FREQUENCY OF ONCOLOGIC EMERGENCIES IN CHILDREN WITH NEWLY DIAGNOSED CANCER AT THE VIETNAM NATIONAL CHILDREN HOSPITAL

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Oncologic emergencies are life-threatening complications that require urgent recognition and management in pediatric cancer patients. This study aimed to evaluate the pattern of oncologic emergencies as well as its frequency in newly diagnosed childhood cancers at Vietnam National Children's Hospital (VNCH). From July 2019 to June 2020, 392 children aged 0 - 15 years were newly diagnosed with cancer. The median age was 3 years old, and males accounted for 58% of cases. The most common forms of cancers were acute leukemia (37.8%), neuroblastoma (19.4%), lymphoma (11.5%), and malignant brain tumors (9.9%). Oncologic emergencies were present in 19.4% of patients at diagnosis, with hematological emergencies such as severe anemia (25%) and thrombocytopenia (26%) being the most frequent, followed by respiratory failure (17%) and leukocytosis (11%). Mortality within 7 days due to oncologic emergencies was 7.9%, primarily caused by superior vena cava syndrome and tumor lysis syndrome. These findings emphasize the need for early detection and timely management of oncologic emergencies to improve treatment outcomes in pediatric cancer patients in Vietnam.

Keywords: Oncology emergency, childhood cancer, Vietnam.

I. INTRODUCTION

Childhood cancer remains a major global health concern, although survival rates for childhood cancers have improved substantially in high-income countries, children in low- and middle-income countries often presented late with advanced disease and suffer disproportionately from preventable complications.[1] Among the most critical of these are pediatric oncologic emergencies-acute, life-threatening conditions resulting from the cancer itself or its treatment that require immediate medical intervention.[2] These emergencies can occur at diagnosis, during treatment, or at the terminal stage, and include conditions such as tumor lysis syndrome, superior vena cava syndrome, spinal cord compression, hyperleukocytosis, febrile neutropenia, and disseminated intravascular coagulation.[3,4] The prevalence of oncologic emergencies varies by cancer type and region but has been reported in up to 20 - 30% of newly diagnosed pediatric cancer cases.[5] If unrecognized or poorly managed, these emergencies can lead to significant morbidity, long-term sequelae, and even death - despite the potentially curable nature of the underlying malignancy. Therefore, early recognition and prompt management

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of these conditions are critical to improving survival and quality of life for pediatric cancer patients.[3] However, research on the prevalence and patterns of pediatric oncologic emergencies remains scarce in Southeast Asia, including Vietnam. This study aims to examine the spectrum of childhood cancers and the frequency of oncologic emergencies among newly diagnosed patients at the Oncology Center of the National Children's Hospital in Vietnam. Findings from this study will help provide essential insights to support early recognition and timely management of emergencies, ultimately improving treatment outcomes in pediatric oncology.

II. MATERIALS AND METHODS

This is a cross-sectional, prospective descriptive study. Information was collected from all patients aged 0 - 15 years old, diagnosed with cancer based on result of bone marrow aspiration or histopathology in oncology center, emergency department, intensive care unit, surgical intensive care unit in the VNCH from July 1, 2019 to June 30, 2020.

Oncologic emergencies in this study were defined as acute, potentially life-threatening complications occurring within the first 7 days of hospital admission, directly related to the malignancy or its systemic effects. These were classified into three groups. Compressive emergencies included superior vena cava (SVC) syndrome-characterized by facial or upper limb swelling, venous engorgement, and respiratory distress confirmed by chest imaging; spinal cord compression-presenting with motor or sensory deficits, or urinary retention, diagnosed via MRI and respiratory failure due to airway compression by a mediastinal or thoracic mass. Hematological emergencies comprised hyperleukocytosis, defined as white blood cell count exceeding 100,000/mm³ with or without leukostasis symptoms; severe anemia with hemoglobin < 60 g/L requiring urgent transfusion; and severe thrombocytopenia, defined as platelet count < 20,000/mm³, with or without clinical bleeding. Metabolic emergencies were represented by tumor lysis syndrome (TLS) with at least two laboratory abnormalities (elevated uric acid, potassium, phosphate, or low calcium), with or without clinical features such as arrhythmia or acute kidney injury.[5] The patients with oncologic emergencies were recorded and followed up outcome.

