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HEAD AND NECK SOFT TISSUE SARCOMAS: DIAGNOSIS AND MANAGEMENT REVIEW

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ABSTRACT

Soft tissue sarcomas (STS) of the head and neck are rare and histologically diverse malignancies that present unique diagnostic and therapeutic challenges due to their proximity to critical anatomical structures. They originate from various tissues, including fat, muscle, nerves, blood vessels, and others. Although they account for a small proportion of all STS, their management requires individualized care within experienced sarcoma centres. While surgery and radiotherapy remain the primary modalities, newer systemic and targeted strategies are increasingly being incorporated into clinical practice. In this review we summarise current state of knowledge related to the diagnosis, staging, and treatment of head and neck STS in adults. We also discuss evolving systemic and targeted therapies with potential relevance to clinical oncology practice.

KEYWORDS

Soft Tissue Sarcoma, Head and Neck, Radiothearpy, Chemotherapy

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1. Introduction

Head and neck sarcomas constitute only 2% of head and neck tumours and roughly from 5% to 10% of all sarcomas(Brockstein, 2004). The uncommonness of these tumours poses a significant challenge for prospective studies, requiring conclusions to be predominantly drawn from limited case series, retrospective reviews, and personal experiences. These neoplasm form a heterogenous group in terms of histology and clinical characteristics, ranging from locally invasive to aggressive tumours with a high potential to metastasize(Galy-Bernadoy & Garrel, 2016). This article aims to provide an overview of the current diagnostic, prognostic and therapeutic factors regarding head and neck soft tissue sarcomas in adults.

2. Clinical presentation and diagnostics

The most frequent presenting symptom is typically a painless mass, often occurring without other visible signs. However, a spectrum of less common clinical manifestations may be observed. These include neurological sequelae (e.g., sensory or motor deficits), epistaxis, ophthalmological abnormalities, protracted sinus inflammation, and otalgia(Stavrakas et al., 2016).

Imaging modalities, including ultrasound, magnetic resonance imaging (MRI), computed tomography (CT), and positron emission tomography-computed tomography (PET-CT), are essential for the diagnosis and staging of head and neck soft tissue sarcomas (STS)(Pavlidis & Pavlidis, 2023). Ultrasound is particularly valuable for the identification of benign lesions. In contrast, both computed tomography (CT) and magnetic resonance imaging (MRI) are critical for assessing local tissue invasion, regional lymph node involvement, and the presence of distant metastases in malignant tumors. While the precise role of positron emission tomography-computed tomography (PET-CT) in this context requires further elucidation, its pre-operative application demonstrates potential in evaluating tumor response to systemic treatment(Dangoor et al., 2016).

3. Histological Subtypes Relevant to Head and Neck Region

Sarcomas are broadly categorized based on their mesenchymal origin into STS and bone sarcomas. Notably, sarcomas involving cartilage and nerve tissues are typically included within the soft tissue subcategory due to their mesenchymal lineage. The most common histological subtypes are: malignant fibrous histiocytoma, fibrosarcoma, angiosarcoma, malignant peripheral nerve sheath tumour and non-classified sarcoma. The most frequent location of tumours is superficial face and scalp, followed by superficial neck and parotid area and sinuses with nasal cavities(Galy-Bernadoy & Garrel, 2016). The head and neck region can be the site of a wide variety of these histological subtypes, many of which are exceedingly rare. Table 1 summarizes the characteristics of the most common STS in the head and neck.

Table 1. Common Histological Subtypes of Head and Neck Soft Tissue Sarcomas

Subtype Name	Primary Tissue of Origin	Risk factors	Key Characteristics	Relative Prevalence in H&N	References
Rhabdomyosarcoma (RMS)	Muscle cells	Syndromes: Li-Fraumeni, Neurofibromatosis type 1, DICER1, Costello, Noonan, Beckwith-Wiedemann, Prenatal X-ray exposure, premature birth, use of fertility medications, paternal and maternal drug use	More common in children; pleomorphic variant common in adults.	Common in children, present in adults	(Agaram, 2022; Skapek et al., 2019)
Malignant Fibrous Histiocytoma (MFH) / Undifferentiated Pleomorphic Sarcoma (UPS)	Fibroblasts/Histiocytes (now often reclassified as UPS)	Increased with age (particularly after the seventh decade of life), exposure to radiation, Li-Fraumeni syndrome, Neurofibromatosis type 1, and Retinoblastoma, chronic inflammation or injury, phenoxyacetic acid in herbicides and chlorophenols in wood preservatives	Aggressive, can be superficial in H&N; MFH is historically common.	UPS accounts for 2.7-38% of the primary head and neck sarcomas	(Boccalatte et al., 2019; Munuswamy et al., 2024)
Fibrosarcoma	Fibrous tissue cells	Middle-aged and older adults, sex: male, bone infarcts, chronic osteomyelitis, Paget disease, and irradiated tissues	Rare fibroblastic tumor.	Present, but rare (1% of soft tissue sarcomas overall)	(Angiero et al., 2007; Augsburger et al., 2017; Kaur et al., 2022)
Angiosarcoma	Endothelial cells (blood/lymph vessels)	Chronic lymphedema, e.g. after breast cancer surgery, radiotherapy, syndromes: Neurofibromatosis, Maffucci syndrome, Carcinogens, e.g. Vinyl chloride, androgenic steroids or arsenic, ultraviolet radiation, immunocompromised state	Often superficial, linked to lymphedema.	H&N is the most common site for cutaneous angiosarcoma	(Kim & Kim, 2023; Ramakrishnan et al., 2022; Young et al., 2010)

