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Tiffani Strickland
Wayne State University School of Medicine, tstrickl@med.wayne.edu

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Autologous blood patch after CT-guided lung biopsy might reduce pneumothorax requiring chest tube placement

TIFFANI STRICKLAND, Wayne State University School of Medicine, tstrickl@med.wayne.edu

ABSTRACT A critical appraisal and clinical application of Malone LJ, Stanfill RM, Wang H, Fahey KM, Bertino RE. Effect of intraparenchymal blood patch on rates of pneumothorax and pneumothorax requiring chest tube placement after percutaneous lung biopsy. *American Journal of Roentgenology.* 2013;200(6):1238-1243. doi: 10.2214/ajr.12.8980.

Keywords: *autologous blood patch, pneumothorax, CT-guided lung biopsy, chest tube placement*

Clinical Context

An 82-year-old African American woman with a past medical history of nicotine dependence, hypertension, hepatitis C, arthritis, and depression presented to the Emergency Department (ED) for a fall at home. The patient lived in an apartment on her own, but was oriented only to person. She was tearful and upset that she was unable to recall her daughters' contact information. A CT scan of the cervical spine demonstrated an incidental finding of a left lung mass, prompting a CT of the thorax. This demonstrated a solid irregular mass of the posterior left apex measuring 3.2 x 4.7 x 4.6 cm with adjacent satellite nodular densities. A CT guided biopsy of the lung was performed: A 17-gauge trocar was advanced to the left upper lobe lung mass and an 18-gauge Bard core biopsy needle was then used to obtain several core specimens of the left upper lobe lung mass. A few hours after the biopsy, the patient developed a small pneumothorax on the left side as noted on a routine follow-up chest x-ray. Our team became aware of this finding the next morning when the patient complained of worsening, sharp chest pain. At this point, she had developed a large pneumothorax. A chest tube was placed and the pneumothorax and patient's symptoms resolved. We discussed what had happened with the patient. We wanted to identify ways in which to prevent a pneumothorax from occurring again if she were to have another biopsy performed. A team member suggested autologous blood patch. The patient was discharged in stable condition with recommendation to obtain an outpatient PET/CT and to follow up with her oncologist.

Clinical Question

Does an autologous blood patch reduce the incidence of pneumothorax following CT-guided lung biopsy?

Research Article

Malone LJ, Stanfill RM, Wang H, Fahey KM, Bertino RE. Effect of intraparenchymal blood patch on rates of pneumothorax and pneumothorax requiring chest tube placement after percutaneous lung biopsy. *American Journal of Roentgenology.* 2013;200(6):1238-1243. doi: 10.2214/ajr.12.8980

TIFFANI STRICKLAND is a medical student at Wayne State University School of Medicine.

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Related Literature

The rate of pneumothorax following CT-guided lung biopsy is estimated to be between 17 to 26.6%, and is the most common complication following this procedure. Additionally, the rate of pneumothorax requiring chest tube placement is between 1 to 14.2%. There are a few variables that may increase or decrease this rate, including the technique used for biopsy, history of emphysema, size and location of the lesion, or prior trauma to the lung.[8] Despite the variation in rate, the risk of pneumothorax is still significant, and can result in longer hospital stays for patients, increased morbidity, and higher costs.

The PubMed database was used to search for relevant literature using the keywords “blood patch pneumothorax” which yielded 38 results. Articles that described a pneumothorax not resulting from a percutaneous lung biopsy, letters, and opinion pieces were excluded, which ultimately left four articles to investigate. The references of these studies were also examined and two additional studies assessing the use of a blood patch for pneumothorax prevention after lung biopsy was found, resulting in a total of 6 studies, two retrospective and four prospective, controlled trials.

