Sensitivity And Specificity Of Ultrasound In Detection And Localization Of Undescended Testes

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Abstract

Isolated cryptorchidism (undescended testis) is one of the most common congenital anomalies found at birth and affects upward of 3% of full-term male newborns[1] and approximately 0.8% of infants at one year old.[2] Men with a history of an undescended testis are at risk for infertility and testicular tumors. There is controversy as to the diagnosis when a clinical examination fails to identify a testis.[3] In this prospective study ultrasound evaluation was compared to clinical examination and operative finding in 33 children in whom a testis was not present in the scrotum. The aims of this study were to detect the sensitivity and specificity of ultrasound in the diagnosis of undescended testis, and evaluate the correlation between the preoperative ultrasonographic data and operative findings. Forty-one boys (age: 6months -14years) with undescended testes were examined between June 2007 and December 2010. A testis was clinically palpable(not in the scrotum) in 33 of these children and not palpated in 8. All the boys had undergone a sonogram performed for detection and localizing the undescended testes. Only 33 boys were sent for inguinal exploration, or other surgical procedures for localizing the undescended testes. We calculated specificity, sensitivity, positive predictive value (PPV), negative predictive value (NPV), and the accuracy of ultrasonographic diagnosis in boys with undescended testes. Thirty-three boys with undescended testes were examined clinically and ultrasonographically followed by surgical exploration and included in this study. Ultrasonography had a sensitivity of 80%, a specificity of 0%, PPV of 92.4%, NPV of 0%, and accuracy of 70.2% in the diagnosis of the undescended testis. Conclusions: The sensitivity and specificity including NPV of uetrasound had the unsatisfactory outcomes.

Keywords: sensitivity , specificity, pediatric, testis, ultrasound, undescended

Introduction

An undescended testis can be located anywhere between the abdominal cavity and just outside the anatomic scrotum. Less commonly, the testis can also migrate to ectopic positions outside the scrotum, not along the normal path of descent. Cryptorchidism is a term that has been used interchangeably with the term undescended testis. Both terms refer to an abnormally positioned testis, but
cryptorchidism literally means “hidden testis.” Therefore, an undescended testis may be a more appropriate term because most testes that are not within the scrotum at birth are detectable by palpation. [1]

Isolated cryptorchidism is one of the most common congenital anomalies found at birth and affects upward of 3% of full-term male newborns[1] and approximately 0.8% of infants at one year old [2]. The higher frequency of undescended testes in premature infants is largely related to birth before the completion of testicular inguinoscrotal migration. This normally begins in the 28th week of pregnancy and is not typically complete until 40 weeks of gestation [4]. Scorer and Farrington (1971) reported a 30.3% incidence of undescended testes in premature infants. Many other studies have confirmed similar results in preterm male infants less than 37 weeks' gestation and weighing less than 2500 g. Although most are commonly found unilaterally, two undescended testes are found in nearly 10% of patients [5].

Men with a history of an undescended testis are at risk for infertility and testicular tumors[6]. The incidence of infertility is only slightly increased in cases of unilateral cryptorchidism, but is 40-70% in men with a history of bilateral undescended testis. There is circumstantial evidence to suggest that early orchidopexy (at 6-12 mo of age) may improve ultimate fertility. The risk of testicular cancer in men with a history of cryptorchidism is 5-10 times that in the general population. This increased risk is greater for intraabdominal than for inguinal testes. There is no direct evidence that orchidopexy reduces the tumor risk, but it puts the testicle in a location where tumors are more easily palpated and therefore detected earlier. All men with a history of an undescended testis should perform routine testicular self-exam after puberty.(1)

Approximately 20% of undescended testes are non-palpable on physical examinations [6]. In the group of non-palpable testes, approximately 50% are abdominal, 45% are atrophic, and only 5% are in the inguinal canal [7, 8]. The atrophic testis is known as the vanishing testis, and is usually in the inguinal canal. An intra-abdominal testis is usually located just inside the internal ring, commonly within a few centimeters, although intra-abdominal testes have been observed anywhere along a line between the lower pole of the kidney and the internal ring[2].

There is currently controversy as to the diagnosis when a clinical examination fails to identify a testis[9]. Ultrasound is the most common diagnostic imaging study. This study employs the evaluation of undescended testes for several reasons[10]. These are that most undescended testes lie within the inguinal canal and are
therefore readily accessible for evaluation, there is non-ionizing radiation, and the technology is portable and widely available[11].

**The objective of this study:** To identify the Sensitivity And Specificity of ultrasound in the diagnosis of undescended testes, and evaluate the correlation between the preoperative ultrasonographic data and the operative findings.

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**Materials and methods**

Data were collected prospectively between June 2007 and December 2010 of 41 boys under the age 14 years. The boys had been physically examined for identification of undescended testes and whether the testes are palpable or not and to identify and exclude the boys with retractile testes. We excluded those boys with retractile testes and those who had had a previous inguinal surgical procedure such as a hernia repair or orchidopexy. Only 33 boys were sent for inguinal exploration, or other surgical procedures for localizing the undescended testes. Nine boys had bilateral undescended testes, and 20 boys had a unilateral undescended testis. All boys had undergone a sonogram performed for localizing the undescended testes. The examination was performed by a radiologist or the resident in radiology under radiologist control.

An undescended testis appears hypoechoic and may be round or ovoid depending upon location. The mediastinum testis was identified for confident diagnosis (see Fig 1).

We used a two-by-two table for calculating specificity, sensitivity, positive predictive value (PPV), negative predictive value (NPV), and the accuracy of ultrasonographic diagnosis in boys with undescended testes.

