—Original Article—

An international, multi-institution survey on performing EUS-FNA and fine needle biopsy

Jintao Guo[1], Anand V. Sahai[2], Anthony Teoh[3], Paolo Giorgio Arcidiacono[4], Alberto Larghi[5], Adrian Saftoiu[6], Ali A. Siddiqui[7], Brenda Lucia Arturo Arias[8], Christian Jenssen[9], Douglas G. Adler[10], Sundeep Lakhtakia[11], Dong-Wan Seo[12], Fumihide Itokawa[13], Marc Giovannini[14], Girish Mishra[15], Luis Sabbagh[16], Atsushi Irisawa[17], Julio Iglesias-Garcia[18], Jan Werner Poley[19], Juan J. Vila[20], Lachter Jesse[21], Kensuke Kubota[22], Evangelos Kalaitzakis[23], Mitsuhiro Kida[24], Mohamed El-Nady[25], Sh Untaro Mukai[26], Takeshi Ogura[27], Pietro Fusaroli[28], Peter Vilmann[29], Praveer Rai[30], Nam Q. Nguyen[31], Ryan Ponnudurai[32], Chalapathi Rao Achanta[33], Todd H. Baron[34], Ichiro Yasuda[35], Hsiu-Po Wang[36], Jinlong Hu[1], Bowen Duan[1], Manoop S. Bhutani[37], Siyu Sun[1]

[1]Department of Gastroenterology, Sheng Jing Hospital of China Medical University, Shenyang, Liaoning Province, China; [2]Center Hospitalier de l'Université de Montréal, Montreal, Canada; [3]Department of Surgery, Prince of Wales Hospital, Shatin, New Territories, Hong Kong, China; [4]Pancreato-Biliary Endoscopy and Endosonography Division, Pancreas Translational & Clinical Research Center, San Raffaele Scientific Institute, Milan, Italy; [5]Digestive Endoscopy Unit, Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, Italy; [6]Department of Endoscopy, University of Medicine and Pharmacy, Craiova, Romania; [7]Endoscopy Center, Thomas Jefferson University Hospital, Philadelphia, PA, USA; [8]Endoscopy Center, Medical Research Group University of Manizales, SES University Hospital of Caldas, Caldas, Colombia; [9]Department of Medical, Krankenhaus Märkisch Oderland Strausberg, Wriezen, Germany; [10]Department of Gastroenterology, University of Utah School of Medicine, Salt Lake City, UT, USA; [11]Endoscopy Center, Asian Institute of Gastroenterology, Hyderabad, Telangana, India; [12]Department of Gastroenterology, University of Ulsan College of Medicine, Seoul, South Korea; [13]Department of Gastroenterology and Hepatology, Tokyo Adventist Hospital, Tokyo, Japan; [14]Department of Gastroenterology, Institute Paoli-Calmettes, Marseille, France; [15]Department of Gastroenterology, Wake Forest Baptist Health, Winston-Salem, North Carolina, USA; [16]Department of Gastroenterology, Sanitas University Foundation, Clinica Reina Sofia, Bogota, Colombia; [17]Fukushima Medical University Aizu Medical Center, Aizuwakamatsu, Japan; [18]Endoscopy Center, University Hospital of Santiago de Compostela, Santiago de Compostela, Spain; [19]Erasmus MC University Medical Center Rotterdam, Rotterdam, The Netherlands; [20]Department of Gastroenterology, Complejo Hospitalario de Navarra, Pamplona, Spain; [21]Department of Gastroenterology, Rambam Healthcare Campus, Haifa, Israel; [22]Department of Gastroenterology, Yokohama City University School of Medicine, Yokohama, Japan; [23]Department of Gastroenterology, University Hospital of Heraklion, University of Crete, Heraklion, Greece; [24]Department of Gastroenterology, Kitasato University East Hospital, Sagamihara, Japan; [25]Department of Gastroenterology, Faculty of Medicine, Cairo University, Giza, Egypt; [26]Department of Gastroenterology, Tokyo Medical University, Tokyo, Japan; [27]Department of Gastroenterology, Osaka Medical College, Osaka, Japan; [28]Department of Gastroenterology, University of Bologna, Bologna, Italy; [29]Department of Gastroenterology, GastroUnit, Herlev and Gentofte Hospital, Copenhagen University, Copenhagen, Denmark; [30]Department of Gastroenterology, Sanjay Gandhi Postgraduate Institute of Medical

Access this article online

Quick Response Code:

Website: www.eusjournal.com

DOI: 10.4103/eus.eus_56_20

How to cite this article: Guo J, Sahai AV, Teoh A, Arcidiacono PG, Larghi A, Saftoiu A, *et al*. An international, multi-institution survey on performing EUS-FNA and fine needle biopsy. Endosc Ultrasound 2020;9:319-28.

Address for correspondence

Dr. Siyu Sun, Department of Gastroenterology, Sheng Jing Hospital of China Medical University, No. 36, Sanhao Street, Shenyang 110004, Liaoning Province, China. E-mail: sunsy@sj-hospital.org, sun-siyu@163.com

Dr. Anand V. Sahai, Center Hospitalier de l'Université de Montréal, Montreal, Canada. E-mail: anand.sahai@sympatico.ca

Received: 2020-05-01; **Accepted:** 2020-08-10; **Published online:** 2020-08-31

Sciences, Lucknow, Uttar Pradesh, India; [31]Department of Gastroenterology, Royal Adelaide Hospital, North Terrace, Adelaide, Australia; [32]Prince Court Medical Center, Kuala Lumpur, Malaysia; [33]Department of Gastroenterology, KIMS Icon Hospital, Visakhapatnam, Andhra Pradesh, India; [34]Department of Gastroenterology, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA; [35]Department of Gastroenterology, Teikyo University Mizonokuchi Hospital, Kawasaki, Japan; [36]Department of Gastroenterology, National Taiwan University Hospital, Taipei, Taiwan, China; [37]The University of Texas MD Anderson Cancer Center, Houston, TX, USA

