Trigeminal cardiac reflex in post-operative sphenoid orbital meningioma

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ABSTRACT: The trigeminal cardiac reflex (TCR) is a phenomenon that composed of bradycardia, arterial hypotension, apnoea, and gastric hypermobility. It most occur during skull base surgery at or around structures that are innervated by any sensory branch of the trigeminal nerve. We report a 48-year-old female who was diagnosed of having left sphenoid orbital meningioma and performed crano-orbitozygomatic approach to remove the tumor. Six hours post-operative, she had sudden decreased in heart rate 31% decreased from baseline, and also mean arterial blood pressure decreased 35% from base line. Laboratory finding was normal, oxygen saturation was 100% and no hypercarbia occurred. She was suspected to have trigeminal cardiac reflex. Intravenous administration of atropine abolished the reflex, heart rate and MABP slowly increased to normal. Keywords: Sphenoid orbital meningioma, Trigeminal cardiac reflex

1 INTRODUCTION

The trigeminal cardiac reflex (TCR) happened in 10–18% of patients who performed skull base surgery. The TCR leads to an immediate decrease of the mean arterial blood pressure and the heart rate of more than 20% compared to the baseline level with surgical-mechanical, electrical or chemical stimulation of the central part of any sensory branches of the trigeminal nerve and to apnoea and gastric hypermobility coinciding with the surgical manipulation at or around any branch of the trigeminal nerve.

Since 20th century, TCR has earned much clinical attention, oculocardiac reflex (OCR) which is the cardiac response (mainly bradycardia) associated with stimulation of the ophthalmic division of the trigeminal nerve during ocular surgeries. Then, Schaller, for the first time, demonstrated that a similar reflex occurs with stimulation of the intracranial portion of the trigeminal nerve. Since then, much discussion has been performed about the reflex itself and treatment of the TCR when occurs during intracranial or extracranial procedures. But until now, there is no clear provision how to manage TCR.
3 DISCUSSION

The estimate mechanism for the development of the TCR is that the sensory nerve endings of the trigeminal nerve send neuronal signals via the Gasserian ganglion to the sensory nucleus of the trigeminal nerve, forming the afferent pathway of the reflex arc. This afferent pathway continues along the short internuncial nerve fibres in the reticular formation to connect with the efferent pathway in the motor nucleus of the vagus nerve. Several lines of experimental evidence demonstrate that trigeminally induced cardiovascular reflexes could be mediated initially in the trigeminal nucleus caudalis and subsequently in the parabrachial nucleus, the rostral ventrolateral medulla oblongata, the dorsal medullary reticular field, and the paratrigeminal nucleus in animal models.

TCR cases were defined as a drop in MABP and HR, both more than 20% to baseline levels and had to fulfill at least 2 major criteria in plausibility and reversibility and 2 minor criteria in repetition and prevention, as described earlier by Schaller. These points would help in clinical practice to assess whether the observed hemodynamic changes are related to a TCR-phenomenon. In daily clinical practice, not all the criteria must/can be always required to confirm a TCR. But the more of these criteria are present the more confirmed is a TCR.

### Table 1. Major criteria (plausibility and reversibility) and minor criteria (repetition and prevention)

<table>
<thead>
<tr>
<th>Evidence of TCR by Cause-Effect Relationship</th>
<th>Plausibility</th>
<th>Reversibility</th>
<th>Repetition</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The appearance of TCR must be explainable by an adequate stimulation of the trigeminal nerve</td>
<td>Stimulus cessation abolishes the reflex and cardiopulmonary parameters return to baseline</td>
<td>Reapplication of the stimulus on cranial nerve V will result in similar hemodynamic changes</td>
<td>A lighter stimulus of the same type does not result in the same severe TCR</td>
</tr>
<tr>
<td></td>
<td>The TCR appears promptly after the stimulus is applied</td>
<td></td>
<td></td>
<td>Trigeminal nerve block abolishes the TCR</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Application of anticholinergic drugs blocks the occurrence of the reflex</td>
</tr>
</tbody>
</table>

### 3.1 Type of TCR

A central (proximal) TCR is triggered by the stimulation upon the intracranial part of the trigeminal nerve, thus upon the section which is located after the Gasserian ganglion. A peripheral (distal) TCR is therefore triggered by stimulation upon the extra-cranial course of the trigeminal nerve, distal to the Gasserian ganglion. The peripheral TCR is further subdivided based on the branch of the affected trigeminal nerve into the oculo-cardiac reflex (V1) and the maxillo-cardiac reflex (V2–V3). A TCR, triggered at the Gasserian ganglion has, according to the latest studies.

