



Comparative Assessment of Salivary Flow Rate, Buffering Capacity, Resting pH and Dental Caries Status in Children Undergoing Chemotherapy

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ABSTRACT

Aim: The aim of the present study was to compare the salivary flow rate, buffering capacity, and resting pH in children undergoing chemotherapy with healthy children and their association with dental caries.

Methods: A total of 100 children were included in the study, study group consisted of 50 pre and post-chemotherapy cases reported at Kidwai Institute of oncology Bangalore and control group consisted of 50 healthy children who visited the Department of Pedodontics and Preventive dentistry, V S dental college for a routine dental check-up. Ethical clearance and signed written informed consent were obtained from both the Institutional ethical committee and parents/guardians of the children. Salivary parameters like flow rate, buffering capacity and resting pH was measured using Saliva-check Buffer kit (GC Europe). Clinical assessment was carried out using DMFT and dmft index by WHO criteria 1997.

Results: Salivary flow rate, buffering capacity and resting pH was lower in children post-chemotherapy when compared to that of children before chemotherapy and healthy children, the results were statistically significant. There was a positive correlation between salivary parameters and dental caries.

Conclusion: In the present study reduced salivary flow rate, low buffering capacity and reduced resting pH has been observed in children undergoing chemotherapy, which could be the causative factors for the increased incidence of dental caries in these children.

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Keywords: Chemotherapy, Salivary Flow Rate, buffering Capacity, Resting pH, Dental Caries.

1. Introduction:

Saliva is a muco-serous exocrine secretion which is clear and slightly acidic. Major and minor salivary glands, GCF, Oral bacteria together combine to form this complex mixture (Humphrey, & Williamson, 2001). Flushing and neutralizing effects are the most important caries protective function of saliva which is dependent on the buffering capacity (BC) of saliva and the flow rate (FR) (Lagerlöf, 1994). A sudden reduction in the salivary FR can lead to rapid formation of caries lesions (Edgar, Higham, & Manning, 1994).

Saliva contains Electrolytes and proteins which helps in protection of hard tissues against acid attacks and prevent demineralization. The quality and quantity of saliva affects the oral ecological system and influences

patient quality of life (Epstein, Tsang, Warkentin, & Ship, 2002). Several chemotherapeutic agents cause mucosal toxicity effects the dividing cells of Basal epithelium and also, direct contact of these agents with connective tissues can lead to their extensive damage. A large amount of mucosal damage is caused because of the interaction of epithelial and connective tissue cytokines makes it critical to have a fundamental knowledge of the toxic effects of chemotherapeutic agents on the oral environment (Epstein, Tsang, Warkentin, & Ship, 2002).

So, taking above aspects into consideration along with available scattered reports and the scarcity of available data, the present study was undertaken to compare the salivary flow rate, buffering capacity, resting pH and dental caries in children undergoing chemotherapy.



2. Methodology:

A total of 100 children aged 5-15 years, were included in the study, study group consisted of 50 pre and post-chemotherapy cases reported at kidwai institute of oncology Bangalore and control group consisted of 50 healthy children who visited the Department of Pedodontics and Preventive dentistry, VS Dental college for a routine dental check-up. Salivary parameters like flow rate, buffering capacity and resting pH was measured using Saliva-check Buffer kit (GC Europe). Clinical assessment was carried out using DMFT and dmft index by WHO criteria 1997. Ethical clearance and written signed informed consent was obtained from the Institutional ethical committee and parents/guardians of the children participating in the study.

3. Procedure:

Salivary parameters were measured using Saliva-check buffer kit (GC Europe) for both the groups. The salivary flow rate of unstimulated saliva was noted by visual inspection of the level of hydration, by everting the lower lip gently, blotting the labial mucosa with a small piece of gauze and observing the mucosa under good light for droplets of saliva at the orifice of the minor salivary glands.

