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Review Article

Juvenile Nasopharyngeal Angiofibroma: Key Points for Global Approach and Management

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Abstract

Juvenile nasopharyngeal angiofibroma (JNA) is a rare, benign, vascular neoplasm. Unilateral nasal obstruction, epistaxis, and lobulated mass extending into the nasopharynx are the most common symptoms. The diagnosis is based on clinical and imaging features and should be suspected in male adolescents presenting this triad. Treatment and surgical approaches are challenging, and lack of optimum management protocols still causes ongoing debate. In this review, I discuss the available surgical and clinical treatments for every tumor stage and focus on the techniques for optimal tumor resection. I also describe my surgical routine step by step and highlight tips and pitfalls based on thirty years of extensive study and practice which together may contribute to improved JNA management.

Keywords: Angiofibroma; Skull Base; Nasopharyngeal Neoplasms; Embolization; Therapeutic

Introduction

Juvenile nasopharyngeal angiofibroma (JNA) is a rare, benign, vascular neoplasm accounting for less than 0.5% of all head and neck tumors [1]. It develops mainly in male adolescents between the ages of 14 and 25 and grows in an unpredictable pattern [2]. JNA should be suspected in adolescents presenting the triad of unilateral nasal obstruction, epistaxis, and lobulated mass extending into the nasopharynx [3].

Predominance in adolescent males and the presence of androgen receptors suggest hormonal influence on tumor growth [4,5]. JNA typically originates from the first branchial arch artery, and between embryological day 22 and 24 it usually regresses to form a venous plexus in the sphenopalatine foramen. One theory is that JNA is caused by an incomplete regression of this vascular plexus which creates a vascular malformation vulnerable to form and grow JNA by hormonal stimulation during adolescence [6,7].

Surgery is considered the gold standard in JNA management. Several approaches are currently available, ranging from microendoscopic techniques to midfacial degloving and even infratemporal fossa resection [8,9].

Discussion

My experience over the last 30 years has involved many techniques, and today the transnasal endoscopic technique is my preferred surgical method for all patients. Use of current endoscopic technology may reduce the risk of geographic loss and improve the possibility of postoperative local control. Moreover, endoscopic approach can prevent facial scarring, deformity, and dysfunction, leading to better patient quality of life. I have witnessed steady progress in lesion treatment due to the development of improved techniques in skull base surgery (Figure 1).

The limits of endoscopic technique remain undefined, and during the last two decades have gradually been moving toward more

Figure 1: CT scan and anatomical specimen showing a small tumor that was removed entirely using endoscope technique.

advanced tumors as seen in the two cases below (Figure 2). The low prevalence of these lesions limits the number prospective studies, so the literature contains mainly retrospective studies and case series.

Figure 2: A. MRI showing JNA invading intracranial and parapharyngeal structures that were successfully treated using endoscope technique combined with Caldwell–Luc access. B: CT scan showing JNA invading intracranial structures that were successfully treated using endoscope technique.

A recent analysis comparing endoscopic and traditional approaches suggests that although the entry gate for instrumentation is greater during an open approach, it does not create a substantially larger working space or visual field compared to the endoscopic approach.

The endoscopic endonasal approach enhances tumor visualization by distinguishing it from adjacent tissues and therefore improves dissection. It is considered the treatment of choice. Although the smaller gate presents a barrier for instrumentation, visualization to the surgical target is provided by endoscope. The open approach is only 6.8% larger than the surgical chamber [10-12].

Successful JNA management depends on surgeon experience, skill, and careful patient selection. Despite general indications, the most suitable approach should be discussed for each patient.

Preoperative assessment performed on all patients is based on nasal endoscopy, paranasal CT scans, magnetic resonance images, and arterial angiography.After analyzing the exams,the tumors are staged [13]. An external approach should be considered in selected cases due to massive intracranial extension and either optic nerve or carotid artery encasement. Greater under standing of skull base anatomy, radiological studies, and technological advances offers prognostic value and guides the approach [14,15].

All patients undergo an embolization procedure 24 to 48 hours before surgery. Several studies show the procedure reduces intraoperative bleeding to less than half compared to non-embolized patients. In some patients,presence of feeding vessels from the internal carotid artery (ICA) is detected,and they should be uninvolved in the procedure [16-19]. A recent data metaanalysis from five studies has demonstrated that ICA and bilateral arterial supplies are predictive of increased blood loss and recurrent disease [20].

