



Original Article

Urine Cortisol Levels in Children Before Dentistry Consultation to Measure the Presence of Anxiety: A Cross Sectional Study

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Abstract

Objective: To assess and compare cortisol levels in urine before dentistry consultation in children with signs of anxiety and without it. **Material and Methods:** Participation of 36 children (18 boys and 18 girls) aged 3 - 10 years. They were divided into two groups: patients with anxiety and patients previously adapted to the visit according to the Hamilton Anxiety Scale. A urine sample was taken from each patient 10 minutes before the dentistry consultation. The samples were preserved in cold and were then analyzed by chemiluminescence to determine cortisol serum levels. The data were analyzed by using Mann-Whitney U test, with SPSS software. A 5% confidence level was used, taking $p < 0.05$ values as statistically significant. **Results:** 18 patients (50%) were classified as anxious patients and 18 (50%) as no anxious. Urine mean cortisol levels in anxious patients were 16.55 ± 8.47 mcg/dL and 3.88 ± 2.08 mcg/dL, in children without stress signs. Statistical significance was observed when both groups were compared ($p \leq 0.0001$). Cortisol levels were higher in girls with signs of anxiety (19.74 ± 9.16 mcg/dL) versus boys under the same condition (13.37 ± 6.75 mcg/dL). With regard to the levels of cortisol according to the age group, the results were 13.28 ± 5.24 mcg/dl in the first group (3 to 5 years old), 14.67 ± 7.23 mcg/dl in the second (6 to 8 years old) and 30.13 ± 5.78 mcg/dl in the third (9 and 10 years old) in anxious patients. **Conclusion:** High serum cortisol levels are directly related with anxiety and stress signs in children before dentistry consultation.

Keywords: Hydrocortisone; Child Behavior; Dental Anxiety.

Introduction

Dental fear and anxiety translates into complications in managing pediatric patients. Avoiding dental long-term treatment as a result of anxiety may deteriorate oral health condition and increase cavity incidence [1].

In the dental practice many children usually do not cooperate during dental treatment. In some occasions, it is difficult to manage the behavior of the child in the dental clinic. These issues are not only related to the technical procedures of the treatment, but to different children moods. The most common emotional upsets evidenced during consultation are anxiety and fear, which may be the result of previous negative experiences [2]. It is also well known that dental treatment may cause pain and discomfort. In fact, pain expectation increases dental anxiety and this is why there is a large number of anxious patients [3].

Dental anxiety is a common problem developed especially during childhood and adolescence. Approximately half of children exhibit moderate dental anxiety, and between 10% and 20% report high levels of dental anxiety. It must be recognized that the nature of the dental anxiety of a child can vary significantly and while some children exhibit fears or phobias in relation to specific dental stimuli, such as needles, other children report generalized anxiety related with the dental setting [4].

Likewise, anxiety is usually defined as a physiological and psychological reaction generated by the organism as a defense mechanism against internal or external threats and has at least two components: One of the components relates with the hypothalamic-pituitary-adrenal (HPA) axis and the secretion of glucocorticoids, such as cortisol in the blood stream. The second one implies the activation of the autonomic nervous (AN) system and the release of catecholamines, such as norepinephrine [5]. Cortisol levels are a very useful non-invasive biomarker to measure acute stress levels, and therefore it has been used in different studies to evaluate anxiety in dentistry consultation [5-7].

The objective of this study was to assess and compare urine cortisol levels prior to dental consultation in children with evident anxiety signs and no anxious children in order to plan the behavior management of the patient.

Material and Methods

Population

Thirty-six pediatric patients, aged between 3-10 years who attended the graduate program unit in pediatric dentistry of Santa Maria University, Caracas, Venezuela, during the summer period were intentionally selected. Patients were divided into anxious patients with evident signs of anxiety at the dentistry consultation and no anxious patients, according to the items described in Hamilton Psychic Anxiety Scale.

Among the inclusion criteria, all patients whose parents or guardians had signed an informed consent accepting to be part of the study, were included, as well as all the patients with special needs, hormonal disorders or patients consuming any corticosteroids were excluded.

Data Collection

Urine samples were taken from each patient 10 minutes before entering the dentistry consultation. Samples were cryopreserved and sent to the lab in order to determine cortisol levels, and processed by chemiluminescence in an integrated system of immunoassay Architect ci 16200 (Abbott Laboratories, Illinois, USA).

Statistical Analysis

The results were evaluated statistically with IBM SPSS software version 20.0 (IBM Corporation, New York, USA) with a descriptive analysis. Mann-Whitney U test was used in independent samples taking equal variances among groups and Chi square test was used with quantitative variables. A 5% confidence level was used, taking $p < 0.05$ values as statistically significant.

Ethical Aspects

The research was based on the ethical aspects established in the meeting of Helsinki. Likewise, the ethical approval for the study was granted by the Bioethics Committee of the School of Dentistry of Santa Maria University.

Results

Thirty-six children with a mean age of 5.87 ± 2.07 years participated in this study. The most prevalent gender was males with 50% (18 boys) while females represented 50% (18 girls). According to the items of the Hamilton Psychic Anxiety Scale, 18 patients (50%) were classified as anxious patients and 18 (50%) as no anxious.

