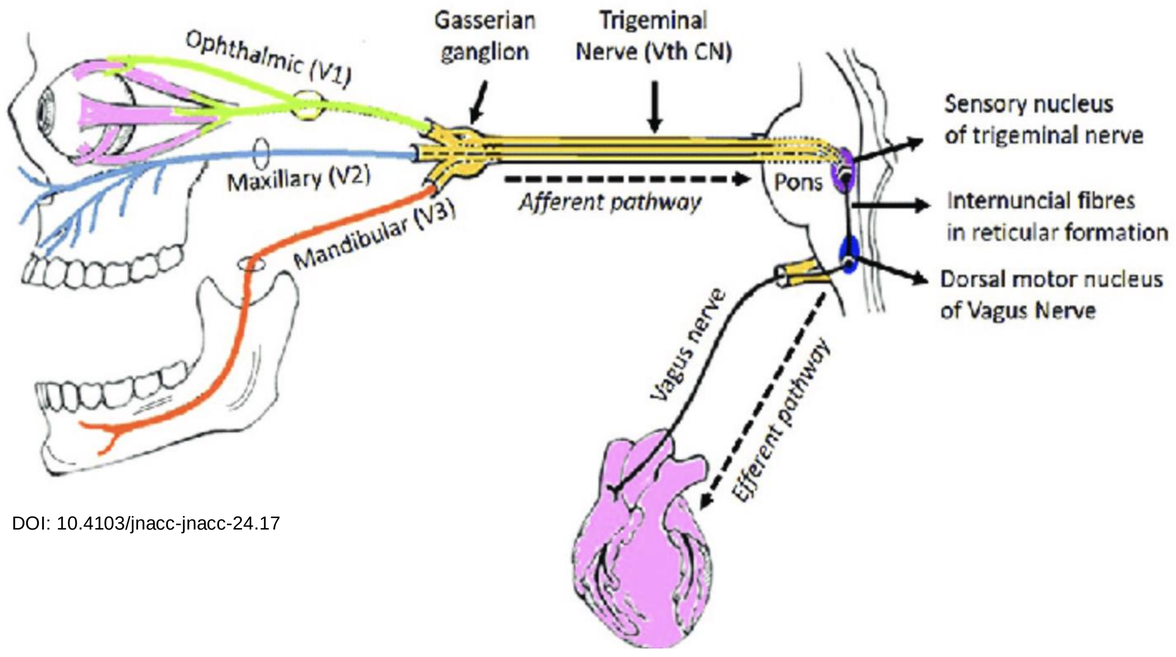
Skull-Base Surgery and the Trigeminocardiac Reflex: A Systematic Review

Mohammadmahdi Sabahi (MD.MPH)[1], Omid Yousefi (MD)[2], Mohammad Mirahmadi Eraghi (MD.HMBA)[3], AmirAli Rastegar Kazerooni (MD.MPH)[2], Sara Mostafavi (MD.MPH)[2] , Badih Adada (MD)[1], Hamid Borghei-Razavi (MD)[1]

1) Department of Neurological Surgery, Pauline Braathen Neurological Center, Cleveland Clinic Florida, Weston, FL, USA. 2) Department of Neurosurgery, Shiraz University of Medical Sciences, Shiraz, Iran. 3) Brain and Spinal Cord Injury Research Center, Neuroscience Institute, Tehran University of Medical Sciences, Tehran, Iran.

Introduction

The trigeminocardiac reflex (TCR) is a significant but often under-recognized phenomenon encountered during skull-base surgery. This systematic review aims to elucidate the incidence, management, and surgical outcomes associated with TCR in skull-base procedures.