### Table 2. The new classification of TCR

<table>
<thead>
<tr>
<th>The New Classification of TCR</th>
<th>Peripheral</th>
<th>Maxillo-Mandibular</th>
<th>Gasserian Ganglion</th>
<th>Central</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimuli</td>
<td>Oculocardiac</td>
<td>V2 and V3 stimulation</td>
<td>Direct stimulation</td>
<td>Stimulation beyond ganglion</td>
</tr>
<tr>
<td>HR</td>
<td>Bradycardia</td>
<td>Bradycardia</td>
<td>Bradycardia</td>
<td>Bradycardia</td>
</tr>
<tr>
<td>MABP</td>
<td>Hypotension / normotension</td>
<td>Hypotension / normotension</td>
<td>Hypotension</td>
<td>Hypotension / Hypotension</td>
</tr>
<tr>
<td>Respiration</td>
<td>Apnea</td>
<td>Apnea</td>
<td>Apnea</td>
<td>Apnea</td>
</tr>
<tr>
<td>Interventions</td>
<td>Strabismus surgery, intraocular injection, ocular trauma, acute glaucoma</td>
<td>Fracture reduction</td>
<td>Percutaneous ganglion ablation</td>
<td>CP angle, skull base tumors, trans sphenoidal cerebral aneurysm</td>
</tr>
</tbody>
</table>

### 3.2 Risk Factor

As there is a lack of detailed knowledge of the physiology of the TCR, the risk factors gain increased importance. The risk factors already known to increase the incidence of TCR include: (i) hypercapnia; (ii) hypoxemia; (iii) light general anesthesia; (iv) age (more pronounced in children); (v) the nature of the provoking stimulus (stimulus strength and duration); and (vi) drugs. Drugs known to increase the TCR include: (i) potent narcotic agents (sufentanil and al-

Figure 1. Orbital CT, T1, T1 contrast, T1 contrast coronal MRI of patient with sphenoidal meningioma.
fentanyl\textsuperscript{9,10}, (ii) beta-blockers; and (iii) calcium channel blockers\textsuperscript{9,10}.

3.3 Risk of TCR

Risk of TCR may range from mild bradycardia which responds to simple cessation of the stimulus to asystole and severe bradycardia requiring additional intervention with vagolytics\textsuperscript{8,9}. In some rare but serious cases, it may lead to death if not detected early and appropriate measures taken. In addition, hypotension which occurs during the TCR may lead to myocardial and cerebral infarction in those who are at risk for these conditions\textsuperscript{8,9}.

3.4 Management of TCR

The best action in managing TCR is to prevent the risk factor above\textsuperscript{2}. Intravenous anticholinergics, atropine and/or glycopyrrolate IV may be used to treat and prevent a TCR during operation\textsuperscript{11}. Hunsley et al. evaluated the efficacy of IV atropine and glycopyrrolate in preventing the occurrence of the OCR in children operated for strabismus. They tested different doses of the two drugs, glycopyrrolate 5 and 7.5 mg/kg and atropine 10 and 15 mg/kg\textsuperscript{11}. Overall, there is a reduction in the rate of bradycardia to 23.8% to 33.3%. But, they noticed that even higher doses of the two drugs, atropine 15 mg/kg and glycopyrrolate 7.5 mg/kg i.v., given 5 min before induction of anesthesia, are not sufficient to protect completely against the OCR in children\textsuperscript{11}.

4 CONCLUSION

TCR was defined as a drop in MABP and HR, both more than 20% to baseline levels, had to fulfill at least 2 major criteria in plausibility and reversibility and 2 minor criteria in repetition and prevention. The best management is prevent the risk factor and cholinergic agent are best to treat TCR during and post operation.

REFERENCES


