Egyptian Journal of Surgery Vol. (19), No. (4), Oct., 2000

LOCALIZATION OF NON-PALPABLE TESTIS IN CHILDHOOD: MAGNETIC RESONANCE IMAGING VS LAPAROSCOPY

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Laparoscopy and magnetic resonance imaging (MRI) are competitive tools in the diagnosis of non-palpable testis. A prospective evaluation to determine the accuracy of MRI vs laparoscopy in the detection of undescended non-palpable testis was performed in 13 boys with 15 non-palpable testes. The results were compared between MRI, laparoscopy and definitive surgical diagnosis in all patients. MRI have reached a correct diagnosis in 13 out 15 non-palpable testes (86.6%). Three testes were located intra-canalicular, 5 were located just-canalicular, 3 were located intra-abdominal on the sides of urinary bladder. In the other 2/13 cases MRI showed small poorly defined testes with low signal intensity on both T1 and T2-weighted images indicative of fibrotic changes. These 2 testes proved to be atrophic after surgical exploration. MRI failed to detect or localize undescended non-palpable testis in 2 cases.

On the other hand, initial laparoscopy revealed 5 testes to be intra-abdominal, and another 5 testes to be just-canalicular. Laparoscopy diagnosed inguinal testis in 3 instances, in which the vas and vessels were seen entering an open internal ring. In another 2 cases, the vas and vessels have entered a closed internal ring, they were diagnosed as vanished or atrophic testes in the inguinal canal.

We recommended the use of non-invasive, non-ionizing MRI initially for all children with non-palpable testes to locate normal or atrophic testis, as a positive MRI finding locates the testis reliably, and limit minimally invasive diagnostic laparoscopy to patients with negative MRI findings.

Key words : Non-palpable testis – Magnetic resonance imaging – Laparoscopy.

INTRODUCTION

The testis usually descend into scrotum around the 8th month of foetal life. Most of undescended testis will be corrected spontan-eously by the age of 1 year, but 0.8% of boys continue to have undescended testis[1].

In 20% of these cases undescended testis is clinically non-palpable[2]. Different possibilities exist since the non-palpable testis may be intra-abdominal, intracanalicular, or it may be a vanishing testis[3]. Early diagnosis and treatment are essential to minimize the risk of malignancy, decreased fertility, torsion, and inguinal hernia-conditions that commonly develop with cryptorchidism [4].

Different diagnostic modalities have been used for detection and localization of non-palpable testis including ultrasonography, computed tomography (CT) and magnetic resonance imaging (imaging techniques) and laparoscopy (visualization) [5]. Ultrasound proved to be useful in localizing the testis within the inguinal canal but it shows difficulty in differentiating enlarged inguinal lymph node and testis. It usually fails to visualize intra-abdominal testis[6]. Also, difficulties arise in fatty and uncooperative young patients, furthermore, the accuracy of ultrasound depends on the skill of the operator[7]. With CT the non-palpable testis is more easily identified and can be distinguished from the contents of the cord and enlarged lymph nodes[8]. However, CT has never been reported to have enabled identification of high abdominal testis, its main disadvantage is the associated radiation hazard to the testis[9]. Magnetic resonance imaging (MRI) and laparoscopy are competitive tools in the diagnosis of non-

palpable testis [10].

MRI has the advantages of being non-invasive, non-ionizing, capable of obtaining multiplanar images, and has the potential for tissue characterization[11]. The goal of diagnostic laparoscopy is to provide information on testis location and documentation on its presence or absence [12].

The aim of this work is to determine the accuracy of MRI vs laparoscopy in the detection of non-palpable testis.

PATIENTS AND METHODS

Patients :

This study included prospective randomized MRI and laparoscopic evaluation of 13 boys aged 15 months to 14 years with a mean age of 7.8 years. All had non-palpable testes that were not demonstrated neither by careful palpation of the scrotum and groin nor by ultrasound examination as unilateral non-palpable undescended testis in 11 cases and bilateral in 2 cases with a sum of 15 testes. Patients with associated anomalies such as ambiguous genitalia, the prune-belly syndrome, or genetic disorders, were excluded. For each patient, MRI then laparoscopy were performed. All findings were verified by open surgical procedure.

