Juvenile Nasopharyngeal Angiofibroma

Ted L. Tewfik, MD, FRCSC, FACS,
André K. W. Tan, MD, FRCSC, Khaled Al Noury, MD, FRCSC,
Khalid Chowdhury, MD, FRCPC, Donatella Tampieri, MD,
Jean Raymond, MD, FRCSC, and Te Vuong, MD, FRCPC

Abstract
This is a retrospective study of 17 patients with juvenile nasopharyngeal angiofibroma treated from 1983 to 1996. Patients with Stage I or II disease according to the Fisch classification system were treated surgically by a transpalatal approach. One patient underwent a Le Fort I osteotomy and down-fracture approach for access. Three patients underwent combined transpalatal and lateral rhinotomy for access, whereas one underwent a transcervical double mandibular osteotomy to facilitate the exposure. A patient with Stage IV disease underwent a combined subcranial frontonasal osteotomy plus a Le Fort I osteotomy for access to a massive angiofibroma. Initial surgical management prevented recurrence in 79% of patients. Two patients with intracranial extension were treated with primary irradiation therapy; their tumours became asymptomatic. Preoperative angiography and embolization were used to treat all surgical candidates. The use of newer craniofacial or subcranial techniques and infratemporal fossa approaches with osteotomies can provide access to large angiofibromas even when there is skull base or intracranial involvement. Surgical exposure may also be enhanced by the use of the Le Fort I osteotomy and down-fracture approaches.

Sommaire
Nous présentons une étude rétrospective de 17 patients avec angiofibrome nasopharyngé juvénile traités entre 1983 et 1996. Les patients avec des stades I ou II de Fisch ont été traités par approche trans-palatine. Pour un patient nous avons utilisé une ostéotomie de type Le Fort I. Chez 3 patients nous avons combiné une approche trans-palatine avec une rhinotomie latérale. Une approche trans-cervicale avec double ostéotomie de la mandibule a été choisie chez un autre. Chez un patient avec une pathologie massive de stade IV, une approche combinant des ostéotomies frontonasales sous crânienne avec une ostéotomie type Le Fort I a été nécessaire. Le traitement chirurgical initial a prévenu la récidive chez 79% des patients. Deux patients avec une extension intracrânienne ont été traités par radiothérapie avec disparition des symptômes. Angiographie et embolisation pré-opératoires ont été utilisés avant toute intervention chirurgicale. L'utilisation de nouvelles techniques crânio-faciales ou sous-craniennes et les approches de la fosse infratemporelle avec ostéotomies permettent accès aux gros angiofibromes même quand il y a atteinte de la base du crâne et même extension intracrânienne. L'exposition chirurgicale peut aussi être améliorée par l'utilisation d'ostéotomies de type Le Fort I.

Key words: angiofibroma, juvenile, nasopharyngeal

Juvenile nasopharyngeal angiofibroma (JNA) is a histologically benign, uncommon vascular tumour occurring primarily in male adolescents. This tumour was described by Hippocrates, but the term “angiofibroma” was first used by Friedberg in 1940. Juvenile nasopharyngeal angiofibroma constitutes only about 0.05% of all head and neck tumours. This lesion originates from the posterolateral wall of the nasal cavity, in close proximity to the superior aspect of the sphenopalatine foramen where the posterior part of the middle turbinate attaches. The tumour expands by bony erosion and displacement of adjacent structures. Often, this lesion is locally aggressive. It may extend from the nasal cavity to the nasopharynx, the paranasal sinuses, the orbit, and the pterygopalatine fossa and may even invade the skull base. Common sites of intracranial extension include the pterygoid fossa and the anterior and middle portions of the cranial fossa. Only rarely are the cavernous sinuses involved.
The cause of this tumour remains unclear. However, because it occurs most often in male adolescents, a hormonal target theory has been suggested. Other researchers have suggested that JNA arises from the nonchromaffin paranganglionic cells of the terminal end of the maxillary artery or as a desmoplastic response of the nasopharyngeal perineurium to an ectopic focus of vascular tissue.

