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*Case Report*

# Spontaneous regression of a posterior fossa meningioma: A case report

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## ABSTRACT

**Background:** Since most incidentally discovered meningiomas grow or remain unchanged, spontaneous regression is extremely rare. Here, we report a case of posterior fossa meningioma showing spontaneous regression.

**Case Description:** A 55-year-old female was referred to our hospital because she was diagnosed with a left posterior fossa meningioma (diameter: 1.6 cm) during a brain check-up. The patient was followed up on periodic magnetic resonance imaging studies. Tumor size remained almost unchanged for 2 years but then began to regress. Twelve years after the initial examination, the tumor diameter idiopathically decreased from 1.6 cm to 1.1 cm while the tumor volume decreased from 2.3 $cm^3$ to 0.5 $cm^3$ (about 1/4$^{th}$ the original size). Postmenopausal hormonal imbalances may have been associated with the observed spontaneous regression.

**Conclusion:** Understanding the natural history of meningiomas is essential for a better selection of treatment approaches or appropriate follow-up. This case may provide new insights into the progression of meningiomas.

**Keywords:** Asymptomatic, Meningioma, Posterior fossa, Spontaneous regression

## INTRODUCTION

Meningiomas, reported to account for 13–26% of all primary intracranial tumors,[15] are mostly benign tumors arising from the arachnoid cap cells and widespread use of computed tomography and magnetic resonance (MR) imaging has increased their discovery. Most meningiomas grow larger or remain unchanged over time (growth rate: 17.5–37.5%)[7] and rarely regress spontaneously. Symptomatic meningiomas are generally removed surgically while small and asymptomatic meningiomas are followed up with periodic imaging studies. However, there are no clear guidelines for follow-up duration or frequency of imaging. Therefore, understanding the progression of meningiomas is essential for a better selection of treatment approaches or appropriate follow-up. This article reports a case of spontaneous regression of meningiomas with relevant literature review.

## CASE PRESENTATION

A 55-year-old woman diagnosed with a brain tumor during a brain check-up was referred to our hospital for further examination in April 2009. On admission, she had no neurological deficits,

with a medical history of uterine myoma and no risk factors for atherosclerosis. Menopause had occurred in her early 50s. MR imaging showed a round-shaped mass near the left transverse-sigmoid junction protruding into the posterior fossa (1.6 cm × 1.6 cm × 1.7 cm). The tumor appeared as an isointense mass on T1-weighted imaging (WI) and slightly hyperintense on T2WI with enhancement after gadolinium administration [Figure 1]. Cerebral angiography showed no abnormalities in the major cerebral vessels while selective external carotid angiography revealed slight tumor staining. The radiological diagnosis was meningioma in the posterior fossa and the incidental and small size indicated follow-up with an annual MR imaging study. No size changes were observed for 2 years after the initial diagnosis, but gradual regression was seen from the 3rd year [Figure 2]. MR angiography during the follow-up period showed no major cerebral vessel occlusions or atherosclerotic changes. Twelve years after diagnosis, the most recent MR imaging showed that the tumor had further regressed to 1.1 cm × 1.0 cm × 0.9 cm, and the tumor volume decreased from 2.3 $cm^3$ to 0.5 $cm^3$ (about a quarter of the original size) [Figures 2 and 3].

Due to the increased size of the uterine myoma, the patient underwent hysterectomy and bilateral oophorectomy in 2019 (10 years after discovering the brain tumor) but the brain tumor remains asymptomatic.

## DISCUSSION

Asymptomatic tumor discovery has increased with the spread of diagnostic imaging and the advent of an aging society. Therefore, it is essential to know the progressive nature of a disease to develop an appropriate treatment and follow-up policy since tumors generally grow over time but some may exhibit spontaneous regression. Almost all varieties of malignant tumors can spontaneously regress,[21] an effect often seen in brain tumors such as pituitary adenomas, schwannomas, germinomas, and malignant lymphomas.[14] Immune activation, apoptosis, and the tumor microenvironment are key factors in such events;[21] however, meningiomas rarely show spontaneous regression.

So far, 19 cases (male-female ratio 6:13) of spontaneous meningioma regression, including this case, have been reported [Table 1].[3-5,7,8,10,11,13,19,21-25] The average age was 54.7 (17–80) years at the time of tumor discovery, with a tendency to regress over several years. The sites of tumor development varied but appeared to be the same as in common meningiomas while only our case occurred in the posterior fossa. The tumor diameter from each paper was calculated along the axis showing the most significant change. At the first measurement, the average size was 33.4 mm, decreasing to 17.6 mm at the final measure over an average observation period of 34.3 months. The average observation period for patients suspected of being involved

