

ORIGINAL ARTICLE

HIGH RESOLUTION ULTRASONOGRAPHY IN THE LOCALIZATION OF NON-PALPABLE TESTES IN CHILDREN UNDER TWO YEARS OF AGE.

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ABSTRACT

Background:-Most prevailing genitourinary congenital anomaly in male infants is undescended testes, out of which 20% are non-palpable testes. Many studies had been done in the past to ascertain the location of testes with varying results. There was no study done in the past exclusively using high resolution ultrasound in boys under two years of age?

Methodology:-Non-probability consecutive sampling technique was used to collect data in boys with non-palpable testes. Ultrasound was done using high frequency linear array transducer with virtual convex function rather than convex probe or simple linear probe having limited depth and frequency. Either testis was localized or not surgery was performed by surgical team invariably.

Results: - High resolution ultrasound evaluation had an accuracy of 81.9%, sensitivity of 89.4%, and specificity of 75.6%, PPV of 88.4% and a NPV of 77.5% in in the diagnosis of the undescended testis.

Conclusion:- High resolution ultrasound is highly recommended and beneficial in pre surgical evaluation of children with undescended testes because confirm localization of the existence of the testis reassure family and give courage about the early and well time decision about surgery and at the same time guide the surgeon about the extent of surgical exploration determined by the site of the testes.

Keywords:undescended testes, cryptorchidism, sonography,intra-abdominal testes, pre-operative assessment

INTRODUCTION:

Undescended Testes (UDT) also known as Cryptorchidism which is a Greek word and comprised of cryptus = hidden and orchid = testis.¹ Cryptorchidism can be defined as failure of one or both testes to permanently descend into the scrotum.² The UDT remains a significant clinical issue in paediatric population as well as key risk factor for infertility and testicular malignancy in young ones.³ Thus Descent of the testes into the echo friendly

environment of the scrotum constitute an indispensable developmental step on the path toward successful human reproduction.² During embryological development of human beings, there are two separate phases of testicular descent. First phase comprises of enlargement of genito- inguinal ligament or gubernaculum and atrophy of the cranial suspensory ligament at 8 to 15 weeks of embryological life while the 2nd phase needs transfer of gubernaculum and testis to the scrotum from

inguinal region at 25 to 35 weeks of embryo life⁴. Normally testis descends from lower pole of either kidney to the base of scrotum thus an UDT can be found in between this route.⁵ Prevalence of UDT is variable depending upon either the child is born full term 1.0% to 4.6%⁶ or preterm 18–30%⁷. Prevalence reduced to 1–2% within first three months of life spontaneously while it is rare after six months⁸.

Roughly one fifth (20%) of the UDT are NPT^{9,10}. Study by Opeoluwa A showed US has accuracy of 86.5%, sensitivity of 89.8%, and specificity of 33.3%^[11] while systematic review and meta-analysis by Gregory E. showed sonography has a sensitivity of 45% (95% confidence interval [CI]: 29–61) and a specificity of 78% (95% CI: 43–94).^[12]

UDT is linked with inguinal hernia, infertility, and increased probability of testicular tumours.^[13] There are multiple radiological tools to localize the UDT before surgery, namely retrograde venography, computed tomography (CT scan), magnetic resonance imaging (MRI), and USG with variable results^[14,15]. The Abdominoscrotal sonogram appears most useful of all because it is non-invasive, sedative free, without radiation exposure; above all USG is very economical and easily accessible modality in all part of world. In this modern era with latest ultrasound machines and software enhancing the accuracy and capabilities compare to past when only convex probe or just linear probe with limited frequency available. With the advent of high resolution probes having virtual convex function or wide view highly increased the diagnostic capabilities in our experience. In our research, we find the importance of HRUSG in detecting UDT and correlate the results between surgical and sonographic findings.

MATERIALS AND METHODS:

Sample size was calculated by using sample size calculator for sensitivity and specificity by Dr Lin Naing. By Taking statistics of proportion 20%^[10] of undescended testes. Ultrasound has a sensitivity of 89.8%^[11] and a specificity of 78%^[12], at margin of error 10% for sensitivity and 12% for specificity

with confidence interval 95%. The calculated sample size was 126 cases. Non-probability consecutive sampling technique was used to collect data with written as well as verbal consent from the parents / guardian of the child from December 2016 to December 2019 from Paediatrics radiology Department of National Institute of Child Health, Karachi. All boys age of =6 months and =24 months with NPT were included in the research except the boys with prune belly syndrome because almost always they have bilateral UDT located intra-abdominally. Young kids with past history of inguinal surgery like hernial repair or/and orchiopexy were excluded.

