CLINICAL STUDY

Pulmonary Intraparenchymal Blood Patching Decreases the Rate of Pneumothorax-Related Complications following Percutaneous CT–Guided Needle Biopsy

Peter Graffy, BS, Scott B. Loomis, MD, Perry J. Pickhardt, MD, Meghan G. Lubner, MD, Douglas R. Kitchin, MD, Fred T. Lee, Jr, MD, and J. Louis Hinshaw, MD

ABSTRACT

Purpose: To investigate whether an autologous intraparenchymal blood patch (IPB) reduces the rate of pneumothorax-related complications associated with computed tomography (CT)–guided lung biopsies.

Materials and Methods: This study included 834 patients: 482 who received an IPB and 352 who did not. Retrospective review was performed of all CT–guided lung biopsies performed at a single institution between August 2006 and September 2013. Patients were excluded if no aerated lung was crossed. The rate of pneumothorax, any associated intervention (eg, catheter placement, aspiration), chest tube placement, and chest tube replacement requiring hospital admission were compared by linear and multiple regression analysis.

Results: Patients who received an IPB had a significantly lower rate of pneumothorax (145 of 482 [30%] vs 154 of 352 [44%]; $P < .0001$), pneumothorax-related intervention (eg, catheter aspiration, pleural blood patch, chest tube placement; 43 of 482 [8.9%] vs 85 of 352 [24.1%]; $P < .0001$), and chest tube placement along with other determinants requiring hospital admission (18 of 482 [3.7%] vs 27 of 352 [7.7%]; $P < .0001$). No complications related to the IPB were noted in the study group.

Conclusions: Autologous IPB placement is associated with a decreased rate of pneumothorax and associated interventions, including chest tube placement and hospital admission, after CT–guided lung biopsies, with no evidence of any adverse effects. These results suggest that an IPB is safe and effective and should be considered when aerated lung is traversed while performing a CT–guided lung biopsy.

ABBREVIATIONS

FNA = fine needle aspiration, IPB = intraparenchymal blood patch, PBP = pleural blood patch

Pneumothorax is one of the most common complications associated with percutaneous computed tomography (CT)–guided lung biopsies. Rates of pneumothorax in lung biopsy cases remain at 20%–53% in some studies, and chest tubes are required in approximately 3%–15% of patients (1–7). Chest tube placement after lung biopsy is time-consuming and adds additional expense, risk, pain, and inconvenience, frequently including at least an overnight hospital admission (8). Therefore, there is a compelling reason to develop and refine interventions that decrease the risk of pneumothorax and the associated interventions.

To date, several techniques have been developed in an attempt to decrease the rate of pneumothorax in patients

From the Department of Radiology, University of Wisconsin School of Medicine and Public Health, 600 Highland Ave., Mail Code 3252, Madison, WI 53792-3252. Received April 14, 2016; final revision received December 16, 2016; accepted December 18, 2016. **Address correspondence to** P.G.; E-mail: graffy@wisc.edu

S.B.L. currently is located at Rocky Mountain Radiologists, Denver, Colorado and D.R.K. currently is located at Madison Radiologists, Madison, Wisconsin.

None of the authors have identified a conflict of interest.

Figures E1 and E2 are available online at *www.jvir.org*.

J Vasc Interv Radiol 2017; XX:▮▮▮–▮▮▮

http://dx.doi.org/10.1016/j.jvir.2016.12.1217

undergoing lung biopsy, including intraparenchymal blood patches (IPBs); the injection of glue, plugs, or other substances to occlude the puncture site (9); removal of the needle in end-expiration; positioning of the patient with the biopsy side down immediately after the procedure; and high-flow oxygen (9–14). Published studies of IPBs have shown consistently positive results with few limitations in study size or design (10,11). For instance, Malone et al (10) found an 11% decrease in pneumothorax for those with an IPB ($P = .12$) and a significant decrease in chest tube placement. As such, the IPB technique deserves further study.