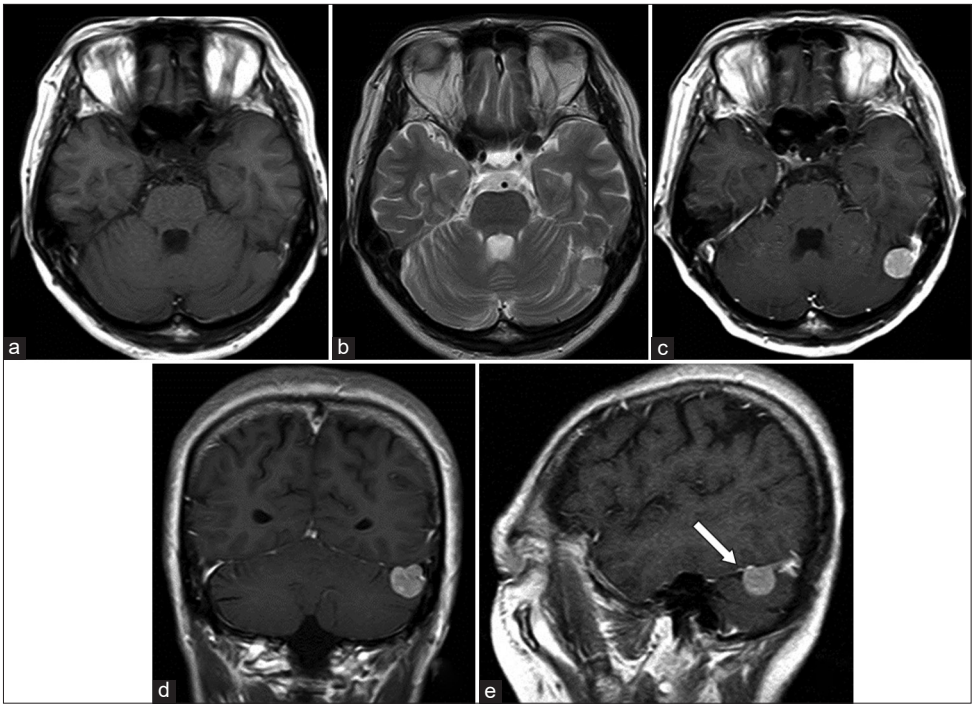


**Figure 1:** T1- (a) and T2-weighted (b) magnetic resonance (MR) images showing a left posterior fossa meningioma (1.6 cm × 1.6 cm × 1.7 cm). Gadolinium-enhanced axial (c), coronal (d), and sagittal (e) images showing a well-enhanced mass. The dural tail sign is seen in the sagittal image (arrow).

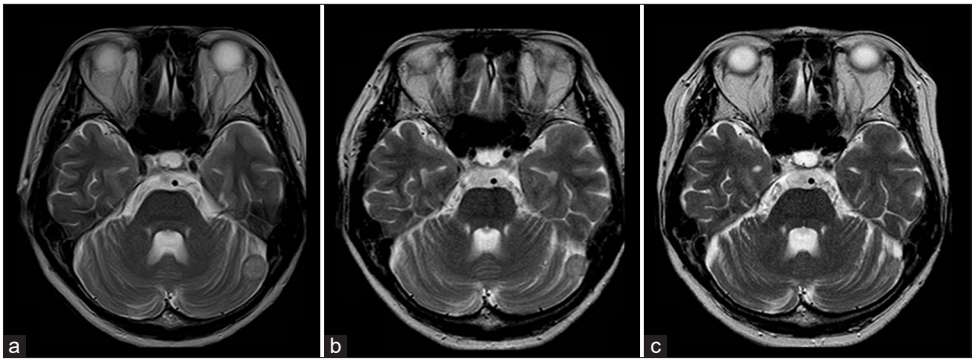


**Figure 2:** T2-weighted MR images taken 4 years (a), 8 years (b), and 12 years (c) after the initial diagnosis, showing gradual regression from 1.4 cm × 1.3 cm × 1.0 cm to 1.1 cm × 1.0 cm × 0.9 cm.

