ORIGINAL ARTICLE

Role of Magnetic Resonance Spectroscopy in Differentiating Benign From Malignant Thyroid Nodules, Taking Tissue Diagnosis as Gold Standard

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ABSTRACT

Background: Magnetic Resonance Spectroscopy (MRS) is used to find out the molecular composition of components and to identify the compound presence. MRS can differentiate malignant lesions from benign lesions.

Aim: To determine the diagnostic accuracy role of Magnetic Resonance Spectroscopy in differentiating benign from malignant thyroid nodules by taking tissue diagnosis as a gold standard.

Methods: Almost70 patients with malignant thyroid nodule on clinical examination of age 30 - 70 of either gender were included. Patients with previous thyroid surgery and already biopsy proven malignant thyroid and contraindication to MRS were not included in this study. Magnetic Resonance Spectroscopy was done for choline peak and choline / creatine (Cho /Cr) ratio. The results then compared with tissue diagnosis.

Results: Among MR-Spectroscopy positive patients, we found 46 patients to be true positive while 03 were false positive. Among 24 MR-Spectroscopy negative patients, 16 were true negative while 05 were false negative patients (p = 0.0001). Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of Magnetic Resonance Spectroscopy in diagnosing malignant thyroid nodule taking tissue diagnosis as gold standard was 93.51%, 84.35%, 95.24%, 79.51% 91.40% respectively.

Conclusion: After conducting the study, we concluded that MRS is the non-invasive imaging of choice with high diagnostic accuracy in analyzing malignant thyroid nodules.

Keywords: Thyroid Nodules, Magnetic Resonance Spectroscopy, Sensitivity.

INTRODUCTION

Thyroid nodules are swellings which can commonly occur in an otherwise normal thyroid gland. A thyroid nodule can appear in any part of the gland. Prevalence of palpable nodules was found to be 4-7% in adults and about 50% have non-palpable nodules.[1] In patients with thyroid nodules timely diagnosis is of vital significance as it is one of the most treatable malignancies.[2] Fine Needle Aspiration Cytology (FNAC)is considered to be the most important pre-operative method to differentiate between malignant and benign thyroid nodules.[3] But compared to FNAC, Magnetic Resonance Imaging (MRI) is a non-invasive technique to give immediate and detail information.[4]

Magnetic Resonance Imaging has emerged as the most competent and adaptable imaging tool for diagnosis, prognosis, evaluation of treatment, progression of disease and treatment planning.[5] Another imaging technology, Magnetic Resonance Spectroscopy (MRS) uses to measure biochemical changes and molecular composition of tissue and can identify malignant nodules[6,7] In malignant lesions, there is a high concentration of choline, indicating increase membrane synthesis and cell turnover[8].

As the available literature on the problem discussed was very scarce, so we had planned to conduct a study in determining the role of Magnetic Resonance Spectroscopy in differentiating malignant thyroid nodule from benign by considering tissue diagnosis as the gold standard.

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The result of this study will give surgeons an accurate, non-invasive imaging modality for pre-operative assessment of the thyroid malignant and take the treatment plans accordingly.

METHODOLOGY

This detailed, cross sectional study was conducted from October 2017 to October 2018, taking 70 patients having thyroid nodule on clinical analysis, having age between 30-70 years of both genders. The patients were referred to the radiology department of children hospital and institute of child health, Multan. The patients who had history of thyroid surgery, already biopsy proven malignant thyroid, claustrophobic patients and contraindications to Magnetic Resonance Spectroscopy i.e. cardiovascular implanted electronic devices were excluded. Sample size was calculated by using WHO calculator and taking 95% confidence level, 80% power of study.

After taking informed consent and history from all the patients, subjects went through MRS for the thyroid gland. The proton Magnetic Resonance Spectroscopy (1H MRS) was conducted using 1.5 Tesla Magnetic resonance system with gradient strength of 33 mT/m. A scout scan was taken and the technique used in the scan was point-resolved Magnetic Resonance Spectroscopy single-voxel technique. After this water suppression pulses and data acquisition were obtained. For interpretation, all the images were then consulted by the radiologists having at least 7 years of post-fellowship experience in MRS. On Magnetic

Resonance Spectroscopy, presence of increased choline level and reduced NAA level on MR Spectrum with increased choline / creatine (Cho / Cr) ratio> 1.5 (normal is 1.2) and decreased NAA / choline (NAA / Cho) ratio < 1.2 (normal is 1.6) was considered as malignant. Each Magnetic Resonance Spectroscopy report was correlated with gold standard histopathology report.

