

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

Thesis

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Contents

	Page
List of Abbreviations	I
List of Tables	III
List of Figures	IV
Introduction & Aim of Work	1
Review of Literature	
Chapter (1): Embryology of male genitals	4
Chapter (2): Anatomy of male genital organs	10
Chapter (3): Pathology of cryptorchidism	20
Chapter (4): Radiological investigations of undescended testes.....	36
Chapter (5): Management of UDT and Laparoscopy overview	60
Patients & Methods	69
Results	75
Cases illustration	83
Discussion	101
Conclusion & Recommendations.....	111
Summary.....	112
References	114
Arabic Summary	

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-bismethylamide (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

List of Tables

Tables		Pages
1	Table shows a comparison of undescended testes with ectopic testes.	23
2	Table shows MRI protocol parameters.	71
3	Table shows identification of UDT by US before MRI examination.	75
4	Table shows location-based distribution of non-palpable UDT according to laparoscopic findings.	76
5	Table shows a comparison between the localization of UDT by combined DWI & conventional MRI by two radiologists and laparoscopy.	79
6	Table shows classification of location and identification of non-palpable UDT by DWI, conventional MRI, and combined DWI & conventional MRI according to laparoscopic findings.	79
7	Table shows the McNemar test of correlated proportions of both radiologists to calculate <i>p</i> value of significant differences in sensitivity & accuracy between DWI, conventional MRI and combined MR imaging.	80
8	Table showing detection of viability of non-palpable UDT by combined DWI & conventional MRI in comparison with laparoscopy.	81

List of Figures

Figures		Pages
1	Illustrating chart of the normal reproductive system development.	4
2	Illustrating diagram showing the development of testes and migration of the primordial germ cells.	5
3	Illustrating diagram of transverse section through the lumbar region of a 6 week embryo showing the indifferent gonad with the primitive sex Cord.	8
4	Diagram showing the descent of testis in different stages of development.	9
5	Illustrating diagram of male (human) testicles.	11
6	Illustrating diagram of transverse section through the left side of the scrotum and the left testis.	12
7	Illustrating diagram showing the right testis, exposed by laying open the tunica vaginalis.	15
8	Illustrating diagram of the male reproductive system.	17
9	Ultrasound of testis (a)Longitudinal image (b)Transverse image showing prominent rete testis, a normal variant.	39
10	CT axial images of a male adult 25 yrs old (a)Normal right descended testis (b)Left undescended testis at the left inguinal canal.	41
11	Testicular venogram of left testicular vein in a patient with impalpable intracanalicular testis.	42
12	Transverse section MR images of left intraabdominal testis in an 8 yrs old boy (a)T1WI (b)T2WI (c)Fat-suppressed T2WI (d)DWI.	45

13	Coronal section MR images of left intraabdominal testis in an 8 years old boy (the same patient of Fig. 12) (a)DWI(b)Fat-supT2WI.	45
14	Coronal and transverse section MR images of right intraabdominal testis in a 13 months old boy (a,d)Fat-sup T2WI (b,c)T1WI, T2WI (e) DWI	46
15	Coronal and transverse section MR images of left intracanalicular testicular nubbin (a, b, c, d & f) and contralateral unaffected testis (e, g) in a 15 months old boy.	46
16	Coronal T2 weighted image of right intraabdominal testis and left intra-canalicular testis in a 1 yr old boy.	48
17	Multipplanar volume reconstruction postprocessing MR image showing blind ended right pampiniform venous plexus of vanishing right testis in a 9 yrs old boy.	49
18	MR angiography showing right and left pampiniform venous plexus draining from scrotum with right vanishing testis in a 9 yrs old boy.	49
19	Gd-infusion MR angiography images of right intraabdominal and left intracanalicular testes in a 1 year old boy.	51
20	MR images of 28 years old male with normal descended right testis in (a)T2WI and (b)Diffusion weighted image.	53
21	Illustrating diagram showing the diffusion driven random trajectory of a single water molecule during diffusion.	53
22	Illustrating diagram showing diffusion of water molecules (a)Restricted and (b)Free diffusion.	54
23	Diagrammatic representation of measuring water	57