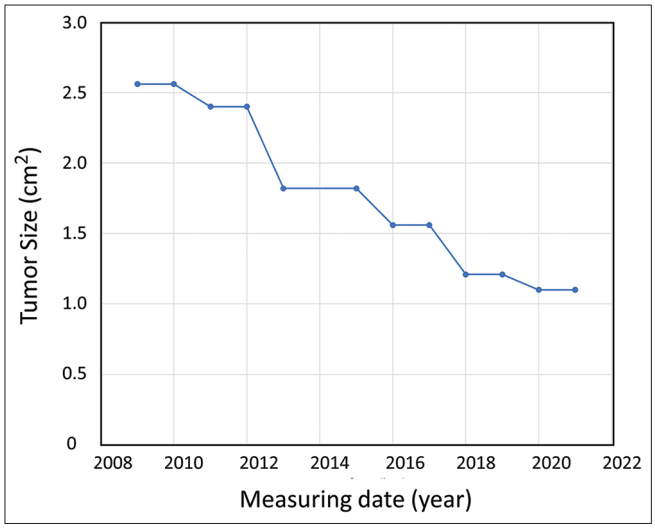


**Figure 3:** Changes in tumor size measured from serial magnetic resonance imaging.

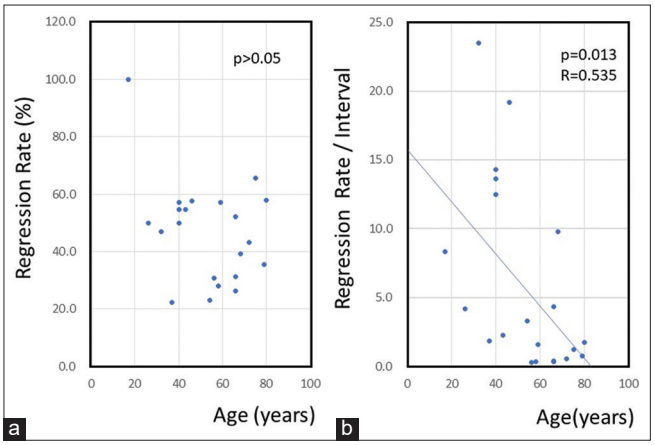


**Figure 4:** (a) A graph showing the relationship between age and tumor regression rate. There is no correlation between age and regression rate. (b) A graph showing the relationship between tumor regression rate and observation interval. The tumor regression rate over a period of time is significantly lower in the elderly (regression analysis, $P < 0.05$).

in sex hormone fluctuations, such as discontinuing drug treatment, was 10.1 months. In cases of other causes, the average observation period was 67.8 months, which was longer than in hormone-related cases. In other words, cases involving drug treatment related to sex hormones tended to cause the tumor to regress in a shorter period than those in which the cause was unclear.

There is little difference between our case and the other reported cases, except for the occurrence site. Our case may be slightly older than other reported cases. When examining patient age and tumor regression, tumor size decreases at all ages, regardless of age [Figure 4a]. In contrast, the rate of tumor regression over a period of time was significantly smaller for the elderly [Figure 4b]. Therefore, when planning imaging follow-up, a shorter examination period is recommended for younger patients and a relatively longer period for older patients.

Several factors may have caused spontaneous regression, including hormone therapy discontinuation, hormone balance changes associated with pregnancy and delivery, intratumoral hemorrhage, tumor cell calcification promoted by a high glucose level, and atherosclerosis. The involvement of atherosclerosis appears to be conspicuous in the elderly and hormone-related factors seem essential in other age groups. Only three cases, including ours, had little or no known cause.

It has also been reported that the residual tumor disappeared spontaneously after partial resection.[9,16] Possible causes of regression include occlusion of the tumor feeding vessels during surgery and inflammation around the tumor due to surgery, which may have caused environmental changes in the tumor.[9,16]

The mechanism of spontaneous regression in our case is unknown. Depending on the histology of the meningiomas and hormone receptors, there may be types of meningiomas that tend to regress. The cause of regression may be apoptosis, activation of the immune system, or changes in the feeding vessels to the tumor due to aging or atherosclerosis. In this case, however, these are only speculations, as there were no

