

## Diffusion weighted MRI in differentiation of benign from malignant thyroid nodules

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**Conflicts of Interest:** Nil

### Abstract

**Background:** The aim of this study is to find out the efficacy of DWI MRI in differentiation of benign from malignant Thyroid nodule assuming histopathological as gold standard.

**Methods:** DWI was performed in patients with thyroid nodule by means of a 3-T scanner magnetic resonance imaging (MRI). Images were obtained at *b* value of 0, 500, and 1000 mm<sup>2</sup>/s to draw an ADC (apparent diffusion coefficient) map. Findings were compared with postoperative histopathologic results.

**Results:** Mean ADC 1000 in benign tumor 1.78±0.37×10<sup>-3</sup> mm<sup>2</sup>/s and in malignant tumor was 0.72±0.32×10<sup>-3</sup> mm<sup>2</sup>/s. The difference of ADC was found statistically significant.

**Conclusion:** DWI is highly accurate for discrimination between benign and malignant thyroid nodules

**Keywords:** DWI, Thyroid, ADC

### Introduction

Diffusion-weighted MR imaging (DWI) is an emerging technique for central nervous system (CNS) diseases. DWI is sensitive to changes in the microstructural

organization of tissue that may affect water diffusion. It has been used in various forms to evaluate head and neck tumors. The Apparent Diffusion Coefficient (ADC) value, a metric obtained from DWI scans, could be a quantitative parameter for distinguishing malignant tumors from benign lesions.<sup>1-2</sup> In our current study, we assess the ability of DWI and ADC to differentiate benign from malignant thyroid nodule.

### Material and method

**Study type:** Cross-sectional and prospective (Quantitative) study.

**Study design:** Observational study

### Inclusion criteria

- All patients with USG determined thyroid nodules and lesions larger than 1 cm in the greatest minimal transverse diameter will be included in study.
- Age 18-70 year
- Those who give written informed consent to be included in study.

**Exclusion criteria**

- Those who previously underwent thyroid surgery due to either malignant or benign reason will be excluded from study.
- Purely cystic nodules.
- Patients with thyroid nodule unfit to undergo MRI like metallic aneurysms clips, pacemakers, metallic vascular clamp placement.
- Non compliant patient.
- Patients with history of claustrophobia.
- Those who underwent previous radiation therapy and thyroiditis will be excluded from study.
- Patients having lesions less than 1cm in the greatest minimal transverse diameter will be excluded from study

This study included patient with thyroid nodules on the basis of ultrasonographic examination. Their age ranged from 18-70 years.

Prior to examination, written and informed consent from patient/guardian. Preliminary gray scale ultrasonographic and color doppler sonography was done for all patients.

**Results**

Table 1: Distribution of cases according to histopathological diagnosis

| Histopathological diagnosis | No of cases | Percentage |
|-----------------------------|-------------|------------|
| Benign                      | 30          | 66.67      |
| Malignant                   | 15          | 33.33      |
| Total                       | 45          | 100.00     |

In present study, 66.667% cases were benign and 33.33% cases were malignant.

Table 2: Distribution of cases according to ADC and type of tumor

| ADC      | Benign |      | Malignant |      | p-value  |
|----------|--------|------|-----------|------|----------|
|          | Mean   | SD   | Mean      | SD   |          |
| ADC 500  | 1.83   | 0.38 | 0.76      | 0.31 | 0.001(S) |
| ADC 1000 | 1.78   | 0.37 | 0.72      | 0.32 | 0.001(S) |

In present study, mean ADC 500 in benign tumor  $1.83 \pm 0.38 \times 10^{-3} \text{ mm}^2/\text{s}$  and in malignant tumor was  $0.76 \pm 0.31 \times 10^{-3} \text{ mm}^2/\text{s}$ . The difference of ADC was found statistically significant.

Mean ADC 1000 in benign tumor  $1.78 \pm 0.37 \times 10^{-3} \text{ mm}^2/\text{s}$  and in malignant tumor was  $0.72 \pm 0.32 \times 10^{-3} \text{ mm}^2/\text{s}$ . The difference of ADC was found statistically significant.

Table 3: Diagnostic accuracy of ADC level.

|                                      |                |
|--------------------------------------|----------------|
| Area under the ROC curve (AUC)       | 0.964          |
| Standard Error <sup>a</sup>          | 0.0299         |
| 95% Confidence interval <sup>b</sup> | 0.862 to 0.997 |
| z statistic                          | 15.543         |
| Significance level P (Area=0.5)      | <0.0001        |
| Youden index J                       | 0.9000         |
| Associated criterion                 | $\leq 0.97$    |
| Sensitivity                          | 93.33          |
| Specificity                          | 96.67          |

According to the final pathology results, the best cutoff for the mean ADC value was calculated as  $0.97 \times 10^{-3} \text{ mm}^2/\text{s}$  with a sensitivity of 93.33%, a specificity of 96.67%, a positive predictive value of 83.33%, and a negative predictive value of 89.13%. It was determined that the detection of a mean  $\text{ADC} \leq 0.97 \times 10^{-3} \text{ mm}^2/\text{s}$  was associated with 15 times higher risk of malignancy (P=0.001)

## Discussion

In present study, mean ADC 500 in benign tumor  $1.83 \pm 0.38 \times 10^{-3} \text{ mm}^2/\text{s}$  and in malignant tumor was  $0.76 \pm 0.31 \times 10^{-3} \text{ mm}^2/\text{s}$ . The difference of ADC was found statistically significant. Mean ADC 1000 in benign tumor  $1.78 \pm 0.37 \times 10^{-3} \text{ mm}^2/\text{s}$  and in malignant tumor was  $0.72 \pm 0.32 \times 10^{-3} \text{ mm}^2/\text{s}$ . The difference of ADC was found statistically significant. According to the final pathology results, the best cutoff for the mean ADC value was calculated as  $0.97 \times 10^{-3} \text{ mm}^2/\text{s}$  with a sensitivity of 93.33%, a specificity of 96.67%, a positive predictive value of 83.33%, and a negative predictive value of 89.13%. It was determined that the detection of a mean  $\text{ADC} \leq 0.97 \times 10^{-3} \text{ mm}^2/\text{s}$  was associated with 15 times higher risk of malignancy ( $P=0.001$ ).

Nakahira et al. investigated the efficacy of DW-MRI on distinguishing malignant thyroid nodules. They found that the mean ADC value for the benign nodules was  $1.93 \pm 0.37 \times 10^{-3} \text{ mm}^2/\text{s}$ , and the mean ADC value for the malignant nodules was  $1.20 \pm 0.25 \times 10^{-3} \text{ mm}^2/\text{s}$ . They concluded that the mean ADC value of the malignant nodules was significantly lower than the benign nodules ( $P < .01$ ).<sup>3</sup> In another study, El-Hariri et al. evaluated 56 thyroid nodules of 37 patients with nodular goiter via DW-MRI, and they found the mean ADC value to be  $1.85 \pm 0.24 \times 10^{-3} \text{ mm}^2/\text{s}$  for the benign nodule group, whereas this value was calculated to be  $0.89 \pm 0.27 \times 10^{-3} \text{ mm}^2/\text{s}$  for the malignant nodule group, once again, demonstrating that the mean ADC value of the malignant nodules was significantly lower ( $P < .01$ ).<sup>4</sup>

## Conclusion

DWI is highly accurate for discrimination between benign and malignant thyroid nodules

## References

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