

# World Journal of *Meta-Analysis*

*World J Meta-Anal* 2017 April 26; 5(2): 14-70



**SYSTEMATIC REVIEWS**

- 14 Environmental tobacco smoke exposure and heart disease: A systematic review  
*Lee PN, Forey BA, Hamling JS, Thornton AJ*
- 41 Statin use and risk of cancer: An overview of meta-analyses  
*Undela K, Shah CS, Mothe RK*

**META-ANALYSIS**

- 54 Is there a difference between 19G core biopsy needle and 22G core biopsy needle in diagnosing the correct etiology? - A meta-analysis and systematic review  
*Kandula M, Bechtold ML, Verma K, Aulakh BS, Taneja D, Puli SR*
- 63 Mucin expression and the pancreas: A systematic review and meta-analysis  
*Niv Y*

**ABOUT COVER**

Editorial Board Member of *World Journal of Meta-Analysis*, Aiping Lu, MD, PhD, Director, Dean and Chair Professor, School of Chinese Medicine, Hong Kong Baptist University, Hong Kong, China

**AIM AND SCOPE**

*World Journal of Meta-Analysis (World J Meta-Anal, WJMA, online ISSN 2308-3840, DOI: 10.13105)* is a peer-reviewed open access academic journal that aims to guide clinical practice and improve diagnostic and therapeutic skills of clinicians, with a specific focus on meta-analysis, systematic review, mixed-treatment comparison, meta-regression, overview of reviews.

*WJMA* covers a variety of clinical medical fields including allergy, anesthesiology, cardiac medicine, clinical genetics, clinical neurology, critical care, dentistry, dermatology, emergency medicine, endocrinology, family medicine, gastroenterology and hepatology, geriatrics and gerontology, hematology, immunology, infectious diseases, internal medicine, obstetrics and gynecology, oncology, ophthalmology, orthopedics, otolaryngology, pathology, pediatrics, peripheral vascular disease, psychiatry, radiology, rehabilitation, respiratory medicine, rheumatology, surgery, toxicology, transplantation, and urology and nephrology, while maintaining its unique dedication to systematic reviews and meta-analyses.

**INDEXING/ABSTRACTING**

*World Journal of Meta-Analysis* is now indexed in Emerging Sources Citation Index (Web of Science).

**FLYLEAF**

**I-IV** Editorial Board

**EDITORS FOR THIS ISSUE**

**Responsible Assistant Editor:** *Xiang Li*  
**Responsible Electronic Editor:** *Dan Li*  
**Proofing Editor-in-Chief:** *Lian-Sheng Ma*

**Responsible Science Editor:** *Jin-Xin Kong*  
**Proofing Editorial Office Director:** *Xiu-Xia Song*

**NAME OF JOURNAL**  
*World Journal of Meta-Analysis*

**ISSN**  
 ISSN 2308-3840 (online)

**LAUNCH DATE**  
 May 26, 2013

**FREQUENCY**  
 Bimonthly

**EDITOR-IN-CHIEF**  
**Giuseppe Biondi-Zoccai, MD, Assistant Professor,**  
 Department of Medico-Surgical Sciences and Biotechnologies, Sapienza University of Rome, Latina 04100, Italy

**EDITORIAL BOARD MEMBERS**  
 All editorial board members resources online at <http://www.wjgnet.com/2308-3840/editorialboard.htm>

**EDITORIAL OFFICE**  
 Xiu-Xia Song, Director

*World Journal of Meta-Analysis*  
 Baishideng Publishing Group Inc  
 7901 Stoneridge Drive,  
 Suite 501, Pleasanton, CA 94588, USA  
 Telephone: +1-925-2238242  
 Fax: +1-925-2238243  
 E-mail: [editorialoffice@wjgnet.com](mailto:editorialoffice@wjgnet.com)  
 Help Desk: <http://www.f0publishing.com/helpdesk>  
<http://www.wjgnet.com>

**PUBLISHER**  
 Baishideng Publishing Group Inc  
 7901 Stoneridge Drive,  
 Suite 501, Pleasanton, CA 94588, USA  
 Telephone: +1-925-2238242  
 Fax: +1-925-2238243  
 E-mail: [bpgoffice@wjgnet.com](mailto:bpgoffice@wjgnet.com)  
 Help Desk: <http://www.f0publishing.com/helpdesk>  
<http://www.wjgnet.com>

**PUBLICATION DATE**  
 April 26, 2017

**COPYRIGHT**  
 © 2017 Baishideng Publishing Group Inc. Articles published by this Open-Access journal are distributed under the terms of the Creative Commons Attribution Non-commercial License, which permits use, distribution, and reproduction in any medium, provided the original work is properly cited, the use is non commercial and is otherwise in compliance with the license.

**SPECIAL STATEMENT**  
 All articles published in journals owned by the Baishideng Publishing Group (BPG) represent the views and opinions of their authors, and not the views, opinions or policies of the BPG, except where otherwise explicitly indicated.

**INSTRUCTIONS TO AUTHORS**  
<http://www.wjgnet.com/bpg/gerinfo/204>

**ONLINE SUBMISSION**  
<http://www.f0publishing.com>

## Is there a difference between 19G core biopsy needle and 22G core biopsy needle in diagnosing the correct etiology? - A meta-analysis and systematic review

Manasa Kandula, Matthew L Bechtold, Kaninika Verma, Bhagat S Aulakh, Deepak Taneja, Srinivas R Puli

Manasa Kandula, Division of Internal Medicine, University of Illinois College of Medicine at Peoria, Peoria, IL 61614, United States

Matthew L Bechtold, Division of Gastroenterology and Hepatology, University of Missouri School of Medicine at Columbia, Columbia, MO 65211, United States

Kaninika Verma, Bhagat S Aulakh, Deepak Taneja, Illinois Lung and Critical Care Institute, University of Illinois College of Medicine at Peoria, Peoria, IL 61614, United States

Srinivas R Puli, Division of Gastroenterology and Hepatology, University of Illinois College of Medicine at Peoria, Peoria, IL 61614, United States

**Author contributions:** Kandula M contributed to acquisition of data, data interpretation and analysis, and drafted the article; Bechtold M, Aulakh BS and Taneja D analyzed the data; Verma K, Aulakh BS and Taneja D interpreted the data; Puli SR contributed to conception and design of the study, verification of statistical methods; Bechtold M, Verma K, Aulakh BS, Taneja D and Puli SR revised the article, and approved the final version of published manuscript.

**Conflict-of-interest statement:** The authors deny any conflict of interest.

**Data sharing statement:** No additional data available.

**Open-Access:** This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

**Manuscript source:** Unsolicited manuscript

**Correspondence to:** Manasa Kandula, MD, Division of Internal

Medicine, University of Illinois College of Medicine at Peoria, 530 NE Glen Oak Avenue, Peoria, IL 61614, United States. [manasakandula14@gmail.com](mailto:manasakandula14@gmail.com)  
Telephone: +1-309-6249400  
Fax: +1-309-6242291

Received: June 6, 2016

Peer-review started: June 12, 2016

First decision: September 13, 2016

Revised: November 13, 2016

Accepted: December 13, 2016

Article in press: December 14, 2016

Published online: April 26, 2017

### Abstract

#### AIM

To compare the accuracy of endoscopic ultrasonography (EUS) 19G core biopsies and 22G core biopsies in diagnosing the correct etiology for a solid mass.

