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Clinical Features and Surgical Treatment of Asymptomatic Meningiomas

Asemptomatik Menenjiyomların Klinik Özellikleri ve Cerrahi Tedavisi

Yuguang LIU, Feng LI, Chuanwei WANG

Qilu Hospital of Shandong University, Brain Science Research Institute of Shandong University, Department of Neurosurgery, Jinan, PR China

Corresponding Author: Yuguang LIU / E-mail: NS3000@126.com

ABSTRACT

AIM: To explore clinical features and surgical treatment of asymptomatic meningiomas (AMs).

MATERIAL and METHODS: Clinical materials of 122 patients with AMs treated surgically were analyzed retrospectively and the associated literatures were reviewed.

RESULTS: There were 39 males and 83 females whose ages ranged from 38 to 72 years with a mean of 58.6 years in this series. The cerebral convexity (32.8%), parasagittal region (31.1%), and parafalcine (29.5%) ranked in the top three of all locations of AMs. The average size of the tumors was 2.8 cm in diameter, with a tumoral calcification rate of 33.6%. Among the 82 cases of AMs monitored with serial computerized tomography (CT) or magnetic resonance imaging (MRI) scannings, 44 had no obvious growth during a period of 3 to 18 months (mean 10.5 months) whereas 38 increased in diameter from 0.2 to 1.8 cm (mean 0.4 cm) every year during a period of 6 to 38 months (mean 26 months). Total resection was achieved in all cases. No death or permanent neurological deficits occurred.

CONCLUSION: AMs have some marked clinical characteristics compared with the symptomatic meningiomas. Their definitive treatment project rests with patients'age, results of follow-up, surgical risk-effect ratio, size, calcification of the tumor as well as patient preference.

KEYWORDS: Asymptomatic meningiomas, Clinical features, Surgical treatment

ÖZ

AMAÇ: Asemptomatik menenjiyomların (AM'ler) klinik özellikleri ve cerrahi tedavisini incelemek.

YÖNTEM ve GEREÇLER: Cerrahi olarak tedavi edilen 122 AM hastasının klinik materyali retrospektif olarak analiz edildi ve ilgili literatür gözden geçirildi.

BULGULAR: Bu seride 39 erkek ve 83 kadın vardı ve yaşları ortalama 58,6 yıl ile 38 ile 72 yıl arasında değişiyordu. AM'lerin en sık görüldüğü üç konum serebral konveksite (%32,8), parasagittal bölge (%31,1) ve parafalsin bölge (%29,5) oldu. Tümörlerin ortalama çapı 2,8 cm ve tümör kalsifikasyon oranı %33,6 bulundu. Dizisel bilgisayarlı tomografi (BT) veya manyetik rezonans görüntüleme (MRG) taramalarıyla izlenen 82 AM olgusu arasında 3 ila 18 aylık bir dönemde (ortalama 10,5 ay) 44'ünde büyüme olmazken 38'inin çapı 6 ila 38 aylık (ortalama 26 ay) bir dönemde her yıl 0,2 - 1,8 cm (ortalama 0,4 cm) çap artışı gösterdi. Tüm olgularda total rezeksiyon elde edildi. Herhangi bir ölüm veya kalıcı nörolojik defisit oluşmadı.

SONUÇ: AM'lerin semptomatik menenjiyomlara göre bazı özel klinik özellikleri vardır. Kesin tedavileri hastanın yaşına takip sonuçlarına cerrahi risk-etki oranına, tümörün büyüklüğü ve kalsifikasyonuna ve ayrıca hasta tercihine bağlıdır.

ANAHTAR SÖZCÜKLER: Asemptomatik menenjiyomlar, Klinik özellikler, Cerrahi tedavi

INTRODUCTION

The so-called "asymptomatic meningiomas"(AMs) are those found incidentally by autopsy or computerized tomography (CT) / magnetic resonance imaging (MRI) scannings for health examinations, or cerebral injury, cerebrovascular diseases and some symptoms not caused by meningiomas. The detection rate of AMs is increasing with the development of diagnostic imaging modalities, especially the widespread use of CT and MRI equipment and the prevalence of health examination. However, there are still controversies about management strategy for AMs because some may remain silent until the patient's death. From February 2003 to May 2013, 122 cases of AMs were treated surgically in Qilu Hospital of Shandong University, representing 12.8% of all intracranial meningiomas during the same period.

