Original Article

Evaluation of Oral Health Status of Acute Lymphoblastic Leukemic Children Undergoing Anticancer Therapy in Rajasthan

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Abstract

Background: Acute Lymphoblastic Leukemia (ALL) is the most common pediatric malignancy, often requiring intensive anticancer therapies, such as chemotherapy and radiotherapy. These treatments are associated with significant oral health complications that can affect patients' quality of life and treatment compliance. **Objectives:** To evaluate the oral health status of pediatric patients diagnosed with ALL undergoing anticancer therapy in Rajasthan. **Methods:** This prospective, observational study included 120 pediatric patients aged 1–15 years receiving treatment at Bhagwan Mahaveer Cancer Hospital & Research Centre, Jaipur, and Maharao Bhim Singh Hospital, Kota. Participants were divided into three groups: Patients undergoing chemotherapy, radiotherapy, and combined chemotherapy and radiotherapy. Oral health assessments included parameters, such as oral mucositis (graded using the World Health Organization oral toxicity scale), gingival index, decayed, missing, and filled teeth (DMFT)/decayed, extracted, filled teeth (DEFT) scores, and simplified oral hygiene index. Data were analyzed using SPSS with Chi-square tests and ANOVA for group comparisons. **Results:** The findings revealed that oral mucositis was prevalent in 30.8% of participants, with the highest incidence in patients undergoing chemotherapy. Gingivitis was observed in 49.1%, and the mean DMFT (3.16 ± 2.1) and mean DEFT (4.65 ± 4.40) scores were higher in patients receiving radiotherapy. Poor oral hygiene (2.90 ± 1.56) and a significant burden of dental caries were noted among the participants, particularly in those receiving combined treatment modalities. Statistical analysis demonstrated significant differences across groups for gingival inflammation, mucositis grades, and oral hygiene index ($P < 0.05$). **Conclusion:** ALL treatments are associated with substantial oral health challenges, including mucositis, gingivitis, and poor oral hygiene. Early involvement of pediatric dental professionals for preventive care, regular monitoring, and tailored interventions can help mitigate these complications and improve treatment outcomes.

Keywords: Acute lymphoblastic leukemia, Chemotherapy, Decayed, missing and filled teeth, Gingivitis, Mucositis, Oral health, Pediatric oncology, Radiotherapy.

Introduction

Cancer is a major public health issue, with leukemia being the most common pediatric malignancy. Acute lymphoblastic leukemia (ALL) arises from malignant transformation of hematopoietic B or T cell progenitors, accounting for 80% of childhood leukemia cases. The incidence follows a bimodal distribution, peaking in childhood and later in adulthood. The etiology remains largely unknown, but genetic and environmental factors contribute to its development. Children with Down syndrome, neurofibromatosis, and immunodeficiency disorders are at a higher risk of developing ALL.[1,2]

The exact cause of ALL remains unknown, but several factors play a role. Genetic mutations, such as chromosomal translocations (e.g., t(9;22) BCR-ABL1 fusion gene), have been linked to leukemogenesis. Environmental exposures, including ionizing radiation, pesticides, and benzene, have been associated with increased ALL risk. In addition, viral infections, such as Epstein-Barr virus and human T-cell leukemia virus may contribute to pathogenesis.

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Immunodeficiencies, such as ataxia-telangiectasia and Bloom syndrome, have also been linked to increased susceptibility.[3-5]

ALL treatment includes chemotherapy, radiation therapy, and stem cell transplantation. Advances in chemotherapy have improved survival rates, but 40% of children experience long-term complications, including oral health issues.[6] Chemotherapeutic agents, such as methotrexate, vincristine, and cyclophosphamide affect oral tissues, leading to conditions, such as mucositis, xerostomia, gingival bleeding, and dental developmental anomalies.[7,8]

Oral mucositis is the most common complication, affecting up to two-thirds of leukemia patients. Children are more susceptible due to higher mitotic activity in the oral epithelium, but they also recover faster.[9,10] Radiation therapy exacerbates xerostomia, increasing the risk of dental caries and periodontal disease.[11]

The American Academy of Pediatric Dentistry emphasizes early intervention to mitigate treatment-related oral complications. Preventive strategies include maintaining oral hygiene, fluoride application, and regular dental visits. Intrathecal chemotherapy increases the risk of fungal and bacterial infections, making antimicrobial prophylaxis essential. A multidisciplinary approach involving oncologists, pediatric dentists, and nutritionists is crucial in managing these complications.[12]

Despite improved survival rates, pediatric ALL patients remain vulnerable to significant oral health challenges. Early dental intervention and personalized preventive strategies can improve quality of life during and after cancer treatment. This study aims to evaluate the oral health status of pediatric ALL patients undergoing anticancer therapy in Rajasthan. Objectives include assessing oral mucositis prevalence and the impact of chemotherapy and radiotherapy on oral health.