Of the retrospective reviews, one was a study by Graffy et al., which examined patients who received CT-guided lung biopsy at one institution (n=834) between 2006 and 2013. The researchers found that there was a statistically significant reduction in the rate of pneumothorax and chest tube placement in patients who received an intraparenchymal blood patch compared to those who did not.[4] The second study, by Clayton et al., reviewed 6 years of patients who received CT-guided lung biopsies and found a statistically significant decrease in the rate of pneumothorax and chest tube placement in patients who received an autologous nonclotted blood patch.[2] These retrospective studies are open to significant bias because there was undoubtedly a reason some patients received the blood patch and others did not. Yet, these studies provide the rationale for further study.

There were four prospective, randomized studies found. The first, by Bourgouin et al. in 1988 looked at 140 patients and demonstrated no significant difference in pneumothorax rate after transthoracic biopsy between patients with a blood patch and those without.[1] Herman et al. examined 93 patients with lung biopsies and also determined that there was no significant difference in the rate of pneumothorax or chest tube placement between patients with a blood patch and a control.[5] Another study by Lang et al. in 2000 evaluated 100 patients randomly assigned to receive a blood patch or not during lung biopsy and found a statistically significant reduction in the rate of pneumothorax in those who received a blood patch.[6] Finally, the study by Malone et al. examined 242 patients undergoing percutaneous biopsy of the lung and determined that the rate of pneumothorax requiring chest tube placement was significantly reduced in the group with an intraparenchymal blood patch compared with the control.[7] This study was ultimately chosen for analysis because it was a prospective, randomized controlled trial, had the largest sample size, was the most recent, and was most applicable to our patient. The patient population in this study included mostly elderly patients, patients with and without a smoking history, and a fairly equal amount of men and women. Our patient met inclusion criteria for this study, and the patient population examined had similar characteristics to our patient, i.e., an elderly woman with a smoking history.

Critical Appraisal

This prospective, randomized controlled clinical trial was conducted at a single institution, University of Illinois College of Medicine at Peoria, and enrolled 242 patients who needed percutaneous CT-guided lung biopsies. The research personnel were blinded to the results until data collection was complete. Inclusion criteria were age over 18 and a lung or mediastinal lesion of undetermined cause. Patients who were pregnant, had a history of bleeding disorders, and had a lesion where the biopsy track did not pass through aerated lung parenchyma were excluded. A random-number generator was used to randomly assign patients to either the blood patch or control group. The researchers stratified potential confounding variables such as presence of emphysema, smoking history, guiding needle insertion frequency, needle size, fissure crossed, and if the operator was a resident or attending, although they did not account for prior lung trauma. Power analysis showed 121 subjects were needed in each testing group to evaluate for at least a 15% difference in rates of pneumothorax (providing for a significance level of 0.05 and a minimum power of 80%). The patient characteristics between the treatment (n=123) and control group (n=119) were similar in age, sex, smoking history, emphysema, lesion size, and length of needle track used to obtain the biopsy. No patients were lost to follow-up.[7]

Standard protocol for biopsy was used, including patient fasting, use of sedation, and holding anticoagulation medications. All biopsies were done with CT guidance. The biopsy track was chosen to traverse at least 2 cm of lung and to avoid any blebs, fissures, and blood vessels. The performing physicians were one of six fellowship-trained interventional or body radiologists with 8-28 years

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of experience, or by a radiology resident under direct supervision of one of these fellowship-trained radiologists. A 17 or 19-gauge guiding needle was used, and an 18 or 20-gauge spring-loaded core biopsy gun was used to obtain core tissue samples. If assigned to the blood patch group, 4-8 mL of the patient's blood was administered through the guiding needle as it was pulled back through the pleural surface. After biopsy, all patients were instructed to avoid coughing and to lie with the needle entry side down for 1 hour. Chest radiographs were obtained at 1 and 3 hours after the procedure and read by both radiology residents and attending radiologist, who were both blinded to the study. A chest tube was placed if there was a large, enlarging, or symptomatic pneumothorax.[7]

The primary outcomes of the study were rate of pneumothorax and rate of pneumothorax requiring chest tube placement. The patients were analyzed in the groups to which they were randomized. The researchers found that while the rate of pneumothorax was reduced in the blood patch group compared to the control (26% vs 35%, respectively), this was not statistically significant (p=0.12). However, the rate of pneumothorax requiring chest tube placement was significantly reduced in the blood patch group compared to the control (9% vs 18% respectively, p=0.048). Although this barely reached statistical significance, it seems the reduction of chest tubes was a clinically important difference. The number of patients needed to treat with a blood patch to prevent one pneumothorax requiring chest tube placement was 12.