MATERIAL and METHODS

Patient Populations

There were 39 males and 83 females in this group. Their ages ranged from 38 to 72 years with a mean of 58.6 years. All cases were found incidentally by CT or MRI scannings. The reasons for CT or MRI scannings include health examinations in 14 cases, craniocerebral trauma in 52, cerebrovascular diseases in 11, and some symptoms not caused by intracranial meningiomas in 45.

Radiological Images

All cases were given CT or/and MRI scannings in this series. Enhanced CT or MRI revealed moderate to marked enhancement of tumors. The findings of the last CT or/and MRI examinations before surgery were shown in Table I.

Management Strategy

Of the 122 cases of AMs, 18 cases younger than 50 years old were treated surgically without dynamic observation after meningiomas were found, and 22 were resected after a less than three-month follow-up because patients asked for operations. Of the other 82 cases followed up by enhanced CT or MRI every 3-12 months, 44 had no obvious growth during a period from the initial detection by CT or MRI to the last preoperative examination of CT or MRI, ranging from three to nineteen months (mean 12.5 months), but 14 became symptomatic due to the aggravation of peritumoral edema. Tumor growth was observed in the other 38 cases on the last images of CT or MRI, in contrast with the initials during a period from the initial detection by CT or MRI to the last preoperative examination of CT or MRI, varying between six and thirty-six months (mean 24 months), and the annual increase varied from 0.2 to 1.8 cm (mean 0.4 cm) in maximum diameter. However, the meningioma-related symptoms appeared only in 20 cases.

Table I: CT/MRI Findings of 122 Patients with AMs

Tumors	No. of cases
Locations	
cerebral convexity	40
parasagittal regions	38
cerebral falx	36
sphenoid ridge	4
middle cranial fossa	2
olfactory groove	1
cerebellar convexity	1
Size (cm) (mean 2.8 cm)	
≤1	8
1-3	87
≥3	27
Texture	
homogeneous	80
calcified	41
necrotic	1
cystic	0
hemorrhagic	0
Peritumoral edema	
no	103
mild(<2cm)	18
medium (2-4cm)	1
severe (>4cm)	0

RESULTS

Surgical Results

Simpson I or II resection (18) was achieved in all cases. Postoperatively, the sporadic hemorrhage in the surgical field occurred in one case at the age of 72 years old. No death and severe complications or permanent neurological sequelae were observed in this series.

Pathological Results

Pathology revealed that benign meningiomas were confirmed in 121 cases and malignant in 1. In the subtypes, 52 cases were psammomatous, 38 fibroblastic, 28 meningothelial, 3 mixed and 1 malignant.

Follow-up Results

There was no recurrence after a follow-up of 12-72 months (mean 33 months). The patient with malignant meningioma was given radiotherapy after surgery and had not reccurence of tumor at 15 months after operation.

DISCUSSION

Incidence Rate

It is difficult to estimate accurately the incidence rate of AMs because they are found incidentally. The incidence rate of AMs detected at autopsy was 1%-2.3%, and more than 3% of those over 60 years old (3, 11). An estimated 0.5%-3% of the population has an incidental AM (17, 20). With the wide use of neuroimaging examinations and the decrease of autopsy, the rate of AMs detected incidentally by neuroimaging has increased year by year from 0.16:100,000 per year to 2.28:100,000 per year, whereas the rate of meningiomas found incidentally at autopsy has decreased from 5.25:100,000 per year to 3.92:100,000 per year (5). The proportions of AMs to all meningiomas reported in literature varied widely between 20.7% and 75% (3, 5, 14, 16, 21). The main causes of this wide gap include the different constitution of patients' age, the prevalence of CT and/or MRI, the different research subjects and diverse research methods (3). Nishizaki et al reported 108 cases of AMs treated surgically represented 20.7% of all meningiomas during the same period (14). Go et al reported 35 patients with AMs followed-up dynamically accounted for 28.9% of all meningiomas (5). It's reported that 38.9% of all 1536 meningiomas had no symptoms by Kuratsu et al (6). Radhakrishnan found 75% of 136 meningiomas were asymptomatic during population statistics (16). Generally thinking, the incidence rate of AMs increases continuously with age (5,13,15,17). According to the statistical data of autopsy by Nakasu and his colleagues, the age incidences of AMs were 0.5% younger than 40 years, 1.2%% 40-60, 2.4% 60-69, 3.6% 70-79 and 4.6% over 80, respectively (11). And 21% of 75 meningioma patients over 60 years old, treated surgically by Award et al, were asymptomatic (1). Niiro et al observed 92 cases of meningioma at the age of over 70 years old, and 69 cases (75%) had no symptoms (13). Of the 1536 meningiomas reported by Kuratsu et al, the proportion of patients with AMs

