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Early Detection of Adenoid Cystic Carcinoma And its Implication on Prognosis – A Clinical Study

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Abstract: *Adenoid cystic carcinoma is an uncommon salivary gland malignancy that presents insidiously and is generally advanced when diagnosed. It is a slow growing malignant tumour, characterized by wide local infiltration, perineural spread, a propensity to local recurrence late distant metastases and delayed reporting & diagnosis. Little progress has been made in advancing "curative" treatment of adenoid cystic carcinoma of the head and neck. The disease is said to have a fatal outcome. The time is now opportune for a multicenter, randomized, controlled trial to identify patients who would benefit from adjuvant radiotherapy and/or chemotherapy in the control of loco regional recurrences and the prevention of distant metastases.*

A Series of Six cases were reported to our OPD with a swelling of the palate which were diagnosed histopathologically as ACC and referred to Higher centres for surgery and Radiotherapy as the earliest for better prognosis.

Keywords: *Adenoid Cystic Carcinoma; Salivary Gland Malignancy: Palatal Swelling.*

I. Introduction

Adenoid cystic carcinoma (ACC) was first described by three Frenchmen (Robin, Lorain, and Laboulbene) in two articles published in 1853 and 1854[1]. It was they who described the cylindrical appearance of this tumor. Many articles since then have remarked that Billroth, in

1859, first described ACC under the name cylindroma, but it was he who described that ACC had a "great tendency to recur." Spies [2], in 1930, is credited with the term adenoid cystic carcinoma, in a discussion of tumors, cutaneous and noncutaneous, of the basal cell variety. The early history of this tumor, and the numerous different names given, has been reviewed by Tauxe et al. [3].

It was through the major work of Foote and Frazell [4] that an accepted classification of salivary tumors was proposed. It was they who described that adenoid cystic tumors were located in the major and minor salivary glands, they who recorded that the tumors were usually small with an incomplete capsule, and they who recorded the variations in histology that had a propensity to perineural spread. It was they who suggested that the low cure rates reflected "a relatively conservative surgical approach," and expected that a more radical surgical treatment could show considerable improvement. It is currently recognized that ACC remains an extremely difficult disease to treat. It was described by Conley and Dingman [5], as "one of the most biologically destructive and unpredictable tumors of the head and neck." It has a high, almost inevitable, predisposition to recur if a patient lives long enough, and this occurs even when radical excision has been performed [6]. In the past, radical or superradical surgery was advocated for curative intent, but it gradually became apparent that this may not improve survival and may not even reduce local recurrence rates compared with a more conservative surgical approach and postoperative radiotherapy [7-9].

ACC accounts for approximately 10% of all neoplasms of the salivary glands. The parotid gland is the single most common site of origin (25%) in the head and neck. Most ACCs arise in the minor salivary glands (60%). ACC of minor salivary gland origin occurs most frequently in the oral cavity (palate). ACCs arising from the minor salivary glands are often advanced at the time of diagnosis, and complete excision is limited by their large size (with perineural extension involving the cranial base) and the proximity of the tumor to important neural and vascular structures.

We present a case of adenoid cystic carcinoma of the palate, and a brief literature review on its clinical, histopathological and therapeutic aspects

II. Materials

There were 6 cases reported to our OPD at Arupadaiveedu Medical College & Hospital during the year 2015 & 2016, in which 3 males & 3 females, 4 were on Right side of palate & 2 were on Left side of the

palate. The age varies from 40 to 70 years. Patient accepted to involve in the study were only included in this study.

III. Methods

All the cases taken for study were taken complete haemogram, OPG (Orthopantomogram), CT (Computer Tomography) scan, Chest X-ray Posterior-Anterior View, and after getting Medical Fitness and Informed Consent, finally perform Incisional Biopsy under Local Anesthesia and sent for Histopathological examination. Test dose of 1cc Xylocaine was administrated sub-cutaneously for all patients to rule out LA allergy. The Incised soft tissue was stored in 10% Formalin and sent to Pathology Department. The Closure was done by simple interrupted suture using 3-0 half circle round body Mersilk and removal after 1 week.

