Comparison of Diameters of Ipsilateral and Contralateral Foramen Spinosum in Patients with Supratentorial Meningiomas

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Abstract

Objective: Most of the supratentorial meningiomas is supplied by the middle meningeal artery (MMA) that enters the cranial cavity through the foramen spinosum. We aimed to analyze the maximal diameters of ipsilateral and contralateral foramen spinosa in patients with supratentorial meningioma, and to investigate whether the enlargement of foramen spinosum (FS) at ipsilateral side suggesting enlargement of MMA is present.

Methods: A total of 44 patients who underwent brain CT examination between January 2010 and January 2016, who had supratentorial meningioma were included in this study. The maximal diameter of ipsilateral and contralateral foramen spinosa was measured and compared.

Results: In 44 patients (28 women, 16 men; mean age 58.59 years, range 15-89 years), maximal FS diameter of was ranged between 1.4 and 4.4 mm (mean, 2.79±0.55 mm) at the ipsilateral side, between 1.6 and 3.4 mm (mean, 2.51±0.47 mm) at the contralateral side. The ipsilateral FS was larger than that of the contralateral with statistically significant.

Conclusion: The maximal FS diameter, which is probably related to the enlargement of MMA, was significantly greater in ipsilateral sides in supratentorial meningiomas. This finding may be kept in mind in differentiating meningiomas that have atypical imaging features from other masses.

Keywords: Meningioma, foramen spinosum, middle meningeal artery, diameter, computed tomography, supratentorial tumor

Supratentoryal Menenjiyomlarda İpsilateral ve Kontralateral Foramen Spinozum Çaplarının Karşılaştırılması Öz

Amaç: Supratentoryal menenjiyomların çoğu kraniyal kaviteye foramen spinozumdan (FS) giren orta meningeyal arterden (OMA) beslenir. Bu çalışmada, supratentoryal menenjiyomlarda ipsilateral ve kontralateral foramen spinozum maksimum çaplarını analiz etmek ve ipsilateral FS'da OMA genişlemesini yansıtan genişleme olup olmadığını araştırmak amaçlandı.

Yöntemler: Ocak 2010'dan Ocak 2016'ya kadar beyin BT çekilen, 44 supratentoryal menenjiyomalı olgu bu çalışmaya dahil edildi. İpsilateral ve kontralateral FS maksimum çapları ölçüldü ve karşılaştırıldı.

Bulgular: Kırk dört olguda (28 kadın, 16 erkek; ortalama yaş 58,59 yıl, yaş aralığı 15-89 yıl) ipsilateral FS maksimum çapı 1,4 and 4,4 mm aralığında (ortalama, 2,79±0,55 mm), kontralateral FS maksimum çapı 1,6 and 3,4 mm aralığında (ortalama, 2,51±0,47 mm) bulundu. İpsilateral FS çapı, kontralateral FS çapından istatistiksel olarak büyük bulundu.

Sonuç: Supratentoryal menenjiyomlarda ipsilateral FS maksimum çapı, olasılıkla OMA genişlemesi ile ilişkili olarak daha büyük bulundu. Bu bulgu, atipik görüntüleme bulguları olan menenjiyomların diğer kitlelerden ayrımında akılda tutulmalıdır.

Anahtar Kelimeler: Menenjiyoma, foramen spinozum, orta meningeyal arter, çap, bilgisayarlı tomografi, supratentoryal tümör

Meningiomas are the most common extra-axial neoplasm [1]. They arise from the arachnoid cells of the leptomeninges. Meningiomas are usually easily recognized by imaging techniques with typical features, such as similar density or signal intensity to cortex, homogeneous enhancement after contrast administration, and an enhancing ''dural tail,'' which reflects neoplastic dural infiltration and/or reactive vascularity [1, 2]. However, they sometimes have variable appearance on CT and MRI and are indistinguishable by imaging from other lesions.

Most of the supratentorial meningiomas are supplied by the middle meningeal artery (MMA) [3, 4]. The