ABSTRACT

Background and Objectives: Endoscopic ultrasound-guided fine needle aspiration (EUS-FNA) and fine needle biopsy (FNB) are effective techniques that are widely used for tissue acquisition. However, it remains unclear how to obtain high-quality specimens. Therefore, we conducted a survey of EUS-FNA and FNB techniques to determine practice patterns worldwide and to develop strong recommendations based on the experience of experts in the field. **Methods:** This was a worldwide multi-institutional survey among members of the International Society of EUS Task Force (ISEUS-TF). The survey was administered by E-mail through the SurveyMonkey website. In some cases, percentage agreement with some statements was calculated; in others, the options with the greatest numbers of responses were summarized. Another questionnaire about the level of recommendation was designed to assess the respondents' answers. **Results:** ISEUS-TF members developed a questionnaire containing 17 questions that was sent to 53 experts. Thirty-five experts completed the survey within the specified period. Among them, 40% and 54.3% performed 50–200 and more than 200 EUS sampling procedures annually, respectively. Some practice patterns regarding FNA/FNB were recommended. **Conclusion:** This is the first worldwide survey of EUS-FNA and FNB practice patterns. The results showed wide variations in practice patterns. Randomized studies are urgently needed to establish the best approach for optimizing the FNA/FNB procedures.

Ke ywords: consensus, EUS-FNA, fine needle biopsy, survey

INTRODUCTION

EUS-FNA and EUS-fine needle biopsy (EUS-FNB) are well-established techniques for tissue acquisition in lesions in and around the gastrointestinal (GI) tract. These are safe and effective methods to achieve definitive diagnoses and to plan therapeutic decisions. Studies have confirmed that several variables affect the diagnostic rate of EUS-FNA/FNB, including the skill and experience of the endoscopist and the cytopathologist, the gauge of the FNA/FNB needle, different techniques regarding the use of suction and stylet, the number of needle passes, and the presence of on-site cytopathology assessment.[1] Methods to optimize the quality of FNA/FNB specimens and improve the diagnostic rate are emerging research topics.

However, there is no consensus on how to effectively utilize these techniques to maximize their diagnostic potential. To address these questions, the International Society of EUS (ISEUS) members developed a questionnaire.

METHODS

Design of the questionnaire

A questionnaire draft about EUS-FNA/FNB practice patterns was circulated among members of the ISEUS Task Force (ISEUS-TF) in June 2019. The draft was developed to explore hot topics and controversial issues in clinical application around EUS-FNA/FNB. After in-depth discussion, ISEUS-TF members developed a questionnaire containing 17 questions. The questions were grouped under several sections, including endoscopists' experiences, various acquisition methods for different lesion types, choice of needle types and sizes, special puncture techniques, and other aspects.

Sending and collection of the questionnaire

The survey was administered by E-mail through the SurveyMonkey website (https://surveymonkey.com/). For all questions, the options with the greatest numbers of responses were summarized. Another questionnaire regarding levels of recommendation was designed to assess how well the respondents recommended the most choices from the previous questionnaire. Statements were formulated by combining a formal literature review on EUS-FNA/FNB with expert opinions from members of ISEUS-TF. This study was approved by the ISEUS.

RESULTS

The questionnaire was sent to 53 ISEUS experts; 35 experts from 35 different endoscopy centers worldwide

completed the survey. A literature search was conducted again in January 2020. All authors participated in the review and revision of the manuscript and agreed with the final revision. The questionnaire, the results of each question, and the recommended strength can be viewed in the supplemental material.

All endoscopic experts who participated in the questionnaire had extensive FNA/FNB experience. Among them, 40% (14/35) performed 50–200 FNA/FNB procedures annually and 54.3% (19/35) performed more than 200 procedures annually. All bar charts are original pictures of the results on the SurveyMonkey website. The questions are summarized in the following categories:

How to choose cytological or histological evaluation?

In our survey, cytologic evaluation as the first choice was recommended for biliary strictures, splenic masses, and peritoneal carcinomatosis. For submucosal (SMTs) lesions, suspected lymphomas, solid pancreatic masses, liver lesions, left adrenal gland lesions, and lymph nodes, tissue evaluation was recommended.

Histological evaluation was primarily used by 51.4% (18/35) of experts (37.5% strongly approve and 54.2% approve), while 31.4% (11/35) used both cytological and histological evaluation.

How to choose the puncture needle according to different needs?

For routine EUS-guided sampling of solid masses and lymph nodes, the ISEUS-TF prefers 22G needles for both cytology (33.3% strongly approve and 37.5% approve) and histology (25% strongly approve and 45.8% approve).

To perform FNB, most endoscopic experts prefer using the Acquire™ and Procore® needles.

How to use suction/stylet in solid lesions?

For the cytologic evaluation of solid lesions, dry syringe suction was preferred by 51.4% (18/35) of experts (25% strongly approve and 45.8% approve), while the use of a stylet was preferred by 71.4% (25/35) of experts. The lack of difference between wet suction technique (WST) and dry suction technique (DST) for obtaining tissue was expressed by 77.4% (27/35) of experts (37.5% strongly approve, 33.3% approve).

Is rapid on-site evaluation (rapid on-site evaluation needed? Should rapid on-site evaluation or macroscopic on-site evaluation be chosen?

A total of 52.9% (18/34) of experts consider that the utilization of ROSE increases the sensitivity for cancer detection (41.7% strongly approve and 33.3% approve), while 38.2% (13/34) hold an opposite opinion. Rapid on-site evaluation (ROSE) reduces the number of passes performed in the opinion of 68.6% (24/35) of endoscopic experts (54.2% strongly approve and 33.3% approve).