A 70 years old female patient reported to our dental op with the complaint of painful swelling in the upper front region for past 1 month, patient was apparently normal before 1 month, then she developed tooth pain in that region which was mobile and self exfoliate. later she developed swelling in that same region which was progress slowly rapidly to attain the present status **(Fig: 1)**. H/o pain is gradual in onset, continuous, pricking, with moderate intensity and no aggravating or relieving factor. Pain radiating to nasal and forehead region. H/o betel nut chewing for past 10 years with frequency of 3 times per day. On extra-oral examination, facial asymmetry seen due to diffuse swelling seen in middle third of the face with right nasal deviation seen. Right nasal stuffiness is evident on palpation. Intraoral examination reveals, A single, ill defined swelling seen in the maxillary alveolar and hard palate and borders are irregular, size of 5x6cm approx, extends anteriorly – involving the upper labial vestibule, posteriorly – involving soft palate crossing midline and palatal aspect of 13,14,15,16 to palatal aspect of 23,24,25,26,27&28. Mucosa over the swelling appears erythematous with slough in maxillary alveolar region and posteriorly appears hyperpigmented. On palpation - firm in consistency of posterior palatal region, hard in consistency of anterior alveolar region. Bleeding on probing and pus discharge present.

Plain film radiographic examination (OPG) revealed a diffuse ill defined mixed radiolucency lesion extending from the distal aspect of right maxillary canine region to the mesial aspect of right maxillary 2nd premolar region. There was loss of lamina dura around the involved teeth. The floor of the right maxillary sinus was not evident **(Fig:2)**.

CT contrast reveals – serial axial CT sections of facial bones done followed by 3D & multiplanar volume reconstruction with IV contrast.Well enhancing huge soft tissue density mass with pre contrast Hu 42 IU and post contrast HU 72 IU noted arising from hard palate and extending to right maxillary sinus and left maxillary antrum. From right maxillary antrum superiorly it extends with erosion up to the inferior wall of the orbit and medially it extends into left maxillary antrum with erosion of medial and lateral wall of right maxillary antrum medial wall of left maxillary antrum **(Fig: 3)**. Based on the clinical and radiographic appearance, the case was provisionally diagnosed as Carcinoma of palate. The differential diagnosis considered were Salivary gland tumour , adenomatoid odontogenic tumor, and odontogenic myxoma.

The specimen was submitted for histopathological examination to establish a definitive diagnosis . Histopathological examination reveals that the given section shows dense fibrous connective tissue exhibits numerous islands of epithelium of varied sizes. The cells are small and round with hyperchromatic nuclei and minimum cytoplasm. Many island show, small cystic spaces. some of them with mucinous material.There is capsulation in the periphery, numerous neurovascular bundles are noted in the stroma. Inflammatory cells are minimally seen. Histopathology of the given section is suggestive of adenoid cystic carcinoma **(Fig: 4)**.

All the patients were well explained; counseled and referred to higher centers as the earliest with the Histopathological report, slide, if needed the wax block for surgical excision and Radiotherapy for better prognosis.

IV. Discussion

The clinical behavior of ACC is a paradox: First, tumor growth is slow, but its clinical course is relentless and progressive. Second, operative intervention is usually feasible, but multiple local recurrences are the rule. Third, metastatic spread to regional lymph nodes is uncommon, but distant spread to the lungs and bones is frequent.