The data collected in the study were analyzed using SPSS software (version 20.0, Inc, Chicago, IL, USA). We conducted a descriptive statistical analysis of the patients demographics (e.g. gender, age), disease type, status of emergency. Quantitative data were summarized using means and standard deviations for normally distributed variables, or medians and interquartile ranges for non-normally distributed variables. The Chi-squared test (χ^2) was used to compare the differences, with adjustments made using Fisher's exact test when expected values were less than 5. A p-value of less than 0.05 was considered statistically significant.

The study was approved ethically by the Ethics Council of the National Children's Hospital, under decision No. 1645/BVNTU-VNCSKTE at 31st October 2019. The study was observational, posing no risk to the participants. All procedures were conducted purely for scientific purposes, and patient confidentiality was rigorously maintained throughout.

III. RESULTS

Over the course of the study year, a total of 392 patients with cancer were newly diagnosed at the VNCH. The majority of these patients were males (58.4%), the male-to-female ratio was 1.4.

The median age of the patients at diagnosis was 3 years old. The largest age group affected was children aged 0 to 4 years old, which constituted 63.7% of all cases. Seventy-nine percent of patients continued to be treated at our hospital, 16% of patients were referred to other hospitals because the hospital was overloaded, and the abandonment rate was only 5%. The distribution of cancer types among the newly diagnosed pediatric patients is detailed in Chart 1.

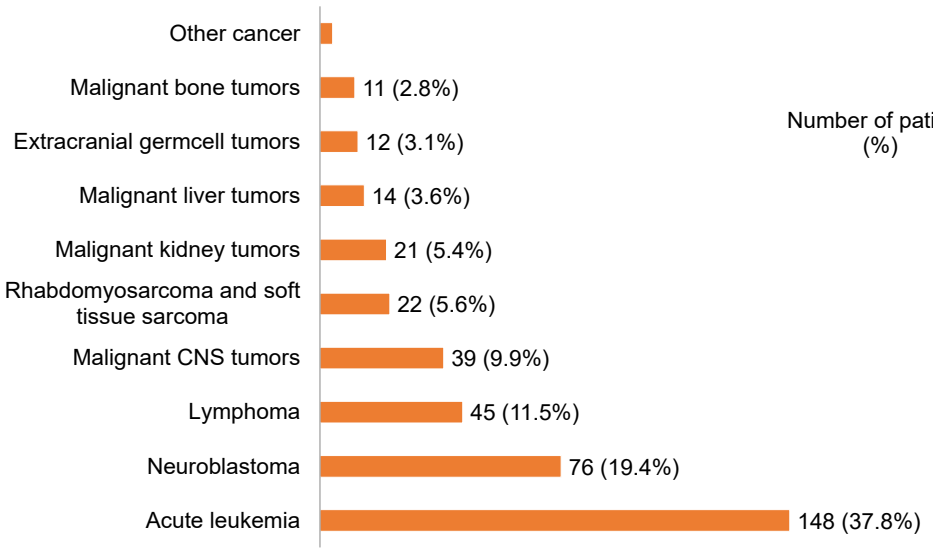

Chart 1. Disease patterns in a group of newly diagnosed cancer children

Among the newly diagnosed pediatric cancer patients at the Vietnam National Children's Hospital, acute leukemia was the predominant type, affecting 148 patients (37.8%). This was followed by neuroblastoma, diagnosed in 76 patients (19.4%), lymphoma in 45 patients (11.5%), and malignant brain and central nervous system tumors in 39 patients (9.9%). Less common cancers accounted for the remainder of the diagnoses.