#### METHODS

Articles were searched in Medline, PubMed, and Ovid journals. Pooling was conducted by both fixed and random effects models.

#### RESULTS

Initial search identified 4460 reference articles for 19G and 22G, of these 670 relevant articles were selected and reviewed. Data was extracted from 6 studies for 19G ( $n = 289$ ) and 16 studies for 22G ( $n = 592$ ) which met the inclusion criteria. EUS 19G core biopsies had a pooled sensitivity of 91.6% (95%CI: 87.1-95.0) and pooled specificity of 95.9% (95%CI: 88.6-99.2), whereas EUS 22G had a pooled sensitivity of 83.3% (95%CI: 79.7-86.6) and pooled specificity of 64.3% (95%CI: 54.7-73.1). The positive likelihood ratio of EUS 19G core biopsies was 9.08 (95%CI: 1.12-73.66) and EUS 22G core biopsies was 1.99 (95%CI: 1.09-3.66).

The negative likelihood ratio of EUS 19G core biopsies was 0.12 (95%CI: 0.07-0.24) and EUS 22G core biopsies was 0.25 (95%CI: 0.14-0.41). The diagnostic odds ratio was 84.74 (95%CI: 18.31-392.26) for 19G core biopsies and 10.55 (95% CI: 3.29-33.87) for 22G needles.

### CONCLUSION

EUS 19G core biopsies have an excellent diagnostic value and seem to be better than EUS 22G biopsies in detecting the correct etiology for a solid mass.

**Key words:** Endoscopic ultrasound guided fine needle aspiration; Solid mass lesions; Endoscopic ultrasound; Pancreatic mass; Pancreatic cytology; Core biopsies; 19G procure needle; Meta-analysis; Systematic review; 22G procure needle

© **The Author(s) 2017.** Published by Baishideng Publishing Group Inc. All rights reserved.

**Core tip:** Management of pancreatic solid mass lesions relies greatly on accuracy of diagnosis of these lesions. Procure fine needle biopsy needles have been found to have a diagnostic accuracy comparable to, if not better than the standard needles in diagnosing the intestinal and extra-intestinal mass lesions. Amongst the Procure needles, the 19G and 22G Procure needles have both been shown to obtain good quality core tissue samples but both have unique characteristics of their own. This meta-analysis compares the feasibility and accuracy of 19G and 22G Procure needles in determining the diagnosis of solid mass lesions.

Kandula M, Bechtold ML, Verma K, Aulakh BS, Taneja D, Puli SR. Is there a difference between 19G core biopsy needle and 22G core biopsy needle in diagnosing the correct etiology? - A meta-analysis and systematic review. *World J Meta-Anal* 2017; 5(2): 54-62 Available from: URL: <http://www.wjgnet.com/2308-3840/full/v5/i2/54.htm> DOI: <http://dx.doi.org/10.13105/wjma.v5.i2.54>

## INTRODUCTION

Endoscopic ultrasound guided fine needle aspiration (EUS-FNA) is the recommended procedure for the sampling of solid mass lesions within the gastrointestinal tract and extra-intestinal organs, especially pancreatic mass lesions<sup>[1-4]</sup>. It has been reported from previous studies that EUS-FNA has high diagnostic accuracy (78%-95%)<sup>[5,6]</sup>, sensitivity (64%-95%) and specificity (75%-100%)<sup>[6,7]</sup> for cytological diagnosis. To make an accurate diagnosis though, histological studies are essential in addition to cytological studies. Although cytological study can detect cellular findings like anisonucleosis and nuclear enlargement that suggest malignancy, inflammation in the tissue causes regenerative and reactive changes that make it hard to distinguish it from well

differentiated neoplasia based on cytological study alone. Moreover, there are certain neoplasms like lymphomas and stromal tumors that would require tissue architecture and cell morphology for accurate pathological assessment and this is not possible without obtaining histological samples<sup>[8-10]</sup>. Other factors that influence the diagnostic accuracy of EUS-FNA include the availability of an onsite cytopathologist to render a diagnosis, experience of the endosonographer, location of the lesion, the method of preparation and the type and size of the needle used to obtain the sample<sup>[11-14]</sup>.

Currently, there are three needle sizes (19G, 22G and 25G) that are commercially available, of which 22G is probably the most widely used. Theoretically, it is difficult to obtain histological samples with smaller needles. Hence, the trucut biopsy needle (Cook Medical, Bloomington, IN, United States) was developed with 19G needles<sup>[15]</sup>. EUS-trucut needle biopsy (EUS-TNB) technique was more accurate than FNA for neoplasms requiring histological analysis, but the 19G caliber posed certain difficulties. It was difficult to maneuver the needle owing to its rigidity, and the mechanical friction of the firing mechanism limited its use in evaluating pancreatic head masses and duodenal lesions where a transduodenal approach was required<sup>[8]</sup>.

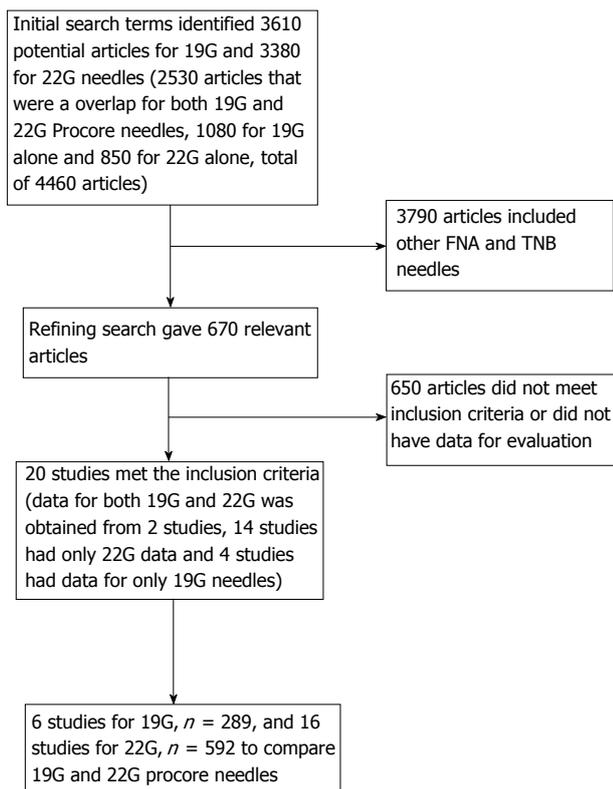
The Procure EUS-fine needle biopsy (EUS-FNB) needle, a newer generation, with reverse beveled technology was developed to improve quality of core tissue samples for histologic analysis. These needles (Procure, Cook Medical, Winston-Salem, NC, United States) available in different sizes were shown to have promising results. The histologic samples obtained by the 19G procure needle had a diagnostic accuracy of more than 90% as shown in a large prospective study done in Europe<sup>[16]</sup>. There were still some technical problems encountered with the 19G Procure when performing transduodenal passes. Hence the same FNB device was developed in the 22G caliber. In several other studies, the 22G Procure needle was found to require lower number of passes to achieve the same contributive sample rate as the FNA needles<sup>[17-19]</sup>.

There have been a lot of studies comparing the Procure FNB needles with standard FNA and TNB needles. These studies have established that the feasibility, yield and accuracy of the Procure needles in diagnosing intestinal, extra-intestinal mass lesions as well as peri-intestinal lymphadenopathy is comparable, if not better than the standard needles. We conducted a meta-analysis from the relevant studies done so far, and reviewed the literature to determine if there was a difference in the diagnostic accuracy of 19G Procure vs 22G Procure biopsy needles in the evaluation of solid mass lesions.