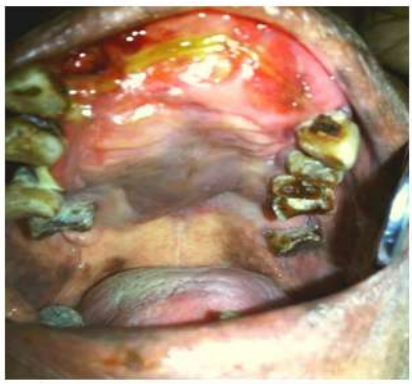

Fig: 1 ACC Palatal View

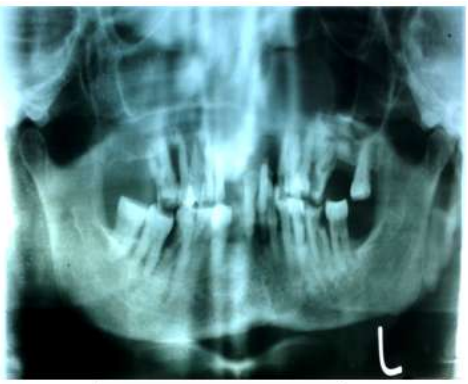

Fig: 2 OPG

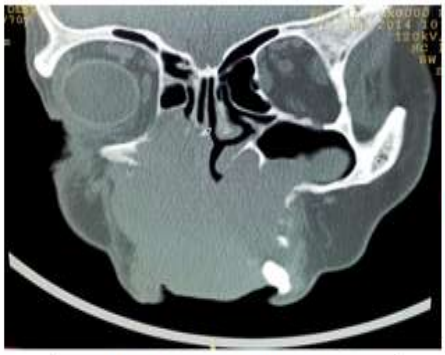

Fig: 3 CT Axial view

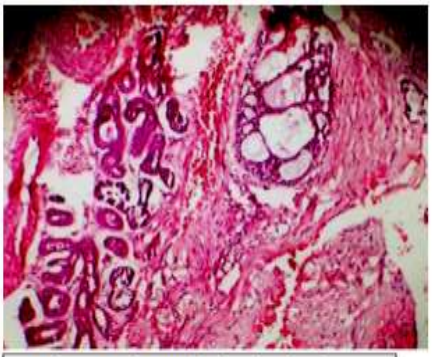

Fig: 4 Hitopathological View

And fourth, 5-year survival rates are optimistically high, but 10- to 20-year survival rates are dismally low [10]. Tumor stage is considered the most reliable indicator of overall outcome [11], but some authors have emphasized the importance of histologic subtyping. There is a strong positive correlation between site of origin and prognosis. The more favorable outcome with major (relative to minor) salivary gland ACC is attributed to the earlier discovery of the neoplasm at these more accessible locations. It has been reported that ACC of the nasal cavity and paranasal sinuses has a worse prognosis than in any other area of the head and neck region [12,13].

Histologically, ACC can be categorized into three growth patterns: cribriform, tubular, and solid. In most studies, a solid growth pattern is associated with a worse prognosis, caused by advanced stage and development of distant metastases [9,10]. A unique feature of ACC is the propensity for perineural invasion, even with early-stage tumors. Tumor is graded according to Szanto et al. [14], cribriform or tubular (grade I), less than 30% solid (grade II), or greater than 30% solid (grade III). In patients treated by similar modalities, the cribriform and tubular variants of ACC demonstrated no difference in the rate of distant metastases and overall survival. The cribriform variant demonstrated a significantly worse prognosis in terms of local recurrence rate. The patients who had a solid histologic pattern of ACC appeared to have an overall worse prognosis in terms of distant metastases and long-term survival [15]. The use of fine-needle aspiration biopsy is widely accepted in the diagnostic procedure of head and neck lesions. The cytologic typing of ACC is feasible in most cases by the finding of large globules of extracellular matrix, partially surrounded by basaloid tumor cells, but lacking characteristic globules [16]. However, one needs to be wary that the pleomorphic adenoma is the most frequent other salivary tumor confused when ACC is being considered on fine-needle aspiration.

Prognosis of ACC has been reported on histologic subtypes, presence of tumor at the surgical margins, anatomic site, and metastases, but none of these parameters has proved to be an unequivocal predictor of disease activity. The use of immunohistocytochemistry, and the staining pattern of p53, bcl-2, P-glycoprotein, glutathione Stransferase, and topoisomerase, as well as sequencing analysis of p53, because of their proved association with poor prognosis and therapy resistance, have been analyzed [17]. These results have demonstrated that p53 alteration is an independent prognostic marker and that proteins known for their association with radio- and chemotherapy resistance can be overexpressed in some ACCs, suggesting that those molecules could influence the outcome of new therapeutic approaches. ACC is known to have aggressive tumor behavior by its ability to invade and metastasize. One such factor regulating these functions is the urokinase-type plasminogen activator and its receptor. The urokinase-type plasminogen activator receptor participates in several

