Efficacy and Safety of 20G vs. 22G Needles in CT-Guided Transthoracic Fine Needle Aspiration Biopsies

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Abstract

Aim: This study aims to compare the diagnostic accuracy and complication rates of 20G and 22G needles in transthoracic fine needle aspiration biopsy (TFNAB).

Method: This retrospective study reviewed lung biopsy results from procedures performed between January 2018 and March 2020. Patients included had non-diagnostic bronchoscopic biopsies or were deemed inappropriate for bronchoscopic biopsy. A total of 127 patients underwent Computed tomography (CT) guided TFNAB using either 20G or 22G needles. Data on lesion size, localization, diagnostic adequacy, and complications were collected and analyzed.

Results: The study cohort included 127 patients with a mean age of 63.21 years. Of these, 72 underwent biopsies with a 22G needle and 55 with a 20G needle. The overall diagnostic accuracy was 96.8%, with no significant differences between the 20G and 22G needle groups (p=0.206). Complications occurred in 59 patients (46.5%), with pneumothorax being the most common, and two cases required chest tube placement. The rate of pulmonary hemorrhage was 18.9%. There were no significant differences in complication rates between the needle sizes (p=0.985).

Conclusion: CT-guided TFNAB using both 20G and 22G needles is safe and effective, with high diagnostic accuracy and low complication rates. The choice of needle size does not significantly impact diagnostic

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outcomes or complication rates, allowing clinicians flexibility based on patient-specific factors and procedural requirements.

Keywords: Biopsy, pneumothorax, computed tomography, transthoracic biopsy, fine-needle aspiration biopsy, diagnostic accuracy, complications, lung mass, needle gauge.

20G ve 22G İğnelerin BT Kılavuzluğunda Transtorasik İnce İğne Aspirasyon Biyopsisinde Etkinliği ve Güvenliği

Öz

Amaç: Bu çalışma, transtorasik ince iğne aspirasyon biyopsisinde (TTİİAB) 20G ve 22G iğnelerin tanısal doğruluk ve komplikasyon oranlarını karşılaştırmayı amaçlamaktadır.

Yöntem: Bu retrospektif çalışmada, Ocak 2018 ile Mart 2020 arasında bilgisayarlı tomografi (BT) eşliğinde gerçekleştirilen transtorasik akciğer biyopsisi sonuçları incelendi. Toplamda 127 hastaya BT kılavuzluğunda TTİİAB kullanılarak 20G veya 22G iğnelerle biyopsi yapıldı. Biyopsi yapılan olgularda lezyon boyutu, lokalizasyonu, tanısal yeterlilik ve komplikasyonlar hakkında veriler toplandı ve analiz edildi.

Bulgular: Çalışmaya dahil edilen hastaların yaş ortalaması 63,21 yıl olup, toplamda 127 hasta mevcuttu. Bu hastalardan 72'sine 22G iğne ile, 55'ine ise 20G iğne ile biyopsi yapıldı. Genel tanısal doğruluk %96,8 olup, 20G ve 22G iğne grupları arasında tanısal doğruluk açısından anlamlı fark bulunmamıştır (p=0,206). Komplikasyonlar 59 hastada (%46,5) görülmüş olup, en yaygın komplikasyon pnömotorakstır. Pnömotoraks oranı %22,8 olup, iki vakada göğüs tüpü yerleştirilmiştir. İkinci en sık komplikasyon pulmoner hemoraji olup, %18,9 oranında görülmüştür. İğne boyutları arasında komplikasyon oranları açısından anlamlı bir fark bulunmamıştır (p=0,985).

Sonuç: BT kılavuzluğunda TTİİAB, 20G ve 22G iğneler kullanılarak güvenli ve etkili şekilde gerçekleştirilebilmekte olup, yüksek tanısal doğruluk ve düşük komplikasyon oranlarına sahiptir. İğne boyutu seçimi, tanısal sonuçları veya komplikasyon oranlarını etkilememektedir.

