Unconventional Approaches for CT-guided Biopsy: Anatomic and Technical Considerations

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Learning objectives

Show unconventional CT guided biopsies in hard to reach lesions. Evaluate risks and benefits of each biopsy approach.
Background

The value of diagnostic and therapeutic interventional procedures is widely recognized. The 60s saw the first outbreak of fluoroscopically guided biopsies with image intensifier.

In 1966, Dahlgren and Nordenstrom began to use fluoroscopy with image intensification to direct fine needle biopsies of lung tumors. Their results showed high accuracy and a low frequency of complications.

Over the last 30 years (Haaga 2005), computed tomography (CT) has developed into a well accepted and widely used guiding tool for a broad range of percutaneous interventions. It can be used either as an alternative to sonography or fluoroscopy guidance.

Most image-guided biopsies can be performed on an outpatient basis.

Most biopsies are done through conventional access and are quite straightforward to perform. However, there is a small number of CT guided biopsies that require more imaginative and unconventional approaches. Usually these unconventional biopsies are an outcome of lesions in which conventional approaches associate a high risk for complications or when lesions are placed in difficult locations. Our goal is to show some of those unconventional approaches while highlighting the cautions to take and the structures to avoid.
Findings and procedure details

The patient is laid on the CT scanner, either in supine, prone or lateral decubitus depending on the target. The lesion and biopsy route is assessed through a short helical acquisition; after the route is determined, the angle of entry and depth of the lesion is measured. Depending on the entry angle, lesion depth and tissue sample needs, the needle and technique (coaxial technique, aspiration or cut needles, etc) are chosen.

The area of needle access is sterilized with iodopovidone solution and afterwards a sterile field is placed. Local anesthesia is achieved through subcutaneous injection of 2% lidocaine without epinephrine. All through the needle approach to the lesion CT images are periodically obtained for control and route/angle correction. All samples are extended on a glass for an onsite pathologist to confirm that it is appropriate in quality and quantity or to request more biopsies from the lesion as the needle/patient is in place. Complications should be ruled out with a final CT acquisition of the area and through a small observation time in the recovery area, where vital signs are assessed.

Clinical case 1: Left pneumonectomy patient due to lung adenocarcinoma 11 years ago. Follow up CT shows a tumor in the contralateral hemi-thorax. It is decided that a sample is needed to differentiate primary from secondary disease. It is also desired, if it turns out to be a primary, to search for molecular markers, thus requiring tissue rather than cells. Conventional access to the lesion would be transpulmonary, but because of his background, this approach makes a possible pneumothorax riskier. In this case a transvertebral approach was undertaken to reduce the risk for this complication (Fig.1-3). The lesion turned out to be another primary lung cancer.

Clinical case 2: Patient with an osteolytic mass located on the skull base which shows enhancement after intravenous contrast injection. Biopsy was requested for diagnosis and the transnasal route under general anesthesia was chosen as the less riskier and best available option (Fig.4-7). The coaxial technique used allowed to take many samples. Diagnosis was reached and the lesion was catalogued as a plasmocytoma.

Clinical case 3: Patient presenting with a mass-like lesion in the posterior segment of the superior lobe of the left lung, right in front of the fissure. Conventional access would be through pulmonary parenchyma, but since the location of the lesion implies crossing pleura and fissure, increasing the risk for pneumothorax, a route across the scapula was chosen to minimize the risk of pneumothorax (Fig.8-10). Diagnosis was successfully reached and the lesion turned out to be primary lung cancer.

Clinical case 4: Patient presenting with an expansive lesion of the nasopharynx that showed enhancement after intravenous contrast injection. Biopsy was requested to reach
final diagnosis and select the most appropriate treatment. Due to the lesion location and the critical structures near it, an approach under the zygomatic arch, between the mandibular condyle and coronoid apophysis, was chosen (Fig.11-13). Final diagnosis was lymphoma. The patient began chemotherapy.

Clinical case 5: Patient presenting with a fluid collection behind the dens displacing and compressing the spinal cord. The patient had progressive weakness in all four limbs and sphincter disorders secondary to spinal cord compression. Due to the difficult location and high risk of sequelae, an interventional approach was first attempted, rather than surgery. A lateral approach was used to evacuate the injury (Fig.14-17). The obtained liquid was cultured and analyzed. The lesion turned out to be an odontoid synovial cyst. After the procedure all of the symptoms subsided.

Clinical case 6: Patient presenting with an osteolytic lesion of the body of the axis. The patient had a history of previous lung tumor. Biopsy was requested to rule out metastatic spread and determine appropriate treatment. Transoral access parallel to anesthesia tube was chosen, thus avoiding jugular carotid space and minimizing the risk for complications (Fig.18-21). In this case you should avoid the lateral approach. Final diagnosis of the lesion was metastatic adenocarcinoma.

