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MANAGEMENT OF TEMPORAL BONE MALIGNANCIES - GUIDELINES TO A SUCCESSFUL ONCOLOGIC AND FUNCTIONAL OUTCOME

ENT

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ABSTRACT

Objective: This study aims to highlight the clinical presentation of temporal bone neoplasms, including their presenting symptoms, type of tumour and work up with relevant staging, surgical treatment options, adjuvant treatment and morbidity following surgery. **Materials and Methods:** We studied 18 cases of primary temporal bone malignancies over the past ten years at a tertiary cancer centre in Bangalore, India. **Results:** 12/18 patients had squamous cell carcinoma, two with adenoid cystic carcinoma and one each with malignant myoepithelioma, malignant schwannoma, chondrosarcoma and malignant melanoma. All the patients were treated with surgery viz subtotal temporal bone resections (12), lateral temporal bone resections (3), sleeve resections (2), and one total temporal bone resection. Reconstructive procedures varied depending upon the size of the defect and included anterolateral thigh flap (1), pectoralis major myocutaneous flap (7), supraclavicular flap (3), submental flap (1) and latissimus dorsi flap. 11 patients experienced postoperative complications. One patient developed local recurrence, one patient had persistent disease after surgery and two patients developed distant metastasis. Median disease-free survival was 16 months (6-24 months). **Conclusion:** Even though squamous cell carcinoma is the most common temporal bone malignancy, it is quite rare to come across these cases regularly. Because it shares common symptoms with chronic ear disease which often leads to delay in diagnosis and also its aggressive nature, treatment of temporal bone malignancy is complex and often needs a multidisciplinary team. Standard of treatment is surgery followed of by adjuvant radiotherapy, typically administered to patients with stage T2 and above.

KEYWORDS

Temporal bone tumours, CSF leak, Squamous cell carcinoma

INTRODUCTION

Primary temporal bone malignancies are rare, comprising less than 0.2% of all head and neck malignancies. The estimated incidence is 1-6 per 100,000 population[1-3]. Squamous cell carcinoma is the most common malignancy, accounting for 60-80% of the spectrum, followed by basal cell carcinoma, and salivary gland tumors such as adenoid cystic carcinoma and adenocarcinoma. Primary temporal bone neoplasms are uncommon, it is usually involved by cutaneous malignant tumours of the pinna, or external auditory meatal skin or metastatic carcinoma involving the intra-parotid or post auricular nodes[4]. Metastasis from distant sites is extremely rare and usually originates from breast, lung or kidney neoplasms[5].

Although these malignancies can occur in all age groups, they typically occur in older patients with an average age group of 65 years and 75% of them occur in men[6]. There are various risk factors attributed to the development of these neoplasms, with prior actinic radiation exposure to the local site being the most common contributing factor, especially in fair-skinned individuals[7]. Chronic otitis media is a frequent coexistent finding in the presence of temporal bone carcinoma. However, it has not yet been proven for it to be the causative etiology[8]. The other risk factors that have been mentioned as possible carcinogens include chlorinated disinfectants and human papilloma virus infection (HPV16,18)[9]. Signs and symptoms of the disease are vague, such as otorrhea, deep seated earache, hearing loss, facial nerve palsy, often resembling chronic ear infection. Due to such nonspecific symptoms, diagnosis is often delayed and patients usually present in advanced stage. Secondary lymphatic spread is rare due to paucity of lymph vessels in this area and occurs when the skin of external ear is involved. The first echelon is usually the intra-parotid lymphatics and from there they can spread to upper neck and retropharyngeal group of nodes[10].

Accurate tumour diagnosis and staging include a complete otorhinolaryngological and neurologic clinical examination, complemented with cross-sectional imaging, and histopathological confirmation of type of malignancy. Computerized tomography (CT) with contrast offers excellent delineation of soft-tissue abnormalities against a background of air (middle ear cavity, external auditory canal, mastoid air cells) and assessment of bony involvement. Magnetic resonance imaging (MRI) offers a more detailed characterization of soft tissue and fluid, allows better visualisation due to enhancement of small structures, and aids in differentiating soft tissues of different natures, like granulation tissue versus malignant tissue. Positron-emission tomography (PET) is used to evaluate distant metastasis in cases of locally advanced malignancy[11].

