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DIAGNOSTIC ACCURACY OF CONTRAST-ENHANCED MAGNETIC RESONANCE IMAGING (MRI) AND DIFFUSION WEIGHTED MRI IN DETECTING THE LOCOREGIONAL RECURRENCE OF MALIGNANT HEAD AND NECK TUMOR

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ABSTRACT

Multiple complications can be seen with treatment that may mimic recurrent tumor in the head and neck cancers. These may occur either early on during the initial post-treatment period or many years later. The radiologist needs to be familiar with the expected post-treatment changes so that any areas suspicious for residual or recurrent disease are recognized early, allowing potential salvage treatment. Interpretation of post-treatment imaging is challenging but can also be integral in the clinicians' management decision process. The radiologist must be aware of the expected changes following both surgery and radiotherapy in order to recognize possible complications or tumor recurrence. Hospital based retrospective study done with a sample size of 20 cases. All cases included had pretreatment and post treatment MRI's in the PACS. Contrast enhanced MRI in association with Diffusion weighted imaging has a Sensitivity of 85.7% Specificity of 84.6% and Accuracy of 85.0% in detecting recurrence in post treatment neck for cancer, usually squamous cell carcinoma.

KEYWORDS: Contrast enhanced Magnetic resonance imaging (CEMRI), diffusion-weighted MRI (DWI), head and neck cancer, treatment follow-up.

INTRODUCTION

Imaging of head and neck cancer is challenging for the radiologist due to the complex anatomy and the variable appearances of the pathologies that affect this area. This is compounded following treatment, when a vast array of postoperative or chemoradiotherapy changes and complications can be seen. Multiple complications can be seen with treatment that may mimic recurrent tumor. These may occur either early on during the initial post-treatment period or many years later. The radiologist needs to be familiar with the expected post-treatment changes so that any areas suspicious for residual or recurrent disease are recognized early, allowing potential salvage treatment.

Patients with squamous cell carcinoma of the head and neck (HNSCC) are treated with radio(chemo)therapy, surgery or with a combination thereof.[1,2] It has been suggested thatmup to 50% of patients with HNSCC will experience disease relapse during their lifetime, locoregional recurrence being more common than distant metastases or second primary tumors.

Local recurrence constitutes an important prognostic factor and influences the 5-year survival rate and quality of life.[2,3] Early diagnosis of local recurrence and precise depiction of tumor extent are important since surgical salvage increases overall survival.[4] Locally recurrent HNSCC is often more difficult to detect than primary SCC. Endoscopy may fail in the presence of submucosal recurrence and findings at cross-sectional imaging may be confusing since radio(chemo)therapy may induce morphological, functional and metabolic changes that are difficult to interpret.[1,5,6] Nonetheless, previous studies have suggested that both magnetic resonance imaging (MRI) with diffusion-weighted imaging (DWI) sequences and FDG positron emission tomography computed tomography (PET/CT) can substantially improve the detection of recurrent HNSCC.[5–9] As the combined use of PET/CT and MRI with DWI can add diagnostic certainty in difficult post-treatment situations.[1,9]

Diffusion-weighted MRI (DWI) characterizes tissues based on the random Brownian displacement of water molecules, which is influenced by the underlying tissue specific microstructural hindrances. These random water molecule displacements are quantified by using the apparent diffusion coefficient that reflects the amount of signal loss on the DWI images, inversely correlated with tissue cellularity.[10] DWI is increasingly researched and applied in head and neck cancer with the aim of improving tumor detection and characterization and regional and distant staging, as well as the detection of

tumor recurrence after treatment.[11,12] Technical issues caused by the high prevalence of air–tissue (susceptibility) boundaries and much lower water molecule density than in the brain have limited the introduction of DWI to the head and neck region until recent years. However, this has largely been overcome by technical improvements, such as the better shim gradients and more optimal shim calculations, stronger main magnetic fields, homogeneous high-quality imaging gradients, phased-array receiver coils and parallel imaging.[13]

Before DWI images can be correctly interpreted, adequate knowledge of the normal diffusion weighted anatomy in the head and neck is required. A number of structures have a variable physiological amount of impeded diffusion that should not be confused with tumoral lesions and may hamper the visual detection of tumoral lesions because of the increased background signal. These structures include the parotid and submandibular salivary glands, the thyroid gland, the palatine tonsils, normal lymph nodes, sebaceous cysts, the spine and the nerve roots of the brachial plexus. Contrary to this, the mucosal, submucosal, fatty and muscular tissue as well as blood vessels show complete signal loss on high b-value images. It is also beneficial for correct evaluation of DWI to always correlate the diffusion images with high-quality anatomical sequences. The choice of b-values is pivotal to implement standardized clinical head and neck DWI as it largely impacts both qualitative and quantitative.