The blood supply of JNA comes primarily from branches of the external carotid system, although feeders from the internal carotid artery could contribute to its vascularity. Because it is highly vascular, JNA has always presented a treatment challenge to surgeons. In the past, surgical excision of the tumour was complicated by extensive hemorrhage, the need for multiple blood transfusions, and, very often, inadequate resection. With improvements in diagnostic imaging techniques and the use of preoperative angiographic embolization, however, most authorities today recommend surgery as the preferred treatment method for JNA. Irradiation has been used as an adjuvant to subtotal resection, both for unresectable lesions and for those with intracranial extension. The use of radiotherapy as a primary treatment method has also been advocated, despite rare reports of malignant transformation.

The purpose of this study is to present our experience with the treatment of 17 patients from two North American academic centres and summarize the demographic data, clinical presentation, and the surgical management of this disease.

Method

This is a retrospective review of 17 Caucasian patients with JNA treated by the senior authors (TTT, KC) at our institutions in the last 13 years. All tumours were classified according to the Fisch system on the basis of computed tomography (CT) studies (Table 1). Three patients (two stage II and one stage IV) were treated in Denver, CO and the rest in Montreal.

All angiographic studies were performed by selective catheterization of the internal carotid arteries from the femoral artery with a 4F or 5F catheter and by supraselective catheterization of the distal internal maxillary arterial branches and other external carotid branches with a 4F or 2.5/5F coaxial system (Tracker 18, Target Therapeutics, Fremont, CA). A standard angiographic protocol for identifying all possible feeders was followed in all cases. After supraselective catheterization and identification of potentially dangerous external-internal carotid anastomoses, progressive embolization of the tumour's vascular bed was performed with polyvinyl alcohol particles or with Dextranspheres. Embolization was monitored by serial supraselective digital subtraction angiograms until the tumour blush had been completely obliterated. Branches arising from the internal carotid or ophthalmic arteries were not embolized.

Results

Demographic Data
Juvenile nasopharyngeal angiofibroma was diagnosed in 17 patients, all of whom were boys, from 1983 through 1996. The average age of the patients when they were first seen was 14 years (range: 8–17 years). The average length of follow-up was 63 months (range: 24–84 months).

Symptoms and Signs
Most of these patients were first seen with nasal obstruction (82%) and epistaxis (47%). Other complaints included facial swelling and headache (Table 2). The duration of these symptoms varied between 4 and 7 weeks before the initial consultation. Most nasal masses (82%) were visible upon initial physical examination. Other physical signs observed were orbital mass, periorbital or facial swelling, and proptosis (see Table 2).

Radiologic Studies
In this study, plain sinus radiography was used for 12 of the 17 patients and showed the nasopharyngeal mass in all 12. All 17 patients underwent CT scans with contrast enhancement (Fig. 1 shows an example of a preoperative CT), which demonstrated intracranial extension in three patients. Six patients, including the three with intracranial extension, underwent magnetic resonance imaging (MRI) as an adjuvant work-up procedure (Figs.

<table>
<thead>
<tr>
<th>Table 1 Classification System According to Fisch</th>
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<tbody>
<tr>
<td>Stage I</td>
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<tr>
<td>Stage II</td>
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<td>Stage III</td>
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<td>Stage IV</td>
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| Table 2 Symptoms and Signs of Patients with JNA When First Seen (n = 17) |
|-----------------------------|---------------------|---------------------|
| Symptom                     | Number of Patients (%)
<table>
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<tbody>
<tr>
<td>Nasal obstruction</td>
<td>14 (82)</td>
</tr>
<tr>
<td>Epistaxis</td>
<td>8 (47)</td>
</tr>
<tr>
<td>Facial swelling</td>
<td>2 (12)</td>
</tr>
<tr>
<td>Headache</td>
<td>4 (24)</td>
</tr>
<tr>
<td>Sign</td>
<td>---------------------</td>
</tr>
<tr>
<td>Nasal mass</td>
<td>14 (82)</td>
</tr>
<tr>
<td>Orbital mass</td>
<td>3 (12)</td>
</tr>
<tr>
<td>Proptosis</td>
<td>3 (12)</td>
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formed before irradiation therapy for control of epistaxis. For all embolized tumours, an immediate control angiogram showed devascularization of the parts of the tumour fed by branches of the external carotid arteries (Figs. 4 and 5). No complications were associated with embolization.

