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Pediatrics

ICU Admissions and Outcomes of Childhood Cancer Patients in Single Tertiary Hospital in the Private Sector in India

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Abstract

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Background Modern-day treatment of childhood cancer is punctuated by the necessary need for intensive care. This study was performed to understand the intensive care unit (ICU) admission rates and factors associated with ICU admission in a cohort of newly diagnosed childhood cancer patients in India.

Materials and Methods All childhood (age <18 years) patients in the hospital-based cancer registry who had registered between March 1, 2013, and May 31, 2018, formed the cohort. ICU admissions were recorded and demographic and clinical factors associated with ICU admission were investigated. ICU admission rates were the primary outcome of interest and secondary outcomes were ICU admission rates for sick/supportive reasons, ICU admission rates for surgical/procedural reasons and mortality during ICU admission.

Results In a cohort of 258 children (66% males, 61% from India, and median age 7 years), 149 (58%) patients needed one or more ICU admission (median one with range of one to five) with total 204 ICU admission episodes. While age group, gender, and nationality were not significantly associated with ICU admission, cancer type was (highest in neuroblastoma (82%) and central nervous system (CNS) tumors (71%)). Sick/supportive care ICU admissions were significantly higher in patients of younger age, Indian origin, and certain cancers (leukemias, lymphomas). Surgical/procedural ICU admissions were significantly higher in international patients and certain cancers (CNS tumors, neuroblastomas, and soft tissue sarcomas). There were 17 ICU deaths (11% of patients admitted to ICU) and all but one were from sick/supportive care ICU admissions.

Conclusion Our study highlights higher than reported ICU admission rates and lower than reported mortality in children with cancer in low- and middle-income countries. We next plan to develop more specific ICU admission criteria, prospectively evaluating severity metrics in these patients, and explore the development of a high dependency unit.

Keywords
- ICU admissions
- intensive care
- childhood cancer
- sick/supportive
- surgical/procedural
- mortality
- India

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Introduction

In the last half century, survival for children's cancers in high-income countries (HIC) has more than doubled and now nearly 85% are cured.[1,2] Much of this is because of a 70% decrease in mortality rates.[1] Better supportive care coupled with risk stratification has allowed clinicians to optimize the intensity of treatment and reduce relapses.[3] Advances in critical care have underscored the role they play in improving outcomes.[4–6]

In contrast to HIC, the availability and affordability of pediatric intensive care in low- and middle-income countries (LMIC) pose a challenge.[7–9] Centers in LMIC are hamstrung as they treat childhood cancer patients with restricted staff and infrastructure. In this context, the published literature is limited in the patterns of care and outcomes of children with cancer needing intensive care in LMIC[10–15] and completely absent in factors associated with admission to intensive care unit (ICU). It is important to understand these factors and outcomes to better counsel families and utilize intensive care resources judiciously. This study was performed to understand the ICU admission rates and factors associated with ICU admission in a cohort of newly diagnosed childhood patients in India.

Materials and Methods

The setting was a single tertiary hospital where 50 to 80 children newly diagnosed or with relapsed cancers are treated every year. The hospital-based cancer registry was started in 2013 and hematopoietic stem cell transplant (HSCT) services were commenced in July 2017. All newly diagnosed childhood (age <18 years) cancer patients in the hospital-based cancer registry who had registered between March 1, 2013, and May 31, 2018 formed the cohort.

We retrospectively searched our hospital electronic records to identify if they were ever admitted to the ICU which was the primary outcome of interest. Besides the dedicated pediatric ICU, children may also have been admitted to the oncosurgical ICU and the neurosurgical ICU. There is no high dependency unit (HDU). The dedicated pediatric ICU has 14 beds with timely access for patients needing intensive care, is staffed by two pediatric intensivists, supported by trained nursing staff, and where childhood cancer patients are managed in collaboration with the pediatric oncologist. All of these are quality indicators of providing pediatric oncocritical care in LMIC.[16]

Secondary outcomes of interest were ICU admission rates for sick/supportive reasons, ICU admission rates for surgical/procedural reasons, and mortality during ICU admission. We further evaluated the association of demographic (age, gender, nationality) and clinical (diagnosis) variables with ICU admission rates. The analysis of factors associated with outcomes of interest was done using the Pearson chi-squared test on IBM® SPSS® Statistics and frequency analysis using cross-tabulation. The hospital-based cancer registry has already been ethically approved and no additional approval was sought for retrospective analysis of ICU admission data.

