MR diffusion weighted image in solid head and neck masses in pediatrics

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List of abbreviation

SMC	:	Sternocleidomastoid muscle
LN	:	Lymph nodes
CSF	:	Cerebro spinal fluid
EAC	:	External auditory canal
ICA	:	Internal carotid artery
OMC	:	Osteomeatal complex
PPF	:	Pterygopalatine fossa
NHL	:	Non-Hodgkin lymphoma
HL	:	Hodgkin lymphoma
EBV	:	Epstein Barr virus
RECIST	:	Response evaluation criteria in solid tumors
IRECIST	:	Immune Response evaluation criteria in solid tumors
US	:	Ultrasonography
CT	:	Computed tomography
MRI	:	Magnetic resonance imaging
DWI	:	Diffusion weighted imaging
ADC	:	Apparent diffusion coefficient
RMS	:	Rhabdomyosarcoma
PNET	:	Primitive neuroectodermal tumor
NPC	:	Nasopharyngeal carcinoma
CBT	:	Carotid body tumor
JNA	:	Juvenile angiofibroma
ITF	:	infratemporal fossa)
SPF	:	sphenopalatine foramen
PMF	:	pterygo-maxillary fissure
IOF	:	inferior orbital fissure
GA	:	General anesthesia
FDA	:	Food and drug administration

NSF	:	Nephrogenic systemic fibrosis
MRA	:	Magnetic resonance angiography
DCE	:	Dynamic contrast enhanced
RF	:	radiofrequency
ROI	:	Region of interest
SCC	:	Squamous cell carcinoma
NCI	:	National Cancer Institute
ROC	:	receiver-operating characteristic
CI	:	Confidence interval
PPV	:	Positive predictive value
(NPV)	:	Negaitive predictive value
SD	:	Standard deviation

Introduction

A solid head and neck mass is a common finding in pediatric age group. It can present a diagnostic challenge on clinical and radiological levels. Differentiation of benign from malignant pediatric tumors is essential for treatment planning as well as for prognosis of malignant tumors. ***(Youssef et al. 2014)***

Pediatric Populations are subdivided as follows:

- ✓ Newborn birth to 1 month of age
- ✓ Infant 1 month to 2 years of age
- ✓ Child 2 to 12 years of age
- ✓ Adolescent 12-21 years of age ***(Nelson et al. 2015)***

Although the upper age limit used to define the pediatric population varies among experts, including adolescents up to the age of 21 is consistent with the definition found in several well-known sources. ***(Rudolph et al 2011).***

The head and neck masses includes benign and malignant lesions. The most common benign masses are Hemangioma, Venous malformation, Neurofibroma, Pleomorphic adenoma, Inflammatory nodes, Tuberculous lymph node, Scleroma and Fibroma. ***(Abdel Razek et al. 2009)***

The most common pediatric head and neck malignancies include non-Hodgkin lymphoma, Hodgkin lymphoma, rhabdomyosarcomas, thyroid malignancies, nasopharyngeal carcinomas, salivary glands malignancies and neuroblastomas. ***(Chadha and Forte 2009)***

The head and neck are regions that present both high anatomical and functional difficulties, making the precise diagnosis and staging of regional tumors a challenging task**.** ***(Barbero et al. 2013)***

A variety of imaging techniques can help in characterization of pediatric head and neck masses. Ultrasound has a role in cystic lesions but cannot determine the nature of solid masses, CT is associated with radiation exposure. ***(Abdel Razek et al. 2009)***

MR sequences provide very accurate information about tumor size and morphology and thanks to T2 high resolution sequences which clearly depict in most cases both location and morphological characteristics of tumors in head and neck regions**.** ***(Barbero et al. 2013)***

Different routine pulse sequences of MR imaging cannot accurately differentiate benign from malignant tumors. Biopsy is commonly used, but it is invasive and may give false results**.** ***(Abdel Razek et al. 2009)***

Diffusion weighted echo-planer MR imaging is a completely non-invasive technique for evaluation of the motion of microscopic water in tissues. The extent of translational diffusion of molecules measured in the human body is referred to as the apparent diffusion coefficient (ADC). ***(Youssef et al. 2014)***

The ADC is expected to vary according to the cellular density of the lesion. ***(Abdel Razek et al.2009)***

In normal tissues or in areas exhibiting vasogenic edema, the motion of water molecules is not limited and no restricted diffusion is noted. In tissues with cytotoxic edema or in highly cellular regions there is diffusion restriction and low ADC value. ***(Shah et al., 2008)***

The lower ADC value of the malignant lesions is explained by difference in histopathological features of benign and malignant tumors. Malignant tumors have enlarged nuclei, hyperchromatism and angulation of nuclear contourand they show hypercellularity. Theses histological characteristics reduce the extracellular matrix and the diffusion space of water protons in the extracellular and intracellular dimensions with a resultant decrease in ADC. ***(Youssef et al. 2014)***

In the head and neck region, DWI has demonstrated usefulness in differentiating benign and malignant solid lesions and characterization of neck lymph nodes. ***(Elshahat et al.2013)***

Aim of Work

The aim of the work is to assess the clinical usefulness of the ADC calculated from DW MR images in the characterization of the head and neck masses in pediatrics.

Review of literatures

Radiological anatomy of the head and neck regions

The neck region consists of two fascial layers; the superficial and the deep cervical fascia. The former is a thin layer of connective tissue between the dermis and the deep cervical fascia. It contains the platysma muscle, vessels, LNs and nerves. Teratoma, vascular malformations, lipoma, plexiform neurofibroma, keloid, scar and subcutaneous fat fibrosis are the most common lesions ***(Meuwly et al 2005)***

The deep cervical fascia consists of four layers which share in the formation of the boundaries of the supra and infra-hyoid deep neck spaces ***(Hoppe et al 2014)***

The first one is the investing fascia which completely surrounds the neck then splits enclosing both the sternocleidomastoid and trapezius muscles. Then the pretracheal fascia encloses the contents of the visceral space. Then the paravertebral fascia encloses the paraspinous together with the prevertebral muscles to form the pre-vertebral space ***(Morton et al 2011)***

The latter is divided into alar fascia anteriorly and true pre-vertebral fascia posteriorly. Eventually the carotid sheath surrounds the carotid arteries, the internal jugular vein and the vagus nerve (Alnoury and Lotfy 2010)The neck region is divided into two major triangles to facilitate the understanding of its regional anatomy: (fig1-1)

Anterior Triangle:

- The anterior triangle of the neck is bordered by the sternocleomastoid muscles (SCMs) and the mandible.
- The anterior triangle is divided into the suprahyoid and infrahyoid regions by the hyoid bone
- The suprahyoid region is divided into the submandibular and submental triangles by the mylohyiod muscle.
- The infrahyoid region is divided into the carotid and muscular triangles by the superior belly of the omohyoid muscle.
- The carotid triangle contains the carotid sheath ***(Rayahi et al 2015)***

Posterior triangle:

- The posterior triangle is bordered by the SCMs, trapezius and clavicle.
- The inferior belly of the omohyoid muscle divides the posterior triangle into the superior and inferior regions.