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Review

Development of minimally invasive surgery for sinonasal malignancy

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ABSTRACT

Sinonasal malignancies are rare and histologically heterogeneous. Treatment is complicated by tumor aggressiveness and location near critical anatomic structures (orbita, skull base, etc.). This low incidence and histologic diversity make prospective studies unfeasible, and thus therapeutic guidelines difficult to establish. The gold standard for surgery is a transfacial approach, with craniofacial resection in case of skull-base involvement. However, these techniques are associated with non-negligible perioperative morbidity. In the past two decades, endoscopic surgery has made major progress, extending its indications: initially developed for functional sinus surgery, it is now applied in benign skull-base pathologies (CSF leakage, meningocele, etc.) and, more recently, in sinonasal malignancy. Literature analysis shows a significant decrease in morbidity and improved quality of life associated with endoscopic endonasal surgery, with oncologic safety and efficacy in well-selected cases, although dependent on operator experience. Additional studies with longer follow-up and comparison between histologic subtypes will be needed.

1. Introduction

Sinonasal malignancy is rare, and shows wide heterogeneity on histology [1,2]. Treatment is complicated by local aggressiveness and proximity to critical neurovascular structures such as the orbita and skull base [2]. The gold standard attitude is transfacial surgery or, in case of skull-base extension, craniofacial resection combining subfrontal or transbasal craniotomy and a transfacial approach. Endoscopic endonasal surgery has greatly progressed in the last 20 years, broadening its indications. It was first introduced as functional endoscopic sinus surgery (FESS), and later developed for benign skull-base pathologies such as cerebrospinal rhinorrhea and meningocele. More recently, transnasal-transethmoid approaches were developed, enabling an endoscopic approach to the anterior level of the skull base, with transnasal craniotomy if needed [2]. This technical progress, combined with improved understanding of the natural history of sinonasal malignancy [3,4], has made endoscopic endonasal surgery a genuine alternative to transfacial approaches [3–11]. The present study first summarizes the clinicopathologic features of these tumors and the principles of treatment, then describes the principles of transfacial surgical resection and the state of the art in endoscopic surgery, leading to oncologic application, indications for which are precisely defined.

2. Sinonasal malignancy: overview

Sinus and nasal cavity malignancy accounts for 3–5% of head and neck cancer [1], with incidence of 5–10 per million per year [12–15]. Clinical sinonasal signs are often non-specific (nasal obstruction, epistaxis, etc.), delaying diagnosis and treatment. Chronic unilateral symptomatology is an alarm signal, especially in at-risk occupations: occupational exposure is to be screened for systematically, whatever the histologic type and sinonasal location. Any sinofacial cancer can be considered of occupational origin in case of prolonged occupational exposure to tannins (wood, leather) or nickel, according to the criteria of Tables 36, 37[c] and 47 of the French occupational diseases listing [16]. Histologic identification on well-conducted endoscopic biopsy is essential to diagnosis and treatment, but should not involve ethmoidectomy with partial tumor resection, which inevitably destroys important anatomic landmarks.

Squamous cell carcinoma is the most frequent form of sinonasal malignancy [2], especially in the maxillary sinus and nasal cavity. It develops from respiratory mucosa subject to malpighian metaplasia. Inverted papilloma is the most frequent form of benign sinonasal tumor, associated with squamous cell carcinoma in about

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10% of cases [2]. Mean age at onset is 60 years, with a male/female sex-ratio of 2:1. The most frequent location is maxillary; lymph-node involvement is found in 10–20% of cases. Overall 5-year survival is 50–60%, taking all stages together [15].

Some 80% of sinonasal malignancies are of ethmoid origin. Unlike in American series, intestinal adenocarcinoma is found in 80% of cases in Europe [1]. Most etiologies are occupational, involving prolonged wood-dust exposure (mean: 20–30 years, with a minimum of 2 years) [17]. Other occupational factors have also been reported, such as exposure to nickel, or chromium in the leather industry. The strong male predominance is related to a male predominance in these at-risk occupations. Mean age at diagnosis is 60 years; symptom latency means that diagnosis is usually late, with 65–80% of cases staged T3-4 [17,18]. Lymph-node involvement is rare, as is remote metastasis. Overall survival is 64% at 5 years and 49% at 10 years [16].

Cystic adenoid carcinoma (CAC) is the third most frequent form. The sex-ratio is 1, and mean age at onset ranges between 40 and 60 years [10]. It develops in accessory salivary glands of the face. The most frequent location is maxillary. There is marked neurotropism, with frequent perineural infiltration along V2 and V3. Lymph-node involvement is rare [19]. Remote (pulmonary) metastasis is frequent and often late [16]. Overall survival is 57% at 5 years and 33% at 10 years [16].