older than 70 years was 49% (6). In our series, 122 cases of AMs represented 12.8% of all 953 meningiomas, the rate of which was significantly lower than that reported in the literature. The main causes were that the patients treated conservatively and with γ-knife were not included in this group.

Clinical Characteristics

Compared with symptomatic meningiomas, AMs exhibit some clinical characteristics as follows (2-7, 10,11,13-15,22):

1. The tumors occur frequently in the aged. The brain atrophy of the elderly is the likely one of factors making meningiomas asymptomatic during a certain period. However, the mean age of our series is lower than that reported in the literature, which may be relate to the selection of cases because the surgical treatment is usually given the patients with AMs at the relative young age.
2. The proportion of tumors in females is much higher, ranging from 68% to 91%.
3. The tumors are usually small, with a mean 2.8 cm diameter, infrequently accompanied by peritumoral edema. The sizes of tumors are often less than 1 cm in diameter when patients' ages are under 30 years and the proportion of tumors greater than 3 cm in diameter increases when over 50 years.
4. The cerebral convexity is the most common site of AMs, accounting for 41.7% to 65.7%.
5. Calcification rates of tumors increase (18%-68.6%), but cystic or necrotic generation, intratumoral hemorrhage happen rarely.
6. The rate of complete resection is higher.
7. Psammomatous, fibroblastic and meningothelial meningiomas constitute the majority of subtypes, while malignant meningiomas are rare (about 1%).

Investigation of Neuroimaging

Surgical management must be based on the natural history of AMs. However, it was difficult to investigate the history of AMs before the era of CT. Now follow-up of CT or MR imaging associated with clinical symptomatology make it possible to study the natural history for a certain period. Olivero et al followed up 45 cases of AMs monitored with serial imaging, and found that the tumors didn't grow in 35 cases for 3 to 72 months (mean 29 months) and grew in 10 cases with an increase of an average 0.24 cm in diameter per year for 0.5 to 15 years (mean 47 months) (15). Firsching et al investigated 17 patients with AMs by CT or MRI scannings for 2 to 89 months (mean 21 months), and found that the annual growth rates of the tumors ranged from 0.5% to 21%, with a mean rate of 3.6% (3). According to the follow-up data of 40 AMs reported by Niiro et al (13), no tumors growth were detected in 65% of all cases and 84.2% of cases with tumoral calcifications (mean follow-up period of 41.8 months, range 10-97 months), and growth in 35% (mean follow-up period of 32.1 months, range 10-88 months) with an average increase in diameter from 30.9mm to 39.0 mm, of which 35.7% became symptomatic. Therefore, they concluded that 2/3 of AMs didn't grow for years, while 1/3 grew, of which 10% got symptomatic. Yano et al reported that 37.3% of 67 patients with AMs followed up for longer than 5 years had tumor growth, and 16.4 % developed symptoms over a mean follow-up period of 3.9 years (21). In addition, AMs with calcification grew significantly slowly than those without calcification. Only 4 cases increased in diameter with an annual growth rate of 12% among 35 AMs followed-up for 5-182 months by Go et al, and 19 cases with calcifications had no growth (5). Nakamura et al. evaluated the absolute and relative growth rates of 47 AMs by a neuroimaging follow-up of 6-105 months (mean 43 months) (10). The tumor growth rate was less than 1 cm^3/yr in 66% of cases, the absolute growth rate ranged from 0.03 to 2.62 cm^3/yr (mean 0.796 cm^3/yr) and the relative growth rates ranged from 0.48% to 2.8% (mean 14.6%). The tumor doubling time ranged from 1.27 to 143.5 years (mean 21.6 years). Though the different methods were used to calculate the growth rate of tumor in the literature, the conclusions were consistent. That is to say, most AMs do not grow or only grow slowly within a certain period. In conclusion, the surgical treatment of AMs was selectively performed under the guidance of continuous neuroimaging observations.

