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Trigeminocardiac reflex and haemodynamic changes during Le Fort I osteotomy

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Abstract. The Le Fort I osteotomy is performed under general anaesthesia and specific haemodynamic conditions, i.e. hypotensive general anaesthesia. This study assessed the incidence of the trigeminocardiac reflex (TCR) during the different stages of the Le Fort I osteotomy. Forty-seven patients requiring a Le Fort I osteotomy were included. General anaesthesia was induced. In terms of haemodynamic changes, each patient's oxygen saturation (SpO_2), mean arterial pressure (MAP), heart rate (HR), and electrocardiogram (ECG) were monitored by SADAAT Monitoring System and recorded during the different stages of osteotomy: before the induction of anaesthesia, before osteotomy cuts, after finishing the right pterygoid plate osteotomy, after finishing the left pterygoid plate osteotomy, and after performing down-fracture of the maxilla. No significant alteration in haemodynamic values was seen at the different stages of Le Fort I osteotomy. One patient showed arrhythmia with non-sinus junction rhythm after sinus bradycardia and two premature atrial contractions in the down-fracture stage, which led to the abrupt cessation of the procedure by the surgeon. This study showed no significant alterations in haemodynamic values during the different stages of Le Fort I osteotomy. Halting the procedure momentarily was sufficient to allow spontaneous normalization of the HR, blood pressure, and dysrhythmia.

Key words: TCR; haemodynamics; osteotomy; Le Fort.

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The Le Fort I osteotomy is among the most common maxillofacial operations. This procedure is usually performed under general anaesthesia and specific haemodynamic conditions, namely hypotensive general anaesthesia. Asystole, bradycardia, and other cardiac dysrhythmias are among the inherent intraoperative complications of maxillofacial surgery.[1–20] Although uncommon, these complications may be life-threatening.[2,3]

Such dysrhythmias are mostly discussed in ophthalmology,[1,4–6] and there are few documented reports on the frequency of cardiac dysrhythmias in craniofacial surgery.[2,3,7–10] Recently, two clinical trials evaluated the occurrence of this haemodynamic complication in Le Fort I and bilateral sagittal split osteotomy (BSSO) operations.[7,8]

Surgery performed near the cranial nerves, especially the trigeminal nerve (V), may induce bradycardia by stimulation of the vagus nerve (X) and finally activation of the parasympathetic system resulting in various types of dysrhythmia.[9] This physiological reaction is probably initiated by stimulating receptors of afferent fibres of the trigeminal nerve, including the greater palatine nerve and/or posterior superior alveolar nerve, originating from the maxillary branch of the trigeminal nerve. The stimulated nerves send signals to the sensory nucleus of the trigeminal nerve via the Gasserian ganglion, which forms the afferent pathway of this reaction. This afferent pathway continues and forms a reticular network together with short fibres and connects to the efferent pathway. The efferent pathway originates from the motor nucleus of the vagus nerve and continues to the myocardium.[2,9] This reaction may be dangerous or life-threatening.[2] There are reports of severe bradycardia while repositioning the fractured zygomatic arch,[3,17] while repositioning midface fractures,[18,19] during osteotomies,[7,8,10] and during temporomandibular joint surgery.[1,20]

The trigeminocardiac reflex (TCR) may be initiated by peripheral nerve stimulation during Le Fort I osteotomy and may result in clinically significant asystole, bradycardia, and/or hypotension. This study was performed to assess the incidence of haemodynamic changes influencing the cardiovascular system during the different stages of the Le Fort I osteotomy.

Materials and methods

Patients requiring a Le Fort I osteotomy for the correction of protrusion, open bite, vertical maxillary excess, maxillary hypoplasia, etc., who were referred to the study clinic over a 6-month period, were examined. Those without any systemic or neurological disorders (American Society of Anesthesiologists (ASA) status I) were informed about the study and enrolled after providing signed informed consent. The same surgical team performed all the procedures, and all the osteotomy operations were done by an experienced senior surgeon. A unique hypotensive anaesthesia protocol was applied. Patients fasted for at least 8 h prior to surgery. One hour before surgery, 8 mg dexamethasone and 1 g cefazolin were administered intravenously. The general anaesthesia protocol included three stages, namely premedication, induction, and maintenance. In the premedication stage, the patients received midazolam 0.1–0.2 mg/kg, fentanyl 2–3 μg/kg, and 2% lidocaine 1–1.5 mg/kg. In the induction stage, thiopental 5–7 mg/kg, propofol 2 mg/kg, atracurium 0.5 mg/kg, and succinylcholine (as a muscle relaxant) were administered. After nasoendotracheal intubation, anaesthesia was maintained using propofol 1–2 mg/kg/h and remifentanil 0.25–0.40 μg/kg/min. In the case of any change to the anaesthesia protocol, the patient was excluded from the study. Based on these criteria, 47 patients were included: 33 were women (70.2%) and 14 were men (29.8%), and they ranged in age from 18 to 30 years (mean 24.2 years).

