

Comparison of diagnostic accuracy of endoscopic ultrasound-guided fine-needle aspiration with 22- and 25-gauge needles in the same patients

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Abbreviations: EUS-FNA, endoscopic ultrasound-guided fine-needle aspiration

Background: Various factors, such as the optimal number of passes, aspiration pressure, and the use of 19-gauge and Trucut biopsy needles, have been studied to improve the diagnostic accuracy of endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA). We retrospectively compared the diagnostic accuracy of EUS-FNA between 25- and 22-gauge needles, which have been widely used recently.

Subjects and Methods: The study group comprised 47 consecutive patients who underwent EUS-FNA with both 22- and 25-gauge needles from October 2007 through March 2010. Their underlying diseases were pancreatic cancer in 24 patients, submucosal tumors in 11, other pancreatic tumors in 4, chronic pancreatitis in 4, enlarged lymph nodes in 3, and gall bladder cancer in 1. Tissue specimens, which were pushed out of the puncture needle, were placed into physiological saline solution. Gray-whitish, worm-like specimens were used for histologic diagnosis. The remaining specimen was centrifuged, and the sediment was plated on slides and examined by a cytopathologist to obtain the cytologic diagnosis.

Results: A total of 75 punctures (mean, 1.6) were performed with 25-gauge needles, and 69 punctures (mean, 1.4) were performed with 22-gauge needles. The overall tissue-sampling rate for cytology was 100% (47/47), which was significantly ($p=0.01$) superior to 83% (39/47) for histology. The overall diagnostic accuracy on the cytologic and histologic examinations was 79% (37/47) and 85% (33/39) ($p=0.48$). According to needle type, the tissue-sampling rate for cytology and histology on each puncture was 97% (73/75) and 56% (42/75) with 25-gauge needles, and was 97% (67/69) and 58% (40/69) with 22-gauge needles, the accuracy of cytologic diagnosis on each puncture was 73% (53/73) with 25-gauge needles and 66% (44/67) with 22-gauge needles ($p=0.37$); the accuracy of histologic diagnosis on each puncture was 60% (25/42) and 75% (30/40) ($p=0.14$), respectively. No patient had complications.

Conclusions: The tissue-sampling rate and diagnostic accuracy did not differ significantly between 22- and 25-gauge needles in patients with pancreatic or gastrointestinal diseases who underwent EUS-FNA.

Introduction

Endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA) was first described by Vilmann et al. in 1992. EUS-FNA is now widely used clinically for a broad range of indications. EUS-FNA has become an essential tool for diagnosis and treatment in clinical practice.¹ In general, the diagnostic accuracy of EUS-FNA ranges from 70% to 100%, with a 0% to 3% incidence of complications.^{2,3} To further improve diagnostic accuracy, devices such as 19-gauge needles and Trucut biopsy needles have been developed, and their clinical usefulness has been evaluated. At present, 19-gauge needles are usually used to improve the diagnostic accuracy of EUS-FNA when tissue specimens cannot be collected with a 22-gauge

needle or when large tissue samples are required for the diagnosis of diseases such as autoimmune pancreatitis and malignant lymphoma.⁴⁻¹⁰ However, puncture may be difficult to perform with even 22-gauge needles, let alone 19-gauge needles. Because of these factors, EUS-FNA has started to be mainly performed with a 25-gauge needle in recent years.¹⁰⁻¹³ The aim of this study was to compare the tissue-sampling rate and the diagnostic accuracy rate of EUS-FNA between the use of 25- and 22-gauge needles in the same patients.

Subjects and Methods

We investigated retrospectively the subjects of 47 patients (21 men and 26 women) who underwent diagnostic EUS-FNA with the use of both 22- and 25-gauge puncture needles from October 2007 through March 2010 (**Table 1**). Their mean age was 59.0 years (range, 34 to 86). Informed written consent for the study of EUS-FNA was obtained from all patients. The underlying