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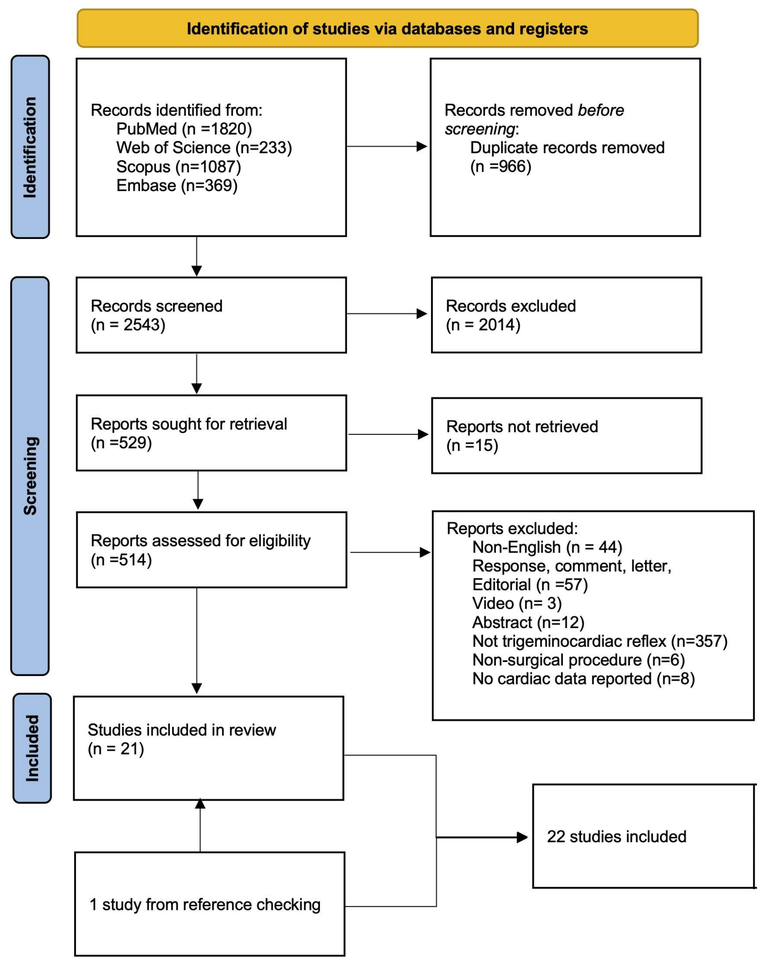
Material and Methods

Following PRISMA guidelines, PubMed, Scopus, Embase, and Web of Science were searched until October 10th, 2024, using specified keywords. Inclusion criteria involved studies describing patients with NFPA or RCC, where headache was the sole surgical indication. Data were extracted, and quality assessed using the Joanna Briggs Institute (JBI) checklist.



