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Review Article

Juvenile Nasophryngeal Angiofibroma,New Aspects in Management

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Abstract

Juvenile nasopharyngeal angiofibroma (JNA) is a rare, benign and locally invasive tumor. Massive bleeding because of vascularity of tumor and postoperative recurrence are potential problems of management. Endonasal approach reduces the rate of postoperative recurrence, intraoperative bleeding, and complications of surgery, time of operation and duration of hospitalization. In this article, we review the indications and contraindications of endoscopic surgery, indications of radiotherapy in treatment of JNA and our policy in postoperative follow-up and management of patients.

Keywords:

Endoscopic approach, Endoscopic surgery, Juvenile nasopharyngeal angiofibroma

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Introduction

Juvenile nasopharyngeal angiofibroma (JNA) is a rare and benign vascular mass that comprises less than 0.05% (1) of head and neck tumors. Most patients are young males. Some surgeons believe that JNA is a tumor or neoplasm (2), but according to new researches, this vascular mass is a hamartoma or vascular malformation and originates from incomplete regression of some branchial arteries (3,4). The effects of sexual hormones and some vascular and endothelial factors are proposed in the growth and development of JNA; although application of sexual hormones in the treatment of JNA has no proven efficacy (5,6). Histologically, JNA is a benign tumor but local invasion is the predominant feature of this mass (7). In contrast to its rarity, this tumor is interesting because of its clinical impact, potential ability for morbidity and mortality and difficultly of surgical treatment.

Clinical Manifestations and Diagnosis

Clinical course of JNA is slow and has a progressive expansion with bone erosion and extension through the fissures and foramina of the skull base. Unilateral or bilateral nasal obstruction, recurrent epistaxis, proptosis and facial asymmetry are its common signs and symptoms. Typically in boys or young men complaining from recent nasal obstruction and recurrent epistaxis, this diagnosis should be considered. On nasal endoscopy a soft vascular and submucosal mass is seen beyond the middle turbinate. Diagnosis is confirmed by CT with IV contrast or contrast enhanced MRI. Considering the probability of severe bleeding after biopsy, preoperative tissue diagnosis is done only in rare cases which imaging data for JNA diagnosis are not ensuring enough. The following findings in CT or MRI are suggestive of its diagnosis: (1) tumor origin area is always at the level of the pterygopalatine fossa, (2). After IV injection, the mass exhibits a hypervascular appearance (3); Tumor has a distinct pattern of growth and extension (8). Preoperative angiography is useful for the evaluation of feeding vessels of the mass and also embolisation, especially in advanced tumors.

Extension of Tumor

JNA usually originates from the superior margin of the sphenopalatine foramen. Initially it grows submucosally and subperiosteally in the nasopharyngeal roof. Then the tumor reaches the septum and posterior part of the nasal cavity. Gradually it involves anterior wall of the sphenoid sinus (9) through which it invade basisphenoid and clivus posteroinferiorly. Lateral and anterior extension through the pterygomaxillary fissure causes bulging of posterior wall of the maxillary sinus into the sinus cavity. Further lateral extension involves the infratemporal fossa. Tumor extends upwards through the base of pterygoid processes into the middle cranial fossa. Other routes for intracranial extension are through foramen lacerum, along the maxillary nerve, pterygoid canal or superior orbital fissure (8,10). There are great obstacles for surgical management in almost 20% of patients because of the tumor penetration into the skull base (11). One of the important features of this tumor is tendency of JNA to recur after surgical resection. Erosion of the skull base and extension through neurovascular canals explain such characteristics of the tumor. Intracranial involvement frequently is extradural (1,12). Although in our experience all cases of primary JNA which extend to the skull base and intracranial space are extradural, some revision cases or recurrent JNAs can involve dura and become intradural.

Staging

Multiple staging systems have been proposed for grading JNA. The most commonly used system is Radkowski's grading system (Table 1) (13,14).

