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Original Article

CT-Guided Lung Biopsy with and without Gelfoam Tract Embolization

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ABSTRACT

Background: CT-guided percutaneous lung biopsy is an essential diagnostic tool for pulmonary lesions but carries risks of pneumothorax and hemorrhage. Gelfoam tract embolization has been proposed to reduce these complications. This study investigates the role of Gelfoam embolization and its association with outcomes in patients undergoing CT-guided lung biopsy, with comparison between Gelfoam and non-Gelfoam groups.
Methods: Ten patients undergoing CT-guided lung biopsy were included; five underwent Gelfoam slurry tract embolization, and five underwent standard biopsy without embolization. Rates of pneumothorax, cough, chest-tube requirement, shortness of breath or oxygen desaturation and bleeding were compared.
Results: No patients in the Gelfoam group experienced significant complications. In the standard group, minor pneumothorax occurred in one case and minimal cough in one case, none requiring intervention.
Conclusion: Gelfoam tract embolization may be associated with lower rates of pneumothorax and other related complications in CT-guided lung biopsies. Larger studies are needed to confirm these findings.

Keywords*: CT guided lung biopsy, gel foam , needle tract embolization, pneumothorax*

INTRODUCTION

CT-guided percutaneous transthoracic lung biopsy is widely used to obtain tissue diagnosis for pulmonary nodules and masses. It provides precise lesion targeting and high diagnostic accuracy, with core and fine needle techniques commonly employed. Despite its utility, this procedure is associated with notable complications, chiefly pneumothorax and pulmonary hemorrhage. Meta-analysis data show that pneumothorax occurs in approximately 25–26% of procedures, with chest-tube drainage required in about 5–7% of cases, while pulmonary hemorrhage has been reported at ~18% in core biopsies[1,2]. Pneumothorax results from air leakage into the pleural space after lung parenchymal disruption. Risk factors include lesion depth, emphysema, fissure transgression, and multiple pleural punctures[3].

To mitigate these complications, various tract-sealing techniques have been investigated. One such strategy is Gelfoam tract embolization, where an absorbable gelatin sponge slurry is deposited within the biopsy needle tract during withdrawal. Gelfoam expands on contact with fluid, promoting clot formation and mechanical tamponade, and is fully absorbed over weeks without permanent vessel occlusion[5]. Emerging evidence suggests that Gelfoam tract embolization significantly reduces the incidence of pneumothorax and the need for chest tube placement after CT-guided lung biopsy compared with non-embolized approaches[6–8]. This series reports ten consecutive CT-guided lung biopsies → five with Gelfoam embolization and five standard → to compare complication rates and preliminary clinical outcomes.

METHODOLOGY

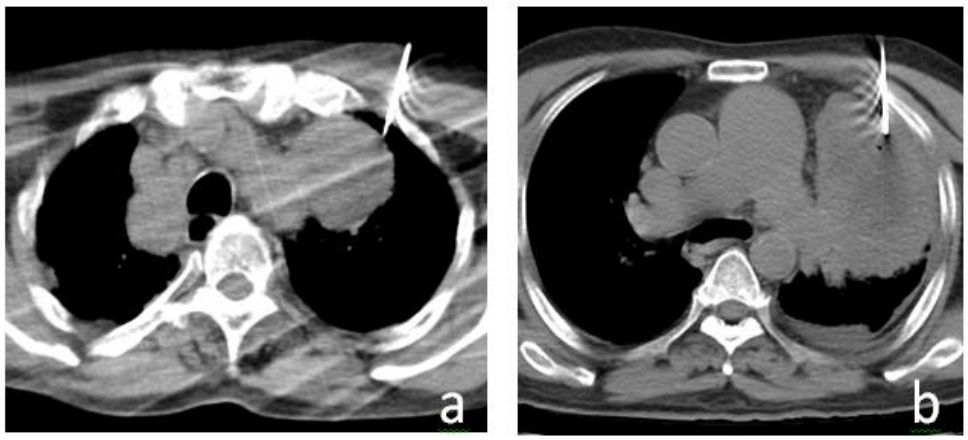
Ten adult patients referred for CT-guided lung biopsy between August 2024 and December 2025 were included. All procedures were performed with coaxial technique using 18 G introducer systems under CT guidance. Standard pre-biopsy coagulation parameters were confirmed. Five patients received Gelfoam tract embolization, prepared as a slurry with

normal saline and deployed on needle withdrawal; five patients underwent standard biopsy without embolization. All patients received immediate post-procedure CT of ROI to assess for complications, and were monitored clinically.