MR imaging studies:

Relatively elderly co-operative boys were examined without sedation while young boys were sedated using either oral chloral hydrate in a dose of 30-50 mg/kg or I.V valium 0.2 mg/kg.

MR image scans were performed on a 0.5 tesla superconducting magnet system (GE signa contour), using "head coil" for young boys and body coil for old boys.

The initial pulse sequence was coronal T1 spin-echo (SE) series TR 500-600 ms/TE 15-20 ms and slice thickness 4-5 mm without gaps and with a field of view covering the normal path of testicular descent from the renal hilum down to the scrotum. Then T1-weighted axial images TR 500-600 ms/TE 15-20 ms followed by T2 coronal and axial images TR 2000-2200 ms/TE 60-80 ms with slice thickness 4-5 mm. MR images were interpreted before surgery and compared with surgical findings.

MR images interpretation :

MR images of both normal and undescended testes show ovoid appearance which is hypointense to fat on T1-weighted images while on T2-weighted images typically they are hyperintense or iso-intense to fat with surrounding black out-line. The mediastinum testis is visualized as a low-signal-intensity band within the testis which improve the specificity in diagnosis. The atrophic testis is diagnosed by its small size and the low signal intensity on both T1 and T2-weighted images.

On coronal views, inguinal testis is located along the course of a linear low-signal-intensity structure which extend to the scrotum. The gubernaculum is seen as a small, cresent-shaped cap of decreased signal intensity on the distal aspect of the testis.

Laparoscopic examination :

Under general anaesthesia, a palpable bladder can be emptied by manual expression using credé manaeuver, a primary peri-umbilical port (3.5 mm) was inserted using an open technique [13]. A pneumoperitoneum was created using carbon dioxide with a flow rate of 0.2-0.5 L/min and an intra-abdominal pressure of 6-8 mmHg was recommended. A 3-mm 30° paediatric telescope was placed through the umbilical port. With use of mild trendlenberg position, the space between the internal ring and the colonic mesentry was inspected to locate the testis and to visualize the testicular vessels and the vas on both sides.

Interpretation of laparoscopic findings :

Several findings are possible during diagnostic laparoscopy. If the vas and a normal sized vessels are seen passing through a closed internal ring, a small viable testis or a testicular remnant is usually located in the canal or in the superficial inguinal pouch. The presence of normal sized vas and vessels entering an open internal ring would suggest the presence of a viable testis which is located at the orifice of an open indirect hernia sac, with manual pressure externally on the inguinal canal, the testis can be pushed into the abdominal cavity, which account for the fact that it is not palpable on examination. Intra-abdominal testis may be found anywhere on the lateral pelvic wall or in the iliac fossa. Atrophic testis is visualized as blind ended vas and vessels.

RESULTS

Fifteen non-palpable testes were identified at surgery, of which 3 were located in the inguinal canal, 5 were located just proximal to the internal inguinal ring and 5 were located intra-abdominally. Unilateral atrophy of the testis was identified in the other 2 cases in the inguinal canal. (Table 1) and (Fig.1) show MRI and laparoscopic results in comparison to surgical findings. MRI have reached a correct diagnosis in 13 out of 15 non-palpable testes. On MRI, 11/13 testes were shown to have a low signal intensity to fat on T1-weighted images and a high signal intensity or iso-intense to fat with characteristic surrounding black out-line on T2-weighted images. The mediastinum testis was identified in 8/11 cases as a low signal intensity band within the testis (Fig. 2,4). Three testes were located intra-canalicular (Fig. 2), five were located just-canalicular (Fig. 3,4), three were located intra-

abdominal on the sides of the urinary bladder (Fig. 5). In the other 2/13 testes MRI showed small poorly defined testis with low signal intensity on both T1 and T2-weighted images proved to be atrophic after surgical exploration (Fig. 3). MRI failed to detect or localize undescended non-palpable testes in 2 cases.

Following initial laparoscopy of the 15 non-palpable testes, laparoscopy revealed 5 testes to be intra-abdominal (Fig. 5D) and another 5 testes to be just-canalicular (Fig. 3E, 4D). Laparoscopy in three instances revealed the vas and vessels entering an open internal ring which was diagnosed laparo-scopically and proved surgically to be inguinal testes (Fig. 2D). In another 2 testes, the vas and vessels have entered a closed internal ring, they were diagnosed as vanished or atrophic testis in the inguinal canal, hypoplasia of testicular vessels was clearly visualized in one case (Fig. 3F). Excision of testicular remnant in this 2 cases revealed no histological testicular parenchyma.