Children were instructed to chew the piece of wax for 5 minutes provided in the kit to measure the stimulated salivary flow rate. Saliva was collected into the collection cup at regular intervals. The quantity of saliva was measured by checking the ml marking on the side of the cup. pH strips were placed in the collected salivary sample for 10sec and then the color change was compared with the testing chart provided in the Saliva-check buffer kit, and the values were assigned accordingly.

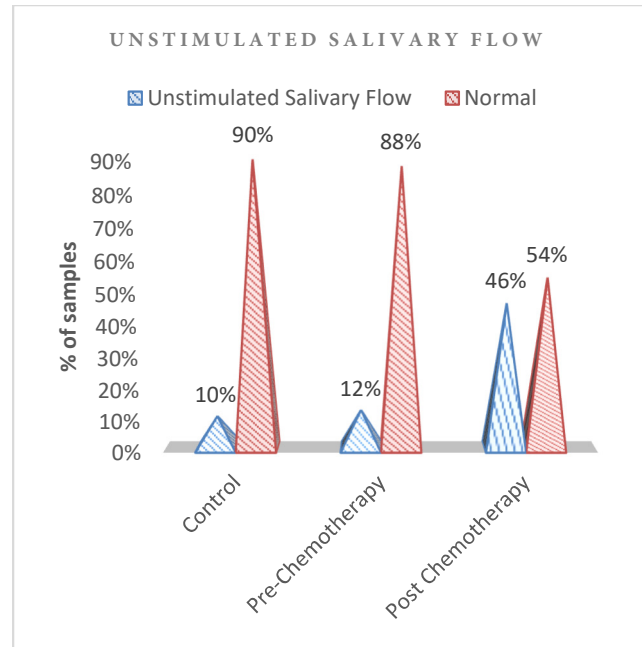
Buffering capacity of saliva was measured using a pipette, sufficient saliva was drawn from the collection cup and then dispensed one drop onto each of the three test pads on the buffer strip. The test pads began to change color immediately and after 2 minutes the final results were calculated by adding the points according to the final color of each pad. Caries evaluation was performed under the standardized condition, using optimal artificial light, mouth mirror and probe. Dental caries was recorded according to the World Health Organization criteria (1997) Avşar, Elli, Darka, & Pinarli, (2007).

4. Results:

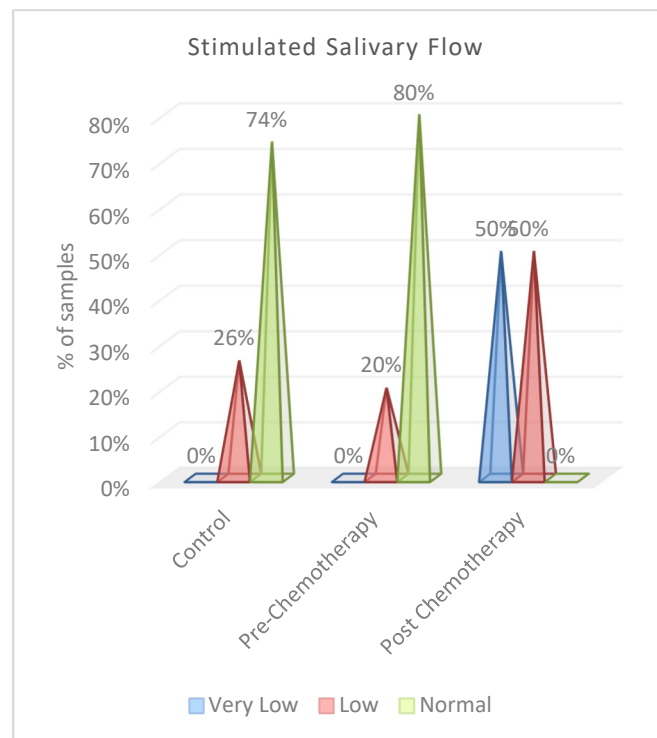
Statistically, a significant association was observed between the groups and the status of unstimulated salivary flow, stimulated salivary flow rate and buffering capacity, salivary resting pH. mean DMFT, mean dmft. (P<0.001) (Graph 1,2,3,4,5,6).