Faced with the choice between ROSE and macroscopic on-site evaluation (MOSE), 71.4% (25/35) of the specialists preferred MOSE (37.5% strongly approve and 54.2% approve).

How to optimize the FNA of pancreatic cystic lesions?

The 22G needle was chosen by 65.6% (21/32) of experts for pancreatic cystic lesions (PCLs) without a solid component (20.8% strongly approve and 45.8% approve). Testing for amylase (69.7%; 23/33) and carcinoembryonic antigen (CEA; 87.88%, 29/33) were recommended for fluid analysis of PCLs. For PCLs, 85.3% (29/34) of the experts believed periprocedural administration of antibiotics is needed (41.7% strongly approve and 37.5% approve).

Do you modify indications and/or sampling technique in the presence of the following situations?

When patients use antiplatelet agents (clopidogrel), anticoagulants (warfarin and apixaban) or have low platelet count (<50,000), most professionals (80%, 28/35; 91.43%, 32/35; and 88.57%, 31/35, respectively) modify indications and/or the sampling technique. Most experts (77.14%, 27/35) still perform FNA/FNB in patients using non-steroidal anti-inflammatory drugs (NSAIDs) (41.7% strongly approve and 54.2% approve).

Opinion about the fanning technique

Needle fanning technique shows better diagnostic ability than the nonfanning technique according to 88.6% (31/35) of experts (33.3% strongly approve and 41.7% approve).

DISCUSSION

EUS tissue acquisition (EUS-TA) has become a fundamental tool to obtain a cytopathological diagnosis

of GI tract or adjacent lesions and is the current gold standard for sampling solid masses. However, ways to improve the diagnostic accuracy and optimizing FNA/FNB remain a matter of debate.

Cytologic or histologic evaluation/FNA or fine needle biopsy

The choice of histologic or cytologic evaluation is a hot topic among EUS experts and opinions might differ depending on the type of lesion to sample. Whether to choose FNA or FNB is also a topic worth discussing.

Most current studies show results similar to the ones on this survey. For SMT lesions, suspected lymphomas, solid pancreatic masses, liver lesions, left adrenal gland lesions, and lymph nodes, histological evaluation has been recommended,[2-4] with the further possibility of performing immunohistochemical, phenotyping, or genetic analyses. For the above lesions, some studies have also demonstrated that FNB has advantages in tissue acquisition.[5-9] A retrospective study conducted by Bang *et al.*[5] evaluated FNA and FNB diagnosis outcomes for various types of solid mass lesions. Diagnostic yield using the cell-block method was significantly superior for FNB compared to FNA for both pancreatic and nonpancreatic lesions (SMTs, lymph nodes, and other lesions). Compared with FNB, FNA was found to be best performed with ROSE, which is not widely available. A prospective randomized study by Kim *et al.*[6] compared FNB and FNA for the histopathological diagnosis of SMTs. The EUS-FNB group had a significantly lower median number of needle passes, higher yield rates of macroscopically and histologically optimal core samples, and a higher diagnostic sufficiency rate. Another study comparing the SharkCore™ FNB needle with a standard EUS-FNA needle in SMTs reported that tissue adequacy was achieved in 100% of cases with EUS-FNB as compared to 65% with EUS-FNA ($P = 0.006$).[7] Similar results were obtained in the multicenter study of Antonini *et al.*,[8] who found that the use of EUS-FNB needle is an effective and safe method for the diagnosis of SMTs. Several studies have demonstrated that there is no difference in morbidity and mortality between EUS-FNA and FNB procedures.[9,10]

In liver biopsies, histology is often necessary. In recent years, the use of EUS as a method for procuring liver tissue has gained acceptance and shown excellent tissue yields.[3] EUS-FNA needles are most commonly used across studies.[11-13] Mok *et al.*[12] compared FNA and FNB needles. The tissue adequacy was higher for the FNA than for the FNB needle since the latter produced samples more prone to fragmentation during specimen processing. Mohan *et al.*[13] performed a systematic review and meta-analysis to estimate the diagnostic yield, specimen adequacy, and adverse events associated with EUS-guided liver biopsy. The 19G FNA needle provided significantly better biopsy specimens and seemed to have better outcomes compared with other core biopsy needles.

In this survey, cytologic evaluation was recommended for biliary strictures, splenic masses and peritoneal carcinomatosis. Several studies reported good accuracy rates using EUS-FNA for biliary masses.[14-16] EUS-FNA has superior performance in diagnosing distal biliary strictures.[14] Moura *et al.*'s study[15] proved this statement by showing a diagnostic accuracy of 97.1% in distal lesions and 86.7% in proximal lesions. In Weilert *et al.*'s study,[16] EUS-FNA had a higher sensitivity for malignancy when strict cytologic criteria were used.

Reports on the diagnosis of splenic masses and peritoneal carcinomatosis by EUS-FNA are scarce. Traditionally, ultrasonography- or computed tomography-guided biopsies are employed for tissue sampling; EUS-FNA has been recently utilized for sampling splenic tumors.[17]

There is no one-size-fits-all answer about whether FNB is more advantageous for tissue acquisition. In a study by Facciorusso *et al.*,[18] the authors conducted a thorough pairwise and network meta-analysis of randomized trials to compare the diagnostic performances of different needle types (FNA and FNB) for EUS-guided sampling. It is believed that the two methods have the same diagnostic performance. However, FNB needles have better tissue acquisition volume and diagnostic accuracy in more studies.[18-21] Bang and Varadarajulu[19] believed the newer-generation FNB needles have revolutionized the practice of EUS-guided tissue acquisition. The diagnostic adequacy on cell block exceeds 90%–95% and thereby obviates the routine use of ROSE, which was hitherto pivotal to achieve optimal outcomes. Additionally, these needles yield "true" histologic results that make molecular profiling possible.[20] In the study of Ang *et al.*,[21] EUS-FNB with acquisition of histologic core improved the diagnostic yield for solid masses. Dedicated FNB needles appeared to achieve a higher histologic core yield compared to 19G FNA needles.

