PET and SPECT in Epilepsy Surgery
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PET Scans (Positron Emission Tomography) and SPECT Scans (Single Photon Emission Computed Tomography) are relatively new nuclear imaging techniques. They have been used in cardiology, neurology, and oncology.

PET and SPECT scanning is done by injecting small amounts of radionuclides (radioactive isotopes) labeled molecules intravenously. The molecules are picked up by specific cellular or molecular targets to be investigated. By detecting the gamma rays emitted from the radiochemicals injected, the cellular function is measured and the location of abnormality detected.

For PET scan, several radiochemicals have been studied for imaging brain function. The one used currently is FDG (Fluorodeoxyglucose), which is radio-labeled glucose. Brain metabolizes glucose as major source of energy. Normal brain picks up FDG in a large amount. In epilepsy, the brain cells (neurons) do not function right or the neurons are lost due to variety of reasons. FDG-PET scan will detect the regions of the brain where the glucose uptake is low (hypo-metabolism), which is often associated with the site of seizure origin.

In contrast, brain SPECT imaging is mainly used to measure blood flow to brain by injecting radio-labeled chemicals (ECD or HMPAO). These molecules are quickly picked up by the brain cells, usually within a minute of injection, and the amount of uptake is proportional to level of blood flow at the time of injection. Injected at the time of seizure onset, the region of hyperperfusion (which is associated with seizure activity) is detected. By computerized analysis of comparing the ictal scan (imaged when having seizure) and the interictal scan (imaged without seizure), the regions of activation in the brain are detected to locate the seizure.

Unlike CT, MRI or Ultrasound, which detect structure changes and anatomy, PET and SPECT can provide physiological, cellular and molecular information of brain. PET and SPECT are clinically indicated for pre-surgical localization of seizure origin. They are covered by most insurance providers. They provide valuable seizure localization information in addition to MRI scan, EEG and clinical assessment to the surgeons.

Slide 6: This is an example of PET scan of a patient with temporal lobe epilepsy, which was co-registered to the MRI scan. Compared to the left temporal lobe (normal red/green color), the right temporal lobe (arrow) showed decreased glucose uptake (hypometabolism, blue color).

Slide 7: This is an example of Ictal-Interictal ECD-SPECT, which was computer processed and fused back to the MRI scan. The region of hyperperfusion at the time of seizure was detected (arrow) in the right frontal region.
How should the patient prepare for PET and SPECT scans?

PET scan:
- Patients should fast at least 4 hours before the scan.
- Optimally, no seizure for 24 hours before the scan if the seizure is infrequent.
- Coordination with EEG lab for EEG monitoring around the time of study (45 minutes before, and 45 minutes after the tracer injection).

SPECT scan:
- SPECT scan is done as inpatient during Video-EEG monitoring. Patients need to be fasting if sedation is planned.
- For pediatric patients, sedation might be needed for optimal imaging quality.