When evaluating urine cortisol levels in patients with anxiety, a mean of 16.55 ± 8.47 mcg/dl was observed, while in patients without anxiety cortisol mean was 3.88 ± 2.07 mcg/dl. A difference was observed between both groups ($p \leq 0.0001$) (Table 1).

Table 1. Cortisol levels in anxious and not anxious patients.

Group	Cortisol (mcg/dL)		p-value
	Mean	SD	
Anxious	16.55	8.47	
Not anxious	3.88	2.07	≤ 0.0001

SD: Standard Deviation

When relating results with gender, it was determined that cortisol values were higher in female patients and they were 19.74 ± 9.16 mcg/dl in anxious patients and 3.52 ± 2.47 mcg/dl in

non-anxious vs male patients who were 13.37 ± 6.75 mcg/dl and 4.23 ± 1.66 mcg/dl respectively. However, even if values were higher, a statistical significant difference of cortisol values was not established between both genders ($p = 0.739$) (Table 2).

Table 2. Cortisol levels (mcg/dl) in patients anxious and not anxious per gender.

Group	Gender				p-value
	Male		Female		
	Mean	SD	Mean	SD	
Anxious	13.37	6.75	10.77	4.15	0.095
Not anxious	4.23	1.66	3.52	2.47	

SD: Standard Deviation

With regard to the levels of cortisol according to the age group, the results were 13.28 ± 5.24 mcg/dl in the first group (3 to 5 years old), 14.67 ± 7.23 mcg/dl in the second group (6 to 8 years old) and 30.13 ± 5.78 mcg/dl in the third group (9 and 10 years old) in anxious patients versus 3.32 ± 2.20 mcg/dl; 3.81 ± 2.10 mcg/dl and 5.65 ± 1.20 mcg/dl, respectively ($p = 0.039$) (Table 3).

Table 3. Cortisol levels (mcg/dl) in patients anxious and not anxious per age group.

Group	Age Group (Years)						p-value
	3-5		6-8		9-10		
	Mean	SD	Mean	SD	Mean	SD	
Anxious	13.28	5.24	14.67	7.23	30.13	5.78	
Not anxious	3.32	2.20	3.81	2.10	5.65	1.20	0.039

SD: Standard Deviation

Discussion

At present, the study of the physiological behavior regarding stress and anxiety has turned in an important need, in order to give a real answer vis-à-vis these circumstances often presented by patients who attend the dental consultation, mainly pediatric patients.

Cortisol is an adrenocortical hormone that diffuses to all body fluids and represents today an investigation target, since high levels in serum, urine and saliva have been observed under stress conditions [1]. Studies reveal that the chronic persistence of this hormone has consequences such as retardation and alteration of wound healing and local suppression of the immune system [8,9].

The results of this study show how urine cortisol levels before dental treatment were significantly higher in children with patent signs of anxiety, such as crying, vs. those children who did not exhibit them. Previous study also evidence that salivary cortisol levels are significantly higher before the dental consultation without detecting signs of stress in the behavior of children [5], while others researchers lower salivary levels before consultation, than during a simple treatment such as dental prophylaxis [10].

Regarding to this topic is important to narrow it that the anticipation of pain during dental treatment while the children is in the waiting room will cause anxiety and stress. For that reason, the high level of stress cause extreme increase in adrenal hyperactivity, which lead to increase secretion of cortisol level.

This study revealed that urine cortisol levels before dentistry consultation are higher in girls; however, there was no statistical significance compared with the boys. Similar results were previously described showing how cortisol saliva levels regarding stress in children of different ages did not show differences in relation to gender [5]. This slight difference might be related to inherent conditions of the personality or characteristics related to social or family conditions.

The characteristics observed in this investigation allow us to assume that the signs that indicate stress in children are directly related with high urine cortisol levels. This can lead us to make decisions on convenient dental procedures for a pediatric patient with clear stress and anxiety markers, mainly those implying surgical procedures, taking into account the possible immune alterations and delayed wound healing.

Even though the most recent studies use salivary cortisol measurements, since they represent a simple and minimally invasive method for patients, some authors affirm that the cortisol pattern in urine follows other patterns in general, but it lags behind the blood response by about two hours [11-13]. In addition, urine samples are composed of all the urine formed since the last micturition. For that reason we chose the urine pattern to measure the cortisol levels prior the dental consultation.

The answer to which could be the ideal moment for the pediatric patient to attend dentistry consultation still has been an issue for years, especially in those cases where oral conditions are scarce and complex dental procedures are necessary together with successive visits aiming at reestablishing oral health, with significant stress and anxiety levels, and an important increase of cortisol levels in serum, urine and saliva. If we consider that high cortisol levels involve psychological and physiological damage in this patient, we could have a mechanism allowing us to plan patient's appointments and the procedures to be performed together with parents depending on urine cortisol levels, a sampling method that is minimally invasive and simple to collect for them.

Conclusion

High urine cortisol levels are correlated with stress and anxiety signs evidenced by children before the dentistry consultation; therefore, monitoring this hormone in urine can become a valuable tool in order to design and plan dental treatment for patients who find it difficult to adapt themselves to the pediatric dentistry consultation. More studies, which allow designing clear protocols relating urine cortisol levels with treatment planning for pediatric dental patients, are necessary.

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