## MATERIALS AND METHODS

### Study selection criteria

Only EUS 19G and 22G core biopsy studies on solid mass lesions confirmed by surgery or appropriate follow-up were selected. Only studies from which a 2 × 2 table



**Figure 1** Flow chart showing search results and study selection. FNA: Fine needle aspiration; TNB: Trucut needle biopsy.

could be constructed for true positive, false negative, false positive and true negative values were included.

### Data collection and extraction

Articles were searched in MEDLINE, PubMed, Ovid journals, Cumulative Index for Nursing and Allied Health Literature, ACP journal club, DARE, International Pharmaceutical Abstracts, old MEDLINE, MEDLINE nonindexed citations, OVID Healthstar, and Cochrane Controlled Trials Registry. Search included articles of all languages from the year 1946 to present. The search terms used were EUS-FNA, ultrasound, endosonography, solid mass lesions, pancreatic mass, pancreatic cytology, core biopsies, 19G procure needle, 22G needle, surgery, histopathology, sensitivity, specificity, positive predictive value, and negative predictive value. Data included in the meta-analysis was obtained by intention to treat analysis of the original data. Two plus two tables were constructed with the data extracted from each study. Two authors independently searched and extracted the data into an abstraction form. No additional data was obtained from the authors. Any differences were resolved by mutual agreement.

### Quality of studies

Clinical trial with a control arm can be assessed for the quality of the study. A number of criteria have been used to assess this quality of a study (e.g., randomization, selection bias of the arms in the study, concealment of

allocation, and blinding of outcome)<sup>[20,21]</sup>. There is no consensus on how to assess studies without a control arm. Hence, these criteria do not apply to studies without a control arm<sup>[21]</sup>. Therefore, for this meta-analysis and systematic review, studies were selected based on completeness of data and inclusion criteria.

### Statistical analysis

Meta-analysis for the accuracy of EUS guided 19G core biopsies and 22G core biopsies in diagnosing solid mass lesions was performed by calculating pooled estimates of sensitivity, specificity, likelihood ratios, and diagnostic odds ratios. Pooling was conducted using both Mantel-Haenszel Method (fixed effects model) and DerSimonian Laird Method (random effects model). The confidence intervals were calculated using the F Distribution Method<sup>[22]</sup>. Forrest plots were drawn to show the point estimates in each study in relation to the summary pooled estimate. The width of the point estimates in the Forrest plots indicates the assigned weight to that study. For 0 value cells, a 0.5 was added as described by Cox<sup>[23]</sup>. The heterogeneity of the sensitivities and specificities were tested by applying the likelihood ratio test<sup>[24]</sup>. The heterogeneity of likelihood ratios and diagnostic odds ratios were tested using Cochran's Q test based upon inverse variance weights<sup>[25]</sup>. Heterogeneity among studies was also tested by using summary receiver operating characteristic (SROC) curves. SROC curves were used to calculate the area under the curve (AUC). The effect of publication and selection bias on the summary estimates was tested by Egger bias indicator<sup>[26]</sup> and Begg-Mazumdar bias indicator<sup>[27]</sup>. Also, funnel plots were constructed to evaluate potential publication bias using the standard error and diagnostic odds ratio<sup>[28,29]</sup>.

## RESULTS

Initial search identified 3610 reference articles for 19G core biopsies and 3380 reference articles for 22G core biopsies (4460 total as there was an overlap of the articles), of these, 670 relevant articles were selected and reviewed. Six studies ( $n = 289$ ) for 19G core biopsies and 16 studies ( $n = 592$ ) for 22G core biopsies which met the inclusion criteria were included in this analysis. Figure 1 shows the search results and Table 1 shows the characteristics for EUS studies included in this meta-analysis. Of the 20 studies included in this analysis, 12 were published as full-text articles and 8 were abstracts in peer reviewed journals. The pooled estimates given are estimates calculated by the fixed and random effects model.

### Accuracy of EUS guided 19G core biopsies to diagnose solid mass lesions

Pooled sensitivity of EUS 19G core biopsies in diagnosing solid mass lesions was 91.6% (95%CI: 87.1%-95.0%). 19G Procure needle had a pooled specificity of 95.9% (95%CI: 88.6%-99.2%). Forrest plot in Figure 2 shows

Table 1 Basic characteristics of the studies

Ref.	Type of article/study	Needle type	Number of biopsies	Type of lesion	Accurate diagnoses (TP and TN)
Irions <i>et al</i> <sup>[40]</sup> , 2011	Abstract	22G	6	Pancreatic adenocarcinoma, esophageal SCC	4
Barresi <i>et al</i> <sup>[44]</sup> , 2014	Full article	22G	60	Pancreatic lesions	36
Alatawi <i>et al</i> <sup>[17]</sup> , 2015	Full article	22G	50	Pancreatic lesions	48
Vanbiervliet <i>et al</i> <sup>[33]</sup> , 2014	Full article	22G	80	Adenocarcinoma, metastatic lung cancer	67
Ganc <i>et al</i> <sup>[19]</sup> , 2014	Full article	22G	15	Pancreatic mass lesions	8
Ramay <i>et al</i> <sup>[48]</sup> , 2013	Abstract	22G	24	Perigastric, peripancreatic subcarinal, mediastinal lymph nodes	24
Larghi <i>et al</i> <sup>[43]</sup> , 2011	Full article	22G	61	Adenocarcinoma, neuroendocrine tumors, lymphoma	54
Strand <i>et al</i> <sup>[34]</sup> , 2014	Full article	22G	28	Solid pancreatic neoplasms	7
Bang <i>et al</i> <sup>[32]</sup> , 2012	Full article	22G	28	Pancreatic masses	25
Ganc <i>et al</i> <sup>[19]</sup> , 2014	Abstract	22G	30	Pancreatic masses	28
Krishnamurthy <i>et al</i> <sup>[45]</sup> , 2013	Abstract	22G	37	Adenocarcinoma, neuroendocrine tumors	24
Komanduri <i>et al</i>	Abstract	22G	10	Pancreatic lesions	10
Kim <i>et al</i>	Full article	22G	12	GI stromal tumors, pancreatic masses, lymphoma	9
Ramay <i>et al</i> <sup>[48]</sup> , 2013	Abstract	22G	40	Pancreatic lesions	40
Park <i>et al</i> <sup>[47]</sup> , 2012	Abstract	22G	43	Solid pancreatic lesions	32
Fabbri <i>et al</i> <sup>[46]</sup> , 2015	Full article	22G	68	Solid pancreatic lesions, pancreatic cystic lesions	56
Petrone <i>et al</i> <sup>[39]</sup> , 2012	Abstract	19G	49	Pancreatic mass, submucosal lesions, mediastinal mass	46
Iglesias-García <i>et al</i> <sup>[41]</sup> , 2014	Full article	19G	114	Pancreatic tumors, mediastinal lymphadenopathy, intraabdominal masses	106
Komanduri <i>et al</i>	Abstract	19G	10	Pancreatic lesions	10
Lovacheva <i>et al</i> <sup>[35]</sup> , 2013	Abstract	19G	23	Mediastinal lymph nodes	19
Iglesias-García <i>et al</i> <sup>[41]</sup> , 2014	Full article	19G	87	Pancreatic tumors, mediastinal lymphadenopathy, intraabdominal masses	83
Irions <i>et al</i> <sup>[40]</sup> , 2011	Abstract	19G	6	Pancreatic adenocarcinoma, GIST, benign lymph nodes	4

TP: True positives; TN: True negatives; SCC: Squamous cell carcinoma; GI: Gastrointestinal; GIST: Gastrointestinal stromal tumors.

the sensitivity and specificity of 19G core biopsies to diagnose solid mass lesions. The positive likelihood ratio was 9.07 (95%CI: 1.12-73.65) and negative likelihood ratio was 0.12 (95%CI: 0.06-0.24). The diagnostic odds ratio, the odds of having the correct histologic etiology of a mass in positive as compared to negative EUS-FNB studies was 84.7 (95%CI: 18.3-392.2). All the pooled estimates calculated by fixed and random effect models were similar. SROC curves showed an area under the curve of 0.95. Figure 3 shows the SROC curves for EUS 19G core biopsies to diagnose solid mass lesions. The *p* for chi-squared heterogeneity for all the pooled accuracy estimates was > 0.10.