normal cellular processes but also influences tumor invasion and metastasis by facilitating the destruction of extracellular matrices. Clinically, cellular expression of urokinase-type plasminogen activator receptor denotes a worse prognosis for many malignancies. So far, studies of skull base ACC urokinase- type plasminogen activator receptor expression seem to be a negative prognostic factor [18]. Other factors studies showing some preliminary usefulness include the proliferating cell nuclear antigen and c-erbB-2 oncoprotein expression [19], the transmembrane tyrosine kinase receptor c- kit (CD117) [20], and the intercellular adhesion molecule-1 [21]. However, there is still a need to identify those patients who have a more aggressive ACC disease to identify them for more novel and possibly experimental therapeutic regimens. Surgical anatomy ACC is thought to arise from the mucous-secreting glands. It arises specifically from the intercalated ducts, and electron microscopy shows that it arises from cells that can differentiate into epithelial and myoepithelial cells. These mucus-secreting tumors are confined to structures derived from the foregut (that is, the parotid, submandibular, and sublingual glands, and the mucus glands throughout the upper respiratory tract). Palatal glands are not found in the midline or anterior to a line between the first molar teeth, nor on the gingiva. There are approximately 250 glands on the hard palate, 100 on the soft palate, and 10 on the uvula. These glands are also associated with the larynx (supraglottis and subglottis), as 128 Head and neck oncology well as the nasal and nasopharynx oropharynx (tonsil and posterior tongue) [6].

The optimal therapy for ACC of the head and neck has not been established. The choice of therapy is affected by site, stage, histologic grade, and biologic behavior of the ACC. There are a number of publications that address the efficiency of surgery and radiation therapy in the treatment of ACC of the head and neck. Most ACCs arising in major salivary glands are treated surgically, with the possible addition of adjunctive radiotherapy. Parotid ACC should be treated by preservation of the facial nerve if not paralyzed preoperatively and not involved intimately by tumors at the time of surgery, followed by postoperative radiotherapy [22]. Sub-mandibular ACC should be treated by a supra-omohyoid neck dissection followed by postoperative radiotherapy [23]. ACC of the minor salivary glands should be treated by local radical excision and postoperative radiotherapy [23]. Although local recurrence appears to be decreased, a survival benefit has not been demonstrated [13]. Pathologic findings correlated with local recurrence rates, and positive resection margins were significantly associated with an increased risk of local recurrence. In patients who receive postoperative radiation therapy, an improved outcome is observed with radical surgery compared with biopsy alone.

Chemotherapy currently is seeking a role in the management of advanced and metastatic salivary gland tumors. There is a need for biomarkers that will allow for better identification of the cohort at greatest risk of distant dissemination to make this approach cost-effective [8].

ACC of the paranasal sinuses and the nasopharynx has attracted considerable amount of publications with the advent of safer techniques used in skull base surgery [24-29]. The principles of combined surgery and radiation therapy are considered the accepted standard of care for minor salivary gland malignancies, and these principles can be applied to ACCs presenting in this area. However, the results of this new surgical technique have not resulted in an overall improvement in diseasefree survival in patients with skull base ACC [28]. Surgery appears to be palliative in most patients treated in this way with advanced skull base ACC. Thus, the morbidity of surgery needs to be tempered by this fact, with consideration given to the preservation of the functioning major neurovascular structures involved with the tumor [24]. ACC presenting or developing cervical lymph node metastases is very uncommon, and is associated almost exclusively with sub-mandibular gland disease, and surgery for nodal disease has had little impact on overall patient survival [30].

A good response is usually seen initially with photon irradiation therapy alone and most tumors will recur locally with time [31]. The best results have been obtained with the combination of radical surgery and radiation therapy. Unfortunately, there are no randomized trials that prove the value of adjunctive radiation therapy or determine which subgroups of patients are most likely to benefit [13]. Radiation, usually in doses or 60 Gy or more, may be of benefit when there is minimal residual microscopic disease. It is likely that there is frequently unrecognized perineural invasion in specimens with "negative" margins that would have benefited from the addition of radiation therapy. Therefore the use of postoperative radiotherapy has been advocated by most clinical practices to ensure locoregional control at a minimum The routine use of radiotherapy is advocated when patients are inoperable or refuse surgical treatment, in those with advanced operated tumors, or in those with distant metastases, as well as in those patients with histologically positive margins [32].

