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Emergency Therapy for Cancer: A Comprehensive Review

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ABSTRACT :

Cancer is one of the leading causes of global mortality, accounting for millions of deaths annually. The progression of malignancies and the toxicities associated with treatment can lead to acute, life-threatening events categorized as oncologic emergencies. These include tumor lysis syndrome (TLS), spinal cord compression, febrile neutropenia, and hypercalcemia of malignancy, among others. The cornerstone of emergency cancer therapy involves timely diagnosis, rapid stabilization, and evidence-based interventions. Recent advances such as immunotherapy, targeted therapy, artificial intelligence, and personalized protocols are revolutionizing emergency oncology. However, challenges like healthcare disparities, limited access in low-resource regions, and drug resistance persist. This review outlines the pathophysiology, management strategies, and emerging therapies for major oncologic emergencies while highlighting the significance of a multidisciplinary approach.

Keywords: Oncologic emergencies, tumor lysis syndrome, febrile neutropenia, spinal cord compression, immunotherapy, emergency oncology, AI in cancer care.

1. Introduction

Oncologic emergencies are defined as life-threatening conditions either caused by cancer itself or as adverse effects of cancer treatment. These emergencies can evolve rapidly, and delay in intervention can result in irreversible damage or death. Common presentations include neurologic compromise, metabolic derangements, and infectious complications【1】.

As cancer incidence rises globally, especially in developing regions, emergency oncology is gaining prominence. Early identification and immediate treatment are crucial for improving prognosis and quality of life【2】. With advancements in biotechnology, novel therapies are being introduced that require prompt recognition and management of associated toxicities.

This review explores common oncologic emergencies, emerging therapies, and the evolving role of precision medicine and artificial intelligence in cancer emergency care.

2. Common Oncologic Emergencies and Their Management

2.1 Tumor Lysis Syndrome (TLS)

TLS is a medical emergency that occurs when cancer cells break down rapidly, releasing intracellular contents into the bloodstream. This results in hyperuricemia, hyperkalemia, hyperphosphatemia, and secondary hypocalcemia, leading to acute kidney injury and arrhythmias. It typically follows initiation of cytotoxic therapy in high-grade lymphomas and leukemias【3】.

Management:

- Aggressive IV hydration (2–3 L/m²/day) to maintain urine output.
- Allopurinol for prophylaxis; rasburicase for treatment of established hyperuricemia.
- Electrolyte correction and dialysis in severe or refractory cases.

Reference: {1}

2.2 Spinal Cord Compression

Malignant spinal cord compression (MSCC) arises due to vertebral metastases or tumor invasion of the spinal canal. Commonly associated with lung, breast, prostate, and lymphoma malignancies, MSCC can result in irreversible neurological damage if not treated early【4】.

Management:

- Immediate corticosteroids (e.g., dexamethasone 10 mg IV bolus followed by 4 mg every 6 hours).
- MRI of the whole spine for diagnosis.
- Urgent radiation therapy or surgical decompression based on neurologic status and prognosis.

Reference: {2}

2.3 Febrile Neutropenia

This condition is defined by fever ≥38.3°C and an absolute neutrophil count (ANC) <500 cells/mm³. It is a frequent complication of chemotherapy and a major cause of morbidity【5】.

Management:

- Empirical broad-spectrum antibiotics within one hour (e.g., piperacillin-tazobactam or carbapenems).
- Antifungals if fever persists beyond 96 hours.
- G-CSF for prophylaxis in high-risk regimens.

Reference: {3}

2.4 Hypercalcemia of Malignancy

Hypercalcemia is seen in up to 20-30% of cancer patients, especially those with bone metastases or paraneoplastic PTHrP secretion【6】. Symptoms include confusion, dehydration, and arrhythmias.

Management:

- Intravenous fluids and bisphosphonates (e.g., zoledronic acid 4 mg IV).
- Calcitonin for rapid short-term calcium reduction.
- Dialysis in severe or refractory cases.

Reference: {4}

2.5 Leukostasis in Acute Leukemia

Leukostasis results from extremely high leukocyte counts (>100,000/μL), leading to vascular obstruction in the lungs or CNS. It is mostly observed in acute myeloid leukemia (AML)【7】.

Management:

- Urgent leukapheresis.
- Hydroxyurea or induction chemotherapy.
- Supportive care with oxygen and fluids.

Reference: {8}

3. Emerging Therapies and Related Oncologic Emergencies

3.1 Immunotherapy-Related Adverse Events (irAEs)

Immune checkpoint inhibitors (ICIs) such as PD-1, PD-L1, and CTLA-4 blockers have revolutionized cancer treatment, but they are associated with immune-related adverse events (irAEs) affecting various organs like the lungs (pneumonitis), colon (colitis), liver (hepatitis), and heart (myocarditis)【8】.

