

RESEARCH ARTICLE

Magnetic Resonance Image Manifestations of the Atypical Meningioma

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Abstract

Through retrospective analysis of 13 cases of magnetic resonance image (MRI) manifestations of atypical meningiomas confirmed by operation and pathology in the First Affiliated Hospital of Xinxiang Medical University, the objective of this study was to evaluate the diagnostic value of MRI in order to improve the accuracy rate of preoperative diagnosis. In this retrospective analysis of MRI findings for atypical meningiomas in First Affiliated Hospital of Xinxiang Medical University from January to July in 2012, the location, morphology and tumor signals and other tumor imaging characteristics were covered. In 13 cases of atypical meningioma patients of this group, most tumors were located at typical sites (10/13), mainly the falx cerebri, parasagittal, convexity, saddle area. Only two cases were at atypical locations, 1 in the cerebellar hemisphere and 1 in a lateral ventricle. Most of the tumors showed T1 and T2 isointensity signals, and necrosis, calcification, and peritumoral edema were always featured. DWI showed isointensity in 11 cases (11/13), and hyperintensity in 2. Some 9 cases had dural tail signs, 12 had accurate positioning (12/13), and 2 were postoperative recurrences. MRI has high value in the diagnosis of atypical meningiomas, with important roles in early clinical diagnosis, treatment and prognosis evaluation.

Keywords: Atypical meningioma - magnetic resonance imaging - pathology - clinical features

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Introduction

Meningiomas are the most common intracranial tumors, accounting for about 15%-20% intracranial tumors (Zhang et al., 2012). Atypical meningioma (AM) is a kind of anaplastic tumor between the benign meningioma (BM) and malignant meningioma (MM), its biological behavior is bad, and has aggressive invasion, easy postoperative recurrence, and bad prognosis. Therefore, the correct preoperative qualitative diagnosis plays an essential role on making operation scheme and treatment plan. The AM imaging features are various symptoms, WHO classifies it into grade II (Kleihuse et al., 2002). This study collected 13 cases atypical meningioma confirmed by pathology, and underwent analysis and summary of their MRI performance, so as to improve the diagnostic level of atypical meningioma.

Materials and Methods

Subject

13 cases atypical meningioma confirmed by operation and pathology in the First Affiliated Hospital of Xinxiang Medical University were included, 5 cases were males, and 8 cases were females, aging 28-59 years old. This

study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Xinxiang Medical University. Written informed consent was obtained from all participants.

Clinical symptoms

The clinical first syndrom mainly is headache, which is always complicated by blurred vision, epilepsy, seizures, movement disorders, loss of consciousness and other nonspecific findings, and is lack of apparent early specific clinical manifestations. The clinical syndroms are always different.

Check methods

The America GE Sigma 3 T MRI scanner was adopted with 8 channel head array coil. Before the examination, it was confirmed that patients should not wear metal foreign body. The MRI routine scan, diffusion-weighted imaging (DWI) and enhanced scan were used, with T1WI (TR 2000 ms, TE 20 ms, TI 750 ms), T2WI (TR 3000 ms, TE 80 ms, TI 2200 MS), layer thickness 5 mm, layer spacing 1 mm, vision 24 cm×24 cm, matrix 256 cm×256 cm. MRI DWI adopted axial imaging (TR 7000 MS, TE 80 ms, 5 mm layer thickness, layer spacing of 1 mm, 24 cm×24

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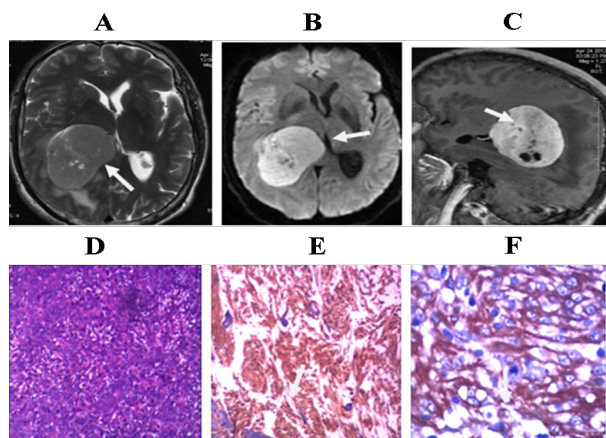


Figure 1. Patient WAS MALE, 55 years old, the Right Lateral Ventricle Atypical Meningioma, Lesion Size Was about 60 mm×50 mm×58 mm. (A) T2WI showed, in the lesion, small necrotic cyst areas were long T2 signal, with the edema zone surrounding brain tissue, and the right lateral ventricle was pressed and narrowed; (B) DWI showed that the lesions were mainly hyperintensity signal, and a little hypointensity signal; (C) T1 T1-weighted images showed the enhanced necrosis in the lesion; (D) Cell density was increased, with increased ratio of nucleus to cytoplasm in HE (10×10); (E) Tumor cells were diffusely positive for EMA (10×10); (F) Tumor cells were diffusely positive for EMA (10×40)

cm vision, matrix of 128 cm×128 cm, diffusion sensitive coefficient b value was 1000 s/mm²). Enhanced scanning used ulnar vein intravenous contrast agent gadopentetate dimeglumine (Gd-DTPA; 0.1 mmol/kg; Bayer Schering Pharma AG, Berlin, Germany).