For data analysis, SPPS version 20.0 was used. Quantitative variables were taken as mean and standard deviation. Qualitative variables were taken as frequency and percentage. To calculate sensitivity, specificity, PPV, NPV and diagnostic accuracy of MRS by using 2x2 contingency table in differentiating malignant thyroid nodule taking tissue diagnosis report (as gold standard), we used 2x2 contingency table.

RESULTS

The patients' ages between 30-70 years with an average age of 46.53±9.15 years. The ages of almost 50% of patients were between 41-50. Out of these 70 patients, 52 females(74.29%) , 18 males(25.31%) and female to male ratio of 1.89 : 1 .Mean duration of disease was 0.83 ± 0.35 years.

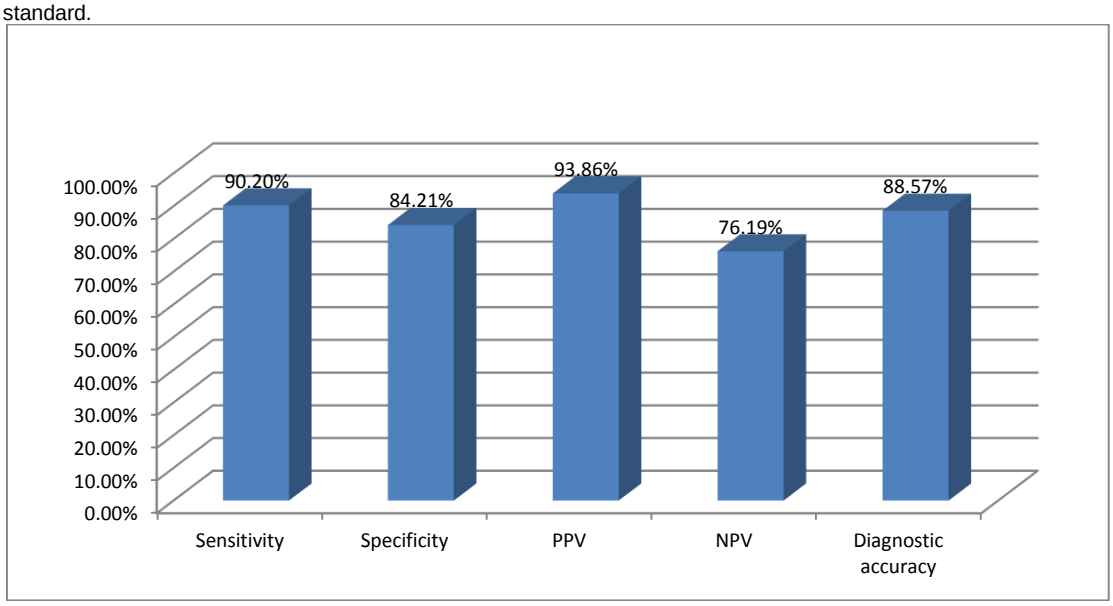
All the patients underwent through Magnetic Resonance Spectroscopy (MRS). MRS diagnose malignant thyroid nodules in 49 (70%) pts. Histopathology findings confirmed malignant thyroid nodules in 51 (72.86%) cases whereas 19 (27.14%) patients were found to be benign thyroid nodules. In MRS positive patients, 46(TP) had malignant thyroid nodule and 03(FP) had benign thyroid nodules on histopathology. Among 24, Magnetic Resonance Spectroscopy negative patients, 05 (False Negative) had malignant thyroid nodules on histopathology whereas 16 (true negative) had benign thyroid nodules on histopathology (p = 0.0001) as shown in table I. The overall sensitivity, specificity, PPV, NPV and diagnostic accuracy of Magnetic Resonance Spectroscopy in differentiating malignant thyroid nodule from benign taking tissue diagnosis (as gold standard) was 93.51%, 84.35%, 95.24%, 79.51% and 91.40% respectively.