The use of fast neutron irradiation seems to have a better response to photon beam therapy because of the higher relative biologic effectiveness of neutron radiation [33,34•]. The conclusion of studies is that neutron radiotherapy is an effective treatment, compared with neutron irradiation, for patients with gross residual disease, and achieves excellent loco-regional control in patients without evidence of gross disease [35].

Reports have shown that patients with ACC arising from sites in proximity to the cranial base (nasopharynx, nasal cavity, and maxilla) have a significantly increased risk of local recurrence. This is related to the difficulty of securing clear resection margins at the cranial base because of technical difficulties associated with the

surgery, intracranial extension of the tumor along nerves, and restrictions on the limits of resection caused by the proximity of critical neural and vascular structures. The use of the gamma knife has been recommended for use in the treatment of recurrent salivary gland tumors involving the skull base, using a median radiosurgery dose of 15 Gy. Most patients reported an excellent symptomatic response, such as decrease in headaches or facial pain. Further repeated radio-surgery has successfully salvaged some patients previously treated [36•]. Hadad et al. [37] demonstrated that positive surgical margins are a strong predictor of poor patient outcome, and Horiuchi et al. [38] showed that radiation therapy is less effective for the treatment of macroscopic residual disease compared with microscopic disease. Pathologic findings also correlate with local recurrence rates: Positive resection margins are ACC of the head and neck Bradley 129 associated significantly with an increased risk of local recurrence, tumors located close to the cranial base and tumor grade, an increased solid component is associated with increased risk of local recurrence. Grade I tumors has also been associated with early recurrence (>1 year) and an earlier risk for development of distant metastases [15].

The pathologic detection of positive resection margins and peri-neural invasion for ACC may vary greatly depending on the extent of sampling of the specimen and the enthusiasm of the histopathologist. Clinicians are all too aware that distant metastases often defeat successful treatment of patients with ACC, despite loco-regional control, and are associated with a low long-term survival rate. The incidence of distant metastasis in ACC, most often the lung, is difficult to estimate, but is certainly dependent on the length of time that patients are followed, usually more than 15 to 20 years, but ranges from 35 to 50% [39]. Spiro [40] suggests that that the incidence of other sites being involved by distant metastasis is likely to be more common, because once lung metastases are detected, no further metastatic investigations are performed. The average time in a series of patients in Japan between detecting lung metastases and death was 32.3 months, and between the occurrence of metastases elsewhere and death was 20.6 months [41]. Kim et al. [42] evaluated the survival of patients in Korea with ACC with distant metastases and observed a 3-year survival rate of 41.3%, which declined to 15.5% at 5 years. Thoracotomy to excise solitary salivary malignant lung metastases may be worthwhile when the salivary histology is low grade and the disease-free interval from treatment of the primary and detection of the metastasis is measured in years. In particular, metastasectomy for ACC would seem to be highly questionable [8] and, because of the anticipated long survival in months with metastases, it has been suggested that a comparison be made of matched patients whose lung metastases have been excised with control subjects.

Past experience indicates that solitary pulmonary metastases are quite unusual in these patients, and it is recognized that some metastatic lesions remain relatively stable for more than 10 years [40]. However, there are advocates for lung resection of ACC metastases who report good-quality survival, with an estimated 5-year survival rate of 84%, which continued to decline until there were no survivors after 14years [43]. An analysis of tumor doubling time of pulmonary metastases showed that metastatic deposits of ACC occurred at 86 to 1064days (average, 393 days), and the time of onset of pulmonary metastases was calculated to be much earlier (average, 227 months) before the first visit [44]. This suggests that the use of an annual chest radiograph at follow-up is not sensitive in making an early diagnosis, and rather supports the use of CT [45]. However, there is the dilemma of what useful treatment can be offered to patients who are diagnosed with lung metastases. It has been suggested that the use of chemotherapy preoperatively and/or postoperatively to reduce the incidence of distant metastases may have a role in improving patients' disease-free survival. The larger the tumor at presentation and the development of loco-regional treatment failure are the two factors most predictive of distant metastases. It has been recorded that when bony metastases occur, especially in the spine, the course of disease is usually rapidly fulminant [46]. Median survival times after appearance of distant metastases among patients with isolated lung metastases and those with bone metastases with or without lung involvement were 54 and 21 months respectively [47•].

