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Case Report

Hybrid operating room for the multidisciplinary treatment of a juvenile nasoangiofibroma at the "Dr. Eduardo Liceaga" general hospital of Mexico: case report and literature review

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ABSTRACT

Nasoangiofibroma or juvenile nasopharyngeal angiofibroma is a highly vascularized benign neoplasm, which mainly affects men between the first and second decade of life. The incidence of this type of lesion is extremely rare and occurs in a 0.05 to 0.5% of all head and neck neoplasm, in which surgical treatment is considered the best treatment option. Treatment of this pathology in a hybrid operating room is considered a novel tool, to carry out an effective multidisciplinary intervention, granting better control of the procedure and hemostasis. The purpose of this publication is to describe the advantages of performing surgery in a hybrid operating room, as well as to conduct a literature review on this condition. Two cases are reported, a 14 and 16-years old male, both with a probable diagnosis of juvenile nasoangiofibroma. The surgical treatment was carried out in the hybrid operating room of the General Hospital of Mexico "Dr. Eduardo Liceaga" by the otorhinolaryngology and the oral and maxillofacial surgery department after embolization by the interventional radiology team.

Keywords: Angiofibroma, Operating room, Hybrid, Fibroma, Juvenile, Embolization

INTRODUCTION

Angiofibroma of the nasosinusal or sinonasal tract, also known as juvenile nasopharyngeal angiofibroma (NAF) is a benign fibrovascular neoplasm characterized by a predominantly aggressive behavior. It originates in the sphenopalatine foramen located in the nasopharynx, where the artery of the same name is located, which is the terminal branch of the internal maxillary artery; this is the reason this tumor is highly vascularized. It can also develop a collateral blood supply from adjacent structures such as the internal carotid artery.[1] Our patients presented a classic triad, nasal obstruction, epistaxis and a sinus/nasopharyngeal mass, the nasal obstruction is present in 91% of cases.[2] Its growth is predominantly asymptomatic and varies according to the tumor size. These patients may also show signs of facial deformity, exophthalmos, decreased visual acuity and headache of varying intensity when invading adjacent structures.[3] When seeking to achieve the best results, a multidisciplinary management by interventional radiology, otorhinolaryngology, oral and maxillofacial surgery and in some cases neurosurgery, is essential.[4] The hybrid operating room has the ideal infrastructure for multidisciplinary treatments. It's characterized by a combination of a conventional operating room and a

hemodynamic room, with the latest and newest equipment, materials and accessories, which contribute to a less invasive and faster surgery, in addition it allows transoperative surgical adjustments with lower risks.[5] The main advantage of the hybrid operating room is the possibility to make an immediate preoperative embolization. This procedure let us reduce transoperative bleeding, improving visibility during the surgery, it reduces the size of the tumor and therefore, facilitating NAF's management.[5] Other advantages include multiple cameras to facilitate visibility of the surgical field from various angles and the recording of the procedure for educational purposes. Also, the availability of a Zeiss Pentero 800 S microscope, with which we can ensure a complete NAF removal avoiding recurrences.[6] This report describes the case of two patients with NAF treated successfully with surgical excision using a Weber Ferguson approach and endoscopy. Multidisciplinary management at the hybrid operating room was made in both cases, for the best results.

CASE REPORTS

Case 1

A 14-year-old male patient, with no significant medical history, began to experience recurrent epistaxis and right nasal obstruction since 2022. He was evaluated at the otorhinolaryngology department of the General Hospital of Mexico "Dr. Eduardo Liceaga " A rhinoscopy was performed, in which a pink mass was observed at the right nostril that obstructed 100% of its lumen, CT and MRI were performed due to suspected intracranial invasion. A clinical and imaging diagnosis of a Chandler IV nasoangiofibroma was concluded; therefore, the patient was scheduled for surgery (Figure 1A).

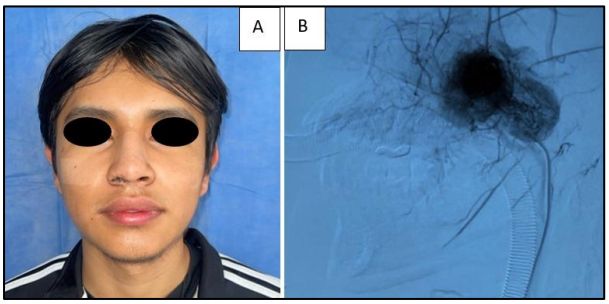

Figure 1: (A) Patients frontal view and (B) fluoroscopy image of the internal maxillary artery and additional branches preoperative embolization, to diminish trans operative bleeding.