Seventy-six patients (19.4%) presented with oncologic emergencies at admission, comprising 92 emergency events. Most patients (83%) had one emergency syndrome, 13.2% had two, and 3.9% experienced three. Hematologic emergencies were the most frequent, including severe anemia (25%) and severe thrombocytopenia (26%). Leukocytosis was present in 11% of patients. Respiratory failure due to compression was also significant, reported in 17% of the cases, followed by leukocytosis (11%) and superior vena cava syndrome (10%). Less frequently observed were spinal cord compression and tumor lysis syndrome, which occurred in 7% and 4% of cases, respectively. Characteristics of hematological emergency and emergency due to compression was shown in Table 1 and Chart 2.

Table 1. Hematological emergencies in children with newly diagnosed cancer

Disease	Severe anemia (n = 23)	Severe thrombocytopenia (n = 24)	Leucocytosis (n = 10)
Acute myeloid leukemia	6 (26.1%)	6 (25%)	6 (60%)
Acute lymphoblastic leukemia	17 (73.9%)	18 (75%)	4 (40%)

Severe anemia was noted in 23 patients, with median hemoglobin levels recorded at 48 g/L (range: 20 - 60 g/L). Leukocytosis occurred in 10 patients, with a median white blood cell count of 118,000/mm³ (range: 100,000 - 248,000/mm³). Severe thrombocytopenia was found in 24 patients, with a median platelet count of 15,000/mm³ (range: 4,000 - 20,000/mm³).

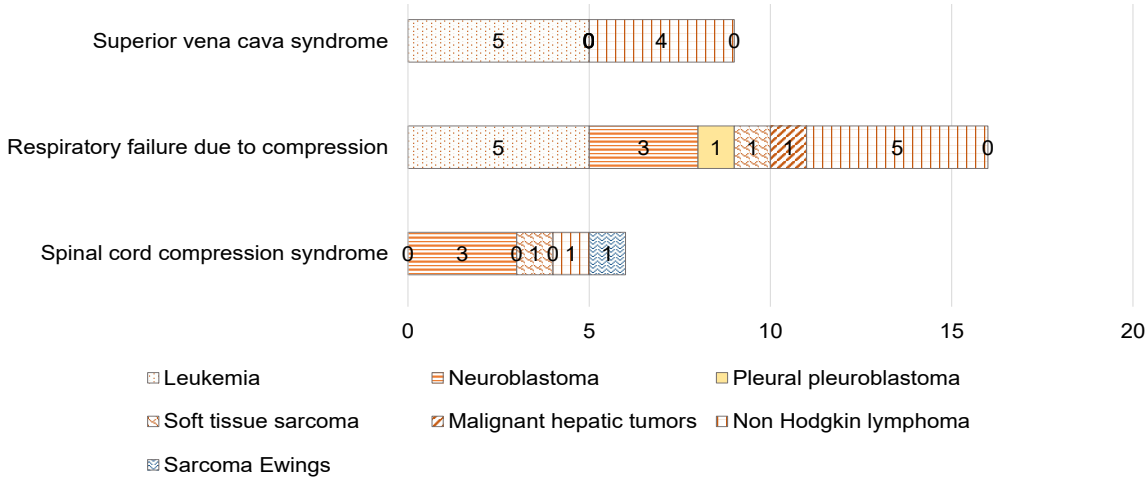

Chart 2. Emergency due to compression in newly diagnosed cancer children

Leukemia was specifically associated with 5 cases each of superior vena cava syndrome and respiratory failure due to compression. Non-Hodgkin lymphoma contributed 4 cases in superior vena cava syndrome. There were 16 patients with respiratory failure due to compression. In addition to the diagnosis of ALL and NHL, other diagnoses included neuroblastoma in 3 patients, pleuropulmonary blastoma, rhabdomyosarcoma, and hepatoblastoma in each one, respectively. 6 patients had malignant spinal cord compression syndrome, including 3 patients with neuroblastoma, each one with soft tissue sarcoma, non-Hodgkin lymphoma and sarcoma Ewings, respectively.