Management:

- High-dose corticosteroids (e.g., methylprednisolone 1–2 mg/kg/day).
- Immunosuppressants like infliximab for steroid-refractory cases.
- Discontinuation of ICIs depending on severity.

Reference: {5}

3.2 CAR-T Cell Therapy and Cytokine Release Syndrome (CRS)

Chimeric Antigen Receptor T-cell (CAR-T) therapy is a breakthrough in hematologic malignancies. However, it can lead to CRS and neurotoxicity (ICANS – immune effector cell-associated neurotoxicity syndrome)【9】.

Symptoms: Fever, hypotension, hypoxia, altered mental status, seizures.

Management:

- Tocilizumab (IL-6 receptor antagonist) is the first-line treatment for CRS.
- Corticosteroids for neurotoxicity and severe CRS.
- ICU support for Grade 3-4 toxicities.

Reference: {10}

3.3 Superior Vena Cava Syndrome (SVCS)

SVCS occurs when a tumor compresses the superior vena cava, leading to venous congestion in the upper body. It's frequently seen in lung cancer and lymphomas【10】.

Symptoms: Facial swelling, dyspnea, distended neck veins, headache.

Management:

- Elevation of head, steroids (dexamethasone), and diuretics.
- Emergency radiation therapy or endovascular stenting.

Reference: {9}

3.4 Malignant Pericardial Effusion

This emergency involves fluid accumulation in the pericardial sac due to malignancy, risking cardiac tamponade. Common in lung, breast cancer, and hematologic malignancies【11】.

Management:

- Emergent pericardiocentesis under echocardiographic guidance.
- Intrapericardial chemotherapy in select cases.
- Indwelling catheter in recurrent cases.

Reference: {11}

3.5 Acute Kidney Injury (AKI) in Cancer Patients

AKI may occur due to nephrotoxic chemotherapeutics, TLS, sepsis, or urinary tract obstruction【12】. Prompt recognition is critical for preventing long-term damage.

Management:

- Withdrawal of nephrotoxic agents.
- Volume resuscitation or diuresis depending on cause.
- Temporary dialysis in refractory or severe cases.

Reference: {14}

4. Infectious, Hematologic, and Thrombotic Emergencies in Oncology

4.1 Sepsis in Immunocompromised Cancer Patients

Sepsis is a leading cause of mortality among neutropenic and immunocompromised cancer patients. Due to blunted immune responses, clinical signs may be subtle【13】.

Management:

- Immediate initiation of broad-spectrum IV antibiotics.
- Aggressive fluid resuscitation and vasopressors if needed.
- Source control and antifungals for persistent fever.
- ICU care and close hemodynamic monitoring.

Reference: {13}

4.2 Bleeding in Thrombocytopenia

Cancer patients, especially those undergoing chemotherapy or with hematologic malignancies, are at risk of bleeding due to thrombocytopenia【14】.

Management:

- Platelet transfusions (typically if platelet count <10,000/mm³).
- Antifibrinolytics (e.g., tranexamic acid) in mucosal bleeding.
- Identifying and managing underlying cause.

Reference: {12}

4.3 Pulmonary Embolism (PE) in Cancer Patients

Cancer increases risk for venous thromboembolism (VTE), particularly PE. Malignancy-related PE is associated with higher recurrence and bleeding risk during anticoagulation【15】.

Management:

- Low molecular weight heparin (LMWH) or direct oral anticoagulants (DOACs).
- Inferior vena cava (IVC) filters in patients with contraindications to anticoagulation.
- Risk-benefit assessment for long-term anticoagulation.

Reference: {15}

5. Challenges and Future Directions

5.1 Global Disparities in Emergency Oncology

Access to timely emergency cancer care is highly variable across countries. In low- and middle-income regions, delays in diagnosis and lack of emergency infrastructure increase mortality【16】. Investment in training, logistics, and resource allocation is urgently needed.

5.2 Artificial Intelligence in Emergency Oncology

AI and machine learning algorithms are now being applied to predict early onset of oncologic emergencies, triage patients, and support clinical decision-making【17】.

Examples:

- Predicting neutropenic sepsis based on blood counts and vitals.
- AI-based alert systems for early spinal cord compression detection from imaging.
- Personalized treatment risk profiling.

Reference: {16}

5.3 Personalized Emergency Protocols

Emerging precision oncology tools, such as genomic markers and real-time patient data, are enabling customized emergency response protocols. Tailored interventions can optimize therapy while minimizing harm【18】.

Reference: {7}

6. Conclusion

Emergency therapy for cancer encompasses a dynamic and multidisciplinary approach to manage acute, potentially fatal complications arising from malignancy or its treatment. From metabolic syndromes like TLS to cutting-edge toxicities such as CRS from CAR-T therapy, the landscape of oncologic emergencies is continuously evolving. The future lies in leveraging technology, artificial intelligence, and biomarker-based personalization to improve patient outcomes. Addressing healthcare disparities and building emergency oncology infrastructure globally are vital to ensure equitable care delivery.

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