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RESEARCH ARTICLE

MAXILLARY SINUS CARCINOMA: A SHORT REVIEW REGARDING MANAGEMENT

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ABSTRACT

Squamous cell carcinoma (SCC) that arises from maxillary sinus generally has far reaching and devastating effects on surrounding tissues due to its proximity to orbit and skull base. SCC that arises in the maxillary sinus is considered to be a para nasal sinus disease that behaves differently from SCC of the maxillary alveolus and hard palate, which are considered to be similar to oral SCC

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INTRODUCTION

The maxillary sinus begins to develop between the second and third month of pregnancy, with an evagination of the nasal passage lateral wall mucosa. At birth, it is about 0.1 to 0.2 cm3 in size and remains small until eruption of the permanent teeth . Development, in terms of pneumatization (the increase of the volume of air contained in it), is completed by adolescence, although its volume may increase further after tooth loss in the posterior maxilla.The maxillary sinus is the largest of the paranasal cavities, which include the ethmoidal, frontal and sphenoidal sinuses and which usually occupies a large part of the maxillary bone. It is an air cavity with a quadrangular pyramidal shape with various walls: a medial wall facing the nasal cavity, a posterior wall facing the maxillary tuberosity, a mesiovestibular wall for the presence of the canine fossae, an upper wall which is the orbit floor, and finally, a lower wall that is next to the alveolar process and which is the bottom of the maxillary sinus itself . The maxillary sinus communicates with the homolateral nasal fossa by means of a natural ostium located antero-superiorly on the medial surface, which drains into the middle meatus. All paranasal sinuses communicate with the nasal fossae and therefore also, indirectly, with each other They serve mainly to humidify and heat the air we breathe in.

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They also contribute to reducing the weight of our facial bones, protect the base of the skull against trauma, thermally insulate the upper nerve centers and influence phonation by acting as an indirect resonance box. The maxillary sinus consists of facial bones, and the symptom of maxillary sinus carcinoma (MSC) is commonly associated with the destruction of the bony walls. Most of the patients with MSC come to the hospital at advanced T stage with cheek pain, cheek swelling, nasal obstruction, nasal bleeding and so on. It is known that the incidence rate of cervical lymph node metastasis in MSC is less than those of other head and neck carcinomas, and the reason is also considered to be associated with the anatomical feature, i.e., the sinus is surrounded by bones(Nishimura, 2006). Squamous cell carcinoma of maxillary sinus are comparatively rare comprising of approx. 1% of all malignancy and 3 % in head and neck tumors (Desiderio Passali*et al.,* 1999). Maxillary sinus carcinoma presents a diagnostic and therapeutic challenge to the oral diagnostician, surgeon and as well as the radiation oncologist, since the patient reports at a fairly advanced stage generally prognosis is moderate to poor. This paper attempts to review the treatment modality of maxillary squamous cell carcinoma (MSC).

Review of literature regarding etiology and treatment

Treating maxillary sinus cancer is challenging because of the crowded anatomy, proximity of critical structures, such as the eye and the brain, which preclude wide surgical excision and

high-dose radiotherapy. The clinical course is indolent at most and low incidence of malignant disease , which makes a low index of suspicion, the majority of cancers of antrum are seen in a late or moderately advanced stage at the time of diagnosis. Combined-modality therapy consisting of surgery and radiotherapy with or without intra-arterial chemotherapy is generally used for the treatment. Local control is a particularly difficult problem, with the majority of failures occurring at the primary site (Vasudevan*et al.,* 2012).The literature about geographical distribution of MSC, it was identified that its incidence among oriental and occidental population are almost the same and ranged from 40% to 80% within the group of the paranasal malignancies. In contrast, some reports from Japanese series have shown a higher MSC incidence in Asiatic population than other regions of the Globe, which might be related to the extensive use of soft wood in the Japanese furniture industry, high prevalence of chronic sinusitis, and widespread use of cigarette smoking (Nishimura*et al.,* 2009). The risk factors associated with MSC development are enormous, but chronic exposure to nickel, chlorophenol, formaldehyde, textile dust, wood, cigarette smoking have been frequently reported (Marchetta*et al.,* 1969).

