Combined Approach of the Anterior Skull Base in Sinonasal Tumours

DRAGOS OCTAVIAN PALADE[1,2], BOGDAN MIHAIL COBZEANU[1]*, PETRONELA ZAHARIA[1], MARIUS DABIJA[2]

[1] Sf.Spiridon Emergency Clinical Hospital, Department of Otorhinolaryngology, 1 Independentei Sq., 700111, Iasi, Romania

[2] Grigore T.Popa University of Medicine and Pharmacy, 16 Universitatii Str., 700115, Iasi, Romania

Malignancies of the nasal cavity and the paranasal sinuses are rare, counting for less than 3 % of the ENT-cancers. The insidious onset of these tumours with non-specific symptoms often leads to a delayed diagnostic. Advanced disease stage combined with the complex anatomy of the sinonasal cavities and anterior skull base encouraged surgeons to extend beyond the boundaries the classic surgical techniques. Surgical approaches to anterior skull base lesions can be divided into open approches: craniofacial, subcranial, endoscopic techniques or combined approaches when a craniotomy is associated with an endonasal endoscopic approach. The indication must take into consideration the oncologic principles, histopathology exam, extent of disease and surgeon skill and experience. Combined approach should be taken into consideration for patients with extended disease or significant intraorbital or intracranial extension. For certain tumours that require a craniotomy for the superior, superolateral, and anterior extensions of the disease and also a nasal and paranasal sinus tumor that could be removed endoscopically, an endoscopic-assisted approach can be considered.

Key words: sinonasal tumors, endoscopy, surgical techniques

Sinonasal and skull base neoplasms are rare tumors that constitute about 3% of tumours in the upper respiratory tract [1]. Patients usually are refered late in the evolution to thhe ENT surgeon due to the non-specfic symptoms which may lead to a delayed diagnosis and treatment. The presence of regional or distant metastases is a poor prognostic sign.

It is often difficult to identify the specific origin of these tumors due to the contiguity of the nasal cavities with the paranasal sinuses. They are often late diagnosed due to similar symptoms of sinusitis: nasal discharge, pressure sensation in the midface, nasal obstruction, difficulty breathing through nose and sometimes nosebleeds. Patients are usually alarmed when the tumors are in late stages determing specific symptoms for cancers (double or blurred vision, tearing, loss of vision, loosening and numbness of the upper teeth, eye bulging, bleeding, blocked nose, anosmia) or even extremely advanced stage lesions (the inability to open the mouth, hypoacusia, headaches, otalgia, mental status changes).

Frequent risk factors of the carcinogenesis of various types of sinonasal malignant tumors are: exposures to industrial smoke, wood dust, nickel refining, exposure to mineral oils, chromium, isopropyl oils etc [2] Even through recent studies demonstrated a higher incidence of nasal cancers in cigarettes smokers, tobacco is not considered yet to be a significant etiologic factor[3,4]. Neuroimagining evaluation, intensive perioperative care, advanced surgical techniques and adjuvant treatment are constantly improving the results of patient evolution[5].

Because the tumours proximity to vital structures (brain, optic nerves, and internal carotid artery), they pose significant challenges for their treatment and may be the source of significant morbidity to the patients. Particulary challenging for the treatment of these tumour represents the assessment for the invasion of important anatomical structures such as the orbit and skull base, expanding the boundaries of the classic surgical techniques with improved strategies to deliver adjuvant radiation, which substantially improved the outcomes in patients with malignancies of the sinonasal tract and skull base [6].

* email: bogdan788@yahoo.com

The primary concern in choosing the surgical approach should consider the oncological principles: *en bloc* excision with safe margins of resection and secondary, a good visualization, the ability to achieve hemostasis, manage potential vascular complications and reconstruction surgery.