Results

There were 258 childhood cancer patients (66% males, 61% from India, and median age seven years) registered, with central nervous system (CNS) tumors (28%), leukemias (23%), sarcomas (16%), lymphomas (12%), and neuroblastoma (9%) the most common. Detailed demographics have been outlined in ►Table 1. Five of these patients had undergone HSCT. One-hundred forty-nine of these patients (58%) needed one or more ICU admission (median one with a range of one to five) with a total of 204 ICU admission episodes. Age, gender, and nationality were not associated with ICU admission (►Table 1). ICU admission rates varied significantly by cancer type ($p = 0.007$) and were highest in neuroblastoma (82%) and CNS tumors (71%).

Of the 204 ICU admission episodes, 90 were sick/supportive care episode-related ICU admissions (33 sepsis, 14 initial presentation and stabilization at diagnosis, 13 respiratory distress, 10 neurological, 7 related to progressive disease, and 13 others) in 74 children (28.7% of the total cohort of 258 children) with a median ICU stay of 4.5 days (range: 1–38 days). One-hundred fourteen patients were surgical/procedural episode-related ICU admissions (97 surgical and 17 procedural) in 94 children (36.4% of the total cohort of 258 children) with a median ICU stay of 3 days (range: 1–16 days). Sick/supportive care episode-related ICU admissions were associated with younger age ($p = 0.046$), Indian nationality ($p = 0.040$), and cancer type (leukemias, renal tumors and lymphomas with $p = 0.016$). There was no relation to gender. Surgical/procedural episode-related ICU admissions were associated with international patients ($p = 0.007$), and cancer type (CNS tumors, neuroblastomas, and soft tissue sarcomas with $p < 0.001$). There was no relation to age or gender.

There were 17 ICU deaths (11% of patients admitted to ICU). Sixteen of these deaths were related to sick/supportive care ICU admissions (21% of 75 patients admitted to ICU) and one was related to surgical/procedural ICU admissions (1% of 94 patients admitted to ICU). Of those 16 who were admitted for sick/supportive care and died, four had progressive disease as the main cause, while 12 had toxicity mainly with sepsis

Discussion

Our study highlights the experience of ICU admission and mortality rates of a cohort of children with cancer being treated at a single tertiary hospital in the private sector in North India. Fifty-eight percent of all patients had one or more ICU admissions that is higher than the previously reported rates of 11 to 44% from HIC (most of whom were children with HSCT) and of 8 to 10% from LMIC like Egypt, Pakistan, and South Africa (most of whom were children with cancer).[11,12,15,16]

There can be multiple reasons for the high ICU admission rates in our center. Some studies exclude postoperative patients[15,16] when reporting their data or these form a small proportion of their ICU admissions.[10,11,13] The ICU admission