Table (1): *Shows the results of MRI and laparoscopy compared with surgery in localization of non-palpable testis in the study group.*

Testis position	*MRI*				*Laparoscopy*			
	True		False		True		False	
	+v	-ve	+ve	-ve	+ve	-ve	+ve	-ve
Canalicular	3	2	0	0	3	2	0	0
Just canalicular	5	0	0	0	5	0	0	0
Abdominal	3	0	0	2	5	0	0	0
Total	11	2	0	2	13	2	0	0

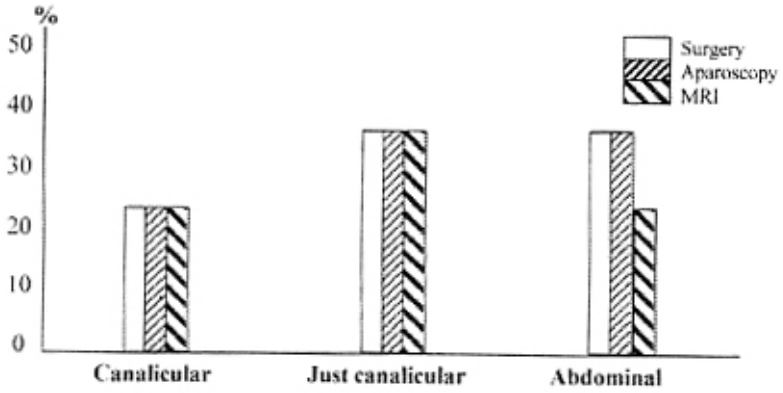

Fig. (1) : *Shows anatomical findings of non-palpable testes diagnosed by open surgery, laparoscopy and MRI*

