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Role of Ultrasonography in Diagnosis of Contralateral Patent Processus Vaginalis in Clinically Diagnosed Unilateral Inguinal Hernia in Pediatrics

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Abstract

Background: In children with unilateral inguinal hernia, there is a debate about exploration of the contralateral side. Herniography, diagnostic pneumoperitoneum, and intraoperative laparoscopy are the procedures that have been proposed to reduce the number of negative contralateral side explorations in children presenting with a unilateral congenital inguinal hernia. However, most of them are invasive methods. In our study we suggest using the ultrasonography (US) in detection of the inguinal hernia with confirmation by laparoscope.

Aim: The aim of this study is to assess the Sensitivity and specificity of US in the diagnosis of occult hernia after confirmation by laparoscopy.

Patients and methods: This study is considered an interventional prospective study that was done on 100 children with unilateral inguinal hernia. All patients underwent US on both groins. US was considered positive if the length of patent processus vaginalis was more than 20 mm or the internal ring diameter was more than 4 mm. After the US, all patients were prepared for laparoscopic exploration to confirm the hernia diagnosis, and to treat the clinical hernia.

Results: By comparing the US and laparoscopic results of symptomatic sides, this study found that all cases that were diagnosed by the US to be positive were confirmed by laparoscopy. In asymptomatic sides, from 9 cases who were diagnosed by the US as positive hernia; the laparoscope confirmed them. However, from 91 cases that were diagnosed by the US to be negative, the laparoscope diagnosed one of them to be positive. The sensitivity and specificity of the US were found to be 100% in the symptomatic side. However, in the asymptomatic side; sensitivity, and specificity were 90, 100%, respectively.

Conclusion: US is a good tool for the diagnosis and early detection of pediatric hernias.

Keywords: Inguinal hernia, Laparoscopy, Patent processus vaginalis, Ultrasonography

1. Introduction

A hernia is when an organ, like the bowel, pushes through the wall of the space where it currently resides. Pediatric hernias are common birth defects that can happen in the umbilical, epigastric, and groin areas.¹ The overall rate of inguinal hernia is between 0.8 and 5% in full-term babies and up to 30% in babies born early or with a low birth weight.² A congenital inguinal hernia

happens when the proximal processus vaginalis does not close up properly. This lets fat, bowel, or other organs move into the processus and the inguinal canal around it. In women, the canal of Nuck is the same thing as the vaginal process. In most cases, a hernia will manifest as a bulge in the groin, but in boys, it may manifest as scrotal enlargement that is only apparent when they strain or cry.³ The gold standard for the treatment of congenital hernia is an open herniotomy. However,

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over the past two decades, minimally invasive surgery has posed a challenge to conventional surgery in terms of cosmetic outcomes and quick recovery.⁴ In children with unilateral or recurrent inguinal hernia, there is a debate about exploration of the contralateral side.^{5,6} However, due to the high prevalence of contralateral patent processus vaginalis (PPV) and associated hernia risk, contralateral groin exploration has been standard practice among pediatric surgeons for nearly 50 years.⁷ Herniography, diagnostic pneumoperitoneum, intraoperative laparoscopy, and ultrasonography (US) are only few of the procedures that have been proposed to reduce the number of negative contralateral side explorations in children presenting with a unilateral congenital inguinal hernia.⁸ Benefits of the laparoscopic inguinal hernia repair include, good cosmetic outcomes, great visual exposure, no trauma to the intraabdominal structures, and no substantial dissection of spermatic vessels and vas deferens.⁹ US is so widely available, noninvasive, reliable, convenient, and easily performed screening technique for inguinal hernias in infants and children. It can also decrease the time of diagnosis, provide prognostic information, and use to perform the therapeutic intervention. It can provide up to 100% accuracy rate for preoperative diagnosis of direct inguinal hernia, which could be misdiagnosed by clinical examination.¹⁰

So, this study aims to assess the sensitivity and specificity of the US in the diagnosis of occult hernia in comparison to laparoscopic assessment.

