PRESURGICAL EMBOLIZATION OF INTRACRANIAL MENINGIOMA

Embolização pré-cirúrgica de meningioma intracraniano

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ABSTRACT

Meningiomas are tumors with high vascularization whose treatment is surgical resection. Preoperative embolization facilitates their removal because it can reduce intraoperative blood loss and surgical time. A 45-year-old female patient presented recurrent headaches for six months that did not respond to analgesics; she also presented visual impairment with loss of visual field, mainly on the left eye, for three months. The patient underwent brain magnetic resonance imaging and contrast-enhanced magnetic resonance angiography. The results demonstrated a solid extra-axial vascularized expansive process in the anterior cranial fossa, suggesting a lesion of meningothelial lineage, including meningioma. A preoperative embolization was performed, followed by a surgical resection on the next day. In the postoperative period, the patient was conscious and oriented and did not present visual impairment. In this sense, preoperative embolization may be useful in meningioma surgery as it reduces intraoperative blood loss and surgical time, softening the consistency of the tumor. However, the possibility of embolic complications should be considered, and emergency craniotomy preparation should be maintained, mainly in patients with large meningiomas.

Keywords: Meningioma; Therapeutic embolization; Angiography; Surgery; Neurosurgery.

RESUMO

Introdução: Os meningiomas são tumores altamente vascularizados cujo tratamento de escolha é a ressecção cirúrgica. Contudo, a embolização pré-operatória destes tem sido estabelecida para facilitar a sua remoção, uma vez que pode reduzir a perda sanguínea intraoperatória e o tempo cirúrgico. **Relato do caso:** Paciente do sexo feminino, 45 anos, com história de cefaleia recorrente há seis meses, que não cedeu aos analgésicos e apresentou déficit visual, com perda de campo visual principalmente à esquerda há três meses. Foi submetida à ressonância magnética do encéfalo e à angiorressonância magnética com contraste, na qual foi evidenciado um processo expansivo sólido extra-axial vascularizado na fossa craniana anterior, sendo a principal hipótese a lesão de linhagem meningotelial (entre elas o meningioma). Em seguida, foi realizada uma embolização pré-operatória da vascularização tumoral e, no dia seguinte, a neurocirurgia de ressecção tumoral. No pós-operatório a paciente cursou sem déficit visual, consciente e orientada. **Comentários:** A embolização pré-operatória pode apresentar uma vantagem na cirurgia para meningioma. O procedimento reduz a perda sanguínea intraoperatória e o tempo de operação, suavizando a consistência do tumor. No entanto, deve-se observar a possibilidade de complicações embólicas e manter o preparo da craniotomia de emergência, principalmente em pacientes com grandes meningiomas.

Palavras-chave: Meningioma; Embolização Terapêutica; Angiografia; Cirurgia; Neurocirurgia.

INTRODUCTION

Meningiomas are highly vascularized tumors that comprise 13% to 20% of all brain tumors, and skull base meningiomas comprise about 44% of skull base tumors. Their vascular supply can derive from extra- and intracranial circulation[1].

Meningiomas can be treated using surgical resection2; however, this procedure exposes the patient to a significant risk of blood loss[3,4]. In this context, preoperative embolization was established to ease surgical resection, as it reduces intraoperative blood loss and surgical time[4,5].

Therefore, the present study aimed to report a case of presurgical embolization of intracranial meningioma and provide evidence of its effectiveness in neurosurgical treatment.

CASE REPORT

The study was approved by the research ethics committee for research involving human beings of the Faculdade de Medicina de Olinda (no. 43998421.0.0000.8033).

A 45-year-old female patient reported recurring headaches for six months, with worsening intensity and without improvement with analgesics usage. For three months, she presented visual impairment, mainly in the left eye.

The patient was submitted to brain magnetic resonance imaging and contrast-enhanced magnetic resonance angiography. In the first exam, a solid extra-axial vascularized expansive process was observed in the anterior cranial fossa, predominantly in the median location, projecting to both sides, but more evident paramedian on the left, extending from the sphenoidal plane to the olfactory region (Figure 1). The tumor was located anterior to the pericallosal and callosomarginal arteries, close to the latter, but without signs of involvement.

