LUMBAR PUNCTURE/ BONE MARROW BIOPSY

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

- General Considerations
  - These procedures are routinely performed as a part of the evaluation, management, and continued surveillance of various hematologic and oncologic diseases.
  - Approximately 50% of leukemia patients will develop central nervous system disease without intrathecal chemotherapeutic prophylaxis.[1-2]
- Patient Considerations
  - Some older children may be candidates for conscious sedation.
  - Most children under 12 years of age will require general anesthesia for the procedure.
- Disease Specific Considerations
  - The anesthetic considerations are influenced by the type of cancer, which is why it is important to gather as much information as possible prior to the start of the case.
- Associated Comorbidities/Syndromes
  - Coagulopathy: Screen for thrombocytopenia
    - Lower platelet count threshold for patients undergoing bone marrow biopsy (BMB) than lumbar puncture (LP).
    - There are varying opinions on the lower limit of platelet count for when it is safe to perform an LP in these patients. Ultimately, certain cases will require careful evaluation by the interdisciplinary team. Suggested lower limits of platelet count are:
      - LP threshold of at least 50 x (10^9 x L^{-1})
      - BMB threshold of at least 20 x (10^9 x L^{-1})
    - Children at an increased risk for coagulopathy are those with an active infection, acute promyelocytic leukemia, and disseminated neuroblastoma. [3]
  - Tumor Lysis Syndrome
    - Patients at an increased risk include those with a large tumor bulk at presentation, such as acute leukocytic leukemia (ALL) and non-Hodgkin's lymphoma (NHL).

Anesthetic Planning:

- Pre-Anesthetic Evaluation
    - A thorough pre-anesthetic evaluation and optimization of the patient's co-morbidities should be performed.
    - Discuss the risks/benefits/alternatives to proceeding with general anesthesia with the patient and their caregivers.
    - Additional laboratory tests may be indicated during the workup.
        - These patients usually have routine laboratory investigations. Review the timing of the most recent laboratory investigations, and the presence of thrombocytopenia or anemia prior to proceeding.
    - Chemotherapy regimens
        - Pay careful attention to the chemotherapy regimen being used. Possible side effects of the chemotherapeutic agents include:[4]
            - Bone marrow suppression: Can result from all the cytotoxic drugs.
            - Cardiotoxicity: Doxorubicin, daunorubicin, and amacrine
            - Nephrotoxicity: Cisplatin, carboplatin
            - Peripheral neuropathies: Vincristine, vinblastine, cisplatin, procarbazine
            - Pulmonary toxicity: Bleomycin and busulfan.
        - Certain pediatric malignancies such as ALL, NHL, Hodgkin's disease, neuroblastoma, and intrathoracic germ cell tumors may be associated with an anterior mediastinal mass.
        - Patients presenting with these malignancies should be assessed for symptoms associated with an anterior mediastinal mass such as shortness of breath lying down, cough, etc.
- Specific or Unique Room Set-Up Requirements
        - Most procedures are performed with a native airway with oxygen administration via a nasal cannula.
        - Make sure to have all emergency airway supplies readily available.
    - Drugs/Infusions
        - A propofol infusion is commonly used for maintenance of general anesthesia.
            - 100-300 mcg/kg/min titrated to effect.
        - Ketamine in small boluses.
        - Can consider eutectic mixture of local anesthetics (EMLA) application or local injection of 1% lidocaine to the LP site prior to the procedure.
    - Monitors
        - Standard American Society of Anesthesiologists monitors must be used.
        - An $EtCO_2$-sensing nasal cannula should be used if the airway is not secured.
            - SpO_2 and chest movement must be observed to confirm oxygenation and ventilation.
    - Blood Availability (if indicated)
        - Usually not required but may be indicated if the platelet count is too low.

Intraoperative Considerations:

- Induction
  - Often these patients will have long-term intravenous (IV) access in place.
    - Ensure proper sterile technique while accessing the vascular port.
  - If no IV is present, a mask induction may be performed prior to IV access and starting the propofol infusion.
- Positioning
  - Following the induction of general anesthesia, the patient is often positioned in the lateral decubitus position for the LP.
  - The BMB may be performed in the supine, prone, or seated position. When combined with an LP, the BMB is typically performed in the lateral decubitus position. BMBs in the prone position can be managed with a native airway. However, it is important to have all airway adjuncts readily available. [5]
- Maintenance
  - General anesthesia is typically maintained with a propofol infusion or intermittent boluses of propofol.
  - Can consider additional opioid administration for BMBs.
  - Additional pain medications are usually not necessary for LPs.
- Hemodynamic/Physiologic goals
  - Maintain the patient's hemodynamics within 20% of their physiologic baseline.
- Surgical Considerations (such as neuromonitoring, muscle relaxation, anticipated blood loss)
  - These are generally brief procedures with no additional surgical considerations.
- Emergence/Disposition
  - Monitoring in the post-anesthesia care unit (PACU) is appropriate for most cases.
  - If there are any concerns, allow the child to fully awaken in the procedure room prior to transport to the PACU.
- Post-op Care
  - Post operative nausea and vomiting (PONV)
    - Be vigilant for dehydration following repeated episodes of emesis.
    - Single agent technique without nitrous oxide is usually associated with a low incidence of PONV.
    - Intrathecal chemotherapy may potentiate nausea. In these cases, pretreat with ondansetron 0.15 mg/kg if the patient is not on a long-acting antiemetic regimen.
    - Patients are often started on an antiemetic regimen, so pay careful attention to the timing of repeat doses of antiemetics.
    - **Avoid dexamethasone** due to the possible risk of tumor lysis syndrome. Additionally, steroids may already be a part of the treatment plan.
  - Pain
    - LPs are generally well tolerated without any additional pain medication.
    - Use of a local anesthetic infiltration for BMB is frequently sufficient for postoperative analgesia. However, one may consider the administration of acetaminophen and a low-dose opioid postoperatively.
    - Ensure that the oncology team is okay with acetaminophen, as fever suppression may be a concern.

Case Specific Complications/Pitfalls

- Post-dural puncture headaches (PDPH)
    - Reported incidence ranges from 8-50%.
    - Risk factors include age, gender, needle diameter, needle tip design, orientation of the tip during puncture, previous PDPH, history of migraine, and repeated attempts to achieve puncture.[6]

References

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