Bonferroni method test was conducted to find out the statistically significant difference amongst the pair of groups. Pair-wise comparisons among mean pH, mean DMFT, mean dmft was found to be statistically significant

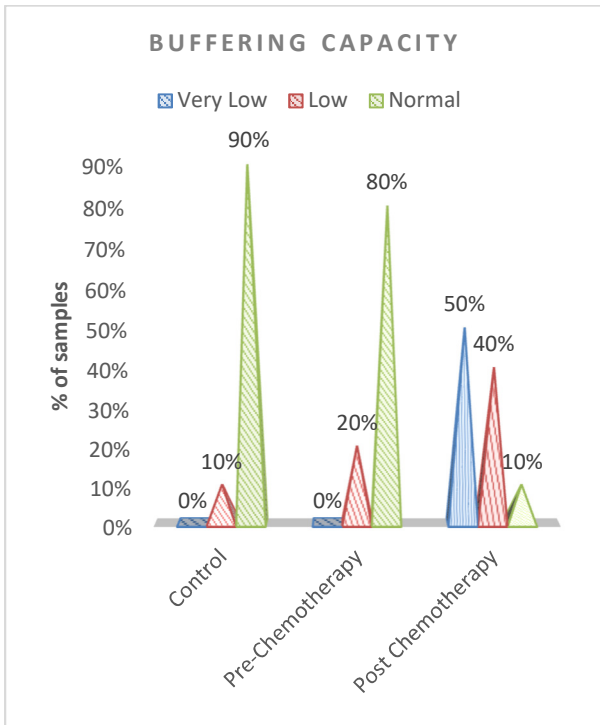
between Control & Post Chemotherapy group (P<0.001) as well as between Pre-Chemotherapy and Post Chemotherapy group (P<0.001). However, no significant difference was observed between the Control & Pre-Chemotherapy Group (P>0.05) (Table 1,2,3).



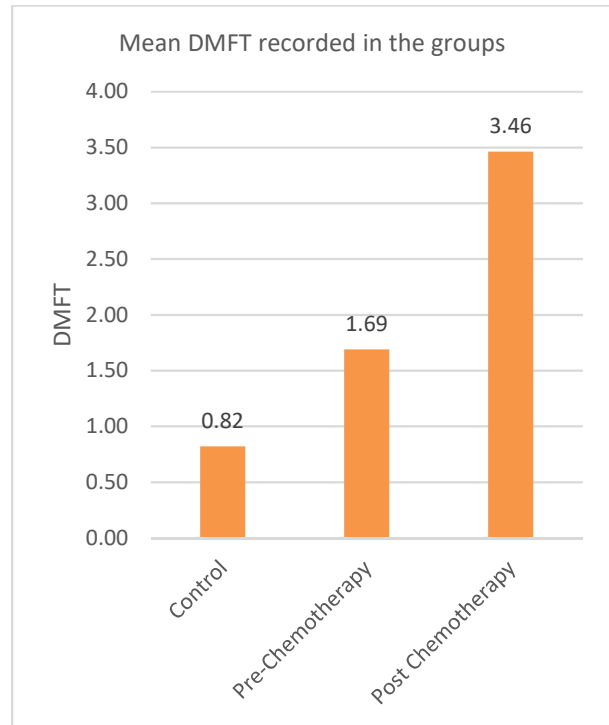
Graph 1. Comparison of unstimulated salivary flow rate between the groups.



