POSITRON EMISSION TOMOGRAPHY (PET) SCAN

Surgical Specialty:	Non-OR Anesthesia (NORA)
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Background:

- General Considerations
  - Positron emission tomography (PET) scans obtain an image following the injection or ingestion of a positron-emitting radiopharmaceutical (radiotracer) agent.(1)
  - As the radiotracer decays to a stable state, the emitted positron will interact with an electron. This interaction annihilates both particles, producing two high-energy photons that are detected by the PET scanner. The culmination of these events is used by the scanner to reconstruct the image of the biodistribution of the radiotracer. (2)
  - PET scans are used to diagnose, stage, and monitor cancers such as Hodgkin and non-Hodgkin lymphoma, osteosarcoma, Ewing sarcoma, and rhabdosarcoma.(1,3)
  - Further applications include the identification of seizure foci, diagnosis of movement disorders, cerebrovascular disease, and cardiac disease. (1,3,4)
  - Fluorine-18 fluoro-deoxyglucose (FDG) is the most commonly used radiotracer. FDG is a glucose analog utilized by cells during metabolic activity. The radiotracer will therefore be most utilized in highly metabolically active cells.
  - Uptake time of the radiotracer can be from 60-120 min. (1)

- Patient Considerations
  - Regardless of whether the patient is receiving sedation or not, they should be fasting 4-6 hours prior to FDG injection. (1,3)
  - Any activity that increases glucose uptake will compromise the integrity of the scan. (1,3)
    - High-sugar content food and drink should be avoided prior to injection. This includes glucose-containing intravenous (IV) fluids and total parenteral nutrition.
    - If the patient eats or receives IV glucose, they will secrete insulin, which will increase the amount of FDG entering the skeletal muscle and degrade image quality.
    - If possible, patients should not vigorously exercise 48 hours prior to injection. (3)

        - If possible, patients should void right before being scanned, as FDG in the bladder can cause an artifact.[3] Some institutions may require a bladder catheter to be placed for certain scans.
    - FDG is taken in by brown adipose tissue. This is an issue in patients with lymphoma as the lymph nodes are often close to sites of brown adipose. [3]
        - This can be attenuated by warming the patient prior to scan. Warming the patient after radiotracer injection is not effective.

- Disease Specific Considerations
    - Diabetic patients can take long-acting evening insulin, but they should get their scan in the early morning. [1]
    - Generally, 4-6 hours of time elapsed is required after the administration of short-acting insulin and before a scan. [1]
    - Insulin pumps can be kept on a night time/basal setting until the scan is over. [1]
    - If the patient is taking metformin, it may need to be held 2-3 days prior to the study as it increases FDG uptake in the colon, small skeletal muscles, and liver. [3]

- Associated Comorbidities/Syndromes
    - Malignancy
    - Seizure Disorders
    - Congenital cardiac anomalies and cardiac transplant.
    - Possible difficult vascular access.

Anesthetic Planning:

- Pre-Anesthetic Evaluation
    - Pregnancy test, if applicable
    - Blood glucose
    - Standard pre-anesthetic evaluation.
- Specific or Unique Room Set-Up Requirements
    - Typically, a remote anesthesia site.
    - Multiple scans or procedures may be done in conjunction, as the patient is already under anesthesia (i.e., computed tomography scan, echocardiogram, etc.), which may require transport of the patient between the sites.
    - Standard resuscitation equipment and backup airway equipment, including age-appropriate laryngoscope, endotracheal tubes, supraglottic airway devices should be available.
    - Most cases can be done with deep sedation with a nasal cannula or general anesthesia with a supraglottic airway.
    - Premedication for pre-procedural anxiety as needed. Propofol infusion for maintenance of sedation during the scan. May use inhalation anesthetic if needed.
    - Standard American Society of Anesthesiologists monitors.
    - Blood Availability- typically not indicated
    - PICU Bed Availability-typically not indicated.

Intraoperative Considerations:

- General
  - Dextrose-containing fluids should be avoided.
  - Bladder catheterization may be helpful for scans focused on the pelvic region as glucose is reabsorbed by the kidneys but FDG is not- making urine light up on the scan. Having a catheter to drain the bladder would then help with having a clearer image.[4,5]
  - There may be evidence that a propofol-only anesthetic may provide a better image versus sevoflurane in localizing epileptic foci. However, this is not definitive.[6]
- Induction
  - May require an inhalational induction or intravenous (IV) induction, depending on the availability of vascular access.
- Positioning
  - Supine
- Maintenance
  - A total IV anesthetic can be used, making titration of anesthetic depth easier as pumps can be placed in the control room. Inhalation agent can be used as well, though this may require entry into scanning area. The airway may be secured as necessary.
- Hemodynamic/Physiologic goals
  - Maintain normal hemodynamic goals
- Surgical Considerations
  - Timing of the scan in relation to injection of the tracer should be discussed with the technologist.
- Emergence/Disposition
  - Typically, ambulatory.
- Post-op Care
  - No specific post-op care indicated.

Case Specific Complications/Pitfalls

- A breastfeeding patient or family member should also avoid exposure to radiotracer.
  - Guidance on time to pause breastfeeding varies widely between radiotracers.
  - For FDG, some authors suggest a more conservative approach respecting ALARA (as low as reasonably achievable) principles, and studies suggest dumping the first expressed milk and then refraining from breastfeeding for at least 4 hours. It is also recommended to refrain from close contact to the breastfeeding child for up to 24 hours, as breast tissue will emit radiation. Others do not recommend breastfeeding cessation. [7,8]
- A high blood glucose (>200mg/dL) is an indication to reschedule the procedure to another time due to the possibility of a compromised image. [1]

References

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