Cranio facial approach

The primary concern is adherence to oncological principles: en bloc excision with adequate margins. Secondary concerns include visualization, the ability to achieve hemostasis and deal with vascular complications, and reconstruction. The primary concern is adherence to oncological principles: en bloc excision with adequate margins. Secondary concerns include visualization, the ability to achieve hemostasis and deal with vascular complications, and reconstruction. The primary concern is adherence to oncological principles: en bloc excision with adequate margins. Secondary concerns include visualization, the ability to achieve hemostasis and deal with vascular complications, and reconstruction. The gold standard approach for sinonasal tumours extended to the anterior skull base is the cranio facial resection with the dissection of the tumor by frontal craniotomy, making possible the en bloc removal of the tumour. This technique also allows direct access for reconstruction of the skull base defect with a pericranial flap. The transbrow approaches and subfrontal approaches have decreased brain retraction, facial scarring and minimized the morbidity percentage [7].

The subcranial approach is an adjustment of traditional craniofacial resection that provides almost similar broad access to the anterior skull base, but with lower mortality and morbidity. It is a safer and more effective technique to successfully treat advanced sinonasal tumours with anterior skull base extension. Combination of transfacial and transcranial procedures in order to allow broad exposure of the anterior cranial fossa and subcranial compartment. This procedure still involves a high risk of postoperative complication. The main limitation of this approach is the need for frontal lobe retraction, which may lead to encephalomalacia, brain edema, the presence of

the cosmetic inconvenience, and subdural bleeding, especially in elderly population.

The subcranial approach have multiple advantages: wide direct exposure of the anterior skull base from anterior to posterior, allows simultaneous intradural and extradural tumour removal, does not require facial incision, minimal frontal lobe manipulation but there is a high risk of bone osteonecrosis post radiotherapy.

Fig.1 Different external approaches/incisions

Physicians encounter great challenges when dealing with malignancies of the paranasal sinuses. An ideal method for tumors that involve surrounding soft tissue, the palate or the orbit is a transfacial or craniofacial approach, that allows a wide resection, even *en bloc*. Some of the standard transcranial approaches include a frontotemporal craniotomy and a sub-basal variation of frontal craniotomy.

Although modern surgery techniques are continuously improving, traditional open surgical approaches still remain the golden standard in certain tumors. This is the reason why skull base surgeons need to permanently improve their technical skills in order for them to be able to manage situations in which endoscopic techniques are insufficient due to anatomical constrains.

Endoscopic approach

Endoscopic surgery has been used in rhinosinusitis surgery since the 1980s[8]. As the knowledge and experience with endoscopic surgery has improved, and the image guidance systems and surgical instruments for endoscopic surgery have evolved, endoscopic surgery has been increasingly used for the treatment of benign tumors and as experience with benign tumor surgery evolved, endoscopic surgery was adapted for the treatment of malignant tumors[14].

This approach is classified into saggital (frontal sinus to C2) and coronal (midline of the roof of the orbit (anterior), the floor of the middle cranial fossa (middle) and the jugular foramen (posterior) offers direct access to the ventral skull base, while eliminating the need for the manipulation of neurovascular structures. This type of approach is indicated in the resection or debulking of neoplasms (benign and malignant), decompression of neural structures and reconstruction of skull base defects.

Complex skull-base pathology has benefited from a great evolution of minimally invasive endoscopic techniques which has facilitated a good management and surgical outcome[15]. By using the endoscopic approach, there are multiple advantages: no external incisions or scars, improved quality of life, significantly reduction of postoperative pain and discomfort, shorter operative times and fewer days of hospitalisation, superior magnification, distal illumination and visualization of the surgical target[8]. Furthermore, there is a lower risk of neurovascular injury, incomplete removal of the tumor or inadequate reconstruction of a dural defect.

The endoscopic technique has proved that it certainly has an important role in the management of patients with sinonasal and anterior skull base malignancies and it is essential for contemporary skull base surgery [2].

However, endoscopic surgery has its limits in the treatment of patients with sinonasal malignancies. Hemostasis is indispensable for endoscopic visualization of the anatomical structures. Improved visibility of the surgical field consist in controlled hypotension and reduction of intraoperative bleeding which must be considered during the treatment planning. Also, the preoperative preparations must include the optimization of comorbidities and cessation of anticoagulation therapy [11] Moreover, the surgeon must have the proper training, expertise and experience and the ability to reconstruct the resulting defect.