#### Accuracy of EUS 22G core biopsies to diagnose solid mass lesions

Pooled sensitivity of EUS 22G core biopsies in diagnosing solid mass lesions was 83.3% (95%CI: 79.7%-86.6%). 22G Procure needle had a pooled specificity of 64.3% (95%CI: 54.7%-73.1%). The positive likelihood ratio was 1.99 (95%CI: 1.09%-3.66%) and negative likelihood ratio was 0.25 (95%CI: 0.14%-0.41%). The diagnostic odds ratio, the odds of having the correct histologic etiology of a mass in positive as compared to negative EUS-FNB studies was 10.55 (95%CI: 3.28%-33.87%). All the pooled estimates calculated by fixed and random effect models were similar. SROC curves showed an area under the curve of 0.95. The *P* for  $\chi^2$  heterogeneity for all the pooled accuracy estimates was > 0.10.

#### Bias estimates

The publication bias calculated by Begg-Mazumdar bias

indicator gave a Kendall's tau *b* value of -0.2, *P* = 0.21 and Egger bias indicator gave a value of -0.56 (95%CI: -2.28 to 1.16, *P* = 0.50). Funnel plots in Figure 4 show no effect of publication bias on the pooled estimates calculated for 19G or 22G core biopsies.

## DISCUSSION

The Procure needles with reverse bevel technology for EUS-FNB are a recent development in the EUS-platform for maximizing acquisition of core tissue specimens for histopathological analysis. The 19G Procure needle was initially developed to overcome the limitations encountered with EUS-TNB, like rigidity of the 19G caliber needle as well as the mechanical friction of the firing mechanism produced by the torqued endoscope<sup>[8]</sup>. The same device was developed in the 22G platform because of the difficulties encountered during transduodenal passes with the 19G needle (the needle had to be advanced out of the scope in the stomach before reaching the duodenum)<sup>[30]</sup>. Obtaining core biopsy specimens would allow for detailed analysis of preserved tissue architecture and also provide the opportunity to immunostain the tissue, thus increasing diagnostic accuracy. It has also been shown to be not inferior to rapid onsite cytological examination, which is known to be a significant factor in decreasing the number of inadequate diagnoses, thus also playing a role in economical cost saving<sup>[31,32]</sup>. The 19G and 22G Procure needles have been studied significantly as to their feasibility and yield in the sampling of solid pancreatic lesions and all these studies have shown that they are comparable to the standard

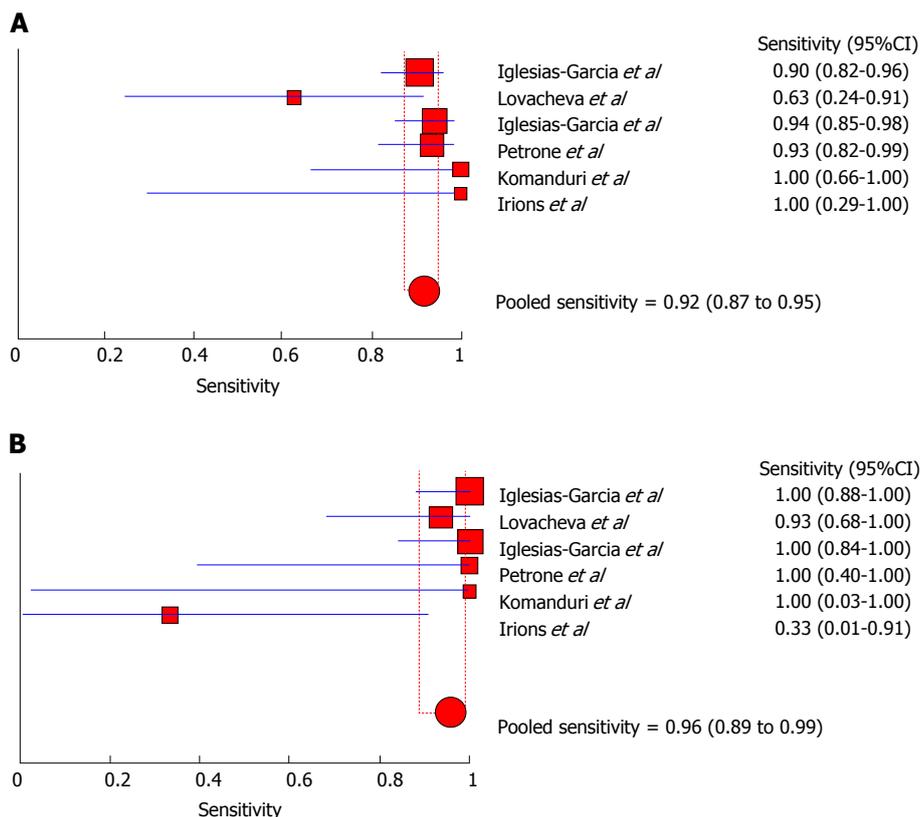


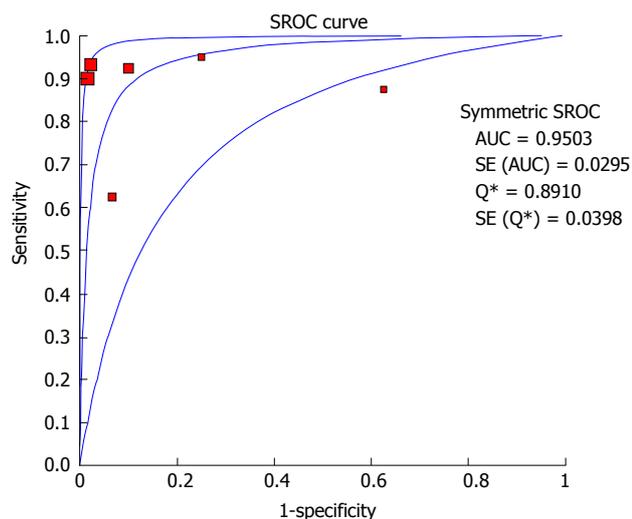
Figure 2 Forest plot showing sensitivity (A) and specificity (B) of 19G Procure needle.

FNA needles<sup>[31-34]</sup>. Our meta-analysis showed that of these two Procure needles, the 19G needle is superior to the 22G needle in core histology yield and diagnostic accuracy.