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**Results**

An undescended testis is defined as a testis that has become arrested in its descent through the normal pathway. This is distinguished from the rarer ectopic testis, which is a testis that has deviated from the normal pathway of descent. The most common location for undescended testes is the inguinal canal. Other sites include the high scrotum, pubic tubercle, superficial inguinal pouch, and the abdomen.

Ectopic testicles may be found in the femoral canal, perineum, prepubic space, or the contralateral scrotum. Because most undescended testes are located in the inguinal canal, they can be evaluated on clinical exam. Impalpable testes present a more challenging problem and require a more extensive evaluation.(1)

Our results of the preoperative ultrasonic evaluation and surgical findings of 33 undescended testes are shown in Table 1. Twenty-six boys had positive ultrasound findings. Of these, twenty-four testes were located within the inguinal canal, and two testes were found in the scrotal sac.
The other seven testes were not found by ultrasound. Of the 26 testes that were found by ultrasound, there was one false positive result, in which the ultrasonic examination revealed a testes placed in the inguinal canal. In breaking down further the location of the testes, the 24 testes found by ultrasound in the inguinal canal were found during the surgical exploration as 19 inguinal testes, four abdominal testes, and one negative surgical findings. The two scrotal testes by ultrasound were found as one inguinal testes and one scrotal testis. Of the seven ultrasound-negative results, two testes were in inguinal canal, and five testes were located in the abdomen. (Table 2).

Based on this, using the two-by-two table, the ultrasound had a sensitivity of 80%, a specificity of 0%, NPV of 0%, PPV of 92.4% and an accuracy of 70.2% in the diagnosis of undescended testes.

Discussion

Approximately 80% of undescended testes are clinically palpable and 20% are nonpalpable. Looking more closely at children with nonpalpable testes, Cisek et al (1998) reported that 18% of these testes could be palpated during physical examination under anesthesia and 12.6% of viable testes discovered at exploration were distal to the inguinal canal and simply missed on physical examination. Between a third and two thirds of children with a nonpalpable testis will be monorchid (1).

Many studies have investigated the value of ultrasound in the diagnosis of undescended testes. There have been 13 studies evaluating the usefulness of ultrasound in undescended testes. However, their conclusions are far from unified. In fact, some authors recommended ultrasound for its feasibility and potential to settle the subsequent operative procedure [12-18]. Others are skeptical because they observed a poor outcome for non-palpable testis and the necessity for laparotomy were not excluded by ultrasound [10, 19-21]. Most of the studies included only a small group of patients [12, 16-17, 19, 20]. The study by Sagrid MP Nijs et al. [11] included the largest group of patients (about 152 testes) and suggested ultrasound as the first modality to evaluate nonpalpable testes in boys for determination of the location to facilitate planning the surgical procedure. Most studies compared ultrasound results with the operative findings [10, 13-15, 17-18]. Others compared computed tomography and/or magnetic resonance imaging with ultrasound [12, 16, 21]. The sensitivity and specificity including accuracy of ultrasound is different among these studies.

In our study, seven testes in a group of negative ultrasounds were localized as five abdominal testes, and one atrophic testis. This corresponds to previous studies that showed 50% of clinically
undescended testes as abdominal testes and 45% as atrophy [10, 11]. In two abdominal testes, ultrasound located them deep in the inguinal canal, which could be sliding between deep inguinal ring and intra-abdomen. The same postulation occurred for one inguinal testis that the ultrasound showed it in a high scrotal sac. Only one false positive result was ultrasonically located in the inguinal canal, which could be a lymph node enlargement, as shown in Fig. 2.

The feasibility of ultrasound, non-ionizing radiation, and portability may convince us to recommend ultrasound for the first modality in the diagnosis of undescended testes. However, the present results of sensitivity and specificity showed unsatisfactory outcomes. Seven false negative results of laparotomy or inguinal exploration in our study should not be omitted even if the ultrasound shows the absence of testis.

In conclusion, the sensitivity and specificity including NPV of ultrasound had an unsatisfactory outcomes.

References
11. Nijs SM, Eijsbouts SW, Madern GC, Leyman PM, Lequin MH, Hazebroek FW. Nonpalpable testes: is there a relationship between ultrasonographic and


<table>
<thead>
<tr>
<th>Table 1. Ultrasound and surgical findings of 33 undescended testes.</th>
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<tbody>
<tr>
<td>Ultrasound positive</td>
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<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Ultrasound positive</td>
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<tr>
<td>Ultrasonegative</td>
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<tr>
<td>Total</td>
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Table 2. Findings of ultrasound and surgical exploration in boys with undescended testes.

<table>
<thead>
<tr>
<th>Ultrasoundographic locations</th>
<th>Surgical locations</th>
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<tbody>
<tr>
<td>7 testes (not visualized)</td>
<td>2 inguinal testes (1 atrophic)</td>
</tr>
<tr>
<td></td>
<td>5 abdominal testes</td>
</tr>
<tr>
<td>24 inguinal testes</td>
<td>1 absence on surgery</td>
</tr>
<tr>
<td></td>
<td>19 inguinal testes</td>
</tr>
<tr>
<td></td>
<td>4 abdominal testes</td>
</tr>
<tr>
<td>2 scrotal testes</td>
<td>1 inguinal testis</td>
</tr>
<tr>
<td></td>
<td>1 high scrotal testis</td>
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Fig. 1 Ultrasonic imaging of a one-year old boy with an undescended testis. This image shows normal size, oval-shaped hypoechoic testis with thin central hyperechoic line, representing a mediastinal testis (indicated by arrow) located in the inguinal canal.
Fig. 2 Ultrasonic image of a one-year old boy with an undescended testis. 1.7-cm hypoechoic lesion in the right inguinal canal are shown by ultrasound. After inguinal exploration, the absence of right testis in the inguinal region is noted. This suggests that this hypoechoic lesion could be an inguinal node.