Of the 76 patients who presented with emergency conditions, 6 succumbed to their complications within 7 days of admission, resulting in a mortality rate of 7.9%. The deaths included 3 cases from superior vena cava syndrome, 2 from tumor lysis syndrome, and 1 from respiratory failure due to compression.

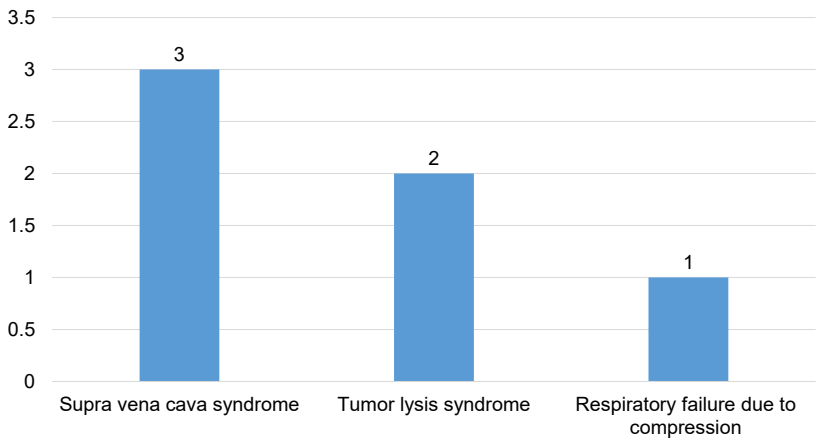

Chart 3. Causes of death in the first 7 days of admission of children with cancer

Relationships between cancer emergency syndrome and type of cancer were shown in Table 2.

Table 2. Relationship between emergency syndromes and type of cancer at admission

Emergency syndrome		Solid tumors n = 22	Leukemia n = 54	p
Respiratory failure due to compression	Yes	11 (50%)	5 (9.3%)	*0.008*[b]
	No	11 (50%)	49 (90.7%)	
Severe anemia	Yes	0 (0%)	23 (42.6%)	*< 0.001*[b]
	No	22 (95.8%)	31 (57.4%)	
Leukocytosis	Yes	0 (0%)	10 (18.5%)	*0.012*[b]
	No	22 (100%)	44 (81.5%)	
Severe thrombocytopenia	Yes	0 (0%)	24 (44.4%)	*< 0.001*[a]
	No	22 (100%)	30 (55.6%)	
Superior vena cava syndrome	Yes	4 (18.2%)	5 (9.3%)	0.194[b]
	No	18 (81.8)	49 (90.7%)	

[a]*Chi-square test;* [b]*Fisher's exact test*

In analyzing of emergency syndromes at admission, results found patients with solid tumors exhibited a 50% higher incidence of respiratory distress syndrome due to compression compared to those with acute leukemia, where the rate was 9.3%. Severe anemia and thrombocytosis were significantly more prevalent in acute leukemia patients, with incidences of 42.6% and 44.4% respectively, as opposed to 0% in those with solid tumors. Additionally, leukocytosis was 18.5% more common in acute leukemia patients compared to those with solid tumors, with a statistically significant difference ($p < 0.05$). Conversely, superior vena cava syndrome was more frequently observed in patients with solid tumors, though the difference was not statistically significant ($p = 0.194$).