2. Patients and methods

This study is considered an interventional prospective study that was done on 100 children with unilateral inguinal hernia, between October 2021 and August 2022 in the department of Pediatric Surgery (Al-Azhar University, Egypt). Our research adhered to the principles of the Helsinki Declaration. The Faculty of Medicine (Al-Azhar University) Institutional Review Board gave us the ethical approval. We included the patients after taking informed consent. The inclusion criteria of the cases were, Age; 1–14 years, children with unilateral inguinal hernia situated for laparoscopic hernia repair. The exclusion criteria were, patients with clinically bilateral inguinal hernia, patients with a previous major abdominal operation, Recurrent inguinal hernia, patients with a unilateral inguinal hernia but with a history of surgical exploration of the contralateral groin, and patients with concomitant undescended testis or hydrocele. Full medical history taking, general examination,

and groin examination were done to all patients during the enrollment. Then, all patients underwent an US on both groins. Using a detector (10 MHz), a specialized urogenital radiologist performed the US. US was considered positive if the length of patent processus vaginalis was more than 20 mm or the diameter of the internal ring was more than 4 mm. US features were fluid, or viscera. After the US, all patients were prepared for laparoscopic exploration to confirm the hernia diagnosis, and to treat the clinical hernia. A five (mm), 30 angled telescope was inserted through or above the umbilicus. We also maintained a pneumoperitoneum at a pressure of 8 mmHg. Then, the unilateral clinical hernia was confirmed and repaired by peritoneal disconnection with ligation of the proximal hernial sac, and the contralateral side was assessed.

Data analysis was done using the SPSS version 26. Continuous data were examined for its normality by using the Kolmogorov-Smirnov test. Continuous data were described as mean \pm SD. Categorical data were described as absolute frequencies (N) with percentages (%). Categorical data were compared using the χ^2 test.

3. Results

Our study included 100 patients with clinically unilateral hernia. **Table 1** describes the US, and laparoscopic findings of the studied patients on both sides either symptomatic or asymptomatic. On the symptomatic side; 100% were diagnosed to be positive by the US, and confirmed by the laparoscope. On the asymptomatic sides; the US diagnosed 9 patients with a hernia (8 right, and 1 left) and excluded 91 patients (33 right, and 58 left), however, the laparoscopy confirmed 10 asymptomatic sides with a hernia and excluded 90 sides. According to the age categories of the patients, we found that male percentages were more than female in all categories. 63 and a half percent (63.5%)

Table 1. Ultrasound and laparoscopic features of the studied patients.

| Variables | Symptomatic side | Asymptomatic side |
|----------------------------|------------------|-------------------|
| Ultrasound features (N %) | | |
| Viscera | 78 (78%) | 1 (1%) |
| Fluid | 22 (22%) | 9 (9%) |
| None | 0 | 90 (90%) |
| Ultrasound results (N %) | | |
| Positive | 100 (100%) | 9 (9%) |
| Negative | 0 | 91 (91%) |
| Laparoscopic results (N %) | | |
| Positive | 100 (100%) | 10 (10%) |
| Negative | 0 | 90 (90%) |