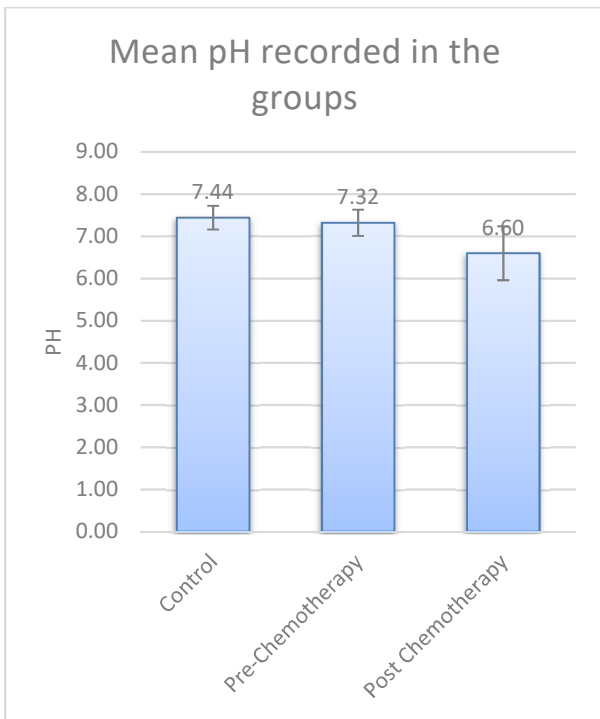
Graph 2. Comparison of stimulated salivary flow rate between the groups.



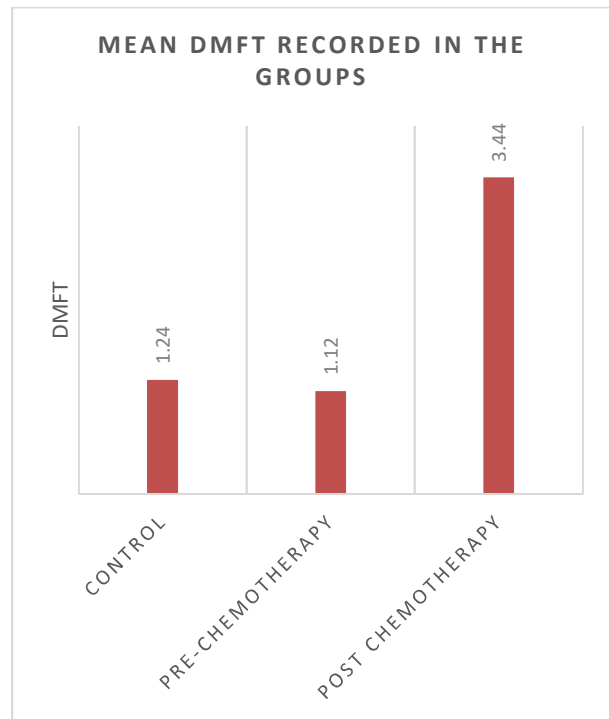
Graph 3. Comparison of buffering capacity between the groups.



Graph 5. Comparison of mean DMFT between the groups.



Graph 4. Comparison of salivary resting pH between the groups.



Graph 6. Comparison of mean dmft between the groups.

Table 1. *Bonferroni Multiple Comparisons for Mean pH.*

Group (I)	Group (J)	Mean Difference (I-J)	P-Value	95% CI For Mean Diff	
				Lower Bound	Upper Bound
Control Group	Pre-Chemotherapy	0.119	0.543	-0.10	0.33
	Post Chemotherapy	0.839	<0.001*	0.63	1.05
Pre-Chemotherapy	Control Group	-0.119	0.543	-0.33	0.10
	Post Chemotherapy	0.720	<0.001*	0.51	0.94
Post Chemotherapy	Control Group	-0.839	<0.001*	-1.05	-0.63
	Pre-Chemotherapy	-0.720	<0.001*	-0.94	-0.51

*denotes significant difference

Table 2. *Bonferroni multiple comparisons for DMFT.*

Group (I)	Group (J)	Mean Difference (I-J)	P-Value	95% CI for Mean Diff	
				Lower Bound	Upper Bound
Control Group	Pre-Chemotherapy	0.119	0.543	-0.10	0.33
	Post Chemotherapy	0.839	<0.001*	0.63	1.05
Pre-Chemotherapy	Control Group	-0.119	0.543	-0.33	0.10
	Post Chemotherapy	0.720	<0.001*	0.51	0.94
Post Chemotherapy	Control Group	-0.839	<0.001*	-1.05	-0.63
	Pre-Chemotherapy	-0.720	<0.001*	-0.94	-0.51