Anahtar Sözcükler: Biyopsi, pnömotoraks, bilgisayarlı tomografi, transtorasik biyopsi, ince iğne aspirasyon biyopsisi, tanısal doğruluk, komplikasyonlar, akciğer kitlesi, iğne boyutu.

Introduction

Computed tomography (CT) guided percutaneous transthoracic needle biopsy is a frequently employed minimally invasive technique that is increasingly significant in assessing thoracic lesions and treating lung cancer, a leading cause of cancer-related deaths globally[1]. Since its introduction, percutaneous lung biopsy has become a crucial method for obtaining lung tissue and characterizing focal lung diseases. The demand for percutaneous lung biopsies is likely to rise due to the rapidly increasing need for histological classification, as well as subtyping and genotyping of lung cancer[2].

Transthoracic needle aspiration biopsy is a simple, rapid, and safe procedure used in the diagnosis of thoracic lesions, with limited morbidity and high patient tolerance[3]. The sensitivity of transthoracic fine needle aspiration biopsy (TFNAB) in diagnosing malignancy ranges from 64% to 99%[4,5]. Pneumothorax, the most common complication, occurs in 5% to 61% of cases[3].

The diagnostic accuracy of tomography-guided TFNAB is influenced by several factors, including lesion size, localization, and imaging techniques[3]. The needle size used in fine needle aspiration (FNA) is also a key determinant of complication rates and diagnostic accuracy. Different needle diameters, ranging from 18G to 25G, can be employed for FNA biopsy[3,6,7]. However, there is a paucity of literature addressing the impact of needle diameter on diagnostic accuracy and complication rates.

The objective of this study is to compare the diagnostic accuracy and complication rates of biopsies performed with 20G and 22G fine needles. By examining and contrasting these two needle sizes, this study aims to provide valuable insights for clinicians in selecting the optimal needle size for lung biopsies, with the ultimate goal of enhancing patient care and diagnostic efficacy.

Material and Methods

This study was approved by the ethics committee of the University of Health Sciences Istanbul Training and Research Hospital (decision number: 237- date: 15.09.2023). All patients provided informed consent before the procedure. Lung biopsy results from procedures performed between January 2018 and March 2020 were retrospectively reviewed. Patients included in this study had either non-diagnostic bronchoscopic biopsies or were deemed inappropriate for bronchoscopic biopsy.

Inclusion and Exclusion Criteria

Patients were excluded if they had lesions less than 5 mm or were suspected to be vascular, uncorrectable coagulopathy (INR >1.5 or PLT <50,000), inability to lie in a suitable position for the procedure, or if they were using antiplatelet or anticoagulant drugs that were not discontinued 3-7 days before the procedure.

Procedure Details

All procedures were performed under CT guidance (Toshiba Aquilion 128-slice, Tokyo, Japan) by a single interventional radiologist with 5 years of experience in interventional radiology and thoracic interventions. Patients were positioned on the CT table in prone,

supine, or lateral decubitus positions, depending on the shortest and safest path to the lesion.

A lung CT scan was performed before the biopsy, with lesions scanned at 20 mAs, 120 kV, and 5 mm section thickness. The biopsy path was selected to ensure the shortest distance to the lesion while avoiding large vascular structures, visible bronchi, fissures, bullae, ribs, or scapula. After skin preparation with povidone-iodine, local anesthesia was administered using a 2% lidocaine injection. The procedure was routinely performed without premedication, sedation, or general anesthesia.

All procedures utilized a 20G or 22G fine needle (Egemen TMT Medical, Izmir, Turkey). Needle selection was random, based on availability and operator preference. Initial insertion was made without passing the pleura, with needle location confirmed by control CT imaging. The patient was instructed to hold their breath while the needle was advanced along the planned biopsy route. Needle location was rechecked with CT, and aspiration was performed with a 10cc syringe. If aspiration yielded sufficient material, the sample was evaluated by a cytopathologist in the procedure room. If insufficient, the biopsy steps were repeated.