Another risk that has been identified is the presence of sinonasal-inverted papilloma (IP), a lesion that may increase in 10% the chance of MSC development. One explanation for that might be the presence of HPV(Batsakis and Suarez, 2001).Several articles show that MSC is diagnosed in advanced stage, which helps to explain the lowest survival rate when compared with other kind of tumors like oral SCC (St-Pierre and Baker, 1983; Kondo*et al.,* 1984; Itami*et al.,* 1998).In general, signs andsymptoms of maxillary sinus carcinoma can be divided into several major categories: oral, nasal, ocular, facialand auditory. Oral presentations occur in 25-35% of patients and include pain involving the maxillarydentition, trismus, palatal and alveolar ridge fullness and frank erosion into the oral cavity. Nasal findings such as persistent sinusitis, unilateral nasal obstruction, nasal discharge andepistaxis were seen in about 50% of patients. Ocular findings occur in approximately 25% and arise from upward extension into the orbit such as unilateral tearing,diplopia, fullness of lids, pain and exopthalmos (Mazlina *et al.,* 2006). Other facial signs that may present includeinfraorbital nerve hyperaesthesia, pain and facial asymmetry. Auditory complaints include hearing impairment secondary to serous otitis media due to nasopharyngeal extension. Intracranial extension maylead to headache, mental status or personality changes(frontal lobe involvement).

Although the majority of maxillary sinus carcinomas are locally advanced at diagnosis because its symptoms are nonspecific and these tumors tend to remain localized to maxilla for a long time and, during evolution, they invade adjacent structures. The most effective barrier against tumors propagation is the integrity of the periosteum that is particularly more resistant in two critical areas: The skull base and orbit (Kimmelman and Korovin, 1988).Destruction of maxillary sinus walls, especially the inferior antral wall, can be identified by panoramic radiography. In advanced cases, this imaging modality may not show evidence of early bone destruction. CT and magnetic resonance imaging (MRI) is the examination of choice in such situation. The primary reason for advising CT and MRI studies in cases of maxillary sinus carcinoma is for better characterizing the invasion of structures beyond the site of origin. On CT studies, all of the cases present as soft tissue masses in the maxillary sinus cavity, with 70 to 90% of cases evidencing bony destruction. CT provides more details of bone involvement than MRI. At MRI, these tumors present middle signal intensity on T1-weighted images and high intensity signal on T2-weighted images, and this method is of help in the evaluation of the posterior cranial fossa, orbit and perineural/perivascular dissemination, allowing the differentiation between retained secretions and neoplastic tissue (Maroldi*et al.,* 1997). When formulating a differential diagnosis for maxillary sinus carcinoma, it is mandate to include primary sinonasal neoplasms (e.g. sinonasal undifferentiated carcinoma, nasopharyngeal carcinoma, lymphoma, esthesioneuroblastoma, primary sinonasal melanoma and adenocarcinoma of minor salivary gland origin) and metastatic disease (Goldenberg*et al.,* 2001). Because of the anatomical features of the head and neck including the maxillary sinus, organ preservation is important to keep functions, e.g., phonation, deglutition and vision, and to minimize the aesthetic appearance changes. To preserve these functions, recent reports have described the efficacy of neo-adjuvant (induction) chemotherapy (NAC) followed by definitive RT and concurrent chemoradiotherapy (CCRT) for the advanced MSC patients (Seiwert and Cohen, 2005).