III. DISCUSSION

In our study, out of 392 newly diagnosed cancer patients at the National Children's Hospital, 310 (79%) of patients continued to be treated at our hospital, 16% of patients were referred to other hospitals because the hospital was overloaded, and the rate abandonment was only 5%. The median age was 3 years old in our study population. The age distribution predominantly fell within the 0 - 4 years old group, accounting for 63.7% of cases. This aligns with global epidemiological data, which reported a similar prevalence in India, China, and the United States.[8-10] The incidence of cancer was higher in boys than in girls in our study. This pattern of male dominance in cancer diagnosis is consistent with a sex ratio ranging from 1.1 to 1.4. with findings from studies conducted by Ward E (2014) in the United State, Zhou H (2021) in China and Kapoor G (2024) in India.[8-10]

This study highlights the burden of oncologic emergencies among newly diagnosed pediatric cancer patients at a national tertiary center in Vietnam. Seventy-six patients (19.4%) exhibited

an oncologic emergency at presentation. Notably, 63 patients had a single emergency syndrome (83%), 10 patients presented with two syndromes (13.2%), and 3 patients had three syndromes upon admission. A study by Ciftci et al. (2018) in Turkey, during June 2014 to December 2015, reported emergencies in 88 cancer patients with 90 syndromes.[6] In our study, hematological emergencies, including severe anemia (hemoglobin < 60 g/L, median 48 g/L; 25%) and/or severe thrombocytopenia (platelet < 20 G/L; median 15 G/L; 26%) were most common. Ciftci's study included both newly diagnosed and recurrent cases, with 30 cases of tumor lysis syndrome, various others such as leukocytosis (19), seizures (11), and pleural effusion (9), among others[6]. Our study's higher incidence of hematological emergencies like anemia and thrombocytopenia can be attributed to the fact that we exclusively included patients newly diagnosed with cancer, predominantly with acute leukemia, where such complications are common.

Severe thrombocytopenia was noted in 24 of our patients, with a median platelet count of 15,000/mm^3, ranging from 4,000 to 20,000/mm^3. This condition affected 22% of acute myeloid leukemia patients (6 out of 27) and 14.9% of acute lymphoblastic leukemia patients (18 out of 121). Severe anemia was found in 23 patients with a median of 48 g/L, range from 20 - 60 g/L. All were seen in patients with acute leukemia, of which 17 of 121 (14%) patients were diagnosed with acute lymphoblastic leukemia, 6 of 27 (22.3%) patients diagnosed of acute myeloid leukemiaSixteen patients (17%) in our study experienced respiratory failure from various cancers. Diagnosis included acute leukemia in five, non-Hodgkin's lymphoma in five, neuroblastoma in three, pleural pleuroblastoma, rhabdomyosarcoma, and hepatoblastoma in one each respectively. Respiratory failure, a frequent emergency in pediatric cancer, often leads to hospitalization and stems from diverse causes that demand early and specific treatment. In this study, we focused on respiratory failures due to compression-related causes like pleural and pericardial effusions, and mediastinal tumors, so identifying acute leukemia, lymphoma, soft tissue rhabdomyosarcoma, and neuroblastoma as the predominant diagnoses, but it can be caused by cancer emergency syndromes such as superior vena cava syndrome, superior mediastinal syndrome, leukocytosis, airway tumors typical of teratomas or lymphomas, and metastatic lung tumors.[7]

In our study, leukocytosis was identified in 10 patients (11%) with a median white blood cell count of 118,000/mm^3, all of whom were part of the acute leukemia group. This represented 6.8% of the 148 patients with newly diagnosed acute leukemia. Specifically, 22.2% (6 out of 27) of patients with acute myeloid leukemia (AML) and 3.3% (4 out of 121) of those with acute lymphoblastic leukemia (ALL) exhibited leukocytosis. Kong SG et al. (2014) observed leukocytosis in 22.2% of newly diagnosed AML patients among 104 pediatric cases.[15] However, our rate of leukocytosis in ALL patients was lower than the 13% reported by Park KM et al. in a study over 12 years at a pediatric hospital in Korea.[16] Kittivisuit S (2023) in Thailand found that 16.6% of 483 childhood ALL patients and 20.3% of 207 childhood AML patients had hyperleukocytosis at diagnosis. The patients with ALL and hyperleukocytosis had more early complications than those without hyperleukocytosis ($p < 0.05$).[17]

In our study, 9 patients (10%) were diagnosed with superior vena cava syndrome upon hospital admission. Of these, 5 patients