Post-procedure, a thorax CT was performed to detect complications such as pneumothorax or pulmonary hemorrhage. Stable patients with small, stable pneumothoraxes were treated conservatively and monitored with direct radiography for 4-6 days post-procedure. Symptomatic or large pneumothoraxes (>30% of the hemithorax) were treated with chest tube drainage and hospitalization for at least one day.

Figures 1, 2, and 3 illustrate samples obtained from CT-guided fine needle aspiration biopsy.

Data Collection

Lesion sizes were measured using pre-procedure thorax CT scans, focusing on the longest axis in the lung window. Lesion localization, imaging characteristics, and CT findings were retrospectively reviewed by a radiologist with four years of experience.

Diagnostic adequacy was assessed by analyzing post-procedural pathology reports. Patients lacking a post-procedure pathology report were excluded. Procedures terminated due to complications or patient noncompliance, or those with insufficient

pathology results, were labeled nondiagnostic. Cases confirmed as benign or malignant were deemed diagnostic.

Figure 1. A) A 50-year-old female patient presents with a solitary mass lesion (indicated by a white-filled arrow) in the paracardial area of the right middle lung lobe. **B)** A fine needle aspiration biopsy was performed using a 20-gauge needle (indicated by a white empty arrow) through an anterior approach, resulting in a diagnosis of neuroendocrine tumor.

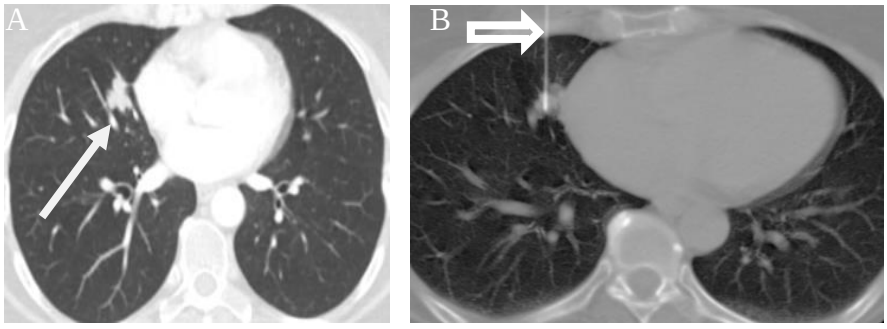


Figure 2. A) 65-year-old male patient with Left upper lobe paramediastinal lung mass, indicated by a white-filled arrow. **B)** Post-biopsy image showing pulmonary hemorrhage along the needle track, indicated by a white empty arrow. The lesion was diagnosed as a low-differentiated adenocarcinoma.

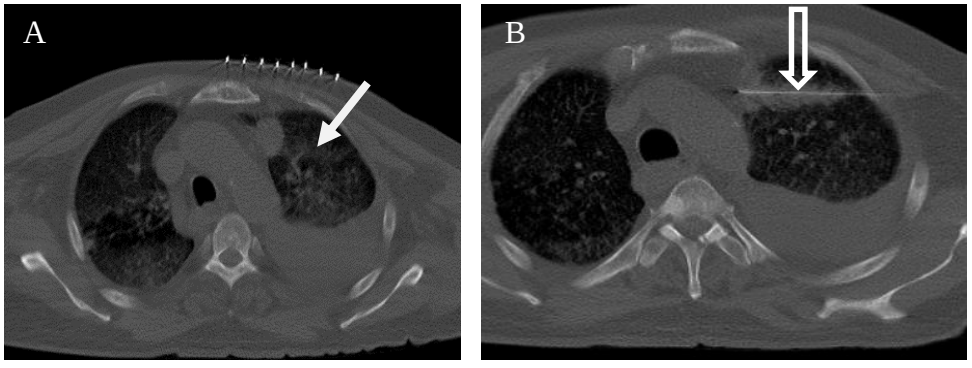
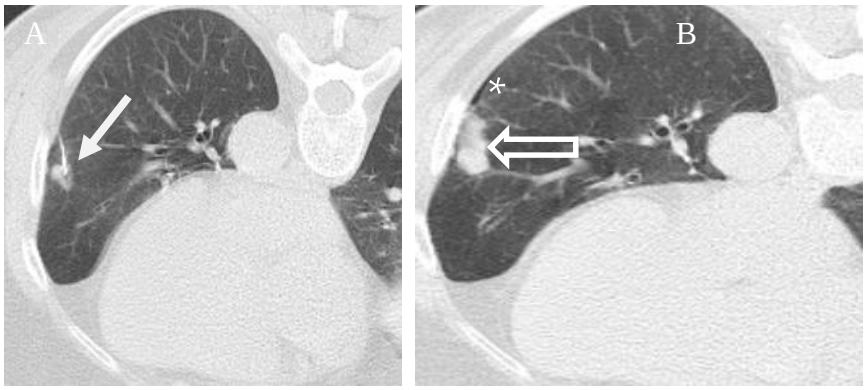


