Diagnostic value of combined Diffusion Weighted MRI and Conventional MRI in the diagnosis of non-palpable undescended testes

Thesis

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List of Abbreviations

ACTH	Adrenocorticotropin hormone
ADC map	Apparent diffusion coefficient map
AMH	Anti-müllerian hormone
CAH	Congenital adrenal hyperplasia
CGRP	Calcitonin gene-related peptide
CT	Computed tomography
DEHP	Di-ethylhexyl phthalate
DHEA	Di-hydroepiandrosterone
DHT	Di-hydrotestosterone
DWI	Diffusion weighted imaging
EPI	Echo planar imaging
Fat supp. T2WI	T2-weighted imaging with fat suppression sequence in magnetic resonance imaging
FN	False negative
FP	False positive
FSH	Follicle stimulating hormone
Gd	Gadolinium
Gd-DTPA-BMA	Gadolinium-diethylenetriaminepentaceticacid-bismethyl-amide (Omniscan contrast)
GnRH	Gonadotropin releasing hormone
hCG	Human chorionic gonadotropin
HFS	Head first supine (MRI position)
IV	Intravenous
LH	Luteinizing hormone
MIS	Müllerian inhibiting substance
MRA	Magnetic resonance angiography

MRI	Magnetic resonance imaging
MRV	Magnetic resonance venography
NPV	Negative predictive value
NSF	Nephrogenic systemic fibrosis
PPV	Positive predictive value
S3	Sacral nerve root 3 (posterior femoral cutaneous nerve)
SD	Standard deviation
SE	Spin echo
SRY	Sex-determining region of the Y chromosome
TDF	Testes determining factor
TE	Echo time
TN	True negative
TP	True positive
T2 STIR	T2-weighted image with fat suppression sequence
TR	Repitition time
T1WI	T1 weighted imaging (MRI sequence)
T2WI	T2 weighted imaging (MRI sequence)
UDT	Undescended testes
US	Ultrasound
USG	Ultrasonography
XY	Male chromosomal karyotype
Yrs	years

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Abstract

Key words:

Diffusion MRI- Conventional MRI- non palpable- undescended testes

Cryptorchidism is a common anomaly in pediatrics. It is the absence of one or both testes in the scrotum since birth. It may be intraabdominal, pelvic, inguinal or absent. Early preoperative identification and location of testes by various imaging techniques is needed to prevent the future complications. The role of combined Diffusion weighted imaging to the conventional MRI using the fat-suppression sequence is essential for accurate diagnosis and localization of testes during surgery due to its high sensitivity and specifity.

INTRODUCTION

Cryptorchidism is a common anomaly in pediatric practice. It is the absence of one or both testes in the scrotum and it is generally synonymous with undescended testis. ***(Williams et al., 2001)***

Approximately 1% of boys have undescended testes, 80% of which are clinically palpable and 20% of which are non-palpable. ***(Elder, 1988)*** The term 'non-palpable testes' implies that the testes cannot be detected on physical examination; they are intraabdominal, absent, vanishing or atrophic. ***(Kavoussi et al., 2007)***

Preoperative identification and location of testicles can help to determine the optimal type of procedure and allow for appropriate advance planning. On the basis of the imaging findings, the surgeon can appropriately counsel the patient and alter the operative approaches needed. In the case of absent or vanishing testicles, imaging findings could obviate the need for surgical exploration. ***(Shah et al., 2006)***

Various imaging techniques have been suggested for use in identifying and locating non-palpable testicles preoperatively with varying limitations including expense, invasiveness technical difficulty, radiation risk, need for contrast medium, and need for sedation. Imaging approaches include ultrasonography, computed tomography (CT), routine MRI, magnetic resonance angiography (MRA), and magnetic resonance venography (MRV), some of which require sedation or anesthesia and are without risks. ***(Miller et al., 2009)***

Ultrasound is the least expensive and frequently used technique of all imaging tools. However it had been shown to have low sensitivity in

identifying non-palpable testicles preoperatively in a recent metaanalysis. ***(Tasian and Copp., 2011)***

Conventional MRI is moderately specific in identifying absent testicles but poorly sensitive in identifying the presence of non-palpable testicles. Conventional MRI appears to be less efficient in locating intra-abdominal functioning testicles and shows limited sensitivity in locating inguino-scrotal testicles, but it fails to locate most of the atrophied testicles, which makes conventional MRI a less reliable technique in providing guidance to differentiate those children needing surgery from those who do not. ***(Krishnaswami et al., 2013)***

Additional MRI assessments, fat-suppressed T2WI and DWI are useful methods to improve the accuracy of diagnosis of non-palpable testes. It could prevent needless surgery and be worth the additional imaging tests. ***(Kato et al., 2011)***

Fat-suppressed T2-weighted imaging is more sensitive to inflammation and water content by suppressing fat. ***(Joseph and Shetty., 1988)*** Therefore, the contrast between the testes and surrounding tissues obtained by this technique was sharp. Fat-suppressed T2-weighted imaging was considered suitable for distinguishing between the testes and lymph nodes. ***(Kato et al., 2011)***

Diffusion weighted imaging is an evolving technology with the potential to improve tissue characterization when findings are interpreted in conjunction with findings obtained with other conventional MRI sequences. It provides functional and structural information about biologic tissues; it is best used to solve specific problems. ***(Qayyum, 2009)***

Use of DWI therefore facilitates characterization of tissue at the microscopic level in a mechanism different from T1 and T2 relaxation. The degree of restriction of water diffusion in biologic tissue is inversely related to tissue cellularity and the integrity of cell membranes (e.g. tumor tissue). Concordantly, intra-abdominal testes are considerably more cellular than the adjacent organs and tissues and can be detected easily on DW images owing to their increased signal intensity. Therefore added DWI to routine MRI to identify non-palpable undescended testes. ***(Kantarci et al., 2011)***

AIM OF THE WORK

To assess the value of combined Diffusion–weighted imaging and conventional MRI including fat-suppressed sequences in proper localization of non-palpable testes before unneeded laparoscopy.