Subtype Name	Primary Tissue of Origin	Risk factors	Key Characteristics	Relative Prevalence in H&N	References
Liposarcoma	Fatty tissue	Radiation, specifically therapeutic radiation utilized in the treatment of various other malignancies, family cancer syndromes, trauma to the lymphatic system, exposure to toxic chemicals	It can grow anywhere, often presents as soft lumps.	Liposarcoma rarely assumes the H&N region	(Davis et al., 2009; Golledge et al., 1995; Jonczak et al., 2024)
Leiomyosarcoma	Smooth muscle cells	The occurrence increases with age (peaking in the seventh decade of life), sex: perimenopausal women, radiation exposure or radiotherapy in early years, genetic syndromes: retinoblastoma (RB1 gene deletion) and Li-Fraumeni syndrome (mutation in the TP53 gene)	Presenting complaints - broad-spectrum and include, e.g. epistaxis, dysphagia, hoarseness, stridor May be misdiagnosed as benign pathologies- a gradually enlarging, well-demarcated, non-ulcerated, and painless lesion.	Extremely rare occurrences in the H&N region, with its infrequency attributed to the scarcity of smooth muscle in this anatomical region.	(Egger et al., 2002; George et al., 2018; Saluja et al., 2019; Yadav et al., 2013)
Synovial Sarcoma	Epithelial differentiation	Translocation between the SS18 gene on chromosome 18 and one of the several synovial sarcoma X (SSX) genes on chromosome X (reported in more than 90% of patients), radiation-induced synovial sarcoma is considered an extremely rare event.	Commonly around joints, but can be in H&N; more common in young adults	Present.	(Egger et al., 2002; Gazendam et al., 2021; Stanbouly et al., 2021)
Malignant Peripheral Nerve Sheath Tumor (MPNST)	Nerve sheath cells	Benign plexiform neurofibromas (PNs), prior radiation therapy, Neurofibromatosis (NF1)	Rare, strong association with Neurofibromatosis type 1 (NF1).	Rare	(Han, 2022; Prudner et al., 2020; Somatilaka et al., 2022)
Kaposi's Sarcoma (KS)	Endothelial cells (blood/lymph vessels)	Human Herpesvirus 8 (HHV-8) / Kaposi Sarcoma-Associated Herpesvirus (KSHV) Infection, Immunosuppression e.g. Human Immunodeficiency Virus (HIV) Infection, Immunosuppressive Medications, Organ transplants, bone marrow or peripheral blood stem cell transplant,	Caused by HHV8 infection, primarily in immunocompromised.	Present, but rare overall	(Agaimy et al., 2018; Luppi et al., 2002; Mariggiò et al., 2017; Ramírez-Amador et al., 2010)

4. Classification

The American Joint Committee on Cancer created a staging system specific to head and neck STS in its eighth edition due to the distinctive factors associated with the head and neck region and the challenges posed by tumour size and location(Amin et al., 2017). The conventional 5-cm size distinction between T1 and T2 soft tissue sarcomas of the extremities and trunk doesn't apply effectively to head and neck STS. Smaller tumours in this area present higher risk of recurrence in comparison to trunk and extremities. Due to proximity to vital structures it is often difficult to obtain clear surgical margins and apply proper level of iodizing

radiation(Cates, 2019). Therefore, the 8th edition size cutoffs are: T1 ≤2 cm, T2 2 to ≤4 cm, T3 94 cm, and T4—for tumours invading the orbit, skull base or dura, facial skeleton or other critical structures(Huang & O'Sullivan, 2017).