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Table 1. Subjects

Total Number	47
Gender	
Male	21
Female	26
Averaged age	59.0 (34-86)
Diseases of subjects	
Pancreatic cancer	24 (51%)
Submucosal tumor	11 (23%)
Other pancreatic tumor	4 (9%)
Chronic pancreatitis	4 (9%)
Lymph node	3 (6%)
Gall bladder cancer	3 (2%)

disease was pancreatic ductal cancer in 24 patients, other pancreatic tumors in 4 (3 endocrine tumors and 1 metastasis of colon cancer), gastrointestinal stromal tumors (GIST) in 6, other gastric submucosal tumors in 5, chronic pancreatitis in 4, enlarged lymph nodes in 3, and gall bladder cancer in 1. Final diagnosis for pancreatic lesions, lymph node, and gall bladder were mainly done by at least 6 months or more clinical follow-up and that for gastrointestinal submucosal lesions were diagnosed by surgical operation. Two convex-array echo endoscopes (GF-UCT240 and GF-2000P, Olympus Co., Tokyo, Japan) were used. Puncture was performed with 22-gauge needles (NA-200H, Olympus Co.) and 25-gauge needles (Echotip, Wilson-Cook, Winston Salem, NC, USA). A 22-gauge needle was used first, followed by a 25-gauge needle randomly, or visa versa by decision of operator. To perform EUS-FNA, the needle was placed in the target site under endoscopic ultrasonographic guidance, and the lesion was punctured. After removing the stylet, a negative pressure of air by 10 or 20 cm syringe was applied in all cases. The needle was passed back and forth in the target lesion 10 to 20 times to obtain a tissue sample. After releasing the negative pressure, the needle was removed. The tissue sample was pushed out of the needle by air delivered with a syringe and placed in physiological saline solution. If the specimen could not be removed, it was flushed out with physiological saline solution delivered with a 2.5-mL syringe. If the specimen still could not be removed, it was pushed out of the needle with a stylet and placed in physiological saline solution. There was no on-site pathologist, then we performed EUS-FNA until gray-whitish, worm-like tissue samples were obtained macroscopically. A pathologist prepared cytologic and histologic specimens. Gray-whitish, worm-like tissue samples were used for histologic diagnosis. The physiological saline solution containing the remaining tissue sample was centrifuged, and the sediment was plated on a slide and used for cytological diagnosis. A cytopathologist assessed all specimens to make a diagnosis.

Before EUS-FNA, antiplatelet agents were temporarily discontinued for an appropriate period, and hematologic examinations (including bleeding time) and serum chemical analyses were performed. On the day of the examination, a continuous intravenous infusion line was secured, and a cephem antibiotic was administered 30 minutes before EUS-FNA. Three

hours after EUS-FNA and on the following morning, physical examination, hematologic examinations, and serum chemical analyses were performed to confirm the presence or absence of complications.

Statistical analysis

The data collected from the EUS-FNA data sheet were analyzed for overall diagnostic yield for each type of needle (25-gauge and 22-gauge). The comparison of sampling rate, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of 25-gauge and 22-gauge needle was done using Chi-square for independence test. P values less than 0.05 were considered statistically significant.

Results

Overall tissue sampling rate and diagnostic accuracy of EUS-FNA

The mean number of punctures per patient was 3.0 (range, 2 to 4). The overall tissue-sampling rate for cytology was 100% (47/47), which was significantly ($p=0.01$) superior to 83% (39/47) for histology (Table 2). The overall diagnostic accuracy of cytology and histology was 79% (37/47) and 85% (33/39) ($p=0.48$). There were no complications such as bleeding, infection, pancreatitis, or perforation.

Comparison of accuracy of EUS-FNA with 22- and 25-gauge needles

The diagnostic accuracy of both cytology and histology was 75% (24/32) and 88% (23/26) in 32 patients in whom puncture was first done with a 22-gauge needle, followed by a 25-gauge needle and 87% (13/15) and 77% (10/13) in 15 patients in whom puncture was first done with a 25-gauge needle, followed by a 22-gauge needles. This difference was not significant ($p=0.60$, $p=0.59$). A total of 69 punctures were performed with a 22-gauge needle (mean number of punctures per patient, 1.4 [range, 1 to 2]), and 75 were performed with a 25-gauge needle (mean number of punctures per patient, 1.6 [range, 1 to 2]). The diagnostic accuracy of cytologic examinations on each case did not differ significantly between the use of a 22-gauge needle (70%, 33/47) and the use of a 25-gauge needle (73%, 33/45) ($p=0.74$) (Table 3). And the diagnostic accuracy of histologic examinations on each case also did not differ significantly between the use of a 22-gauge needle (75%, 24/32) and the use of a 25-gauge needle (70%, 21/30) ($p=0.66$) (Table 4). According to the number of punctures, the overall tissue-sampling rate of and 25-gauge needles for cytology and histology was 97% (67/69) and 58% (40/69) with a 22-gauge needle and 97% (73/75) and 56% (42/75) with a 25-gauge needle ($p=0.67$, $p=0.81$) (Table 5,6), the diagnostic accuracy of cytologic examinations did not differ significantly between the use of a 22-gauge needle (66%, 44/67) and the use of a 25-gauge needle (73%, 53/73) ($p=0.37$) (Table 5). And the diagnostic accuracy of histologic examinations also did not differ significantly between the use of a 22-gauge needle (75%, 30/40) and the use of a 25-gauge needle (60%, 25/42) ($p=0.14$) (Table 6, Fig. 1A, Fig. 1B).