USG of all boys were done using high frequency linear array transducer with virtual convex function or wide view (frequencies of 5-15 MHz Toshiba Xario 200. Same team of radiologist and senior sonologist, who had experience (more than 05 years) in this regards has done all the US both in gray scale and colour Doppler mode in the supine position with the legs widely open (frog leg position) and their shoes and pants removed. US of all the younger kids were done in the presence of their parents generally mothers. Scanning region include scrotum, inguinal canal and abdomen in transverse, longitudinal and oblique planes. Testis which appears small well defined round to oval echo poor structure with or without longitudinal echogenic slit like mediastinum. Once testis was localized spectral or power Doppler was used to show the waveform within testicular vessels. We almost always scan every child without fasting preferably a child drinking either milk or water 30 minutes before the scanning because in this way it is very easy to distinguish it from collapsed small bowel loops as well as to avoid gaseous shadows.

Either testis was localized or not diagnostic laparoscopy was performed by surgical team in every case if viable testis was localized then staged Stephen folwers orchiopexy was done. If testis was not found intra abdominally and internal inguinal ring was open and spermatic cord seen then inguinal exploration was performed regardless of the

sonographic findings.

RESULTS:

126 boys with undescended testes were studied (82 unilateral, 44 bilateral), 100% of the testes were non-palpable. Eighty-five (67.5%) testes were localized pre-operatively by ultrasound. On pre-operative ultrasound the testes, 68 (53.96%) of the undescended testes were visualized within the inguinal canal, 17 (13.5%) were intra-abdominal while 41 (32.5%) were not seen. On the total, 69 (54.8%) of the undescended testes were found within the inguinal canal, 17 (13.5%) were intra-abdominal while 30 (23.8%) were not seen per operatively. [Table.1] Ultrasound evaluation had an accuracy of 81.9%, sensitivity of 89.4%, and specificity of 75.6%, PPV of 88.4% and a NPV of 77.5% in the diagnosis of the undescended testis. [Figure 1]

DISCUSSION:

John Hunte, a British Anatomist in 1786 first time described the process of descent of testis when he dissected the human fetus. Intra-abdominal testis connected to the inguino-abdominal wall through a ligament known as the gubernaculum.^[16] Testis itself emerged from the urogenital ridge in the coelomic cavity. It begins its journey from inguinal canal towards scrotal base approximately at 36 weeks of gestation.^[17]

When the testicle not decent to the base of scrotum from lower pole of kidneys it is known as Cryptorchidism.^[5] Etiology of Cryptorchidism is multifactorial but exact mechanisms unknown, however research and clinical observations able to identify few of the causes which are hereditary, hormonal, anatomic and environmental in Origin^[13]. In 60–70% of cases it appears unilateral and nearly 20–30% of UDT are NPT on physical examination.^[18] Gearhart JP described four likely explanations for this process. First, either the testis located in the scrotum or inguinal canal is small in size or it is not palpable due to the large amount of fat/adipose tissue, second testis placed in the open processus vaginalis, however it moves to and fro intermittently from abdomen to inguinal region (peeping testis) or

vice versa, third testis position in abdomen truly and fourth testis is absent.^[19] It is well known fact UDT is associated with testicular malignancy with more risk when it lies intra-abdominally,^[20] surgery later in life associated with higher risk of testicular cancer^[21] thus in our study we primarily focus the young kids of age =6 months and = 48 months. Researchers classified UDT in various ways. The simplest classification is NPT and UDT.^[22] Other classified NPT as either absent or vanishing testes (20–40%) which occur due to vascular event in embryological life.^[23] Other classified as open-ring or/ closed-ring variety.^[22]