Vascular branches were observed along the medial and anterolateral margins, with no signs of involvement of the sagittal venous sinus. The upper limit was anterior to the rostrum and genu of the corpus callosum, causing a slight impression on the latter. The tumor measured about 3.9 x 3.8 x 3.7 cm in the largest longitudinal, transverse, and sagittal diameters, respectively. A slight impression was observed on the frontal horns of the lateral ventricles, suggesting a lesion of meningothelial lineage, including meningioma.

Then, the neurosurgeon requested preoperative embolization of the tumor, which was performed under general anesthesia and full heparinization using percutaneous puncture of the right common femoral artery, with selective catheterization of the internal and external carotid arteries.

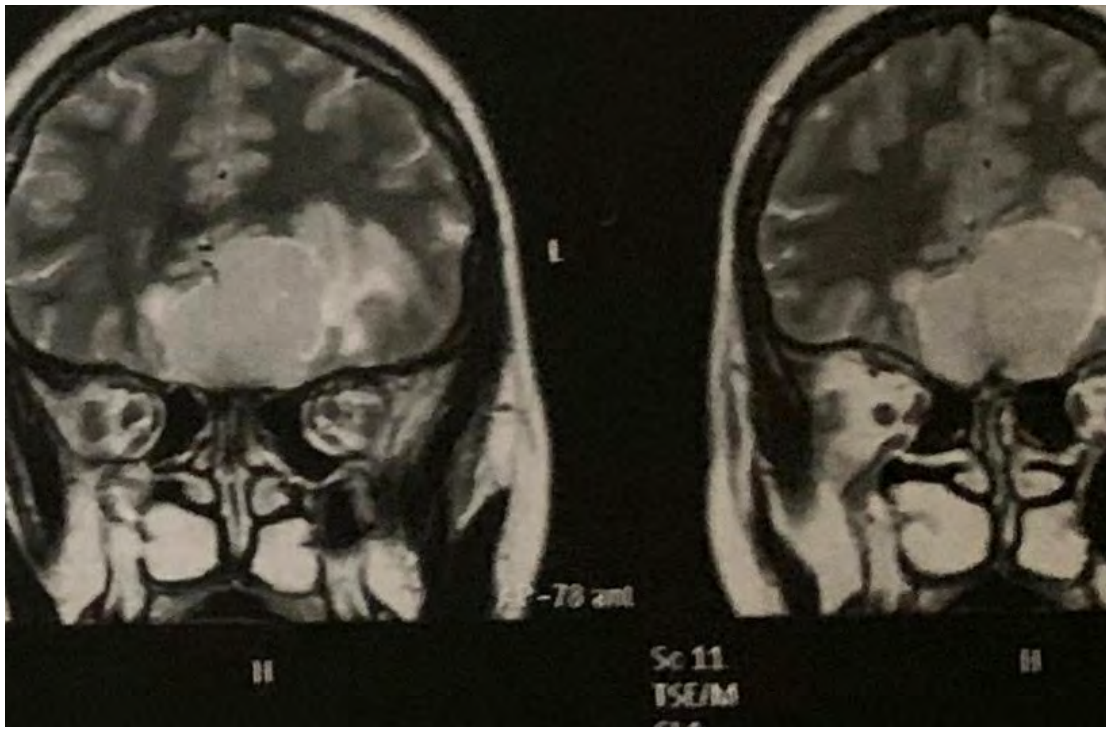

Figure 1. Magnetic resonance imaging of the brain, T1-weighted coronal section, demonstrating a solid extra-axial expansive process (meningioma) vascularized in the frontal basal plane of the olfactory groove and planum sphenoidale.

The observed aspects encompassed a hypervascularized lesion in the frontal region at midline with an opacification with discrete blush in the arterial phase and becoming intense in the venous phase, more evident through selective catheterization of the left internal and external carotid artery. The tumor-feeding vascularization originated from the left anterior and posterior ethmoidal arteries (branches of the left ophthalmic artery), crossing the cribriform plate of the ethmoid, with additional participation of the contralateral homonymous arteries.