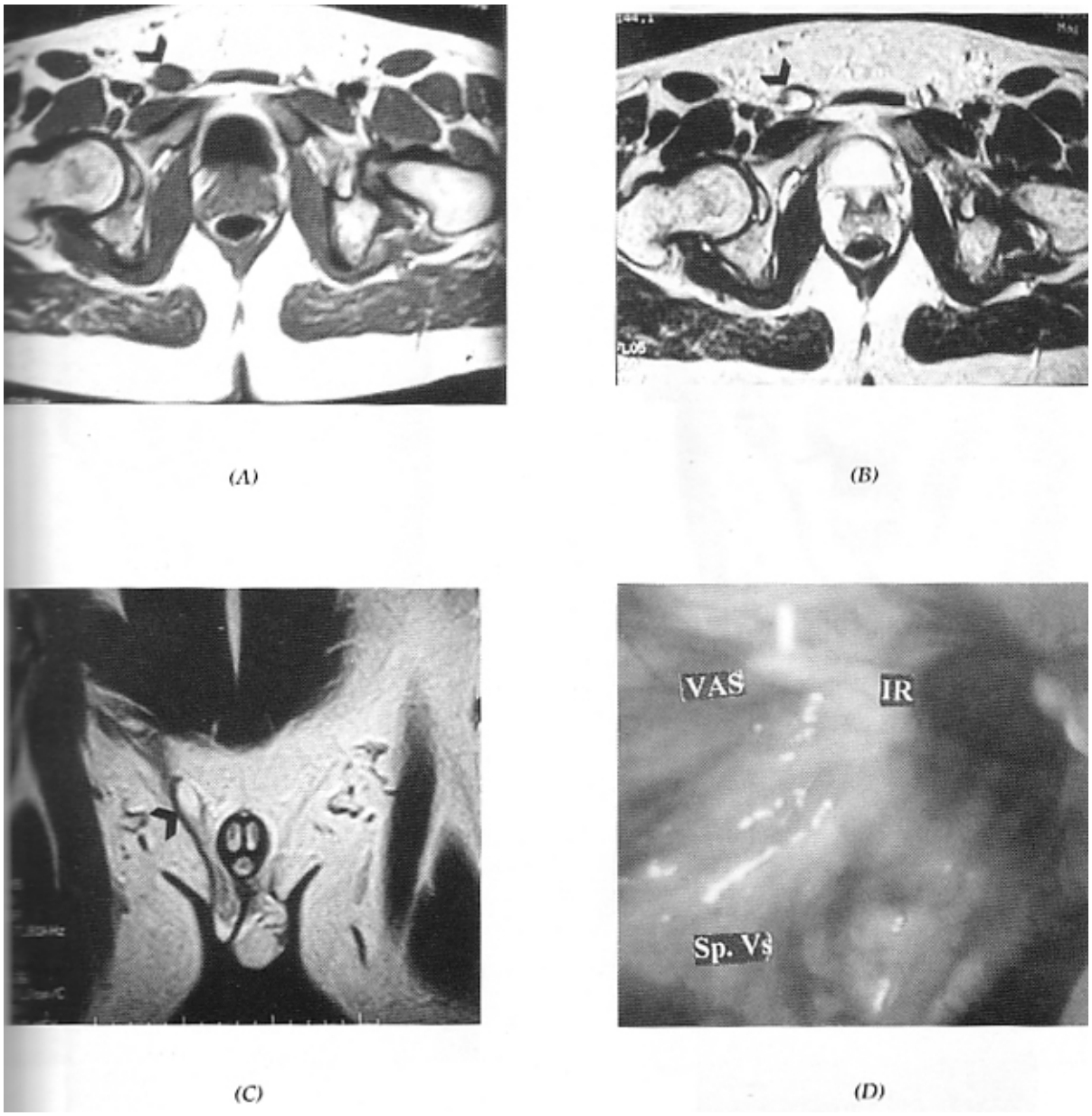

Fig. (2) : ***14 years old obese boy with non-palpable right testis (A) Axial T1-weighted; (B) Axial T2-weighted and (C) Coronal T2-weighted MR images show right globular testis seen in the right inguinal canal associated with right inguino-scrotal hernia. The right testis is hypointense on T1-WI and hyperintense with surrounding black out-line on T2-WI. The mediastinum testis is well seen on axial T2-WI (D) Laparoscopy of the right side showing normal sized vas and testicular vessels entering open internal ring (SP.Vs : Spermatic vessels, VAS : Vas deferens; IR : Open internal ring).***