	diffusion.	
24	Illustrating diagram of echoplanar imaging within each TR period, multiple lines of imaging data are collected.	58
25	Illustrating picture of a 3 port technique for laparoscopic orchidopexy.	63
26	Illustrating picture of laparoscopic view of intra-abdominal testis.	64
27	Illustrating picture of operative view of intra-abdominal testis after its delivery in the inguinal incision.	65
28	Illustrating chart of location-based distribution of non-palpable UDT according to laparoscopic findings.	76
29	Illustrating diagram of location-based distribution of non-palpable UDT according to laparoscopic findings (a) Preoperative diagnosis (b) Surgical diagnosis.	76
30	Illustrating chart of detection of viability of non-palpable UDT by combined DWI & conventional MRI in comparison with laparoscopy.	82
31	Scrotal ultrasonographic axial images of (a)Right UDT seen in the iliac region (b)The normal descended left testis in the scrotum in a 7 yrs old boy.	83
32	Coronal and axial MR images of right intracanalicular UDT in a seven years old boy (the same patient of Fig.32) (a) T1WI (b) T2WI (c-d) Fat-suppress T2WI.	83-84
33	Diffusion axial image at b value of 800s/mm^2 of right intracanalicular UDT of the same patient in Fig. 32	84
34	Axial MR images of the pelvis and lower abdomen of bilateral low intraabdominal UDTs in a 15 years old male patient (a) T1WI (b) T2WI (c) Fat-suppress T2WI	86

35	Diffusion axial MR images of the pelvis & lower abdomen at b value of 800s/mm ² of bilateral low intraabdominal UDTs of the same patient in Fig.34	87
36	Axial MR images of the abdomen & pelvis showing bilateral intraabdominal UDT (the right in high intraabdominal location and the left in low intraabdominal location) in a 15 years old male patient (a-b) T1WI (c-d) T2WI (e) Fat- supp T2WI	88-89
37	Diffusion axial MR images of the abdomen & pelvis of bilateral intraabdominal UDT at b value of 800s/mm ² (a-b) of the same patient in Fig.36	90
38	Axial & coronal MR images of atrophic left intracanalicular UDT(a testicular nubbin) in a 26 years old male (a) T2WI (b-c) T2 STIR (d) T1WI	91-92
39	Diffusion weighted axial image of the low pelvis at b value of 800s/mm ² of left intracanalicular UDT of the same patient in Fig.38 showing low signal intensity or free diffusion (denoting testicular atrophy).	92
40	Axial & coronal MR images of the abdomen & pelvis at different levels (a-d)T2WIs showing non visualization of left testis all through the pathway of its descent (e)T2WI showing high signal intensity of the normal right descended testis in the scrotum and empty left scrotal sac in a thirty months old male boy.	93-94
41	Diffusion weighted axial images at b value of (a)50 (b) 800s/mm ² showing absent left testis with high signal intensity of inguinal lymph nodes of the same patient in Fig.40.	94

42	Ultrasonographic axial image of the normally descended right testis in an 8 months old male infant.	95
43	Coronal MR images of the abdomen & pelvis of the same patient in Fig.42 (a)T1WI (b)T2WI (s)Fat-sup T2WI showing a suspected left lower intraabdominal testis.	95-96
44	Diffusion weighted axial images of the pelvis at b value of 800s/mm ² of the suspected left lower abdominal UDT of the same patient of Fig.43	96
45	Axial & coronal MR images at different levels of the abdomen and pelvis showing absent right testis along the pathway of its descent (a-c)Fat-sup T2WI (d-e)T1WI (f)fat-sup T2WI of the scrotum showing high signal intensity of left descended testis in a 17 years old male patient.	98-99
46	Diffusion weighted axial images of the abdomen & pelvis at b value of 800s/mm ² which show (a)High signal intensity of left testis (b-c)Absence of right testis along the pathway of its descent of the same patient of Fig.45	99-100

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 specificity.

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.