In the study by Iglesias-Garcia *et al*<sup>[16]</sup>, EUS-FNB by 19G Procure needle of 114 lesions were evaluated for sample quality for histological evaluation, and over-all diagnostic accuracy compared with a standard diagnosis. It was found that the 19G Procure needle offered the possibility of obtaining a core sample for histological evaluation with a diagnostic accuracy of over 85%. It reached an accuracy of 92.9% for the detection of malignancy<sup>[16]</sup>. Lovacheva *et al*<sup>[35]</sup> confirmed that 19G Procure needle had a high diagnostic yield when it came to malignancies and histological diagnosis, although there was no significant difference to FNA for cytology in benign diseases. This is much better than the EUS-biopsy with the quick-core needle where the overall accuracy ranged between 61% and 84%<sup>[36-38]</sup>. Although transduodenal passes were difficult with the 19G Procure needle, it was still better than the Quick-Core needle where the sample quality was significantly affected for lesions that needed to be punctured from the duodenum. Petrone *et al*<sup>[39]</sup> had even better results where the needle provided adequate histological sample in 98% of the cases with an overall accuracy reaching 94% with regard to the final gold standard diagnosis. Irions *et al*<sup>[40]</sup> studied both the 19G and 22G Procure needles and determined that samples could be obtained safely and with high yield using either of them. Core samples in this study were

obtained with more than one pass in 80% of the lesions. In another recent study by Iglesias-García *et al*<sup>[41]</sup> with the 19G Procure needle, there were no complications related to the procedure in their 87 patients and it was determined to be as safe as the standard FNA needle. Moreover, this study showed that a single pass of the needle obtained the same results as multiple passes in previous studies by Yasuda *et al*<sup>[42]</sup> and Larghi *et al*<sup>[43]</sup> done with the standard needle, as well as other recent studies with the Quick-Core needle. This may be because of the reverse bevel technology in the Procure needle that cuts the tissue in to and fro movements during a single needle pass and thus obtains an adequate core tissue specimen.

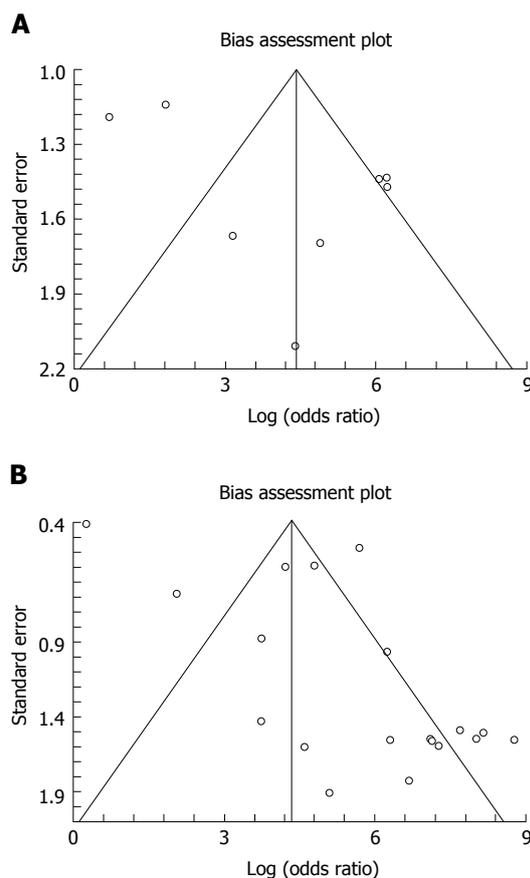
Bang *et al*<sup>[32]</sup> did a study in 2012 to compare 22G FNA and FNB needles and found no significant difference in the yield or quality of the histologic specimens in these groups. They did not find any difference in the median number of passes required to establish an on-site diagnosis. The rate of optimal specimens in this study was 80% as compared to 92.9% reported with the 19G needle in the Iglesias-Garcia study. Over-all, the quality of specimens obtained by the small caliber 22G needle was unsatisfactory for histologic analysis, though this could also be because there were passes that were performed for onsite analysis before specimens were collected for cell block. On the safety front, the 22G FNB needle was similar to the FNA needle and comparable to the 19G needle, with only a couple of minor complications<sup>[32]</sup>. Barresi *et al*<sup>[44]</sup> followed this up and studied the feasibility



**Figure 3** Summary receiver operating characteristic curves for endoscopic ultrasonography 19G core biopsies to diagnose solid lesions. SROC: Summary receiver operating characteristic; AUC: Area under the curve.

and diagnostic yield of 22G Procore needle for EUS-FNA and biopsy of pancreatic cystic lesions. In a subgroup analysis of malignant lesions and lesions with a solid component, the adequacy for cyto-histological diagnosis of the samples obtained by 22G FNB needle was found to be 100% and 94.4% respectively, which is superior to conventional standard FNA needles<sup>[44]</sup>. Some studies looked at different aspects of FNB needle sampling, like stromal fragments in the sample allowing for a more precise histologic diagnosis, or FNB needles making the procedure quicker, and lower number of needle passes required with Procore needles when compared to standard needles<sup>[19,45-48]</sup>. There were several other studies done previously that showed that there was no improvement in diagnostic yield with FNB as compared to FNA needles. Strand *et al* did a study that did not show a significant advantage of using FNB over FNA in terms of being a core biopsy needle although it was comparable in terms of providing material for cytology<sup>[34]</sup>. However, this was a small study and there were also concerns about technical quality of the procedures. Vanbiervliet *et al*<sup>[33]</sup> compared the standard and core 22G needle and showed that the diagnostic accuracy was comparable for solid pancreatic lesions although each patient had two passes with the standard needle and one pass with the core needle, thus biasing the study. Alatawi *et al*<sup>[17]</sup> compared 22G FNA and FNB needles in 100 patients and concluded that despite similar diagnostic accuracy, FNB needles required lower number of needle passes and yielded samples of higher histological quality, thus mitigating previous studies on the limited contribution of FNB needles in pancreatic cancer work up.

From the above discussion, it is clear that Procore needles, both 19 gauge and 22 gauge, with reverse bevel technology has been very promising in obtaining samples for the diagnosis of solid mass lesions. In this pooled analysis, it has been shown that the 19G procore



**Figure 4** Bias assessment plot for 19G (A) and 22G (B) Procore needle.

needle is better at obtaining samples for diagnosing solid mass lesions than 22G Procore needle. The sensitivity of the 19G needle is 91.6% as compared to 83.3% for the 22G. The difference in specificity is even higher with the 19G having 95.9% specificity while the 22G has a specificity of only 64.3% when it came to the adequacy of specimens and diagnostic accuracy with that histologic sample for solid mass lesions. Further studies are required to determine the factors that may have influenced the relatively low specificity of 22G Procore needle seen in this pooled analysis, which may include the differences in sample yield and method of obtaining the sample. Diagnostic odds ratio is defined as the odds of having the correct histologic etiology of the mass in positive as compared to negative EUS-FNB studies. To diagnose the histologic etiology of a solid mass lesion in the intestinal and extra-intestinal organs, the EUS-FNB using the 19G Procore needle had a very high diagnostic odds ratio (approximately 84 times) as compared to the 22G Procore needle (approximately 10 times). For example, if a core biopsy of solid pancreatic mass is done using a 19G Procore needle, the odds of having the correct histologic diagnosis is around 84 times as compared to only 10 times with the 22G needle. The positive likelihood ratio of a test is a gauge of how well the test identifies a disease state. Higher the positive likelihood ratio, the better the test performs in identifying the true disease status. On the other hand, a negative

likelihood ratio of a test is a gauge of how well the test performs in excluding a disease state. The lower the negative likelihood ratio, the better the test performs in excluding a disease. For diagnosing a solid mass lesion, EUS-FNB using a 19G Procure needle had a higher positive likelihood ratio than the 22G needle but the negative likelihood ratio was low for both of them. This indicates that the 19G Procure needle performs better in ruling in a diagnosis than the 22G needle though both of them fared fairly low in excluding a diagnosis.