There are various radiological investigations available to localized NPT before surgery namely retrograde venography, computed tomography (CT scan), Angiography, magnetic resonance imaging (MRI) and USG. Retrograde venography was used in the past to localize UDT as well as to see its viability. The concept behind this procedure was that atrophic testis will have reduced blood vessels while the normal testis will have normal vascular pattern but the drawback of this is that it is an invasive procedure and requires general anaesthesia as well as it is not accurate. On the other hand CT scan and MRI appears good in accuracy in localizing testis but they are costly, not easily available, need either deep sedation or general anaesthesia in kids and at the same time not 100% accurate in localizing UDT. CT scan and angio both used radiation and needed much expert hand compare to HRUSG which is easily available with negligible price and much accuracy.^[24-26]

Sensitivity, specificity, NPV, PPV and accuracy is different for the localization of NPT in literature when comparing with laparoscopic findings. When we compare our study results with the research by AL_Janabi YI^[27] there is significant difference in specificity and NPV of detecting NPT. AL_Janabi YI mention specificity and NPV of 0%^[27] while our study showed Specificity of 75.6% (95% CI; 59.7% to 87.6%) and NPV of 77.5% (95% CI; 64.5% to 86.7%) Further he also mentions the sensitivity of 80% and diagnostic accuracy of 70%

[27] compare to our study results which showed Sensitivity of 89.4% (95% CI; 80.9% to 95.0%) and Accuracy of 81.9% (95% CI; 77.5% to 90.7%). Research by Tasian GE showed sensitivity of US in detecting NPT is 45% and specificity of 78%.^[28] on the other spectrum of Research by Vijayaraghavan SB showed USG had a sensitivity of a 97.9% for localizing UDT^[29] study by Kanemoto K showed sensitivity of 76%, a specificity of 100% and accuracy of 84% in detecting UDT^[30].

These controversial results or opinion in literature regarding the accuracy of USG and our interest in research and education as well as need to interact with different paediatric surgeons, residents, urologist, and general practitioners regarding the guidelines and benefits of timely done surgeries as well as potential risk of delaying the intervention thus increase the early and timely placed referral. Moreover long term follow up studies are required to know about the fertility or subfertility status also

about the development of testicular malignancy later in life.

CONCLUSION:

High resolution ultrasound is highly recommended and beneficial in pre surgical evaluation of children with undescended testes because confirm localization of the existence of the testis reassure family and give courage about the early and well time decision about surgery and at the same time guide the surgeon about the extent of surgical exploration determined by the site of the testes.

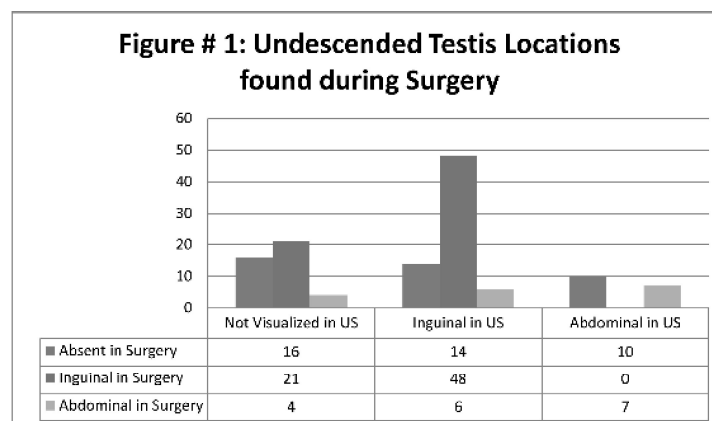
ABBREVIATIONS:

High resolution ultrasound (HRUS), ultrasonography (USG), Ultrasound (US),

Non-palpable testes (NPT), undescended testes (UDT), Positive predictive value (PPV). Negative predictive value (NPV)

Table 1. Ultrasound and surgical findings of undescended testes.

US findings	Surgical findings		Total	Diagnostic accuracy (95% CI)
	Yes	No		
Yes	76	9	85	Sensitivity= 89.4% (95% CI; 80.9% to 95.0%) Specificity= 75.6% (95% CI; 59.7% to 87.6%) PPV= 88.4% (95% CI; 81.5% to 92.9%) NPV= 77.5% (95% CI; 64.5% to 86.7%) Accuracy= 81.9% (95% CI; 77.5% to 90.7%)
No	10	31	41	
Total	86	40	126	



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