Management and Prognosis

No Class I or Class II evidence is available to support the treatment strategy and all recommendations are based on Class III evidence related to expert opinions and retrospective case series (17). It is still controversial whether AMs need to be treated surgically or not, especially in the case of the senile with small and calcified tumor. A wait-and-see strategy is often beneficial for asymptomatic elderly patients. It's suggested that patients with AMs should be firstly followed up for 3-12 months and then the next action is decided (2-7,9-17,19-22) . It is necessary to monitor the patients with AMs with serial neuroimaging, usually starting with a follow-up in every 3-6 months and then 6-9 months, and thereafter 1 year because the growth rate is unpredictable in each individual case (3,7,11). In our opinion, surgery should be recommended immediately if the tumor is large with obvious mass effect or suspected of malignancy. It is hoped that AMs are removed surgically before the appearance of symptoms in respect that the radical resection is usually easier to be achieved by this time (7). The follow-up should be stopped and surgery or γ-knife should be considered once the changes as follows are observed during the neuroimaging and clinical monitoring (7,8,9,11,13):

1. The tumor grows rapidly, with the relative growth rate of more than 25% in an half year.
2. The tumor shows high signal on MR T_2 weighted images and has heterogeneous enhancement, revealing the necrosis and high proliferating potential of tumor.
3. Not only severe edema surrounding the tumor but also the absence of tumoral calcifications are detected.

4. The tumor-related symptoms appear though the tumor has no obvious growth.
5. The tumor grows invasively into the close-by dura mater, venous sinus, brain, skull and others.

We also advise the patients with AMs to adopt surgical removal if they are medically fit for surgery as well as most likely to have complete removal of tumor. The reasons for this proposal include: 1) modern microneurosurgical techniques decrease greatly the surgical mortality and disability of patients with meningioma, and the meningioma is one of tumors with the best surgical effect; 2) so far, no data of lifetime follow-up from a large sample of patients with AMs has been available, and it is impossible to compare the lifetime follow-up results with the surgical effects. In addition, it does not mean the tumors will stop growing even if they grow insignificantly or slowly in a certain time. In fact, the absolutely static meningiomas are rare; 3) the young patients with AMs should be given actively surgical resection because their remaining years are longer and the surgical risk-effect ratio will increase when the tumors grow with age in the future. However, whether older patients need to be treated surgically or not should be considered carefully.

Decisions about therapy need to weigh the natural history of AMs, the risks of intervention, and patient preferences. The following risk factors should be considered when the operative opportunity is determined.

1. Age: Age is a crucial element in deciding whether to treat surgically AMs. Prophylactic resection is suggested in the younger cases with AMs because of a higher growth rate and shorter doubling time of tumors (17). Instead, caution is advised if the operation is given to the patients older than 70 years because the morbidity and mortality of open surgery are increased in those senile patients.

2. Location: Tumor location was not found to be a significant predictive factor (17). But, if the patients are young, it's a reasonable recommendation to remove surgically the tumors located in these regions as early as possible, such as convexity, parasagittal, falx, sphenoidal ridge, saddle area, olfactory groove, and cerebellopontine angle, considering the excellent surgical effects.

3. Mass effect: It is proposed that AMs with mass effect due to their larger volume or peritumoral edema should be removed surgically because an overwhelming majority of AMs larger than 4 cm in diameter will become symptomatic in a short time (7).

4. Surgical risk-effect ratio: For the cases with high surgical risk-effect ratio, such as AM in pineal region or in advanced age, non-surgical therapy (e.g. γ-knife) instead of immediate surgical therapy may be recommended.

5. Patient preference: Patient preference for immediate surgery versus conservative management over time may determine the course of action. The patients refusing surgical removal should be advised to repeat CT or MRI scannings at regular intervals or to take other treatments.