Materials and Methods

The present prospective, observational study aimed to estimate the oral health status of ALL children undergoing anticancer therapy in Rajasthan. The study was conducted at Bhagwan Mahaveer Cancer Hospital and Research Centre, Jaipur, and Maharao Bhim Singh Hospital, Kota. Children diagnosed with ALL were recruited for the study. The study spanned 15 months, with patient enrollment and initial oral health examination conducted over 9 months. A single recall evaluation was performed between 3 and 6 months after recruitment.

The study was approved by the Institutional Ethical Committee (IEC) of Daswani Dental College and Research Centre, Kota. Written informed consent was obtained from all participants. Children aged 1–15 years diagnosed with ALL, willing to participate in the study, and undergoing anticancer therapy were included. Unconscious patients, handicapped patients, those with other systemic disorders, and uncooperative participants were excluded.

For sample size determination, Open-Epi software was used; the required sample size at a 95% confidence interval was determined to be 115, with a final sample size set at 120 participants. A simple random sampling method was used to select study participants in a hospital setting. A single investigator was trained and calibrated in the Department of Pedodontics and Preventive Dentistry, Daswani Dental College and Research Centre, Kota. Intra-examiner reliability was assessed using the Weighted Kappa statistics.

Standard dental instruments, including mouth mirrors, periodontal probes, and disposable gloves, were used, following strict sterilization protocols. Data collection was conducted in two parts. The first part involved a pre-designed questionnaire to gather demographic details, dietary habits, and oral health awareness. The second part utilized the World Health Organization (WHO) Oral Health Assessment Form 2013, covering extra-oral examination, gingival index, decayed, missing, and filled teeth (DMFT) index, and the WHO Oral Toxicity/Mucositis Grading Scale. Participants were categorized into three groups: Group 1 included patients undergoing chemotherapy, Group 2 consisted of patients undergoing radiotherapy, and Group 3 comprised patients undergoing both chemotherapy and radiotherapy. Clinical examinations were performed under adequate natural light using Type III examination methodology. Data were analyzed using SPSS version 25. The Chi-square test was employed to evaluate differences between subgroups, with statistical significance set at $P < 0.05$.

Result

A total of 120 children participated in this study; of these, 27.5% were girls and 72.5% were boys. The participants' mean age was 7.0 ± 4.07 years.14.16% participants belong to age group 1–3 years, 20.83% belonged to 4–6 years of age group.24.16% study participants belong to 7–9 years, 25.83% participants belong to 10–12 years age group, and 15% study participants belong to 13–15 years age group. Based on major illness, 71.66% of the participants have never experienced a major illness. Fever was reported by 9.1%, bleeding and bruises by 7.5%, bone discomfort by 5.83%, any other sickness by 4.16%, and fatigue by 1.66%. Of the participants in this study, 22.5% experienced dental issues, whereas 77.5% had none at all.

The most frequent site of ALL in this study was blood (84.16%), which was followed by bone marrow (3.33%), brain (1.66%), forearm (1.66%), lung (1.66%), duodenum (0.83%), right proximal femur (0.83%), spine (0.83%), parotid (0.83%), and abdomen (0.83%), respectively.

In the present investigation received both chemotherapy and radiation treatment over the course of the study. 19.16% were given chemotherapy alone, while 23.33% were given radiotherapy alone.

When comparing the prevalence of oral mucositis across the three groups in this study, the chemotherapy group had a higher prevalence of the condition (43.48%) than the radiotherapy group (28.57%) and the chemotherapy with radiotherapy group (27.5%). This difference between the groups was also statistically significant ($P = 0.042$) (Figure 1). The WHO mucositis grading scale states that the majority of cases (71.4%) in group I (radiation) fall into grade 0 (none), 14.3% into grade I (mild), 10.8% into grade II(moderate), and 3.5% into grade III (severe). 56.5% of the patients in group II (chemotherapy) had no mucositis, 26% were grade I, 13.04% were grade II, and 4.5% were grade III. 72.5% of group III's members are in grade 0 (none), 18.9% are in grade I, 5.8% are in grade II, and 2.8% are in grade III. Overall, 30.8% of ALL patients had oral mucositis (grades I–19.2%, II–8.3%, and III–3.3%), and there was a statistically significant difference between the groups ($P = 0.05$) (Table 1).