In order to record haemodynamic changes in the patients, four measures – oxygen saturation (SpO_2), mean arterial pressure (MAP), heart rate (HR), and electrocardiogram (ECG) – were monitored by SADAAT Monitoring System (Pooyandegan Rah Saadat Co., Ltd, Tehran, Iran) at five points during surgery: before the induction of anaesthesia (BA), before osteotomy cuts (BOC), after the right pterygoid plate osteotomy (RPO), after the left pterygoid plate osteotomy (LPO), and after down-fracture of the maxilla (DF).

Statistical analysis

The data were analyzed using IBM SPSS Statistics version 22.0 software (IBM Corp., Armonk, NY, USA); repeated measures analysis of variance (ANOVA) was employed (significance set at $P < 0.05$).

Results

Data regarding the haemodynamic changes including HR, MAP, and SpO_2 at each stage of surgery are presented in Table 1. The HR before induction of anaesthesia was significantly different to the HR at all other stages; however, there were no significant differences among the other stages in this regard. Table 2 shows the comparisons of HR values at the different stages.

Compared with the recording before osteotomy cuts, the HR decreased after right pterygoid plate osteotomy by approximately 0.9% and then increased after the left pterygoid plate osteotomy and down-fracture stages by 1% and 1.02%, respectively, showing insignificant changes of HR in the different stages of the Le Fort I osteotomy. In comparison with the stage before osteotomy cuts, 25% of the patients experienced a drop in HR of more than 10% after right pterygoid plate osteotomy, after left pterygoid plate osteotomy, and after down-fracture, which occurred two times more frequently after left pterygoid plate osteotomy compared to right pterygoid plate osteotomy and down-fracture. The maximum drop in HR was about 40% in two patients after left pterygoid plate osteotomy and after right pterygoid plate osteotomy.

Table 3 shows MAP values at the different stages. The MAP before induction of anaesthesia was significantly higher than the MAP in the other stages. In contrast, MAP was significantly lower before the osteotomy cuts than in the other stages. After right pterygoid plate osteotomy, MAP was significantly higher than that before osteotomy cuts and lower than that after the left pterygoid plate osteotomy; however, there was no significant difference between MAP after right pterygoid plate osteotomy and MAP after down-fracture. There was also no difference in MAP between the left pterygoid plate osteotomy and down-fracture stages. The differences in MAP found between the stage before induction of anaesthesia and all the other stages were due to the level of hypotensive anaesthesia at the different times during the osteotomy. Also, 8.5% of patients showed a more than 10% decrease in MAP.

The measured change in SpO_2 was not significant, with a P-value of 0.336.

ECG records in lead II were assessed. One patient showed arrhythmia with non-sinus junction rhythm after sinus

Table 1. Heart rate, mean arterial pressure, and oxygen saturation during the different stages of Le Fort I osteotomy.[a]

	Before induction of anaesthesia (BA)	Before osteotomy cuts (BOC)	After right pterygoid plate osteotomy (RPO)	After left pterygoid plate osteotomy (LPO)	After down-fracture (DF)
HR	85.6 ± 16.3 (60–125)	71.7 ± 8.2 (58–88)	71.2 ± 8.3 (52–90)	71.7 ± 8.1 (50–90)	73.4 ± 9.3 (57–93)
MAP	86.2 ± 14.2 (50.7–104.7)	66.6 ± 7.6 (51.7–90.3)	71.6 ± 9.3 (53.7–90)	72.8 ± 9.9 (53.7–96)	73.3 ± 10 (55–95)
SpO_2	97.8 ± 0.5 (95–100)	96.3 ± 1.3 (95–100)	98.2 ± 1 (96–100)	98.1 ± 1 (96–100)	98.3 ± 1 (97–100)

HR, heart rate; MAP, mean arterial pressure; SpO_2, oxygen saturation.

[a] Results are presented as the mean ± standard deviation, and minimum and maximum values.