Theoretically, the prognosis of AMs is good after surgery. However, the surgical results of AMs are not much better than that of symptomatic meningiomas due to their older ages. Nishizaki et al reported that the mortality and disability rates of 75 AMs and 356 symptomatic meningiomas were 5.3% and 6.1%, respectively, and no obvious difference was found (14). Though no death occurred in 87 AMs treated surgically by Kuratsu et al (6), the postoperative disability rate was as high as 11.4%. The surgical result is related to patient's age to a great degree. The postoperative disability rate was 9.4%-23.3% in the cases over 70 years and 3.5%-12% under 70 years (6,9,21). Awad et al. also reported that the postoperative mortality rate and perioperative disability rate were 6.6% and 30% respectively in the cases older than 60 years (1). In a word, the senility is the main factor influencing the surgical effect. In our series, no death or disability appeared, which was related to the appropriately selective cases, right operative opportunity as well as surgical skills.

REFERENCES

1. Awad IA, Kalfas I, Hahn JF, Little JR: Intracranial meningiomas in the aged: Surgical outcome in the era of CT. Neurosurgery 24:557-560,1989
2. Concise Neurosurgery. Liu YG (ed). Jinan: Scientific and Technological Press of Shandong, 2010:224-226
3. Firsching RP, Fischer A, Peters R, Thun F, Klug N: Growth rate of incidental meningiomas. J Neurosurg 73: 545-547,1990
4. Gao SC: An analysis of 17 cases of asymptomatic meningiomas. Chinese Journal of Misdiagnositics 5: 3357-3358,2005
5. Go RS, Taylor BV, Kimmel DW: The natural history of asymptomatic meningiomas in Olmsted County, Minnesota. Neurology 51: 1718-1720,1998
6. Kuratsu J, Kochi M, Ushio Y: Incidence and clinical features of asymptomatic meningiomas. J Neurosurg 92: 766-770,2000
7. Liu JY, Zhang LJ: Asymptomatic meningiomas. Journal of International Neurology and Neurosurgery 33:221-225,2006
8. Liu YG, Wu CY, Zhu SG: Malignant meningiomas. Chinese Journal of Neurosurgery 22: 617-619,2006
9. Nabika S, Kiya K, Satoh H, Mizoue T, Oshita J, Kondo H: Strategy for the treatment of incidental meningiomas. No Shinkei Geka 35:27-32,2007
10. Nakamura M, Roser F, Michel J, Jacobs C, Samii M: The natural history of incidental meningiomas. Neurosurgery 53: 62-70,2003
11. Nakasu S, Hirano A, Shimura T, Llena JF: Incidental meningiomas in autopsy study. Surg Neurol 27:319-322,1987
12. Nakasu S, Nakasu Y, Fukami T, Jito J, Nozaki K: Growth curve analysis of asymptomatic and symptomatic meningiomas. Journal of Neuro-Oncology 102:303-310,2011
13. Niiro M, Yatsushiro K, Nakamura K, Kawahara Y, Kuratsu J: Natural history of elderly patients with asymptomatic meningiomas. J Neurol Neurosurg Psychiatry 68: 25-28,2000

14. Nishizaki T, Ozaki S, Kwak T, Ito H: Clinical features and surgical outcome in patients with asymptomatic meningiomas. Br J Neurosurg 13:52-55,1999
15. Olivero WC, Lister JR, Elwood PW: The natural history and growth rate of asymptomatic meningiomas: A review of 60 patients. J Neurosurg 83: 222-224,1995
16. Radhakrishnan K, Mokri B, Parisi JE, O'Fallon WM, Sunku J, Kurland LT: The trends in incidence of primary brain tumors in the population of Rochester, Minneseta. Ann Neurol 37: 69-73,1995
17. Roukoz C, Khaled MK, William TC: Incidental meningiomas. Neurosurgical Focus 31:E19,2011
18. Simpson D: The recurrence of intracranial meningiomas after surgical treatment. J Neurol Neurosurg Psychiatry 20: 22-39,1957
19. Wang YQ, Zhong XM, Zheng HM: Asymptomatic meningiomas. Clinical Medicine 24:8,2004
20. Whittle IR, Smith C, Navoo P, Collie D: Meningiomas. Lancet 363:1535-1543, 2004
21. Yano S, Kuratsu J, Kumamoto Brain Tumor Research Group: Indications for surgery in patients with asymptomatic meningiomas based on an extensive experience. Journal of Neurosurgery 105:538-543,2006
22. Yoneoka Y, Fujii Y, Tanaka R: Growth of incidental meningiomas. Acta Neurochir (Wien) 142: 507-511,2000