJM; Dutch Pancreatitis Study Group. Optimal timing of rectal diclofenac in preventing post-endoscopic retrograde

cholangiopancreatography pancreatitis. *Endosc Int Open* 2022; **10**: E246-E253 [PMID: 35295242 DOI: 10.1055/a-1675-2108]

28 **Helleberg L**. Clinical Pharmacokinetics of indomethacin. *Clin Pharmacokinet* 1981; **6**: 245-258 [PMID: 7249487 DOI: 10.2165/00003088-198106040-00001]

29 **Todd PA**, Sorkin EM. Diclofenac sodium. A reappraisal of its pharmacodynamic and pharmacokinetic properties, and therapeutic efficacy. *Drugs* 1988; **35**: 244-285 [PMID: 3286213 DOI: 10.2165/00003495-198835030-00004]

30 **Nicolás-Pérez D**, Castilla-Rodríguez I, Gimeno-García AZ, Romero-García R, Núñez-Díaz V, Quintero E. Prevention of post-endoscopic retrograde cholangiopancreatography pancreatitis: a cost-effectiveness analysis. *Pancreas* 2015; **44**: 204-210 [PMID: 25406954 DOI: 10.1097/MPA.0000000000000245]

31 **Derry S**, Wiffen PJ, Moore RA. Single dose oral diclofenac for acute postoperative pain in adults. *Cochrane Database Syst Rev* 2015; **2015**: CD004768 [PMID: 26151766 DOI: 10.1002/14651858.CD004768.pub3]

32 **Padberg S**, Tissen-Diabaté T, Dathe K, Hultsch S, Meixner K, Linsenmeier V, Meister R, Schaefer C. Safety of diclofenac use during early pregnancy: A prospective observational cohort study. *Reprod Toxicol* 2018; **77**: 122-129 [PMID: 29477808 DOI: 10.1016/j.reprotox.2018.02.007]

33 **Eknoyan G**, Lameire N, Eckardt K. KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. *Kidney int* 2013; **3**: 5-14

34 **Chandok N**, Watt KD. Pain management in the cirrhotic patient: the clinical challenge. *Mayo Clin Proc* 2010; **85**: 451-458 [PMID: 20357277 DOI: 10.4065/mcp.2009.0534]

35 **Lee KH**, Kim EY, Cho J, Kang D, Bang S, Kim HK, Kim GH, Choi HJ, Han JH, Jeon SW, Ryu JK, Moon JS, Lee TH, Cho JW, Kim TH, Cheon YK, Park CH, Lee JK, Moon JH, Cho CM. Risk factors associated with adverse events during endoscopic ultrasound-guided tissue sampling. *PLoS One* 2017; **12**: e0189347 [PMID: 29236743 DOI: 10.1371/journal.pone.0189347]

- 36 **O'Toole D**, Palazzo L, Arotçarena R, Dancour A, Aubert A, Hammel P, Amaris J, Ruszniewski P. Assessment of complications of EUS-guided fine-needle aspiration. *Gastrointest Endosc* 2001; **53**: 470-474 [PMID: 11275888 DOI: 10.1067/mge.2001.112839]
- 37 **Li Z**, Liu W, Xu X, Li P. A Meta-Analysis Comparing Endoscopic Ultrasound-guided Fine-needle Aspiration With Endoscopic Ultrasound-guided Fine-needle Biopsy. *J Clin Gastroenterol* 2022; **56**: 668-678 [PMID: 35470294 DOI: 10.1097/MCG.0000000000001702]
- 38 **Khan MA**, Grimm IS, Ali B, Nollan R, Tombazzi C, Ismail MK, Baron TH. A meta-analysis of endoscopic ultrasound-fine-needle aspiration compared to endoscopic ultrasound-fine-needle biopsy: diagnostic yield and the value of onsite cytopathological assessment. *Endosc Int Open* 2017; **5**: E363-E375 [PMID: 28497108 DOI: 10.1055/s-0043-101693]
- 39 **Matynia AP**, Schmidt RL, Barraza G, Layfield LJ, Siddiqui AA, Adler DG. Impact of rapid on-site evaluation on the adequacy of endoscopic-ultrasound guided fine-needle aspiration of solid pancreatic lesions: a systematic review and meta-analysis. *J*

Table 1 Incidence of post endoscopic ultrasound tissue acquisition pancreatitis

Ref.	n	Type of study	FNA or FNB	Incidence
Ribeiro <i>et al</i> ^[17] , 2018	712	Prospective cohort	FNA and FNB	16/712 (2.2%)
Thomsen <i>et al</i> ^[18] , 2022	852	Retrospective cohort	FNB	20/852 (2.3%)
Kandel <i>et al</i> ^[16] , 2021	50	Prospective RCT	FNA and FNB	2/50 (4.0%)
van Riet <i>et al</i> ^[19] , 2019	608	Prospective RCT	FNA and FNB	2/608 (0.3%)
Gonzalez <i>et al</i> ^[14] , 2022	105	Retrospective cohort	FNA and FNB	0/105 (0.0%)
Ishigaki <i>et al</i> ^[15] , 2020	154	Retrospective cohort	FNA and FNB	2/154 (1.3%)
Chen <i>et al</i> ^[13] , 2022	235	Prospective RCT	FNA and FNB	2/235 (0.9%)

FNA: Fine needle aspiration; FNB: Fine needle biopsy; RCT: Randomized controlled trial.

2%

SIMILARITY INDEX

PRIMARY SOURCES

1

"Endotherapy in Biliopancreatic Diseases: ERCP Meets EUS", Springer Science and Business Media LLC, 2020
Crossref

24 words — 1%

2

Yongru Liu, Dingkun Xiong, Yu Zhao, Zhilan Meng et al. "Endoscopic ultrasound-guided tissue acquisition with or without rapid on-site evaluation for solid pancreatic lesions: five years of experience from a single center", Scandinavian Journal of Gastroenterology, 2023
Crossref

19 words — 1%

3

www.gutnliver.org
Internet

15 words — 1%