Clinical, Radiologic, and Pathological Implications of the Dural Tail Sign in Intracranial Meningiomas: A Systemic Review

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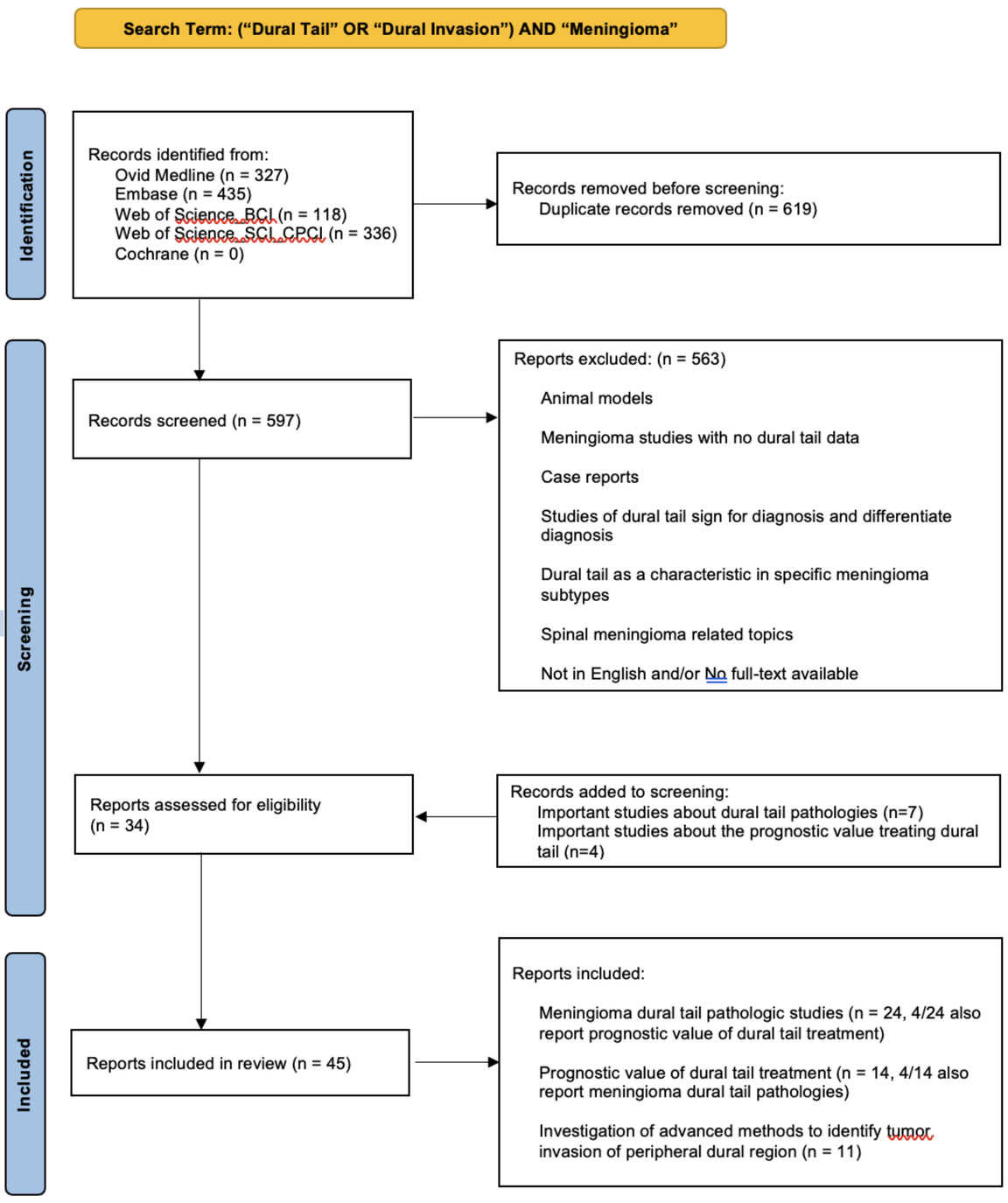
Introduction

The dural tail sign on post-contrast MRI is characteristic of intracranial meningioma. However, there is debate whether the dural tail represents tumor, connective tissue proliferation, or adjacent vascularity. The purpose of this study was to evaluate the agreement between radiologic and pathologic findings of the dural tail, as well as outcomes associated with its treatment.

Methods and Materials

Articles containing "((Dural Tail) OR (Dural Invasion)) AND (Meningioma)" 1957 to 2023 were included. Abstracts were manually reviewed to exclude studies that did not examine dural tail invasion in intracranial meningioma in human patients.



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

Figure 1. Flow Diagram

Results

Among 597 articles, 45 were included, representing 2102 patients with 2159 tumors and 931 dura samples. 816 (74.2%) tumors were radiologically positive for dural tail sign (MRI+). The pathologies of 352 radiologic dural tail samples included: tumor cells (254, 72.2%), vascular changes (79, 22.4%), connective tissue proliferation (23, 6.5%) and inflammation (12, 3.4%). 59 specimens of non-enhancing dura were sampled 1-3 cm away from the tumor edge and were positive for tumor cells in 19 (32.2%) cases. Overall, the sensitivity of the MRI dural tail sign to detect tumor cells is 93.0% with a specificity is 29.0%. PPV of the MRI dural tail sign for tumor cells is 72.2% and the NPV is 67.8%. Five molecular studies revealed dural tails demonstrated higher expression of Gab1 rs1397529A>C SNPs, VEGF and CD34, MMP-1, and AQP-1, respectively. In 609 WHO grade I tumors treated with radiosurgery, 245 (40.2%) had a dural tail sign, with 159 (26.1%) were covered in the treatment field. Tumor control rates were not significantly different after radiosurgery (95-96.5% in covered vs 77.9-97.8% in not covered, p=0.105-1.00). Eleven studies investigated 5-ALA, DESI-MSI, SF, ICG, 3D MRI to identify tumor cells within the dura. However, histopathological correlation and longitudinal survival data are lacking.

Conclusions

The dural tail sign is prevalent in 74.2% of intracranial meningiomas and represents tumor cell infiltration in 72.2% of the tumors. Non-neoplastic dural tail represents vascular changes and less frequently, connective tissue proliferation and inflammation. In adjacent dura in non-dural tail regions, tumor cells were observed in approximately half of specimens. Dural tail radiosurgical treatment is not associated with improved tumor control in WHO-I meningiomas. Newer radiologic imaging and intraoperative surgical visualization adjuncts are under investigation to identify the presence of tumor cells in the surrounding dura more precisely.

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