The results were further stratified according to presence of emphysema, smoking history, guiding needle insertion frequency, needle size, fissure crossed, and if the operator was a resident or attending. Of patients in which a 19-gauge needle was used, there was a significant reduction in both primary outcomes between the blood patch and control group. The relative risk reduction for pneumothorax with the use of a blood patch was 86% when a 19-gauge needle was used and the number needed to treat to prevent one pneumothorax requiring chest tube when a 19-gauge needle was used was 7. Smoking history, needle insertion, and resident or attending operating did not have a significant effect on the primary outcomes.[7]

In summary, using a blood patch after CT-guided lung biopsy reduced the rate of pneumothorax requiring chest tube insertion, but it's unclear if it reduces the rate of pneumothorax alone. However, the use of a 19-gauge guiding needle along with a blood patch has a greater effect on reducing the rate of pneumothorax. A limitation of this study is that it was only conducted at one institution, so it is unclear if the findings can be applied to all patient populations. There was no mention of how patients were recruited, which may bias the findings. In addition, it is possible that the technique of lung biopsy at this institution may differ from others, which could influence the results at outside institutions. Also, as the authors noted, patients with a prior history of chest surgery or radiation, and with multiple punctures of the pleura were not excluded. This prior trauma to the lung may have affected the final outcome. Finally, the fact that physicians were unable to be blinded could lead to biased findings.[7] Given these possible biases, this study is designated as a Level 2 according to the Strength of Recommendation Taxonomy (SORT).[3] Given the discrepancy of the trials reviewed, this body of literature has a level of evidence of B according to the SORT Criteria.

Clinical Application

Our patient met the inclusion criteria for this study, had a 17-gauge guiding needle, did not receive a blood patch, and ended up with a pneumothorax requiring chest tube insertion. The evidence from this study suggests that her risk of a pneumothorax might have been reduced had the operating physician used a 19-gauge needle and a blood patch. The benefit of applying this research to patients is the potential for reducing complications and length of hospital stay without any extra cost or few, if any, side effects. In fact, none of the 6 articles initially found in my search mentioned any adverse effects. However, it is still unclear if we can apply this data to all patient populations so the benefit may not be as great for some groups. A larger, multi-institution and multi-ethnicity study should be done to further support the findings of Malone et al.

This evidence was not discussed with the patient or her daughters prior to CT-guided lung biopsy as the gauge of the needle and patching procedures were unknown at the time. Had it been discussed, the additional challenge to providing procedural options with our patient that appeared overwhelmed by her difficulty recalling information in addition to her possible cancer diagnosis meant that we would have had to use our best judgment. Her daughters would ultimately be responsible for making a decision on her behalf given she was only oriented to person, however, it was clear the patient wanted to maintain autonomy as much as possible. Her newly diagnosed lung mass has major implications for mental health, particularly in this patient who had a history of depression. With

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that said, I recommend to this patient that she, or her daughters, discuss with her doctors the possibility of using a blood patch if she requires another lung biopsy. In the future, my practice will change to include this discussion with patients with the goal of reducing biopsy complications until stronger evidence is found.

Learning points:

1. An autologous blood patch might reduce the rate of pneumothorax requiring a chest tube[7]
2. The use of a 19 gauge needle along with a blood patch significantly reduces the risk of a pneumothorax[7]
3. This trial supports previous findings from Lang et al, however, a larger, multi-institutional investigation should be done to solidify the results

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