International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 688-694 www.ijdmsrjournal.com ISSN: 2582-6018

Role of Diffusion Weighted Mr Sequence in Differentiation of Benign and Malignant Cervical Nodes

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Date of Submission: 20-04-2024 Date of Acceptance: 30-04-2024

ABSTRACT
BACKGROUND :Diffusion weighted magnetic resonance imaging (DW MRI) is an imaging technique showing molecular diffusion. Cell size, density and integrity influence the signal intensity on diffusion-weighted images. This technique is a helpful complementary tool to distinguish tumoral from non tumoral tissue.
AIM:The purpose of this study is to determine the role of diffusion weighted MRI sequence in differentiation of benign and malignant cervical nodes.
KEYWORDS: MRI, ADC,Diffusion weighted MRI, Cervical lymphadenopathy
Nodes
STUDY METHOD :Observational,cross sectional study
STUDY SITE:Department of Radiodiagnosis, Gcs medical college and hospital and research centre,ahmedabad
PATIENTS AND CRITERIA
50 patients were included in this study as sample size with following criterias.
Inclusion criteria
- All patients referred to the department of Radiology in whom subsequently MRI was done will be included in the study.
- The patients included in this study will be consulting to the outpatient clinics suffering from palpable cervical lymph nodes with a known head and neck cancer
- Patients in whom cervical nodes will be seen in Ultrasound with a known head and neck cancer

Exclusion criteria
Implanted electric and electronic devices are a strict contraindication to the magnetic resonance imaging, and in particular:
- heart pacemakers (especially older types)
- insulin pumps
- implanted hearing aids
- neurostimulators
- intracranial metal clips
- metallic bodies in the eye

Metal hip replacements(old type), sutures or foreign bodies in other sites are relative contraindications to the MRI because they obscure the visualization of normal anatomy due to artifact effect.
RESULT : The statistical data obtained were of 30 true-positive, 2 false-positive, 11 true-negative findings,7 false negative -yielding 81% sensitivity, 84 % specificity%, NPV = 61 % and PPV = 93 %
CONCLUSION: The diffusion-weighted MRI is a strong predictor of the presence of metastasis, independently from other predictor such as size and morphology, in patients with cervical nodes. The use of corresponding significantly improves the discrimination between malignant and benign lymph nodes.

I. INTRODUCTION

Introduction to DWI sequence in MRI imaging

Diffusion weighted imaging (DWI) is a method of signal contrast generation based on the differences in Brownian motion.It is an imaging technique showing molecular diffusion and is a method to evaluate the molecular function and micro-architecture of the human body. Cell size, density and integrity influence the signal intensity seen on diffusion-weighted images.DWI uses the random motion of water in the targeted tissue, which reflects the tissue specific diffusion capacity. Thus, the diffusion capacity can be used for tissue characterization. In biologic tissues, the diffusivity of water molecules is confined by the intra-cellular and inter-cellular spaces. Hyper cellular tissue, such as malignant tissues, results in decreased

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mobility of water protons and consequently in a restricted diffusion capacity of the tissue.[1,2, 5].

Importance of diagnosis of metasatic lymphadenoapthy

It is crucial to assess the absence or presence of nodal metastasis before commencing any therapy in head and neck cancer not only for the planning of appropriate treatment but also for monitoring the treatment response.[2, 3,5]

Accurate information about the presence and location of nodal metastases can prove useful in planning the appropriate nodal dissection to address all involved sites; and avoid unnecessary extensive operative treatment.

Role of DWI in characterisation of lymphadenopathy

The diffusion-weighted imaging as a part of the MRI technique being a non-invasive tool without the definite need for administration of intravenous contrast agent will provide a reliable ability in the differentiation between the benign and malignant tissues.

The malignant nodes would present with increased signals on DWI and low ADC values and thus hasbroad utility from its use as an initial screening tool for nodal metastasis detection, followed by staging and surveillance of disease as well as the delivery of appropriate treatment regimens.

This is how DWI can serve as a useful tool in routine MRI pulse sequences in the evaluation of head and neck cancersD [4,5, 6].

II. METHODOLOGY

Study type:Observational,cross sectional study.
Inclusion criteria:All patients referred to the department of Radiology in whom subsequently MRI was done will be included in the study.The patients included in this study will be consulting to the outpatient clinics suffering from palpable cervical lymph nodes with a known head and neck cancer.Patients in whom cervical nodes will be seen in Ultrasound with a known head and neck cancer
Exclusion criteria: Implanted electric and electronic devices are a strict contraindication to the magnetic resonance imaging, and in particular:heart pacemakers and metallic implants,(especially older types),insulin pumps,implanted hearing aids,neurostimulators,intracranial metal clips,metallic bodies in the eye.
Method :After obtaining consent, all patients were sampled for MRI. The MRI study was performed on GE 1.5 Tesla machine with dedicated body coil.