Results

Study	Number of Patients (M:F)	Age	Underlying Pathology	Surgical Intervention	Cardiac Event	Changes
Brown et al. 1988	21 (6:15)	62	TN	Percutaneous micro-compression of the trigeminal ganglion	hypotension in 12 procedures, bradycardia in 16 procedures	Mean pre-op HR 76 ± 14 reduced to 55 ± 22 during procedure
Seker et al. 2007	1 (-:1)	53	Pituitary adenoma	transnasal-transseptal tumor resection	sudden asystole	Flatline ECG for 20 seconds
Schaller et al. 2007	6 (4:2)	60	Vestibular schwannomas	Tumor resection through suboccipital/retrosigmoid approach	Hypotension and Bradycardia	Drop in MBP and HR more than 20% compared with the baseline
Jafar et al. 2008	1 (1:-)	50	Non-functioning pituitary macroadenoma	Two Step surgery: -transsphenoidal, pterional craniotomy	bradycardia, asystole and hypotension	Patient had HR of 29 and BP of 44/17 on TCR onset
Acioly et al, 2010	4 (2:2)	40.5	Non-vestibular schwannoma	two patients pre- and retrosigmoid approach; Retrosigmoid approach with a suprameatal extension patient a retro- sigmoid and far lateral retrocondylar approach	Hypotension	A decrease in the MABP of 20% or more associated with bradycardia lower than 60 beats per minute
Nöthen et al. 2010	19 (12:7)	51	Pituitary adenoma	Trans-sphenoidal 6 (31.6%), transcranial 1 (5.3%)	Hypotension	A decrease in the MABP of 20% or more associated with bradycardia lower than 60 beats per minute
Goyal et al. 2012	2 (2:0)	32.5	Acoustic neuroma - dermoid cyst	Case1: retromastoid suboccipital craniotomy Case2: midline suboccipital craniotomy	Case 1: Bradycardia and asystole Case 2: bradycardia	Case 1: transient bradycardia resolved spontaneously, recurred bradycardia proceeded to asystole, Fifteen minutes
Spiriev et al. 2012	1 (1:-)	18 months	Temporoparietal meningioma	Tumor resection through temporoparietal Entry	Two sessions of hypotension and HR change	First TCR: MBP drop from 67 to 30 and HR drop to 110 Second TCR: MBP drop from 67 to 43 and HR rises to 170
Takano et al. 2014	1 (1:-)	38	Metastatic lesion in right parietal lobe	Tumor detachment from falx and resection	Sudden bradycardia/asystole	Cardiac asystole during tumor detachment from falx cerebri, spontaneously resolved. Repeated asystole upon cessation of falcine manipulation.
Khatibi et al. 2016	1 (1:-)	16	Large cerebellar AVM	Endovascular Onyx embolization	Bradycardic and proceeded to asystole	Resuscitation was done due to asystole
Nicholson et al. 2016	1 (1:-)	59	Dural arteriovenous fistula involving the transverse sinus and torcula	Endovascular Onyx embolization	Sudden asystole	Asystole occurred in the first step of Onyx injection of 3 steps
Wu et al. 2018	23 (4:19)	50.12	Trigeminal Neuralgia	Microvascular decompression	hypotension and bradycardia	MBP and HR drop at least 20% with baseline of 97.2 and 68, retrospectively
Kim et al.2019	1 (-:1)	74	Temporomandibular joint dislocation	Open reduction for temporomandibular joint dislocation	Bradycardia	HR drop to 15 beats/min for 30 seconds
Yazama et al.2020	1 (-:1)	75	Chordoma-like tumor in brainstem	Tumor resection through infratemporal fossa and anterior Petrosal approaches	Sudden asystole	Severe bradycardia and asystole for 10 seconds
Liu et al. 2020	70 (26:44)	60.6	Trigeminal Neuralgia	Microvascular decompression	Rise in MBP in 59 cases	Mean rise of 38.8 in BP
Hammad et al. 2020	3		Cluster headache	Sphenopalatine ganglion implant placement	Cases 1: hypotension and bradycardia Case 2: 2 episodes of bradycardia Cases3: bradycardia	Case 1: HR of 45 and BP of 88/51 Case 2:HR drop to 38 and later 34 Case 3:HR drop to 41
Recinos et al. 2021	1 (-:1)	63	Parafalcine meningioma	Tumor detachment from falx and resection (two step surgery in a six-year span)	ST elevation/ Bradycardia	First surgery: sustained ST elevations before dural opening second surgery (6 years later): profound bradycardia and asystole occurred again
Wang et al. 2021	2 (2:0)	51.5	Pituitary adenoma	Endoscopic transsphenoidal tumor resection	Bradycardia, hypotension and asystole	Case 1: asystole and MBP drop, Case 2: irregular rythm,31 beats/min
Sun et al. 2021	2 (2:0)	56.5	AVF	Endovascular Onyx embolization	Bradycardia and BP change	Case 1: drop from 113/59 mmHg to 96/49 mmHg and decreased quickly from 61 bmp/min to 43 bmp/min, Case 2: increased blood pressure from 122/73 mmHg to 155/84 mmHg and 68 bmp/min to 46 bmp
Yamada et al. 2021	1 (1:0)	51	Aneurysmal subarachnoid hemorrhage	Aneurysm clipping through Right frontotemporal (pterional) craniotomy	Bradycardia, asystole	Asystole during opening dura and during dura manipulation
Zhang et al.2022	14 (NR)	63.1	Trigeminal neuralgia	Percutaneous balloon compression	Bradycardia in 14 cases	Moderate and severe bradycardia
Gupta et al. 2024	74 (25:49)	65	Trigeminal neuralgia	Microvascular decompression	Hypotension and hypertension	2 cases of hypotension and 72 cases of hypertension

Conclusion

The trigeminocardiac reflex presents a significant intraoperative challenge in skull-base surgery. Understanding its pathophysiology, incidence, and management strategies is crucial for improving surgical outcomes. This systematic review highlights the need for increased awareness and better preventive measures to mitigate the risks associated with TCR in skull-base procedures.

Contact

Mohammadmahdi Sabahi, MD.MPH

Postdoctoral Research Fellow

Department of Neurological Surgery, Cleveland Clinic Florida

2950 Cleveland Clinic Blvd., Weston, FL, 33331

Cell: (412) 239 3665

Email: sabahim2@ccf.org

References