(56%) had T-lineage lymphocytic leukemia and 4 patients (44%) were diagnosed with non-Hodgkin's lymphoma. These results are consistent with those found in Yang's research, which analyzed 42 cases of superior vena cava syndrome related to mediastinal malignancies, with 60% having T-cell lymphoblastic lymphoma, 17% T-cell acute lymphoblastic leukemia, 10% anaplastic large cell lymphoma, and the remainder other less common types.[8] Different from research at a pediatric cancer center in Turkey during 2010 to 2017, 19 of 41 patient with mediastinal tumor had vena cava superior syndrome and Hodgkin's disease predominated with 37%.[9]

Malignant spinal cord compression (MSCC) was rare of our emergency oncology (7%). It was diagnosed in 6 out of 392 newly diagnosed cancer patients, representing 1.5% of cases. Diagnosis included neuroblastoma in three, soft tissue sarcoma, non-Hodgkin lymphoma and sarcoma Ewings in one each respectively. This prevalence is lower than in the meta-analysis of Quraishi et al, which were 3 - 5% in children with primary tumors.[10] Neuroblastoma constituted the most common cause for MSCC in children (62.7%) followed by sarcoma (14.2%). De Martino's study, which found that extramedullary tumors accounted for 63.6% of cases, with neuroblastoma (27.2%) and Ewing sarcomas (15.9%) being the most prevalent.[11] They concluded that the majority of patients presented with motor deficit, followed by pain. In children with neuroblastoma or lymphoma, chemotherapy was the primary treatment. Early surgery should be a consideration with rapid deterioration of neurology despite chemotherapy. A multimodality approach including chemo-radiotherapy and surgery should be the treatment of choice in metastatic sarcomas. This is a need for multicenter data collection over many years in Vietnam.

In our study, tumor lysis syndrome (TLS) was identified at hospital admission in 4 patients (4%), underscoring its association with hematologic cancers that feature large, rapidly growing, and chemically sensitive cells such as acute lymphoblastic leukemia, acute myeloid leukemia, and Burkitt lymphoma. Our findings are similar to those reported by Calle MG in Ecuador, with a TLS rate of 5.6% and mainly in ALL patients (61.5%).[12] The incidence of TLS in our study was relatively low compared to Saeed et al. (2014), who observed tumor lysis syndrome in 37.1% of 232 hematological cancer patients in subclinical forms, with 40.7% experiencing spontaneous tumor lysis and 10.3% developing clinical tumor lysis, which had a mortality rate of 7.3%.[13] We prevented TLS by hyperhydration without potassium and allupurinol based on the risk assessment of Howard S et al, so that may be the reason the TLS rate in our study was low.[14]

Only six deaths (7.9%) within 7 days of admission were related to an oncologic emergency, including superior vena cava syndrome or tumor lysis syndrome. This rate was substantially lower than the 34.4% reported by Ciftci et al, which can be attributed to differences in the patient populations.[6] Ciftci's study included both newly diagnosed and recurrent cancer patients, whereas our study focused on those newly diagnosed, with conditions such as superior vena cava syndrome and tumor lysis syndrome being most common.

Our analysis further explored the relationship of specific emergency syndromes with cancer types. Notably, respiratory distress syndrome, predominantly resulting from compression, was significantly associated with solid tumors like lymphoma, neuroblastoma, malignant

liver tumors, and soft tissue sarcoma, with a statistically significant correlation (p = 0.008) according to Fisher's test. Severe anemia, leukocytosis, and severe thrombocytopenia were more commonly linked to acute leukemia, showing strong statistical significance (p-values of < 0.001, 0.012, and < 0.001, respectively). This relationship highlights the impact of acute leukemia as a hematological malignancy that disrupts normal hematopoiesis, leading to these conditions. Additionally, the incidence of superior vena cava syndrome was 18.2% higher in patients with solid tumors compared to those with acute leukemia (9.3%), though this difference was not statistically significant (p = 0.194).

