

Radiotherapy for Pediatric Malignancies: An Experience from a Tertiary Cancer Centre

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Background: Incidences of pediatric malignancies are increasing. In management of various childhood malignancies like hematological, bone and soft tissue tumors radiotherapy plays a crucial role. RT treatment planning and delivery poses a challenge to clinicians. Hence with this study we wanted to know the radiotherapy practices in our institution.

Materials and Methods: This was a retrospective study analyzing case records and RT charts of all pediatric malignancies who received radiation treatment for a period of 3 years from January 2018 to December 2021. Demographic details, RT details, toxicity details were carefully recorded.

Results: Details of 73 pediatric malignancy cases who received RT were analyzed. Median age was 10 years and the majority were males (66%). Commonest malignancies which received RT treatment were ALL (30%), Brain tumors (26%) and bone and soft tissue tumors (22%). Radiotherapy was given as a part of radical intent treatment including neo adjuvant, definitive, adjuvant and prophylactic in 92% of patients. Conformal RT techniques in the form of 3DCRT and VMAT were used in majority (91%) cases. A significant proportion (27%) of cases required anesthesia for RT treatment delivery. 16% of patients had treatment break and common reasons for treatment break being infections (COVID, respiratory) and neutropenia. Grade 3 or more acute toxicities were observed in 14% of patients and hematological toxicity was the most frequent.

Conclusion: Hematological and bone & soft tissue tumors are the most common pediatric malignancies requiring RT as a part of multimodality treatment. For RT treatment delivery anesthesia services may be required in pediatric malignancies. Acute Grade 3 or more toxicities and treatment breaks are a concern and these pediatric cases require a properly coordinated supportive care during treatment.

Introduction

In India, childhood cancers accounts for less than 5% of the total cancer burden [1,2]. In contrast to developed countries the cure rates of childhood cancers in India are very low [3,4]. The most common childhood cancers include leukemia, brain and CNS tumors, and lymphomas, with neuroblastomas, Wilms tumors, and sarcomas being less common [5]. The use of radiotherapy has historically been one of the great successes in the treatment of pediatric cancers, particularly in ALL, HL, Rhabdomyosarcoma, Wilms, and Ewing's sarcoma [6]. One of the most significant side effects for pediatric patients treated with RT has been growth and developmental failure. Other late effects include gastrointestinal dysfunction, pulmonary and cardiac abnormalities, neurocognitive

defects, infertility, and secondary cancers. As the late effects of radiotherapy in pediatric cancer have been well documented, there have been efforts to reserve its use, in tandem with other therapies, to clinical scenarios in which the benefits are well documented and outweigh the risks [7]. The use of radiotherapy in the clinic has varied over time with the advent of effective chemotherapeutics and enhanced surgical techniques. To our knowledge there are only limited studies, which studied the radiotherapy practices in pediatric malignancies in general [8,9]. With this study we wanted to analyze the radiotherapy practices in pediatric malignancies in our institution. The additional objectives were to assess the proportion of cases who needed anesthesia for radiotherapy treatment and to assess the treatment break and toxicity details in pediatric malignancies.

Materials and Methods

This was a retrospective study conducted in Department of Pediatric Oncology & Department of Radiation Oncology, from tertiary cancer centre from India. All pediatric malignancy patients who underwent radiotherapy during the period from 1st January 2018 to 31st December 2021 were included.

The medical records and radiotherapy charts were retrieved and the demographic and treatment details were carefully recorded. The following variables were collected – patient characteristics, diagnosis of patient, site of disease, radiotherapy treatment details (including intent, technique), anaesthesia details, acute toxicities details.

Statistical Analysis

Descriptive statistics like mean, median, frequencies, percentages were used wherever appropriate.

Results

Total of 73 patients details were analyzed and among them majority were males (48 patients). Median age was 10 years (Range 2-18 years). Most common malignancies which received Radiotherapy treatment as a part of their management were Acute lymphoblastic leukemia (30%), Ewing's sarcoma (18%), Glioma (10%), Rhabdomyosarcoma (7%), Hodgkin's Lymphoma (7%) etc. The entire list of different malignancies which received Radiotherapy treatment are shown in Table 1.

Diagnosis	Number (Percentage)
ALL	22 (30)
Ewings Sarcoma	13 (18)
Rhabdomyosarcoma	5 (7)
Retinoblastoma	2 (3)
Glioma	7 (10)
Ependymoma	2 (3)
Soft tissue sarcoma	3 (4)
Wilms Tumor	3 (4)
Osteosarcoma	2 (3)
PNET	2 (3)
Neuroblastoma	1 (1)
Craniopharyngioma	1 (1)
Nasopharyngeal Carcinoma	1 (1)
Medulloblastoma	3 (4)
Hodgkin's Lymphoma	5(7)

Burkitt's Lymphoma	1 (1)
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Table 1. Shows Frequencies of Different Malignancies which Received Radiotherapy.

Based on the intent of Radiotherapy different types of radiotherapy treatment were given. Radical or definitive RT was given in 24 (32%) of patients. Extra corporeal irradiation was given in 2 patients and 6 patients received palliative RT. The types of radiotherapy based on the intent are summarized in Table 2.

