



TRIGEMINO-CARDIAC REFLEX IN VESTIBULAR SCHWANNOMA SURGERY

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ABSTRACT

Introduction: The appearance of bradycardia followed by a drop in mean arterial pressure during vestibular schwannoma surgery may affect the quality of resection of this benign tumor. This phenomenon is currently called Trigemino-cardiac reflex (TCR).

Method: We retrospectively reviewed the case histories of 260 patients who underwent vestibular schwannomas surgery performed at the Neurosurgical department of Ali Ait Idir university hospital, Algiers, Algeria, and were evaluated retrospectively for the occurrence of the TCR.

Results: Fourteen patients (5.38%) had a TCR intra-operatively. In all 14 patients with a TCR, the postoperative courses presented no complications that could be directly related to this intra-operative phenomenon.

Conclusions: The appearance of the TCR allows the surgeon to interrupt surgical maneuvers immediately. This technique is sufficient for the heart rate and the arterial blood pressure to return to normal levels. This phenomenon must not condition the quality of tumor resection.

KEYWORDS : Trigemino-cardiac reflex; vestibular schwannomas; trigeminal nerve; bradycardia; hypotension.

1. INTRODUCTION:

Since the description of bradycardia in neurosurgery, by Cushing as a factor of poor prognosis secondary to compression of the brainstem; the quality of resection of vestibular schwannoma was conditioned by this phenomenon. Thus bradycardia which appears at the time of tumor dissection at the brainstem imposes the immediate stop of the tumor removal.

In 1999, Schaller et al. (6) for the first time reported bradycardia with hypotension due to intra-operative manipulation or traction of the trigeminal nerve during surgery in the cerebellopontine angle, and thus introduced trigemino-cardiac reflex to the neurosurgical community.

In 2005, the trigemino-cardiac reflex was considered to be a brainstem reflex, and has currently been defined as a decrease in heart rate (HR) and mean arterial blood pressure (MABP) of more than 20% as compared with baseline values before application of the stimulus and coinciding with the surgical manipulation at or around any branches of the trigeminal nerve (8). The heart rate and the MABP should return spontaneously to normal levels with cessation of manipulation or traction (7, 8, 9).

2. MATERIALS AND METHODS:

We retrospectively reviewed the case histories of 260 patients who underwent vestibular schwannomas surgery performed at the Neurosurgical department of Ali Ait Idir university hospital, Algiers, Algeria, from January 2011 to February 2016.

Out of the 260 patients, 14 experienced sudden onset of severe bradycardia <40 b/m with a drop in mean arterial blood pressure (MABP). This observation was seen during tumor dissection from the trigeminal nerve at the brainstem. Cessation of traction resulted in a spontaneous increase in the heart rate and the MABP to normal levels.

We have called this phenomenon "the trigemino-cardiac reflex" (TCR).

The study included the intra-operative strategies to manage the TCR and possible complications related to these autonomic changes during the postoperative course.

For this purpose anaesthesiological protocols and surgical reports were evaluated.

2.1. Anesthetic technique:

After oral premedication with midazolam, anesthesia was induced with propofol followed by sufentanil and rocuronium. Anesthesia was maintained with propofol and, when it seemed clinically necessary, an additional bolus of sufentanil and rocuronium was administered.

After endotracheal intubation, the lungs were mechanically ventilated by moderate hyperventilation (PaCO₂/435mmHg) with a mixture of air and oxygen (FiO₂/40.35).

In the operating room patients received routine monitoring including

electrocardiography and urinary bladder temperature monitoring. A radial artery catheter was inserted to allow continuous invasive blood pressure measurement.

2.2. Surgical technique:

All patients were operated in semi sitting position by transmeatal retrosigmoid approach.

Intra operative facial nerve monitoring was conducted routinely.

Tumor removal was done in classically alternating intra-capsular debulking and bimanual dissection under continuous irrigation with normal saline. The use of bipolar coagulation should be avoided.

The anesthesiologist informed the surgeon immediately as soon as a severe Bradycardia occurred (<40 b/m). The blood pressure reading at the moment of bradycardia occurrence found a drop in mean arterial blood pressure. The surgeon then stopped surgical manipulation and removed the cerebellar retractor. After the surgical stimulation ceased hemodynamic parameters returned to normal levels in all cases. A simple change in the traction method or in the area of manipulation allowed continuation of the surgery without further occurrences of TCR.

This phenomenon is found only when the tumor is dissected from the trigeminal nerve.

3. RESULTS:

In the 14 patients who experienced the TCR, the mean age was 43 years (range 24–62 yrs.) and there were 10 women (71.4%) and 4 men (28.6%). The tumor size was measured at the largest diameter. All patients had a large tumor above 30mm in cerebellopontine angle (CPA) (range 30-50mm).