There is no universally accepted staging system for temporal bone malignancies. Recent literature support the Pittsburg Classification proposed by Arriaga et al[12] with modifications given by Moody et al[13]. Surgical resection is the mainstay of treatment[14]. T1, T2 tumours can often be treated with lateral temporal bone resection. T3, T4 tumours generally require subtotal or total temporal bone resection along with possible craniotomy, mandibulectomy, and adjuvant radiotherapy. Parotidectomy and neck dissection are employed for extensive disease. The incidence of cervical lymph node metastasis is 10-23%, usually involving levels II and III[7]. The various surgical approaches as stated above are:

1. Sleeve resection is done for lesions of the external auditory canal limited to the lateral portion. This may involve parts of outer ear such as concha and pinna which may need to be resected and subjected to canalplasty
2. Lateral (LTBR) temporal bone resection is defined as the removal of the osseous and cartilaginous external auditory canal, malleus and incus. It is usually associated with intact facial nerve but will confer a conductive loss of 40-50 dB hearing loss.
3. Subtotal temporal bone resection (STBR) includes the additional removal of the otic capsule with subtotal petrosectomy and usually facial nerve resection as part of the specimen. A blind sac closure and obliteration of the large cavity by muscle flaps is advised especially to protect the dura which is usually exposed and to seal any cerebrovascular /perilymph leaks which may not be uncommon
4. Total temporal bone resection (TTBR) involves the additional removal of the petrous apex. It needs tumour removal from all round the petrous part of the internal carotid artery with occasional

resection and vascular bypass of the internal carotid blood flow; prior to this endeavour it is mandatory to carry out balloon occlusion test to assess intracranial cross over circulation to predict and if possible, pre-empt the surgical morbidity of post-surgical neurovascular deficit. It is a formidable combined procedure which needs neurosurgical, microvascular and H&N expertise[15].

MATERIALS AND METHODS

Aim: This study aims to highlight the clinical presentation of temporal bone neoplasms including their presenting symptoms, type of tumour, and work up with relevant staging; surgical treatment options, adjuvant treatment and morbidity following surgery in 18 patients have been documented with respect to salient feature of management and local disease control at a tertiary cancer centre.

Study Type: Retrospective analysis

Study Population: We studied 18 cases of primary temporal bone malignancy over the past ten years at a tertiary cancer centre in Bangalore, India. Those not willing to follow up or who refused consent were excluded.

Statistical Analysis: The collected data were transformed into variables, coded and entered in Microsoft excel. Data were analysed and statistically evaluated using SPSS-PC-25 version. Quantitative data was expressed in mean ± standard deviation or median with interquartile range while qualitative data were expressed in percentage.

RESULT

Of the 18 patients included in the study, 88.8% were men and 11.1% were women, and the mean age at diagnosis was 45.92 ± 11.34 years. The median age was 43.5 years (37.5-54 years). The most common symptoms reported by the patients were earaches and ear discharge (78%). Symptoms such as peripheral facial nerve palsy and other cranial nerve palsies were rare, which indicated advanced stage disease. Involvement of the medial wall of the middle ear was considered an indication for subtotal temporal bone (STB) resection in 12 cases. One case was subjected to total temporal bone (TTB) resection. In 4 cases, extensive disease in the dura precluded an R0 resection. Except for two salvage surgical procedures for post radiotherapy recurrences, rest were carried out as primary ablative procedures. Patient characteristics are summarised in Table 1.

In our study, there were four types of surgical approaches: twelve subtotal temporal bone resections (STBR), three lateral temporal bone resections (LTBR), two sleeve resections, and one total temporal bone resection (TTBR). Reconstructive procedures varied depending upon the size of the defect and included anterolateral thigh flap (1), (7) pectoralis major myocutaneous flap (Fig1,2), supraclavicular flap (3), submental flap (1) and latissimus dorsi pedicled flap (2). Two patients did not undergo reconstruction. Two patients who had cervical lymph node metastasis underwent lateral neck dissection.