*denotes significant difference

Table 3. *Bonferroni multiple comparisons for dmft.*

Group (I)	Group (J)	Mean Difference (I-J)	P-Value	95% CI for Mean Diff	
				Lower Bound	Upper Bound
Control Group	Pre-Chemotherapy	0.113	1.000	-0.76	0.99
	Post Chemotherapy	-2.205	<0.001*	-3.07	-1.34
Pre-Chemotherapy	Control Group	-0.113	1.000	-0.99	0.76
	Post Chemotherapy	-2.318	<0.001*	-3.19	-1.44
Post Chemotherapy	Control Group	2.205	<0.001*	1.34	3.07
	Pre-Chemotherapy	2.318	<0.001*	1.44	3.19

*denotes significant difference



5 Discussion:

Leukemia is cancer of the blood and bone marrow, it accounts for more than one-fourth of pediatric cancer. It affects the white blood cells and makes them abnormal. Due to the deficiency in the immune system body's ability to fight infection or simple airborne illnesses becomes weak resulting in extensive treatment of common pathogens (Bernard, Abdelsamad, Johnson, Chapman, & Parvathaneni, 2017).

Dental caries is a multi-factorial disease which consists of a progressive demineralization of calcified dental tissue. Oral bacteria metabolize carbohydrate which produces acid leading to decalcification (Dens, Boute, Otten, Vinckier, & Declerck, 1995). The prevalence and severity of dental caries are affected by several factors, which includes diet, age, gender, and socioeconomic factors. Also, some illnesses predispose to a high risk of dental caries, in addition to some medication.

In the present study, the salivary flow rate was found to be significantly lower in post-chemotherapy children when compared to pre-chemotherapy and healthy children. This is comparable to the findings of Jacobson et al. (1996), Epstein et al. (2002), Öhrn, Wahlin, & Sjöden, (2001), Avşar, et al. (2007). They also found that the salivary flow rate was significantly lower in the children who have undergone chemotherapy, as chemotherapeutic agents affect the salivary gland leading to a decrease in salivary secretion.

Buffering capacity was found to be significantly lower in post-chemotherapy children when compared to pre-chemotherapy and healthy children. This is in accordance with findings of Jacobson et al. (1996), Avşar, et al. (2007). They also found that salivary buffering capacity was significantly lower in patients who have undergone chemotherapy. They concluded that hypo salivation has an effect on buffering potential of saliva and these patients are at increased risk of demineralization and development of dental caries (Jacobson et al., 1996).

As there are no reported studies assessing pH in post-chemotherapy children, the present study was the first to assess the same; pH was observed to be low in children after chemotherapy when compared to pre-chemotherapy and healthy children. This reduction in Resting pH, salivary flow rate, buffering capacity might be due to the fact that chemotherapeutic agents have detrimental effects on oral mucosa as well as salivary glands.

In the present study mean DMFT/dmft was found to be significantly higher in patients post-chemotherapy when compared with pre-chemotherapy and healthy children. Similar to the study of VS Nasim, Shetty, & Hegde, (2007). Nemeth, Hermann, Kivovics, & Garami, (2013), Dens et al. (1995), Avşar, et al. (2007). As a requirement of mouth moistening due to hyposalivation, which is usually with sugar-containing soft drinks (Avşar, et al., 2007), also reduced salivary flow due to chemotherapeutic agents

changes the spectrum of oral cavity leading to increase in a caries-related microorganism (Jacobson, et al. 1996). However, Dens, Boute, Vinckier, & Declerck, (1996) concluded that there is no significant change in DMFT and other factors in childhood cancer survivors on a long term basis due to chemotherapeutic agents.

6. Conclusion:

As treatment protocols become more successful in terms of cure rate for cancer patients, more attention should be given to the prevention of long-term effects of the cancer treatment. A good protocol for dental and oral care should be mandatory before, during and after cancer treatment and to instruct patients, parents and all health care workers about possible treatment of oral problems, oral hygiene maintenance, brushing techniques, fluoride application and children should be scheduled for a dental appointment each time they return to the hospital for evaluation.

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