Clinical case 7: Patient presenting with a mass in the posterior mediastinum, between the descending aorta and trachea. Using a trans-pedicular approach and coaxial technique with a Jamshidi bone needle and a Franseen aspiration needle, access to the lesion was obtained. The Jamshidi bone needle was used until the front edge of the vertebra was reached and then the center of the tumor was sample with the Franseen aspiration needle (Fig.22-24). Several samples were taken and final diagnosis was made. The lesion turn out to be a metastatic adenocarcinoma.

Clinical case 8: Patient with a lytic lesion at the body of the axis. The patient had a history of previous renal tumor. This patient resembles the one seen previously in case 6, but in this case the lesion was higher. In this case an approach through the mastication muscles, medial to the jaw, was undertaken (Fig.25-27). Diagnosis was reached and the lesion turned out to be a renal cancer metastasis.
Fig. 1: Right lung nodule (white asterisk) found in a routine follow up of a patient with left pneumonectomy due to lung adenocarcinoma.

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**Fig. 2:** To avoid the pneumothorax risk associated to lung biopsies, a posterior access was chosen (white arrow) using a Jamshidi needle to go through the vertebra (black arrow) and a Franseen needle to aspirate the lesion.

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Fig. 3: A schematic of the biopsy is shown as in figure 2.

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Fig. 4: Osteolytic lesion occupying the base of the cranium and the hypophysial fossa (White arrow).

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**Fig. 5:** The patient was placed in supine decubitus where a Jamsihidi 11G (arrowhead) and a Franseen 18G (white arrow) needle were used with a coaxial technique through the transnasal route.

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Fig. 6: Needles seen in Fig.5 can be seen reaching the lesion in the skull base in an axial CT image (white arrow and arrowhead) through the left nasal fossa.

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Fig. 7: A schematic of the biopsy is shown representing the needle track.

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Fig. 8: Patient with a right lung mass adjacent to the major fissure (asterisk).
Fig. 9: A trans-scapular-intercostal coaxial technique was used to reach the lesion (white arrow).

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Fig. 10: A schematic of the biopsy is shown where the reduced risk for pneumothorax due to avoiding puncturing the pleura and fissure can be better appreciated like in figure 9.

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Fig. 11: MRI of a patient showing a contrast enhancing lesion in the nasopharynx (asterisk).

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Fig. 12: Computed tomography axial image showing the sub-zygomatic access of the needle, to reach the lesion (white arrow).

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**Fig. 13:** A schematic of the biopsy is shown allowing imagine the needle pathway

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Fig. 14: Cervical spine MRI showing a hyperintense fluid like lesion in the posterior aspect of the odontoid process of C2 (asterisk) with subsequent spinal cord displacement.

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Fig. 15: A sagittal plane of the MRI better depicts the spinal cord displacement.

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Fig. 16: A lateral access to the lesion was decided and needle placement in the lesion of C2 can be seen in CT.
Fig. 17: The schematic shows the procedure clearly as in figure 16.

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**Fig. 18:** Osteolytic lesion in the Axis seen both in an axial slice (Fig.18) and a sagittal reconstruction (Fig.19) of a multislice CT (asterisk).

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Fig. 19: Osteolytic lesion in the Axis seen both in an axial slice (Fig.18) and a sagittal reconstruction (Fig.19) of a multislice CT (asterisk).

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Fig. 20: A trans-oral route was selected and the needle reaching the lesion can be seen in an axial CT slice.
Fig. 21: A schematic of the biopsy is shown, trying to demonstrate the needle track.

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Fig. 22: Posterior mediastinal mass (asterisk).

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Fig. 23: CT axial slice (Fig. 23) and schematic (Fig. 24) of the trans-vertebral route that was used to reach the mediastinal lesion.

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**Fig. 24:** CT axial slice (Fig. 23) and schematic (Fig. 24) of the trans-vertebral route that was used to reach the mediastinal lesion.

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**Fig. 25:** Lytic lesion in the vertebral body of the axis (white small arrow)

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**Fig. 26:** Axial CT slice showing the biopsy needle reaching the lesion passing anteriorly to the left mandible ramus (big white arrow).

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**Fig. 27:** A schematic of the biopsy is shown as in figure 26.

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Conclusion

There are many approaches to a lesion in a CT-guided biopsy. It is true that conventional accesses are more common and easy to perform, but unconventional routes may be needed in some cases. To know your options and alternatives helps provide a better patient care and may avoid more invasive complications.
References


