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The value of magnetic resonance imaging in diagnosis and staging of supra-hyoid neck tumors

ABSTRACT

Background: *Magnetic Resonance Imaging (MRI) introduced new description of the supra-hyoid neck (SHN) based on cross-sectional anatomy which enabled precise exploration of the SHN tumor mass.*

Materials and methods: *in the five-year period we retrospectively analysed MRI in 30 patients with supra-hyoid neck tumors, their space of origin according to the cross sectional architecture, extension, relationship with critical structures and nodal metastasis. Finally we assessed tumor, node, metastasis (TNM) staging .*

Results: *cross-sectional anatomy of the SHN obtained on MRI ensures all necessary criteria for the accurate evaluation of the supra-hyoid neck tumor (SHNT). 2/3 of all patients were S4 staged and 19% of patients were in S3 stage. Our study approved MRI as the method of choice for the SHNT evaluation due to superior soft tissue contrast resolution and capability of the multiplanar imaging. For the same reasons, MRI is also the best technique to detect small or occult lesions in patients presented with positive neck lymph nodes but with negative clinical nasopharynx examination. Detection of tumor extension along nerves and vessels is earlier and better seen with MRI than with any other diagnostic tool. The final result of using MRI is to stage primary or nodal tumor which proved to be an accurate method but required more expirience. MRI is the superb method in follow-up of irradiated patients and allows differentiation between tumor recurrence and postirradiation fibrosis.*

Conclusion: *All patients with supra-hyoid neck tumors and those patients suspected to have a supra-hyoid neck tumor should be examined on magnetic resonance imaging and the major task of the radiologist is to determinate the exact tumor extent.*

Key words: *Head and neck; Head and neck tumors; Magnetic resonance imaging, Nasopharyngeal carcinoma; TNM staging*

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INTRODUCTION

The classical subdivision of the supra-hyoid neck (SHN) into oropharynx, nasopharynx and oral cavity was useful for staging of squamos cell carcinoma (SCCa) but was not sufficiently appropriate for the description of the tumor extension routes.

Modern diagnostic procedures - MRI or computerized tomography (CT), allow precise exploration of the SHN, hence a new description based on cross-sectional anatomy was proposed. It is necessary to know all connections within numerous SHN spaces because tumors would often extend from one space to another along these routes. Nasopharynx and oropharynx are divided by fibrous faringobasilar fascia into two compartments: superficial - mucosal and deep, subdivided in parapharyngeal (pre- and poststyloid), masticator, parotid, retropharyngeal and finally perivertebral space.

Oropharynx is the crossroads between the oral cavity, the nasopharynx and the hypopharynx and larynx. It is heterogeneous region, formed by the tonsil region, soft palate, the base of the tongue and the posterior pharyngeal wall. Although interconnected and covered by a common mucosa, each area has its own specific clinical and radiological characteristics. The main spaces in oral cavity are mucosal area with anterior two thirds of tongue, sublingual and submandibular space. This region, easily examined by the clinician on an open mouth is far more difficult to evaluate radiologically. MRI best displays extension to the deep spaces and information on the nature of a mass which can be drawn from a careful analysis of the space of origin.

SCCa of the nasopharyngeal is the most frequent one in SHN and signs of tumor presence are unilateral serous otitis media, nasal obstruction or bleeding, cranial nerve deficits or trismus (2). But very often, patients just have clinically positive cervical nodes (at presentation 90% of patients have clinically positive nodes and even 50% have bilateral positive nodes) and the clinicians have to search for the primary tumor. Frequently, direct endoscopic examination is negative or doubtful in these patients because tumor is too small, growing under a nearly intact mucosa or because the patient is difficult to examine. Clinical examination of the parapharyngeal space is very difficult and therefore the clinicians often have to rely on CT and/or MRI. The main indication for imaging is to recognize the exact routes and extent of the tumor prior to therapy.

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MATERIALS AND METHODS

Thirty patients with SHNT detected on MRI were retrospectively evaluated in the period from January 1995 to January 2000. We evaluated the following tumor characteristics: space of origin according to the cross-sectional architecture, tumor extension, relationship with critical structures (great vessels, cranial nerves) and nodal metastasis. In six patients who have been operated on or irradiated due to malignant tumor, follow-up MRI was performed. Nodal metastases were assessed using classification of the Union Internationale Contre le Cancer (UICC) (3), wherein cervical lymph nodes are subclassified into 12 regions. MRI obtained above mentioned criteria enabled exact TNM (tumor, node, metastasis) staging of supra-hyoid tumors.

The SHN was studied using a standard head coil. T1 and T2 weighted sequences with slice thickness of 4mm in axial plane were followed by axial and coronal T1-weighted and occasionaly T1 weighted fat-suppresed sequence before and after injection of Gadolinium contrast medium - 0.1mmol/kg of body weight (Magnevist® - Schering, Berlin).

RESULTS

Generally, head and neck regions were the most unpopular among all other regions examined with MRI and they comprise 1.2% of all patients.

