**Torsed Appendix Testis**

Gray Scale and Color Doppler Sonographic Findings Compared With Normal Appendix Testis

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**Objective.** The purpose of this study was to compare the size, shape, echogenicity, and blood flow of the appendix testis on sonography in control subjects and in patients with a torsed appendix testis and to evaluate the usefulness as well as the limitations of these criteria. **Methods.** This was a retrospective analysis of 11 lesions with torsed appendix testes and 15 normal appendix testes in 12 children. The following gray scale and color Doppler sonographic features were analyzed: size, shape, echogenicity, and blood flow of the appendix testis. **Results.** The size of the appendix testis was larger in patients with a torsed appendix testis than in the control subjects ($P < .05$). A spherical shape of the appendix testis was more common in patients with a torsed appendix testis ($P < .05$). There was no blood flow within both the torsed and normal appendix testes. However, the frequency of increased periappendiceal blood flow was higher in patients with a torsed appendix testis ($P < .05$). There was no significant difference in the echogenicity between the torsed and normal appendix testes. **Conclusions.** Gray scale and color Doppler sonography may be helpful in the diagnosis of torsion of the appendix testis. A size of 5 mm or larger, spherical shape, and increased periappendiceal blood flow are indicative of a torsed appendix testis. **Key words:** appendix testis; Doppler sonography; sonography; torsion.

The appendix testis is a vestigial remnant of the mesonephric and müllerian duct systems. It is located at the upper pole of the testis in the groove between the testis and the head of the epididymis. $^{1-4}$ The normal appendix testis is 1 to 7 mm in length, and it is oval or pedunculated in shape. $^{1-4}$

Torsion of the appendix testis is the most common cause of an acute painful hemiscrotum in the child. $^{4-7}$ The sonographic findings of torsion of the appendix testis are as follows: the appendix testis is increased in size with an increase or decrease in echo texture. $^{5-9}$ In addition, torsion of the appendix testis is frequently accompanied by hydrocele and scrotal wall thickening. $^{5-9}$ However, there is an overlap between normal and torsed appendix
These overlapping criteria lead to confusion and incorrect diagnosis of torsion of the appendix testis. Therefore, a study was needed in which gray scale sonography and color Doppler sonography of normal and torsed appendix testes were compared. However, to our knowledge, no such study had been performed.

The purpose of this study was to compare the size, shape, echogenicity, and blood flow of the appendix testis on sonography in control subjects and in patients with a torsed appendix testis and also to evaluate both the usefulness and limitations of these criteria.

Materials and Methods

We retrospectively reviewed the case files of 11 patients with torsion in the appendix testis. The patients’ ages ranged from 6 to 13 years (mean, 10 years). The diagnosis of torsion in the appendix testis was based on surgical resection (n = 1) and pertinent sonographic findings with clinical improvement after conservative treatment (n = 10). For the comparison between normal and torsed appendix testes in children, visualization of the appendix testes with sonography was attempted in 12 children (age range, 6–12 years; mean, 9 years) for 2 months. The selection criterion was that the children did not have any signs of scrotal disease. The Gachon Medical School Gil Medical Center Clinical Research Ethics Board approved this study. Informed consent was obtained from the parents of all patients for participation in the study. There was no significant difference in the ages of the patients with torsed and normal appendix testes (P > .05, Wilcoxon rank sum test).

All sonographic examinations were performed with a 5- to 10-MHz linear array transducer (HDI 3000; Philips Medical Systems, Bothell, WA), a 5- to 12-MHz linear array transducer (HDI 5000; Philips Medical Systems), or an 8- to 15-MHz linear array transducer (Acuson Sequoia; Siemens Medical Solutions, Mountain View, CA). Color Doppler sonography and power Doppler sonography were performed with optimized color Doppler parameters. The power level, threshold, persistence, and wall filter were individually adjusted to maximize the detection of blood flow through the field of view.

Sonographic findings were determined by retrospective analysis of the images. The gray scale and color Doppler sonographic images were interpreted by 2 radiologists, who determined the size, shape, echogenicity, and degree of blood flow of the appendix testis and periappendiceal area. Measurement of the appendix testis was performed by maximal length.

Statistical analysis was performed to compare torsed and normal appendix testes by the Wilcoxon rank sum test and the Fisher exact test. P < .05 was considered statistically significant. All statistical analyses were performed with SAS software, release 6.12 (SAS Institute Inc, Cary, NC).