Image analysis

The image were independent red by 2 experienced senior radiologists, and the main points of diagnosis were tumor location, size, shape, boundary, signal change, enhancement and relationship with the surrounding tissue. The edema was classified according to the slightly longer T2 signal range surrounding the lesions on the T2WI, grade 0: no edema or only a ring around the halo, grade I: the edema spreads along the white fiber, grade 2: the edema involving the entire hemisphere of the brain (Mattei et al., 2005; Veillon et al., 2008).

Pathological analysis

Pathological specimens were observed by light microscope and immunohistochemical analysis.

Results

Lesion location

The lesion mostly occurred in the cerebral falx, sagittal sinus, and cerebral convexity (6/13), 3 cases were in the sellar region (Figure 2), 2 cases were in olfactory sulcus, 1 case occurred in the lateral ventricles (Figure 1), and 1 case was in cerebellar hemisphere. The MRI positioning accuracy was 92.3% (12/13).

Lesion size, shape, and edge

The size of the lesions was 2.4-8.9 cm, the smallest was on top of cranial plate, the maximum was in the frontal

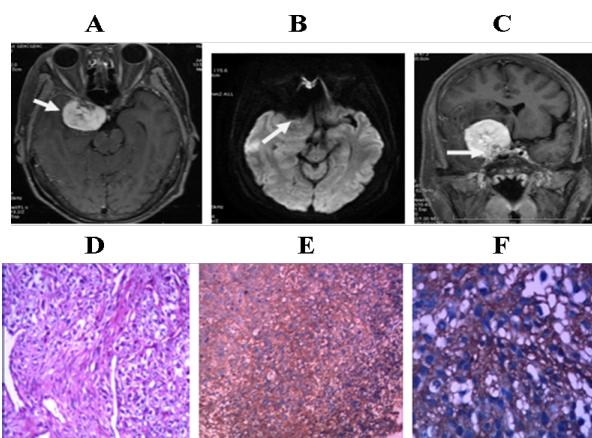


Figure 2. Patient WAS FEMALE, 56 YEARS OLD, RIGHT SPHENOID RIDGE ATYPICAL MENINGIOMA, LESION SIZE WAS about 43 mm×35 mm×40 mm. (A) axial T1-weighted image, lesions were smooth contour and less homogeneous enhancement, and suprasellar cistern was compressed and deformed; (B) DWI showed lesions mainly being hypointensity signal, and a little hypointensity signal shadow; (C) The coronal T1-weighted images showed that the mass connected with dura, and was less homogeneous enhancement; (D) Cell density was slightly increased, with majority of mitosis in HE (10×10); (E) Tumor cells were diffusely positive for EMA (10×10); (F) Tumor cells were diffusely positive for EMA (10×40)

convexity, with 2 cases of grade 0, 8 cases of grade I, and 3 cases of grade II. Part of the lesion with clear boundary showed expansive growth, especially early lesions with benign tumor morphology, visible hemorrhage, necrosis, cystic change and mucinous degeneration. There was 1 case of general diagnosis in this group. Scan showed heterogeneous signal on the fast spin echo (FSE), T1WI, and mixed high signal on FSE T2WI. In this group, there was no obvious enhancement in 1 case. There were 8 cases of homogeneous significant consecutive enhancement at cortex part in 13 enhanced scan cases. DWI showed hyperintensity signal in the majority, but also some showed hypointensity signal.

Discussion

Atypical meningioma radiological manifestations are diverse (Sriram, 2013), which can grow in different part of the brain, when tumor size is small or location is not sensitive, patients may have no symptoms or mild symptoms, such as chronic headache, and when the tumor grew in the brain or sensitive parts, it may show nerve oppression symptoms, such as partial numbness, weakness, seizures, hyposmia, decreased visual acuity, facial numbness or spasm, unilateral hearing loss, psychiatric symptom, and can appear intracranial hypertension symptoms such as headache, vomiting, retinal edema in serious cases (Zaher et al., 2013). Therefore, it is beneficial to the diagnosis and clinical treatment that warning about above clinical symptoms and summarizing atypical meningioma images to provide more reference for specialists and image doctor (Chiu, 2013).

In 2000 WHO new meningioma classification, AM was defined as WHO II (Sameh and Mostafa, 2011). The optical

microscope shows cells diffusion growth, cells abundance, increased density, deep nuclear dying, with focal necrosis, and mitotic count $\geq 4/10$ HP. Immunohistochemistry shows that EMA, Ki67, vimentin is positive, and GFAP is negative, so it could be distinguished from glioma (Veillon et al., 2008). Studies shows that the pathological hallmark of WHO on atypical meningioma is clear, and some difficulties still exist for the diagnosis of the benign and malignant tumor, so the up-to-date studied osteopontin (OPN) and cortactin expression in tumors, is an important sign of evaluating and distinguishing benign, atypical, malignant meningiomas, and also have important value on its recurrence (Lin et al., 2012).