Table 2. Diagnostic yield of cytology & histology

	Cytology (n=47)	Histology (n=47)	p
Pancreas & others (n=36)			
Sampling rate	100% (36/36)	78% (28/36)	0.009
Sensitivity	80% (24/30)	84% (21/25)	0.97
Specificity	100% (6/6)	100% (3/3)	-
PPV	100% (24/24)	100% (21/21)	
NPV	50% (6/12)	43% (3/7)	
Submucosal tumor (n=11)			
Sampling rate	100% (11/11)	100% (11/11)	ns
Sensitivity	64% (7/11)	82% (9/11)	0.63
Specificity	-	-	
PPV	100% (7/7)	100% (9/9)	
NPV	0% (0/4)	0% (0/2)	
Total			
Sampling rate	100% (47/47)	83%(39/47)	0.01
Sensitivity	76% (31/41)	83% (30/36)	0.4
Specificity	100% (6/6)	100% (3/3)	ns
PPV	100% (31/31)	100% (30/30)	
NPV	38% (6/16)	33% (3/9)	
Accuracy	79% (37/47)	85% (33/39)	0.48

Table 3. Diagnostic yield of 22-gauge & 25-gauge needle on cytology

	22G (n=47)	25G (n=47)	p
Pancreas & others (n=36)			
Sampling rate	100% (36/36)	94% (34/36)	0.47
Sensitivity	70% (21/30)	72% (21/29)	0.84
Specificity	100% (6/6)	100% (5/5)	ns
PPV	100% (21/21)	100% (21/21)	
NPV	67% (2/3)	38% (5/13)	
Submucosal tumor (n=11)			
Sampling rate	100% (11/11)	100% (11/11)	ns
Sensitivity	55% (6/11)	64% (7/11)	1
Specificity	-	-	-
PPV	100% (6/6)	100% (7/7)	
NPV	0% (0/5)	0% (0/4)	
Total (n=47)			
Sampling rate	100% (47/47)	96% (45/47)	0.47
Sensitivity	66% (27/41)	83% (28/40)	0.69
Specificity	100% (6/6)	100% (5/5)	ns
PPV	100% (27/27)	100% (28/28)	
NPV	25% (2/8)	29% (5/17)	
Accuracy	70% (33/47)	73% (33/45)	0.74

Discussion

In 1992, Vilmann et al. first reported the use of EUS-FNA in patients with pancreatic cancer.¹ The indications of EUS-FNA have since been broadened to include drainage of pancreatic pseudocysts and abscesses, celiac plexus neurolysis, biliary drainage, pancreatic drainage, immunotherapy, and gene therapy.¹⁴⁻²⁰ Moreover, the clinical usefulness of EUS-FNA, used to obtain tissue specimens for cytologic diagnosis, has been enhanced by combination with immunohistochemical studies and genetic analyses.^{21,22} Consequently, EUS-FNA is now widely

used in clinical practice and has become an essential examination procedure because of its high diagnostic accuracy and acceptable, low incidence of complications. Nonetheless, the most important factor in histological and genetic examinations is to reliably obtain tissue specimens from target lesions for cytologic and histologic diagnoses. Accurate tissue procurement is thus an important issue for EUS-FNA. Previous studies have examined the optimal number of needle passes and found that 5 to 7 passes contributed to increased diagnostic accuracy of EUS-FNA, whereas 8 or more passes did not.^{23,24} Suction pressure has been also evaluated by various studies, but its impact on diagnostic accuracy remains

