Anesthesia Considerations for the Pediatric Cancer Patient

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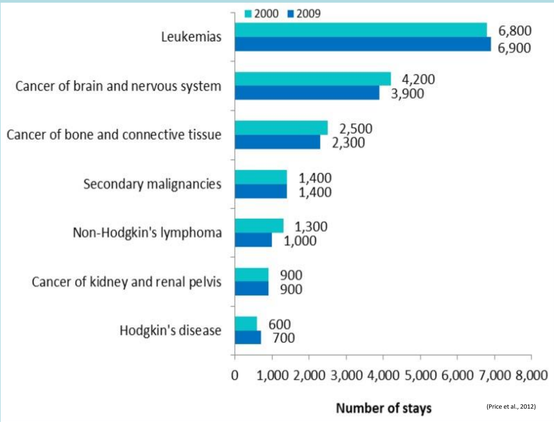
Introduction

Overall, childhood cancer is rare, accounting for only 1% of all cancer diagnoses. However, when these cases do arise, it is the responsibility of the AA to understand how to safely manage these patients. The aim of this analysis is to identify and discuss the most common considerations for anesthesia for the pediatric cancer patient in the current literature, which are as follows:

1. When this population requires anesthesia
2. The effect of anesthetic agents on cancer
3. The systemic effects of chemotherapy & radiation therapy
4. Airway concerns in this population



Background

It is necessary to first understand the demographics of this patient population before considering anesthetic management. Leukemia is the most common childhood cancer type. Its highest incidence is seen in 2-3 year-old patients. 80% of these leukemias present as acute lymphoblastic leukemia (ALL). ALL is the #1 childhood cancer diagnosis. Fortunately, the survival rate is high, about 90%. Cancer of the brain & CNS is the second most common group after leukemia, making it the most common solid tumor. Lymphomas have high incidence in 10-14 year-olds, and include both Hodgkin's disease and non-Hodgkin's lymphoma, the latter being more difficult to treat. Nephroblastoma, or Wilm's Tumor, is the most common childhood renal tumor. Other possible malignancies include cancer of the bone & connective tissue.

Review of Literature

When Anesthesia is Needed

Pediatric cancer patients commonly require anesthesia for the following procedures: short procedures, central venous catheter insertion, radiation therapy, diagnostic MR & CT scans, and surgery. Short procedures include biopsies/diagnostic procedures, such as bone marrow aspiration and lumbar punctures, as well as intrathecal chemotherapy. The common anesthetic choice for these procedures is TIVA with propofol and either fentanyl or remifentanil, as these patients often already have long-term IV access available and will only require analgesia for a short period. Radiation therapy and diagnostic scans are not painful procedures, but younger children may be unable to cooperate and often require anesthesia, commonly as a propofol infusion.

Anesthetic Agents & Cancer

Some studies have observed the use of volatile agents and opioids to be associated with immune system inhibition and promotion of tumor growth. Meanwhile, studies have also observed propofol and local anesthetics to be associated with greater overall survival and lower cancer recurrence. These studies suggest propofol and local anesthetics may increase cancer cell sensitivity to chemotherapeutic agents. The current literature contains conflicting arguments on the effects of dexmedetomidine and ketamine in cancer patients.

Systemic Effects of Chemotherapy

Cardiotoxicity has been associated with doxorubicin, daunorubicin, and idarubicin. Studies argue that these chemotherapeutic agents produce free radicals that may cause myocardial depression, ischemia, and conduction issues (namely SVT and heart block). Studies have observed various early pulmonary complications with methotrexate, vinblastine, paclitaxel, and bleomycin. Bleomycin was observed to cause toxicity (as bleomycin-induced pneumonitis) in up to 10% of patients. Furthermore, its toxicity increases with high FiO2 use after recent administration. In this event, studies recommend an intraop. FiO2 <25%. Myelosuppression may be caused by many chemotherapy agents and/or cancer itself, especially ALL. Many chemotherapy agents also cause nausea, vomiting, and/or diarrhea. Due to this prevalence, dexamethasone is used with many patients. Additional doses increase the risk of tumor lysis syndrome.