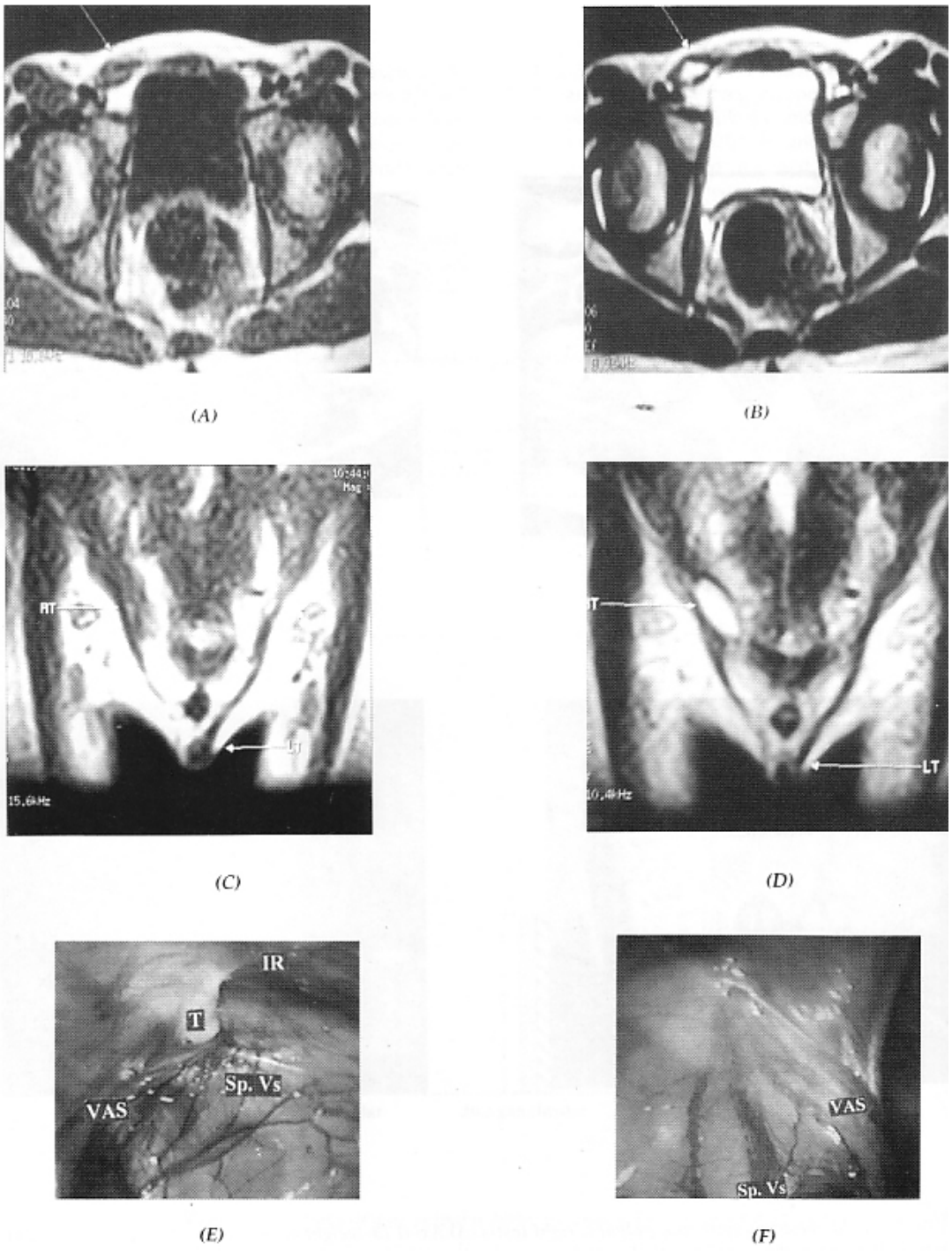

Fig. (3) ***: 7 years old boy with bilateral non-palpable testes (A) Axial T1-weighted; (B) Axial T2-weighted; (C) Coronal T1-weighted and (D) Coronal T2-weighted MR images show oval right testis seen at the right inguinal ring which is hypointense on T1-WI and hyperintense with surrounding black out-line on T2-WI. The left small sized testis (atrophic) is seen in the lower part of the left inguinal canal which is hypointense on both T1 and T2-WI. (E) Laparoscopy of the right side shows the testis partially entering the orifice of the internal ring, (F) Laparoscopy of the left side show hypoplastic vessels entering the internal ring (T : Testis; VAS :Vas deferens; SP.Vs : Spermatic vessels; IR : Open internal ring).***