Table 4. Diagnostic yield of 22-gauge & 25-gauge needle on histology

	22G (n=47)	25G (n=47)	p
Pancreas & others (n=36)			
Sampling rate	69% (25/36)	64% (23/36)	0.62
Sensitivity	64% (14/22)	67% (14/21)	0.83
Specificity	100% (3/3)	100% (2/2)	ns
PPV	100% (14/14)	100% (14/14)	
NPV	27% (3/11)	22% (2/9)	
Submucosal tumor (n=11)			
Sampling rate	64% (7/11)	64% (7/11)	0.66
Sensitivity	64% (7/11)	71% (5/7)	0.45
Specificity	-	-	-
PPV	100% (7/7)	100% (5/5)	
NPV	-	0% (2/2)	
Total (n=47)			
Sampling rate	68% (32/47)	64% (30/47)	0.66
Sensitivity	72% (21/29)	68% (19/28)	0.71
Specificity	100% (3/3)	100% (2/2)	ns
PPV	100% (21/21)	100% (19/19)	
NPV	27% (3/11)	18% (2/11)	
Accuracy	75% (24/32)	70% (21/30)	0.66

Table 5. Diagnostic yield of 22-gauge & 25-gauge needle puncture on cytology

	22G (puncture=69)	25G (puncture=75)	p
Pancreas & others			
Sampling rate	100% (49/49)	96% (55/57)	0.54
Sensitivity	63% (26/41)	70% (32/46)	0.54
Specificity	100% (8/8)	100% (9/9)	ns
PPV	100% (26/26)	100% (32/32)	
NPV	35% (8/23)	39% (9/23)	
Submucosal tumor (n=11)			
Sampling rate	90% (18/20)	100% (18/18)	0.52
Sensitivity	56% (10/18)	67% (12/18)	0.49
Specificity	-	-	-
PPV	100% (10/10)	100% (12/12)	
NPV	0% (0/8)	0% (0/6)	
Total (n=47)			
Sampling rate	97% (67/69)	97% (73/75)	0.67
Sensitivity	61% (36/59)	69% (44/64)	0.37
Specificity	100% (8/8)	100% (9/9)	ns
PPV	100% (36/36)	100% (44/44)	
NPV	26% (8/31)	31% (9/29)	
Accuracy	66% (44/67)	73% (53/73)	0.37

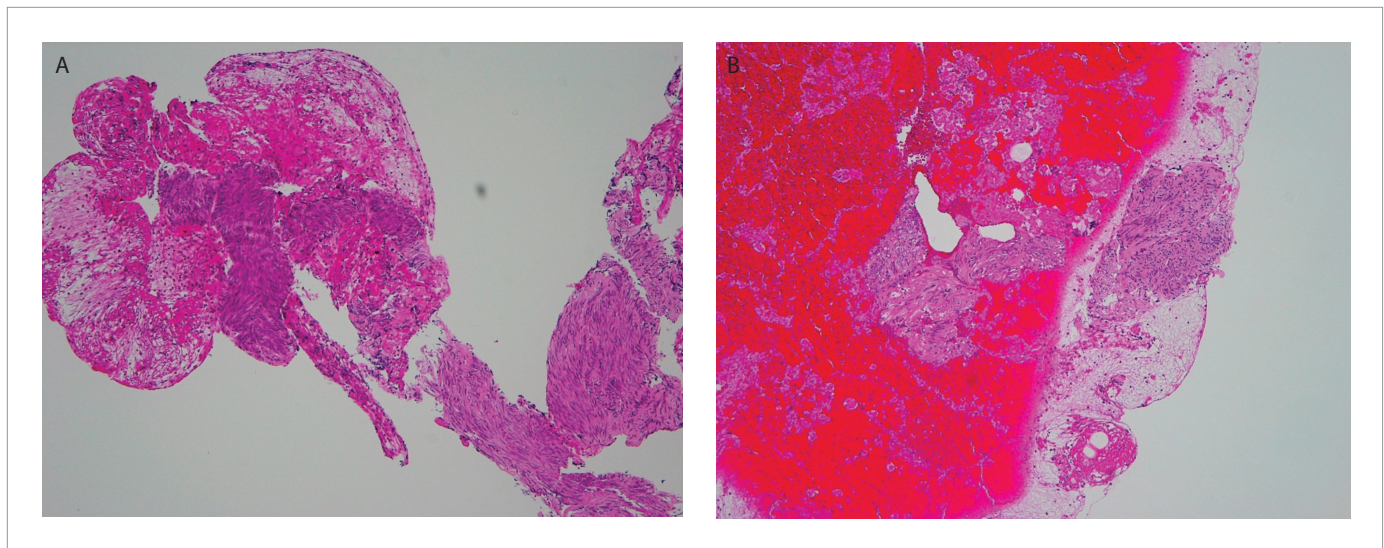
controversial.²⁵⁻²⁷ To improve the diagnostic accuracy of EUS-FNA, 19-gauge needles and Trucut biopsy needles have been developed, and their usefulness has been evaluated. Some studies have reported that FNA with 22-gauge needles provides superior or equivalent diagnostic accuracy^{4,5}, whereas others have found that Trucut biopsy needles are superior⁶. The number of studies showing that a combination of 22-gauge and Trucut needles improves the clinical diagnostic accuracy of EUS-FNA has increased.⁷⁻⁹ At present, 19-gauge and Trucut needles are usually used when tissue specimens cannot be obtained with 22-gauge needles or when large tissue samples are required for the diagnosis