For evaluation of histologic grade in soft tissue sarcoma, the Federation Nationale des Centers de Lutte Contre Cancer (FNCLCC) system is recommended. In this system, the histologic grade is classified into three (grades 1-3) according to the total of the scores of tissue type (degree of tumor differentiation), extent of necrosis and mitotic counts. Grade 1 corresponds to low grade, while grades 2-3 correspond to high grade(Lin et al., 2016).

5. Treatment modalities

5.1 Surgery

According to the European Society for Medical Oncology (ESMO), surgery remains the primary treatment for localized adult-type STS. The standard approach involves an en bloc resection with the goal of achieving R0 margins—complete excision of the tumour along with a surrounding rim of healthy tissue. This procedure should be performed by a surgeon with specific expertise in sarcoma management to ensure optimal oncologic outcomes and reduce the risk of recurrence(Gronchi et al., 2021). The importance of gross total tumour resection in determining treatment efficacy is well-established. Evidence suggests that complete surgical excision is the most critical factor influencing outcomes in head and neck STS, outweighing other treatment modalities in its impact on local control and survival(Sharifi et al., 2013; Trifiletti et al., 2012).

The management of head and neck STS presents unique challenges due to the anatomical complexity and the proximity of tumours to critical neurovascular and functional structures. These constraints often limit the feasibility of wide resections, making the achievement of negative margins more difficult and necessitating the use of postoperative radiotherapy (RT) to improve local control(de Bree et al., 2010). Anatomical location influences the ability to achieve complete surgical resection. For instance, tumours situated between the angle of the mandible and the cricoid cartilage demonstrated the highest rate of R0 resection (80%), whereas those located below the cricoid cartilage had a markedly lower resection success rate (50%) due to the proximity of vital thoracic structures(Vassiliou et al., 2017).

5.2 Radiotherapy

Radiation therapy is frequently used alongside surgery in the treatment of grade 2 and 3 STS, particularly when achieving clear surgical margins is challenging due to the anatomical complexity of the head and neck region. According to current guidelines from the ESMO, RT is generally unnecessary when wide, negative margins are confidently achieved(Gronchi et al., 2021).

Preoperative vs. Postoperative RT

Although direct comparative trials of pre- versus postoperative RT in head and neck STS are lacking, data from extremity STS suggest a higher incidence of wound complications with preoperative RT(Kungwengwe et al., 2021). Contrary to that, a study conducted by O'Sullivan et al. revealed that only 20% of head and neck STS patients experienced major wound complications within 120 days of surgery following neoadjuvant RT—significantly lower than reported rates in extremity STS. Notably, preoperative RT offers long-term benefits, including reduced fibrosis, oedema, bone fractures, and joint stiffness and may preserve critical structures while avoiding irradiation of postoperative skin grafts(O'Sullivan et al., 2002; O'Sullivan et al., 2003). Furthermore, the timing of RT—preoperative versus postoperative—does not significantly influence local control or overall survival(Dagan et al., 2012). Neoadjuvant RT can be safely combined with chemotherapy (CT), showing manageable toxicity and allowing concurrent systemic therapy without delay(Palassini et al., 2015).

Advanced Radiotherapy Techniques

The use of advanced radiation techniques, such as image-guided intensity-modulated radiotherapy (IG-IMRT), is increasingly investigated. In a cohort of 67 patients with head and neck STS, IG-IMRT was associated with significantly improved 5-year locoregional control, though no statistically significant differences in progression-free survival (PFS) or OS were observed(Elsayad et al., 2019). Intensity-modulated radiotherapy and particle therapy, such as proton and carbon-ion therapy, have also shown promising results, particularly for inoperable tumours(Yang et al., 2019). These findings contrast with those of Vitzthum et al. who reported no significant differences between IG-IMRT and conventional RT. While IMRT was linked to fewer acute and chronic adverse events, this benefit did not reach statistical significance(Vitzthum et al., 2016).

Radiotherapy as Monotherapy

RT as a standalone therapy is generally reserved for patients with large, unresectable tumours, where curative options are limited. Its efficacy in such settings remains suboptimal compared to multimodal approaches(Mendenhall et al., 2005; O'Sullivan et al., 2003; Workman et al., 2018). A retrospective study of 24 patients with locally advanced HNSTS found no significant difference in overall survival (OS), distant metastasis-free survival, local-regional relapse-free survival, or progression-free survival between those treated with definitive radiotherapy (with chemo) and those undergoing radical surgery. This suggests that chemoradiotherapy may be a viable alternative for patients unfit for surgery or refusing it(Wu et al., 2023).