What type of fine needle biopsy needle is usually chosen for histologic (tissue) evaluation?

EUS-guided tissue sampling plays a pivotal role in the diagnostic algorithm of some solid lesions. To overcome the limitations of FNA, FNB needles have recently been developed to collect tissue for histologic examination.[22-27]

Both the Acquire™ and Procore® needles are commonly used FNB needles. In this survey, most endoscopic experts prefer using the Acquire™ needle (65.71%, 23/35) while 23.53% (8/34) prefer using the Procore® needle. Karsenti *et al.*[23] performed an observational study to compare EUS-FNB performed with a 20G Procore® needle *versus* a 22G Acquire™ needle for tissue sampling of pancreatic tumors. Histological diagnosis was achieved and core biopsy specimens were obtained in 82% (28/34) and 97% (33/34) of cases, respectively. The mean cumulative length of tissue core biopsies per needle pass was significantly higher with the 22G Acquire™ needle. Ishikawa *et al.*[2] retrospectively reviewed 87 consecutive EUS-FNB specimens obtained from 82 patients using either a 22G Acquire™ needle (Group A, $n = 51$) or a conventional 22G FNA needle (Group B, $n = 36$) to diagnose pancreatic diseases. Although both needles showed high diagnostic accuracy for malignancy with no significant differences, the amount of histological specimens obtained with the Acquire™ needle was significantly higher.

Kurita *et al.*[24] compared diagnostic outcomes and sample adequacy of 22G FNB and FNA needles for EUS-guided sampling of pancreatic masses in their review article. The FNB needle used was ProCore® in all studies except in that by Bang *et al.*[20] where the Acquire™ needle was used. While using the ProCore® needle did not result in a clear advantage in terms of accuracy and adequate tissue sampling, Acquire™ showed significant a benefit in terms of histologic yield quality (relative risk 1.18, $P = 0.02$). In a multicenter retrospective study of Adler *et al.*,[22] 200 patients (121 males and 79 females) underwent EUS-FNB of solid lesions with the Acquire™ needle. Lesions included solid pancreatic masses, adenopathy, submucosal lesions, cholangiocarcinoma, and liver lesions. Overall, this study showed a high rate of tissue adequacy and production of a tissue core with this device with no adverse events. Due to the lack of comparison with other FNB needles, this study can only confirm the safety and tissue adequacy of the Acquire™ needle. There are also habitual factors related to the choice of FNB needles. Large multicenter prospective studies comparing multiple FNB needles are also needed.

Cytologic evaluation with or without suction/stylet in solid lesions

The details of the puncture procedure may influence the outcomes; whether to use suction/stylet is also worthy of attention. Stylet use during the puncture procedure is recommended by most studies. A randomized controlled trial (RCT) demonstrated that the use of a stylet during EUS-FNA has no impact on the diagnostic yield of malignancy or specimen quality. Rather, air flushing in a slow, controlled fashion is superior to reinsertion of a stylet to express EUS-FNA aspirates.[1] Another reason for the use of a stylet is to prevent clogging of the needle lumen by GI wall tissue as the needle traverses the tissue to reach the target lesion, which could limit the ability to aspirate cells from the target lesion. In our questionnaire, 71.43% (25/35) of experts preferred to use a stylet.

The role of suction during EUS-FNA is unclear and not standardized. In our survey, 51.43% (18/35) of experts preferred dry syringe suction in solid lesions. A recent RCT by Lee *et al.*[28] compared the diagnostic yield and cytologic characteristics during EUS-FNA of pancreatic masses with and without suction. EUS-FNA was performed using a 22- or 25G needle and suction was applied using a 10-ml syringe. Samples in the suction group were associated with higher diagnostic yield, accuracy, cellularity, and bloodiness compared with samples obtained without suction.

Should wet suction technique or dry suction technique be used?

WST is a new suction technique, in which flushing the needle with saline solution replaces the air within the needle lumen before needle aspiration. The technique was developed with to improve the quality of aspirates for cytopathological diagnosis. However, some studies have found no difference between WST and DST in specimen acquisition and diagnostic accuracy.[29] This opinion is consistent with the conclusions of the questionnaire.

However, some recent studies have confirmed the advantages of WST. An RCT comparing WST and DST in EUS-FNA for solid lesions was completed by Wang *et al.*[30] WST had a higher diagnostic yield than

DST. A recent RCT by Attam *et al.*[31] compared WST with DST in 117 patients and found a better diagnostic yield when performing tissue acquisition with WST. The inconsistency of conclusions should be attributed to the small number of endoscopy centers using WST and the lack of large sample size and multicenter studies.

Is rapid on-site evaluation needed?

In our survey, 52.94% of experts considered that ROSE increases the diagnostic sensitivity for cancer, while 38.24% held the opposite belief; 68.57% considered that ROSE reduces the number of passes needed.