Most authors report patient outcome as overall survival rather than as a recurrence rate or disease-free survival. This is misleading because there is prolonged survival in many patients with residual or recurrent ACC. Despite local aggressive therapy, the majority of patients (60%) will develop recurrent disease. Approximately 50% of recurrences are clinically evident within 2 years after surgery and radiotherapy [12]. Ellis et al. [48] noted an average time to recurrence of 67 months, and Simpson et al. [49] noted a median time to recurrence of 54 months. In contrast, Vikram et al. [50] demonstrated recurrence in half of their patients within 18 months. It is seldom stated, in most reported series, how patients are monitored after treatment, how recurrences are identified, and what treatment (if any) is offered on diagnosis. It has been suggested that one may question the benefit of long-term follow-up of a patient after surgical removal of an ACC other than for clinical curiosity [41]. It is also often stated that long-term follow-up is necessary to detect recurrent disease in patients with ACC. The routine use of radiologic examinations (especially MRI) during the postoperative period may identify changes indicative of recurrent disease months to years before it is clinically evident. It remains to be reported that early detection of recurrent disease will result in any useful or effective treatment that will result in any patient survival benefit.

V. Conclusion

The primary treatment objective in Adenoid cystic carcinoma patients is local control, normal functionality and distant metastasis prevention. For this purpose, early detection by the team of dental specialists is a pre-requisite, in order to enable a more favourable prognosis and better quality of life. The role of the usefulness of various diagnostic modalities like, biopsy & advanced diagnostic imaging techniques like Computed Tomography has been mentioned in the present case. The therapy involving combination of surgery & radiotherapy remains the modality of choice in most cases. Our patients were referred to higher centres as the earliest without delay along with clinical history, reference letter, OPG, CT scan & report, Histopathological slide, & wax block to avoid delay in starting the treatment for better prognosis.