Patient was scheduled for surgery, orotracheal intubation was performed under balanced general anesthesia. In the first surgical stage, interventional radiology performed an 80% pathology embolization subsequently a central venous catheter was placed by the same department (Figure 1B). After intraoral and facial asepsis and antisepsis, the maxillofacial team made a Weber Ferguson-type surgical access (Figure 2 A & B). The maxillary bone was removed and then the otorhinolaryngology surgeons in a second surgical stage, an inverted T incision was made on the right lateral nasal wall, and the ipsilateral nasolacrimal duct was identified, which was preserved. A pale, multilobulated pink tumor was seen; The right ethmoid and sphenoid were dissected, showing eroded cells, and compromised orbital floor through the lamina papyracea. The pterygomaxillary space is then dissected, finding eroded medial and lateral pterygoid notches. The tumor is resected from the infratemporal and pterygopalatine fossa, the nasal fossa and the right orbital fossa, confirming the tumor's total resection (Figure 3). The lateral nasal wall is closed, hemostasis is confirmed, and resorbable material is placed in the pterygopalatine fossa. The maxilla's reduction is made and osteosynthesis is placed, then facial and intraoral wounds are sutured by planes. Trans-surgical bleeding of 900 ml is reported. Subsequently, the patient is monitored by both services and daily wound cleaning is performed. Adequate facial function, reduction in nasal bleeding, and edema of the middle third of the face are observed. The patient is discharged from the hospital with dated follow-up appointments.

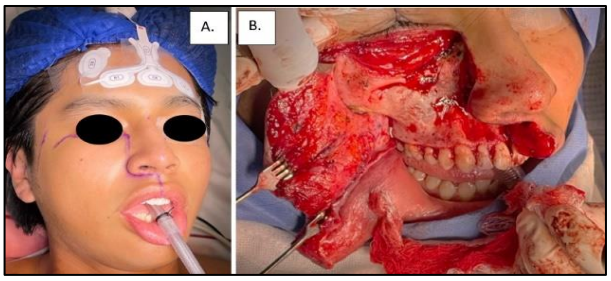

Figure 2: (A). Preoperative Weber Fergusons approach marking, (B). Full-thickness facial flap lifting prior osteotomies.

Figure 3: Macroscopic view of the specimen obtained during surgery.

Case 2

A 16-year-old male patient, with no significant pathological history, began to experience a sensation of

fullness in the right nostril since July 2022. He attended an otorhinolaryngology evaluation in a private clinic, they requested a tomography and a magnetic resonance imaging, with which the diagnosis of nasoangiofibroma was determined, then he was referred to the Otorhinolarygology service of the General Hospital of Mexico "Dr Eduardo Liceaga" to receive a multidisciplinary treatment. The patient was classified as Chandler III, Fish IIA, Andrew IIIA and Radowski IIC, he also presented septal deviation and dehiscence of the inferior, lateral and superior wall of the right sphenoid.

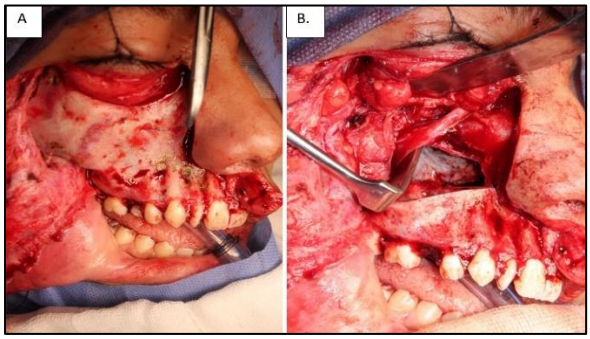

Figure 4: (A). Full-thickness flap using a Weber Fergusons approach and (B) surgical site after the right maxilla bone segment removal.

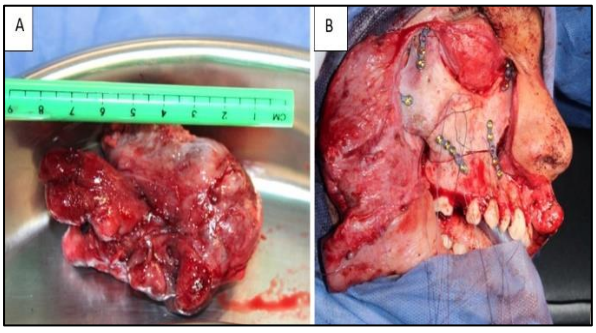

Figure 5: (A) Macroscopic view of the specimen obtained during surgery and (B) reposition of the bone segment with titanium 2.0 plates and screws.