The mean follow-up time was 17 months (6-24 months). A total of 11/18 patients (61%) experienced postoperative complications. The various complications thus experienced are listed in Table 2. Nine (excluding 2 post op deaths) patients developed sensorineural hearing loss. Eight patients including three with pre-op facial palsy were left with permanent peripheral facial nerve palsy post STBR and 4/8 underwent interposition nerve grafting using greater auricular nerve in three and accessory nerve to 7th nerve graft in one. One patient developed 9, 10 and 11th cranial nerve palsies and succumbed to an ascending intracranial infection. Three (16.6%) patients had flap-related complications. Two (11.1%) patients had partial flap loss, one of which required salvage with a pectoralis major myocutaneous flap. One patient developed flap infection, which healed well with intravenous antibiotics and regular dressing. Two (11.1%) patients with dural defects developed CSF leaks. One of these patients also developed meningitis and subdural empyema. The first patient had undergone intracranial resection with supraclavicular flap repair. In the post-operative period, there was partial flap loss and was salvaged with a pectoralis major myocutaneous flap along with repair of the dura. The second case of meningitis with subdural empyema underwent treatment with intravenous antibiotics and surgical drainage. Unfortunately, both the patients succumbed to meningitis on the 20th and the 11th post-operative day.

Neoadjuvant chemotherapy was received by two (11.1%) patients and all except 4 patients received (75%) received adjuvant radiotherapy within a period of 2 months. In the follow up period, one patient developed local recurrence, two patients had persistent disease after surgery and two patients (11.1%) developed distant metastasis. In our study, the median disease -free survival was 16 months (6-24 months). At 2 years, 9 /18 were alive and healthy; all of them had received adjuvant post op radiotherapy after successful R0 resection.

Table 1: Patient Characteristics

Characteristics	N (%)
Sex	
Male	16 (88.9)
Female	02 (11.1)
Age in years (Range)	
31 – 40	06 (33.3)
41 – 50	07 (38.9)
51 – 60	03 (16.7)
61 – 70	02 (11.1)
Presenting complaints	
Ear pain	05 (16.7)
Ear discharge	05 (11.1)
Facial nerve palsy	03(16.7)
Other cranial nerve palsies	01 (5.55)
Deformity/Swelling	04 (22.2)
Deafness	06 (33.3)
No symptoms	08 (44.4)
Type of tumor	
SCC	12 (66.7)
Adenoid cystic carcinoma	02 (11.1)
Malignant schwannoma	01 (5.55)
Myoepithelial carcinoma	01 (5.55)
Chondrosarcoma	01 (5.55)
Malignant melanoma	01 (5.55)

Table 2: Complications

A. Post-operative complications	
CSF leak	02 (11.1)
Meningitis	01 (5.55)
Hearing loss	09 (50)
Facial weakness	08 (44.4)
Other cranial nerve palsies	01 (5.55)
Death	02 (11.1)
B. Flap related complications	
Partial necrosis of flap	03 (16.7)
Flap infection	01 (5.55)