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Bibliography

[4]. Stell PM: Adenoid cystic carcinoma. Clin Otolaryngol 1986, 11:267-291.
[5]. Spies JW: Adenoid cystic carcinoma. Arch Surg 1930, 21:365-404.
[6]. Tauxe WN, McDonald JR, Devine KD: A century of cylindromas. Arch Otolaryngol
[7]. 1962, 75:1-6.
[8]. Foote FW, Frazell EL: Tumours of the major salivary glands. Cancer 1953, 6:1065-1133.
[9]. Conley J, Dingman DL: Adenoid cystic carcinoma in the head and neck (cylindroma). Arch Otolaryngol 1974, 100:81-90.
[10]. Jones AS, Hamilton JW, Rowley H, et al.: Adenoid cystic carcinoma of the head and neck. Clin Otolaryngol 1997, 22:434-443.
[11]. Stell PM, Cruikshank AH, Stoney PJ, et al.: Adenoid cystic carcinoma: the results of radical surgery. Clin Otolaryngol 1985, 10:205-208.
[12]. Spiro RH: Management of malignant tumours of the salivary glands. Oncology 1998, 12:671-
[13]. 680.
[14]. Matsuba HM, Spector GJ, Thawley SE, et al.: Adenoid cystic salivary gland carcinoma: a histologic review of treatment failure patterns. Cancer 1986, 57:519-524.
[15]. Westra WH: The surgical pathology of salivary gland neoplasms. Otolaryngol Clin North Am
[16]. 1999, 39:919-943.
[17]. Spiro RH, Huvos AG: Stage means more than grade in adenoid cystic carcinoma. Am J Surg
[18]. 1992, 164:623-628.
[19]. Howard DJ, Lund VJ: Reflections on the management of adenoid cystic carcinoma of the nasal cavity and paranasal sinuses. Otolaryngol Head Neck Surg 1985, 93:338-341.
[20]. Prokopakis EP, Snyderman CH, Hanna EY, et al.: Risk factors for local recurrence of adenoid cystic carcinoma: the role of postoperative radiation therapy. Am J Otolaryngol 1999, 20:281-86.
[21]. Szanto PA, Luna MA, Tortoledo ME, et al: Histologic grading of adenoid cystic carcinoma of the salivary glands. Cancer 1984, 54:1062-1069.
[22]. Matsuba HM, Simpson JR, Mauney M, et al.: Adenoid cystic salivary gland carcinoma: a clinico-pathologic correlation. Head Neck Surg 1986, 8:200-204.
[23]. Nagel H, Hotze HJ, Laskawi R, et al.: Cytologic diagnosis of adenoid cystic carcinoma of salivary glands. Diagn Cytopathol 1999, 20:358-366.
[24]. Preisegger K-H, Beham A, Kopp S, et al.: Prognostic impact of molecular analysis in adenoid cystic carcinomas of the salivary gland. Onkologie 2001, 24:273-277.
[25]. Doerr TD, Marentette LJ, Flint A, et al.: Urokinase-type plasminogen activator receptor expression in adenoid cystic carcinoma of the skull base. Arch Otolaryngol Head Neck Surg
[26]. 2003, 129:215-218.
[27]. Cho K-J, Lee S-S, Lee Y-S: Proliferating cell nuclear antigen and C-ERBB-2 oncoprotein expression in adenoid cystic carcinomas of the salivary glands. Head Neck 1999, 21:414-419.
[28]. Edwards PC, Bhuiya T, Kelsch RD: C-kit expression in the salivary gland neoplasms: adenoid cystic carcinomas, polymorphous low-grade adenocarcinomas, and monomorphic adenoma. Oral Surg Oral Med Oral Path Oral Radiol Endod 2003, 95:586-593.
[29]. Shirai A, Furukawa M, Yoshizaki T: Expression of intercellular adhesion molecule
[30]. (ICAM)-1 in adenoid cystic carcinoma of the head and neck. Laryngoscope 2003, 1134:1955-
[31]. 1960.
[32]. Castler JD, Conley JJ: Surgical management of adenoid cystic carcinoma in the parotid gland. Otolaryngol Head Neck Surg 1992, 106:332-338.
[33]. Bradley PJ: Submandibular gland and the minor salivary gland neoplasms. Curr Opin
[34]. Otolaryngol Head Neck Surg 1999, 7:72-78.
[35]. Gormley WB, Shkhar LN, Wright DC, et al.: Management and long-term outcome of adenoid cystic carcinoma with intracranial extension: a neurosurgical perspective. Neurosurgery 1996, 38:1105-1113.
[36]. Konno A, Ishikawa K, Numata T, et al.: Analysis of factors affecting long-term treatment results of adenoid cystic carcinoma of the nose and paranasal sinuses. Acta Otolaryngol (Stockh) 1998, (suppl 537):67-74.
[37]. Naficy S, Disher MJ, Esclamado RM: Adenoid cystic carcinoma of the paranasal sinuses. Am J Rhinol 1999, 13:311-314.
[38]. Issing PR, Hemmanouil I, Stover T, et al.: Adenoid cystic of the skull base. Skull Base Surg 1999, 9:271-275.
[39]. Pitman KT, Prokopakis EP, Aydogan B, et al.: The role of skull base surgery for