His surgery was scheduled for March 22 of this year. In a first surgical stage with balanced general anesthesia and orotracheal intubation, a right facial marking was performed for the Weber Ferguson approach., then a selective embolization of the internal maxillary and ascending pharyngeal arteries is performed by the interventional radiology team, embolization of an 85 to 90% of its totality was achieve, with the remaining 5% irrigation coming from the internal carotid artery. In a second surgical stage and after asepsis and antisepsis the maxillofacial surgery team infiltrated lidocaine with epinephrine, after which the middle third of the face was intervened using a Weber Ferguson with a subciliary extension approach on the right side with a 15 scalpel and a laser for hemostatic purposes (Figure 4A). Muscle dissection and neurotomy of important structures such as the infraorbital nerve is made, a right Le Fort I osteotomie is performed at the zygomatic arch, just under the right frontomalar suture and below the right sphenomaxillary suture, 5 mm deep and behind the inferior orbital fissure. The osteotomy continues through the orbital floor, the middle portion of the lacrimal fossa, the right nasal bone of the maxilla and the lateral nasal wall finally ending with the lacrimal sac's dissection. The maxilla is then removed to gain access to the lesion (Figure 4B).

Table 1. Classification for juvenile nasoangiofibroma.

Chandler classification 1984
Stage I: Tumor limited to the nasopharynx. Stage II: Extends to the nasal cavity and/or sphenoidal sinus. Stage III: Extension to one or more of the following maxillary sinuses, ethmoidal sinus, pterygomaxillary fossa, infratemporal fossa, orbit or cheek. Stage IV: intracranial extension and/or to the lateral orbit.
Andrews-Fisch classification 1989
Stage I: Limited to the nasal cavity. Stage II: Invades the pterygopalatine fossa or maxillary sinus, ethmoid or sphenoid sinus. Stage IIIa: Invades the infratemporal fossa or orbit without intracranial involvement. Stage IIIb: Invades the infratemporal fossa or orbit with intracranial involvement. Stage IVa: Intracranial tumor without infiltration of the cavernous sinus, optic chiasma or hypophysis. Stage IVb: Intracranial tumor with infiltration of the cavernous sinus, optic chiasma or hypophysis.
Radkowski classification
Stage Ia: Limited to nose and/or nasopharynx Stage Ib: Extension into one or more sinuses. Stage IIa: Minimal extension into the pterygopalatine fossa. Stage IIb: Complete occupation of pterygopalatine fossa with or without erosion of orbital bones. Stage IIc: Invasion posterior to sphenoid wings. Stage IIIa: Erosion of the skull base with minimal intracranial extension. Stage IIIb: Erosion of the skull base with extensive intracranial extension with or without invasion of cavernous sinus
Classification according to Fisch 1983
Stage I: Limited to the nose and/or nasopharynx without bone destruction. Stage II: Invades the pterygopalatine fossa or maxillary, ethmoid or sphenoid sinus with bone destruction. Stage III: Invades the infratemporal fossa or orbit and/or parasellar area, lateral region of the cavernous sinus. Stage IV: Invades the cavernous sinus, optic chiasma and/or pituitary fossa

Figure 6: Front view after closure.

The otorhinolaryngology team dissects the lesion, performing its surgical excision and confirming the pathology complete elimination through an endoscopy revision (Figure 5A). The maxilla bone segment is repositioned and fixed using a 1.5 mm osteosynthesis system with 4 (4 holes) titanium plates and 18 (4 mm) screws (Figure 5B). Neurorrhaphy of the right infraorbital nerve is performed, and the wound is closed both extraorally and intraorally (Figure 6). Finally, nasal plugs and a postoperative splint are placed, then patient is transferred to the pediatric intensive care unit. Subsequently, monitored by both services and daily wound cleaning are performed. Correct facial function, reduction in nasal bleeding and edema of the middle third of the face are observed. The patient is discharged from the hospital on the tenth postoperative day and follow-up appointments are provided.

DISCUSSION

NAF is a benign fibrovascular neoplasm with an early onset and aggressive behavior. Its etiology is yet unknown, but theories include abnormal connective tissue formation of the nasopharyngeal periosteum as a reaction to an ectopic hamartomatous nest of aberrant vascular tissue (androgens).[7] It generally involves and widens the pterygopalatine fossa with anterior arching of the posterior wall of the maxillary sinus (Holman-Miller sign).[8] It invades through the ostia, paranasal cavities, oropharynx, infratemporal and pterygomaxillary fossa, and the orbit. Intracranial involvement is seen in 20-36% of cases, compromising the cavernous sinus and optic chiasma.

