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Original Article

Preoperative transarterial particulate embolization of juvenile angiofibroma with intracranial extension: Technical and clinical outcomes

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ABSTRACT

Purpose: This retrospective study was constructed to assess the beneficial effects of preoperative transarterial particulate embolization of juvenile angiofibroma (JA) with intracranial extension in terms of intra-operative blood loss and local tumor recurrence.

Patients and Methods: This study included 20 male patients (mean age ± SD: 14.6 ± 7.2 years) with radiologically documented and histologically proved JA. All patients had intracranial extension and underwent surgical resection of the tumor after preoperative transarterial particulate embolization. The amount of blood loss was estimated and follow up scans were assessed for tumor recurrence.

Results: The mean amount of intra-operative blood loss was 560 ml and the mean amount of blood transfusion was 944.4 ml. Local residue/recurrence of tumor was seen in 5 patients (5/20); two patients with intracranial residual tumor (2/20), one patient with intracranial recurrence (1/20) and 2 patients (2/20) with extracranial recurrence. The technique of embolization was safe with no procedure related mortality. Minor complications were seen in all patients and major complication only in one patient.

Conclusion: Preoperative transarterial particulate embolization of JA with intracranial extension helped to perform surgery with mild amount of blood loss compared to the literature.

1. Introduction

Juvenile angiofibroma (JA) is a highly vascular benign yet locally aggressive tumor occurs in the head and neck mainly in prepubertal and adolescent males. It arises from the superior margin of the sphenopalatine foramen with usual extensions to the infratemporal and pterygopalatine fossae [1]. Intracranial extension of (JA) found in 20–36% of patients and is almost always extradural [2] which can occur to the middle cranial fossa and too much less extent to the anterior cranial fossa. The roots of middle cranial fossa extension are via the inferior and superior orbital fissures or directly through the roof of the sphenoid sinus [3] while the anterior cranial fossa extension is usually through the cribriform plate [4].

Management of juvenile angiofibroma has been evolved over the years from spontaneous regression after sexual maturation, to tumor irradiation or sclerotherapy, to surgical resection. Currently the most accepted therapeutic method for JA with intracranial extension is surgical resection [5,6], however recurrence of the tumor can be seen in up to 40% of those patients due to incomplete resection or failure to remove the tumor involving the bone [7,8]. Furthermore surgical resection may create a dilemma due to excessive bleeding [9]. Nicolai et al., reported significant complications and intra operative bleeding reduction in patients underwent preoperative embolization, in addition to minimizing the risk of residual tumor [10].

We aimed to retrospectively to assess the effects of preoperative transarterial particulate embolization of juvenile angiofibroma with intracranial extension on terms of intra operative blood loss.

2. Patients and methods

This retrospective study has been approved by the Institutional Review Board. Among 78 adolescent boys with radiologically documented and histologically proven JA surgically treated in our

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institute in the period from 1997 to 2015, 20 of whom presented with intracranial extension. Clinical, pathological and radiological data for the included patients were extracted from medical records. The enrolled patients' ages ranged from 6 to 20 years and the mean age was 14.6 ± 7.2 years. A written consent was obtained from one of the parents before angiography and embolization after clarification of the possible hazards of the technique. Pre and post contrast CT scan, pre and post contrast MRI including the nasopharynx, skull base region, paranasal sinuses, orbits and brain were performed in all patients before angiography and embolization for proper assessment of tumor extension. All patients were categorized as stage (III or IV) according to Fisch Classification [11] Table 1.

