Access to Deep Brain Stem Lesions Through Safe Entry Zones; A Critical Review of the Literature

Salman Abbasifard MD; Negeen Farida BA; Sajid S. Suriya MD; syed quadri; Mona Rezaei MD; Ketan Verma MD; Martin M. Mortazavi MD

California Institute of Neuroscience

Introduction

Deep intra-axial brainstem lesions had long been considered unresectable due to high risk of morbidity and mortality. During the recent decades, the combination of research enabling better understanding of the micro-anatomy of the brain stem, development of modern neuro-monitoring techniques, and further development of micro-neurosurgical techniques have allowed safe and effective resection of these lesions with low mortality and acceptable morbidity rates. The objective of this study is to review all articles related to surgical resection of deep brain stem lesions through safe entry zones.

Methods

A systematic review of the English literature of the Medline database between 1971 and 2016 was performed with key words including: Brainstem surgical approaches, safe entry zone, and surgical. Each manuscript's reference list relevant to the objective of this study was also reviewed.

Results

This review produced a total of 929 published articles. Twenty-five articles were relevant to the inclusion criteries and underwent full review. Thirteen safe entry zones have been reported for entrance in to different parts of the brainstem. Three zones provided access to the midbrain: Anterior mesencephalic zone, lateral mesencephalic sulcus, and the inter-collicular region. Six zones provided access to the pons: Peri-trigeminal zone, Supra-trigeminal zone, Lateral pontine zone, Supra-collicular zone, Infra-collicular zone, and the median sulcus of the fourth ventricle. Four zones provided access to Medulla Oblongata: anterolateral sulcus, posteromedian sulcus, olivary zone, and the lateral medullary zone.

Conclusions

With a combination of good understanding of the topographical anatomy of the brain stem, intra-operative mapping, CSF-diversion, and modern retractor-less neurosurgical techniques, previously unresectable lesions can now be resected with reasonable morbidity.

Learning Objectives

- Understanding the anatomy of the brainstem
- Identification of safe entry zones for entrance into the brainstem
- Retractorless brain surgery

References

1- Cavalheiro S, Yagmurlu K, da Costa MD, Nicácio JM, Rodrigues TP, Chaddad-Neto F, Rhoton AL. Surgical approaches for brainstem tumors in pediatric patients.Childs Nerv Syst. 2015 Oct;31(10):1815-40. doi: 10.1007/s00381-015-2799-y. Epub 2015 Sep 9.

2- Cavalcanti DD, Preul MC, Kalani MY, Spetzler RF. Microsurgical anatomy of safe entry zones to the brainstem. J Neurosurg. 2015 Oct 9:1-18.

3- Yagmurlu K, Rhoton AL Jr, Tanriover N, Bennett JA. Three-dimensional microsurgical anatomy and the safe entry zones of the brainstem. Neurosurgery. 2014 Dec;10 Suppl 4:602-19; discussion 619-20. doi: 10.1227/NEU.0000000000000466.

11-Lassiter KR, Alexander E Jr, Davis CH Jr, Kelly DL Jr: Surgical treatment of brain stem gliomas. J Neurosurg 34:719–725, 1971

4-Mussi AC, Rhoton AL Jr: Telovelar approach to the fourth ventricle: microsurgical anatomy. J Neurosurg 92:812–823,2000

5-Ramina R, Mattei TA, de Aguiar PH, Meneses MS, Ferraz VR, Aires R, et al: Surgical management of brainstem cavernous malformations. Neurol Sci 32:1013–1028, 2011

de Oliveira JG, Lekovic GP, Safavi-Abbasi S, Reis CV, Hanel RA, Porter RW, et al: Supracerebellar infratentorial approach to cavernous malformations of the brainstem: surgical variants and clinical experience with 45 patients. Neurosurgery 66:389–399, 2010