Table 1 Association of demographic and clinical variables with ICU admission

Variable	Patients ($n = 258$)	ICU admission (%)	*p*-Value	Sick/supportive ICU admission (%)	*p*-Value	Surg/procedural ICU admission (%)	*p*-Value
Age (unknown in one patient)							
0–4 years	81	50 (61.7%)	0.639	33 (39.5%)	0.046	26 (33.3%)	0.417
5–9 years	78	42 (53.9%)		20 (25.6%)		27 (34.6%)	
10–14 years	49	26 (53.1%)		12 (24.5%)		17 (34.7%)	
15–17 years	49	30 (61.2%)		9 (18.4%)		23 (46.9%)	
Gender							
Male	171	98 (57.3%)	0.84	53 (31.0%)	0.250	56 (32.7%)	0.085
Female	87	51 (58.6%)		22 (24.1%)		37 (43.7%)	
Country (unknown in two patients)							
Indian	157	88 (56.1%)	0.576	53 (33.1%)	0.040	47 (30.6%)	0.007
International	99	59 (59.6%)		21 (21.2%)		45 (45.5%)	
Cancer group							
Hematolymphoid	88	43 (48.9%)	0.015	37 (42.0%)	0.001	7 (7.9%)	<0.001
CNS tumors	73	52 (71.2%)		12 (16.4%)		50 (68.5%)	
Solid tumors	97	54 (55.7%)		26 (26.8%)		36 (37.1%)	
Cancer diagnosis							
Leukemias	58	30 (51.7%)	0.007	27 (46.6%)	0.016	4 (6.9%)	<0.001
Lymphomas	30	13 (43.3%)		10 (33.3%)		3 (10.0%)	
CNS	73	52 (71.2%)		12 (16.4%)		50 (68.5%)	
Neuroblastoma	22	18 (81.8%)		9 (36.4%)		13 (63.6%)	
Renal tumors	10	4 (40.0%)		4 (40.0%)		1 (10.0%)	
Bone tumors	24	9 (37.5%)		5 (20.8%)		4 (16.7%)	
Soft tissue sarcoma	19	10 (52.6%)		3 (15.8%)		10 (52.6%)	
Germ cell tumors	11	5 (45.5%)		2 (18.2%)		3 (27.3%)	
Others	11	8 (72.7%)		3 (27.3%)		5 (45.5%)	

Abbreviations: CNS, central nervous system; ICU, intensive care unit.

rates for sick/supportive care for 29% in our cohort are in line with some of the published data. Another reason for higher ICU admission rates could be the absence of a HDU in our center. Provision of an HDU can reduce the dependency on ICU for those patients who have high dependency but not intensive needs, and also drive down healthcare costs.[17–20] HDU admissions are also more satisfying and reassuring for patients and their families as they have been found to be less intimidating and noisy while being more inclusive for visiting family and friends.[21] Finally, the absence of prespecified admission criteria and possibly a greater sense of security for patients admitted in the ICU could have been responsible for our high ICU admission rates.

Cancer type had a bearing not only on the ICU admission rates but also on those for sick/supportive care and surgical/procedural admissions. Treatment for leukemias and lymphomas (particularly non-Hodgkin) is myelosuppressive and leading to greater supportive care, ICU admissions, and mortality.[22] On the other hand, CNS tumors, neuroblastomas, sarcomas need multimodality treatment where surgery plays a prominent role and hence ICU admissions can follow the surgery. Significantly higher ICU admission rates for surgical/procedural reasons were seen in international patients. Our cancer unit is a major hub in India for international medical tourism of all ages and the cancer distribution among this group of patients is tilted toward those needing advanced surgical techniques in their management (e.g., cancer of the stomach, CNS tumors, and sarcomas).[23] Conversely, patients with hematolymphoid neoplasms were mostly of Indian nationality and so the sick and supportive care admissions were seen more in this group.

Our mortality rate of 11% is less than the 13 to 48% reported from other LMIC.[11–15] and as expected, mostly related to sick/supportive care admissions. We need to be cautious in interpreting our mortality results, as our study is limited by the absence of information on the clinical status of these patients using validated scales like the Pediatric Risk of Mortality and Pediatric Index of Mortality to assess the severity of the illness at admission to ICU, making comparisons difficult.

In summary, our results highlight higher than reported ICU admission rates and lower than reported mortality in children with cancer in LMIC. In view of the absence of

prespecified admission criteria and objective metrics of severity, these results should be interpreted with caution. We next plan to develop more specific ICU admission criteria, prospectively evaluating severity metrics in these patients, and explore the development of an HDU.

Conflict of Interest

None declared.

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