Procedural Flow

Patient selection & consent
↓
Review imaging • assess lesion characteristics • confirm coagulation profile
↓
Patient positioning
↓
Supine / prone / decubitus for shortest, safest needle path
↓
Planning CT scan
↓
Localize lesion • mark entry site • plan trajectory
↓
Sterile preparation & local anesthesia
↓
Aseptic draping • pleural anesthesia
↓
Coaxial needle placement (18 G)
↓
CT-guided advancement to lesion
↓
Tissue sampling
↓
Core biopsy through coaxial system
↓
Tract management
↓
• With Gelfoam: inject Gelfoam slurry during needle withdrawal
• Without Gelfoam: direct needle withdrawal
↓
Immediate post-biopsy CT
↓
Assess for complications
↓
Post-procedure monitoring (upto 48 hours)*
↓
Conservative management or intervention as required

SFig. 1 a–c Axial sections of CT thorax in soft tissue window showing lung masses and coaxial needle at different depths, anterior and lateral approach.



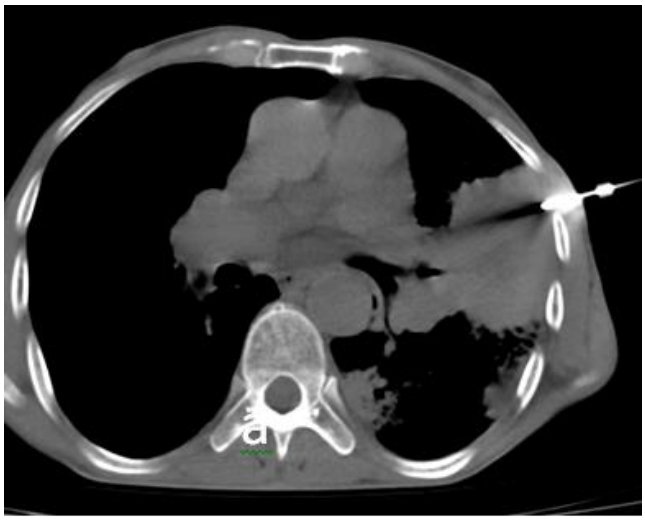
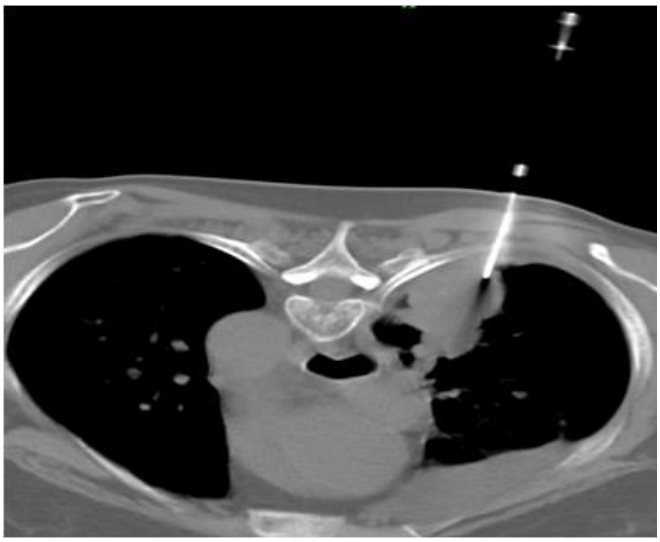


Fig. 2 Axial section of CT thorax in soft tissue window showing full extent of advancing coaxial needle in lung mass, posterior approach.



Post-Procedure Assessment and Monitoring

Immediate post-procedure CT scan
↓
Evaluate for pneumothorax, pulmonary hemorrhage, or other procedure-related complications
↓
Immediate vital signs monitoring (0–1 hour)
↓
Continuous monitoring of heart rate, blood pressure, respiratory rate, oxygen saturation, and symptoms
↓
Early observation phase (first 6 hours)
↓
Clinical assessment and vital sign monitoring every hour • Evaluate for chest pain, dyspnea, hemoptysis • Supplemental oxygen if required
↓
Extended observation phase (6–48 hours)
↓
Clinical assessment and vital signs monitoring every 6 hours • Ongoing evaluation for delayed pneumothorax or bleeding
↓
Disposition
• No complications: discharge with instructions
• Minor complications: conservative management
• Significant complications: appropriate intervention (e.g., chest tube)

