

Estimation of Salivary Cortisol in Children with Rampant Caries

Kavita Rai* / Amitha M Hegde** / Sridhar Shetty*** / Suchetha Shetty****

Dental profession is largely challenged with rampant caries and probable predisposing factors for the same have been evaluated for ages. There is considerable evidence that emotional disturbances may be a causative factor in some cases of rampant caries. Thus the objective of the present study was to estimate the levels of salivary cortisol in children with active rampant caries before and after caries control using electrochemiluminescence assay. A total of 60 children between the age group of 5 to 10 years of both sexes were selected for the study. A questionnaire was also included to evaluate predisposing factors for caries. The results showed that there was an increase in salivary cortisol levels in children with rampant caries, the level decreased gradually when observed for a period of three months following dental treatment which was statistically significant.

Keywords: Salivary cortisol; Dental caries; Rampant Caries; Early Childhood Caries; Stress

J Clin Pediatr Dent 34(3): 249–252, 2010

INTRODUCTION

Good oral health is an integral component of good general health. Although enjoying good oral health includes more than just having healthy teeth, many children have inadequate oral and general health because of active and uncontrolled dental caries. Dental caries is an infections and communicable disease.¹

Rampant caries is a severe form of tooth decay that can affect milk teeth or permanent teeth. It is characterized by its speed of onset and progression by the pattern of attack and its cause.²

The disease is recognized to require primary etiologic

factors like host, a dietary substrate and aciduric bacteria.¹ Many secondary factors, such as salivary composition and flow rate, oral hygiene and diet influence the caries process. In addition to this various predisposing factors like civilization, socioeconomic status, repressed emotions and fears, dissatisfaction with achievement, rebellion against a home situation, a feeling of inferiority, a traumatic school experience, continuous general tension and anxiety and emotional disturbances have been observed in children and adults who have rampant dental caries.¹

The serum cortisol, urinary catecholamine as well as salivary cortisol levels show an increase during periods of stress and anxiety like physical or mental exertion, novelty or uncertainty, social conflict, negative emotions and feelings of threat or loss of control.³ Salivary cortisol was also found to be increased among children due to their anticipation of surgical procedure including dental procedures.⁴ Collection of serum for cortisol analysis is stressful, thereby directly elevating free cortisol concentration and distorting the results of the tests. Urinary catecholamine was also found to be increased in children having dental caries but it has to be repeated over a period of time to get an adequate result.²

Saliva as a diagnostic fluid offers distinctive advantages over serum because it can be collected non invasively by individuals with modest training and less compliance problems. It is a cost effective approach for the screening of large populations.⁵ It is found that salivary cortisol is a better measure in children to assess adrenal cortical function than serum cortisol especially due to noninvasive method.⁶

Hence this study was undertaken to evaluate levels of salivary cortisol in children with rampant caries before and after dental treatment.

* Kavita Rai ,Professor ,Department of Pedodontics and Preventive Children Dentistry, A.B. Shetty Memorial Institute of Dental Sciences.

** Amitha M Hegde , Professor and Head of the Department, Department of Pedodontics and Preventive Children Dentistry, A.B. Shetty Memorial Institute of Dental Sciences.

*** Sridhar Shetty , Post graduate student, Department of Pedodontics and Preventive Children Dentistry,A.B. Shetty Memorial Institute of Dental Sciences.

**** Suchetha Shetty, Associate Professor, Department of Biochemistry K.S Hegde Medical Academy

Send all correspondence to: Dr. Amitha M. Hegde, Professor and Head of the Department, Department of Pedodontics and Preventive Children Dentistry, A.B. Shetty Memorial Institute of Dental Sciences, Derlakatte, Mangalore-575018, Karnataka, India.

Fax no: 0824-2204572.