According to Sato *et al*, patients with advanced MSC had been treated with NAC followed by RT (Sato*et al.,* 1970), and recently, CCRT including cisplatin (CDDP), 5-fluorouracil (5-FU), methotrexate and leucovorin (CCRT–PFML) has been mainly applied. For the patients with complications and/or the elderly, RT with weekly carboplatin (CBDCA) administration and UFT (CCRT–CU), one of oral 5-FU derivatives composing of tegafur and uracil, has been administered as a standard regime (Taguchi*et al.,* 2006). FU is frequently administered as the basic agent of chemotherapy regimens for SCC since it has a synergistic interaction with many anti-neoplastic agents. NAC including CDDP and 5-FU (PF regimen) has been the standard therapy for locoregionally advanced and recurrent SCCs. The maxillary sinus is surrounded by the bony structure which is a structural barrier to local invasion, regional lymph node metastasis and distant metastasis of tumors. Based on the report of Sato *et al.,* 1970 the standard treatment method for MSSCC in Japan has been the combination of surgery, RT and intra-arterial regional chemotherapy via the superficial temporal artery(Sato *et al.,* 1970). Primary surgery of the site strictly follows rule of oncologic clearance and the Orbit is frequently involved in MSC either as direct extension of tumor or in the zone of oncologic clearance. Orbital involvement is associated with a significant reduction in survival both in ethmoid and maxillary sinus tumors. Most authors also found orbital invasion to have a deleterious impact on the outcome of maxillary sinus tumors (Taguchi*et al.,* 2006). In a review of 57 patients who underwent maxillectomy, multivariate analysis confirmed that skull base and orbital involvement were the only factors significantly associated with disease-specific survival (Gullane*et al.,* 1983).

Involvement of the orbit was associated with a 5-year survival of only 17%, as opposed to 49% when there was no invasion . On the other hand, no survival benefit was achieved by orbital clearance, only 11% of patients with orbital involvement remained alive after 5 years despite complete extirpation of orbital contents(Carrillo*et al.,* 2003). Orbital invasion also was an independent prognostic factor in a series of 95 tumors of the maxillary sinus, and T4 tumors with orbital invasion had a worse prognosis than other T4 tumors . No definite consensus has been reached on the degree of orbital invasion that is oncologically safe when sparing orbital contents. Different indications for orbital clearance have been proposed based on involvement of periorbita, orbital fat, extraocular muscles, or orbital apex(Nazar*et al.,* 2004). Thus, a selection bias exists in all of these studies because the tumors in more advanced stages (ie, orbital apex invasion) with expected worse outcomes were treated with orbital clearance, whereas those with more favorable orbital extension were treated with more conservative approaches. Primary surgery of MSC involves maxillectomy which may be complete or partial. Conceptually described by Lazars in 1826, a maxillectomy was not successfully performed until 1828 by Syme (McGuirt, 1995).

In 1927, Portman and Retrouvey described a sublabial-transoral approach that obviated scarring from external incisions, such as a lateral rhinotomy or Weber-Ferguson (Portmann and Retrouvey, 1927). Around the 1950s, advancements in anesthesia, blood replacement, and further improvements of the surgical technique propelled the popularity of the radical maxillectomy. During the 1970s, the midfacial degloving approach, which obviated the need for facial incisions in select patients, also gained popularity (Maniglia, 1986).Combined treatments, including preoperative or postoperative external beam radiation, led to a modest increase in survival.Multiple modifications and extensions were subsequently described to better suit the individual oncologic needs. In 1954, Smith described the extended maxillectomy (Smith and Klopp, 1954),which was associated with improved cancer survival rates (55%) (Ketcham*et al.,* 1973).As the surgical experience expanded, a maxillectomy was combined with skull base resections to address tumors of the pterygoid plate, anterior skull base, or posterior extension toward the nasopharynx. In 1961, Fairbanks-Barbosa was the first to report an infratemporal fossa (ITF) approach for advanced tumors of the maxillary sinus (Barbosa, 1961). This extended approach and its subsequent modifications helped to improve cancer survival rates, as previously unresectable tumors were now amenable to a complete resection.