With the application of high field intensity MRI and multiple sequence multiple plane imaging technology, the MRI can reflect the relationship between tumor and surrounding tissues from multiple perspectives, and it can better reflect the variation of its internal tissue and more accurate positioning than CT (Hakyemez et al., 2007). The localization accuracy was 92.3% (12/13). Most of 13 cases atypical meningioma in this group occurred in the typical parts (11/13) mainly the falx cerebri, parasagittal, convexity, and sellar region, 2 cases occurred in atypical location, 1 case in the lateral ventricles, and 1 case in cerebellar hemisphere.

Diverse atypical meningioma MRI manifestation: 1) Signal are not heterogeneous, and it is visible of cystic degeneration and necrosis in tumor, in this group, 8 cases of tumor show as oval heterogeneous signal lesion, which are consistent with most of the research results (Tomura et al., 2004; Matsushima et al., 2007). It is generally believed that AM usually have no calcification, which may be associated with the rapid growth (Alvarez et al., 1987), but also there are calcification reports of AM (Alvarez et al., 1987; Tomura et al., 2004). 2) Tumor boundary is irregular, and lobules are visible, suggesting the presence of certain malignant degree, in this group, 5 cases of tumor show irregular margin and lobules. 3) Peritumoral edema is common, 13 cases of this group have peritumoral edema, and studies have shown that the peritumoral edema was proportional to some extent with the malignant degree of the tumor (Lakshmi and Glastonbury, 2009), but also some researches run counter to it (Smith et al., 1981; Pharham et al., 1994), as the sample size of our study is limited, therefore, the relationship between the peritumoral edema and latent malignant degree need to be further discussed. 4) Tumor diffusion is restricted, a large number of studies show that, DWI as the only noninvasive method of response in vivo tissue in vivo diffusion (Hsu et al., 2010), makes the application and study of MRI more and more widely in various parts of the body, DWI shows high signal in a certain degree of atypical meningioma or malignant meningiomas (Filippi et al., 2001), but there is a clear link between the DWI signal level and cell density, so the exact relation between the two has not been systemic reported, which will be subject to further study and summary. 5) There are often bone structure changes around the tumor, showing invasive damage (Filippi et al., 2001).

Differential diagnosis of atypical meningioma is difficult, mainly because the diversity of the site, as well as the borderline of imaging features increase the

difficulty for the preoperative diagnosis (Kane et al., 2011). First of all, due to the characteristics of borderline lesion of atypical meningioma, lobules boundary in morphology, heterogeneity signal, cystic degeneration and the indirect signs of destruction of the around bone structure all suggest its developing characteristics (Kim et al., 2009). Predilection sites of atypical meningioma are cerebral falx, parasagittal, convexity of brain and so on (Mogi et al., 2012), which should be differentiated with glioma, lateral ventricle atypical meningioma should be differentiated with ependymoma, choroid plexus papilloma, and lymphoma, we found that the lateral ventricle atypical meningioma always might have leaflike lobules, especially the occurrence of irregular lobules, tumor cystic degeneration, and necrosis (Figure 1), sellar region meningiomas should be differentiated with cavernous hemangioma, and craniopharyngioma identification, and cerebellopontine angle meningioma should be differentiated with acoustic neuroma. Main points of the atypical meningioma diagnosis can be summarized as follows: 1) the atypical meningioma brain tumor characteristics should be grasped, such as the dural tail sign, 2) the signal is heterogeneous than the benign meningioma, such as the tumor cystic degeneration and necrosis, 3) the degree of peritumoral edema degree can indicate the possibility of the atypical meningiomas, 4) the adjacent bone hyperplasia, even bone damage may occur, 5) there are signs of extracranial tumors been wrapped by intracranial artery 6) consisting on postoperative examination, the postoperative recurrence is relatively high than benign meningiomas, which shows atypical meningioma has certain characteristic that can provide better guidance for clinical operation plan. Research shows that MRI is an important examination to the diagnosis and differential diagnosis of meningioma, in addition, the use of PET/MRI inspection system, can make possibility of obtaining image data from structural, functional and molecular structure of the lesions become reality (Boss et al., 2001).

Operation treatment is the best means of clinical cure of the atypical meningioma (Whillte et al., 2004), preoperative imaging analysis can be very instructive to determine the scope and extent of resection operation, studies show that recurrence rate of Simpson grade I resection is lower than that of the Simpson II-III resection surgery, and there is a statistically significant. Another study shows that particle radiation therapy method for the treatment of atypical meningioma is safe and feasible, but its clinical treatment remains to be further evaluated and confirmed in clinical trials (Rieken et al., 2012).

To sum up, MRI imaging has a certain value in diagnosis and differential diagnosis of atypical meningioma, because the number of cases is limited, it still need to accumulate more experience in the future, only effectively achieve early discovery, early diagnosis, early treatment, can it fundamentally improve the treatment effect of atypical meningioma.

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