Email: amipedo@yahoo.co.in
Pedosridhar_shetty@yahoo.co.in

MATERIAL AND METHODS

A total of 60 children between the age group of 5 to 10 years who reported to the Department of Pedodontics and Preventive Children Dentistry, A.B. Shetty Memorial Institute of Dental Sciences, Deralakatte, Mangalore referred from rural centre were selected after getting prior informed consent from parents. These children were equally selected into study and control group. Children of study group had 5 or more active carious lesion⁷ with definite history of pain and infection. The control group comprised of healthy children without the history of dental caries. Estimation of levels of salivary cortisol was done in both the groups. Further evaluation of levels of salivary cortisol in children with rampant caries was done at one month interval for duration of three months after the dental treatment. Questionnaire was also included to evaluate if there is any correlation between various social factors which is stated as predisposing factor for caries. Children on medications and systemic diseases, physically and mentally retarded were excluded from the study.

Oral health status was recorded using modified WHO format by a single examiner. Caries assessment was done using DMFT and dft index.⁸ The selected children were seated head slightly down, and were asked not to swallow or move their tongue or lips during the collection period. The saliva was allowed to accumulate in their mouth for 2 minutes, and he or she was then asked to spit the accumulated saliva in to the receiving vessel.⁹ 2 ml of saliva was collected and maintained at a temperature of 0°C. The collected saliva was then subjected to electrochemiluminescence assay¹⁰ to assess the levels of salivary cortisol using ELECSYS 1010 (Roche Dignostics, U.S).

Comprehensive dental treatment, which included oral prophylaxis, fluoride application, placement of pit and fissure sealants, invasive procedures including pulp therapy, or/ and extraction of non treatable teeth were performed in all the children of the experimental group followed by space maintainer, and/ or stainless steel crown. The evaluation of levels of salivary cortisol in experimental group was done before the start of the treatment and at one month interval for duration of three months after the dental treatment. The results were statistically evaluated using Wilcoxon signed rank test and Chi square test with SPSS software version 11.0.

RESULTS

The study population comprised of 60 children, 30 males and 30 females.

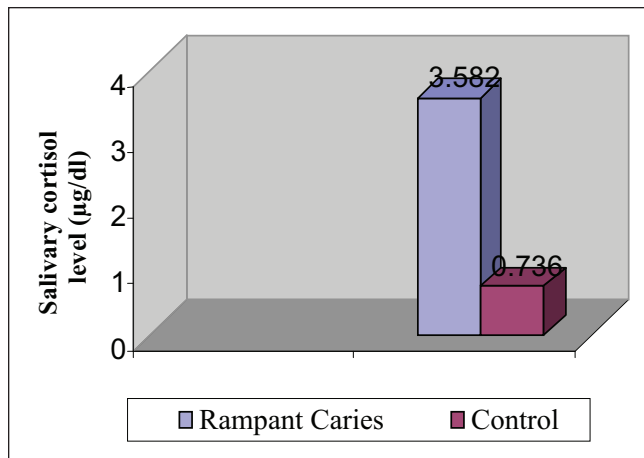
The mean salivary cortisol levels of children with rampant caries was 3.58 µg/dl (SD + 1.344) while that of the controls were 0.736µg/dl (SD+ 0.337) respectively (Table1). The Wilcoxon signed rank test showed this difference to be very highly significant (P 0.001, graph 1).

Mean value of salivary cortisol levels in study group at the end of first month (3.42µg/dl), second month (2.73µg/dl) and third month (2.66µg/dl) after dental treatment showed a gradual reduction (graph 2). The reduction of salivary

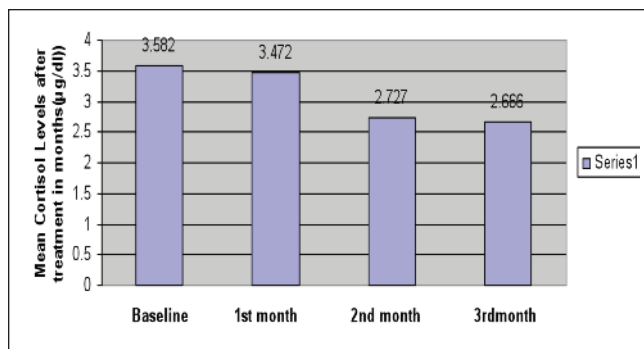
Table 1: Effect of treatment on salivary cortisol levels in µg/dl.

