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British Journal of Oral and Maxillofacial Surgery 53 (2015) 557–560

BRITISH Journal of Oral and Maxillofacial Surgery

www.bjoms.com

Evaluation of cortisol concentrations in saliva as a measure of stress in patients having routine dental extractions

O.T. Umeanuka [a,*], B.D. Saheeb [b], C.C. Uguru [a], F.N. Chukwuneke [a]

[a] *University of Nigeria Teaching Hospital, Enugu, Nigeria*
[b] *University of Benin Teaching Hospital, Benin City, Nigeria*

Accepted 23 March 2015
Available online 14 April 2015

Abstract

We measured changes in the salivary concentrations of cortisol as an index of stress, and to find out if patients were stressed during routine intra-alveolar dental extractions. A total of 126 patients (63 experimental and 63 controls) matched for age and sex with a mean (SD) age of 26 (5) years (range 18–40) were recruited. Samples of saliva from patients whose glands had not been stimulated were collected twice from the study group (30 minutes before, and 10 minutes after, the procedure) and once from the control subjects. All samples were collected between 10.00 and 14.00 hours to standardise the method and control for the diurnal variation of cortisol. There was a slight but not significant increase in the mean salivary concentration of cortisol between the preoperative samples (mean (SD) 12.3 (1.5) ng/ml and the postoperative samples 12.8 (2.3) ng/ml in the study group) and the control 8.7 (1.0) ng/ml. However, there was no difference between the sexes. The study highlights a simple but effective way of evaluating stress in patients having intra-alveolar dental extraction, and emphasises the invaluable role of salivary cortisol in the evaluation of stress (particularly in our environment).

Keywords: Salivary cortisol; Stress; Extraction

Introduction

Selye was the first to describe stress in the 1930s as the non-specific response of the body to any demand whether it is caused by, or results in, pleasant or unpleasant conditions (quoted by[1]). Various physical and psychological stressors can rapidly affect the adrenal cortex. This leads to increased secretion of cortisol,[2–4] which is often used to evaluate stress, and its salivary component has been used by dental research workers to measure stress during dental procedures.[5,6] Concentrations of cortisol in saliva reflect the physiologically unbound active fraction of blood cortisol that is active biologically, and its measurement is an accepted non-invasive way to evaluate them.[7,8]

Though salivary cortisol concentrations have shown that routine dental procedures cause stress, little research has been done into the stress during oral and maxillofacial surgical procedures even though these procedures are accepted as stressful.[10,11] For example, dental extraction is stressful and is one of the routine procedures done by dental surgeons in everyday practice.[12,13]

Our aim was to measure the concentration of cortisol produced as a result of stress exerted on patients by routine dental extractions.

Subjects and methods

One hundred and twenty-six participants were divided into two equal groups, the study group and the control group, that

* Corresponding author at: Oral and Maxillofacial Surgery Department, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Nigeria. Tel.: +234 8037769353.
E-mail address: obitimume@yahoo.co.uk (O.T. Umeanuka).

http://dx.doi.org/10.1016/j.bjoms.2015.03.011

were matched for age (between 18 and 40 years) and sex. Ethical approval for the study was obtained from the institution's Health Research Ethics Committee. Exclusion criteria were patients who were being treated with steroids, pregnant women, and patients with conditions in which cortisol secretion is altered (Addison's disease, Cushing's syndrome, and congenital adrenal hyperplasia). Patients with conditions of decreased or altered secretion of saliva (caused by atropine, calcium channel blockers, antidepressants, antihistamines, Sjogren's syndrome, and radiotherapy) were also excluded, as were patients who were overly anxious about dental treatment and scored over 19 on the Modified Dental Anxiety Scale.[14]

We measured cortisol in saliva because that indicates accurately the active physiologically-unbound fraction that exerts biological activity.[7,8,15] All samples were collected between 10.00 and 14.00 hours to standardise the diurnal variations of the secretion of cortisol.

Saliva 1 ml was collected from patients' unstimulated glands in both groups using disposable micropipettes and graduated polypropylene vials. After 30 minutes, patients in the study group had a simple intra-alveolar extraction of one or more teeth under routine local anaesthesia by the same surgeon. Ten minutes after each extraction a further sample of saliva 1 ml was collected from the study group. Any sample in which there was evidence of contamination by blood was discarded. Each sample was labelled and frozen until analysis. Saliva was analysed with a Salivary Cortisol ELISA research kit (DRG Instruments GmbH Germany, Frauenbergstraβe 18, D-35039 Marburg).

Statistical analysis

We used SPSS (version 17.0, SPSS Inc, Chicago IL), and the significance of differences between salivary cortisol concentrations between groups and within groups were assessed using Student's *t* test. Probabilities of less than 0.05 were accepted as significant.

Results

A total of 189 samples of saliva from 126 subjects were analysed, and 34 of the study participants (54%) had increased cortisol concentrations 10 minutes after extraction. In 26 (41%) they were reduced while 3 (5%) showed no change.

Table 1
Mean (SD) concentrations of cortisol in the saliva of the study group before and after operation ($n = 63$ at each time point).

Value	Before extraction	After extraction
Mean (SD) ng/ml	12.2 (1.5)	12.8 (2.3)
Mean difference	0.5	
t Value	1.43	
p Value	0.16	

Table 2
Mean (SD) concentrations of cortisol in saliva in study patients preoperatively and controls ($n = 63$ in each group).

Value	Study group before extraction	Control group
Mean (SD) ng/ml	12.3 (1.5)	8.7 (1.0)
Mean difference	3.6	
t Value	15.7	
p Value	<0.001	

Table 3
Mean (SD) concentrations of cortisol in saliva in study patients postoperatively and controls ($n = 63$ in each group).

Value	Study group after operation	Control group
Mean (SD) ng/ml	12.8 (2.3) ng/ml	8.7 (1.0)
Mean difference	4.1	
t Value	12.6	
p Value	<0.001	

Table 1 shows the mean (SD) concentrations in the study group before and after extraction, while Tables 2 and 3, and Fig. 1, show the comparison between the study and control groups ($p < 0.001$). There were no significant differences group between the sexes at any age before or after extraction (Tables 4 and 5).

Discussion

We designed the study to assess salivary cortisol concentrations as a measure of stress after routine dental extractions. Miller et al., in a similar study, recorded a rise in concentrations in patients (80% of 10 patients), though they studied a smaller number than we did.[9]

The mean cortisol concentration after extraction was higher than that before, but not significantly so (Table 1). Bunch et al., also found no significant increase after removal of third molars under local anaesthesia,[16] and Banks reported previously that plasma cortisol concentrations had increased only slightly during minor operations that lasted less than an

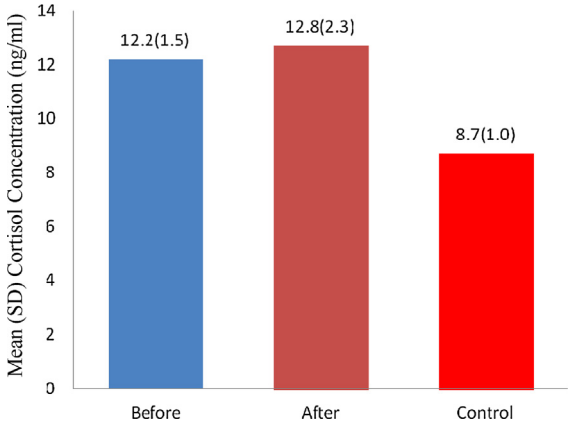

Fig. 1. Histogram showing mean (SD) concentrations of cortisol in patients and controls before and after extraction. Blue = before extraction, brown = after extraction, and red = controls.