Care must be taken during embolization, as JNA contains high flow arteriovenous fistulas (Figure 3 A). Risk of vision loss due to central retina artery occlusion is significant.

Another risk we must consider is embolism through the ICA, potentially resulting inneurovascular acidentes (Figure 3B) [21].

Figure 3: A. MRA showing arteriovenous fistulas. B. MRI showing transversal and coronal view of a stroke that occurred during tumor embolization. Although a necessary procedure, the risk of stroke should be considered because JNA has high arteriovenous fistula.

The first strategy in addressing a JNA tumor is to considering its relationship with the sphenoid bone, especially the pterygoid process and larger sphenoid wing (Figure 4). The base of the pterygoid process (BPP) forms the posterior boundary of the pterygopalatine fossa. Three foramens open into the back wall of the fossa; the pharyngeal canal (PC), the vidian canal (VC), and the foramen rotundum (FR).

Figure 4: The dashed arrow on the right represents the course of endoscopic dissection on the pterygoid base and then along the infratemporal surface of the GWS. The yellow and black arrows depict the course of the maxillary nerve (V2) and internal maxillary artery (IMA) in the pterygopalatine fossa.

The tumor commonly originates around the sphenopalatineforame and initially involves the nasal cavity, nasopharynx, and paranasal sinuses, which maybe eroded. The tumor can also expand into the pterygopalatine fossa, infratemporal fossa, orbit, and even the skull base [22].

The challenges are significant lesion extension beyond neurovascular structures and anatomical restrictions.

During a surgical procedure, several important structures located in the region deserve extreme caution; the internal carotid artery, v2 and v3 branches of the trigeminal nerve, internal maxillary artery with its branches, pterygoid muscles, and the Eustachian tube.

One of the main limitations in JNA surgery is the ICA. We must be more familiar with the main anatomical marks that are involved with it, V2 superior and lateral to the vidian nerve and V3 indicating the petrous segment of the ICA.

The foramen ovale is just anterior to the petrous segment. When drilling V2 and V3, the ICA is anterior and superior to the petrous segment (horizontal segment), and V3 blocks the view of the proximal petrous segment of the ICA.

In case additional infrapetrous approach is required, the surgeon must resect the eustachian tube and fibrocartilaginous tissue of the foramen lacerum after a medial maxillectomy and resection of the pterygoid plates.

The transpterygoid route provides a corridor that allows access to the suprapetrous area which is bounded by the paraclival and lacerum segments of the ICA.

In extensive tumors and when accessing several regions is necessary, I recommend a combination of techniques. Image guidance, combining external incision and tumor debulking may also be necessary.

For large tumors, the combination with The Caldwell–Luc or a partial maxillectomy is usually performed to provide better endoscopic visualization of and access to the pterygopalatine fossa and infratemporal fossa [23].

Most lesions are well treated with simultaneous access. Tumors that exhibit significant anterior extension may be better treated using an endoscopic approach and one or two simultaneous accesses.

The likelihood of significant complications with this combined approach is low [24,25]. The surgical procedure plan should be developed based on the size and location of the tumor.

The procedure may involve the following techniques:

- Perform uncinectomy followed by a large middle antrostomyto expose the posterior wall of the maxillary sinus. Then execute ethmoidectomy with middle turbinate resection and a large sphenoidectomy (Figure 5)

Figure 5: Before the endoscopic approach (Step 1), we can use a strategy to reduce bleeding. Proceed with an injection of 2% lidocaine solution with vasoconstrictors, transorally, by the greater palatine foramen, to reach the pterygopalatine fossa and produce vasoconstriction of the maxillary artery.

- For tumors with lateral extension, partially remove the maxilla with or without inferior turbinate resection.
- For tumors with infratemporal extension, locate V2 and V3 landmarks to access the infratemporal fossa.
- Proceed with pterygoid resection for the entire infratemporal fossa approach.
- Remove the sphenoid sinus floor at the same level as the clivus, until exposing the vidian foramen, an important landmark to locate the internal carotid.
- Peform transseptal, posterior septectomy, or anterior antrostomy with a second surgeon to assist with the resection.
- Cut the tumor into smaller pieces using a Colorado Micro Dissection needle or coblation wand to facilitate dissection.
- For large tumors (Stages III to V), a combination of endoscopic approach with Caldwell–Luc or a partial maxillectomy can be performed to provide better endoscopic visualization of and access to the maxillary sinus and pterygopalatine fossa.