According to the classical subdivision of the supra-hyoid neck, our MRI study revealed 4 tumors in oral cavity, 9 in oropharynx and 17 in nasopharynx but space of lesion origin (or interface between two of them) could be precisely evaluated only by using cross-sectional space description (Table 1). Histopathological diagnosis revealed 13 SCCa of nasopharynx and 8 of oropharynx, one adamantimoma and two osteosarcomas of the mandible, two rhabdomyosarcoma of the nasopharynx, two cysts and one pleomorphic adenoma of the parotid gland and one small salivary tumor of the oropharynx.

Table 1. Number of patients according to the classical and cross-sectional determined space of tumor origin

Classical subdivisions	Space	Number of patients	
Oral cavity	Mucosal area+sublingual space	1	
	Submandibular	3	4
Oropharynx	Tonsilar region+soft pallate	1	
	Base of the tongue	5	9
	Parapharyngeal prestyloid	3	
Nasopharynx	Parotid space	5	
	Mucosal	4	
	Parapharyngeal+retropharyngeal	1	
	Parapharyngeal	4	17
	Masticator	1	
	Perivertebral	2	

TNM classification od SHNT and vital structure involvement are displayed in Table 2.

Unfortunatelly, 2/3 of all patients were staged as S4 - the most advanced stage followed by S3 (19%). In those patients, critical structures were almost regularly involved. Tumors in treatable, early stages were reserved for oral cavity and parotid space, obviously due to easy access for clinical examination.

Administration of contrast improved characterisation of lesion in following patterns: signal intensity alteration, homogeneity, tumor margins-aggressive behaviour necrotic and/or cystic degenerative changes within tumor mass

Table 2. Number of patients staged for TN(M) and involvement of vital structures regarding different space of origin

Space	MA+ SLS	SMS	TA+ SP	BOT	PPS (oro-)	PS	MPS	PPS+ RPS	PPS (naso-)	MS	PVS
TN stage/ invasior											
T1						2			2		
T2	1			3		2			1		
T3		1				1	2				
T4		2	1	2	1		2	1	1	1	2
N0				1		4					
N1		1		2			2		1	1	1
N2	1	2	1	2	1	1	2	1	3		1
N3											
S1						2					
S2				1		2					
S3	1	1		1			1		2		
S4		2	1	3	1	1	3	1	2	1	2
Vessels		1			1		2		1		
IC	1	2			1		2	1	1	1	1
PSV3					1					1	
Skull	1	2					2	1	1		1
MFSt							2				

Legend: **MA+SLS** -mucosal area+sublingual space; **SMS**-submandibular space; **TA+SP**-tonsilla area+soft pallate; **BOT**-base of tongue; **PPS** (oro-)-parapharyngeal space (oropharynx); **PS**-parotid space **MPS**-mucosal pharyngeal space; **PPS+RPS**- parapharyngeal+retropharyngeal space; **PPS** (naso) parapharyngeal space (nasopharynx); **MS**-masticator space; **PVS**-perivertebral space; **IC**-intracranial

Figure 1. SCCA of the mucosal space of nasopharynx involving. Axial enhanced image demonstartes tumor of the left Rosenmller with submucosal invasion (black arrow) and abnormal enhancement of the left jugular fossa (white arrow), which represented invasive SCCa.

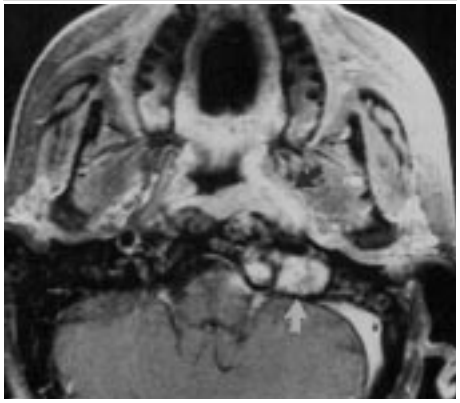


Figure 2. Small salivary gland carcinoma. T2 weighted axial image shows tumor mass in the region of left soft pallate (long arrow) with enlarged ipilateral lymph nodes in anterior and lateral jugular group (small arrows).

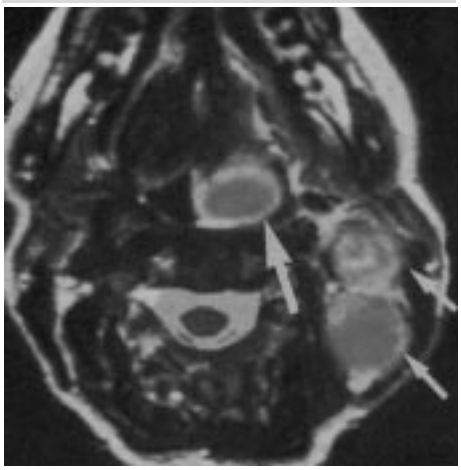


Figure 3. T1 weighted enhanced coronal image of the carcinoma in the right parapharyngeal and masticator space. Invasion of the skull base with thickened infiltrated dura (arrow).