Among Latin American countries, Mexico is where NAF is most frequently present. A new case may occur for every 5,000 to 50,000 patients referred to an otolaryngologist.9 Approximately 12 patients are referred per year. Age varies from 6 to 28 years, with a peak age between 14 and 18 years.[10] Regarding its diagnosis, incisional biopsy at the office or at the operating room is contraindicated due to its potentially profuse bleeding. It is mainly based on clinical history, physical examination and complementary imaging evaluations such as contrast tomography or magnetic resonance depending on its extension.[11] Clinical and radiographic staging systems are used to guide treatment and determine the risk of recurrence and estimate prognosis.[11] Table 1 describes the most used classification systems. Surgical treatment is necessary.[11] The approach selection will depend on imaging studies to delimit the extent of the tumor, blood supply and the presence or absence of an intracranial extension.[12,13] The surgery objectives are to achieve complete tumor resection with maximum neurovascular preservation, minimize morbidities, and avoid the use of radiotherapy.[14] Therefore, it is important that the surgical approach provides adequate tumor exposure.[15,16]

The ideal environment that provides the appropriate conditions for the treatment of these complex injuries is the hybrid surgery room, where diagnosis and intraoperative treatment can be performed by having access to images in real time with success. The 88-square-meter hybrid operating room, completely aseptic, located at the General Hospital of Mexico “Dr. Eduardo Liceaga”, was the first to be inaugurated in Latin America in 2016. It is considered the first center to have high-tech instruments such as a robotic angiography. It offers the best and most advanced facilities for highly complex conditions treatment.[17]

This surgery room is lined with a system of antibacterial stainless-steel panels with radiological protection. It is also equipped with a white light surgical lamp to facilitate doctors’ actions, with a video system and an independent arm monitor, which allow three-dimensional views facilitating several perspectives previously unattainable, a radiolucent surgical table with direct communication to the angiographer.[17] This operating room has a robotic system with “angiotomography” with the ability to superimpose images that offer a constant virtual image: angiography and dynamic tomography. It also has complementary imaging and monitoring equipment integrated by a high-definition microscope, to perform studies with contrast substances, microsurgery and ultrasound that allow studies to be performed while the patient is in the operating room. And to determine success in a precise and shorter time. There are also telemedicine facilities, since the aim is to transmit the procedures that are carried out for medical education.[17]

In a study by Acuna et al in 2016, the specialties of oral and maxillofacial surgery, as well as otorhinolaryngology were the services with the highest demand for hybrid operating rooms. The conditions that were embolized most frequently were: meningioma, cerebral arteriovenous malformation and nasoangiofibroma. The main benefit of this environment is to provide the appropriate conditions and equipment for a harmonious interaction between different specialties. Correct management begins with preoperative embolization, where blood vessels are intentionally occluded with temporary or permanent intravascular materials. This has multiple advantages such as facilitating surgical planning,

identifying and improving the visibility of the tumor, reducing its size, reducing surgical time and recurrences.[18] A reduction in intraoperative blood loss and fewer blood transfusions have been demonstrated when embolization is performed. Blood loss is reduced between 836 and 1200 ml per non-embolized patient; and from 400 to 600 ml per embolized patient.[19] As it can be confirmed in the previously presented cases, with a bleeding of 900 ml and 800 ml, respectively. The arteries involved in NAF are mainly the branches of the external carotid artery, specifically the ipsilateral internal maxillary artery or ascending pharyngeal artery.[20] It has also been shown that the internal carotid artery (ICA) is involved in 51% of cases, especially in large lesions, its embolization is not routinely recommended as it produces a high risk of complications.[21]

Various materials have been described for trans arterial embolization, such as gel form, lipiodol, polyvinyl alcohol, microspheres, glue, copolymers or ethylene vinyl alcohol, which are introduced by selective catheterization, which is one of the minimally invasive treatment options used by interventional radiology. Previously, this type of procedures took place in special rooms before the scheduled surgery with a time of 24 to 48 hours prior to the procedure, currently, they can be carried out minutes before surgery.[22] The hybrid operating room at the "Dr. Eduardo Liceaga" General Hospital of Mexico has zero mortality and minimal morbidity reported, as well as short hospital stays, making it a national reference center for the management of this pathology.

CONCLUSION

Nasopharyngeal angiofibroma, also known as nasoangiofibroma, is a highly vascularized benign tumor that occurs mainly in men between 14 and 18 years of age. It is classified according to its extension and structures involved and, consequently, the surgical plan will be decided based on that. A multidisciplinary approach will allow a sequential, synchronized and simultaneous procedure during the intervention, which, if performed in a controlled environment such as a hybrid operating room, will allow an orderly, successful and low risk surgery for the patient.

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