[40]. the treatment of adenoid cystic carcinoma of the sinonasal tract. Head Neck 1999, 21:402-407.
[41]. Schramm VL, Imola MJ: Management of nasopharyngeal salivary gland malignancy. Laryngoscope 2001, 111:1533-1544.
[42]. Stell PM, Cruickshank AH, Stoney PJ, et al.: Lymph node metastases in adenoid cystic carcinoma. Am J Otolaryngol 1985, 6:433-436.
[43]. Hosokawa Y, Ohmori K, Kaneko M, et al.: Analysis of adenoid cystic carcinoma treated by radiotherapy. Oral Surg Oral Med Oral Pathol 1992, 74:251-255.
[44]. Umeda M, Nishimatsu N, Yokoo S, et al.: The role of radiotherapy for patients with adenoid cystic carcinoma. Oral Med Oral Surg Oral Pathol Oral Radiol Endod 2000,
[45]. 89:724-729.
[46]. Prott F-J, Micke O, Haverkamp U, et al.: Results of fast neutron therapy of adenoid cystic carcinoma of the salivary glands. Anticancer Res 2000, 20:3743-3750.
[47]. Douglas JG, Koh W-J, Austin-Seymour M, et al.: Treatment of salivary gland neoplasms with fast neutron radiotherapy. Arch Otolaryngol Head Neck Surg 2003, 129:944-948. This is an up- to-date review of the experience of fast neutron radiotherapy for the treatment of 279 patients with malignant salivary gland neoplasms.
[48]. Huber PE, Debus J, Latz D, et al.: Radiotherapy for advanced adenoid cystic carcinoma:
[49]. neutrons, photons or mixed beam? Radiother Oncol 2001, 59:161-167.
[50]. Lee N, Millender LE, Larson DA, et al.: Gamma knife radiosurgery for recurrent salivary gland malignancies involving the base of skull. Head Neck 2003, 25:210-216. This report documents a novel option for the treatment of recurrent malignant salivary gland malignancy.
[51]. Haddad A, Enepekides DJ, Manolidis S, et al.: Adenoid cystic carcinoma of
[52]. the head and neck: a clinico-pathologic study of 37 cases. J Otolaryngol 1995, 24:201-205.
[53]. Horiuchi J, Shibuya H, Suzuki S, et al.: The role of radiotherapy in the management
[54]. of adenoid cystic carcinoma of the head and neck. Int J Radiat Oncol Biol Phys 1987, 13:1135-
[55]. 1141.
[56]. Bradley PJ: Distant metastases from salivary glands. Cancer ORL 2001, 63:233-242.
[57]. Spiro RH: Distant metastases in adenoid cystic carcinoma of salivary origin. Am J Surg 1997,
[58]. 174:495-498.
[59]. van der Wal J, Becking AG, Snow GB, et al.: Distant metastases of adenoid cystic carcinoma of the salivary glands and the value of diagnostic examinations during follow-up. Head Neck
[60]. 2002, 24:779-783.
[61]. Kim KH, Sung MW, Chung PS, et al.: Adenoid cystic carcinoma of the head and neck. Arch Otolaryngol Head Neck Surg 1994, 120:721-726. ACC of the head and neck Bradley 131 43 Liu D, Labow DM, Dang N, et al.: Pulmonary metastasectomy for head and neck cancers. Ann Surg Oncol 1999, 6:572-578.
[62]. Umeda M, Nishimatsu N, Masago H, et al.: Tumour-doubling time and onset of pulmonary metastases from adenoid cystic carcinoma of the salivary gland. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999, 88:473-478.
[63]. de Bree R, Deurloo EE, Snow GB, et al.: Screening for distant metastases in patients with head and neck cancer. Laryngoscope 2000, 110:397-401.
[64]. Fordice RH, Kershaw C, El-Naggar A, et al.: Adenoid cystic carcinoma of the head and neck:
[65]. predictors of morbidity and mortality. Arch Otolaryngol Head Neck Surg 1999, 125:149-152.
[66]. Sung M-W, Kim KH, Kim J-W, et al.: Clinicopathologic predictors and impact of distant metastasis from adenoid cystic carcinoma of the head and neck. Arch Otolaryngol Head Neck Surg 2003, 129:1193-1197. This is a retrospective analysis of 94 Korean patients followed from
[67]. 1979 through 2001.
[68]. Ellis ER, Million RR, Mendenhall WM, et al.: The use of radiation therapy in the management of minor salivary gland tumours. Int J Radiat Oncol Biol Phys 1987, 15:613-617.
[69]. Simpson JR, Thawley SE, Matsuba HM: Adenoid cystic salivary carcinoma: treatment with irradiation and surgery. Radiology 1984, 151:509-512.
[70]. Vikram B, Strong EW, Shah JP, et al.: Radiation therapy in adenoid cystic carcinoma. Int J Radiat Oncol Biol Phys 1983, 10:221-223. 132 Head and neck oncology