During tumor dissection from the trigeminal nerve at the brainstem, patient heart rate and MABP decreased significantly:

The duration of the bradycardia (25 to 39 b/m) was on average from 10 to 30 seconds with a return to normal cardiac rhythm within 20 to 40 seconds after the end of surgical manipulation.

The average pressure drop is 50% from a mean of 77.5 mmHg (range 65-90) before manipulation to a mean of 45 mmHg (range 40-50) during tumor dissection and returned to 77.5 mmHg (range 65-90) after cessation of tumor dissection.

None of the patients received Atropine.

The TCR was never the cause of incomplete tumor resection in our study.

There were no complications that could be attributed to occurrence of TCR in any of the patients. There was no cardiac rhythm abnormalities detected in the Intensive care unit post-operatively.

4. DISCUSSION:

Before the description of the phenomenon of TCR the appearance of bradycardia at the moment of tumor dissection from the brainstem, obliged the surgeon to stop tumor dissection. Frequently a tumor remnant adhering to the brainstem was left under the pretext of endangering the patient's life. The appearance of this bradycardia was the cause of an incomplete removal.

We have remarked in our experience that the bradycardia appears only when the tumors is dissected from the trigeminal nerve at the brain stem, accompanied by a drop in the MABP. Cessation of dissection is accompanied by a return to normal of the heart rate and of the MABP.

Indeed Sudden development of cardiac arrhythmia as far as cardiac arrest, arterial hypotension, apnea and gastric hypermobility as manifestations of the trigeminocardiac reflex were initially described in 1870 by Kratschmer et al (3).

The oculo-cardiac reflex which is a physiological subtype of the TCR was first described in 1908 by both Bernard Ascher and Guiseppè Dagnini in cats and rabbits (2).

In 1977 Kumada et al. (4) described similar autonomic "trigeminal depressor" responses after low frequency electrical stimulation within portions of the trigeminal complex in anaesthetized or decerebrated rabbits, indicating that not only peripheral but also central stimulation of parts of the trigeminal pathway results in autonomic reflex responses.

In 1988 the term "trigeminocardiac reflex" was introduced by the anaesthetists Shelly and Church (10).

In 1999, Schaller et al. (6) initially described the occurrence of central TCR in human after stimulation of central parts of the trigeminal nerve during cerebellopontine angle and brain stem surgery. It was then Schaller who merged the two entities of peripheral and central TCR to a common concept, which is now generally accepted.

In the neurosurgical literature, TCR was defined as the onset of bradycardia below 60 b/m along with hypotension with a drop in MABP of 20% or more due to intra operative manipulation or traction of the trigeminal nerve. The heart rate and the MABP should return spontaneously to normal levels with cessation of manipulation or traction.

4.1. Mechanism of TCR (Fig 1):

Manipulations of the trigeminal nerve at brainstem may induce stimulus (trigger the reflex), which sends neuronal signals to the sensory trigeminal nucleus (below the floor of the fourth ventricle) constituting the afferent pathway of the reflex arc (1). This afferent pathway continues along the short internuclear nerve fibers in the reticular formation to connect with the efferent pathway in the motor nucleus of the vagus nerve (5). From the motor nucleus of the vagus nerve cardio-inhibitory fibers arise as the efferent pathway terminating in the myocardium. Therefore, bradycardia and even asystole as well as different cardiac arrhythmias may occur.

5. CONCLUSION:

Bradycardia in vestibular schwannoma surgery should no longer be considered as a factor for partial tumor resection.

The onset of bradycardia accompanied with a drop in mean arterial pressure at the time of the tumor dissection from the trigeminal nerve at the brain stem defined the trigeminocardiac reflex. The heart rate and the MABP should return spontaneously to normal levels with cessation of manipulation or traction without the necessity of additional anticholinergic medication.

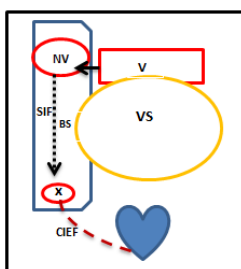


Figure 1: Drawing illustrating the pathway of the TCR.

The TCR occurred during tumor resection (VS) in the CPA, manipulation of the trigeminal nerve (V) at the brainstem (BS) was found to trigger the reflex. The afferent pathway continues to the main sensory nucleus of the trigeminal nerve (V) under the floor of the fourth ventricle. This afferent pathway continues along the short internuclear nerve fibers (SIF) in the reticular formation to connect with the efferent pathway in the motor nucleus of the vagus nerve (X). Depressor fibers of the vagus nerve (cardio-inhibitory efferent fibers CIEF) end in the myocardium leading to autonomic changes.

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