In our study, the 19G Procure was found to be superior in almost every aspect. One limitation that this needle had was that the authors in these studies notably reported failures when it came to transduodenal passes with the 19G Procure needle. The FNB needle had to be advanced out of the echoendoscope while in the stomach before the scope could be passed into the duodenum<sup>[16,41]</sup>. This difficulty was not present with the 22G Procure needle where the FNB needle exited the sheath with relative ease in all the patients in the study by Bang *et al*<sup>[32]</sup>. Another limitation is that there are several factors influencing the diagnostic accuracy that include experience and expertise of the endosonographers and pathologists, as well as size and location of the lesion. Some of the studies had on-site pathologists and others did not and this may affect the difference in the diagnostic accuracy between the 19G and 22G core biopsies depending on whether they used them or not. When comparing diagnostic yield based on number of needle passes, comparing FNA and FNB needles in the same patient, although makes a study more statistically significant, would be difficult as subsequent needle passes would follow the same pathway as the first one and some studies<sup>[17,18]</sup> compared them in different patients to overcome this bias. The number of studies from which data was extracted was not equal for 19G (6 studies) and 22G (16 studies) as there were not as many studies done on the 19G yet, with only two studies that directly compared them, and this may have affected the results.

Heterogeneity among different studies was determined by drawing SROC curves and finding the AUC, since different studies might use slightly different criteria for staging. An AUC of 1 for any test indicates that the test is excellent. SROC curves for 19G Procure needle showed that the value for AUC was very close to 1, indicating that this needle has an excellent diagnostic value in detecting the correct histologic etiology of a solid mass lesion.

Studies with statistically significant results tend to be published and cited. Smaller studies may show larger treatment effects due to fewer case-mix differences (*e.g.*, patients with only early or late disease) than larger trials. This bias can be estimated by bias indicators and construction of funnel plots. This publication and selection bias may affect the summary estimates. Also, bias among studies can affect the shape of the funnel plot. In this meta-analysis and systematic review, bias calculations using Egger bias indicator<sup>[26]</sup> and Begg-

Mazumdar bias indicator<sup>[27]</sup> showed no statistically significant bias. Furthermore, analysis using funnel plots showed no significant publication among the studies included in this analysis.

In conclusion, EUS 19G core biopsies have an excellent diagnostic value and seem to be superior to the EUS 22G biopsies in detecting the correct etiology for a solid mass lesion. The specificity and sensitivity are both higher for the 19G Procure needle when compared to the 22G Procure needle. Though the 22G may be easier to maneuver for lesions requiring transduodenal passes, the overall diagnostic accuracy is greater for 19G. In conclusion, 19G needles may be strongly considered over 22G needles when evaluating solid mass lesions. Further randomized controlled trials comparing the two needles directly are required for more definitive conclusions.

## COMMENTS

### Background

Procure fine needle biopsy needles have been found to have a diagnostic accuracy comparable to, if not better than the standard needles in diagnosing intestinal and extra-intestinal mass lesions. This is a meta-analysis and systematic review comparing the 19G and 22G core biopsy needles in making the correct etiologic diagnosis.

### Research frontiers

Management of pancreatic solid mass lesions relies greatly on accuracy of diagnosis of these lesions. Research has been directed towards the various fine biopsy needles used in the diagnosis which will in turn affect the management and prognosis in a patient.

### Innovations and breakthroughs

In the present study, the authors investigated the outcomes of two commonly used Procure needles in the diagnosis of solid mass lesions. This is the first meta-analysis that compares 19G procure and 22G procure needles with regards to their overall accuracy and efficacy.

### Applications

This study gives information about both procure needles and their outcomes with solid mass lesions, thus helping the endoscopist in choosing the appropriate needle for their specific procedure.

### Peer-review

This is an interesting paper and is worth to be published.

## REFERENCES

- 1 Erickson RA. EUS-guided FNA. *Gastrointest Endosc* 2004; **60**: 267-279 [PMID: 15278063 DOI: 10.1016/S0016-5107(04)01529-9]
- 2 Chang KJ. Endoscopic ultrasound (EUS)-guided fine needle aspiration (FNA) in the USA. *Endoscopy* 1998; **30** Suppl 1: A159-A160 [PMID: 9765114 DOI: 10.1055/s-2007-1001505]
- 3 Mortensen MB, Pless T, Durup J, Ainsworth AP, Plagborg GJ, Hovendal C. Clinical impact of endoscopic ultrasound-guided fine needle aspiration biopsy in patients with upper gastrointestinal tract malignancies. A prospective study. *Endoscopy* 2001; **33**: 478-483 [PMID: 11437039 DOI: 10.1055/s-2001-14966]
- 4 Shah JN, Ahmad NA, Beilstein MC, Ginsberg GG, Kochman ML. Clinical impact of endoscopic ultrasonography on the management of malignancies. *Clin Gastroenterol Hepatol* 2004; **2**: 1069-1073 [PMID: 15625651 DOI: 10.1016/S1542-3565(04)00444-6]
- 5 Itoi T, Sofuni A, Itokawa F, Irisawa A, Khor CJ, Rerknimitr R. Current status of diagnostic endoscopic ultrasonography in the