Among the patients with ALL, 46.5% in group I, 43.5% in group II, and 55% in group III did not have gingivitis, based on their gingival status. Gingivitis in group I was mild in 32.1% of cases, moderate in 17.8%, and severe in 3.6%. 43.5% of group II's gingivitis was mild, 8.6% was moderate, and 4.3% was severe. Gingivitis was classified as mild in group III in 27.5% of cases, moderate in 13%, and severe in 4.5% of cases. The difference between the groups was statistically significant ($P = 0.036$) (Figure 2).

Group I, which received radiotherapy, had the highest mean gingival score (1.68), followed by Group III (1.25), while the group receiving chemotherapy had the lowest mean GI score (1.08). The difference between the groups was statistically significant ($P = 0.000$) (Table 2).

Within this study, group I (radiation) had the highest mean DMFT score (3.16), followed by group III (2.57) (chemotherapy and radiation), and group II (chemotherapy) had the lowest mean DMFT score (2.36). The group differences were also statistically significant ($P = 0.05$). Group I's mean decayed, extracted, filled teeth score was 4.65, Group II's was 3.87, and Group III's was 4.01; nevertheless, there was no statistically significant difference between the groups ($P = 0.623$) (Table 3).

Among all patient groups, the highest mean simplified oral hygiene index (OHI-S) score was observed in Group III (2.90), indicating the poorest oral hygiene. This was followed by Group II (chemotherapy), with a mean score of 1.94. Group I had the lowest mean score (1.58), suggesting the best oral hygiene practices. These differences between the groups were found to be statistically significant ($P = 0.000$) (Table 4).

Discussion

Oral complications are prevalent in pediatric ALL patients undergoing anticancer therapy. Among these, mucositis is a significant concern, affecting up to 30.8% of participants, with the highest prevalence (43.48%) in chemotherapy patients.

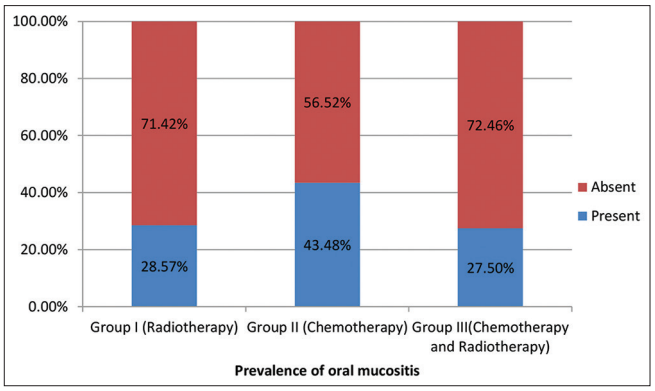

Figure 1: Comparison of prevalence of oral mucositis among three groups

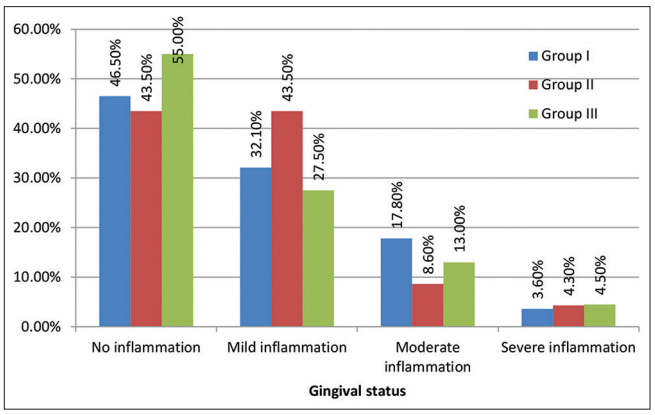

Figure 2: Comparison of gingival grading among three groups

Studies by Pratiwi *et al.*[13] and Costa *et al.*[14] also observed high mucositis prevalence in children undergoing chemotherapy, with rates of 18.2% and 71.4%, respectively. The severity of mucositis is linked to chemotherapy intensity, with induction therapy showing the highest rates.[15,16]