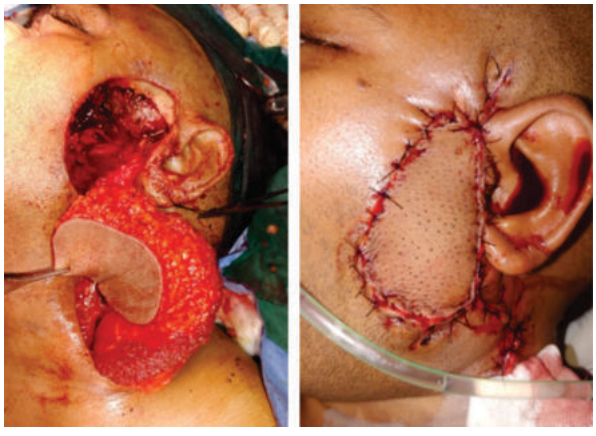

Fig 1,2: Reconstruction Of The Defect With PMMC Pedicled Flap

DISCUSSION

Primary malignancies of the temporal bone are infrequent, it is usually more likely to be involved secondarily by the tumours arising from the parotid gland or preauricular skin[16].Squamous cell carcinoma makes up 60-80% of primary temporal bone malignancies, whereas it accounts for only around 40% of all the tumours of the temporal bone[6,16]. In our study, 66.7% of patients were diagnosed with squamous cell carcinoma. Higgins et al.[17] states that 60% of patients are men and the most common age at diagnosis is 60 to 69 years. In our study, we found that 88.9% of patients were male and the mean age at diagnosis was 46 years. Their initial presentation resembles chronic ear infection, hence quite often results in delayed diagnosis. Madsen et al.[18] observed symptoms of chronic ear infection for an average of 13 months prior to the diagnosis of temporal bone malignancy. In our

study, the most common presenting complaints were earaches and ear discharge. As the majority of the temporal bone is inaccessible for direct visualisation, imaging plays a significant role in staging and management. Computed tomography (CT) and magnetic resonance imaging (MRI) provide complementary information regarding tumour extent. Whereas CT scan helps in identifying bony erosions, MRI is especially helpful in identifying perineural disease or involvement of dura[16].Role of positron emission tomography (PET) is to evaluate distant metastases[4].

Primary surgery is the preferred treatment in fit individuals who consent to this procedure[14]. There are widely three options for resection: lateral temporal bone resection (LTBR), subtotal temporal bone resection (STBR), and total temporal bone resection (TTBR). T1, T2 tumours can often be treated with lateral temporal bone resection. The medial extent of the tumour is critical and needs accurate preoperative delineation by cross sectional radiology. This can generally be achieved in an enbloc manner and should be controlled with intraoperative frozen section. LTBR results in post-operative conductive hearing loss. Ghavami et al.[19] aimed at preserving hearing by modifying LTBR. They performed a standard LTBR but preserved the tympanic membrane and ossicles and reconstructed the remaining external auditory canal with a split-thickness skin graft. The mean post-operative air-bone gap was 9 dB, significantly less than expected after a standard LTBR. Medial extension of tumour into the middle ear cavity or mastoid air cells viz. T3 and T4 generally require subtotal or total temporal bone resection along with possible craniotomy, mandibulectomy and adjuvant radiotherapy. STBR results in sensorineural hearing loss and often permanent facial nerve paralysis[20]. Parotidectomy and neck dissection are added for disease extension and proper staging of the neck in advanced stage lesions. The facial nerve cannot be preserved in entirety in such resections and therefore attempts have to undertaken for rehabilitation of periocular and perioral commissures at the same time as the resection with static or dynamic rehabilitative procedures for facial nerve reanimation. Since tumour cells infiltrate the mastoid air cells, it is essential to resect them in toto by encompassing them with appropriate bony cuts in the tegmen antri-tympani superiorly, sinus plate posteriorly, glenoid fossa anteriorly including the condyle of mandible, and finally inferiorly staying medial to the disease in the hypotympanum after ligating the inferior jugular vein and protecting the internal carotid artery as it enters the petrous temporal bone. The medial most bony cut is taken lateral to subarcuate eminence in subtotal resection (STR) and may require removal of petrous apex in a piece meal manner in total temporal bone resection (TBR). Limited dural resection can be undertaken but involvement of brain indicates a bad case selection and should not be undertaken as it has a bad prognosis with increased morbidity. At end of procedure the subarachnoid space should be sealed with autologous tissue such as fascia or muscle and there should be no evidence of CSF leak on positive valsalva by the anaesthetist. Areas of caution are the inferior petrosal sinus as it drains inferomedial aspect of jugular bulb. Overt use of electrocautery should be avoided as this area is very close to the last 4 cranial nerves in the vicinity of the jugular foramen. Packing with surgical/gelfoam is preferred and generally arrests the haemorrhage. Similar caution should be exercised in the area medial to glenoid fossa as it is filled with sinusoidal venous plexus draining the pterygoid fossa. In STBR and TTBR frozen section is not possible owing to bony nature of specimen. However, it is essential to identify the marginal tissue from the tumour bed after removal of specimen for regular histologic examination and tag high risk area with titanium liga clips to aid the radiation oncologist to direct their portals to boost these areas which are in close proximity to the vital intracranial and vascular structures. TTBR is a highly morbid procedure and also lacks a proven survival benefit, many authors believe that TTBR is not justified and it is rarely performed today[21]. Local canal resection (LCR), also termed as "sleeve resection", is a procedure that involves removal of the bony ear canal skin and reconstruction with a split-skin thickness graft. This method is not oncologically sound, Austin et al.[22] reported that 60% of patients with T1 disease developed local recurrence when treated with LCR alone.