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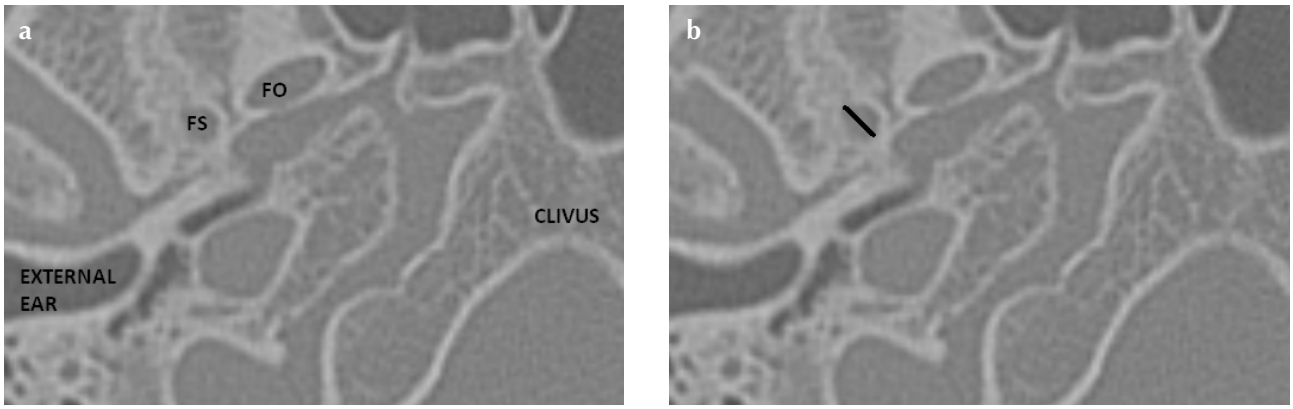

Figure 1. a, b. (a) On axial CT image, foramen ovale and foramen spinosum are seen (FO, FS). (b) The FS is measured at its greatest diameter (line)
FO: foramen ovale; FS: foramen spinosum

MMA is a branch of the maxillary artery, one of the two terminal branches of the external carotid artery. After branching off the maxillary artery in the infratemporal fossa, it enters the cranial cavity through the foramen spinosum (FS). The FS is circular and is located posterolateral to the foramen ovale [5].

In this study, we aimed to analyze the maximal diameters of ipsilateral and contralateral foramen spinosa in patients with supratentorial meningioma, and to investigate whether the enlargement of FS at the ipsilateral side suggesting the enlargement of MMA is present.

Material and Methods

Subjects

Our retrospective study was approved by the institutional review board (Eskisehir Osmangazi University 30 March 2020, decision no:2020-82). We retrospectively queried the radiology reports of brain CT examinations performed between January 2010 and January 2016 using the keyword "meningioma." Posterior fossa, tentorium/clivus, intraventricular, and olfactory groove meningiomas were excluded due to feeding from other arteries [6]. Because parasagittal meningiomas often have arterial contributions from both the ipsilateral and contralateral MMA [7], patients with midline meningiomas were also excluded.Patients with multiple meningiomas were not included due to the study design, which is focused on supratentorialmeningiomas. Patients had supratentorial meningioma were included in this study.

Ethics committee approval was received for this study from the ethics committee of Eskisehir Osmangazi University Non-Invasive Clinical Investigations Ethical Committee decision no: 2020-82.

CT analysis

All CT examinations were performed with a multislice CT scanner (Aquilion 64, Toshiba Medical Systems, Otawara, Japan). Scanning parameters were 120 kVp, 200 mAs, and a pitch of 1.5. CT studies were postprocessed on an independent workstation (Vitrea, Vital Images), which allows the reader to draw lines. Measurements were measured by two radiologists (one with 12 years of experience, whose specialty was neuroradiology, and one four-year resident), who were unaware of meningioma laterality but were aware that all were meningioma cases. The reviewers measured on the left and right FS at their greatest diameters on an axial image parallel to the skull base section (Figure 1). The resulting diameter measurements computed for each FS were averaged between the 2 reviewers.

Statistical analysis

Statistical Package for the Social Sciences for Windows 20.0 (IBM SPSS Corp.; Armonk, NY, USA) and Sigmastat 3.5 were used for statistical analysis. All data were analyzed for normal distribution with the Shapiro-Wilk normality test. All data were represented as the mean ± standard deviation. For comparison of FS diameter in ipsilateral and contralateral sides, the measurement data were tested by the parametric independent t test. P values <0.05 were deemed to indicate the statistical significance.

Results

A total of 44 patients (28 women, 16 men; mean age 58.59 years, range 15-89 years) who were diagnosed on typical radiologic findings of meningiomas were considered in this study. Of the 44 meningioma patients, 14 were operated, of whom 13 were categorized as WHO grade I and 1 was categorized as WHO grade III (rhabdoid type).

In 44 patients, the maximal FS diameter ranged between 1.4 and 4.4 mm (mean, 2.79±0.55 mm) at the ipsilateral side, and between 1.6 and 3.4 mm (mean, 2.51±0.47 mm) at the contralateral side. The ipsilateral

