ral approach allows exposure of the lateral upper pons as well as the pontomesencephalic junction. However, the trigeminal nerve entry zone is actually the major landmark in approaching most of the anterolateral pontine lesions. Thus, approaches that aim toward the emergence of CN V represent the main routes to managing pontine lesions.

Despite the complexity of dissection and drilling work, the anterior petrosectomy offers the best direct anterior view of the peritrigeminal zone. The retrolabyrinthine approach is also time consuming and provides a limited posterolateral view of the CN V entry zone. However, the retrosigmoid approach is the workhorse for managing anterior and lateral pontine and high-riding medullary lesions, while providing a more posterolateral exposure of the pons and the middle cerebellar peduncle than other approaches (Fig. 13). Additionally, its widespread use in managing vestibular schwannomas and neurovascular conflicts provides experience for those who employ it to attack pontine lesions directly or through the peritrigeminal, supratrigeminal, and lateral pontine safe zones.

Dorsal pontine lesions abutting or close to the rhomboid fossa can be reached through a suboccipital telovelar approach. The depth of the rhomboid fossa is rich in nuclei and tracts, which limits free manipulation. The facial colliculus is the major landmark and guides the surgeon to the supracollicular and infracollicular safe zones when the lesion does not reach the surface. Lastly, cranial lesions can be resected through the median sulcus.

Medullary Lesions

The far-lateral approach is chosen to manage anterolateral lesions within the medulla. Cranial lesions not abutting the pial surface are reached through the olivary safe zone. Otherwise, caudal lesions are approached through the anterolateral sulcus between the emergence of the hypoglossal and C-1 spinal nerve rootlets.

Lateral lesions close to the pontomedullary junction require mainly a retrosigmoid approach. This craniotomy can also be employed to manage some lateral caudal lesions if the long axis of the lesion is amenable to the oblique angle of view provided by the retrosigmoid approach (Fig. 13).4 Deeper dorsolateral lesions can be managed by tailoring an incision over the lateral medullary zone. Finally, posterior lesions can be directly accessed via a median suboccipital approach. The neurosurgeon should avoid any manipulation on the calamus scriptorius, an extremely eloquent region, populated by the nuclei of the lower cranial nerves. A posterior midline medullary incision below the obex is advised instead.

A Note of Caution

Brainstem lesions represent some of the most challenging entities faced by neurosurgeons. In this article, we have summarized the approaches and safe entry zones into the brainstem. However, no region in the brainstem is truly “safe” for entry. The zones presented in this paper represent the regions through which lesions can be accessed with the least morbidity. As clinical experience from our group has demonstrated, surgery in the brainstem is associated with a high rate of temporary, but real, deficits.1 Practitioners with limited experience operating in the posterior fossa and the brainstem should consider referring these patients to high-volume centers with the requisite experience.

Conclusions

Progress in medical technology combined with the experience and dissemination of knowledge regarding microsurgery and brainstem pathology changed the paradigm that the brainstem represented a “no man’s land” for neurosurgeons.

Our revisit of the main safe entry zones provided by each major surgical approach to the brainstem, which includes detailed dissection images and shows areas of exposure, may allow better planning to approach lesions of the brainstem and may help disseminate the techniques for successful resection of intrinsic brainstem lesions.

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References


FIG. 13. Illustration of a retrosigmoid craniotomy and microsurgical resection of an intrinsic lesion in the posterolateral medulla. The flocculus and choroid plexus protruding through the foramen of Luschka are mobilized, and the lateral medullary zone is entered to gain access to the lesion. Reproduced with permission from Barrow Neurological Institute, Phoenix, Arizona. First published in Deshmukh et al: 723–9, 2014.


Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Cavalcanti. Acquisition of data: Cavalcanti. Analysis and interpretation of data: Cavalcanti. Drafting the article: Cavalcanti, Kalani. Critically revising the article: Peul, Kalani, Spetzler. Reviewed submitted version of manuscript: Peul, Kalani, Spetzler. Administrative/technical/material support: Peul. Study supervision: Peul, Spetzler.

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