Gingivitis was observed in 49.1% of participants, consistent with previous reports by Azher and Shiggaon[17] and Shayani *et al.*,[18] which documented gingivitis prevalence of 40% and 69.57%, respectively. Immunosuppression from chemotherapy exacerbates gingival inflammation, making patients susceptible to bacterial infections.[18,19]

The mean DMFT and OHI-S scores indicated that oral hygiene was compromised, particularly in children receiving radiation therapy. Similar findings were reported by Fleming *et al.*[20] and Lauritano *et al.*,[21] who noted higher caries rates in children undergoing chemotherapy. The reduction in salivary flow due to radiation-induced gland hypoplasia further increases the risk of dental plaque accumulation, leading to caries progression.[22,23]

Long-term effects of anticancer therapy include enamel hypoplasia, hypodontia, and microdontia, which were evident in several participants. These findings align with studies by Gawade *et al.*[22] and Kaste *et al.*,[24] emphasizing the long-term impact of chemotherapy and radiation on dental development.

Table 1: Comparison of study participants according to the WHO oral mucositis grading scale among three groups (*n*=120)

The WHO oral mucositis grading scale Grade	Group I (Radiotherapy) (*n*=28) (%)	Group II (Chemotherapy) (*n*=23) (%)	Group III (Chemotherapy and Radiotherapy) (*n*=69) (%)	Total (*n*=120) (%)	*P*-value
0 (None)	20 (71.4)	13 (56.5)	50 (72.5)	83 (69.2)	0.05*
I (Mild)	04 (14.3)	06 (26.0)	13 (18.9)	23 (19.2)	
II (Moderate)	03 (10.8)	03 (13.04)	04 (5.8)	10 (8.3)	
III (Severe)	01 (3.5)	01 (4.5)	02 (2.8)	4 (3.3)	
IV (Life-threatening)	00 (0.0)	00 (0.0)	00 (0.0)	00 (0.0)	
Total	28 (100)	23 (100)	69 (100)	120 (100)	

*Significant

Table 2: Comparison of mean gingival score among three groups

Variable	Mean gingival score (mean±SD)			*F*-value	*P*-value
	Group I (Radiotherapy) (*n*=28)	Group II (Chemotherapy) (*n*=23)	Group III (Chemotherapy and radiotherapy) (*n*=69)		
Gingival index	1.68±0.19	1.08±0.28	1.25±0.43	20.26	0.001*

*Significant

Table 3: Comparison of mean DMFT and mean DEFT scores among three groups

Variable	Group I (Radiotherapy) (*n*=28)	Group II (Chemotherapy) (*n*=23)	Group III (chemotherapy and radiotherapy) (*n*=69)	*F*-value	*P*-value
	Mean score (Mean±SD)	Mean score (Mean±SD)	Mean score (Mean±SD)		
DMFT score	3.16±2.1	2.36±1.5	2.57±0.43	3.004	0.05*
DEFT score	4.65±4.40	3.87±4.39	4.01±2.1	0.475	0.623

DMFT: Decayed, missing, and filled teeth, DEFT: Decayed, extracted, filled teeth, *Significant

Table 4: Comparison of mean debris, mean calculus, and mean OHI-S score among study participants of three groups

Variable	Group I (radiotherapy) (*n*=28)	Group II (chemotherapy) (*n*=23)	Group III (chemotherapy and radiotherapy) (*n*=69)	*F*-value	*P*-value
	Mean score (Mean±SD)	Mean score (Mean±SD)	Mean score (Mean±SD)		
Debris score	1.18±0.752	1.78±1.35	1.98±1.97	2.340	0.101
Calculus score	0.41±0.472	1.13±1.65	1.24±1.54	3.614	0.030*
OHI-S score	1.58±1.13	1.94±1.35	2.90±1.56	9.976	0.001*

OHI-S: Simplified oral hygiene index, *Significant

Preventive strategies, such as fluoride applications, professional dental cleanings, and patient education, play a crucial role in mitigating these complications. The American Academy of Pediatric Dentistry[12] emphasizes the need for routine dental care and proactive management to reduce the burden of oral complications in pediatric cancer patients.

Conclusion

The detrimental effects of antineoplastic therapy on oral health significantly impact a cancer patient's overall well-being. Dental caries, gingivitis, xerostomia, and oral mucositis are prevalent in pediatric ALL patients. Early intervention by pediatric dentists, coupled with structured oral hygiene protocols and regular follow-ups, can alleviate these adverse effects. More extensive studies are needed to explore correlations between different chemotherapeutic regimens and their impact on oral health outcomes.

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