Table 1: Current staging systems for juvenile nasopharyngeal angiofibroma

Source	Stage I	Stage II	Stage III	Stage IV
Onerci et al, 2006	Nose, NP, ethmoid and sphenoid sinuses or minimal extension into PMF	Maxillary sinus, full occupation of PMF, extension to anterior cranial fossa, limited extension into ITF	Deep extension into cancellous bone at pterygoid base or body and GW sphenoid, significant lateral extension into ITF or pterygoid plates, orbital, cavernous sinus obliteration	Intracranial extension between pituitary gland and ICA, tumor localization lateral to ICA, middle fossa extension, and extensive intracranial extension
Radkowski et al, 1996	Stage Ia: limited to nose or NP; Stage Ib: as in stage Ia,with extension into ≥1 sinus	Stage IIa: minimal extension through SPF and into medial PMF; Stage IIb: full occupation of PMF, displacing posterior wall of maxilla forward,orbit erosion, displacement of maxillary artery branches; Stage IIc: ITF, cheek, posterior to pterygoid plates	Erosion of skull base: Stage IIIa: minimal intracranial extension; Stage IIIb: extensive intracranial extension±cavernous sinus	TNA
Andrews et al, 1989	Limited to NP; bone destruction negligible or limited to SPF	Invading PPF or maxillary, ethmoid or sphenoid sinus with bone destruction	Invading ITF or orbital region: Stage IIIa: no intracranial; Stage IIIb: extradural, (parasellar) involvement	Intracranial, intradural tumor: Stage IVa: with Stage IVb: without cavernous sinus, pituitary or optic chiasm infiltration
Chandler et al, 1984	Limited to NP	Extension into nasal cavity or sphenoid sinus	Tumor into antrum, ethmoid sinus, PMF, ITF, orbit and/or cheek	Intracranial extension
Sessions et al, 1981	Stage Ia: limited to nose and NP; Stage Ib: extension into ≥1 sinus	Stage IIa: minimal extension into PMF; Stage IIb: full occupation of PMF with or without erosion of orbit; Stage IIc: ITF with or without cheek extension	Intracranial extension	NA

Abbreviations:
GW, greater wing; ICA, internal carotid artery; ITF, intratemporal fossa; NA, not applicable; NP, nasopharynx; PMF, pterygomaxillary fossa; PPF, pterygopalatine fossa; SPF, sphenopalatine foramen

The common feature of these staging systems is that the stage of tumor depends on the extent and site of tumor involvement. The new staging system of University of Pittsburgh Medical center (UPMC) incorporates the following prognostic factors that were not addressed by prior staging systems: route of extension and residual vascularity following embolisation (Table 2) (14).

Table 2: University of Pittsburgh Medical Center (UPMC) staging system for angiofibroma

Stage	UPMC Staging System
I	Nasal cavity, medial pterygopalatine fossa
II	Paranasal sinuses, lateral pterygopalatine fossa; no residual vascularity
III	Skull base erosion, orbit, infratemporal fossa; no residual vascularity
IV	Skull base erosion, orbit, infratemporal fossa; residual vascularity
V	Intracranial extension, residual vascularity; M, medial extension; L, lateral extension.

We think these classifications are not exactly suitable for all JNAs which are endoscopically operated; for example JNA can invade the infratemporal fossa or retropterigoid space (stage IIc in Radkowski's grading system) and this part of the tumor is more difficult to remove and has a higher risk of bleeding in comparison to tumors which invade planum sphenoidal and enter the intracranial space (stage III a in Radkowski's grading system). Although, the UPMC classification of JNAs is a more acceptable and accurate classification, but it is only on the basis of angiography. Today and based on the present literature angiography is not necessary for all JNA cases (15).

Management

Different therapeutic strategies have been proposed in the management of JNA during the recent years: radiotherapy, hormone therapy, cryotherapy and electrocoagulation; Nevertheless, in most cases, surgery is the treatment of choice (1,8,9).

Depending on the tumor's location, its dimensions and experience of the surgeon, different surgical techniques have been used. Transpalatal, lateral rhinotomy, midfacial degloving, Lefort 1 osteotomy and recently endoscopic techniques are used as common surgical approaches. An optimal surgical technique should have the ability to control bleeding, minimize destruction of healthy tissue and reduce its recurrence rate (9,13). Currently, endoscopic approaches are applicable in most tumors, even in some large tumors with limited involvement of the middle cranial fossa. Comparing them with traditional techniques, endoscopic approaches have some advantages: prevention of facial incisions, no need for removal of facial bones and plating for reconstruction. These maneuvers result in growth asymmetry in the child's face. Endoscopy has the ability of multiangle vision with magnification of the mass and surrounding tissue (1,10,16). The surgeon can find the residual tumor mass beyond the corners and inaccessible areas (1). Time of operation, duration of hospitalization and complications such as postoperative lacrimation, facial anesthesia, trismus and pain are less than the traditional techniques (9,10,17).

In a systematic review, Hwang evaluated 26 studies including 547 patients. 62% of the patients underwent traditional open surgery. Endoscopic surgery was performed in 26% of patients. Combination of open and endoscopic surgery was used in 12%. Recurrence rate, intraoperative bleeding and complications' rate was compared between these groups

whereas the endoscopic approach was significantly better than the traditional one (18).

In the same time, the endoscopic technique has some limitations as well: loss of ability to work with both hands and loss of vision due to massive bleeding in the surgical field. Cooperation of two surgeons during surgery resolves such problems to some degrees (7,17,19).

There are other reports on endoscopic excision of high stage tumors even in small stage III masses (7). Involvement of the infratemporal fossa, orbit and parasellar areas is not a contraindication for endoscopic surgery while endoscopic excision of the tumor in these areas is a great challenge for the surgeon. Surgical access and resection of the tumor in these difficult parts of the skull base are also problematic with conventional open approaches (7).

