Differentiation of benign and malignant head and neck pathology using apparent diffusion coefficient and dynamic contrast enhanced MRI

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- A diagnostic challenge.
- Conventional imaging techniques.
- Volumetric and morphological criteria.

- Lesions that have indeterminate findings.

- Advanced magnetic resonance techniques.

- A differential diagnosis of benign and malignant lesions of the head and neck is critical.
ADC map
DCE-MRI

- The change in the amount of contrast material in a lesion versus time is related to the tissue vascularity and angiogenetic characteristics, which is different in benign and malignant lesions.
- Rapid growth patterns associated with malignant tumors require increased supply of blood. angiogenesis or neovascularity.
- The tumor microenvironment is different from normal tissues in having increased microvascular permeability and diameter, increased flow and blood volume of microvasculature.

- All these parameters result in rapid onset of contrast enhancement, which may taper off rapidly or persist depending further on additional tissue parameters.
- After passing into extracellular spaces, the contrast begins to diffuse into tissue compartments farther than vasculature and eventually over several minutes to hours, diffuse back into vasculature.
- However, in areas of fibrosis and necrosis, the elimination of contrast is slower because of slower exchange rates and hence they exhibit persistent delayed contrast characteristics.
The objective of our study was to demonstrate the benefit of DCE MRI and ADC value in discriminating benign from malignant head and neck lesions.

MRI imaging studies were conducted for 20 patients complaining of head and neck lesions.

MR images were performed on 1.5 T system (Acheiva 1.5 Tesla, Philips Medical Systems) by using a 16 channel sense neurovascular head and neck coil.

All patients underwent diffusion weighted and DCE MR imaging examinations in addition to conventional MRI imaging.
• ADC maps were generated from the DWIs.

• In DCE MRI, 10 scans were obtained sequentially, about 38 s for each scan with a total of about 6.3 minutes.

• ROIs were placed in the solid portion of the lesion avoiding necrotic areas.

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\text{Washout ratio (WR) (\%) = CI}_{\text{max}} - CI_{360}.\]
RESULTS

Type 1 curve
Washout ratio >-11%

Type 2 curve
Washout ratio >-11,<22 %

Type 3 curve
Washout ratio >22%
- Overall ADCs of malignant tumors were significantly smaller than those of benign and inflammatory lesions.

- **An ADC cutoff point of 1.1130 mm²/s** was best for differentiating benign or inflammatory lesions from malignant tumors; it provided diagnostic ability of 90% sensitivity, 83% specificity and 87% accuracy.

- Only the washout ratio showed statistical significant difference in differentiating benign or inflammatory lesions from malignant lesions with sensitivity, specificity and overall accuracy of 100%.

- **Type 2 curve (washout ratio between -11 and 22%)** was found exclusively in malignant lesions.

- **Type 1 curve (washout ratio < -11%)** were found in benign and inflammatory lesions.

- **Type 3 curve (washout ratio > 22%)** was found in hypervascular benign lesions.
Male patient 59 years old complaining of stridor

ADC value of 1
Female diabetic patient 60 years old presenting with right neck swelling and fever since three weeks.
very low ADC value 0.6

Non-Hodgkin Lymphoma

washout ratio -5.13%
Adult male 23 years old complaining of right neck swelling since 45 days

ADC value 1
Female patient 39 years old complaining of left ear discharge, she was diagnosed as left sided cholesteatoma and underwent left canal wall down mastoidectomy since few months. Now complaining of recurrent discharge.
Squamous cell carcinoma

ADC value 1

washout ratio 4.72%
Adult male 23 years old complaining of nasal obstruction and epistaxis.

ADC value was 1.8
JUVENILE ANGIOFIBROMA

TIC was type 3, washout ratio 24.4%

Female patient 40 years old complaining of right neck swelling.
ADC value 1.3

Glomus jugulare

type 3 curve and washout ratio 33.9%
Female patient 39 years old complaining of left ear discharge since childhood, now pus discharge and left retroauricular abscess.

ADC value was 1.19
Granulation tissue

TIC type 1 with washout ratio -23.76%

CONCLUSION
- ADC value can reliably differentiate between benign or inflammatory and malignant head and neck lesions.

- Cut off value of 1.1130 mm²/s showed overall accuracy of 87% in differentiating benign from malignant lesions.

- Regarding TIC, only washout ratio shows statistically significant difference in discriminating benign or inflammatory from malignant head and neck lesions.

- DCE MRI showed overall accuracy of 100% reflecting its potential in differentiating head and neck lesions and narrowing the differential diagnosis.

Our recommendation is to imply DWI and DCE MRI whenever there is a head and neck lesion that remains unsolved by conventional imaging techniques.
Thank you