Then, selective microcatheterization of the left middle meningeal, left accessory middle meningeal, and left maxillary arteries was performed, from which originated the branches that fed the periphery of the meningioma (Figure 2). Polyvinyl alcohol microspheres were used for embolization. The peripheral region of the tumor was devascularized, remaining the main vascular supply from the skull base. This region did not undergo embolization due to the risk of inducing ischemia in other brain regions.

After embolization, the patient was transferred to an intensive care unit conscious and underwent neurosurgery for tumor resection. About 90% of the tumor was removed, with a small portion remaining adherent to the skull base. The embolization was effective, as it caused atrophy of the tumor region most adherent to the optic chiasm, allowing the removal of the meningioma without damaging the optic chiasm and optic nerve; damage to these structures is considered the most significant risk in this surgery. The patient remained conscious, oriented, and without visual impairments in the postoperative period.

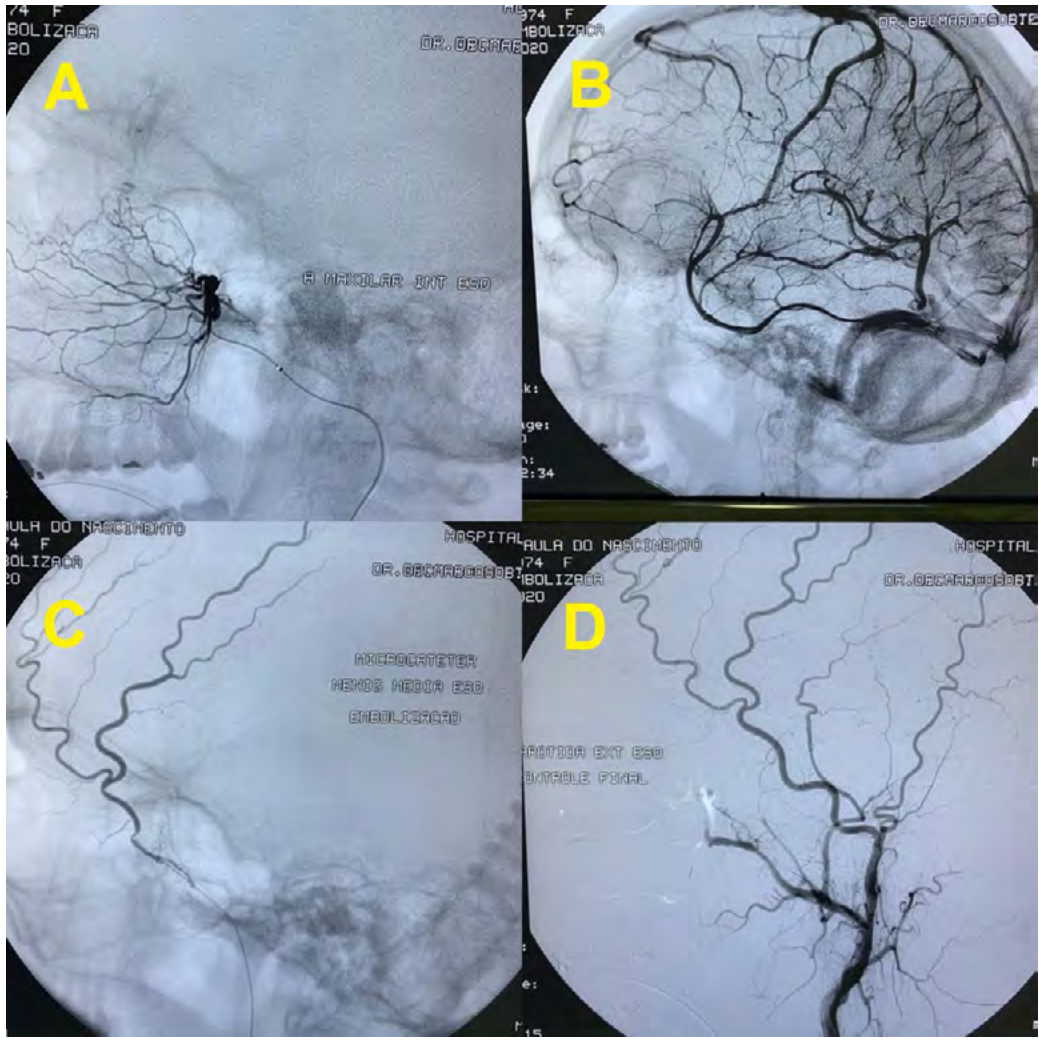

Figure 2. Brain arteriography. A: Embolization of the left maxillary artery; B: Meningioma; C: Embolization of the middle meningeal artery; and D: Arteriography of the left external carotid artery.

COMMENTS

Preoperative embolization decreases surgical blood loss, surgical time, and infection rates[7]. Furthermore, the procedure can improve the resectability of the meningioma by reducing its vascularization and firmness[6,7].

Several embolic agents are used for presurgical embolization. However, preoperative embolization still presents some potential risks, regardless of the agents used. Some risks include stroke due to irregular migration into other cerebral arteries[8], blindness, hemorrhage, and cranial nerve palsy[9]. Non-neurological complications related to endovascular treatment can also occur, including groin hematoma, femoral pseudoaneurysm, and arteriovenous fistula[10].

The overall complication rate of preoperative embolization ranges from 0% to 9%2,3. The present study is consistent with the literature, as no complications were observed during the procedure[10].

In the present study, the interval between embolization and tumor resection was 24 h; the ideal time interval between these procedures is not well established. Some studies recommend a minimum of 24 hours if the goal is to maximize tumor devascularization and reduce operative blood loss, and at least one week is recommended when attempting to optimize tumor resectability and decrease edema[11].