Traditionally, the infratemporal fossa has been the most challenging area to be reached (Figure 6), and tumors occurring in this region have been systematically addressed over the years through external access. Currently, however, these tumors may be completely removed via endonasal surgery. Resecting the entire pterygoid process is sometimes necessary to access the infratemporal fossa and parapharyngeal regions [26,27].

Figure 6: MRI showing a left infratemporal fossa JNA. The image displays a lesion and shows angles to access the tumor: tranasalseptotomy (green), ipsolateral endonasal (yellow), endoscopically-assisted ipsolateral Caldwell–Luc (red), and endoscopically-assisted transtemporal (blue).

In most situations, some degree of involvement or combination of the infratemporal fossa roof, cavernous sinus, and sphenoid body is associated with an increased relapse rate. Invasion of the sphenoid diploe is an important indicator of recurrence, and meticulous removal of the infiltrated cancellous bone is recommended. The literature indicates that drilling the sphenoid base has been shown to reduce recurrence rates.

No standard therapeutic approach exists for recurrent and unresectable JNA (Figure 7). Recurrent disease occurs with in the third post operative year, supporting current consensus of a minimum of a three-year follow-up. For residual or recurrent tumors, inspection of the nasal cavity with endoscope is indenspensible postoperatively, and I recommend an MRI every six months [9].

Na incomplete resection may not progress, and involution of remnant may occur. The recurrence rate for JNA remains around

Figure 7: CT axial view showing recurrent tumor that invaded the middle cranial fossa.

20%, and the primary fator is the stage at the time of diagnosis [28]. The presence of intracranial extension, apart from increased risk of postoperative recurrence, also has potential morbidity related to the intracranial surgery. Appropriate management of intracranial tumors still raises debate.

In the case of carotid encasement (Figure 8), the carotid artery must be studied, and na adequate procedure could envolve intravascular stent, occlusion test, intratumoral embolization, or expectant management [8,9,26].

Figure 8: A. Axial CT scan showing a residual tumor with a right internal carotid artery encasement. B. Coronal MRI displaying a right internal carotid artery encasement.

Although associated with tumor regression and symptom relief, radiation therapy (RT) may lead to serious complications, including secondary malignancies, hypopituitarism, cataract, growth retardation, and encephalopathy. The decision to use RT in advanced JNA should be based on the surgical intervention risk versus the risk of RT complications. Nevertheless, adjuvante radiotherapy is sometimes recommended after incomplete resection [29,30].

Adjunctive treatment with cytotoxic (AI) drugs remains experimental. The nonsteroidal androgen antagonist, flutamidehas demonstrated some effectiveness in pospuberal adolescents [31]. The estrogen receptor antagonist, glucocorticoids, and b-Blockers are in need of further investigation [8,9].

Conclusion

Due to its abundant vasculature, deep location in the skull, important neurovascular structures, and posterior and medial borders without stable and fixed anatomical structures, the JNA procedure has always presented challenges, even for highly skilled surgeons.

With the evolution of available endoscopic techniques and the ability to incorporate a Caldwell– Luc or partial maxillectomy(endoscopicDenker's approach)when appropriately planned, the surgery is associated with a lower rate of residual lesions. Currently, no standard treatment for all tumors exists. Treatment choice should be decided case by case and consider the lesion stage, size, and degree of extension and invasion.

The approach above offers the advantage of less morbidity, higher efficacy of resection, and better control of the internal carotid artery with only minor postoperative complications. By using this technique, after thirty years of study and practice, we can now prevent facial scarring, deformity, and dysfunction, therefore leading to a better patient quality of life.

Although unresectable tumors and recurrances remain challenging, further research and continuing development of the techniques should contribute to improved future treatment results for this complex lesion.

Bullet Point Summary

- Juvenile nasopharyngeal angiofibroma (JNA) is a rare, benign, vascular neoplasm

- Treatment and surgical approaches are challenging, and lack of optimum management protocols still causes ongoing debate
- Manuscript discusses available surgical and clinical treatments for every tumor stage and focuses on techniques for optimal tumor resection
- I describe my surgical routine step by step and highlight tips and pitfalls based on thirty years of extensive study and practice which together may contribute to improved JNA management.

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