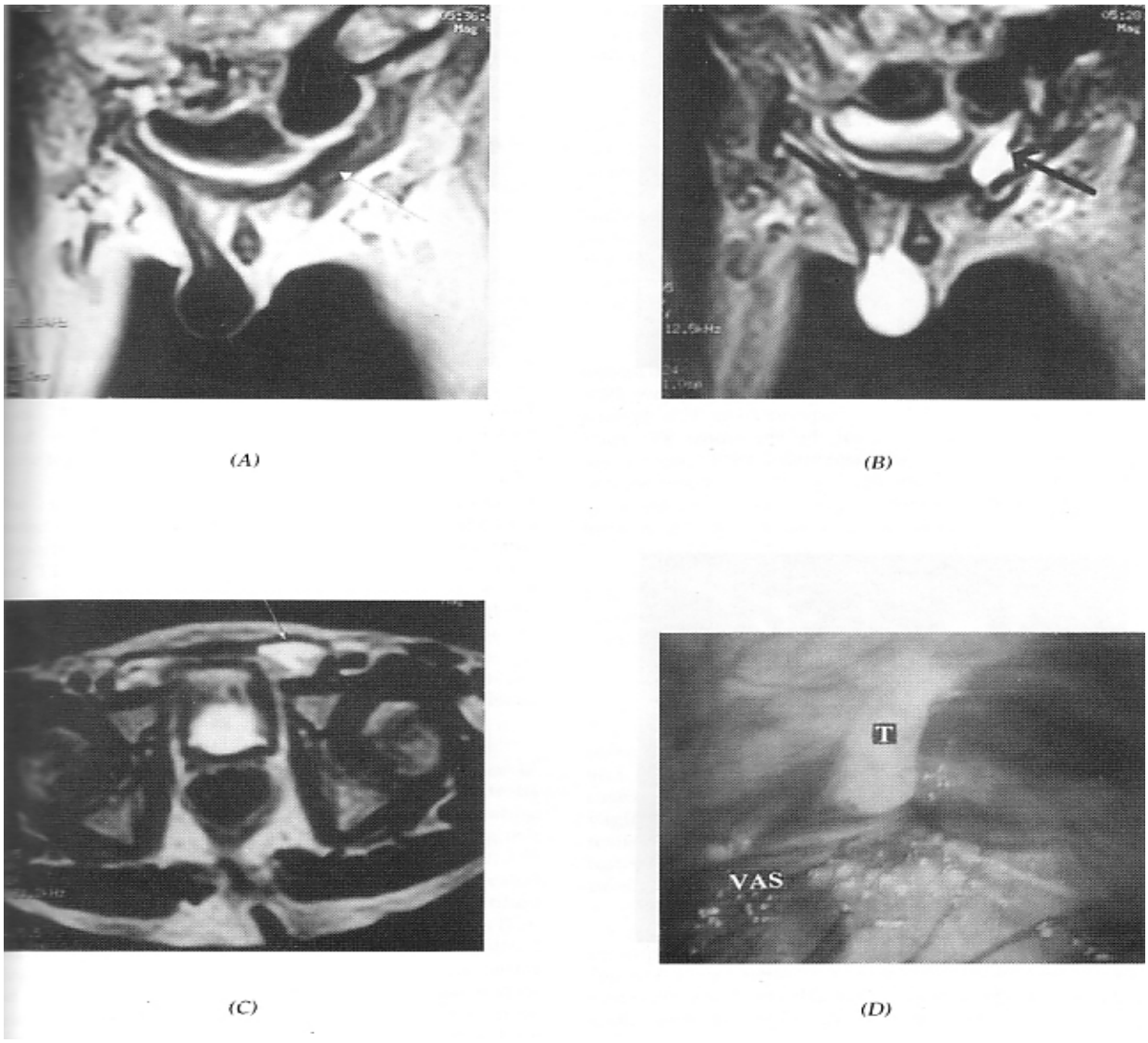

Fig. (4) : ***4 years old boy with non-palpable left testis (A) Coronal T1-weighted, (B) Coronal T2-weighted and (C) Axial T2-weighted MR images show the right testis in the scrotum and the left testis proximal to the left inguinal ring. Both testes were clearly demonstrated by low signal intensity on T1-WI and bright intensity on T2-WI. The mediastinum testis is well seen in axial T2-WI as low signal intensity band through the testis (D) Laparoscopy of the left side shows the testis at the orifice of internal ring (T : Testis, VAS : Vas deferens).***