However, they also resulted in higher postoperative mortality rates, frequently from meningitis (Donald, 1981). In 1977, Sessions and Larson (Sessions and Larson, 1977) coined the term "medial maxillectomy" to describe a partial maxillectomy indicated for benign and malignant lesions of the lateral nasal wall. Although initially described with a lip-splitting technique, many authors subsequently described modifications which obviated this extension. As endoscopic sinus surgery continued to advance, it was not long until an endoscopic medial maxillectomy was described (Waitz and Wigand, 1990).This technique offered superior visualization and resulted in favorable recurrence rates when compared to external approaches (Waitz and Wigand, 1992).Surgical anatomy, as it relates to maxillectomy, should include the discussion of bordering structures, as tumor extensions into these areas most often determines the extent of surgery and need for adjuvant therapy. The superior wall of the maxillary sinus is shared with the orbit, while the pterygoid plates, pterygoid space, and infratemporal fossa are located posterior to the sinus. Ohngren noted that involvement of these superior and posterior areas signifies a poor prognosis (Ohngren, 1933). He described an imaginary line extending from the medial canthus through the angle of the mandible. Lesions posterior-superior to this line have poorer outcomes than those anterior-inferior to this line, possibly as a result of the relative ease of resecting anterior-inferior lesions en bloc.

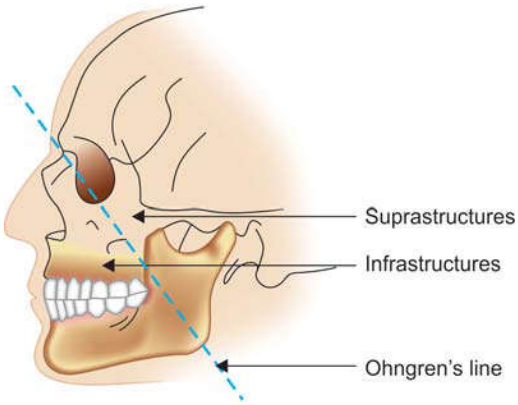

Fig. 1. Ohngrens line

Fig. 2. A standard Weber Fergusson incision marking for maxillectomy

Fig. 3. Modification by diffenbach for orbital clearance

Other close relationships include the oral cavity, adjacent paranasal sinuses, nasopharynx, skull base, and intracranial fossa. By understanding these relationships, one can interpret the varied presenting signs and symptoms as they relate to tumors of the maxillary sinus.Orbital exenteration is one of the most common extensions of a total maxillectomy in MSC. An orbital exenteration is indicated when the tumor invades the orbital soft tissues (lids, lacrimal apparatus, globe, muscles, or fat). Orbital preservation is advocated in patients with isolated bony erosion without invasion through the periorbita.

An exenteration requires palpebral incisions (or lid sacrifice) that can be incorporated into other incisions used for the maxillectomy. In general, both upper and lower lids should be preserved unless involved by tumor so they may be closed shut at the completion of surgery. Resection of the lower lid may be necessary if the tumor extends through the orbital septum.If not involved, the incision may be extended through the conjunctiva of the lower lid, which will allow the cheek flap to be reflected laterally. If complete resection of the entire orbital contents is required, an incision may be made through the conjunctiva of the upper lid. After appropriate skin incisions have been chosen, the dissection is carried posteriorly along the roof of the orbit, transecting the supraorbital neurovascular bundle.

Neck Dissection

Controversy remains about management of the neck in squamous cell carcinoma (SCC) of the maxillary sinus and we know of no reports of the use of elective selective neck dissection for management in this site.SCC that arises in the maxillary sinus is considered to be a paranasal sinus disease that behaves differently from SCC of the maxillary alveolus and hard palate, which are considered to be similar to oral SCC. As a result, management of the neck for cases with clinically clear nodes is controversial .There is some evidence to show that in T4 cases regional metastases are most likely to involve levels I and II and that this elective neck dissection has been successful in controlling regional recurrence (Le*et al.,* 2000).The use of elective selective neck dissection, however, may reduce the burden of radiotherapy in patients with pathologically clear nodes, and seems to be reasonable if the neck requires access for recipient vessels during free tissuetransfer. If after elective selective neck dissection nodes are invaded then the radiotherapy can be increased in those areas at high risk.