- evaluation of pancreatic mass lesions. *Dig Endosc* 2011; **23** Suppl 1: 17-21 [PMID: 21535194 DOI: 10.1111/j.1443-1661.2011.01132.x]
- 6 **Yoshinaga S**, Suzuki H, Oda I, Saito Y. Role of endoscopic ultrasound-guided fine needle aspiration (EUS-FNA) for diagnosis of solid pancreatic masses. *Dig Endosc* 2011; **23** Suppl 1: 29-33 [PMID: 21535197 DOI: 10.1111/j.1443-1661.2011.01112.x]
  - 7 **Eloubeidi MA**, Chen VK, Eltoun IA, Jhala D, Chhieng DC, Jhala N, Vickers SM, Wilcox CM. Endoscopic ultrasound-guided fine needle aspiration biopsy of patients with suspected pancreatic cancer: diagnostic accuracy and acute and 30-day complications. *Am J Gastroenterol* 2003; **98**: 2663-2668 [PMID: 14687813]
  - 8 **Levy MJ**, Wiersema MJ. EUS-guided Trucut biopsy. *Gastrointest Endosc* 2005; **62**: 417-426 [PMID: 16111962 DOI: 10.1016/j.gie.2005.04.044]
  - 9 **Wiersema MJ**, Vilmann P, Giovannini M, Chang KJ, Wiersema LM. Endosonography-guided fine-needle aspiration biopsy: diagnostic accuracy and complication assessment. *Gastroenterology* 1997; **112**: 1087-1095 [PMID: 9097990 DOI: 10.1016/S0016-5085(97)70164-1]
  - 10 **Mesa H**, Stelow EB, Stanley MW, Mallery S, Lai R, Bardales RH. Diagnosis of nonprimary pancreatic neoplasms by endoscopic ultrasound-guided fine-needle aspiration. *Diagn Cytopathol* 2004; **31**: 313-318 [PMID: 15468134 DOI: 10.1002/dc.20142]
  - 11 **Bentz JS**, Kochman ML, Faigel DO, Ginsberg GG, Smith DB, Gupta PK. Endoscopic ultrasound-guided real-time fine-needle aspiration: clinicopathologic features of 60 patients. *Diagn Cytopathol* 1998; **18**: 98-109 [PMID: 9484637 DOI: 10.1002/(SICI)1097-0339(199802)18:2<98::AID-DC4>3.0.CO;2-P]
  - 12 **Fritscher-Ravens A**, Topalidis T, Bobrowski C, Krause C, Thonke E, Jäckle S, Soehendra N. Endoscopic ultrasound-guided fine-needle aspiration in focal pancreatic lesions: a prospective intraindividual comparison of two needle assemblies. *Endoscopy* 2001; **33**: 484-490 [PMID: 11437040 DOI: 10.1055/s-2001-14970]
  - 13 **Savides TJ**. Tricks for improving EUS-FNA accuracy and maximizing cellular yield. *Gastrointest Endosc* 2009; **69**: S130-S133 [PMID: 19179138 DOI: 10.1016/j.gie.2008.12.018]
  - 14 **Mertz H**, Gautam S. The learning curve for EUS-guided FNA of pancreatic cancer. *Gastrointest Endosc* 2004; **59**: 33-37 [PMID: 14722544 DOI: 10.1016/S0016-5107(03)02028-5]
  - 15 **Levy MJ**. Endoscopic ultrasound-guided trucut biopsy of the pancreas: prospects and problems. *Pancreatol* 2007; **7**: 163-166 [PMID: 17592229 DOI: 10.1159/000104240]
  - 16 **Iglesias-Garcia J**, Poley JW, Larghi A, Giovannini M, Petrone MC, Abdulkader I, Monges G, Costamagna G, Arcidiacono P, Biermann K, Rindi G, Bories E, Doglioni C, Bruno M, Dominguez-Muñoz JE. Feasibility and yield of a new EUS histology needle: results from a multicenter, pooled, cohort study. *Gastrointest Endosc* 2011; **73**: 1189-1196 [PMID: 21420083 DOI: 10.1016/j.gie.2011.01.053]
  - 17 **Alatawi A**, Beuvon F, Grabar S, Leblanc S, Chaussade S, Terris B, Barret M, Prat F. Comparison of 22G reverse-beveled versus standard needle for endoscopic ultrasound-guided sampling of solid pancreatic lesions. *United European Gastroenterol J* 2015; **3**: 343-352 [PMID: 26279842 DOI: 10.1177/2050640615577533]
  - 18 **Alatawi A**, Beuvon F, Grabar S, Leblanc S, Chaussade S, Terris B, Prat F. Comparison of Fenestrated versus Standard Needles for Endoscopic Ultrasound-Guided Biopsy of Solid Pancreatic lesions. *Gastrointest Endosc* 2014; **79**: AB428- AB429 [DOI: 10.1016/j.gie.2014.02.593]
  - 19 **Ganc R**, Colaiaacovo R, Carbonari A, Altenfelder R, Pacheco AJ, Rocha H, Rossini L, Giovannini M. Endoscopic ultrasonography-fine-needle aspiration of solid pancreatic lesions: A prospective, randomized, single-blinded, comparative study using the 22 Gauge EchoTip® ProCore™ HD (A) and the 22 Gauge EchoTip® Ultra HD (B) endoscopic ultrasound needles. *Endosc Ultrasound* 2014; **3**: S11 [PMID: 26425507 DOI: 10.1016/j.gie.2014.02.591]
  - 20 **Jadad AR**, Moore RA, Carroll D, Jenkinson C, Reynolds DJ, Gavaghan DJ, McQuay HJ. Assessing the quality of reports of randomized clinical trials: is blinding necessary? *Control Clin Trials* 1996; **17**: 1-12 [PMID: 8721797 DOI: 10.1016/0197-2456(95)0013-4]
  - 21 **Stroup DF**, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, Moher D, Becker BJ, Sipe TA, Thacker SB. Meta-analysis of observational studies in epidemiology: a proposal for reporting. Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group. *JAMA* 2000; **283**: 2008-2012 [PMID: 10789670 DOI: 10.1001/jama.283.15.2008]
  - 22 **Leemis LM**, Trivedi KS. A Comparison of Approximate Interval Estimators for the Bernoulli Parameter. *Am Stat* 1996; **50**: 63-68
  - 23 **Cox DR**. The analysis of binary data. London: Methuen; 1970
  - 24 **Agresti A**. Analysis of ordinal categorical data. New York: John Wileys & Sons; 1984
  - 25 **Deeks JJ**. Systematic reviews of evaluations of diagnostic and screening tests. In Egger M, Smith GD, Altman DG (eds). *Systematic Reviews in Health Care. Meta-analysis in context*. London: BMJ Books; 2001 [DOI: 10.1002/9780470693926.ch14]
  - 26 **Harbord RM**, Egger M, Sterne JA. A modified test for small-study effects in meta-analyses of controlled trials with binary endpoints. *Stat Med* 2006; **25**: 3443-3457 [PMID: 16345038 DOI: 10.1002/sim.2380]
  - 27 **Begg CB**, Mazumdar M. Operating characteristics of a rank correlation test for publication bias. *Biometrics* 1994; **50**: 1088-1101 [PMID: 7786990 DOI: 10.2307/2533446]
  - 28 **Sterne JA**, Egger M, Smith GD. Systematic reviews in health care: Investigating and dealing with publication and other biases in meta-analysis. *BMJ* 2001; **323**: 101-105 [PMID: 11451790 DOI: 10.1136/bmj.323.7304.101]
  - 29 **Sterne JA**, Egger M. Funnel plots for detecting bias in meta-analysis: guidelines on choice of axis. *J Clin Epidemiol* 2001; **54**: 1046-1055 [PMID: 11576817 DOI: 10.1016/S0895-4356(01)00377-8]
  - 30 **Karadsheh Z**, Al-Haddad M. Endoscopic ultrasound guided fine needle tissue acquisition: where we stand in 2013? *World J Gastroenterol* 2014; **20**: 2176-2185 [PMID: 24605016 DOI: 10.3748/wjg.v20.i9.2176]
  - 31 **Hikichi T**, Irisawa A, Bhutani MS, Takagi T, Shibukawa G, Yamamoto G, Wakatsuki T, Imamura H, Takahashi Y, Sato A, Sato M, Ikeda T, Hashimoto Y, Tasaki K, Watanabe K, Ohira H, Obara K. Endoscopic ultrasound-guided fine-needle aspiration of solid pancreatic masses with rapid on-site cytological evaluation by endosonographers without attendance of cytopathologists. *J Gastroenterol* 2009; **44**: 322-328 [PMID: 19274426 DOI: 10.1007/s00535-009-0001-6]
  - 32 **Bang JY**, Hebert-Magee S, Trevino J, Ramesh J, Varadarajulu S. Randomized trial comparing the 22-gauge aspiration and 22-gauge biopsy needles for EUS-guided sampling of solid pancreatic mass lesions. *Gastrointest Endosc* 2012; **76**: 321-327 [PMID: 22658389 DOI: 10.1016/j.gie.2012.03.1392]
  - 33 **Vanbiervliet G**, Napoléon B, Saint Paul MC, Sakarovich C, Wangermez M, Bichard P, Subtil C, Koch S, Grandval P, Gincul R, Karsenti D, Heyries L, Duchmann JC, Bourgaux JF, Levy M, Calament G, Fumex F, Pujol B, Lefort C, Poincloux L, Pagenault M, Bonin EA, Fabre M, Barthet M. Core needle versus standard needle for endoscopic ultrasound-guided biopsy of solid pancreatic masses: a randomized crossover study. *Endoscopy* 2014; **46**: 1063-1070 [PMID: 25098612 DOI: 10.1055/s-0034-1377559]
  - 34 **Strand DS**, Jeffus SK, Sauer BG, Wang AY, Stelow EB, Shami VM. EUS-guided 22-gauge fine-needle aspiration versus core biopsy needle in the evaluation of solid pancreatic neoplasms. *Diagn Cytopathol* 2014; **42**: 751-758 [PMID: 24550162 DOI: 10.1002/dc.23116]
  - 35 **Lovacheva O**, Shumskaya I, Evgushenko G, Lepekha L. Comparative Efficacy Of Endoscopic Ultrasound-Guided Fine-Needle Aspiration For 22G Versus 19G Needle Using Bronchoscope In Mediastinal Lymphadenopathies Of Uncertain Origin [M]/B102. *Advances in Interventional Pulmonology and Bronchoscopy. American Thoracic Society*, 2013: A3570-A3570
  - 36 **Wittmann J**, Kocjan G, Sgouros SN, Deheragoda M, Pereira SP. Endoscopic ultrasound-guided tissue sampling by combined fine needle aspiration and trucut needle biopsy: a prospective study. *Cytopathology* 2006; **17**: 27-33 [PMID: 16417562 DOI: 10.1111/