125I Seed Brachytherapy

The use of stereotactic body radiotherapy (SBRT) is being explored as an alternative to conventional fractionation in select postoperative cases, showing comparable efficacy(Kahvecioglu et al., 2025). For cases of locally recurrent head and neck STS where both surgery and RT have failed, 125I seed brachytherapy has emerged as a potential salvage option. In a study by Chen et al. it demonstrated favourable short-term outcomes, including effective local control and improved survival. The treatment-related adverse events were mostly limited to grade 1–2 mucosal and skin toxicities. The effectiveness of this treatment was mainly affected by recurrent T stage and histological grade(Chen et al., 2020).

Elective Nodal Irradiation

The use of elective nodal irradiation in head and neck STS remains controversial. O'Steen et al. reported that only 29% of patients in their study received it, and nodal recurrence occurred in only one patient(O'Steen et al., 2020). Similarly, Sharma et al. found positive lymph nodes in just 2 of 7 patients who underwent nodal dissection(Sharma et al., 2018). These findings, along with those of Vitzthum et al., indicate that routine ENI may not be necessary in all patients and should be considered on an individual basis(Vitzthum et al., 2016).

5.3 Systemic therapy

Chemotherapy

The role of chemotherapy (CT) in the management of STS particularly those of the head and neck, remains controversial and continues to evolve. CT may be considered for medically fit patients at high risk of recurrence, especially those with large, high-grade, or deep-seated tumours(Pasquali et al., 2019). The most commonly used chemotherapeutic agents for HNSTS include doxorubicin, ifosfamide, and cisplatin(Akagunduz et al., 2021). Neoadjuvant chemotherapy using a three-cycle regimen of epirubicin and ifosfamide has shown improved overall survival (OS), with comparable efficacy to longer, five-cycle protocols(Gronchi et al., 2016).

The response to CT varies significantly across histological subtypes. Tumours such as alveolar soft part sarcoma, extraskeletal myxoid chondrosarcoma, and clear-cell sarcoma demonstrate limited chemosensitivity and may not benefit substantially from conventional regimens. Liposarcoma, leiomyosarcoma, synovial sarcoma, undifferentiated pleomorphic sarcoma, and angiosarcoma exhibit a moderate sensitivity to chemotherapy. The greatest sensitivity to chemotherapy is shown by sarcomas that are more frequently seen in children and adolescents, such as extraskeletal Ewing sarcoma, embryonal and alveolar rhabdomyosarcoma, and desmoplastic small round cell tumour.(Eriksson, 2010).

For patients with localized, high-risk STS, the addition of regional hyperthermia to neoadjuvant CT has been associated with improved OS and enhanced local progression-free survival (PFS)(Issels et al., 2018). In advanced or unresectable cases, CT with doxorubicin and ifosfamide remains the standard first-line systemic therapy. This combination may also be used to manage pulmonary metastases prior to metastasectomy or stereotactic body radiotherapy(Gronchi et al., 2021).

Targeted Therapy

Targeted therapies have shown potential in the treatment of head and neck STS, particularly in locally advanced or unresectable disease. Apatinib, a selective tyrosine kinase inhibitor of vascular endothelial growth factor receptor-2 (VEGFR-2), has demonstrated clinical activity across several malignancies, including advanced gastric, breast, hepatic, and oesophageal cancers(Scott, 2018). The combination of apatinib with IMRT was evaluated in patients with locally advanced head and neck STS who either had positive surgical margins following resection or declined surgical intervention. After one year, the local control rate reached 93.5%, with a PFS of 75.8% and OS of 89.7%. Treatment-related adverse events were mostly mild (Grade 1–2), with Grade 3 oral mucositis occurring in 25% of patients. These findings suggest that targeted therapy, particularly in combination with advanced radiotherapy techniques, may offer a viable treatment strategy for select patients with limited surgical options(Ye et al., 2020).

6. Conclusions

Head and neck soft tissue sarcomas (STS) constitute a vast group of tumours with diverse characteristics. Currently, surgery remains the primary form of treatment. Due to recent advances in oncological and reconstructive surgery, surgeons have more possibilities to obtain clear surgical margins with decent aesthetic and functional results. Depending on surgical margins, anatomy, and histological subtype of the tumour, adjuvant or neoadjuvant therapy should be applied. The effectiveness of chemotherapy is not completely proven. It occurs that some subtypes are more sensitive to such treatment. Targeted therapy is thoroughly investigated, but few studies have assessed its validity in head and neck STS. These tumours should be treated in specialized reference centres by a highly experienced multidisciplinary team. Due to the rarity and small numbers of patients in studies, further research is necessary to assess the most effective treatment of these sarcomas.

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