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Case Report

Anesthesiologist's Perspective on a Child with Acute Lymphoblastic Leukemia undergoing Neurosurgery: Case Report

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ABSTRACT

Acute lymphoblastic leukemia (ALL) is the most common hematological malignancy in the pediatric age group. Anesthesia in such patients necessitates special considerations, in terms of disease progression and its respective treatment as well. We present a case of a 2-year-old child, a known case of ALL posted for drainage of multifocal brain abscess under general anesthesia. Anesthetic management of children with ALL presenting for neurosurgical procedures should focus on disease and its various systemic manifestations, treatment-related side effects, and anesthetic interactions which sometimes may be disastrous.

Introduction

Leukemia is the most prevalent pediatric cancer globally. Medical advancements have led to remarkable survival rates with a 5-year survival rate of 80-90%, especially with Acute lymphoblastic leukemia (ALL) [1]. Both hematological malignancy and its treatment directly affect the bone marrow, impairing the immune system and heightens susceptibility to infections [2]. Although brain abscesses are uncommon with ALL, have a 90% fatality rate it happens [3]. Not all patients will exhibit the typical trifecta of fever, headache, and neurological symptoms. Once the diagnosis of brain abscess has been made, vigorous treatment is required that may include surgical intervention and thus need anesthesia. For the best anesthetic approach in ALL, there is limited knowledge and no established recommendations.

Case Report

A 2-year, 14kg girl child was scheduled for neuro-navigation-assisted brain abscess excision. Three months ago, the child was diagnosed with ALL and she received an induction phase of chemotherapy with daunorubicin, L-asparaginase, vincristine, intrathecal methotrexate, and prednisolone. She developed febrile fungal neutropenic mucositis during this period and received antifungal therapy. Later, she got admitted for generalized tonic-clonic seizure. Contrast Enhanced Computed Tomography (CECT) head revealed multiple intracranial ring-enhancing lesions with peri-lesional edema (Figure 1). Therefore, brain abscess excision and drainage were planned.

The pre-anesthetic check-up was unremarkable except for the presence of tooth decay and oral scrapings. All preoperative investigations were within the normal range including hemogram, coagulogram, serum electrolytes, and renal and liver functions. The chest X-ray and ultrasound abdomen were also normal.

Standard fasting guidelines were followed and prescribed medications were continued. In the operating room, routine monitors were applied. Forced-air warming blanket was used to cover the child. A 20G intravenous cannula was secured under sevoflurane in 100% oxygen till loss of limb movements. Anesthesia was induced with intravenous fentanyl 30 mcg and atracurium 7 mg was used followed by tracheal intubation. Under all aseptic

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precautions, the left radial artery was cannulated with a 24G cannula. Sevoflurane in air-oxygen mixture was used to maintain anesthesia. Pressure-controlled ventilation was targeted to achieve end-tidal carbon dioxide between 32-35 mmHg. Injection of cefuroxime 50 mg/kg was given 30 minutes before the commencement of the skin incision. The surgery lasted for an hour and analgesia was supplemented with intravenous paracetamol 15 mg/kg. Goal-directed fluid therapy using systolic and pulse pressure variation was followed and a total of 250 ml 0.9% saline was administered. The intraoperative urine output was 30 ml and the blood loss was 40 ml. No osmotic diuretics or blood products were used. At the end of the surgery, the trachea was extubated under satisfied conditions following reversal with neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg. The patient was discharged in stable condition after five days of uneventful hospital stay.

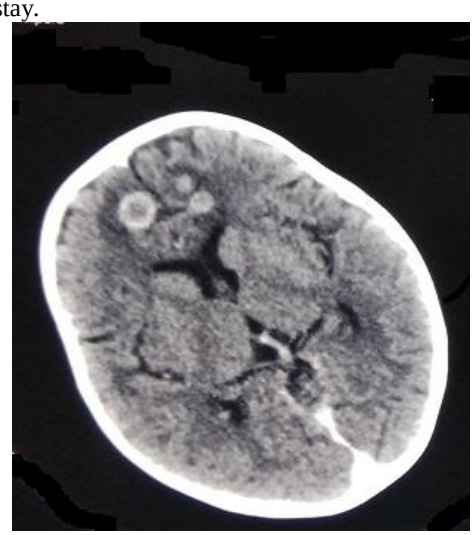

Figure 1- CECT head in axial section showing multifocal ring enhancing lesions in bilateral frontal lobes with perilesional edema and mass effect.