In some studies, ROSE is applied during FNA to improve the diagnostic yield. To the best of our knowledge, there are no formal guidelines standardizing the process and determining who performs ROSE.[32] In addition, the conclusions of various studies provide diverse perspectives. Most initial studies believed ROSE was useful.[33,34] Two retrospective studies in 2003 and 2011 supported the use of ROSE. One of the two studies showed ROSE significantly improved the positive and negative diagnostic yield for malignancy ($P = 0.001$) as well as specimen quality ($P = 0.035$); indeed, suspected malignancy occurred more frequently in the ROSE group ($P = 0.025$).[33] Similarly, another study from 2011 showed a remarkably lower number of unqualified specimens (1.0 *vs.* 12.6%, $P = 0.002$) and significantly higher sensitivity (96.2 *vs.* 78.2%; $P = 0.002$) and diagnostic accuracy (96.8 *vs.* 86.2%; $P = 0.013$) when ROSE was available.[34] However, recent studies present an opposing view. Three RCTs carried out from 2015 to 2018 provided convincing evidence for the noninferiority of forgoing ROSE.[35,36] The latest meta-analysis about the use of ROSE, which included seven studies, confirmed the lack of differences in diagnostic efficiency between both approaches.[37] A study adopting a discrete-event simulation model, which was determined by three input parameters (average per-pass adequacy rate, assessor sensitivity, and assessor specificity) analyzed the advantages of ROSE.[38]

The emergence of the FNB needle is also a factor giving rise to divergent results. In the study of Rodrigues-Pinto *et al.*,[39] FNB sampling without ROSE was compared with FNA with ROSE and the concordance of FNA and FNB sampling was calculated. Thirty-three patients underwent 312 passes for 42 different lesions. FNB sampling without ROSE performed as well as FNA with ROSE. In Fabbri *et al.*'s study,[40] the influence of ROSE on the adequacy and accuracy of EUS-FNB in patients with pancreatic solid lesions was evaluated. The conclusion of the study was that in the absence of ROSE, the FNB needle is preferred, because it can achieve tissue sampling adequacy and accuracy comparable to that of FNA with ROSE.

If the FNB needle is used, ROSE is dispensable. The presence of ROSE can be helpful if FNA needles are used, especially for the diagnosis of difficult cases or when the lesions are in locations that are difficult to puncture.

For core biopsy, should rapid on-site evaluation or macroscopic on-site evaluation be used?

In this survey, 71.4% (25/35) of experts used MOSE for core biopsy, with 37.5% strongly approving and 54.2% approving its use. ROSE specimens cannot provide information about conditions such as lymphoma or GI stromal tumors because of the lack of cellularity; they also do not allow advanced molecular or other tests to be performed. White or yellow tissue bars, termed macroscopic visible cores (MVCs), can be identified using MOSE in FNA specimens by cytotechnologists or EUS technologists; these histologic cores are indispensable for the final pathological diagnosis.

A study assessed the efficacy of MOSE in EUS-FNA in which the standard 19G needle was selected to obtain specimens from solid lesions of different organs.[41] MVCs appeared in 91.1% (216/237 passes) of specimens with a median length of 8 mm (interquartile range 4–12 mm). The histologic core was found in 78.9% (187/237) of passes, with a sensitivity and specificity for malignant lesions of 94.0% and 100%, respectively. Another prospective, double-blind, controlled study investigated the adequacy of specimens obtained by standard 22G needles and MOSE diagnostic performance.[42] Almost all 234 slides of specimens from 37 patients were reviewed by EUS technologists, cytotechnologists, and cytopathologists who gave their independent diagnosis and graded specimen quality. The kappa coefficient between cytopathologists' and EUS technologists' diagnoses was 0.19 (95% confidence interval [CI], 0.08–0.30), while for cytotechnologists it was 0.20 (95% CI, 0.09–0.31).

Recently, improved FNB needles have been designed to obtain more tissue and to increase diagnostic accuracy.

A set of FNB needles, including 19-, 22-, and 25G were used in the study, which compared the diagnostic performance of MOSE and ROSE.[43] A trained endosonographer performed MOSE and achieved a sensitivity, specificity, positive predictive value, and negative predictive value of 91.7%, 100% 88.9%, and 95.0%, respectively. The indices related to diagnosis were comparable between trained endosonographers and experienced cytopathologists.

For a more advanced comparison between MOSE and ROSE in EUS-FNB, a multicenter randomized noninferiority trial called FROSENOR is ongoing in 16 medical centers in 4 continents. This large-scale trial could determine whether MOSE may replace ROSE in FNB.[44]

In pancreatic cystic lesions, what markers should be chosen for fluid analysis?

Due to the remarkable mortality of pancreatic cancer and malignancy potential of PCLs, it is important to identify these lesions as nonneoplastic or neoplastic for making the clinical decision. In this survey, amylase (69.7%; 23/33) and CEA (87.88%, 29/33) were considered necessary for fluid analysis of PCLs.

Some studies have confirmed that EUS-FNA is superior to other imaging tests in the diagnosis of PCL. One of the most important factors is that the fluid can be aspirated for analysis.[45,46] Amylase and CEA were recommended. The CEA level recorded after FNA has been used to distinguish mucinous and nonmucinous lesions with a cut-off value of 192 ng/ml.[45]

FNA can also provide fluid for advanced tests such as molecular analysis, including KRAS and GNAS.[47,48] In a recent study, the combination of CEA and KRAS achieved a sensitivity of 100% in differentiating mucinous lesions.[48]

Periprocedural application of antibiotics for pancreatic cystic lesions

In this survey, periprocedural administration of antibiotics was recommended by 85.3% (29/34) of experts.

For the FNA of PCLs, periprocedural application of antibiotics is controversial. In the latest European Society of Gastroenterology guidelines, only low-quality evidence supports the recommendation to use antibiotic prophylaxis.[49] Since there is no sufficient evidence to object to the administration of antibiotic prophylaxis, we may comply with the clinical pathway described in the current guidelines. Given the risks related to antibiotic abuse, however, single-dose intravenous antibiotic therapy may be recommended. Klein *et al.* showed no antibiotic-related adverse events and infection occurring under a regimen of single-dose ceftriaxone, suggesting it is a safe and acceptable alternative.[50]

What situations may modify indications and/or the sampling technique?

In our survey, when managing patients using antiplatelet agents (*e.g.*, clopidogrel), anticoagulants (*e.g.*, warfarin, apixaban) or with a low platelet count (<50,000), most experts (80%, 28/35; 91.43%, 32/35; and 88.57%, 31/35; respectively) modify indications and/or the sampling technique. FNA/FNB is still performed by most experts (77.14%, 27/35) in patients using NSAIDs.

