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Case report

Asymptomatic internal carotid artery occlusion after gamma knife radiosurgery for pituitary adenoma: Report of two cases and review of the literature

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ABSTRACT

Background: Gamma knife radiosurgery is an effective and safe treatment modality in the management of pituitary adenomas. Internal carotid occlusion is a rare but possible complication of Gamma Knife Radiosurgery for lesions within the cavernous sinus.
Aim: To stress the importance of considering the Internal carotid artery as an organ at risk in cavernous sinus invading adenomas and reduce the dose delivered to this structure whenever possible.
Case description: We report two cases of asymptomatic occlusion of the intracavernous segment of the internal carotid artery seven years after treatment in acromegalic patients. After trans-sphenoidal surgery, residual tumour was treated with gamma knife radiosurgery. The maximal doses to the affected artery were higher than 40 Gy and the 90% isodose was close to the arterial wall.
Conclusion: Every effort should be done to minimize the radiation dose to the internal carotid artery. If not possible, "hot spots" exceeding the 90% isodose close to this vessel should be avoided.

1. Aim

To stress the importance of considering the Internal Carotid Artery as an organ at risk in cavernous sinus invading adenomas and reduce the dose higher than 90% isodose along the wall of this artery.

2. Introduction

Pituitary adenomas are benign tumours which usually grow causing compression of adjacent anatomical structures. However, some pituitary adenomas may infiltrate adjacent tissues. Six to ten percent of pituitary adenomas involve the cavernous

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sinus[1,2] and are considered to be invasive.[3,4] Dural wall invasion usually implies partial surgical removal of the tumour.[5] Adjuvant treatment (i.e. conventional radiation therapy, radiosurgery or medication) is often necessary in these patients. Stereotactic radiosurgery and Radiotherapy are effective and safe radiation modalities to realize real salvage treatment for recurrent skull base tumours such as pituitary adenomas.[6]

In recent years, Gamma Knife Radiosurgery (GKRS) has emerged as an important treatment modality in the management of residual or recurrence of pituitary adenomas. Advances in computer guidance and imaging of the pituitary disease and surrounding normal structures have led to substantial improvements in GKRS; however, many unanswered questions regarding dose and complications still remain.

The major potential risks associated with the GKRS for pituitary adenomas are delayed optic neuropathy and new endocrine deficiencies. Vascular structures and cranial nerves within the cavernous sinus appear to be less susceptible to adverse radiation effects.[7] Nowadays, only two cases of symptomatic internal carotid artery (ICA) occlusion were reported in patients following GKRS for a pituitary adenoma.[8,9] Other two cases of asymptomatic ICA stenosis after GKS for hormone-producing pituitary adenoma have been reported in the literature.[10] We report two cases of asymptomatic ICA occlusion 7 years after GKS for a pituitary adenoma growth-hormone secreting with particular regards to the dose delivered to the ICA.

3. Materials and methods

3.1. *Case report no. 1*

A 30-year-old female patient presented at our institution with the diagnosis of acromegaly unresponsive to medical treatments. A contrast-enhanced magnetic resonance imaging (MRI) scan revealed the presence of a sellar lesion with an extension to the right cavernous sinus. In 2003, the patient underwent a trans-sphenoidal surgery with subtotal removal. In February 2004, the patient was treated with GKRS for persistent acromegaly activity of the residual intracavernous tumour. The treatment was performed with Gamma Plan 5.32 (Elekta instruments, Stockolm, Sweden). We prescribed 22 Gy at the 50% isodose. Treatment was performed with Leksell Gamma Knife C (Elekta instruments). The patient received postoperative pegvisomant treatment and was followed clinically and by MRI. GKRS achieved complete tumour growth control as confirmed by following MRI controls. Five years after GKRS, remission of acromegaly was achieved and medical treatments were interrupted. Seven years after GKRS, angio-MRI revealed occlusion of the cavernous segment of the right ICA (Fig. 1). The patient was asymptomatic and remained cured and asymptomatic 11 years after GKRS, no further treatments were started and the patient was annually followed with angio-MRI.

3.2. *Case report no. 2*

A 35-year-old female patient presented at our institution with the endocrinological diagnosis of acromegaly unresponsive to medical treatments. A contrast-enhanced magnetic resonance imaging (MRI) scan revealed the presence of a sellar-suprasellar tumour with an extension to the left cavernous sinus. The patient underwent a trans-sphenoidal surgery with subtotal removal in 2006 and 2008. The pathological finding confirmed a mixed-cell adenoma, secreting growth hormone and prolactin. In April 2008 the patient was treated with GKRS for persistent acromegaly activity of the residual intracavernous lesion. We prescribed 23 Gy at the 50% isodose. Treatment was performed with Leksell Gamma Knife Perfexion (Elekta instruments). The patient received postoperative somatostatin analogues treatment. GKRS achieved complete tumour growth control, as confirmed by following MRI controls. In 2010 pegvisomant was started and a biochemical remission of acromegaly was achieved (normalization of serum IGF-1 concentrations). Seven years after GKRS, angio-MRI showed occlusion of the cavernous segment of the left ICA (Fig. 2). The patient was asymptomatic and was annually followed with angio-MRI.

For arterious venous malformation the rate of vessel obliteration depends on the marginal dose administered to the nidus. In order to analyze the dosimetry delivered to the ICA, we retrospectively created a volume of the intracavernous portion of the ICA. In both cases the ICA received a maximal dose higher than 35 Gy and the 90% isodose was close to the arterial wall (Fig. 3). In case no. 1 the maximal

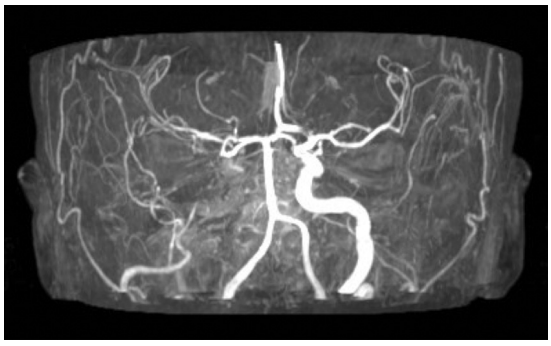

Fig. 1 – Angio-MRI showing complete right internal carotid artery occlusion in case 1.

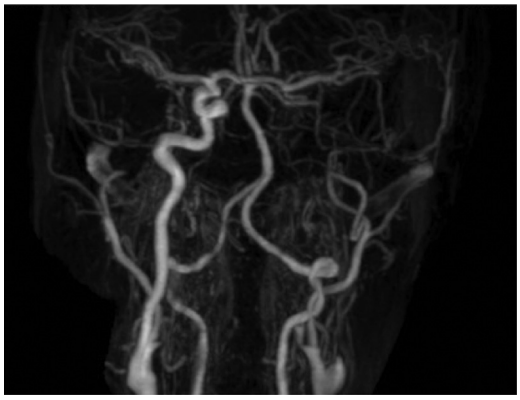

Fig. 2 – Angio-MRI showing complete left internal carotid artery occlusion in case 2.