IV. CONCLUSION

Nearly one in five newly diagnosed patients at Vietnam National Children's Hospital presented with oncologic emergencies, with hematologic emergencies being the most prevalent. While overall early mortality rates were low, superior vena cava syndrome and tumor lysis syndrome remain significant clinical challenges. These findings underscore the importance of timely diagnosis and comprehensive emergency management to improve outcomes for pediatric cancer patients in Vietnam.

The authors declare no conflicts of interest.

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REFERENCE

1. Steliarova-Foucher E, Colombet M, Ries LAG, et al. International incidence of childhood cancer, 2001-10: a population-based registry study. *Lancet Oncol*. 2017;18(6):719-731.

2. Lewis MA, Hendrickson AW, Moynihan TJ. Oncologic emergencies: Pathophysiology, presentation, diagnosis, and treatment. *CA Cancer J Clin*. 2011 Sep-Oct;61(5):287-314. doi: 10.3322/caac.20124. Epub 2011 Aug 19.

3. Stephanos K, Picard L. Pediatric Oncologic Emergencies**.** *Emerg Med Clin North Am*. 2018;36(3):527-535. doi: 10.1016/j.emc.2018.04.007.

4. Prusakowski MK, Cannone D. Pediatric Oncologic Emergencies. *Hematol Oncol Clin North Am*. 2017;31(6):959-980. DOI: 10.1016/j.hoc.2017.08.003.

5. Hastings CA, Torkildson JC, Agrawal AK. *Handbook of Pediatric Hematology and Oncology*. 2nd edition. 2012. Chapter 13: 133-143. Wiley-Blackwell.

6. Çiftçi AÇ, Kupeli S, Sezgin G, et al. Evaluation of pediatric patients with an oncologic emergency: Single center experience. *Turk J Pediatr*. 2018;60(6):660-668. DOI: 10.24953/turkjped.2018.06.006.

7. Leung KKY, Hon KL, Hui WF, et al. Therapeutics for paediatric oncological emergencies. *Drugs Context*. 2021 Jun 23;10:2020-11-5. doi: 10.7573/dic.2020-11-5. PMID: 34234831; PMCID: PMC8232653.

8. Yang QS, Han YL, Cai JY, et al. Analysis of 42 cases of childhood superior vena cava syndrome associated with mediastinal malignancy. *Zhonghua Er Ke Za Zhi*. 2022;60(10):1026-1030. DOI: 10.3760/cma.j.cn112140-20220323-00239

9. Ozcan A, Unal E, Karakukcu M, et al. Vena cava superior syndrome in the children with mediastinal tumors: Single-center experience. *North Clin Istanb*. 2020;7(3):255-259. DOI: 10.14744/nci.2019.46354

10. Quraishi NA, Palliyil N, Hassanin MA, et al. Malignant spinal cord compression in

the paediatric population-a systematic review, meta-analysis. *Eur Spine J*. 2023;32(12):4306-4313. DOI: 10.1007/s00586-023-07820-3

11. De Martino L, Spennato P, Vetrella S, et al. Symptomatic malignant spinal cord compression in children: a single-center experience. *Ital J Pediatr*. 2019;45(1):80. DOI: 10.1186/s13052-019-0671-5.

12. Calle MG, Valdez SG, Quiroz EG. Characteristics of tumor lysis syndrome in pediatric oncology patients. A single-center observational study. *Oncología (Ecuador)*. 2023:33(3). 228-238, DOI: 10.33821/728.

13. Saeed F, Ali MS, Ashraf MS, et al. Tumour lysis syndrome in children with haematological cancers: Experience at a tertiary care hospital in Karachi. *J Pak Med Assoc*. 2018;68(11):1625-1630.

14. Howard SC, Jones DP, Pui C-H. The Tumor lysis syndrome. *N Engl J Med.* 2011;364:1844-54. doi: 10.1056/NEJMra0904569.