Olfactory neuroblastoma is a rare neuroendocrine tumor developing in the olfactory epithelium; this location classically accounts for the observed early invasion of the cribriform plate and anterior level of the skull base, although forms not involving the cribriform plate exist [4]. Metastatic lymph-node involvement is found in 5–8% of patients at diagnosis and 20–25% of patients overall [19,20]; remote metastasis (lung and bone) is found in 10% of patients. There are two main classifications: Kadish's (clinical-radiological) and Hyams' (histological); recently, the Dulguerov classification was reported to be of better prognostic value. Five-year survival ranges between 37% and 85% [21]; recurrence-free survival is 77% at 5 years and 53% at 10 years [21].

Mucosal melanoma accounts for 1% of melanomas and 3% of sinonasal malignancies. It develops from melanocytes in the neural crests and disseminated in the sinonasal mucosa. There is male predominance, and a mean age of 60 years at diagnosis. Classic locations are: septum, turbinates (especially inferior) and maxillary sinus. There is lymph-node invasion in 10–20% of cases, and less than 5% remote metastasis at diagnosis [19]. Prognosis is poor: 5-year survival is less than 30%, with high risk of metastasis and of locoregional recurrence [22,23]; median survival is 24 months [23].

This diversity of histologic types and low incidence make prospective studies unfeasible, and consensual guidelines difficult to determine. A decision tree was drawn up by the International and European Rhinology Societies in 2008 [2] (Fig. 1). Postoperative radiation therapy is usually recommended [2,16]: preferably intensity-modulated (IMRT), it provides benefit in local control and 5-year survival [2].

3. "Classic" surgical treatment of sinonasal malignancy

Transfacial approaches are the gold-standard surgical treatment in sinonasal malignancy [24–26]. Various approaches have been described for facial tumor. The paralateronasal approach gives access to the ethmoid, while palpebral extension (Weber-Ferguson) provides wide access to the whole mid-level of the face. These are preferable to sublabial approaches (Caldwell-Luc, Rouge-Denker, degloving), which entail less esthetic blemish but provide less satisfactory operative site exposure, despite extensive release, incompatible with oncologic requirements.

After performing a transfacial approach, two situations arise:

- the tumor involves the maxillary infrastructure, requiring maxillectomy (usually in case of squamous cell carcinoma). Skull-base involvement is rare in these cases, and classically contraindicates craniofacial resection. When extension is restricted to the infratemporal fossa, medial or paramedian mandibulotomy may be associated: the hemimandible is luxated laterally to give access to the parapharyngeal spaces and skull base, from the pterygoid root medially to the floor of the medial cranial fossa laterally. Free flap reconstruction now enables extensive facial resection, with acceptable esthetic and functional results;

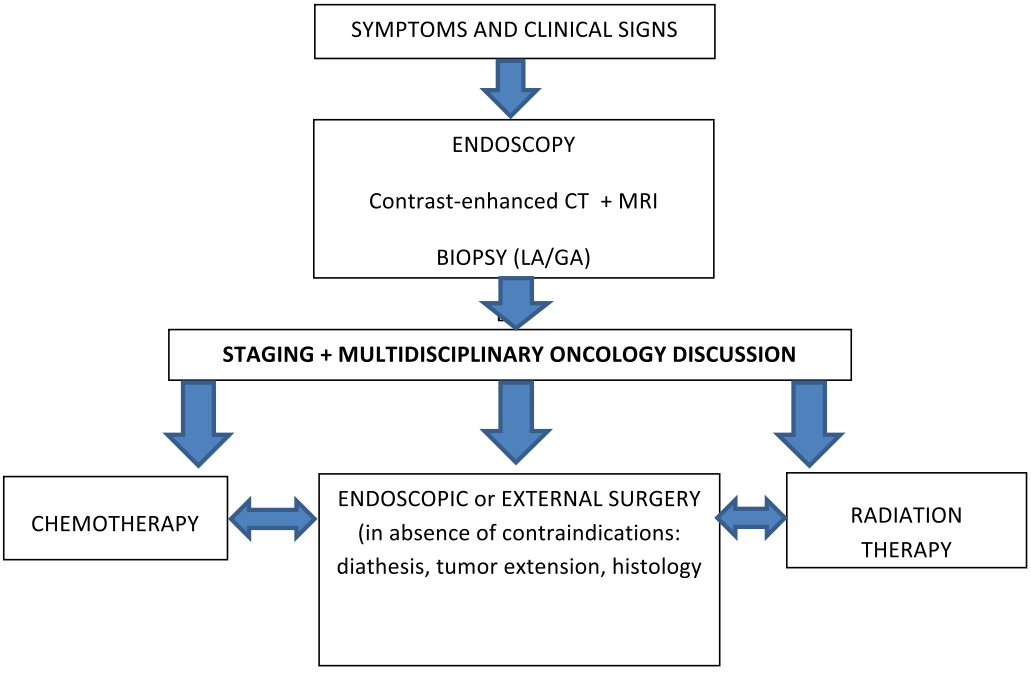

Fig. 1. Diagnostic and therapeutic management of sinonasal malignancies according to the International and European Rhinology Societies' guidelines [4].