| Comparison of cortisol levels at different periods. | Paired | | Z | p |
|-----------------------------------------------------|--------|-------|-------|-------|
| | Mea | Std. | | |
| Baseline-1st month | 0.15 | 0.13 | .86 | .38 |
| Baseline-2nd month | 0.84 | 0.10 | 0.3.5 | 001 |
| Baseline-3rd month | 0.91 | 0.908 | 0.41 | 001 |
| 1st month-2nd month | 0.69 | 0.12 | 0.29 | 0.003 |
| 1st month-3rd month | 0.76 | 0.12 | 0.33 | 001 |
| 2nd month-3rd month | 0.071 | 0.934 | .37 | .70 |

Z= Wilcoxon signed rank sum



Graph 1. Comparison of salivary cortisol levels at baseline in study group and control group



Graph 2. Mean cortisol levels after treatment in study group after 1 month, 2 months, 3 months respectively

cortisol following dental treatment was statistically significant (Table 1).

67.7% of children had reduced levels of salivary cortisol level at first month compared to baseline, whereas 80.0% had reduced cortisol level at second month compared to baseline and 90.0% had reduced cortisol level at third month compared to baseline which was statistically significant (Table 2).

Results of questionnaire study

The average monthly income of parents in rampant caries group was 2322 Rupees while that of the parents in control

Table 2. No. of children with decreased cortisol levels to previous appointment

| Months | Baseline-1 st month | 1 st month-2 nd month | 2 nd month-3 rd month |
|-----------------------------------------------|-----------------------------------|------------------------------------------------|------------------------------------------------|
| No. of Children With decreased Cortisol Level | 17 | 24 | 27 |
| Percentage | 67.7% | 80.0% | 90.0% |

group was 1575 Rupees, which was statistically significant.

School performance was found to be superior in control group than in rampant caries group. It was observed that 20.0% of children were found to be good performers and none of them were outstanding performers in the study group. Where as in control group 66.7% were good performers and 3.3% were outstanding performers. The result was statistically significant (Table 3).

Table 3: Comparison of school performance

| Comparison of school performance | | GROUP | | Total |
|----------------------------------|-------|--------|---------|--------|
| | | Case | Control | |
| Poor | Count | 1 | 0 | 1 |
| | % | 3.3% | .0% | 1.7% |
| Fair | Count | 5 | 0 | 5 |
| | % | 16.7% | .0% | 8.3% |
| Average | Count | 18 | 9 | 27 |
| | % | 60.0% | 30.0% | 45.0% |
| Good | Count | 6 | 20 | 26 |
| | % | 20.0% | 66.7% | 43.3% |
| Outstanding | Count | 0 | 1 | 1 |
| | % | .0% | 3.3% | 1.7% |
| Total | Count | 30 | 30 | 60 |
| | % | 100.0% | 100.0% | 100.0% |

a. $\chi^2=17.538$ $p=0.002$ hs

Dental pain was a major contributing factor among 86.7% of children from the study while another 6.7% of children complained of esthetics in addition to pain, which was statistically highly significant. (Table 4).

The other factor in the questionnaire such as qualifica-

Table 4: Comparison of psychology towards poor dentition

| Psychology on poor dentition | | GROUP |
|------------------------------|-------|--------|
| | | Case |
| Pain | Count | 26 |
| | % | 86.7% |
| Aesthetic | Count | 2 |
| | % | 6.7% |
| Both | Count | 2 |
| | % | 6.7% |
| Total | Count | 30 |
| | % | 100.0% |

tion, occupation, change of school, type of family, presence of habits, control of diet, emotional status of child played a minor role but did not show a statistically significant results.

DISCUSSION

Cortisol levels in saliva were analyzed as a measure of the human stress response for several reasons. Although the concentration of cortisol in saliva makes up only about 50-60% of the concentration of the cortisol in plasma,¹¹ numerous publications have shown that salivary cortisol is an accurate measure of adrenocortical function as an index for stress.¹² Moreover cortisol in serum is known to be rapidly transferred to saliva (within 5 min) and is not affected by salivary flow rate.¹³ Salivary collection was found to be non invasive, repeatability of protocol can be achieved without undue discomfort.¹⁴ Hence in the present study salivary cortisol was used and children were found to be comfortable during the procedure. It was stated that children with stressful emotional states are more susceptible to infection with *s mutans* or other bacteria, due to immunosuppression related to stress including dental caries.² So we have undertaken this study to assess the level of stress in children with rampant caries.