Discussion

The main treatment modality for ALL is chemotherapy. Tumor lysis syndrome may occur during the induction phase of chemotherapy (which lasts about 4-6 weeks). Therefore, the patient should be watched for adequate hydration, urine output and serum electrolytes. Drugs that can cause hyperkalemia and renal toxicity avoided.

Pediatric patients, immanent disease pathology, inimical effects of anticancer agents on multi-organ systems, and their interaction with anesthetic agents must be addressed. The airway, intravenous access, fluid requirements, and drug dosages of the pediatric population do not correspond to those of adults. Further, one should have a lower tolerance for blood loss and a higher tendency for hypothermia, which complicates the intraoperative course even more.

The burden of disease and multiple admissions increases the anxiety of parents and children. Thus, preoperative counseling and anti-anxiety therapy are a must to prevent the future risk of psychological effects.

ALL have the potential to affect the cardiorespiratory system. These patients can develop pericardial effusion, heart failure, pericardial tamponade, pleural effusion, large vessel compression, tracheal compression, and asymptomatic mediastinal mass. Consequently, difficult airway equipment should be readily available for troubleshooting.

Myelosuppression, often observed with cancer drugs like daunorubicin and cytarabine, increases the risk of infections. Therefore, asepsis should be ensured at every step, i.e., strict hand hygiene, wearing sterile gloves, etc., including appropriate antibiotic administration. Minimizing invasive lines is essential. Pediatric bacterial-viral filters and a disposable anesthetic circuit with minimal dead space are mandatory.

Oral mucositis (inflammation, ulceration, and mucosal bleeding in the oral mucosa) occurs in 40-70% of children treated with chemoradiotherapy. Therefore, airway instrumentation during anesthesia can lead to bleeding and a problematic airway, especially if associated coagulopathy is present.

ALL patients are prone to bleeding due to drug-induced thrombocytopenia, bone marrow suppression, and iron deficiency anemia. Hence, blood and blood product transfusions are frequently required. Following multiple transfusions, the patients may develop resistance to platelets from random donors, necessitating the use of single donor platelets and cryoprecipitate. It is preferable to use CMV-depleted or irradiated blood. For neurosurgical patients, the transfusion threshold remains at 1 lakh. A platelet transfusion is recommended if the absolute platelet count is less than 10,000/mm3 without bleeding or 20,000/mm3 with bleeding [4].

The perioperative period imposes a neuroendocrine storm and immunocompromised patients on chemotherapy will be under add-on stress. Nitrous oxide should be avoided in these patients as it interferes with methionine and vitamin B12 metabolism. This can aggravate marrow suppression and increase the toxicity of methotrexate. However, the best anesthetic technique in ALL patients is inconclusive [5-6]. The various anesthetic drugs interact with anticancer therapy and may promote cancer recurrences. The proposed mechanism for this is said to be immune and genetic modulation, inflammation, and hormonal triggers. Long-term interactions of anesthesia drugs with chemotherapy are still not clear [7].

Dedicated post-anesthesia care should be provided to these patients to watch for neurological status and related complications. Prolonged fasting, vomiting with raised intracranial pressures, dyselectrolytemia, and nitrous oxide increases the risk of postoperative nausea and

vomiting (PONV). Adequate hydration, modification of anesthesia, and multiple antiemetics are required in patients receiving chemotherapy [8]. Pain management using non-opioids and non-sedatives on a clock basis should be used for maximum comfort of the patient.

Conclusion

Hence, immanent disease pathology and inimical effects of anticancer agents ought to be considered while providing anesthesia to patients with ALL. Furthermore, a distinct set of physiological, pharmacological, and psychological requirements of pediatric patients should be well thought-out.

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