of the included males were in the age category 1–5 years, and 76.9% of the included females were in the same age category. However, only 5 males and 1 female were present at the age of greater than 12 years, with no significant association between the gender and Age category (P value = 0.45). Also, we found no significant association between the side of the symptoms, and the gender (P value = 0.2). As regards the US findings, the most prevalent finding on symptomatic sides was the presence of viscera which was present in 78% of the patients (43 right sides and 35 left sides), with no significant association between the US findings and the side of symptomatic hernia (P value = 0.12). However, on the asymptomatic side, we found that one patient had viscera on the right side, 9 patients had fluid (7 on the right side, and 2 on the left side) with a significant association between the US findings and the side of asymptomatic hernia (P value = 0.02) (Tables 2 and 3). By comparing the US and laparoscopic results on the symptomatic sides, we found that all cases that were diagnosed by the US to be positive were confirmed by laparoscopy, (Table 4). In the asymptomatic side, from 9 patients who were diagnosed by the US with a positive hernia; the laparoscope confirmed them. However, from 91 cases that were diagnosed by the US to be negative, the laparoscope diagnosed one of them to be positive (Table 5) (Fig. 1). The sensitivity and specificity of the US were found to be 100% in the symptomatic side. However, in the asymptomatic side; sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were found to be 90, 100, 100, 98.9, and 99%, respectively (Table 6) (Fig. 2). Finally, we calculated the sensitivity, specificity, and accuracy of the US in diagnosing the hernia on both sides, and were; 99.09, 100, and 99.5%, respectively.

4. Discussion

Inguinal hernias are one of the birth defects that pediatric surgeons see most often. Our study

Table 2. Association between ultrasound features, and side of the symptoms.

| | Side of symptoms. N (%) | | | P value |
|--------------------|-------------------------|----------|----------|------------------|
| | Right | Left | Total | |
| US features. N (%) | | | | |
| Viscera | 43 (43%) | 35 (35%) | 78 (78%) | 0.1 ^a |
| Fluid | 16 (16%) | 6 (6%) | 22 (22%) | |
| Total | 59 (59%) | 41 (41%) | 100 | |

Data represented as number and percentage (number = percentage).

^a Chi square test.

Table 3. Association between the ultrasound features, and Asymptomatic side.

| | Asymptomatic Side. N (%) | | | P value |
|--------------------|--------------------------|----------|----------|---------------------|
| | Right | Left | Total | |
| US features. N (%) | | | | |
| Viscera | 1 (1%) | 0 | 1 (1%) | 0.02 ^{a,b} |
| Fluid | 7 (7%) | 2 (2%) | 9 (9%) | |
| None | 33 (33%) | 57 (57%) | 90 (90%) | |
| Total | 40 (40%) | 59 (59%) | 100 | |

Data represented as number and percentage (number = percentage).

^a Chi square test.

^b Significant P value.

included 100 patients with clinically unilateral inguinal hernia. In our study, we found that 59% of symptomatic hernias were on the right side, and 41% were on the left side. This is in line with the result of Ohkura and colleagues,¹¹ predominance of the inguinal hernias on the right side because of a combination of factors including a neuromuscular damaging abdominal incision, physiological asymmetry of the body's musculature, and anatomical differences between the two sides of the inguinal canals Bradley and colleagues.¹² In a study done by Wang and colleagues,¹³ who included 12 190 patients with inguinal hernia, found that 87.3% of the cases were unilateral and 12.7% were bilateral. This finding is similar to ours as we found that 91% of our confirmed cases were unilateral and 9% were bilateral. In bilateral cases, we found 6 males and 2 females, which disagrees with the finding of Pan and colleagues,¹⁴ who reported that bilateral inguinal hernia is more common in females than males, this disagreement may be due to that our sample is small and the accurate incidence needs larger sample size. According to the content of the hernia, 78% of our patients had viscera, and others had fluid. This is in agreement with the finding of Ohkura and colleagues.¹¹ For the clinician, when caring for patients with an inguinal bulge, it is critical to appropriately identify the hernia contents in order to establish an appropriate treatment strategy. As regards the US results, we used the Toki

Table 4. Comparison between the ultrasound and laparoscopic result of symptomatic sides of the studied patients.

| | Laparoscopic result of symptomatic sides. N (%) | | |
|--------------------------------------|---|----------|------------|
| | Positive | Negative | Total |
| US result of symptomatic sides N (%) | | | |
| Positive | 100 (100%) | 0 | 100 (100%) |
| Negative | 0 | 0 | 0 |
| Total | 100 | 0 | 100 |

Table 5. Comparison between the ultrasound and laparoscopic result of asymptomatic sides of the studied patients.