Complete endoscopic surgical resection followed by radiation therapy have drastically minimized the local recurrence, morbidity and cosmetic deformity [9]. The microscopic view provided by endoscopy, with or without complementary approaches, allows the complete removal of the tumour [16].

Combined approach

The goal of surgery is complete removal of all tumor with clear resection margins while maintaining the key oncological principles[12,13].

Overall, surgical planning using both open and endoscopic approach has better outcomes and surgical performances.

We reviewed the general principles in the surgical management of sinonasal malignancies, the technical aspects of open and endoscopic approach alone and highlighted the advantages of the combined approaches of the sinonasal tumors. Furthermore, we selected one particular case of a 50 years old male patient diagnosed with inverted papilloma with frontal sinus invasion, who required combined surgical approach.

This patient was admitted to our clinic with complaints of nasal obstruction, fullness sensation and headache located to the frontal region. Past history revealed that the patient was treated twice before for similar complaints in other ENT Departments. No epistaxis, cervical lymphadenopathy or visual changes were declared by the patient. Clinical examination revealed a papillomatous mass to the left and right of the nasal septum with extension into the posterior and superior nasal cavity.

Additional investigations concluded a diagnosis of inverted papilloma with frontal sinus invasion.

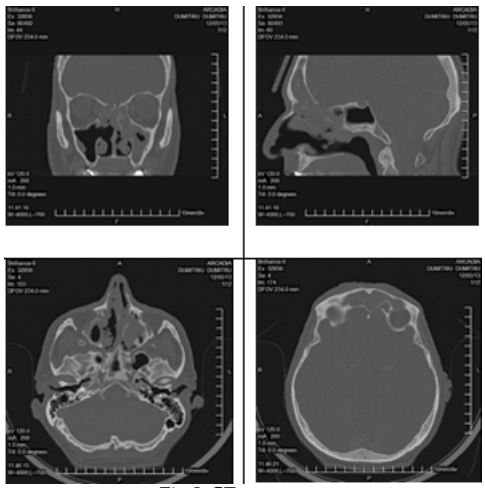

Fig.2 CT-scan

Combined approach was selected as the treatment of choice:

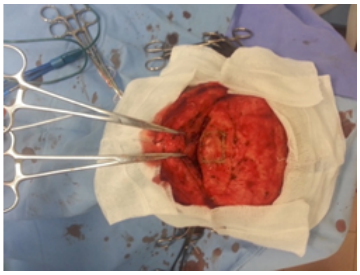

Fig.3 Marking the osteotomy area

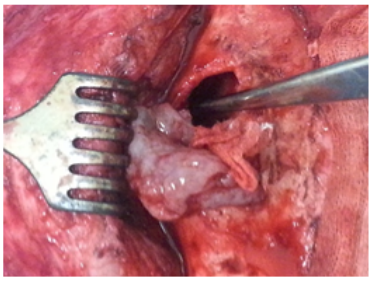

Fig.4 Revealing the tumour and showing the right frontal sinus

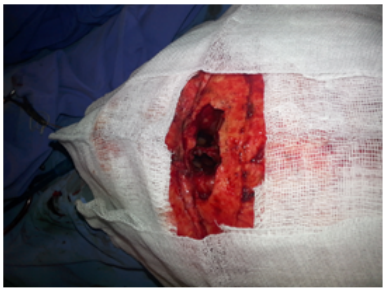

Fig. 5 Cavity left after the complete excision

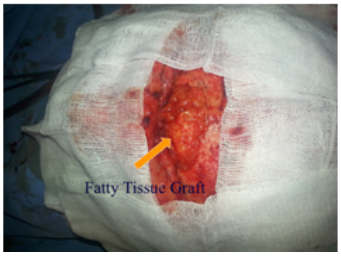

Fig.6 The exclusion of the frontal sinuses using a fatty tissue graft

Results and discussions

This article is unique in that it presents a case in which a mixed approach is used as treatment for inverted papilloma with frontal sinus invasion, having better outcome than using the classical ones.

Because the invasion of the anterior wall of the frontal sinus the endoscopy alone doesn't give a good exposure and a complete resection. The external approach alone would allow complete resection but possible with some small parts (infracentimetric) left in place. That's why, in our opinion, the combined procedure will give a complete exposure and a complete resection even of the hidden areas in the sphenoid and posterior ethmoid sinuses.