Reconstruction

The first step in reconstruction is a dacryocystorhinostomy (DCR), which is performed as previously described. Once the adequacy of the lacrimal sac marsupialization has been confirmed, the reconstruction of the rest of the orbital walls, especially the inferior orbital floor and rim, can proceed.An anatomic preservation of the orbital soft tissues does not always equate to functional preservation. Both the surgeon and patient should recognize that several factors may compromise the function of the eye. Resorption of orbital fat and wound contracture may result in enophthalmos, diplopia, and restricted range of motion. Postoperative radiation therapy increases the risk of visual compromise by inducing cataract formation, fat atrophy, and scar formation. If removal of the orbital floor was undertaken, reconstruction can proceed with alloplasts, such as a preformed or titanium mesh or autologous tissues, such as free cartilage or bone grafts or osteocutaneous free microvascular flap, (McCarthy and Cordeiro, 2010) depending on the size of the defect, as well as preference and experience of the surgeon.If the cavity is not reconstructed (no free microvascular flap), the inner aspect should be lined with a split-thickness skin graft or acellular dermis. These promote rapid healing and prevent contraction of the surgical cavity, which produces the subsequent collapse of the mid face. The scar band that develops at the interface of the skin graft and the remaining buccal mucosa often aids to secure the prosthesis. The ipsilateral temporalis flap or temporoparietal fascia flap is used to cover the orbital floor implant. In select cases, it may also be used to obliterate the cavity. However, flap tends to atrophy, and the cosmetic results at long term are inferior to those obtained with a free microvascular flap (eg, rectus abdominismicrovascular flap). Grafting is not required if a tissue flap is used to fill the defect.

If a surgical obturator was designed preoperatively, it can be inserted and secured with its own retaining clasps. Alternatively, if the dentition does not allow adequate retention of the obturator, 2 lag screws can be placed through to the remaining hard palate. Holes may be drilled in the posterior aspect of the splint to allow sutures to be placed from the soft palate to the splint. This reduces oro-nasal reflux and facilitates the early return to a normal diet. A surgical obturator may also be designed intraoperatively using thermoplastic material. Although, never as well-fitting or functional as that made by a prosthodontist, it is a reasonable alternative when circumstances do not allow a preoperative prosthodontics consultation. For moderate-sized defects, prosthetic devices and free-flap reconstructions appear to have equivalent results; however, in complex or extensive defects (eg, requiring replacement of facial skin, after orbital exenteration with or without a craniofacial resection) an osteocutaneous free-flap reconstruction has better functional outcomes (Kinnunen*et al.,* 2010). When closing the wound, the medial canthal tendon is sutured to a Y- or T-plate (1.5 mm) fixed to the ipsilateral nasal bone. The horizontal plate is screwed to the remaining nasal bone while the vertical plate extends to a point corresponding to that where the medial canthus was originally attached. The periosteum of the nasal bone and the skin incision is meticulously closed in layers. The temporary tarsorrhaphy or corneal shield is then removed.A surgical obturator also serves to hold the skin graft bolster (eg, ointment-soaked gauze roll), thus promoting adherence and take of skin graft. A temporary prosthesis is immediately fitted after the bolster is removed postoperative day 5th to 7th day. The prosthesis is further adjusted 2-4 weeks later (which may require multiple adjustments), and a final prosthesis can be fitted after the incisions are healed and the edema has resolved (usually after the adjunctive radiotherapy or chemoradiotherapy are completed). Two recent studies have looked at the quality of life in patients rehabilitated with obturator prosthesis. Overall, the quality of life is favorable with the use of obturators and the postoperative radiotherapy is the main variable that affects quality of life (Chigurupati*et al.,* 2013).

DISCUSSION

Symptoms of tumours of the paranasal sinuses usually develop late. Patients who do not respond to medical treatment for their sinonasal symptoms should be investigated for malignancies. Therefore, it is important for the diagnostician to maintain a high index of suspicion to allow for early recognition and referral of these patients. One should have eagle's eye in all cases involving swellings of the head and neck. In the presence of signs, such as pain and swelling with associated paresthesia, or if conventional therapy failsto resolve the swelling rapidly, prompt referral for biopsyis needed to arrive at definitive diagnosis.

It is mandate to advise advanced imaging techniques, such as CT and MRI,when conventional radiography fails to help in diagnosis atthe early stage of disease. Though chemotherapy and radiotherapy remain the first line of choice in advanced cases ,surgical approach should be chosen carefully. This is determined by type of the tumour, the extent of the tumour and involvement of the neighbouring structures.

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Figures displayed are obtained from google images.

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