Adventitial Adversity: Histopathology of the Distal Dural Ring

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Background

The distal dural ring (DDR) is a conserved intracranial anatomic structure making the boundary point at which the internal carotid artery (ICA) exits the cavernous sinus (CS) and enters the subarachnoid space. Although the CS has been well described in a range of anatomic studies, to our knowledge no prior study has analyzed the histologic relationship between the ICA and DDR. Our objective was to assess the relationship of the DDR to the ICA and determine whether the DDR can be dissected from the ICA and thus divided, or can only be circumferentially trimmed around the artery.

Methods

The authors examined ten fresh-frozen, adult cadaveric specimens. A standard frontotemporal craniotomy, orbito-optic osteotomy and extradural anterior clinoidectomy was performed, bilaterally. The cavernous ICA, DDR and supracranial ICA were harvested as an en bloc specimen. Specimens were fixed in formalin and analyzed via standard histologic staining techniques, including hematoxylin and eosin, and Masson trichrome.

Results

In all ten specimens, extensive microscopic investment by the DDR of the underlying ICA adventitia was observed, and a clear plane could not be defined between them. Low power (20X) H&E and Masson trichrome histopathology of the ICA in longitudinal section at the level of the DDR shows the gross insertion point of dural collagen (arrowheads), tangent to the arterial wall (Figure 1A). Higher magnification (40X) demonstrates the convergence of collagen fiber from both the dural and adventitial layers (Figure 1B). Under highest magnification (100X), the inner arterial layers of intima and muscularis are visualized with a clear boundary between the muscularis and adventitia (arrows); by contrast, the adventitial later is fully invested by dural collagen, and there is no evidence of a clear plane separating adventitia from dura (Figure 1C).

Conclusion

Histologic analysis suggests that the ICA and DDR are highly interrelated, continuous structures, and therefore attempted intraoperative dissection between these structures may carry an elevated risk of injury to the ICA. We correspondingly recommend circumferential trimming of the DDR in lieu of direct dissection in cases requiring mobilization of the clinoideal ICA.

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References

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