Systemic Effects of Radiation Therapy

Children have a large portion of developing tissue more sensitive to radiation compared to adults. History of head and neck radiation may create a difficult airway via tissue stiffness limiting mouth opening and/or neck ROM or laryngeal stenosis and edema narrowing the airway. Cardiac complications may arise months to years following radiation, including pericarditis, pericardial or valvular fibrosis, and conduction issues. Radiation therapy may also result in restrictive lung function, with the most common complication being radiation-induced pneumonitis.

Airway Concerns

Beyond radiation therapy, unique airway concerns in this population include patients with an anterior mediastinal mass, which may cause superior vena cava syndrome if sufficient SVC compression. Furthermore, lymphoma patients may present with enlarged lymph nodes, including tonsils and adenoids, which increase the risk of a difficult airway. These patients may present with OSA and/or stridor. A third unique airway concern is mucositis, caused by many chemotherapeutic agents, which may present with painful, ulcer-like lesions in the oral cavity, indicating the presence of friable tissue and possible subglottic edema.

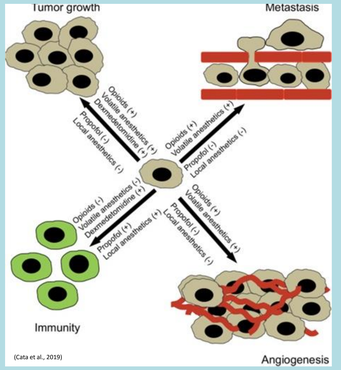


Table 2
List of traditional chemotherapeutic agents by class (17,20,38)

Alkylating agents	*Antimetabolites*	*Natural products*
Nitrogen mustards	Folic acid analogues	Vinca alkaloids
Mechlorethamine	Methotrexate	Vinblastine
Cyclophosphamide	Pyrimidine analogues	Vincristine
Ifosfamide	Fluorouracil	Vinorelbine
Melphalan	Cytarabine	Vindesine
Chlorambucil	Gemcitabine	Epipodophyllotoxins
Ethylenimines	Purine analogues	Etoposide
Thiotepa	6-Mercaptopurine	Teniposide
Alkyl sulfonates	6-Thioguanine	Enzymes
Busulfan	Pentostatin	L-Asparaginase
Nitrosoureas	Cladribine	Antibiotics
Carmustine	Fludarabine	Actinomycin D
Lomustine	Clofarabine	Daunorubicin
Streptozotocin		Dactinomycin
Platinum complexes		Doxorubicin
Cisplatin		Idarubicin
Carboplatin		Bleomycin
Oxaliplatin		Mitomycin
Triazenes		Plicamycin
Dacarbazine		Camptothecin analogues
		Topotecan
		Irinotecan
		Taxanes
		Paclitaxel
		Docetaxel

(Latham and Greenberg, 2010)

Cardiotoxicity
Pulmonary toxicity
Myelosuppression
Nephrotoxicity
Neurotoxicity

Discussion & Conclusion

The review of literature provides unique considerations that allow for safer management of this patient population. For example, patients on chemotherapy with known cardiotoxicity, a preop echo should be reviewed before receiving anesthesia. Fortunately, these patients may undergo frequent testing, and may already be dose-limited if cardiotoxic effects are present. For any pediatric cancer patient, a preop CBC should be conducted due to myelosuppression risk. Due to the GI effects of many chemotherapy agents, there should be a higher suspicion of aspiration risk in these patients as well. However, due to common administration, further doses of dexamethasone should be avoided. Finally, the literature identifies unique conditions in these patients' histories and airway exams that are not commonly considered in other populations, allowing for more accurate prediction and preparation for a possible difficult airway in this population.

Possible limitations in the current literature include the sparse & sometimes conflicting arguments on the effect of anesthetic agents on cancer. One explanation may be the methods chosen for these studies, which are largely in-vitro, not clinical. This discrepancy suggests that a cancer diagnosis is not currently an absolute contraindication of the use of a particular anesthetic agent.

In conclusion, the current literature suggests that anesthetic agent choice is of lesser importance in making anesthetic considerations for pediatric cancer patients. Instead, emphasis should be placed on understanding a patient's medical history, including their diagnosis, treatments, and possible airway exam findings, in order to identify and prepare for specific systemic effects and airway risks in these patients.

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