**Classification**
After the initial work-up had been completed, each tumour was staged according to the Fish classification system. Twelve of the 17 tumours (71%) were Stage I or Stage II, 2 (12%) were Stage III with cavernous sinus involvement, and 3 (18%) were Stage IV, with cavernous sinus involvement in two of these (Table 4).

**Management**
Eleven of the 12 patients with Stage I or II disease underwent primary surgical resection: 9 through a standard transpalatal approach, 1 through a combined lateral rhinotomy and transpalatal approach, and 1 through a transcervical external approach with "double" mandibular osteotomy because of extension of JNA to the pterygomaxillary fossa. For religious reasons (Jehovah's Witness), the remaining patient refused all additional treatment after embolization, including radiotherapy, and was lost to follow-up. One of two patients with Stage III tumours underwent a Le Fort I osteotomy with down fracture via a midface degloving approach. The second patient was treated via a lateral rhinotomy approach.

Three patients had intracranial extension and cavernous sinus involvement (Stage IV), and two of these were treated with primary external irradiation therapy. Minimal side effects were noted with no long-term
Table 3  Angiographic Findings of JNA Patients (n = 16)

<table>
<thead>
<tr>
<th>Origin of Vascular Supply</th>
<th>Number of Patients (%)</th>
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<tbody>
<tr>
<td>Ipsilateral IMA</td>
<td>15 (94)</td>
</tr>
<tr>
<td>Ipsilateral IMA and APA</td>
<td>1 (6)</td>
</tr>
<tr>
<td>Embolization procedure</td>
<td>16 (100)</td>
</tr>
<tr>
<td>Results devascularization</td>
<td>16 (100)</td>
</tr>
<tr>
<td>Complications</td>
<td></td>
</tr>
</tbody>
</table>

IMA = internal maxillary artery, APA = ascending pharyngeal artery.

sequelae. Neither patient showed any evidence of residual tumour or recurrence at 24 and 40 months follow-up, respectively. The third patient had a large angiofibroma indenting the cavernous sinus and extending to the posterior orbit, causing proptosis. Surgical excision was performed through a craniofacial-subcranial approach with nasofronto-orbital osteotomy combined with a Le Fort I approach for wide access after preoperative embolization (Figs. 6–8). The posterior table was removed by the neurosurgeon at the same sitting and the portion of the tumour adjacent to the cavernous sinus was peeled off.

All patients who underwent primary surgical resection were treated with preoperative selective angiographic embolization. The average surgical blood loss was 800 cc (range, 450–1000 cc). Only two patients required blood transfusions. All patients were monitored in the intensive care unit for an average of 1.2 days postoperatively. Nasal packing remained in place for an average of 3.4 days. For most patients (10), the nasal packing was removed in the operating room. The average length of hospital stay was 6.5 days.

Recurrence

Every patient was seen 3 months postoperatively and twice yearly thereafter. A CT scan (for the patients seen before 1993) or MRI scan was done in the second postoperative visit. The physical examination included nasopharyngoscopy at every visit. At follow-up (26 months to 8 years), residual tumour or recurrent disease was detected in 4 of 14 patients (28%) treated with primary surgical resection. Two of these patients were treated with preoperative embolization and further surgical resection. One patient underwent surgical resection through a Le Fort I osteotomy approach without further embolization; his initial operation had been performed through a transpalatal approach. The second patient had transpalatal removal as well. One patient’s tumour received its blood supply partially from the internal carotid system; this patient had an incomplete resection and postoperative irradiation therapy. The fourth patient had intracranial tumour extension and underwent irradiation therapy as secondary treatment (Table 5).