Scanning technique:
50 patients were included in this study as sample size with following criterias.
Diffusion weighted sequence was performed in the MRI scan of all 50 patients to be studied.
Corresponding ADC value was calculated in largest lymph nodes.
A threshold ADC value for differentiating malignant from benign nodes was taken as $1000 \times 10^{-6} mm^2/s$. The imaging results were then compared to histopathology findings.

OBSERVATION:
The type of head and neck cancer that were studied here were:

Site of head and neck cancer	No. of patients	Percentage
Tongue	32	64
Buccal mucosa	15	30
Lip	1	2
Larynx	1	2
Parotid	1	2

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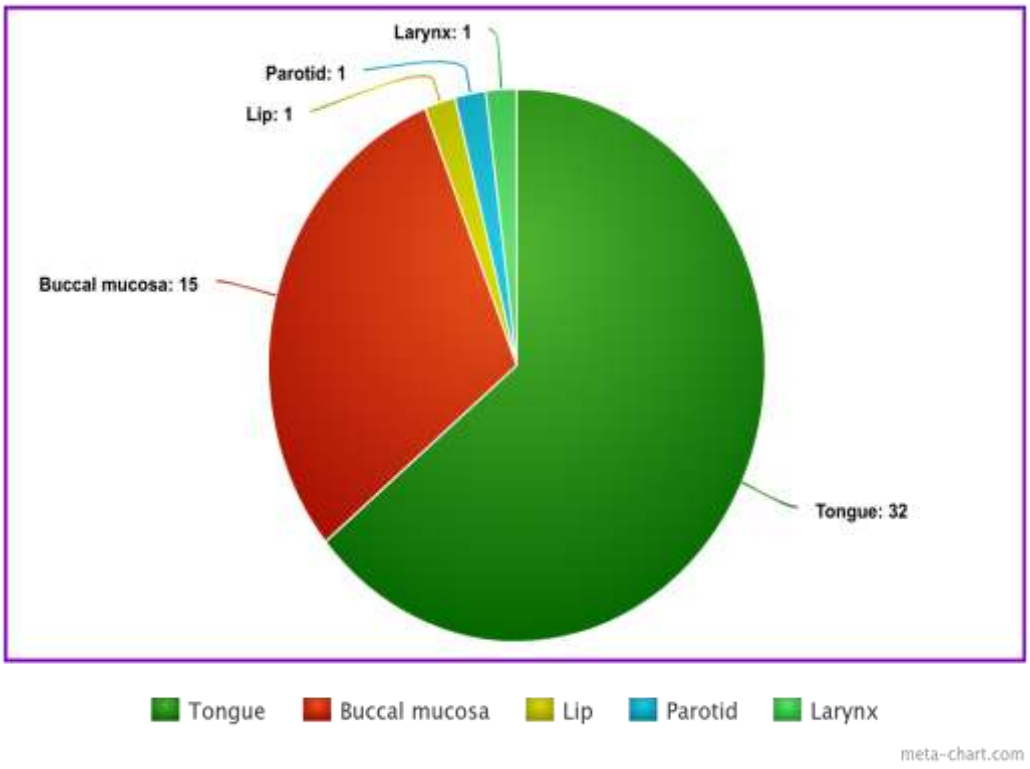

MRI * HPE CROSSTABULATION				
		HPE DIAGNOSIS		TOTAL
		MALIGNANT	BENIGN	
MRI – DIFFUSION RESTRICTION WITH ADC VALUES–	<1000 $\times 10^{-6}$ mm^2/s	30	2	18
	>1000 $\times 10^{-6}$ mm^2/s	7	11	32
TOTAL		13	37	

	Frequency	Percentage
True positive	30	60
False positive	2	4
False negative	7	14
True negative	11	22
TOTAL	50	100

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III. STATISTICAL ANALYSIS

The imaging results were compared to histopathology findings with following results:
-the statistical data obtained were 30 true-positive, 2 false-positive, 11 true-negative findings,7 false negative -yielding 81% sensitivity, 84 % specificity%, NPV = 61 % and PPV = 93 %.