of diseases such as autoimmune pancreatitis and malignant lymphoma. This appears to be the general consensus. However, it is usually not possible to puncture lesions situated at the head of the pancreas, particularly those at the uncinata process, with the use of 19-gauge or Trucut needles.¹⁰

Diagnostic accuracy has also been attempted to be improved by the development of 25-gauge needles, smaller in diameter than 22-gauge needles. Recent studies have confirmed the clinical usefulness of these smaller needles.¹⁰⁻¹³ Although these studies were small, currently available evidence suggests that 25-gauge-needles are equivalent to or significantly better than 22-gauge-needles for

Table 6. Diagnostic yield of 22-gauge & 25-gauge needle puncture on histology

	22G (puncture=69)	25G (puncture=75)	p
Pancreas & Others			
Sampling rate	61% (30/49)	49% (28/57)	0.21
Sensitivity	67% (18/27)	54% (14/26)	0.34
Specificity	100% (3/3)	100% (2/2)	ns
PPV	100% (18/18)	100% (14/14)	
NPV	25% (3/12)	14% (2/14)	
Submucosal tumor (n=11)			
Sampling rate	50% (10/20)	78% (14/18)	0.37
Sensitivity	90% (9/10)	64% (9/14)	0.34
Specificity	-	-	-
PPV	100% (9/9)	100% (9/9)	
NPV	0% (0/1)	0% (0/5)	
Total (n=47)			
Sampling rate	58% (40/69)	56%(42/75)	0.81
Sensitivity	73% (27/37)	58% (23/40)	0.16
Specificity	100% (3/3)	100% (2/2)	ns
PPV	100% (27/27)	100% (23/23)	
NPV	23% (3/13)	11% (2/19)	
Accuracy	75% (30/40)	60% (25/42)	0.14

**Figure 1.** Histology of GIST of the same patient taken by 25-gauge (A) and 22-gauge (B) (×10). There is not so difference on sample size and quantity between two needles, if succeeded.

the diagnosis of pancreatic lesions.¹⁰⁻¹³ A 25-gauge-needle was also associated with a lower incidence of complications.¹³ In addition, the puncture of lesions at the head of the pancreas, particularly the uncinata process, has been reported to be significantly easier with a 25-gauge needle.¹⁰ This finding is supported by the results of our study. We also found that a 25-gauge needle could easily puncture lesions located at the head of the pancreas, particularly those at the uncinata process, which are considered difficult to puncture, as well as small submucosal tumors. We had the impression that a 25-gauge needle is superior to a 22-gauge needle for the puncture of small, mobile target lesions, such as submucosal tumors,

particularly when the deflection of the endoscope makes puncture difficult.

Concerning about the sampling rate, that for cytology is generally superior to that for histology, however the overall diagnostic accuracy did not differ between cytology and histology. As for the diagnostic accuracy of 25-gauge needles, the tissue sampling rate and diagnostic accuracy did not differ significantly between 25- and 22-gauge needles in our study too. Sakamoto et al. and Imazu et al.^{10,12} have reported that 22-gauge needles can obtain larger specimens than 25-gauge needles. Although the specimen size was sometimes small in our study, diagnostic

accuracy on cytologic and histologic examinations did not differ significantly between 22- and 25-gauge needles, confirming that 25-gauge needles are clinically useful.

In conclusion, our results suggest that the diagnostic accuracy of EUS-FNA with a 25-gauge needle is equivalent to that of EUS-FNA with a 22-gauge needle. Randomized studies of larger numbers of patients are needed to confirm our results. However, we believe that 25-gauge needles will be more widely used clinically in the future because they can facilitate the puncture of selected lesions.

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