

**Is Your Patient at Risk?
Air Embolism Post CT
Guided Lung Biopsy: A
Rare But Potentially Fatal
Complication**

Lauren Miller RN, MSN-L, CRN

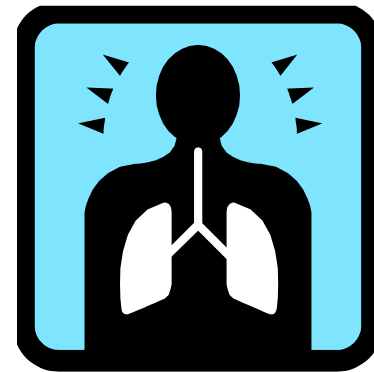
Why a Percutaneous Lung Biopsy?

- ▶ When a lung nodule is found (usually of intermediate size of over 8mm)
 - Used to confirm or exclude malignancy
 - Used to establish a specific benign diagnosis such as infection to guide treatment



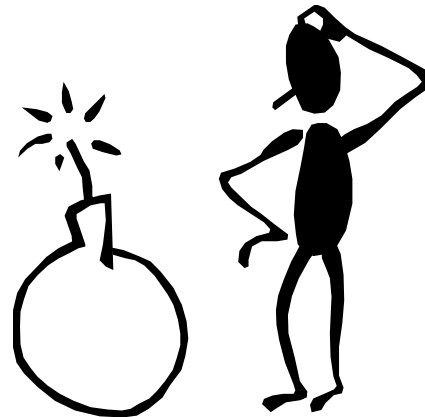
Percutaneous Lung Biopsy

- ▶ Percutaneous lung biopsy is a minimally invasive procedure that is an indispensable tool in the diagnosis of thoracic lesions
- ▶ Serious complications can occur even when technique is excellent and patient cooperation is perfect



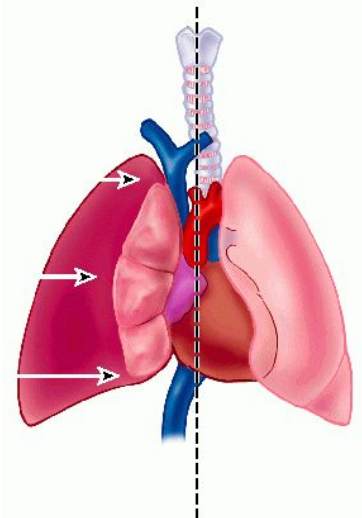
Complications of Lung Biopsy

- ▶ Pneumothorax
 - Most common complication occurrence of 17–26% with chest tube insertion needed 1–14% of the time
- ▶ Hemorrhage
 - 4–27%
- ▶ Air embolism
 - Rare but potentially fatal complication 0.06%
- ▶ Tumor seeding
 - Extremely rare 0.012%



Pneumothorax

- ▶ Risks
 - History of tobacco use
 - COPD
- ▶ Safeguards
 - Patient positioning
 - Rapid patient rollover into biopsy side down position
 - Injection of substances into biopsy path
 - Saline
 - Hydrogel plug
 - Blood Patch



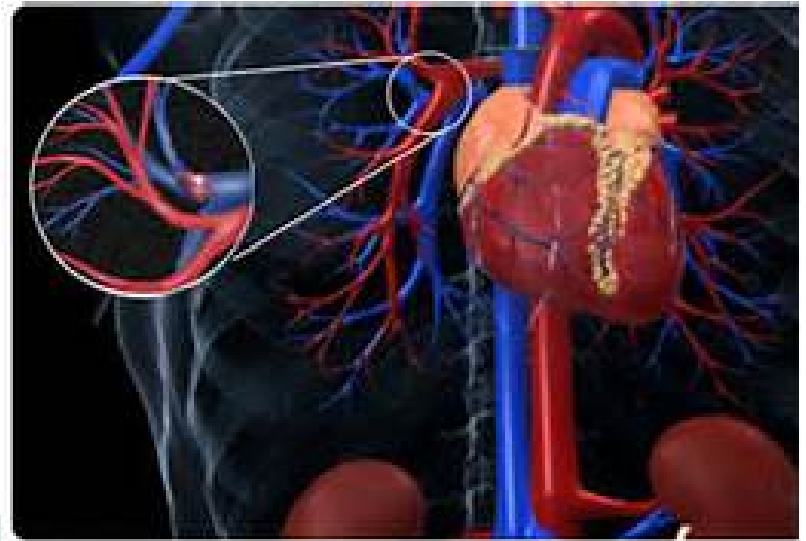
Hemorrhage

- ▶ Risks
 - COPD
 - Female
 - Smaller nodule size
- ▶ Safeguards
 - Hold anticoagulants prior to biopsy if able
 - PT/INR <1.5