- j.1365-2303.2006.00313.x]
- 37 **Storch I**, Shah M, Thurer R, Donna E, Ribeiro A. Endoscopic ultrasound-guided fine-needle aspiration and Trucut biopsy in thoracic lesions: when tissue is the issue. *Surg Endosc* 2008; **22**: 86-90 [PMID: 17479313 DOI: 10.1007/s00464-007-9374-x]
  - 38 **Aithal GP**, Anagnostopoulos GK, Tam W, Dean J, Zaitoun A, Kocjan G, Ragunath K, Pereira SP. EUS-guided tissue sampling: comparison of “dual sampling” (Trucut biopsy plus FNA) with “sequential sampling” (Trucut biopsy and then FNA as required). *Endoscopy* 2007; **39**: 725-730 [PMID: 17620230 DOI: 10.1055/s-2007-966400]
  - 39 **Petrone MC**, Arcidiacono PG, Bruno MJ, Giovannini M, Iglesias-Garcia J, Larghi A, Poley JW, Abdulkader I, Biermann K, Monges GM, Rindi G, Dogliani C, Testoni PA. Sa1540 Comparison Between EUS-Guided 19G and 22G Procure Needle Biopsies in Pancreatic Masses: a Prospective Multicenter Study in 72 Cases. *Gastrointest Endosc* 2012; **75**: AB195 [DOI: 10.1016/j.gie.2012.04.329]
  - 40 **Irions EL**, Sharma N, Romagnuolo J, Hawes RH, Hoffman BJ. Initial experience with the EchoTip Procure Needle for Endoscopic Ultrasound (EUS) guided diagnosis of mass lesions. *Gastrointest Endosc* 2011; **73**: AB255 [DOI: 10.1016/j.gie.2011.03.455]
  - 41 **Iglesias-García J**, Abdulkader I, Lariño-Noia J, Domínguez-Muñoz JE. Evaluation of the adequacy and diagnostic accuracy of the histology samples obtained with a newly designed 19-gauge EUS histology needle. *Rev Esp Enferm Dig* 2014; **106**: 6-14 [PMID: 24689710 DOI: 10.4321/S1130-01082014000100002]
  - 42 **Yasuda I**, Tsurumi H, Omar S, Iwashita T, Kojima Y, Yamada T, Sawada M, Takami T, Moriwaki H, Soehendra N. Endoscopic ultrasound-guided fine-needle aspiration biopsy for lymphadenopathy of unknown origin. *Endoscopy* 2006; **38**: 919-924 [PMID: 16981110 DOI: 10.1055/s-2006-944665]
  - 43 **Larghi A**, Verna EC, Ricci R, Seerden TC, Galasso D, Carnuccio A, Uchida N, Rindi G, Costamagna G. EUS-guided fine-needle tissue acquisition by using a 19-gauge needle in a selected patient population: a prospective study. *Gastrointest Endosc* 2011; **74**: 504-510 [PMID: 21872709 DOI: 10.1016/j.gie.2011.05.014]
  - 44 **Barresi L**, Tarantino I, Traina M, Granata A, Curcio G, Azzopardi N, Baccarini P, Liotta R, Fornelli A, Maimone A, Jovine E, Cennamo V, Fabbri C. Endoscopic ultrasound-guided fine needle aspiration and biopsy using a 22-gauge needle with side fenestration in pancreatic cystic lesions. *Dig Liver Dis* 2014; **46**: 45-50 [PMID: 23916241 DOI: 10.1016/j.dld.2013.06.008]
  - 45 **Krishnamurthy S**, Sholl AB, Weston BR, Kundu U, Ross WA, Bhutani MS, Lee JH. Emerging utility of a dual-use 22-gauge (Cook EchoTip ProCore HD) needle for endoscopic ultrasound-guided cytologic and histologic sampling of solid pancreatic lesions. *J Am Soc Cytopathol* 2013; **1**: S6
  - 46 **Fabbri C**, Luigiano C, Maimone A, Tarantino I, Baccarini P, Fornelli A, Liotta R, Polifemo A, Barresi L, Traina M, Virgilio C, Cennamo V. Endoscopic ultrasound-guided fine-needle biopsy of small solid pancreatic lesions using a 22-gauge needle with side fenestration. *Surg Endosc* 2015; **29**: 1586-1590 [PMID: 25303907 DOI: 10.1007/s00464-014-3846-6]
  - 47 **Park DH**, Lee JH, Hong SM, Iwashita T, Nakai Y, Lee JG, Chang KJ. Sa1511 Results of Prospective Randomized Trial on Endoscopic Ultrasound (EUS) Guided Core Biopsy of the Pancreas Comparing Trucut Biopsy Needle (TCB) Versus New Core Histology Needle (Chn, 19G, 22G, and 25g) in a Porcine Model: Which Needle Is Best? *Gastrointest Endosc* 2012; **75**: AB186 [DOI: 10.1016/j.gie.2012.04.300]
  - 48 **Ramay F**, Singh M, Sood V. Su1537 Retrospective Study Comparing Yield of EUS 22G FNA/FNB of Abnormal Lymph Nodes-Single Tertiary Referral Center Experience. *Gastrointest Endosc* 2013; **77**: AB360 [DOI: 10.1016/j.gie.2013.03.1190]

**P- Reviewer:** Camellini L **S- Editor:** Gong ZM **L- Editor:** A  
**E- Editor:** Li D





Published by **Baishideng Publishing Group Inc**  
7901 Stoneridge Drive, Pleasanton, CA 94588, USA  
Telephone: +1-925-223-8242  
Fax: +1-925-223-8243  
E-mail: [bpgoffice@wjgnet.com](mailto:bpgoffice@wjgnet.com)  
Help Desk: <http://www.f6publishing.com/helpdesk>  
<http://www.wjgnet.com>