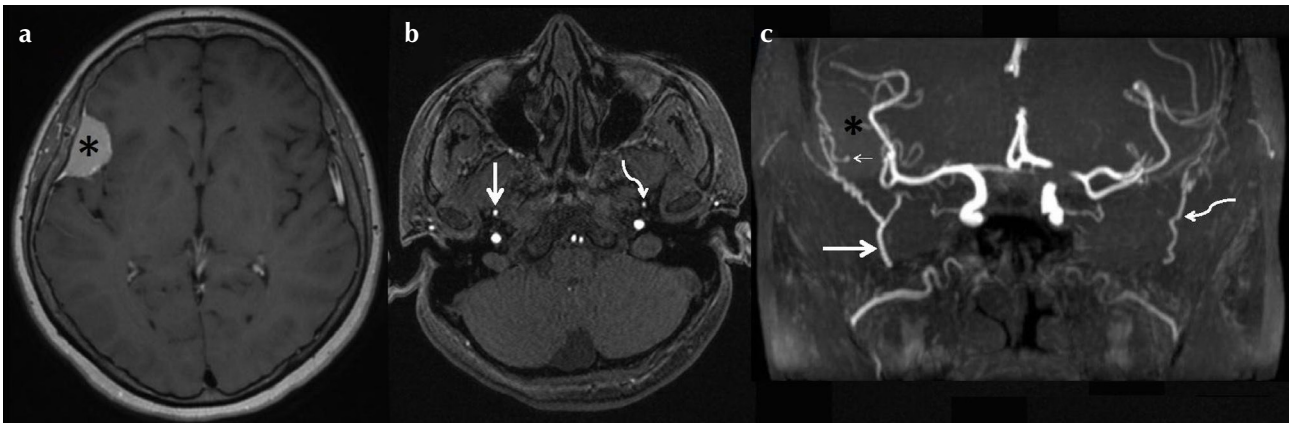

Figure 2. a-c. (a) Post-contrast T1 weighted image shows the right temporofrontal typical meningioma with dural tail (asterisk). (b) Axial TOF image demonstrates MMAs. The right MMA (straight arrow) is larger than left MMA (curved arrow). (c) Oblique coronal maximum intensity projection image shows the meningioma (asterisk), the ipsilateral right MMA (straight arrow) and the contralateral left MMA (curved arrow). The feeding artery (small arrow) originates from the right MMA
MMA: middle meningeal artery

Table 1. Comparison of FS area of two groups

	FS diameter	
Group	**Range**	**Mean (±SD)**
Ipsilateral side	1.4 and 4.4 mm	2.79±0.55 mm
Contralateral side	1.6 and 3.4 mm	2.51±0.47 mm

FS: foramen spinosum

FS was significantly larger than that of the contralateral FS ($p<0.05$).

Figure 2 shows an example of a meningioma supplied from MMA. Table 1 shows the comparison of maximal FS diameters between groups.

Discussion

Whether the enlargement of the FS in that MMA enters the cranium is present in patients with meningioma has not been evaluated so far. This study shows that the ipsilateral FS diameter was greater in patients with unilateral meningiomas. We suggest a possibility that the ipsilateral FS diameter enlargement might relate to a greater demand for blood flow in MMA.

Meningiomas are usually easily recognized by imaging techniques with typical features. However, meningiomas may be sometimes indistinguishable by imaging from other extra-axial lesions. For this reason, additional criteria can be useful in differentiating meningiomas having atypical imaging features from other masses. Meningiomas are highly hypervascular tumors. There are several studies that report that relative cerebral blood value (rCBV) can help distinguish intracranial masses by demonstrating lesion vascularity [8-12]. The conclusion of these studies comparing perfusion parameters of meningiomas and other extra-axial tumors such as dural metastasis, choroid plexus papilloma, and schwannoma is that increased perfusion may suggest the diagnosis of meningioma [10-12]. In our study, we found that the maximal diameter of FS at lesion side was bigger than that of the contralateral side. Basis this information, if further studies comparing FS diameter in meningiomas and in other extra-axial tumors are planned, whether FS diameter is used as a useful tool in differentiation of meningiomas and other extra-axial tumors may be revealed.

Most meningiomas are unilateral and are supplied by ipsilateral meningeal arteries. However, parasagittal meningiomas often have arterial contributions from both the ipsilateral and contralateral MMAs. In the series of Hattori et al. [13], anaplastic (malignant) meningiomas were more plentiful in the contralateral feeding group. However, we could not compare the ipsilateral and contralateral FS diameters in patients with anaplastic meningiomas due to the small sample size.

A limitation of this study was the small sample size. For this reason, a precise relationship between meningioma and the enlargement of FS diameter needs further confirmation in future studies with large sample sizes. Further studies may highlight this relationship.

In conclusion, we found that the ipsilateral FS was larger than that of the contralateral FS. If further studies clarify the relationship between the enlargement of FS and meningioma, these findings may be kept in mind in differentiating meningiomas that have unusual imaging features from other masses.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Eskişehir Osmangazi University (30 March 2020, decision no:2020-82).

Informed Consent: Due to the retrospective design of the study, informed consent was not taken.

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Hasta Onamı: Çalışmanın retrospektif tasarımından dolayı hasta onamı alınamamıştır.

Hakem Değerlendirmesi: Dış bağımsız.

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