Stereotactic biopsy

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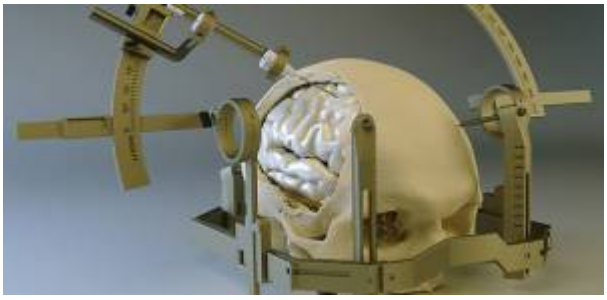

A stereotactic biopsy is a medical procedure used to obtain a small sample of tissue from a specific area of the body, usually within the brain. The term “stereotactic” refers to the use of three-dimensional coordinates to precisely locate the target tissue for sampling. This procedure is often performed when a lesion or abnormality is detected in imaging studies, and further examination is needed to determine its nature.

Procedure

Imaging: Before the biopsy, detailed imaging studies are conducted, typically using techniques such as computed tomography (CT) or magnetic resonance imaging (MRI). These images help identify the location and dimensions of the abnormality.

Frame Placement (In Frame-Based Stereotactic Biopsy): In traditional frame-based stereotactic biopsies, a rigid Stereotactic System is attached to the patient's head. This frame serves as a reference point and helps guide the surgeon to the precise coordinates of the target tissue.

Coordinate Calculation: Using the imaging data, the surgeon calculates the coordinates of the target tissue within the body. This information is crucial for accurate navigation during the biopsy.

Navigation System (In Frameless Stereotactic Biopsy): In frameless stereotactic biopsies, a navigation system is employed to guide the surgeon to the predetermined coordinates without the need for a rigid frame. This system uses advanced imaging technology to track the position of the surgical

instruments in real-time.

Biopsy Needle Insertion: A small incision is made, and a biopsy needle is inserted into the targeted area. The surgeon uses the calculated coordinates or the navigation system to guide the needle to the precise location of the abnormality.

Tissue Sample Collection: Once the biopsy needle is in position, a small sample of tissue is collected. The sample is then sent to a pathology laboratory for detailed analysis.

Pathological Examination: In the laboratory, pathologists examine the tissue sample under a microscope to determine the nature of the abnormality. This analysis helps diagnose whether the tissue is cancerous, non-cancerous, or other specific conditions.

Post-Procedure Care: After the procedure, patients are monitored for any complications. In most cases, stereotactic biopsy is a minimally invasive procedure, and patients can often resume normal activities relatively quickly.

Stereotactic biopsies are valuable for diagnosing lesions in areas that are challenging to reach without invasive surgery. The choice between frame-based and frameless stereotactic biopsy depends on various factors, including the location of the lesion, patient characteristics, and the surgeon's preference. Always consult with a healthcare professional for personalized information regarding any medical procedure.

Navigated transcranial magnetic stimulation can be implemented to aid with the planning of a stereotactic biopsy procedure in eloquent areas of the brain, and should be considered part of the neurosurgical armamentarium [1)].

Diagnostic yield of stereotactic biopsy

Diagnostic yield of stereotactic biopsy

Indications

Stereotactic biopsy indications.

Methods

Müller et al., presented a paper to demonstrate a new method of stereotactic biopsy, based on a patient-specific 3D printed platform in dogs. The system was tested on two canine cadavers, a small (Shih Tzu) and a large (Labrador) breed. Imaginary biopsy targets were defined in a superficial (caudate nucleus) and a deep (piriform lobe) position. Based on 3 Tesla MRI, individualized stereotactic platforms were designed using a semi-automatic approach, and manufactured additively using ABS M30. A pre- and intra-operative CT was performed to compare the planned vs. the realized needle position for precision analyses of the procedure. The target points varied with a precision between 0.09 mm and 0.48 mm. Manufacturing time required 480 to 700 min per platform. The presented patient-specific stereotactic system seems a suitable instrument for application in small

animal neurosurgery. In particular, the implementation of relevant stereotactic data may help performing the procedure in rapid sequence and with higher precision than currently-used systems. Required adjustments and adaptions to the respective anatomical conditions are omitted and make the procedure reliable and safe [2].

Both the frame-based and the frameless stereotactic (navigation) systems are currently used for biopsy of intracranial tumors. However, all these equipment are very expensive [3] [4].

Frame based stereotactic brain biopsy

Frameless stereotactic brain biopsy

A frameless stereotactic biopsy is a medical procedure used to obtain a tissue sample from a specific area within the body, typically the brain, for diagnostic purposes. Unlike traditional stereotactic biopsy that use a rigid frame attached to the patient's head to precisely target the biopsy location, frameless stereotactic biopsies utilize advanced imaging technology for guidance, eliminating the need for a fixed frame.

Frameless stereotactic biopsy

Target selection

Glioma heterogeneity and the limitations of conventional structural MRI for identifying aggressive tumor components can limit the reliability of stereotactic biopsy and, hence, tumor characterization, which is a hurdle for developing and selecting effective treatment strategies.

In vivo MR spectroscopy (MRS) and PET enable noninvasive imaging of cellular metabolism relevant to proliferation and can detect regions of more highly active tumor.

18F-FET-PET imaging is considered to identify metabolically active tumor tissue and to differentiate it from therapy-associated changes.

18F-FET-PET image-guided surgical targeting yielded histological diagnosis with decent specificity and high sensitivity in our cohort of pediatric brain tumor patients. Our results warrant further evaluation of 18F-FET-PET imaging for surgical guidance [5].

Microrecording

Microrecording is useful to delineate the brain tumor from its surroundings. Stereotactic diagnostic biopsy and removal of the brain tumor were facilitated by this adjuvant method [6].

Image-guided stereotactic biopsy performed using depth microrecording was safe, it provided accurate positional information in real-time, and it could distinguish the tumor from brain structures during surgery. Moreover, this technique has potential for studying the epileptogenicity of the brain tumor [7].

see Stereotactic brain biopsy in dog.

Contraindications

1. coagulation disorders

a) coagulopathies: bleeding diatheses, iatrogenic (heparin or coumadin)

b) low platelet count (PC): PC < 50,000/ml is an absolute contraindication, it is desirable to get the PC ≥ 100,000

2. inability to tolerate general anesthesia and to cooperate for local anesthesia.

Complications

see Stereotactic biopsy complications.

Case series

see Stereotactic brain biopsy case series.

Case reports

see Stereotactic brain biopsy case reports.

1)
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3)
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4)
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5)
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