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Salivary alpha amylase and cortisol levels in children with global developmental delay and their relation with the expectation of dental care and behavior during the intervention

Márcio José Possari dos Santos [a,1,*], Daniel Galera Bernabé [b,1], Ana Cláudia de Melo Stevanato Nakamune [c], Silvia Helena Venturoli Perri [d], Sandra Maria Herondina Coelho Ávila de Aguiar [e], Sandra Helena Penha de Oliveira [f]

[a] Center for Dental Care of Persons with Disabilities – CAOE, School of Dentistry of Araçatuba, UNESP – Univ Estadual Paulista, Araçatuba, São Paulo, Brazil
[b] Laboratory of Pharmacology, Department of Basic Sciences, and Oral Oncology Center, School of Dentistry of Araçatuba, UNESP – Univ Estadual Paulista, Araçatuba, São Paulo, Brazil
[c] Discipline of Biochemistry, Department of Basic Sciences, School of Dentistry of Araçatuba, UNESP – Univ Estadual Paulista, Araçatuba, São Paulo, Brazil
[d] Discipline of Biostatistics, Department of Support, Production and Health Animal, School of Veterinary Medicine of Araçatuba, UNESP – Univ Estadual Paulista, Araçatuba, São Paulo, Brazil
[e] Discipline of Pediatric, Department of Pediatric Dentistry and Social, School of Dentistry of Araçatuba, UNESP – Univ Estadual Paulista, Araçatuba, São Paulo, Brazil
[f] Discipline of Pharmacology, Department of Basic Sciences, School of Dentistry of Araçatuba, UNESP – Univ Estadual Paulista, Araçatuba, São Paulo, Brazil

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ABSTRACT

The purpose of this study was to analyze the alpha-amylase (sAA) and cortisol levels in children with Global developmental delay (GDD) before and after dental treatment and its association with the children's behavior during treatment. The morning salivary cortisol levels and activity of sAA of 33 children with GDD were evaluated before and after dental treatment and were compared to 19 healthy children. The behavior of children with GDD during dental care was assessed by the Frankl scale. Children with GDD showed lower levels of sAA activity than healthy children, but this result was not significant. The salivary cortisol levels were similar between GDD and healthy children. GDD children showed increased levels of sAA (but not cortisol) prior to the dental treatment as compared to the post-treatment phase. GDD children who showed less favorable behavior during dental care had higher levels of sAA and salivary cortisol than GDD children with more favorable behavior, but only the sAA results were significant. In conclusion, GDD children show hyperactivity of the SNS-axis in anticipation of dental treatment which indicates the need for strategies to reduce their anxiety levels before and during dental care.

1. Introduction

Global developmental delay (GDD) is a subset of Developmental Disabilities defined as a significant delay in two or more of the following developmental domains: gross/fine motor, speech/language, cognition, social/personal, and daily living activities (Shevell et al., 2003). In some instances, the term developmental delay is used as an equivalent to mental retardation (Petersen, Kube, & Palmer, 1998). GDD describes a clinical presentation that has a heterogeneous etiologic profile and is associated with age-specific deficits in adaptation and learning skills. Infants and children may have GDD owing to

* Corresponding author at: Centro de Assistência Odontológica à Pessoa com Deficiência – CAOE, School of Dentistry of Araçatuba, São Paulo State University – UNESP, José Bonifácio st. 1193, CEP 16015-050, Araçatuba, SP, Brazil. Tel.: +55 18 3636 2753; fax: +55 18 3636 2814.
E-mail address: marciokada@hotmail.com (Santos).
[1] These authors contributed equally to this work.

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conditions such as cerebral palsy, certain neuromuscular disorders, and other conditions such as early environmental deprivation, yet when they are old enough to measure cognitive level they do not score in the mentally retarded range (Majnemer & Shevell, 1995; Shevell et al., 2003). The prevalence of GDD is unknown. Estimates of 1–3% of children younger than 5 years are reasonable given the prevalence of mental retardation in the general population (Yeargin-Allsopp, Murphy, Cordero, Decouflé, & Hollowell, 1997). Based on approximately 4 million annual births in the United States and Canada, between 40,000 and 120,000 children born each year in these two countries will manifest GDD.