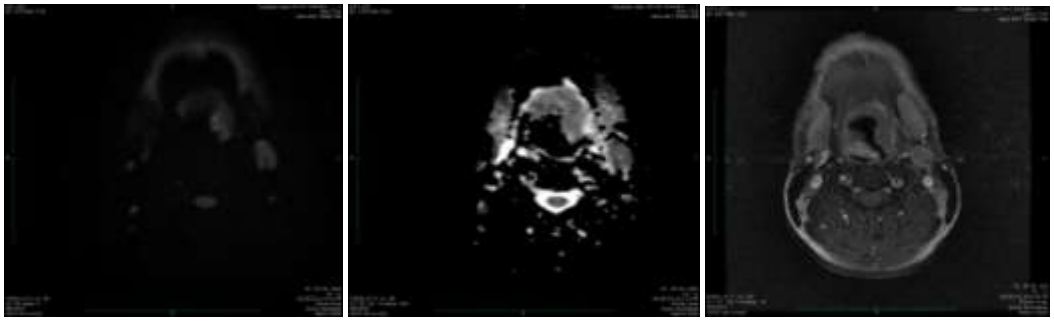
ADC values ranged from 500 to 1500 $10^{-6}mm^2/s$ in our study group. The values of malignant lymph nodes ranged from 500 to1000 $\times10^{-6}$mm/s .The values of benign lymph nodes ranged from 1000 to 1500 $\times10^{-6}$ mm/s.

The median ADC value calculated for benign lymph nodes was 1250 $\times10^{-6}mm^2/s$ and the median ADC value calculated for malignant lymph nodes was 750 $\times10^{-6}mm^2/s$.

IV. IMAGE ANALYSIS

1)Ca. Tongue

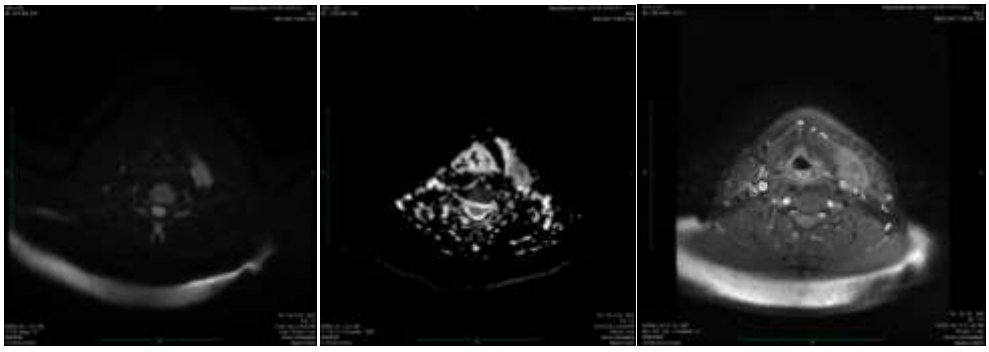
MRI neck of49 years male with ulcerative growth on tongue show ill -defined soft tissue intensity mass lesion in the anterior third of left half of tongue in a K/C/O ca. Tongue.Presence of a well defined enlarged lymph node with necrotic areas seen at left level Ib, II, III and IV. The largest lymph node of size 23x 12 mm in left level II show diffusion restriction (A) with corresponding low ADC values of 705 $\times10^{-6}mm^2/s$ (B) and heterogenous post contrast enhancement.



(A) (B) (C)

2)Ca. Larynx

MRI neck in 51 -year male with history of pain in neck region shows well defined soft tissue intensity lesion involving the lingual surface of epiglottis andbase of tongue on left side which on histopathology was conclusive of malignancy.Presence of well defined subcentimetric and enlarged lymph nodes with necrotic areas seen at level Ib, II and III. The largest lymph node of size 35 x 26 mm in left level II show diffusion restriction (A) with corresponding low ADC values of 630 $\times10^{-6}mm^2/s$ (B) and heterogenous post contrast enhancement(C) .
By histopathology, the node proved to be metastatic.



(A) (B) (C)

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3) Ca. parotid

MRI neck in a 58 year old male with history of swelling inright parotid region in a biopsy proven Mucoepidermoid carcinoma