Figure 3. A) A 48-year-old male patient with a right lower lobe lung mass undergoing fine needle biopsy with a 22G needle, indicated by a white-filled arrow. **B)** Post-biopsy image displaying pulmonary hemorrhage along the needle track and minimal pneumothorax (marked with an asterisk). The patient was asymptomatic, without dyspnea or other symptoms. The lesion was diagnosed as adenocarcinoma.



Statistical Analysis

All statistical analyses were performed using IBM Corp.'s Statistical Package for the Social Sciences (SPSS), version 23.0 (Armonk, NY, USA). Continuous variables were expressed as mean±standard deviation (SD), and categorical variables were presented as frequencies and percentages.

Comparison of Groups

Diagnostic accuracy and complication rates between the 20G and 22G needle groups were compared using the chi-square test or Fisher's exact test for categorical variables, and the independent t-test or Mann-Whitney U test for continuous variables, as appropriate.

Statistical Significance

A p-value of < 0.05 was considered statistically significant for all analyses. All analyses were conducted under the supervision of a biostatistician to ensure the accuracy and reliability of the results.

Results

This study involved 127 patients who underwent CT-guided TFNAB. The ages of the participants were as follows: mean age of 63.21 years, median age of 63.0 years, with the

first quartile (Q1) at 55.0 years and the third quartile (Q3) at 70.0 years; the standard deviation (SD) was 10.08 years. The cohort consisted of 28 males and 99 females. Needle sizes used were as follows: 72 patients underwent biopsies with a 22G needle and 55 with a 20G needle. The average number of punctures per procedure was 1.76, with a median of 2.

Of the 127 biopsies performed, 123 were diagnostic while 4 were nondiagnostic. The nondiagnostic cases included two biopsies halted due to pneumothorax before specimen collection, one stopped due to poor patient cooperation, and one where the specimens collected were insufficient for diagnosis despite two attempts. Among the diagnostic results, the most common finding was adenocarcinoma, noted in 45 cases. The average lesion size was 32.08 mm, with the most frequent lesion localization in the right upper lobe, recorded in 39 cases. Detailed demographic and lesion characteristics are presented in Table 1.

Complications were observed in 59 patients, resulting in a complication rate of 46.46%. Perilesional parenchymal hemorrhage was seen in 24 patients (1 with minimal pneumothorax), pneumothorax without intervention in 27 patients, pneumothorax requiring tube insertion in 2 patients, and parenchymal hemorrhage with hemoptysis in 6 patients. Only the 2 patients with pneumothorax requiring intervention needed tube insertion and one day of hospitalization. All other complications resolved spontaneously and did not require hospitalization. The overall diagnostic accuracy was 96.8%.