Discussion

Historically, various methods have been used to treat patients with JNA, including cryotherapy, sclerosing therapy, hormonal treatment, irradiation therapy, surgery, and embolization.22 Sporadic reports have suggested that spontaneous regression may occur in patients older than 20 years.23,24 However, this historical information indicates that surgical resection and irradiation therapy are the most successful treatments. In the current study, 14 of 17 patients were treated with primary surgical resection. Patients with limited involvement of the skull base (Fisch Stages I and II) were often treated through a transpalatal approach. Two patients underwent primary external beam irradiation therapy because the results of the initial CT scan indicated intracranial involvement. Another patient with extensive involvement of the skull base, the orbit, and the cavernous sinus was successfully treated with surgical resection through a craniofacial-subcranial approach. Thus far (14–40 months), none of these three patients with intracranial involvement has suffered
Table 4 Staging of Patients According to Fisch Classification System

<table>
<thead>
<tr>
<th>Stage</th>
<th>Primary Disease (Number of Patients)</th>
<th>Recurrence (Number of Patients)</th>
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<tbody>
<tr>
<td>I</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>II</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>III</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>IV</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Two additional patients whose tumours recurred after primary surgical resection were subsequently treated with irradiation therapy, one for a small intracranial recurrence.

Advocates of primary irradiation therapy have reported an 80% success rate after initial treatment. Despite this relatively favourable response to irradiation, the authors urge caution in the use of primary irradiation because other researchers have reported the possibility of malignant transformation. The potential for osteoradionecrosis and damage to the optic nerve leading to blindness needs to be considered. Radiation doses of 3000 to 4000 cGy have been used to treat JNA. Furthermore, the decision to use primary irradiation therapy to treat a surgically resectable and benign tumour in young patients needs to be weighed carefully. When irradiation is used to treat intracranial extension or recurrent tumour, precision targeting with stereotactic radiosurgery (Gamma Knife) should be considered because of the potential advantage of delivering lower doses of radiation to the surrounding normal tissues along the skull base.

A transpalatal, transmaxillary, or sphenoethmoidal approach can be used for small tumours (Fisch Stages I and II). Large tumours, especially those with extensive skull base or intracranial involvement, require a more extensive approach to lower the increased risk of complications and the likelihood of tumour recurrence. Obviously, the approach chosen should be carefully tailored to the extent and location of the JNA as delineated by imaging studies. The infratemporal fossa approach described by Fisch may be advantageous in treating JNA with considerable lateral extension. However, some of the disadvantages of this approach include permanent conductive hearing loss, numbness of the lower lip, and temporal depression caused by use of the temporalis muscle flap. The infratemporal fossa approach can be combined with a midface degloving approach for transmaxillary access to the JNA. The midface degloving approach can be combined with a Le Fort I or hemi-Le Fort osteotomy to further improve posterior access. Janecka et al. described the facial translocation approach combining an external Weber-Ferguson incision with a coronal incision for a frontotemporal craniotomy or midface osteotomies for access. In addition to facial scars, however, transection and reanastomosis of temporal branches of the facial nerves with sacrifice of sensory nerves may create some morbidity when this combined craniotomy approach is used. Raveh et al. have described an extended subcranial approach, using an osteotomy of the frontonasal-orbital frame, that
provides improved access to the sphenoid or sphenoidal planes while avoiding frontal lobe retraction or external facial incisions. This improved access to the anterior skull base and clival sphenoidal planes permits optic nerve decompression with exposure of the medial aspect of the cavernous sinus for removal of JNA in this area. Frontal lobe retraction is avoided, and water-tight realignment of the dura is feasible through this approach.

Improved imaging techniques using CT scanning and MRI in combination with the development of newer skull base approaches, as described above, have increased the likelihood of complete surgical resection of JNA with intracranial involvement while resulting in decreased patient morbidity. Improvements in anaesthesia and monitoring techniques, as well as the use of hypotensive anaesthesia, have also assisted in the development of these skull base approaches. Recent advances in angiographic techniques permit preoperative embolization of the tumour’s feeding vessels, thus reducing intraoperative blood loss, a common complication in the past. In the current series, all patients treated with surgical resection also underwent preoperative embolization, resulting in an average intraoperative blood loss of less than 800 cc. The two patients treated in this series with primary irradiation for intracranial involvement would probably now undergo embolization and surgical resection using some of the newer skull base approaches discussed above. Close et al., Neul, Ward and Abeam, May, and Economou et al. reported similar results. Recurrent disease or JNA with intracranial extension that cannot be removed without damage to vital structures by using these newer skull base techniques may still require irradiation as an adjunctive treatment. Postoperative CT scanning or, preferably, MRI permits close follow-up for residual or recurrent disease.

References
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