Although the American Society of Gastrointestinal Endoscopy states that high-risk endoscopic procedures can safely be performed on patients taking aspirin and other NSAIDs in standard doses, there is a paucity of data specific to EUS-FNA. Kien-Fong Vu *et al.* studied the safety and cellular yield of EUS-FNA and/or trucut biopsy (TCB) in patients taking aspirin, NSAIDs, or prophylactic low molecular weight heparins (LMWHs). Bleeding events occurred in 0% (0/26), 33.3% (2/6), and 3.7% (7/190) of patients in the aspirin/NSAIDs, LMWH, and control groups, respectively ($P = 0.023$). The conclusion of the study was that EUS-FNA or TCB was safe to perform in patients taking aspirin or NSAIDs. However, stopping LMWH before the procedure should be considered.[51] A single-center retrospective study analyzed bleeding adverse events after EUS-FNA in 908 consecutive patients using antithrombotic agents which were divided into three groups: continuous medication, discontinuation, and heparin replacement. The conclusion of the study was that EUS-FNA was a safe procedure for patients using antithrombotic agents, even when antithrombotic therapy is not discontinued during EUS-FNA.[52] A retrospective study conducted with 742 consecutive patients who underwent EUS-FNA for solid lesions compared bleeding event rates among patients not using antithrombotic agents, those discontinuing their use, those continuing treatment with aspirin or cilostazol, and those who were on replacement therapy with heparin. A low incidence of EUS-FNA-related bleeding

in patients receiving antithrombotic treatment was found; the bleeding event rate was low even in patients who underwent EUS-FNA while continuing aspirin or cilostazol.[53]

Current studies show that most antithrombotic and anti-inflammatory drugs do not increase the risk of EUS-FNA-related bleeding; however, further multi-center studies using big data are still needed.

Fanning technique

Fanning technique was recommended by 88.6% (31/35) of experts in this survey; this view is supported by most current studies. The RCT conducted by Bang *et al.*[54] evaluated the standard targeting and fanning techniques in pancreatic masses. According to the study protocol, the needle moved back and forth 4 times in 4 directions from margin to margin in a single pass. The results showed no difference in diagnostic accuracy and technical failure rate; however, there was a significant difference in the number of needle passes and the rate of diagnostic achievement. Sampling with fewer needle passes reduces the possibility of complications related to the procedure and saves time. Moreover, in their study, 4 of 6 patients who were not diagnosed after the standard technique achieved diagnosis using the fanning technique. Another prospective comparative study[55] published in 2018 confirmed the effectiveness of the fanning technique. In their study, different techniques were alternately applied to the same lesion of the same patient, generating paired comparisons in pancreatic specimens. The fanning technique showed significantly better diagnostic accuracy as well as reduced blood contamination.

CONCLUSION

The contents of the consensus reached in this study are as follows:

1. In our survey, cytologic evaluation was recommended as the first choice for biliary strictures, splenic masses, and peritoneal carcinomatosis. For submucosal SMTs, suspected lymphomas, solid pancreatic masses, liver lesions, left adrenal gland lesions, and lymph nodes, tissue evaluation was recommended
2. For routine EUS-guided sampling of solid masses and lymph nodes, the ISEUS-TF prefers 22G needles for both cytology (33.3% strongly approve and 37.5% approve) and histology (25% strongly approve and 45.8% approve). To perform FNB, the Acquire™ needle was preferred by most endoscopic experts (45.8% strongly approve and 33.3% approve)
3. For cytologic evaluation of solid lesions, dry syringe suction was recommended (25% strongly approve and 45.8% approve)
4. ROSE reduces the number of passes (54.2% strongly approve and 33.3% approve)
5. Faced with the choice between ROSE and MOSE, MOSE was recommended (37.5% strongly approve and 54.2% approve)
6. Testing for amylase and CEA were recommended for fluid analysis of PCLs
7. Needle fanning technique shows better diagnostic ability (33.3% strongly approve and 41.7% approve).

This is the first worldwide survey about the practice of EUS-FNA and FNB. There were wide variations in practice and randomized studies are urgently needed to establish the best approach for these procedures.

Acknowledgments

This study was supported by the National Natural Science Foundation of China (Grant No. 81900601), the Natural Science Foundation of Liaoning Province (Grant No. 20170541024), and Outstanding Scientific Fund of Shengjing Hospital (Grant No. 201701 and 201702). We thank all the doctors who participated in this study.

Supplementary Materials

Supplementary information is linked to the online version of the paper on the *Endoscopic Ultrasound* website.

Financial support and sponsorship

This study was supported by the National Natural Science Foundation of China (Grant No. 81900601), the Natural Science Foundation of Liaoning Province (Grant No. 20170541024), and Outstanding Scientific Fund of Shengjing Hospital (Grant No. 201701 and 201702).

Conflicts of interest

There are no conflicts of interest.

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SUPPLEMENTARY MATERIALS

Questionnaire

Question 1: How many EUS-fine needle aspiration (FNA)/fine needle biopsy (FNB) procedures do you perform every year?

A <50 patients

B 50–200 patients

C 200–500 patients

D >500 patients

Answer: All endoscopic experts who participated in the questionnaire had extensive FNA/FNB experience. Among them, 40% (14/35) performed 50–200 FNA/FNB procedures annually and 54.3% (19/35) performed more than 200 procedures annually.

Part I How to choose cytological or histological evaluation?

Question 2: For different types of solid lesions, which is the first choice between cytologic and histologic evaluation?

1. Submucosal tumors/subepithelial lesions

A Cytologic evaluation

B Histologic (tissue) evaluation

Answer: Histologic evaluation was recommended almost unanimously (94.3%, 33/35).