The IPB technique uses the clot-forming properties of whole blood to decrease the likelihood of an air leak following parenchymal lung punctures. The technique is simple, has no associated costs, and has no known safety risks (10). Therefore, if it were effective, it would be a useful intervention and could become a common adjunct procedure, as shown in published results (10,12,13).

The present study is based on the hypothesis that an IPB will decrease the rate of pneumothorax and associated interventions in patients undergoing CT-guided lung biopsies, and is potentially important because of the large number of patients and the lack of significant biases (ie, all procedures were performed by the same cohort of operators, with no difference between the patient populations other than the time period in which the procedure was performed). The purpose of this single-center retrospective study was to compare the incidence of pneumothorax and pneumothorax-related interventions during CT-guided lung biopsies in patients who received an IPB compared with a control group who did not.

MATERIALS AND METHODS

Patient Demographics

A total of 834 patients were included in the study: 482 (57.7%) who received an IPB and 352 (42.3%) control patients who did not. Introducer needle gauge and depth were found to be significantly different between the two groups, but biopsy type and patient age and sex were not (Table 1). The introducer needle gauge was significantly larger among the IPB group versus the non-IPB group: a 19-gauge introducer was used in 74.5% of patients with an IPB versus 53% of those without an IPB. Nodule depth was also significantly different, as the group who received IPBs had an average nodule depth that was 0.9 cm deeper than in the non-IPB cohort (Table 1). A total of nine fissures were crossed in the entire patient population. Within the patient population, 58.5% of patients (488 of 834) had no emphysema, 18.2% (152 of 834) had mild emphysema, 14.1% (118 of 834) had moderate emphysema, and 9.1% (76 of 834) had severe emphysema. Among the total patient population, there were 299 total pneumothoraces (35.8%) requiring 128 additional interventions (15.3%), including 90 pleural blood patches (PBPs; 10.8%), 39 chest tubes (4.6%), and 45 hospital admissions (5.4%; Fig 1).

Table 1. Demographic Data of Patients with and without an IPB

Characteristic	IPB (n = 482)	No IPB (n = 352)	*P* Value
Age (y)			.84*
Mean ± SD	66.2 ± 10.8	63.4 ±12.5	
Range	18–90		
Sex (%)			.83†
Male	57.7	58.5	
Female	42.3	41.5	
Needle size			< .001†
17-gauge	2	1	
18-gauge	1	5	
19-gauge	359	188	
20-gauge	115	152	
21-gauge	1	2	
Unknown	4	4	
Biopsy type			.3395†
FNA only	341	262	
Core only	50	54	
FNA and core	91	33	
Neither	0	3	
Needle depth (cm)			< .001†
Mean	2.9	2	
SD	1.8	1.6	

FNA = fine needle aspiration; IPB = intraparenchymal blood patch; SD = standard deviation.
*Kruskal–Wallis test.
†Fisher test.

This study was approved by the institutional review board under waiver of informed consent and performed in compliance with the Health Insurance Portability and Accountability Act. The electronic medical records and procedural imaging of patients who had a lung biopsy performed between August 2006 and September 2013 were reviewed by a board-certified radiologist with 17 years of clinical experience. Exclusion criteria included a needle path that did not traverse aerated lung (eg, ultrasound-guided biopsies of peripheral lung nodules), biopsy without coaxial technique, and the presence of a pneumothorax on CT before needle removal.

The following variables were collected: patient sex and age, the use of a blood patch and volume of blood, needle size (gauge) and type of biopsy (coaxial, fine needle aspiration [FNA], core), location of the procedure relative to lung anatomy (lobe of target lesion), the presence and severity of emphysema, nodule depth from the pleura along the biopsy tract, presence or absence of a pneumothorax, and whether the patient required a pneumothorax-related intervention (needle aspiration, pleural blood patch, chest tube placement) or hospitalization. Emphysema severity was qualified by assessing the lung parenchyma at the site of the biopsy according to previously described methods (15) that distinguish