In brief, the best candidates for endoscopic excision of JNA are stage IA to stage IIb Radkowski tumors with limited pterygopalatine
fossa involvement (16), this strategy is also true for stage IIIa and midline expansion of stage IIIb JNAs. Limited conventional approaches such as sublabial incision and pushing forces are added for stage IIc tumors. Combined endonasal and external approaches are recommended in advanced tumors with extensive involvement of the cavernous sinus or internal carotid artery. In patients with intracranial involvement, midfacial degloving technique or infratemporal fossa approaches are applicable. Other alternative in extensive intracranial involvement is the excision of intra- and extra cranial components of the tumor in two separate sessions. Nicolai believes that extensive feeding from the internal carotid artery (ICA), surrounding of this artery by the tumor or intracranial extension of the tumor lateral to the paraclival segment of ICA are contraindications of endonasal surgery (10).

Preoperative Embolisation

Many surgeons believe that embolisation of the tumor's feeding vessels some days before surgery (1-2 days prior to surgery) reduces intraoperative bleeding and make surgery easier (20,21). Douglas and Wormald stated that preoperative embolisation reduces intraoperative blood loss to less than 1000 ml (7). In cases of a large JNA, the tumor may receive blood from two sides necessitating bilateral embolisation. In the presence of skull base erosion, the tumor may receive branches from the internal carotid artery. Embolisation of the contribution from the ICA is not practical (22). In some centers preoperative embolisation is a prerequisite for endoscopic surgery in all cases of JNA (14). This idea is questionable. It seems that preoperative embolisation in small tumors has no role in reducing intraoperative bleeding (15). Lloyd believes that preoperative embolisation increases the risk of leaving residue during surgery (23). This idea has not been proved in many other similar studies.

Radiation Therapy

There are some doubts about the use of radiation therapy in JNA treatment because of the potential probability of sarcomatoid changes in the tumor and induction of malignant tumors by radiation in the future years (10). Radiation therapy should be restricted to especial cases of unresectable disease. Some surgeons recommend this type of treatment in advanced tumors or in recurrent cases that have no chance of total tumor resection with acceptable morbidity (8).

Recurrent Tumor

Generally, recurrence of the tumor is a sign of residual disease. Many factors reduce the ability for local control: invasion to sphenoid or pterygoid process, involvement of the infratemporal fossa, foramen lacerum and cavernous sinus. (8) For prevention of tumor recurrence,

endoscopic surgery was accomplished paying respect to two important rules. The first tip is that the JNA was never resected in a piecemeal manner. In our experience, the tumor bulk was pushed to the nasopharyngeal space using a meticulous mechanical dissection. When progressing toward the nasopharyngeal area, every accessory division of the tumor was handled exclusively. For example, the tumor extension toward pterygomaxillary fissure was approached via removing the posterior wall of the maxillary sinus and force insertion toward pulling it out of that region. After the main parts of the tumor were led into the oropharyngeal and nasopharyngeal areas, they were removed completely by using a mouth gag instrument and a large-size forceps intraorally.

The second tip is at the end of the operation; a search was conducted for any residual tissues and abnormal bleeding sites that could denote remnant disease. We strongly recommend drilling of the clivus, pterygoid root and sphenoid diploe in patients with obvious involvement of bone in these locations. This strategy reduces the chance of leaving residue in the skull base (9). Because of limitations of our current knowledge about the natural history of JNA and the behavior of residual disease, we recommend to monitor the existence of residual disease with contrast enhanced imaging. This shows probable postoperative changes of residual tumor (10).

When clear signs of constant tumor enlargement are visible or when the patient is symptomatic, resection of the recurrent or residual tumor is decided. Spontaneous regression of ostoperative tumor residue is not uncommon.

Postoperative Follow-up

In most cases, recurrent disease grows submucosally. CT or MRI with IV contrast has a more important role than endoscopic examination in follow up. Many recurrences occur during the first postoperative year (8). In our clinic the patient is evaluated endoscopically in 2 weeks, postoperatively, monthly for the next six months and annually afterwards. Annual CT imaging with IV contrast is performed since the third postoperative month (9).

Conclusion

The main advancement in the treatment of juvenile nasopharyngeal angiofibroma (JNA) is the introduction of the endoscopic approach. Surgical excision of JNA has evolved from traditional open approaches to newer endoscopic approaches. Endoscopic excision of JNA appears to be superior to open techniques in terms of recurrence, intraoperative blood loss, and rate of complications. Endonasal endoscopic excision can be performed safely in early-stage tumors. In advanced lesions ESS can be used as an adjuvant to other external techniques in order to achieve complete removal and minimal intraoperative blood loss. The preoperative embolisation of the patients, if done by an expert interventional radiologist, can dramatically decrease the intraoperative hemorrhage rate. Two points are strongly advised in the prevention of JNA recurrence; the first is global versus picemeal resection of tumor and the second is perioperative drilling of the clivus.

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