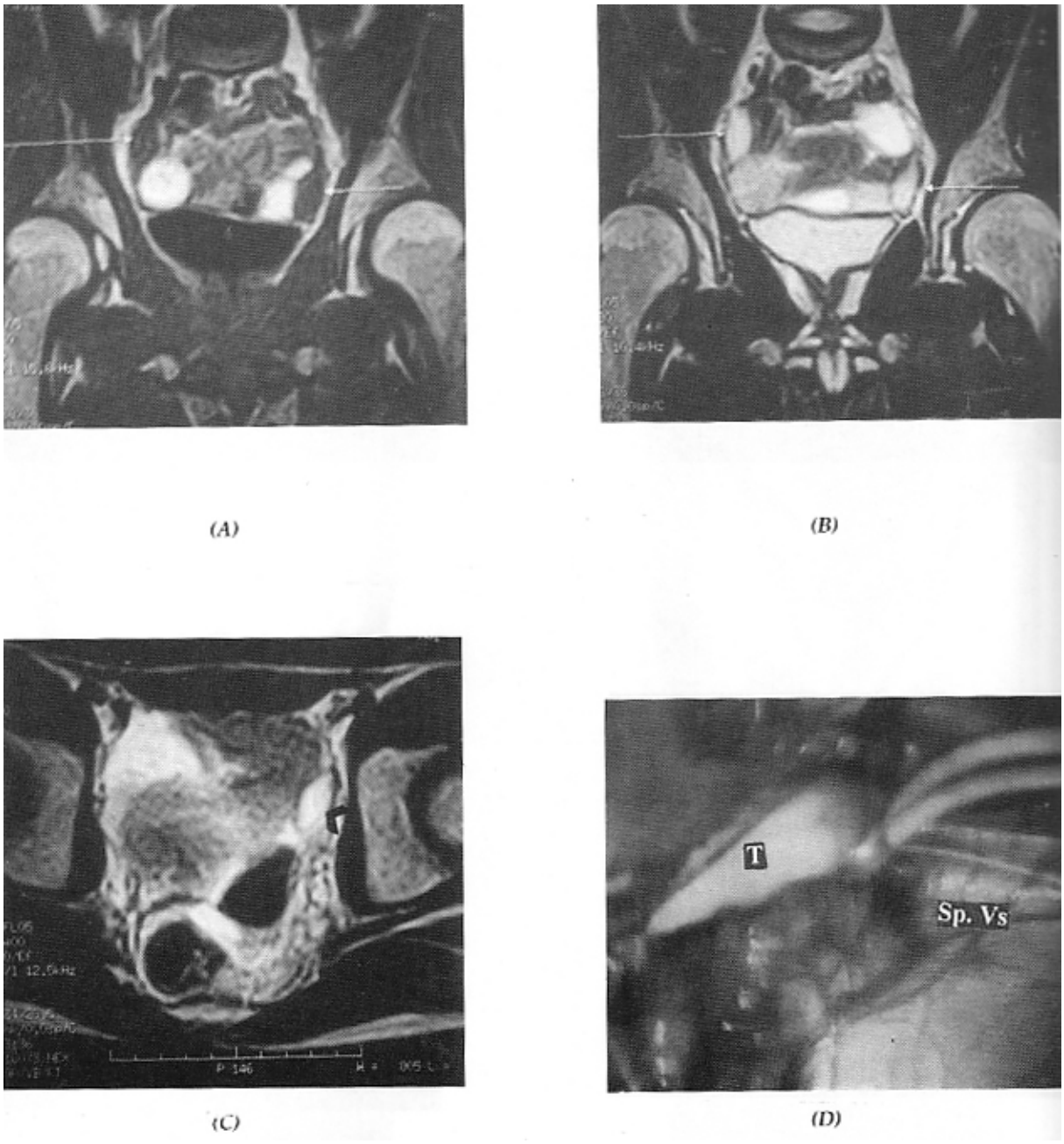

Fig. (5): ***12 years old boy with bilateral non-palpable testis (A) Coronal T1-weighted; (B) Coronal T2-weighted and (C) Axial T2-weighted MR images show both right and left testis intra-abdominal at the sides of the bladder. The right testis is not seen in the axial image because it is obscured with the bowel, but both testes are well seen in coronal images appearing as hypointense on T1-WI and hyperintense with surrounding black out-line on T2-WI. (D) Laparoscopy reveals abdominal testis (T : Testis, SP.Vs : Spermatic vessels).***

DISCUSSION

Thirteen boys with 15 non-palpable testes were included in our study. For each patient, MRI then laparoscopy were performed, all findings were verified by open surgery.

MRI had reached a correct diagnosis in 13 out of the 15 non-palpable testes. Eleven of this 13 testes were shown to have a low signal intensity to fat on T1-weighted images and a high signal intensity or iso-intense to fat with characteristic surrounding black out-line on T2-weighted images.

Similar MRI testicular configuration have been reported by Keir et al.[8] in their prospective study about evaluation of non-palpable testis with MRI of 14 patients with 15 undescended testes, they identified mediastinum testis in 13/16 cases and reported that identification of mediastinum testis provide an improved specificity in diagnosis. In our study, the mediastinum testis was identified in 8/11 cases as a low signal intensity band within the testis.

The value of MRI in tissue characteri-zation is manifested in the other 2/13 cases in which MRI showed small poorly defined testis with low signal intensity on both T1 and T2-weighted images proved to be atrophic after surgical exploration. Fritzsche et al.[11] in their study about the value of MRI in undescended testis had attributed the low signal intensity on both T1 and T2-weighted images to the presence of fibrosis and had reached the following conclusion : MRI has the ability to identify the functional status and tissue characterization of the testis before surgery.