Table 1. Patient demographics and diagnostic findings

Characteristic	**Value (n=127)**
Age	63.21
Median (years)	63.0
1st Quartile (Q1) (years)	55.0
3rd Quartile (Q3) (years)	70.0
Standard Deviation (SD)	10.08
Gender	**n (%)**
Male	28 (22%)
Female	99 (78%)
Needle Size Used	

22G	72 (57%)
20G	55 (43%)
Number of Punctures	
Mean	1.76
Median	2
Biopsy Results	
Diagnostic	123 (96.8%)
Non-diagnostic	4 (3.2%)
Pathologic Findings	
Adenocarcinoma	45 (37%)
Squamous cell cancer	24 (19%)
Adenocarcinoma metastasis	19 (15%)
Atypical cells	9 (7%)
Small cell lung cancer	7 (6%)
Inflammation findings	6 (5%)
Granulomatous reaction	5 (4%)
Neuroendocrine tumor	3 (2%)
Non-small cell lung cancer	3 (2%)
Lung parenchyma and blood cells	2 (2%)
Non-diagnostic material	4 (%3)
Lesion Characteristics	
Solitary lesions	64 (50%)
Spiculated lesions	30 (%24)
Multiple lesions	14 (11%)
Cavitary lesions	12 (9%)
Consolidations	2 (%2)
Atelectasis	2 (%2)
Cavitary lesions	2 (%2)
Ground-glass lesion	1 (%1)
Lesion Localization	
Right upper lobe	39 (31%)
Left upper lobe	28 (22%)
Right lower lobe	26 (20%)

Left lower lobe	15 (12%)
Right middle lobe	11 (9%)
Left lingular segment	8 (6%)
Lesion Size	
Mean (mm)	32.08
Median (mm)	28.0
Standard Deviation (SD)	16.87

Abbreviations: G: gauge, SD: standard Deviation, n: number, %: percentage

In this analysis, we evaluated the impact of using 20G and 22G needles on diagnostic yield, complication rates, and other outcomes in needle biopsies. Study findings revealed no statistically significant differences between the two needle sizes in terms of mean ages (p=0.586), sex distribution (p=0.787), lesion localization (p=0.541), or complication rates (presence p=0.985, type p=0.564). Similarly, lesion size and imaging findings showed no significant differences across needle sizes (p=0.698 and p=0.588, respectively).

Additionally, the number of needle passes exhibited a non-significant difference (p=0.066). The diagnostic yields between the two groups were comparable, with a p-value of 0.206. Notably, the presence of nondiagnostic cases in the 22G group did not statistically impact the overall results.

Overall, these results suggest that needle size does not significantly affect diagnostic outcomes, complication rates, or other procedural aspects, allowing clinicians the flexibility to select the needle size based on clinical factors rather than statistical differences (Table 2).

Table 2. Comparison of outcomes between 20G and 22G needles with statistical tests

Parameter	**20G Needle Group**	**22G Needle Group**	**p-value**
Age	Mean: 63.69 Median: 66.00 SD: ±10.10	Mean: 62.71 Median: 63.00 SD: ± 9.99	0.586[a]
Sex Distribution	Female: 11 Male: 44	Female: 17, Male: 55	0.787[b]
Lesion Localization	Right Upper: 19 Right Middle: 4	Right Upper: 20 Right Middle: 7	0.541[b]

	Right Lower: 12 Left Upper: 14 Left Lingula: 2 Left Lower: 4	Right Lower: 14 Left Upper: 14 Left Lingula: 6 Left Lower: 11	
Complication	Absent: 30 Present: 25	Absent: 38 Present: 34	0.985[b]
Complication Type	No Complication: 30 PTX: 13 Perilesional Hemorrhage:11 Hemoptysis: 1	No Complication:34 PTX: 16 Perilesional Hemorrhage:13 Hemoptysis: 5	0.564[b]
Lesion Size	Mean: 31.42 Median: 28.00 SD: ±16.11	Mean: 32.58 Median: 28.00 SD: ±17.51	0.698[a]
Imaging Findings **Solitary** **Cavitation** **Spiculated** **Multipl lesions** **Consolidation** **Atelectasis** **Calcification Ground Glass**	 32 3 12 3 1 1 1 1	 32 9 18 7 2 1 1 0	0.588[b]
Number of Passes	Mean: 1.64 Median: 2.00 SD: 0.68	Mean: 1.86 Median: 2.00 SD: 0.68	0.066[a]
Diagnostic Yield	Diagnostic: 55 Non-Diagnostic: 0	Diagnostic: 68 Non-Diagnostic: 4	0.206[b]

