Does tumor size, peritumoral edema, location and necrosis can be used to predict grading of meningioma?

Abstract

Background: Meningioma based on WHO classification divided into grade I (typical or benign, 88–94%), grade II (atypical, 5–7%) and grade III (anaplastic or malignant, 1–2%). Treatment of meningioma is tailored to their histological grade.

Objective: The purpose of this study was to examine whether imaging features included tumor size, peritumoral edema, location and necrosis on conventional MRI could be used to predict grading of meningioma.

Method: We performed a retrospective review of 20 patients which histopathologically confirmed after surgical resection, who were imaged with MRI at our institution from 2016 until 2019. Image features of each sample include tumor size, peritumoral edema, location and necrosis was analysed and correlate with WHO histopathological grading.

Result: In our study from 20 patients, age range from 21 to 67 years old, 16 female, 4 male, 16 classified as WHO grade I, 3 grade II, and 1 grade III, with histopathology mostly transitional type. Tumor volume ranges from 17-252.4cm³ in grade I, 28.5-143cm³ in grade II & 190cm³ in grade III, necrosis present in 44% of grade I, 33% of grade II and 100% of grade III. Based on location from 16 cases of grade I, mostly in convexity, 2 out of 3 grades II in skull base and 1 case of grade III in convexity. In WHO grade I, 44% have severe edema and conversely case of grade III have mild edema.

Conclusion: Imaging features of tumor size, peritumoral edema, location and necrosis broadly varied in each grade of meningioma, Advanced MRI such as DTI should be study to found more promising predictor.

Keywords: meningioma, tumor, peritumoral edema, necrosis

Introduction

Background

Meningioma based on The World Health Organization (WHO) classification divided into WHO grade I, which are typical or benign (88–94%), WHO grade II, which are atypical (5–7%) and WHO grade III, which are anaplastic or malignant (1–2%). WHO II/III tumors are far more likely to recur than benign meningioma, even when resected completely, and often require adjuvant radiation. Patients with radiographically detected meningioma are either observed or undergo surgical resection. Surgical treatment is usually recommended for patients with neurologic symptoms, large tumors, and/or associated cerebral edema. However, patients with more aggressive WHO II/III meningiomas could benefit from early resection even in the absence of these clinical and radiographic features. It is quite simple to diagnose meningioma with characteristic imaging findings in conventional MRI. However, the ability of conventional MRI to differentiate low-grade from high-grade meningioma remains uncertain. Some studies have reported that conventional MRI findings are not specific and reliable in identifying meningioma grade. Previous studies have not found a single specific criterion predictive of atypical meningioma, despite an impressive battery of studies examining clinical presentation, imaging results, and immunohistochemical studies. Thus, a non-invasive diagnostic method that can differentiate between low and high-grade meningioma is required.

Objective

The purpose of this study was to examine whether imaging features included tumor size, peritumoral edema, location and necrosis on conventional MRI really could be used to predict grading of meningioma.

Method

Patients

We performed a retrospective review of 20 patients which histopathologically confirmed after surgical resection, who where...
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Image features analysed based on meningioma grading

<table>
<thead>
<tr>
<th>Imaging features</th>
<th>Meningioma</th>
<th>WHO grade I</th>
<th>WHO grade II</th>
<th>WHO grade III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumor size</td>
<td></td>
<td>17-252.4cm³</td>
<td>28.5-143cm³</td>
<td>190cm³</td>
</tr>
<tr>
<td>Peritumoral Edema</td>
<td>44% severe edema</td>
<td>mild to severe edema</td>
<td>mild edema</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>mostly in convexity</td>
<td>2 out of 3 in skull base</td>
<td>convexity</td>
<td></td>
</tr>
<tr>
<td>Necrosis</td>
<td>44%</td>
<td>33%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

In our study, we found that tumor volume as suggested by Hale et al. as the strongest predictor of atypical meningioma, didn’t always correlate with meningioma grade. In our samples, there were 6 (37.5%) meningioma WHO grade I with tumor volume more than 50 cm³, with the biggest volume 252.4 cm³ (Figure 1) and 1 (33%) of atypical meningioma (WHO grade II) with tumor size 28.5 cm³. Hale also suggested that peritumoral edema as a predictor of higher grade meningioma. In our study, we found 1 case of anaplastic meningioma (WHO grade III) with mild edema and conversely, 44% of meningioma WHO grade I with severe edema (Figure 2). In this study, we also found that tumor along the falx and convexity were more often atypical than in skull base or posterior fossa. In this study, samples of meningioma WHO grade I mostly (37.5%) located in convexity, 25% in falx and in atypical meningioma WHO grade II turned out 67% located in skull base (Figure 3). That study also found that tumor necrosis was associated with an increased risk for atypical meningioma. In this study, we found 67% of atypical meningioma WHO grade II without tumor necrosis and 44% of typical meningioma WHO grade I with tumor necrosis (Figure 4). 1 case of anaplastic meningioma (WHO grade III) in our study had large tumor volume (>50 cm³), located in convexity and with tumor necrosis although there was one predictor that didn’t suit which in this case had mild peritumoral edema (Figure 5).

Table 1
Does tumor size, peritumoral edema, location and necrosis can be used to predict grading of meningioma?

Figure 1 Female, 44 y.o with meningioma fibroblastic type, WHO Grade I; tumor volume was 252.4 cm³.

Figure 2 Female, 45 y.o with meningioma at right occipital convexity, tumor vol 26.2 cm³ surround with severe edema turned out as fibroblastic and microcystic type, WHO grade I.

Figure 3 (A) Meningioma at parasagital falx cerebri, fibroblastic type, WHO grade I. (B) Meningioma at left falx cerebri, microcystic type, WHO Grade I. (C) Meningioma at right temporal convexity, turned out to be microcystic type, WHO Grade I.

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Figure 4 Left image: Female 46 y.o with meningioma, transitional type, WHO Grade I with tumor necrosis; Right image: Male 67 y.o with atypical meningioma, WHO grade II, without tumor necrosis.

Figure 5 Male, 21 y.o, tumor vol 190.2 cm$^3$ with mild peritumoral edema, located at left frontoparietal convexity, tumor necrosis (+), turned out to be meningioma anaplastic type, WHO grade III.

Conclusion

i. Imaging features of tumor size, peritumoral edema, location and necrosis broadly varied in each grade of meningioma

ii. Advanced MRI such as DTI should be study to found more promising predictor.

Acknowledgements

None.

Funding

None.

Conflicts of interest

Author declares that there are no conflicts of interest.

References