De Filippo et al.[10] in their study on the application of MRI for the pre-operative localization of non-palpable testis in obese children reported that MRI is useful for locating inguinal testis since this type of imaging clearly distinguish testicular from surrounding soft tissues. In our study, 3/3 testes located in the inguinal canal and 5/5 testes located just proximal to the internal ring were correctly identified with MRI. Troughton et al. [9] have a similar results as they studied prospectively 8 undescended testes, they detected 6/6 inguinal and just canalicular testes. The two testes missed in their study were intra-abdominal. Miyano et al.[14] in their study on the value of MRI for localizing the non-palpable undescended testis have explained the high accuracy rate of MRI in detecting intra-canalicular testis by that identification of the remnant of the gubernaculum on coronal images provide a helpful landmark for localizing inguinal testis, which located along the medial border of the remnant. Moreover, as the testis is elliptical when located in inguinal canal, the coronal planes are more sensitive and easier in showing the elliptical configuration. Nguyen et al.[15] added that MRI possesses another advantage as the oblique orientation in the coronal plane and transverse orientation in the axial plane may help distinguish inguinal testis from inguinal lymph node.

In our study, MRI had correctly located the abdominal position in 3/5 testes. MRI failed to demonstrate the abdominal position of non-palpable testis in 2 cases. It seems that MRI failure to show non-palpable abdominal testes was not related to the size of the testis as the 2 testes found at surgery were of average size, but they were high in position. The apparent explanation of this failure may be due to obscuring the testis with bowel loops, as the lack of gastro-intestinal contrast media in MRI makes detection of high intra-abdominal testis very difficult.

Fritzsche et al.[11] in a retrospective study, examined 15 undescended testes. Two were abdominal, a testis missed by MRI was found at surgery to be near the gall bladder fossa. Kier et al.[8] in a prospective study examined 14 patients with 15 undescended testes. Three testes were intra-abdominal, MRI interpretation was able to locate 1 of 3 prospectively and 2 of 3 retrospectively. The false negative occurred in a case of high abdominal testis in which the testis was located adjacent to pelvic kidney.

De Filippo et al.[10] in their study have reported that MRI was useful for locating inguinal testis, but its overall accuracy was from 80-90%, as it was insufficiently sensitive for localizing intra-abdominal testis.

Following initial laparoscopy of the 15 non-palpable testes, laparoscopy revealed 5 testes to be just-canalicular. The diagnosis of canalicular testis was made in three instance according to visualization of a normal sized vessels and vas entering an open processus vaginalis. In another 2 cases, the vas and vessels have entered a closed processus vaginalis, they were diagnosed as vanished or atrophic testis in the inguinal canal. Testicular location of this 10 testes in our study proved by surgery and have prospectively the same MRI diagnosis.

Holcomb[16] in his study on laparoscopy for diagnosis of impalpable testis have found that incomplete descent of the testis was usually associated with a patent processus vaginalis and conversely, closure of the processus vaginalis indicates that complete descent had occurred.

These results are in keeping with other series. Godbole et al.[12] in a review of 86 non-palpable testes found that all 26 absent or vanished testes had a closed processus vaginalis. They attributed testicular absence with vas and vessels entering a closed ring to the occurrence of a vascular accident in the perinatal life following testicular descent.

Laparoscopy in our study was informative regarding testis location in all intra-abdominal cases, compared with MRI which missed 2/5 high intra-abdominal testes.

In a series of 48 children, Humphrey et al.[17] correctly identified intra-abdominal testis in 20 children with 100% diagnostic accuracy. They highlighted the need to inspect thoroughly the posterior peritoneum when the spermatic vessels have not passed through the internal ring.

CONCLUSION

MRI offers a promising opportunity for localization and morphologic estimation of non-palpable testis and should be performed before invasive diagnostic laparoscopy. Whereas positive MRI findings, locates the testis reliably and negative findings needs further laparoscopic evaluation.

We recommended the use of non- invasive, non-ionizing MRI initially for all children with non-palpable testis to locate normal or atrophic testis and limit the use of minimally invasive laparoscopy to patients with negative MRI findings.

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