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Original Article

Trigeminocardiac reflex during non-surgical root canal treatment of teeth with irreversible pulpitis

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KEYWORDS
Trigeminocardiac reflex;
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Mean arterial blood pressure;
Hypotension;
Teeth

Background/Purpose: Trigeminocardiac reflex (TCR) is a unique clinical incident of acute change in hemodynamic balance, which may lead to hypotension, bradycardia, and even clinical crisis. Up to date, no study so far considers the impact of non-surgical root canal treatment (NSRCT) of irreversible pulpitis teeth under either local infiltration or block anesthesia on hemodynamic change possibly related to TCR.
Methods: This study enrolled 111 patients with 138 irreversible pulpitis teeth that were treated by two sessions of NSRCT. The first session involved mainly the removal of vital pulp tissue with the direct stimulation of the dental branches of the trigeminal nerve, and the second session included the root canal enlargement and debridement with minimal disturbance to the dental branches of the trigeminal nerve. Vital signs mainly the blood pressure were recorded during both NSRCT sessions.
Results: The incidences of NSRCT patients with MABP decrease $\geqq$10%, $\geqq$15%, or $\geqq$20% were all significantly higher in the first NSRCT session than in the second NSRCT session (all the P-values $<$ 0.001). In the first NSRCT session, the incidence of patients with MABP decrease $\geqq$10% was significantly associated with tooth type. For both upper and lower teeth, the patients with premolars treated by NSRCR had significantly higher incidences of MABP decrease $\geqq$10% than those with either anterior or molar teeth treated by NSRCR (all the P-values $<$ 0.05).

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Conclusion: We conclude that vital pulp extirpation may lead to a substantial drop in patient's blood pressure possibly related to TCR.

Introduction

Trigeminocardiac reflex (TCR) is a unique clinical incident of acute change in hemodynamic balance, manifesting as a sudden decrease in heart rate (HR) and mean arterial blood pressure (MABP), and respiratory and gastric changes caused by the evocation of the trigeminal nerve.[1] It was first described in 1908 as oculocardiac reflex occurring during the ophthalmic surgery.[2] Another synonym of TCR is trigeminovagal reflex which represents additional sudden autonomic response with or without hemodynamic change when the trigeminal nerve is stimulated.[1,3] Different from oculocardiac reflex, TCR develops as a physiological response to the stimulations of the trigeminal nerve or one of its three branches (ophthalmic, maxillary and mandibular nerve). These afferent nerves may send the signal of stimulations through the Gasserian ganglion to the sensory nucleus of the trigeminal nerve.[4]

The criteria for a diagnosis of TCR may vary in different clinical situations. The most common definition of TCR is a sudden decrease in HR and MABP by more than 10% or 20% compared with the baseline values, resulting from the stimulation of the trigeminal nerve or its branches.[1] According to a report of TCR during rhinoplasty, the authors noted that because rhinoplasty was a less invasive operation than maxillofacial surgery, they preferred to define TCR as a reduction in HR by at least 10%.[2] Due to the differences in the scope of treatments, the definition of TCR may vary from study to study.

According to the previous literature, TCR may occur during the ocular surgery, reduction of zygomatic arch fractures, managing midface fractures, maxillary Le Fort I osteotomy, orthognathic surgery, treatment for eye-orbital trauma or nasoethmoidal fractures, operation of the cerebellopontine angle, and contact lens insertion.[5–7] The incidence of reflex bradycardia was found to be about 1.6% during maxillofacial surgical procedures.[4]

Since dental pulp is innervated by abundant sensory nerve fibers originating from the maxillary and mandibular branches of the trigeminal nerve, stimulations of the dental pulpal nerves may possibly result in TCR. Once the dental pulp is invaded or infected by the bacteria, root canal treatment could be an option for preserving the tooth. During root canal treatment, the peripheral branches of trigeminal nerve may be stimulated, thereby evoking TCR.

Although TCR has been widely observed during ocular, nasal, and maxillofacial surgeries, there has been no previous research on its relation to non-surgical root canal treatment (NSRCT), which is also a stimulation of the nerve endings of trigeminal nerve branches. The purpose of this study was to investigate the incidence and effect of TCR in a series of 138 irreversible pulpitis teeth that received NSRCT under either local infiltration or block anesthesia.

Materials and methods

Case enrollment criteria

This clinical study was approved by the institutional review board of Chung Shan Medical University Hospital (CSMUH, protocol CSMUH No. CS14112). Patients with irreversible pulpitis teeth that received NSRCT under local infiltration or block anesthesia from June, 2014 to October, 2015 were included. The inclusion criteria were patients whose ages were between 20 and 69 years old and patients with irreversible pulpitis teeth that had complete root formation, were tested positive by the vitality pulp test, and were treated by NSRCT under local infiltration or block anesthesia. Patients with major systemic diseases such as diabetes mellitus, hypertension, severe renal, hepatic or cardiovascular diseases and incomplete clinical medical and dental records were excluded.

Clinical data collection and procedures

The age, gender, treated tooth type, and type of anesthesia (local infiltration or block anesthesia) of each patient were recorded. In both NSRCT sessions, the local infiltration or block anesthesia was performed with 1.7 ml of xylocaine with 1:80,000 epinephrine. The rubber dam isolation was performed during each NSRCT.

In the first NSRCT session, all vital pulp tissues were removed by both hand files and rotary instruments. Repeated irrigations with 2.5% sodium hypochlorite (NaOCl) solution and inter-appointment medication with calcium hydroxide ($Ca(OH)_2$) were performed in the treated root canals. In the second NSRCT session, complete root canal debridement with hand files and rotary instruments plus repeated 2.5% NaOCl solution irrigations were undertaken. If no symptoms and signs were noted at the second NSRCT, root canals were cleaned, dried, and filled with gutta-percha points (DiaDen, Almere, Netherlands) and root canal sealer (Canals, Showa, Tokyo, Japan) by lateral condensation technique. All procedures were performed by the same clinician, Dr. I.S. Huang.

The MABP (1/3 systolic blood pressure + 2/3 diastolic blood pressure; mmHg) was monitored with CSI Model 506 DXN (Criticare System Inc., Waukesha, WI, USA). Patients' initial (baseline) and minimal values of MABP during the two NSRCT sessions were recorded and only the data of MABP were used for further statistical analyses in this study.

Statistical analyses

The rate of MABP decrease was the percentage calculated by the equation of (the initial MABP minus minimal MABP

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