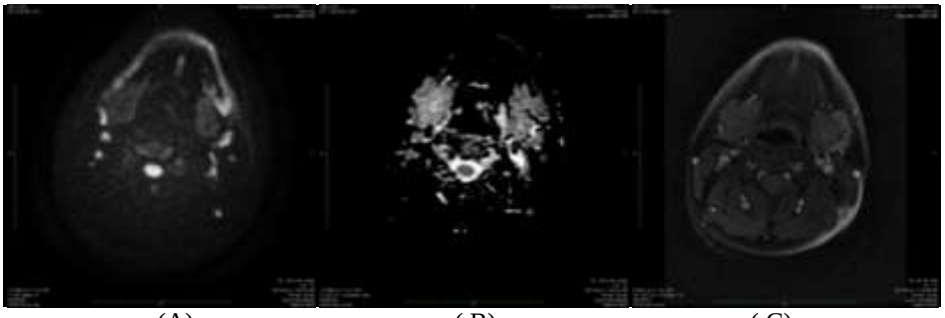
Presence of a well defined subcentimetric lymph node with necrotic areas seen at level Ib, II and. The lymph node of size right level II show diffusion restriction (A) with corresponding low ADC values of 789 $\times 10^{-6} mm^2/s$ (B) and heterogenous post contrast enhancement(C) . By excisional biopsy, the LN was proved to be metastatic.

(A) (B) (C)

3)Ca. Left Buccal mucosa

MRI neck in 28 -year male with biopsy proven Ca. Left buccal mucosa was performed. Presence of a well defined subcentimetric and enlarged lymph node with necrotic areas seen at left I to IV. The largest lymph node of size 15 x 8 mm in left level II show diffusion restriction (A) with corresponding low ADC values of $830\times10^{-6} mm^2/s$ (B) and heterogenous post contrast enhancement(C) .

By histopathology, the node proved to be metastatic.



(A) (B) (C)

4)Ca.Right Buccal mucosa

MRI neck in 46 -year male with biopsy proven Ca. Right buccal mucosa was performed. Presence of a well defined subcentimetric and enlarged lymph node with necrotic areas seen at right I to V. The largest lymph node of size 12 x 8 mm in left level IB show diffusion restriction (A) with corresponding ADC values of $1250\times10^{-6} mm^2/s$ (B) and heterogenous post contrast enhancement(C) .

By histopathology, the node proved to be non-metastatic.

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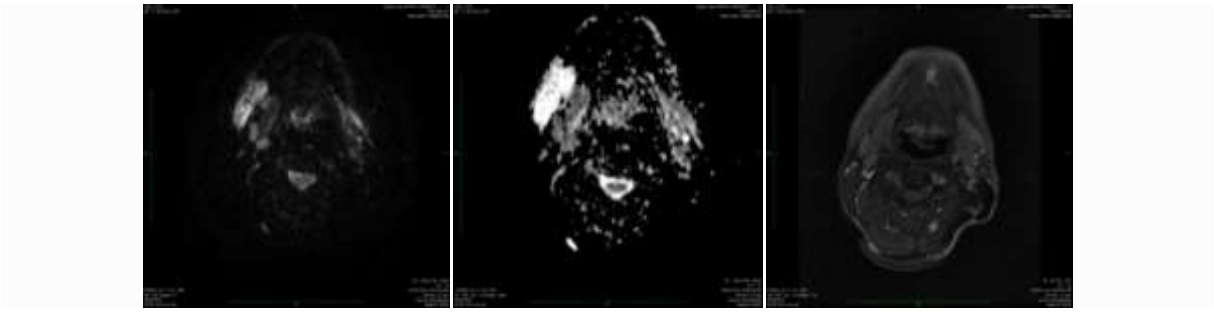

(A) (B) (C)

V. DISCUSSION

In this study, there was a significant difference in the ADC values between benign and malignant lymph nodes matching the findings with prior studies; malignant lymph nodes had a relatively lower ADC values than that of benign nodes.

R.B.J. de Bondt et al suggested that the optimal ADC threshold for that study population had appeared to be 1.0×10^{-3} mm^2/s with the statistical results concluding 92.3 percent sensitivity and 83.9 percent specificity .[1]

This is in concordance with our study with ADC value threshold of 1000 x $\times 10^{-6} mm^2/s$ in correspondence to Diffusion restriction in cervical nodes.

We are able to determine that ADC value of 1000x 10−6 mm2/s.- is able to conclude statistically high sensitivity as well as specificity in correlation with the histopathology findings of the same.

In this study, DW imaging with the use of ADC had high accuracy in the detection of metastatic lymph nodes.Use of this technique also improved the identification of benign enlarged lymph nodes.

VI. CONCLUSION

Diffusion weighted imaging (DWI)is more reliable and sensitive than conventional MRI imaging, providing an alternative way to differentiate benign lymph nodes from malignant ones.It can be demonstrated that,with predominantly small lymph nodes that ADC values calculated on the diffusion-weighted MRI is a strong predictor of the presence of metastasis, independently from other predictor such as size and morphology, in patients with cervical nodes. The use of ADC values in combination with the other MRI criteria significantly improves the discrimination between malignant and benign lymph nodes.

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