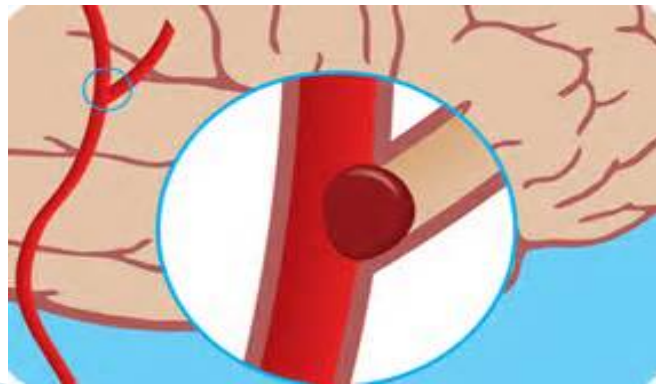
Air Embolism

- ▶ Reported occurrence is 0.06% but true occurrence is probably much higher as it can be asymptomatic
- ▶ Air in the pulmonary venous system embolizes to coronary or cerebral arteries
- ▶ 2ml of air into cerebral circulation can be fatal
- ▶ 0.5–1 ml of air into the pulmonary veins can cause cardiac arrest from coronary embolism
- ▶ Risk of immediate death



Air Embolism

- ▶ Can occur from
 - Air being injected into pulmonary veins
 - Air being injected into pulmonary arteries which reaches pulmonary veins by traversing the pulmonary microvasculature
 - The needle may penetrate simultaneously at an air-containing space (alveolar space, bronchus, cavity or air cyst) and a nearby pulmonary vein creating a fistula

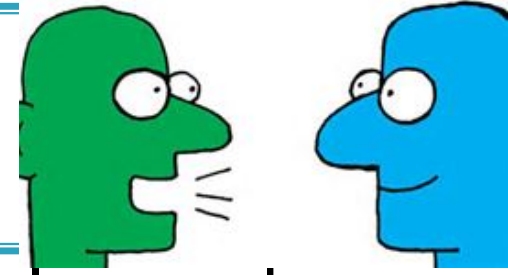


Risk Factors

- ▶ COPD
- ▶ Corticosteroid use
- ▶ Confused patient who cannot follow breathing instructions
- ▶ Coughing during the biopsy
- ▶ Needle depth in the tumor
 - Deeper the tip of needle is in tumor, less risk of air embolism because no aerated parenchyma is involved
- ▶ Level of tumor above the left atrium
- ▶ Prone position during biopsy



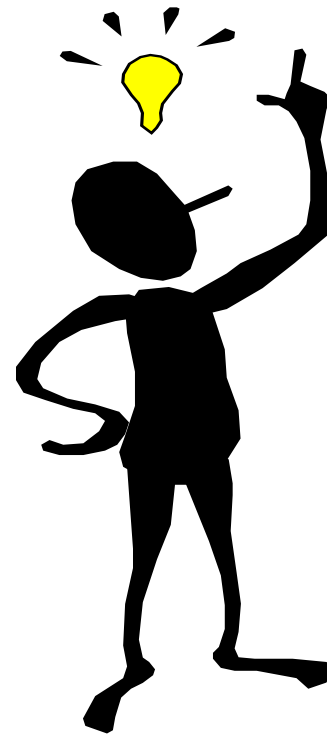
Safeguards



- ▶ Biopsy should be avoided for intractable cough
- ▶ Avoid biopsy through a cavitory lesion
- ▶ Assess patient ability to follow instructions and communicate before procedure
- ▶ Patient needs to hold their breath during biopsy
- ▶ Validate patient breathing instruction using return demonstration method
- ▶ Review and reinforce patient education content related to breathing, positioning, pain, anxiety, and communication.
- ▶ Maintain verbal communication with A&O patient
- ▶ Use of continuous capnography monitoring

Recognition of Air Embolism

- ▶ A decrease in end-tidal carbon dioxide levels (Capnography)
- ▶ Rapid deterioration of neurologic and/or cardiac status
- ▶ Arrhythmias (tachy-arrhythmias and ST-T changes)
- ▶ Circulatory collapse
- ▶ Cardiac Failure
- ▶ Neurological defects
- ▶ Seizures
- ▶ Sudden Death



Interventions for Air Embolism

- ▶ Place patient left lateral decubitus / Trendelenburg position (left lateral decubitus position may be superior to avoid air entering the left heart from the right heart)
- ▶ Administer 100% Oxygen (aiding elimination of nitrogen and reducing embolus volume)
- ▶ Transfer for hyperbaric oxygen chamber treatment if available



Interventions– Symptomatic

- ▶ Supportive therapy
 - CPR
 - Fluid resuscitation
 - 100% Oxygen
 - Consider Heparin therapy
 - Vasopressors for hemodynamic support
 - Intubation
 - Mechanical ventilation



Case Study #1

- ▶ 81 year old male
- ▶ Medical History
 - Tobacco use
 - CAD
 - Prostate Cancer
 - COPD
 - On Plavix (held for 5 days)
- ▶ Allergies
 - NKA
- ▶ Imaging
 - CT showed 2.4x1.2cm nodule left upper lobe. PET recommended
 - PET/CT showed increased uptake with nodule left upper lobe

Case Study #1

- ▶ Patient A&O and able to follow breathing instructions
- ▶ Lung biopsy completed without incident with patient in supine position
- ▶ During hour 2 of recovery in the recovery area patient developed right sided weakness, difficulty with speech, ALOC.
- ▶ CT of head showed lucencies/gas in cerebral & cerebellar arterial vessels.
- ▶ Patient stabilized and received hyperbaric oxygen therapy
- ▶ After 5 days in the hospital, patient discharged from hospital to rehab due to residual right sided weakness
- ▶ After 12 days in rehab, patient discharged to home with minimal but still present right sided weakness with speech clear, no noticeable deficits in memory or cognition.