**Table 1:** Summary of cases with meningioma showing spontaneous regression.

| Case No. | Author/year | Age/sex | Location | Size (mm in diameter) | | Interval (month) | Regression rate (%) | Regression rate/interval | Possible factors affecting regression |
|---|---|---|---|---|---|---|---|---|---|
| | | | | First | Final | | | | |
| 1 | Shimizu *et al.*/2008 | 80/M | Sphenoid | 50 | 21 | 33 | 58 | 1.8 | Discontinuation of progesterone agonist (chlormadinone acetate) |
| 2 | de Almeida *et al.*/2009 | 66/F | Convexity | 23 | 11 | 12 | 52.2 | 4.3 | Intratumoral hemorrhage |
| 3 | Goncalves *et al.*/2010 | 46/F | Olfactory groove | 33 | 14 | 3 | 57.6 | 19.2 | Discontinuation of the anti-androgen agent (cyproterone acetate) |
| 4 | Wantanbe *et al.*/2012 | 75/M | Parasagittal | 35 | 12 | 54 | 65.7 | 1.2 | Atherosclerosis (HT, DM) |
| 5 | | 72/M | Sphenoid | 30 | 17 | 78 | 43.3 | 0.6 | Atherosclerosis (HT, DM) |
| 6 | | 79/M | Olfactory groove | 31 | 20 | 48 | 35.5 | 0.7 | Atherosclerosis (CI) |
| 7 | Hirota *et al.*/2014 | 66/F | Falx | 42 | 31 | 84 | 26.2 | 0.3 | Calcification, atherosclerosis (DM) |
| 8 | Kerschbaumer *et al.*/2015 | 32/F | Sphenoid | 66 | 35 | 2 | 47.0 | 23.5 | Pregnancy/delivery |
| 9 | Yilmaz *et al.*/2016 | 17/M | Spinal (C2-3) | 38 | 0 | 12 | 100.0 | 8.3 | (-) |
| 10 | Hoegestoel and Berg-Johnsen/2016 | 59/M | Sphenoid | 35 | 15 | 36 | 57.1 | 1.6 | α1-adrenoceptor blocker (tamsulosin) |
| 11 | Galloway *et al.*/2017 | 56/F | Falx | 26 | 18 | 120 | 30.8 | 0.3 | Interferon beta-1a |
| 12 | Kalamarides and Peyre/2017 | 26/F | Convexity | 60 | 30 | 12 | 50.0 | 4.2 | Discontinuation of the anti-androgen agent (cyproterone acetate) |
| 13 | | 43/F | Sphenoid | 55 | 25 | 24 | 54.5 | 2.3 | Discontinuation of the anti-androgen agent (cyproterone acetate) |
| 14 | Passeri *et al.*/2019 | 37/F | Sphenoid | 36 | 28 | 12 | 22.2 | 1.9 | Discontinuation of progesterone agonist (nomegestrol acetate) |
| 15 | | 68/F | Clivus | 23 | 14 | 4 | 39.1 | 9.8 | Discontinuation of progesterone agonist (nomegestrol acetate) |
| 16 | | 54/F | Sphenoid | 26 | 20 | 7 | 23.1 | 3.3 | Discontinuation of progesterone agonist (nomegestrol acetate) |
| 17 | Kumaria *et al.*/2020 | 58/F | Sphenoid | 50 | 36 | 84 | 28.0 | 0.3 | (-) |
| 18 | Shahin *et al.*/2021 | 40/F | Falx | 11 | 5 | 4 | 54.5 | 13.6 | Discontinuation of exogenous progesterone (megestrol) |
| | | | Parietal convexity | 7 | 3 | 4 | 57.1 | 14.3 | |
| | | | Frontal convexity | 8 | 4 | 4 | 50.0 | 12.5 | |
| 19 | Present case/2022 | 66/F | Posterior fossa | 16 | 11 | 120 # | 31.3 | 0.3 | (-) |

Regression rate = (Initial size–Final size)/Initial size × 100 (%). HT: Hypertension, DM: Diabetes mellitus, # 2011 to 2021

histological diagnoses or changes in the major blood vessels of the brain on MR angiography.

Since meningiomas frequently occur in women, it has long been argued that female hormones are involved in the development and growth of tumors. Meningiomas are 50–80% positive for progesterone receptors and 10–30% positive for estrogen receptors.[20] As there have been reports of tumor regression in elderly patients who did not consent to surgery and were treated with anti-estrogens,[17,18] these sex hormones appear to affect tumor growth. Furthermore, these sex hormones are associated not only with cell proliferation but also with apoptosis,[12] which may be related to tumor regression. The incidence of meningiomas does not vary with age at menarche and menopause, the number of births, or the presence of hormone therapy. On the other hand, it has been reported that women with uterine myoma (also affected by sex hormones) are at higher risk of developing meningiomas than women without them.[26] In our case, the patient underwent a total hysterectomy and bilateral oophorectomy due to a gradual increase in uterine myoma after menopause. The meningiomas had already regressed at the time of the uterine surgery, so it is unlikely that the hormonal fluctuations caused by the uterine surgery directly affected the meningioma regression. Therefore, the most likely cause is the influence of rapid changes in the hormonal environment around menopause. In short, physiological sex hormones had previously stimulated the meningioma but menopause may have reduced the supply of hormones and caused regression.

As a limitation of this case report, noncontrast MRI has been used for the follow-up tool. Although noncontrast MRI is reported to be equivalent to postcontrast MRI when following up on changes in meningioma tumor size,[1,6] postcontrast MRI may be more accurate when evaluating rare phenomena such as spontaneous regression.

During tumor follow-up with diagnostic imaging, clinicians should always consider the differential diagnosis. For example, as solitary fibrous tumors resemble meningiomas on imaging but may be more invasive than meningiomas, diffusion-weighted MR imaging with apparent diffusion coefficient mapping has been reported to help differentiate such tumors.[2] In addition, clinicians should remember that meningiomas can regress spontaneously, although this is infrequent. Factors associated with tumor growth and regression are still unknown and further research is needed to elucidate the mechanisms and factors that lead to spontaneous regression. This case may offer new insight into the progressive nature of meningioma.

## CONCLUSION

Understanding the natural history of meningiomas is essential for a better selection of treatment approaches or appropriate follow-up. This case may provide new insights into the progression of meningiomas.

### Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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