| | Laparoscopic result of asymptomatic sides (n) | | Total |
|--|---|----------|----------|
| | Positive | Negative | |
| US result of asymptomatic sides. N (%) | | | |
| Positive | 9 (9%) | 0 (0%) | 9 (9%) |
| Negative | 1 (1%) | 90 (90%) | 91 (91%) |
| Total | 10 (10%) | 90 (90%) | 100 |

and colleagues,¹¹ criteria for determining the US results, it was considered positive if the length of patent processus vaginalis was more than 20 mm or the diameter of the internal ring was more than 4 mm. On symptomatic sides; the US diagnosed 99% of them as positive cases, however, on the asymptomatic side, it diagnosed 7% of them as positive and 93% as negative. The laparoscopic results showed that 99% of the symptomatic sides were positive hernia and only 1% was negative, however in the asymptomatic side it diagnosed 8% of them positive cases and 92% as negative cases. In our study, the US sensitivity and specificity in a symptomatic side were found to be 90%, and 100%, respectively, it was high as the US was done by a urogenital specialist. This result is similar to the finding of Bradley and colleagues,¹⁵ who reported US sensitivity was 100% with 100% specificity. In a systematic review and meta-analysis that was done by Robinson and colleagues,¹⁶ they found that US has a sensitivity of 86% and a specificity of 77% in

Table 6. Diagnostic values of the US results in asymptomatic sides.

| US test | Overall value |
|-------------------------------|---------------|
| Positive predictive value (%) | 100% |
| Negative predictive value (%) | 98.9% |
| Sensitivity (%) | 90% |
| Specificity (%) | 100% |
| Accuracy | 99% |

occult inguinal hernias. This study and Ozgur and colleagues,¹⁴ study agree with our conclusions. Another systematic review and meta-analysis by Piga and colleagues,¹⁵ compared the sensitivity and specificity of different imaging modalities (Computed tomography (CT), MRI, and US) in the diagnosis of the inguinal hernia, and he found that the US had the highest specificity, and sensitivity. Young and colleagues¹⁶ reported that the US can delineate the layers of muscle and fascia of the abdominal wall. Real-time US technology lets doctors see the inguinal canal, so they can see how the muscles move and how hernias move down and through the defect, separating the anterior layer of the external oblique from the inguinal canal floor. Also, adding color-flow Doppler to see the deep epigastric and femoral blood vessels can help to differentiate between the direct and indirect hernias. The US can also differentiate between the fluid-filled masses and real hernias in people with cirrhosis. It can also find epigastric hernias in overweight people, as well as umbilical and Spigelian hernias.

