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

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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%
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.
- 0.5–1ml 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 cavitary 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-arrythmias 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
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
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

- Arnold BW, Zwiebel WJ. Percutaneous transthoracic needle biopsy complicated by air embolism. AJR 2002; 178: 1400–1402
- Wu CC, Maher MM, &Shepard JO. Complications of CT-guided percutaneous needle biopsy of the chest: Prevention and management. AJR 2011; 196:678–682