During childhood, several situations trigger fear and anxiety with behavioral interference in the development of the child. Dental care is one of these conditions where factors related to the environment and the diversity of clinical procedures can induce emotional changes (Akyuz, Pince, & Hekin, 1996; Miller, Dembo, Falace, & Kaplan, 1995). The prevalence of fear or anxiety in children undergoing dental treatment varies according to the population analyzed and tends to decrease as they get older (ten Berge, Veerkamp, Hoogstraten, & Prins, 2002). It has been observed that children with neurological and/or behavioral disorders may have different neuroendocrine responses in relation to children with no neurological impairment. For example, Blomqvist et al. (2007) evaluated the levels of salivary cortisol, an important marker of physiological stress, in children with attention deficit hyperactivity disorder (ADHD) prior to dental treatment. They found that children with disabilities had lower levels of cortisol as compared to healthy children. During dental care, children with GDD may have a variable behavioral response ranging from complete refusal to participate to collaboration during treatment. However, studies assessing cortisol levels of children with GDD submitted to dental treatment are not available.

Stress is known to be a physical and psychological reactions characterized by the activation of the Hypothalamus-pituitary-adrenal (HPA) axes with the release of cortisol and of the sympathetic nervous system (SNS) (Webster Marketon and Glaser, 2008). Due to the diffusion of plasma free cortisol to saliva, the salivary cortisol levels reflect the concentrations of plasma free cortisol (Umeda et al., 1981). The SNS axis activation in stress full situations is characterized by increased systemic levels of catecholamines produced by the adrenal medulla and sympathetic neurons. Numerous studies have shown that monitoring the activation of the SNS can be accomplished by measuring the activity of the enzyme salivary alpha amylase (sAA). For example, increased levels of sAA have been detected in response to some situations of psychological stress, such as preparation for the practice of parachuting (Chatterton, Vogelsong, Lu, & Hudgens, 1997), pre-examination (Bosch et al., 1996), after application of the Trier Social Stress Test (TSST) (Nater et al., 2006) and after pharmacological manipulation of the SNS axis (van Stegeren, Rohleder, Everaerd, & Wolf, 2006). However, studies evaluating sAA alterations in children undergoing dental treatment under conditions of stress and anxiety, or in children with GDD, are non-existent.

2. Aim

The purpose of this study was to analyze activity levels of sAA and salivary cortisol levels in children with GDD submitted to dental treatment comparing these levels to those of healthy children, and evaluate its association with children's behavior.

3. Patients and methods

The study included thirty-three children with GDD from 6 to 12 years (average of 9.4 years). All patients were under dental treatment between 2007 and 2009 at the Center for Dental Care of Persons with Disabilities (CAOE), UNESP – Univ Estadual Paulista, Araçatuba, São Paulo, Brazil. The caretakers voluntarily approved the patients' participation and signed the informed consent approved by the Ethics Research Committee. In an initial analysis 142 patients with GDD aged from 6 to 12 years were selected. The diagnosis of GDD was issued by a single specialist in neurology in accordance with the International Classification of Diseases to Neurology (ICD-10 NA) (World Health Organization, 1997). Children selected had mild psychomotor retardation characterized by showing greater adaptation to dental treatment. The study included patients undergoing the following dental procedures: surgery (tooth extraction and/or residual root extraction), restoration (resin restorations, glass ionomer, invasive sealant or amalgam) and prevention (prophylaxis and removal of supra gum stones). Out of the 33 children selected, 23 were boys and 10 were girls. Exclusion criteria were: patients being unable to be present at the research collection procedures, patients undergoing dental procedures other than those defined for the study, patients who exceeded the upper age limit at the time of collection, patients who gave up dental care during the study period and patients who were taking medication or were suffering from comorbidity. Twenty healthy children with no neurological disorder and undergoing dental treatment were randomly recruited for the control group. A child of the control group was excluded from the study due to suspected errors at sampling or analysis. The control group was then composed by 19 children (15 boys, 4 girls) with a mean age of 8.3 years.

3.1. Saliva collection

Morning saliva samples of children with GDD and healthy children were collected before and after dental intervention. Collection prior to the dental procedure was performed between 9:00 and 9:30. The patients then underwent dental procedures which lasted 30–45 min. Soon after dental care was over a new saliva sample was collected. All saliva samples were collected using a specific material (Salivette®, Sarstedt, Nümbrecht, Germany) consisting of a centrifuge tube that has an internal device with a hole containing a cotton wool swab. This cotton wool swab was placed on the child's mouth floor until fully wetted with saliva. It was then put back inside the tube and taken to the laboratory. The tube containing the cotton