2.1. Technique of angiography and embolization

All procedures were done under local anesthesia using 10 ml of 2% Xylocain (Lidocain hydrochloride 20 mg/ml) and through transfemoral route. Selective catheterizations were performed using 4–5 French catheters and microcatheters. In the first 6 embolization procedures angiography and embolization of the tumor were performed in two separate sessions, where angiography was performed first, then one or two weeks later after careful review of the obtained angiograms to rule out vascular anomalies and aberrant internal to external carotid communications, embolization was performed in a second session. In the remaining embolization procedures after we had a considerable experience, both the diagnostic and the embolization procedures were carried out in the same session. Before embolization in all patients a detailed diagnostic angiography including bilateral external, internal carotid and vertebral angiograms was performed, then selective catheterization of the supplying artery of the tumor (the internal maxillary artery (IMA)) as distal as possible, either unilateral or bilateral was performed. Particle embolization was performed; type of particles used were at the discretion of the operator. Particles used were gelatin sponge (Gel foam) slurry (Upjohn company, Kalamazoo, MI, USA), Contour particles (Boston Scientific, Fremont, CA, USA) and PVA particles (Cook, Bloomington, Indiana, USA). We used the small size particles of the Contour (150–250 & 250–355 μm) and PVA (90–180 & 180–300 μm). Injection of the embolizing material was carried out very gentle by free hand technique to guard against reflux into the internal carotid artery (ICA). After completion of embolization, a post embolization angiogram was obtained by contrast media injection into the origin of supplying internal maxillary artery or external carotid artery (ECA). The technical outcome was assessed by the percentage of residual tumor blush on control angiograms and divided the results into two categories; suboptimal (70%–90%) and near complete (90%–99%) radiographic devascularization, by estimating the volume of residual tumor blush on final control angiogram in relation to the whole tumor bed volume in the pre-embolization angiograms.

Table 1
Fisch staging [11].

Stage I	– Tumors limited to nasal cavity, nasopharynx with no bony destruction
Stage II	– Tumors invading pterygomaxillary fossa, paranasal sinuses with bony destruction
Stage III	– Tumors invading infratemporal fossa or orbit **IIIA:** Without intracranial extension **IIIB:** Extradural, parasellar involvement
Stage IV	– Invades dura **IVA:** Without cavernous sinus, pituitary, or optic chiasm involvement **IVB:** With any of the above

2.2. Technique of surgery

Surgery was performed within 24–72 h after the embolization procedure. Two surgical approaches were used, anterior transfacial, sub-cranial and trans-maxillary approach, and cranio-facial approach. The surgeons were asked to calculate the amount of blood loss and the amount of blood transfusion during the operation. They estimated the blood loss amount by measuring the operative bed fluid collected by suction and subtracting the amount of saline administrated during the surgery.

3. Results

3.1. Clinical data

This study included 20 male patients with Juvenile angiofibroma and intracranial extensions. The primary clinical presentation before operation were; persistent nasal obstruction & recurrent attacks of sever epistaxis in all patients, unilateral cheek swelling in 5 patients, unilateral proptosis in 2 patients, unilateral deafness in 1 patient and trigeminal neuralgia in one patient. The different clinical presentations are outlined in Fig. 1.

3.2. Tumor extension, staging & blood supply

Tumor staging was determined by review of the imaging studies and physical examination including CT and MRI for all patients. Extension of tumor into the middle cranial fossa was seen in 19 patients (95%) [Right side in 11 (55%) and left side in 8 (40%)], while midline tumor extension to the anterior cranial fossa (Fig. 2) was seen only in one patient (about 5%). The tumors were classified according to Fisch classification to Stage IIIB in 17 patients (85%) & stage IVA in 3 patients (15%). Blood supply to the tumor was the internal maxillary artery (IMA) in all patients; bilateral supply was found in 4 patients (20%) and unilateral supply in 16 patients (80%). Blood supply from ICA was found in 5 patients.

3.3. Effectiveness and complication of embolization

Twenty-three embolization procedures were performed in 20 patients (three repeated embolization procedures were performed for 3 patients with recurrence). The internal maxillary artery (IMA) was embolized bilaterally in 4 patients and unilaterally in 16 patients. Embolization was done using gelatin sponge slurry in 7 procedures, Contour particles in 12 procedures and PVA particles in 4 procedures. The average time of the embolization procedure was 66 minutes. We achieved near total devascularization in 18 procedures with suboptimal devascularization in 5 procedures due to internal carotid artery supply.

Embolization was a relatively safe procedure with no intra or post procedural related mortality in our group. Minor complications as considered by referring physician were seen nearly in all patients except one patient who had a major complication in the form temporary visual loss. The vision improved gradually and the patient fully regained vision after one month. Review of the pre-embolization angiogram of this patient showed aberrant left ophthalmic artery arising from the left middle meningeal artery. Minor complication were mild to moderate pain in the embolized vascular territory and slight elevated temperature in all patients which were treated by simple analgesics, other complications were nausea in 3 patients, focal small necrosis in the ear pinna which was treated conservatively and local subcutaneous edema in one patient. The embolization complications are listed in Table 2.