AIMS AND OBJECTIVE

To determine accuracy of contrast enhanced MRI (CEMRI) and Diffusion weighted MRI (DWI) in detecting tumor recurrence and tumor residual in head and neck region following treatment.

MATERIAL AND METHODS

Hospital based retrospective study done with a sample size of 20 cases. All cases included had pretreatment and post treatment MRI's in the PACS. Patients with no MRI, patients lost to follow up, and those patients where final diagnoses was not confirmed were excluded from study. MRI was done on GE optima 450, 1.5 tesla machine. Diffusion imaging was performed using b-values at 0, 500 and 1000 s/mm^2 and corresponding ADC calculated.

RESULTS AND DISCUSSION

Table 1: Age, gender and regional distribution of cases. M=Male, F=Female, n=number of cases.

Age in years	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69
Gender M:F=12:8	1M	-	1F	1M1F	2M1F	3M2F	4M2F	1M1F
Number of cases n=20	1	0	1	2	3	5	6	2
Pharyngolaryngeal n=10	0	0	0	1	1	3	3	2
Oral cavity n=6	0	0	1	0	1	2	2	0
Sinonasal Cavity n=4	0	0	0	1	2	1	0	0

Out of 20 patients included in the study 12 were men and 8 women (ratio 3:2). Patients were in the age range of 34-68 years with mean age of 55.85 years, most patients (n=16) were 50-68 years. The primary tumor locations were the Pharyngolaryngeal (n=10), Oral cavity (n=6), Sinonasal cavity (n=4). Various surgical procedures or radiation therapy techniques were performed according to the disease extent and location.

From the sample size of 20 patients 8 cases showed enhancement as well as restriction on diffusion weighted images at the treatment or operated site. 4 patients showed only enhancement without significant restriction.8 patients showed no enhancement and no restriction. Patients having both enhancement and restriction were considered positive while rest were considered negative for recurrence or residual disease.

Out of 8 cases which showed both enhancement and restriction, 6 cases showed growth on follow up exams or were found positive on histopathology, so were considered true positive. Among the cases which showed only enhancement 1 showed growth on follow up exam, so was counted as false negative. Rest of the cases remained stable or showed improvement on followup exams, and were counted as true negative.

Table 2- 2 x 2 table.

	MRI positive {Enhancement +Restriction}	MRI negative {None or Only enhancment}
Positive on followup	6	1
Negative on followup	2	11

Contrast enhanced MRI in association with Diffusion weighted imaging has a Sensitivity of 85.7% Specificity of 84.6% and Accuracy of 85.0% in detecting recurrence in post treatment neck for cancer, usually squamous cell carcinoma. Positive predictive value is 75.0 % and Negative predictive value is 91.6 %. Anouk van der Hoorn et al were able to demonstrate almost similar results with a benefit of DWI with derived ADC data over anatomical conventional MRI sequences. Pooled ADC values showed a higher sensitivity (89%) and specificity (86%) than anatomical MRI for the primary site (84% and 82%, respectively).[14]

Minerva Becker et al demonstrated Sensitivity, specificity, and positive and negative predictive value of PET/DWIMRI were 97.4%, 91.7%, 92.5% and 97.1% per patient, and 93.0%, 93.5%, 90.9%, and 95.1% per lesion, respectively.[15]

CONCLUSION

Interpretation of post-treatment imaging is challenging but can also be integral in the clinicians' management decision process. The radiologist must be aware of the expected changes following both surgery and radiotherapy in order to recognize possible complications or tumor recurrence. Integrating information about the patient's initial tumor and their surgical or non-surgical treatment with the clinical question or area of concern can be very beneficial in interpreting the imaging findings; however, as always, developing good communication with the treating clinicians can be helpful for the reporting radiologist, and can result in a much more useful interpretation of the imaging. MRI has acceptable accuracy in differentiating recurrence from post treatment changes; however, PETCT and PETMRI are superior as per other studies.[16]

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