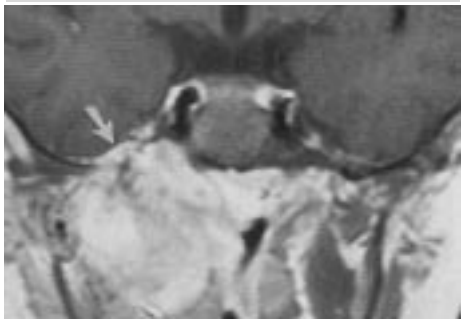
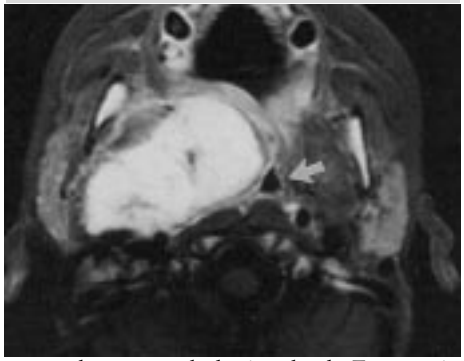


Figure 4. An enhanced axial fa-suppresed image of the right sublingual and parapharyngeal with significant mass effect and airway deviation (arrow).



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and presence of perineural spread. Though CT is superior imaging tool for evaluation of bone involvement, MRI is capable to detect infiltration of bone marrow (e.g. mandible, skull base, vertebral body).

Figure 5. T1 sagital image demonstrates chain of enlarged superficial cervical lymph nodes (long arrow) and solitary enlarged submandibular node small arrow).

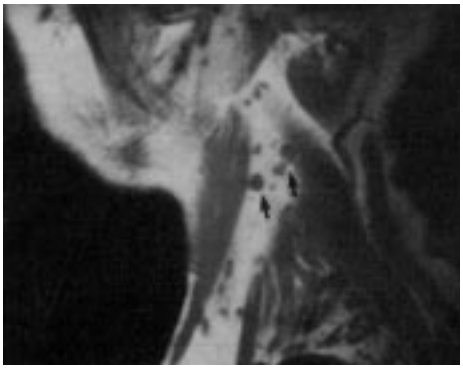
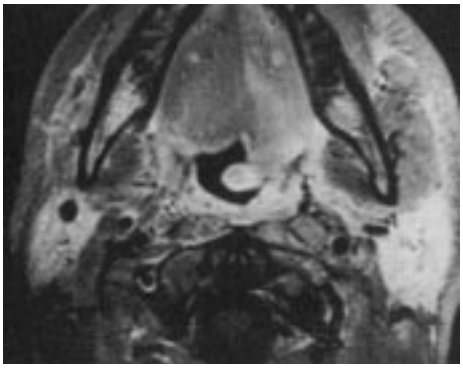


Figure 6. Fat-suppresed T1 weighted image in patients previosly treated for pharyngeal mucosal space carcinoma shows abnormally increased left parapharyngeal enhancement from recurrence and left tongue fatty atrophy secondary to hypoglossal nerve involvemnet.



DISCUSSION

The purpose of this study is to promote broader usage of MRI in order to make early and accurate diagnosis of SHNT. The main interests of the head and neck cross-sectional anatomy description obtained with MRI, are:

It describes the preferred pathways for deep extension of tumors following the ways of less resistance to infiltration

It allows systematic analysis of MRI images, searching remote extensions towards the base of the skull

It allows identification of the space of origin of deep masses and offers clues to diagnosis of the nature of lesion

The detection of minimal infiltration of the intracranial compartment through the skull base apertures and tumor involvement of the vital structures that are in contact with the extensions routes, are major contribution of MRI in the staging of regional tumors.

Gadolinium allows more detailed anatomic evaluation (visualisation of small structures such as small muscles, vessels and nerves), which requires better knowledge of normal anatomy (4,5). Detection of small tumors and their subtle infiltrations in the surrounding tissue is far easier with contrast administration (6).

MRI has improved the accuracy of nodal staging over psychic examination and allows visualization of nonpalpable nodes deep to the sternocleidomastoid muscle or in the retropharyngeal space. UICC classification proved to be very precise and easily applicable comparing numeric (level) classification and Rouviere Modification. Study of Anzai (7) suggested that minimal axial diameter of 11 mm for the jugulodigastric nodes and 10 mm for all other nodes more accurately reflects the presence of metastases. Other authors suggested that metastatic nodal disease was suspected when retropharyngeal nodes were greater than 8mm in diameter (8). Therefore, therapeutic outcome of SHN cancer is influenced strongly by the presence of nodal metastases.

Nasopharyngeal carcinoma is usually treated with radiation therapy, neck dissection is reserved for bulky adenopathy. Post-therapy baseline studies are recommended 3 to 6 months following the initial therapy and every 6 months within the initial two years for diagnosing the early recurrent disease (9,10). Low signal intensity in T2-weighted images is seen in case of fibrosis and high signal intensity in case of reccurence. However the signal intensity pattern of tumor (recurrence) is not specific and may also be seen in radiation edema and infection (11).

CONCLUSION

MRI is a mandatory diagnostic and staging tool in all patients with supra-hyoid neck tumors due to its advantages over clinical examination and CT. Our study.confirmed excellent capabilities of MRI in tumor detection/delineation as well as in the follow-up of irradiated patients where it allows differentiation between tumor recurrence and postirradiation fibrosis.

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