Case Study #2

- ▶ 66 year old female
- ▶ Medical History
 - Left lower lobe lung resection within past year for Lung Cancer
 - PVD
 - Diabetes
 - Tobacco use
 - Hypertension
- ▶ Allergies
 - Vicodin
- ▶ Imaging
 - CT showed 2.6cm nodule left upper lobe

Case Study #2

- ▶ Patient A&O and able to follow breathing instructions
- ▶ During the biopsy, multiple needle repositioning necessary due to continued motion of the patient as well as respiratory variation
- ▶ Post biopsy CT images demonstrated immediate pneumothorax of at least 50% and a chest tube was placed
- ▶ 2 days later, patient returned for repeat lung biopsy as results were “non-diagnostic” with chest tube still in place
- ▶ Biopsy completed with patient in prone position and post CT images shows small amount of peri-nodule blood with punctate gas within the SQ tissues. Note of punctate gas within left ventricle but information not given to nurse caring for patient
- ▶ Patient voiced complaint of nausea and chest pain
- ▶ Nurse suspected possible vasovagal episode and pain from pre-existing chest tube
- ▶ All complaints resolved once patient on gurney
- ▶ In recovery area, patient experienced new onset left arm weakness, heaviness, decreased grip, weakness in jaw and neck.
- ▶ Patient placed in trendelenberg and symptoms resolved after approx. 5 – 10 min.
- ▶ Patient received hyperbaric oxygen therapy
- ▶ Next day, chest tube removed and patient discharged without lasting effects

Case Study #3

- ▶ 76 year old male
- ▶ Medical History
 - Diabetes
 - Hyperlipidemia
 - COPD
 - Pulmonary Fibrosis
- ▶ Imaging
 - CT showed 3.5cm round mass in the anterior aspect of the left upper lobe
 - PET/CT showed increased uptake

Case Study #3

- ▶ Patient A&O and able to follow breathing instructions
- ▶ Patient placed in left lateral decubitus position
- ▶ After sample was obtained and being placed in formalin nurse noted patient was bradycardic and unresponsive
- ▶ Patient bag ventilated and reversal agents given
- ▶ Chest CT showed small amount of air in the epicardium and no evidence of pneumothorax
- ▶ Head CT showed large amount of air along the subarachnoid spaces and in the frontal, parietal and temporal occipital lobes
- ▶ Patient stabilized and received hyperbaric oxygen therapy
- ▶ Post CT showed resolution of air embolism but showed hyper densities and sub acute ischemic changes
- ▶ Patient had residual right sided deficit and agitation
- ▶ Patient stay was complicated by diffuse alveolar hemorrhage and he died 16 days after biopsy

Case Study #4

- ▶ 60 year old male
- ▶ Medical History
 - Asthma
 - COPD
 - Melanoma of right cheek removed 4.5 years earlier
- ▶ Imaging
 - CT showed 2.5cm mass in the posterior segment of the left lower lobe
 - PET/CT showed increased uptake

Case Study #4

- ▶ Patient A&O and able to follow breathing instructions
- ▶ Patient placed in right lateral decubitus position
- ▶ Biopsy completed without incident with no episodes of coughing
- ▶ After removal of the needle, patient briefly coughed and expectorated a small amount of bright red blood
- ▶ CT obtained and ruled out pneumothorax
- ▶ Patient again coughed and expectorated a small to moderate amount of bright red blood
- ▶ While moving patient to avoid aspiration, patient became unresponsive and cardiac and respiratory arrest occurred. Code Blue called and resuscitative efforts begun
- ▶ Efforts unsuccessful and patient died on the CT table

Following the Incident

- ▶ Complete an Incident Report
- ▶ Notify your Supervisor/Director
- ▶ Notify Quality Department
- ▶ Notify Risk



Summary

- ▶ When choosing needle biopsy of a pulmonary lesion, providers and patients should not only consider the risks but also factors that increase a patient's risk of complications
- ▶ Air embolism during percutaneous lung biopsy may be inevitable and can occur despite long experience and meticulous care
- ▶ Be aware of the protocol to call for help such as rapid response, stroke alert, and code Blue
- ▶ Be aware of the nearest facility that has a hyperbaric chamber that can accept in-patient acute cases

THANK YOU!!!!

Any Questions??

References

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