Types of Radiotherapy	No.of patients (Percentage)
Radical	24 (32)
PCI (Prophylactic cranial irradiation)	22 (30)
Adjuvant	19 (26)
ECI (Extracorporeal irradiation)	2 (3)
NART (Neo adjuvant Radiotherapy)	1 (1)
Palliative	6 (8)

Table 2. Shows Frequencies of Different Types of Radiotherapy Based on Intent of Treatment.

Different Radiotherapy techniques like 2D conventional RT, 3D Conformal RT (3DCRT) and Volumetric modulated Arc therapy (VMAT) were used for treatment delivery. Conformal Radiotherapy with 3DCRT and VMAT were used in majority (91%) cases. 3DCRT in 40 (55%) cases and VMAT in 26 (36%) cases. 7 (9%) cases were treated with 2D conventional technique.

Since this study included the pediatric population, some proportion of patients required Anesthesia for radiation treatment. 20 (27%) patients required anesthesia (General anesthesia) for radiotherapy treatment delivery. Treatment breaks during radiotherapy was observed in 12 (16%) patients. Median no.of days of treatment break was 5 days. It ranged from 1-19 Days. Table 3 shows details of the reason for the treatment break.

Reason for RT break	Number (Percentages)
COVID infection	3 (25)
Respiratory Infection	3 (25)
Fever	1 (8)
Neutropenia	2 (18)
Grade III mucositis	1 (8)
Varicella Zoster infection	1 (8)
Transaminitis	1 (8)

Table 3. Showing Reason for Radiotherapy Break in Pediatric Malignancies.

Acute Grade III/IV toxicities were observed in 10 (14%) patients. Frequencies of different toxicities are shown in Table 4.

Acute Grade III/IV toxicity	Number
Grade III Hematological	3
Grade IV Hematological	2
Grade III mucositis	2
Grade III Dermatitis	1
Grade III Dermatitis & Mucositis	1
Grade III transaminitis	1

Table 4. Showing Type of Acute Grade III/IV Toxicity in Pediatric Malignancies.

Discussion

Median age of the pediatric patients who underwent Radiotherapy in our study was 10 years. Median age of females were 10 years and males were 9 years in a similar study and since it was an interview study the number of male and female children were made the same with stratified sampling [9]. But in our study the number of male children were more around 60%. Another similar study from India which studied the clinical profile of pediatric patients who underwent Radiotherapy showed the majority of males and the mean age of children was 9.3 years [10].

Most common type of malignancy for which RT was given as a part of management was Acute Lymphoblastic Leukemia. Hematological malignancies accounted for 30% of our cases and it was around 40 % in study by Suhag et al [10]. In this study other common malignancies were Brain tumors and Bone & soft tissue sarcoma , accounting for 26 % and 22% respectively. Proportion of Bone and soft tissue tumors (25%) was slightly higher than brain tumors (18%) in our study. Another study with lesser number of patients showed a higher proportion of brain tumor cases [9].

In study by Suhag et al the most common indication for RT was adjuvant setting (48%) followed by PCI (28%). But in our study the most common indication was Radical RT (32%), followed by PCI (30%). In our patients RT was given in adjuvant setting in 26% and as palliative in 8% cases. One patient received initial radical intent treatment followed by palliative RT. Conformal RT in the form of 3DCRT was used in 88 % cases in study by Suhag et al [10]. We also used conformal radiotherapy in 89% cases, with 3DCRT and VMAT in 55% and 36% respectively.

Out of the 73 patients, 20 (27%) patients required anesthesia for Radiotherapy treatment delivery. Study by LaRiviere et al gave RT for 78 pediatric patients under General anesthesia (GA) and did not report any major anesthesia related complication [11]. All our patients who required anesthesia were given RT under GA and no anesthesia related complications were reported.

Treatment related breaks were observed in 12 (16%) patients in our study. RT breaks ranged from 1-19 days. In a similar study break was observed in 16% patients and the longest break observed was 20 days [10]. The main reasons for treatment break were Covid infection, respiratory infection and neutropenia. Grade 3 or more toxicities were observed in 10 (14%) patients. Commonest toxicities being hematological (Grade 3 in 3 patients, Grade 4 in 2 patients) , Grade 3 mucositis in 2 patients and Grade 3 dermatitis in 2 patients.

In conclusion, commonest pediatric malignancies requiring Radiotherapy as a part of multimodality treatment are hematological malignancies and bone and soft tissue tumors. Radiotherapy is mostly given in pediatric malignancies as a part of radical intent treatment and use of palliative intent RT is less compared to adults. A significant proportion of pediatric patients may require anesthesia for treatment delivery. Treatment breaks are not that uncommon and a small proportion of patients may develop acute Grade 3 or more toxicities. Incidence of pediatric malignancies are on the rise and radiotherapy is a vital component of multimodality treatment for various pediatric malignancies. Radiotherapy treatment in pediatric malignancies needs a properly coordinated multidisciplinary effort with proper supportive care during treatment.

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