In previous studies the importance of circadian rhythm of cortisol is emphasized.¹⁵ Considering this the saliva samples were collected from children in the present study at the same appointment hours. All the appointments were scheduled for morning appointments, between 9:00-11:00 A.M.

Our study recorded the mean salivary cortisol levels of children in rampant caries group as 3.58 $\mu\text{g}/\text{dl}$ (SD + 1.344) with a range of 1.08 $\mu\text{g}/\text{dl}$ to 6.29 $\mu\text{g}/\text{dl}$, while that of the controls was 0.736 $\mu\text{g}/\text{dl}$ (SD+ 0.337) with a range of 0.23 to 1.56 $\mu\text{g}/\text{dl}$. The salivary cortisol level was elevated in the experimental group offering support for relationship between stress and cortisol in saliva. This is in accordance with previous study where the urinary catecholamine was found to be increased in children with dental caries.²

The selected children in the present study with active rampant caries had definite history of pain and infection. Comprehensive dental treatment was given to all the children after recording the baseline cortisol level. The dental treatment procedure included oral prophylaxis, fluoride application, placement of pit and fissure sealants, invasive procedures including pulp therapy, or/ and extraction of non treatable teeth followed by space maintainer, and/ or stainless steel crown including counseling. The entire treatment protocol was uniform for all children of the study group. This helped us to study if pain, discomfort during eating, their limitation due to excessive dental decay and alleviation of these during treatment had a bearing on levels of salivary cortisol. The baseline cortisol level followed by levels at one month duration for three months showed a gradual reduction. The reduction of salivary cortisol was less at the end of first month post treatment in comparison to second and third month which could be attributed to an anticipation of invasive dental procedure which they have undergone during the first month.

Dental pain was a major contributing factor in our questionnaire among 86.7% of children from the study group while another 6.7% of children complained of esthetics in addition to pain, which was statistically highly significant.

This may be the main reason for increased level of salivary cortisol.

Post treatment, we observed a fall in level of cortisol among these children which can be attributed to reduced level of stress due to the absence of dental pain and infection.

The children form a part of a larger family system. A change in the family may affect the child, so the basic etiologic factor for caries may be affected by a number of indirect factors.¹⁶ The psychosocial background, life events and family interaction of the children in the control and experimental group when collected was not found to be of much relevance. This may be mainly because of the small sample size and needs further study with bigger group.

The children in the control group had families with greater organization and consistency and had better coping skills and stressful situation which is significant from lower levels of salivary cortisol, which we compiled in our study.

Our study recorded rampant caries in children of families with higher monthly income which may be due to overindulgence of parents, feeding the child on demand and a carbohydrate rich diet.

Our study recorded increased level of dental caries in children from lower socioeconomic status. Stress affects immune function and disease susceptibility.¹⁷ Paradoxically even the higher socioeconomic status reported the same which may be due to overindulgence of parents, feeding the child on demand and a carbohydrate rich diet.

Pain and infection are one of the sequelae of nursing and rampant caries. This affects even the general health. When there is pain there is increased cortisol level and decreased growth hormone secretion and disturbed sleep patterns.¹⁸ This may also affect their day to day functioning and performance of daily activities including academics. It was observed that only 20.0% of children were found to be good performers and none of them were outstanding performers in the study group, where as in control group 66.7% were good performers and 3.3% were outstanding performers. The children in the control group largely had good academic track record when compared to experimental group.

Other factors such as qualification, occupation, change of school, type of family, loss of family member, presence of habits, extracurricular activities, control of diet and emotional status of child did not show a significant result. However a larger sample size would be beneficial to assess these predisposing factors before coming to any definitive conclusions.

CONCLUSION

- Elevated salivary cortisol levels were recorded in children with rampant caries which reduced gradually following dental treatment.
- Academic performance was also average in children with rampant caries.
- Pain rather than esthetics contributed significantly on parental attitude for seeking treatment in children with rampant caries.

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