Level of evidence (LOE)*: Level II

Vote:

A Strongly approve 70.8%

B Approve 29.2%

C Neither approve nor disapprove 0%

D Disapprove 0%

E Strongly disapprove 0%

2. Solid pancreatic lesions

A Cytologic evaluation

B Histologic (tissue) evaluation

Answer: Histologic evaluation was recommended by 68.6% of experts (24/35).

LOE: Level III

Vote:

A Strongly approve 54.2%

B Approve 37.5%

C Neither approve nor disapprove 8.3%

D Disapprove 4.2%

E Strongly disapprove 0%

3. Assessment of mediastinal and abdominal lymph nodes

A Cytologic evaluation

B Histologic (tissue) evaluation

Answer: Histologic evaluation was recommended by 74.3% of experts (26/35).

LOE: Level III

Vote:

A Strongly approve 54.2%

B Approve 33.3%

C Neither approve nor disapprove 4.2%

D Disapprove 8.3%

E Strongly disapprove 0%

4. Liver lesions (metastasis, hepatocellular carcinoma)

A Cytologic evaluation

B Histologic (tissue) evaluation

Answer: Histologic evaluation was recommended by 60% of experts (21/35).

LOE: Level III
Vote:

A Strongly approve 41.7%

B Approve 37.5%

C Neither approve nor disapprove 16.7%

D Disapprove 4.2%

E Strongly disapprove 0%

5. Left adrenal gland lesions

A Cytologic evaluation

B Histologic (tissue) evaluation

Answer: Histologic evaluation was recommended by 60% of experts (21/35).

LOE: Level III
Vote:

A Strongly approve 16.7%

B Approve 45.8%

C Neither approve nor disapprove 20.8%

D Disapprove 12.5%

E Strongly disapprove 4.2%

6. Biliary strictures

A Cytologic evaluation

B Histologic (tissue) evaluation

Answer: Cytologic evaluation was recommended by 68.6% of experts (24/35).

LOE: Level III
Vote:

A Strongly approve 16.7%

B Approve 50%

C Neither approve nor disapprove 25%

D Disapprove 8.3%

E Strongly disapprove 0%

7. Splenic masses

A Cytologic evaluation

B Histologic (tissue) evaluation

Answer: Cytologic evaluation was recommended by 54.29% of experts (19/35).

LOE: Level VII
Vote:
A Strongly approve 20.8%

B Approve 41.7%

C Neither approve nor disapprove 12.5%

D Disapprove 25%

E Strongly disapprove 0%

8. Peritoneal carcinomatosis

A Cytologic evaluation

B Histologic (tissue) evaluation

Answer: Cytologic evaluation was recommended by 57.1% of experts (20/35).

LOE：**Level VII**
Vote:

A Strongly approve 29.2%

B Approve 50%

C Neither approve nor disapprove 12.5%

D Disapprove 8.3%

E Strongly disapprove 0%

9. Suspicious of lymphoma

A Cytologic evaluation

B Histologic (tissue) evaluation

Answer: Histologic evaluation was recommended by 94.3% of experts (33/35).

LOE: Level III

Vote:

A Strongly approve 83.3%

B Approve 12.5%

C Neither approve nor disapprove 4.2%

D Disapprove 0%

E Strongly disapprove 0%

Question 3: Do you primarily use cytology or histology (core)?

A. Cytology

B. Histology

C. 50/50

Answer: Histology is primarily used by 51.4% of experts (18/35).

LOE：Level VII

Vote:

A Strongly approve 37.5%

B Approve 54.2%

C Neither approve nor disapprove 4.2%

D Disapprove 4.2%

E Strongly disapprove 0%

Part II How to choose the puncture needle according to different needs?

Question 4: What needle size do you usually choose for cytology?

A. 19-gauge

B. 20-gauge

C. 22-gauge

D. 25-gauge

Answer: The 22-gauge needle was recommended for cytology (77.1%; 27/35).

LOE: Level IV

Vote:

A Strongly approve 33.3%

B Approve 37.5%

C Neither approve nor disapprove 20.8%

D Disapprove 4.2%

E Strongly disapprove 4.2%

Question 5: What needle size do you usually choose for histology?

A. 19-gauge

B. 20-gauge

C. 22-gauge

D. 25-gauge

Answer: The 22-gauge needle was recommended for histology (71.4%; 25/35).

LOE: Level IV

Vote:

A Strongly approve 25%

B Approve 45.8%

C Neither approve nor disapprove 12.5%

D Disapprove 12.5%

E Strongly disapprove 4.2%

Question 6: What type of FNB needle do you usually use for histologic evaluation?

A. Acquire™ needle (Boston Scientific Co., Natick, MA)

B. SharkCore FNB needle (Covidien-Medtronic Inc, Minneapolis, MN)

C. Procore™ needle (Wilson Cook Medical, Winston-Salem, NC)

D. 19-gauge cytology needle

Answer: The Acquire™ needle was recommended by most endoscopic experts (65.71%, 23/35).

LOE: Level IV

Vote:

A Strongly approve 45.8%

B Approve 33.3%

C Neither approve nor disapprove 12.5%

D Disapprove 8.3%

E Strongly disapprove 0%

Part III How to use suction/stylet in solid lesions ?

Question 7: For cytologic evaluation of solid lesions, which sampling technique do you use?

A. Dry syringe

B. Wet syringe

C. Slow pull

D. No suction

Answer: Dry syringe suction was preferred by 51.4% (18/35) of experts.

LOE: Level III

Vote:

A Strongly approve 25%

B Approve 45.8%

C Neither approve nor disapprove 12.5%

D Disapprove 12.5%

E Strongly disapprove 4.2%

Question 8: Do you use a stylet to perform cytologic evaluation of solid lesions?

A. With stylet

B. Without stylet

Answer: The stylet was preferred by 71.4% (25/35) of experts.