Reconstruction of temporal defects is important to ensure proper healing and to prevent complications. Reconstruction following temporal bone resection is challenging due to the complex postsurgical defects and the need to accomplish multiple cosmetic and functional goals. Rosenthal et al.[23], mentioned the incorporation of well-vascularised tissue able to withstand irradiation, and lower the susceptibility to denervation atrophy. In our series, due to institutional restrictions, free anterolateral thigh flap was done only in one case following subtotal temporal bone resection. The majority of the defects were reconstructed with a pectoralis major myocutaneous regional flap. For smaller defects, supraclavicular and submental flaps were used. When the facial nerve is sacrificed with normal pre-operative facial nerve function, immediate nerve grafting is recommended provided tumour free proximal and distal stumps are confirmed by frozen section. For patients with pre-existing facial paralysis, static facial slings, gold weight implants, and canthoplasties can be employed[24]. In our study, intraoperative damage to the facial nerve occurred in four patients and was immediately repaired with cable nerve grafting.

The role of radiotherapy in the management of temporal bone malignancy is usually in the adjuvant setting. Indications include lymph node metastasis, positive margins, perineural invasion, bone invasion, recurrent, T3 and T4 tumors[25]. Morita et al.[1] found improved overall survival in patients with T1 or T2 temporal bone squamous cell carcinoma treated with surgery and adjuvant radiation versus definitive radiotherapy. In our study, all T3 and T4 resections received postoperative radiotherapy to tumour bed as soon as wound healing is deemed complete. One should be vigilant about cerebrospinal fluid (CSF) leaks and try to manage it with diuretics or a spinal drain if necessary. Ascending infection has to be prevented at all costs. Tamponade of the resultant mastoid cavity by fresh vascularised muscle and watertight dural repair at initial surgery are important to prevent CSF leaks Two of three patients who had R1 resections with gross disease left behind and required radiotherapy due to positive margins which recurred within 8 months and one succumbed to post op complications secondary to CSF leak and ascending infection. The cases who had R0 complete resection and prompt adjuvant radiotherapy all remained controlled at 2 years post treatment with a minimum follow up of 18 months. Chemotherapy is an emerging modality in the treatment of temporal bone malignancies. Nakagawa et al.[26] proved preoperative use of chemoradiotherapy helpful in obtaining tumour free margins in T3 and T4 tumours. In our study, two patients received neo-adjuvant chemotherapy. Moody et al observed that two-year overall survival rates for T1, T2, T3 and T4 tumours were 100%, 80%, 50%, and 7%[13]. Other studies show 5-year disease free survival and disease specific survival for combined T1 and T2 tumours to range from 67% to 100% and from 92% to 100%. The same for T3 and T4 tumours to range from 41% to 59% and 48% to 65% respectively[14,27]. In our study, the median disease-free survival was 16 months (6-24 months).

CONCLUSION

Even though squamous cell carcinoma is the most common temporal bone malignancy, it is quite rare to come across these cases regularly. Because it shares common symptoms with chronic ear disease, which often leads to delay in diagnosis and also its aggressive nature, treatment of temporal bone malignancy is complex and often needs a multidisciplinary team. The standard of treatment is surgery followed by adjuvant radiotherapy, typically administered to patients with stage T2 and above.

Ethics Declarations

1. COMPLIANCE WITH ETHICAL STANDARDS – The study is compliant with the ethical standards
2. FUNDING – No funding was provided by any source for this study
3. CONFLICT OF INTEREST - There has been no conflict of interest
4. ETHICAL APPROVAL – Our institute ethics committee has confirmed that no ethical approval is required
5. INFORMED CONSENT – A written informed consent was taken from all the patients to be a part of the study

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