[a] t test, [b]Chi-squared Test, PTX: Pneumothorax, SD: standard deviation

Discussion

In this study, we retrospectively evaluated the efficacy and reliability of 20G and 22G needles in performing TFNABs. Study findings indicate that there are no significant differences in complication rates or diagnostic adequacy between the two needle sizes. This equivalence in performance suggests that both needle gauges can be effectively and safely used for transthoracic biopsies, providing clinicians with flexibility in choosing the

appropriate needle based on other clinical factors, such as patient anatomy or specific procedural requirements.

In lung lesions, both FNA and cutting needle biopsies are viable options. FNA can be performed using either the coaxial or non-coaxial methods. This study employed the non-coaxial FNA technique, achieving a diagnostic accuracy comparable to that of the coaxial FNA. Historically, the diagnostic accuracy of the coaxial technique in TFNABs has ranged between 93% and 97%[8-11]. However, recent literature on transthoracic biopsies using non-coaxial FNA is limited, with only a few studies such as those by Nair et al. and Uzun et al. reporting diagnostic accuracies ranging from 80% to 97.6%[6,12]. Research demonstrates that employing smaller FNA needles does not reduce diagnostic yield, and improvements in FNA cytology now facilitate lung cancer subtyping directly from cytological specimens[13]. Several studies, consistent with these findings, indicate that there is no significant difference in diagnostic accuracy between 20G and 22G needles[3,6,12]. Consequently, both sizes of needles can be used with similarly high rates of success.

In TFNAB, pneumothorax emerges as the most frequent complication, exhibiting a broad incidence range from 5% to 45%, and the requirement for chest tube insertion varies between 1% and 14.2%[6,14-16]. In this analysis, the rate of pneumothorax was 22.8% (29 out of 127 cases), with two instances (1.6%, 2/127) necessitating chest tube placement, aligning with the figures reported in earlier research. The relationship between needle size and pneumothorax incidence remains indeterminate. Notably, studies by Geraghty et al. and Kuban et al. observed a significant correlation, indicating a higher risk with 18G needles compared to 19G needles[9,17]. Conversely, Cox et al. detected no link between needle size and pneumothorax risk when comparing 19G with 22G needles, and similar findings were reported by Uzun et al. for 20G versus 22G needles[12,18]. This study also found no significant correlation between 20G and 22G needles in terms of pneumothorax risk.

Pulmonary hemorrhage is the second most common complication that can occur, presenting either with or without hemoptysis. The incidence rates reported in studies vary, with intrapulmonary hemorrhage occurring in 4% to 27% of cases, and hemoptysis in 1.25% to 5%[15,19,20]. In this study, pulmonary hemorrhage was observed in 18.9% (24 out of 127) of the cases, and hemoptysis was noted in 4.7%, aligning with the existing literature. Both pulmonary hemorrhage and hemoptysis resolved spontaneously without the need for additional interventions and did not lead to shock or hypoxia. In an overall

comparison, there was no significant difference between the 20G and 22G needles in terms of complication subtypes, including pneumothorax, pulmonary hemorrhage, or hemoptysis.

Limitations

This study has several limitations. The retrospective design and small sample size may limit study findings. The absence of long-term follow-up and surgical outcomes leaves final diagnoses undetermined. The fact that all procedures were conducted at the same center by the same operator and evaluated by the same cytopathologist may affect generalizability.

Future research should include prospective, randomized controlled studies with larger sample sizes and long-term follow-up data. Replicating the study across various centers with different operators and cytopathologists would enhance generalizability and reduce potential biases.

Conclusion

Study findings indicate that CT-guided FNA of pulmonary lesions using both 20G and 22G needles is a safe and effective technique. The procedure is characterized by low complication rates and commendably high diagnostic accuracy. This study supports the use of either needle size, providing clinicians with the flexibility to choose based on patient-specific clinical factors and procedural requirements.

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