LOE: Level II

Vote:

A Strongly approve 16.7%

B Approve 25%

C Neither approve nor disapprove 33.3%

D Disapprove 16.7%

E Strongly disapprove 8.3%

Question 9: Do you think wet suction technique could obtain more tissue than the traditional technique (dry suction technique)?

A Yes, wet suction technique could obtain more tissue.

B No

Answer: The lack of difference between wet and dry suction techniques was expressed by 77.4% (27/35) of experts.

LOE: Level III

Vote:

A Strongly approve 37.5%

B Approve 33.3%

C Neither approve nor disapprove 20.8%

D Disapprove 8.3%

E Strongly disapprove 0%

Part IV ROSE is needed or not? Choose ROSE or MOSE?

Question 10: Do you think rapid on-site evaluation (ROSE) increases the sensitivity for cancer detection?

A. Yes

B. No

C. Unsure

Answer: The utilization of ROSE increases the sensitivity for cancer detection according to 52.9% of experts (18/34), against 38.2% (13/34) who hold a negative opinion.

LOE: Level III

Vote:

A Strongly approve 41.7%

B Approve 33.3%

C Neither approve nor disapprove 12.5%

D Disapprove 8.3%

E Strongly disapprove 4.2%

Question 11: Do you think ROSE will reduce the number of passes needed?

A. Yes

B. No

C. Unsure

Answer: ROSE reduces the number of passes performed according to 68.6% of experts (24/35).

LOE: Level III

Vote:

A Strongly approve 54.2%

B Approve 33.3%

C Neither approve nor disapprove 12.5%

D Disapprove 0%

E Strongly disapprove 0%

Question 12: For core biopsy, do you use ROSE or macroscopic on-site evaluation (MOSE)?

A. ROSE

B. MOSE

Answer: For core biopsy, 71.4% (25/35) of experts use MOSE.

LOE: Level III

Vote:

A Strongly approve 37.5%

B Approve 54.2%

C Neither approve nor disapprove 4.2%

D Disapprove 4.2%

E Strongly disapprove 0%

Part V How to optimize the FNA of PCLs?

Question 13: For pancreatic cystic lesions without a solid component, which type of needle do you usually choose?

A. 19-gauge

B. 20-gauge

C. 22-gauge

D. 25-gauge

Answer: The 22-gauge needle was chosen by 65.6% of experts (21/32).

LOE: Level VII

Vote:

A Strongly approve 20.8%

B Approve 45.8%

C Neither approve nor disapprove 12.5%

D Disapprove 20.8%

E Strongly disapprove 0%

Question 14: For pancreatic cystic lesions, which markers do you choose for fluid analysis?

A. Amylase

B. Carcinoembryonic antigen (CEA)

C. Cancer antigen (CA) 19-9

D. CA 72-4

E. CA 125

F. Mucin

G. Other (specify)

Answer: Amylase (69.7%; 23/33) and (CEA; 87.88%, 29/33) were recommended.

LOE: Level II
Vote:
A Strongly approve 62.5%

B Approve 25%

C Neither approve nor disapprove 8.3%

D Disapprove 0%

E Strongly disapprove 4.2%

Question 15: For pancreatic cystic lesions, is periprocedural administration of antibiotics needed?

A. Yes, periprocedural application of antibiotics is needed.

B. No, it is not needed.

Answer: Periprocedural administration of antibiotics is needed according to 85.3% of experts (29/34).

LOE: Level V

Vote:

A Strongly approve 41.7%

B Approve 37.5%

C Neither approve nor disapprove 16.7%

D Disapprove 4.2%

E Strongly disapprove 0%

Part VI Do you modify indications and/or sampling technique in the presence of the following situation?

Question 16: YES or NO: Do you modify indications and/or sampling technique in the presence of…

A. Non-steroidal anti-inflammatory drugs (NSAIDs)

B. Antiplatelet agents (ex: clopidogrel)

C. Anticoagulants (ex: warfarin, apixaban)

D. Low platelets (<50 000)

Answer: When patients use antiplatelet agents (ex: clopidogrel), anticoagulants (ex: warfarin, apixaban) or have low platelet count (<50 000), most professionals (80%, 28/35; 91.43%, 32/35; and 88.57%, 31/35; respectively) will modify indications and/or sampling technique. FNA/FNB will be performed by most experts (77.14%, 27/35) in patients using NSAIDs.

Vote:

A Strongly approve 41.7%

B Approve 54.2%

C Neither approve nor disapprove 0%

D Disapprove 4.2%

E Strongly disapprove 0%

Part VII Opinion about Fanning technique

Question 17: In your opinion, does needle fanning technique possess a better diagnostic ability than the standard technique?

A. Yes, it does.

B. No, it is similar to the standard technique

Answer: Needle fanning technique shows a better diagnostic ability than the standard technique according to 88.6% of experts (31/35).

LOE: Level II

Vote:

A Strongly approve 33.3%

B Approve 41.7%

C Neither approve nor disapprove 8.3%

D Disapprove 12.5%

E Strongly disapprove 4.2%

***Level of evidence (LOE):**

Level I
Evidence from a systematic review or meta-analysis of all relevant RCTs (randomized controlled trial) or evidence-based clinical practice guidelines based on systematic reviews of RCTs or three or more RCTs of good quality that have similar results.

Level II
Evidence obtained from at least one well-designed RCT (*e.g*. large multi-site RCT).

Level III
Evidence obtained from well-designed controlled trials without randomization (i.e. quasi-experimental).

Level IV
Evidence from well-designed case-control or cohort studies.

Level V
Evidence from systematic reviews of descriptive and qualitative studies (meta-synthesis).

Level VI
Evidence from a single descriptive or qualitative study.

Level VII
Evidence from the opinion of authorities and/or reports of expert committees.