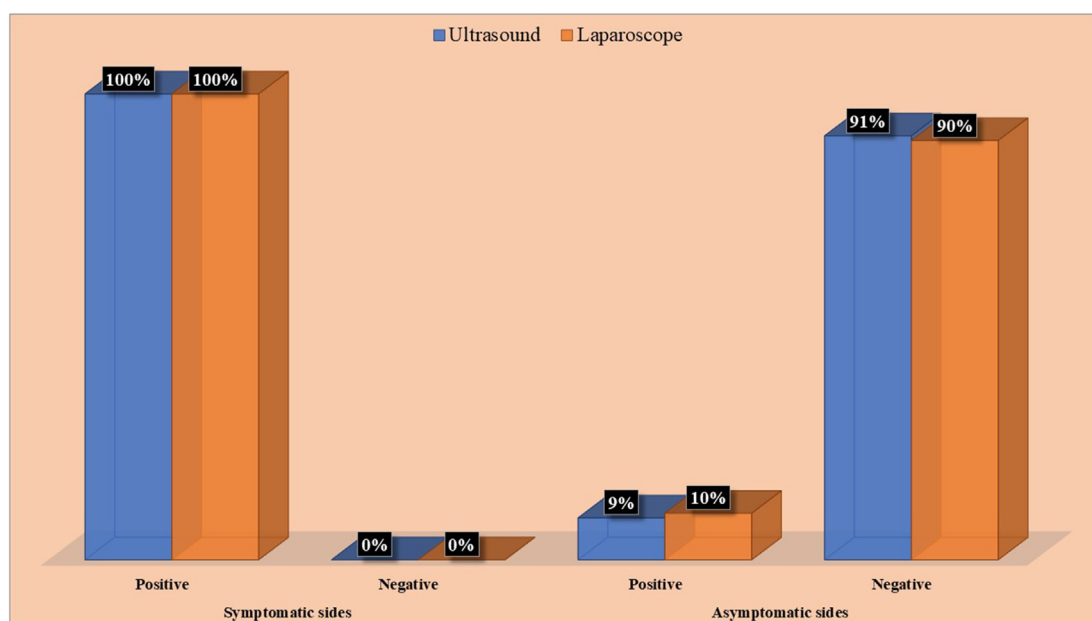


Fig. 1. Shows the ultra sound and laparoscopic results of the studied patients.

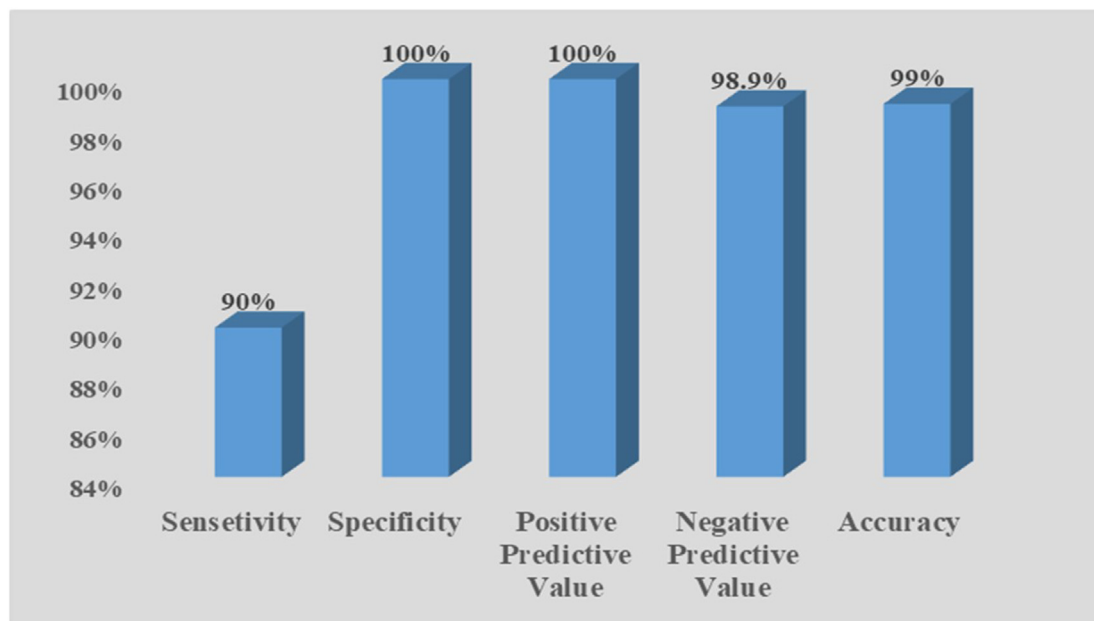


Fig. 2. Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy in Asymptomatic side.

4.1. Conclusion

The US is a good tool for the diagnosis and early detection of pediatric hernias. The preoperative US may be used to check for a contralateral hernia because it is non-invasive, doesn't use radiation, is widely available, and isn't too expensive.

This study has some potential limitations; our sample is small, so further studies in the future are needed to confirm our result on a larger sample. Another limitation is that US is operator-dependent, it depends highly on the level of the operator's experience. So, the diagnosis of hernia by the US needed a highly experienced operator.

Disclosure

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