Table-I Summary of Results

	Positive results of histopathology	Negative results of histopathology
MRS positive	46(TP)*	3(FP)***
MRS negative	05(FN)**	16(TN)****

*-TP = True Positive
**-FP = False Positive
***-FN = False Negative
****-TN= True Negative

Figure-I: Role of Magnetic Resonance Spectroscopy in differentiating benign from malignant thyroid nodule taking tissue diagnosis as gold standard.



DISCUSSION

Magnetic resonance spectroscopy (MRS) uses strong magnetic fields to measure biochemical changes and molecular composition within body.[9,10] This study was conducted to determine the positive predictive value (PPV) of magnetic resonance spectroscopy in differentiating benign from malignant thyroid nodule taking tissue diagnosis as gold standard.

In this study, the average age was 46.53 ± 9.15 years. Out of 70 patients, 52 (72.29%) female and 18 (25.31%) males with female to male ratio of 1.89:1. In MRS positive patients, 46 (TP) had malignant thyroid nodules and 03 (FP) had benign thyroid nodules on histopathology. Among 24, MRS negative patients, 05 (FN) had malignant thyroid nodules on histopathology whereas 16 (TN) had benign thyroid nodules on histopathology (p=0.0001). Overall sensitivity, specificity, PPV, NPV and diagnostic accuracy of magnetic resonance spectroscopy in diagnosing malignant thyroid nodule taking tissue diagnosis as gold standard was 93.51%, 84.35%, 95.24%, 78.51% and 91.40% respectively.

A study had found the sensitivity of 100%, specificity of 89% and positive predictive value of 90.0% of choline peak in detecting malignancy.[11] In another study by Gupta N et al had found the sensitivity, specificity, positive predictive value and negative predictive value of magnetic resonance spectroscopy (MRS) in identifying malignant thyroid nodule was found to be 100%, 94.11%, 88.88% and 100% respectively.

Elshafey R et al[12] in his study has found that all the malignant nodules (13 nodules) and two benign nodules (mild elevation) had choline peak while it was absent in 26 other benign nodules. In malignant nodules, Choline / Creatine ratio ranged from 1.3 to 5.4, while it was 0.9 and 1.1in two benign nodules. The author reported the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of magnetic resonance spectroscopy in malignant thyroid nodules as 96%, 85%, 92% and 92% respectively.

Similar results were also concluded by Aydin H et al[13] who studied proton MRS and diffusion coefficient values and its role in diagnosing malignant thyroid nodules. The results concluded that Cho/Cr ratio for the malignant nodules was 2.95±1.54-5.3±2.38**.** The sensitivity, specificity, PPV, NPV and diagnostic accuracy of MRS in malignant nodules was found out to be 93.41%, 89.13%, 90.54%, 91.05% and 91.24% respectively.

Another study showed[14] that the positive predictive value of magnetic resonance spectroscopy in diagnosing thyroid malignancy is 95% compared with 100% in tissue. Previous studies were done to emphasize the noninvasive radiological means which helps the management of thyroid nodules. These studies produced interesting results but still to be used in clinical setting. These investigations can be divided into in vivo or ex vivo nature. When examinations is done in vivo, we came across several issues such as bearing the financial load of MR scan of whole body used as screening, magnetic susceptibility effects, movement of lump as a result of breathing, and artifect from surrounding fat. These limitations indicate that in vivo examination is helpful only in large tumors[15].

Tumor characterization depend on their biochemical changes and molecular composition, in vivo assessment recognize just two basic metabolities (choline and creatine). For diagnosis of thyroid cancer, two basic metabolites (either choline alone or the choline/creatine ratio) have 100% sensitivity and 88.88% specificity[10,15]**.** MRS differentiates normal thyroid gland from tumour (proven clinically or histologically) with an accuracy of 100%[16,17]**.**

End result: We concluded that magnetic resonance imaging (MRS) is an extremely sensitive and noninvasive tool which gives accurate method for diagnosing malignant thyroid nodules. Now we have improved preoperative diagnostic ability for characterization of thyroid lumps and it aids the surgeons in accurate decision making. So, we suggest that magnetic resonance spectroscopy (MRS) should be done regularly in all suspicious cases of malignant thyroid lesions for accurate pre-operative evaluation and opting for proper surgical approach.

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