Regarding vascular supply, the anterior skull base meningiomas may exhibit a varied and complex vascular supply, as observed in the case studied. The anterior or posterior ethmoidal arteries (or both) are the main feeding arteries in less than 13% of skull base meningiomas. The vascularity of meningiomas in the olfactory groove and planum sphenoidale may arise from dural, transosseous, and even pial supply[12]. The middle meningeal arteries supply about 17% of sphenoid ridge meningiomas[13].

Tumors in the anterior skull base may also be fed by arteries that supply the edges of the superior orbital fissure, such as the anterior branch of the middle meningeal arteries, the recurrent meningeal branches of the ophthalmic and lacrimal arteries, the meningeal branches of the internal carotid artery, the tentorial branch of the meningohypophyseal trunk, the anterior branch of the inferolateral trunk, and the terminal branches of the internal maxillary artery[12]. These collateralizations predispose meningiomas to high vascularization. In a study of skull base meningiomas of the anterior and middle fossa, only one complete embolization was achieved in 55 attempts[14].

Early embolization of the feeding branches of the anterior and posterior ethmoidal arteries can reduce blood loss and assist in safe resection. However, vessel wall hypertrophy and hyperostotic sclerotic foramen lining can present challenges. The edematous brain tissue and large tumor size may hinder retraction, limiting access to the feeding vessels during surgery. Endovascular embolization of feeding vessels can result in significant complications, such as blindness due to unintentional retrograde embolization of the ophthalmic artery1.

A study evaluating the outcomes of meningioma embolization via the ophthalmic artery reported no visual changes in five patients. However, one developed transient oculomotor nerve palsy. The authors claimed that the chance of complications in embolization of the feeding branches arising from the ophthalmic artery is lower if the microcatheter is selectively placed distally to the central retinal artery, minimizing reflux of the embolic agent[15].

In conclusion, preoperative embolization has proven useful in meningioma surgery. Surgical time and intraoperative blood loss were reduced by the process, softening the tumor consistency. However, the possibility of embolic complications must be considered, and emergency craniotomy preparation should be maintained, mainly in patients with large meningiomas.

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