RESULTS

Parameter	Gelfoam group(n=5)	Standard Group (n = 5)
Mean age (years)	58	60
Lesion size (mm)	51	48
Lesion depth (mm)	32	30
Biospsy type	Core	Core

Complication	Gelfoam Group	Standard Group
Pneumothorax	0	1
Pulmonary hemorrhage	0	0
Cough	0	1
Pleural Effusion	0	0
Diagnostic adequacy	5/5	5/5

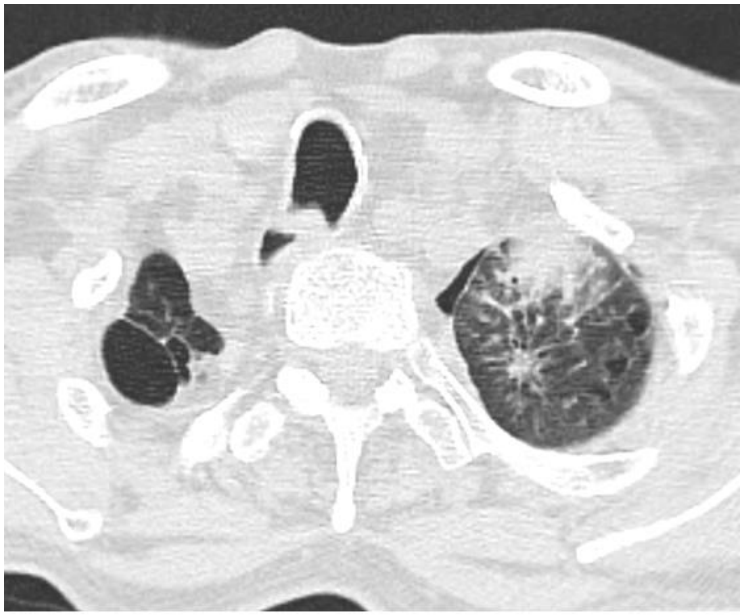


Fig. 3 Axial section of HRCT thorax in lung window showing post procedural left minimal pneumothorax

None of the observed complications in either group required invasive intervention. Minor pneumothoraces in the standard group resolved with conservative management. Minor cough observed in the standard group, not warranting oxygen supplementation on post-biopsy CT without hemoptysis.

DISCUSSION

CT-guided lung biopsy remains indispensable but is not without risk. Pneumothorax is the most frequent complication, with reported incidence ranging from ~15% to ~35% and chest tube placement rates up to ~15% in some series[1,9]. Pulmonary hemorrhage is also common—often subclinical and self-limiting—but can complicate imaging and patient recovery[1,4]. Rare complications such as air embolism have been described but occur in <1% of cases[10]. The pathogenesis of pneumothorax involves air leakage through the visceral pleural defect created by the biopsy needle, compounded by traverse of aerated lung. Bleeding along the tract can also contribute to space disruption and may influence air-leak dynamics[11].

In our series, none of the patients undergoing Gelfoam tract embolization developed pneumothorax or other complications, whereas minor pneumothorax and a minor cough event occurred in the standard group. These findings align with larger retrospective and meta-analytic evidence: tract embolization with Gelfoam slurry is associated with significantly reduced pneumothorax and chest tube placement rates in CT-guided lung biopsies compared with non-embolized controls[6,7]. Studies have demonstrated up to ~59% reduced odds of pneumothorax and ~63% reduced odds of severe pneumothorax requiring drainage with Gelfoam tract embolization[6].

Mechanistically, Gelfoam provides immediate temporary sealing of the biopsy tract, facilitating clot formation and potentially reducing air leak into the pleural space. Its absorbable nature limits long-term tissue reaction. Importantly, tract embolization did not compromise diagnostic yield in our series or in published cohorts[6–8]. Limitations include the small sample size and non-randomized design. Nonetheless, the absence of significant complications in the Gelfoam group supports further investigation in larger controlled studies.

CONCLUSION

In this study, Gelfoam tract embolization during CT-guided lung biopsy was associated with no pneumothorax or other related complications, in contrast to minor complications observed in the standard biopsy group. These preliminary findings, consistent with larger studies, suggest that Gelfoam may be a useful adjunct to reduce common complications of lung biopsy while preserving diagnostic yield.

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