Conclusions

Combined approach is superior to any of the simple approach alone. Endoscopic approach is useful to assess the limits of the excision and its minimal invasive nature results in fewer complications, faster recovery time and better cosmetic results. Unfortunately, not all lesions involving the sinonasal region and anterior skull base are accessible to sinonasal endoscopy. Therefore, it is mandatory for the surgeon to be able to convert every moment the endoscopy into an open approach.

References

1.DHRUBA K, RADHEY SM, ACHAL S, ASHOK G, SHASHI S Sinonasal teratocarcinosarcoma involving nasal cavity, nasopharynx, and all paranasal sinuses with bilateral orbital and intracranial extension: A rare case report, Asian Journal of Neurosurgery, 2017 Apr-Jun; Nr. 12(2), p. 232–240.

2.BINAZZI A, FERRATE P, MARINACCIO A. Occupational exposure and sinonasal cancer: a systematic review and meta-analysis. BMC Cancer. 2015 Feb 13; Nr.15, p. 49.

3.BENNINGER MS The impact of cigarette smoking and environmental tobacco smoke on nasal and sinus disease: a review of the literature. American Journal of Rhinology, 1999 Nov-Dec;13, p. 435-438.

4. CAPLAN LS, HALL HI, LEVINE RS, ZHU K Preventable risk factors for nasal cancer. Annals of Epidemiology. 2000 Apr,10, p.186-191.

5.SHAH JP, BILSKY MH, PATEL SG. Malignant tumors of the skull base. Neurosurgical Focus, October 2002 ,Vol. 13, p. 1-12

6.BANUCHI V, MALLEN J, KRAUS D. Cancers of the nose, sinus, and skull base. Surgery Oncology Clin N Am. 2015;24, p. 563–577.

7.K. J. LEE Essential Otolaryngology Head and Neck Surgery, 11th edition 2015,p. 676-677

8.TICHENOR WS, ADINOFF A, SMART B, HAMILOS DL. Nasal and sinus endoscopy for medical management of resistant rhinosinusitis, including postsurgical patients. J Allergy Clin Immunol. 2008 Apr;121, p. 917-927.

9.BUCHMANN L, LARSEN C, POLLACK A, TAWIK O, SYKES K, HOOVER LA. Endoscopic techniques in resection of anterior skull base/ paranasal sinus malignancies. Laryngoscope. 2006 10;116(10), p. 1749–1754.

10.CORDOBA A, MD Anesthetic Techniques in Endoscopic Sinus and Skull Base Surgery, Otolaryngologic Clinics of North America Volume 49, Issue 3, June 2016, p. 531-547

11.AMOROCHO MC, FAT I Anesthetic Techniques in Endoscopic Sinus and Skull Base Surgery Otolaryngol Clin North Am. 2016 Jun;49(3), p. 531-47

12.STEFANESCU, D.C., CEACHIR, O., ZAINEA, V., HAINAROSIE, M., PIETROSANU, C., IONITA, I.G., HAINAROSIE, R., Rev.Chim. (Bucharest), **67**, no. 7, 2016, p. 1255

13.ROXBURY C, MASARU I, RICHMON J, BLITZ AM, REH DD,GALLIA GL Endonasal Endoscopic Surgery in the Management of Sinonasal and Anterior Skull Base Malignancies Head Neck Pathology,10,2016, p. 13–22

14.SNYDERMAN CH, CARRAU RL, Endoscopic skull base surgery: principles of endonasal oncological surgery, Journal of Surgical Oncology. 2008, 97(8) Pag. 658-64

15.KWON D, ILORETA A, MILES B et al. Open Anterior Skull Base Reconstruction: A Contemporary Review. Expert Rev Med Devices. 2010 Nov;7(6), p.781-791.

16.STEFANESCU, D.C., CEACHIR, O., ZAINEA, V., HAINAROSIE, M., PIETROSANU, C., IONITA, I.G., HAINAROSIE, R., Rev.Chim.(Bucharest), **67**, no. 7, 2016, p. 1327

Manuscript received: 21.11.2017