Table 1. Results of Gray Scale and Color Doppler Sonographic Features of Torsed and Normal Appendix Testis

<table>
<thead>
<tr>
<th>Feature</th>
<th>Torsed (n = 11)</th>
<th>Normal (n = 15)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size, mm*</td>
<td>7 ± 1.8</td>
<td>3.1 ± 0.8</td>
<td>.0001</td>
</tr>
<tr>
<td>Shape</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spherical</td>
<td>9 (82)</td>
<td>4 (27)</td>
<td>.015</td>
</tr>
<tr>
<td>Ovoid or pedunculated</td>
<td>2 (18)</td>
<td>11 (73)</td>
<td></td>
</tr>
<tr>
<td>Echogenicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyperechoic</td>
<td>4 (36)</td>
<td>2 (13)</td>
<td>NS</td>
</tr>
<tr>
<td>Isoechoic</td>
<td>7 (64)</td>
<td>13 (87)</td>
<td></td>
</tr>
<tr>
<td>Blood flow within appendix testis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>0</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>Absent</td>
<td>11 (100)</td>
<td>15 (100)</td>
<td></td>
</tr>
<tr>
<td>Increased periappendiceal blood flow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>7 (64)</td>
<td>0</td>
<td>.0005</td>
</tr>
<tr>
<td>Absent</td>
<td>4 (36)</td>
<td>15 (100)</td>
<td></td>
</tr>
</tbody>
</table>

Numbers in parentheses are percentages. NS indicates not significant (P ≥ .05).
*Data are mean ± SD.
Results

The sonographic findings in patients with either a torsed or normal appendix testis are summarized in Table 1, and examples are shown in Figures 1–4. The mean sizes of the appendix testes were 7 mm (range, 5–10 mm) for the torsed appendix testes and 3.1 mm (range, 1.6–4.3 mm) for the control group. There was a significant difference between the torsed and normal appendix testes in the mean size on the basis of the Wilcoxon rank sum test ($P < .05$).

In terms of the shape of the appendix testis, a spherical shape was seen in 9 (82%) of 11 cases of torsed appendix testis and 4 (27%) of 15 cases of normal appendix testis. The spherical shape of the appendix testis was found more frequently in the torsed appendix testis group than in the control group ($P < .05$, Kruskal-Wallis test).

Two kinds of echogenicity of the lesion were observed: hyperechoic and isoechoic to the testis. Echogenicity hyperechoic to the testis was observed in 4 (36%) of 11 cases of torsed appendix testis and 2 (13%) of 15 cases of normal appendix testis. There was no significant difference in the echogenicity between torsed and normal appendix testes ($P > .05$, Kruskal-Wallis test).

On color Doppler sonography, there was no blood flow within the torsed and normal appendix testes. An increase in periappendiceal blood flow was seen in 7 (64%) of 11 cases of torsed appendix testis, but this increase was not seen in the cases of normal appendix testis. There was a significant difference between the torsed appendix testis group and the control group in the degree of periappendiceal blood flow ($P < .05$, Kruskal-Wallis test).

Discussion

We observed several differences between torsed and normal appendix testes on gray scale and color Doppler sonography, such as the size and shape of the appendix testis and the degree of periappendiceal blood flow.

In terms of the size of the appendix testis, the torsed appendix testis is larger than the normal appendix testis. In our study, the size of the torsed appendix testis ranged between 5 and 10 mm (mean, 7 mm), and the size of the normal appendix testis ranged between 1.6 and 4.3 mm (mean, 3.1 mm). Therefore, in our study, the cutoff point was 5 mm or larger for the size of the appendix testis as a sonographic criterion that suggests the presence of torsion. These results are in accordance with those of another study, which reported that the size of the torsed appendix testis ranged between 5 and 16 mm. However, another study reported that the size of the normal appendix testis ranged between 1 and 7 mm. The differences in results between these previous studies and ours may be explained by the difference in age groups that were used in the studies. In our study, the mean age of the control group was 9 years. In contrast, the mean age in the previous study was 43 years. The normal appendix testis in children may be smaller than that in adults. Therefore, the size of

Figure 1. Normal appendix testis in a 6-year-old boy. A, Longitudinal gray scale sonogram showing the ovoid shape of the appendix testis (3.3 × 1.3 mm; arrow) between the testis (T) and the head of the epididymis (E). The echogenicity of the appendix testis is isoechoic to the testis. Hydrocele is present. B, Longitudinal color Doppler sonogram showing no blood flow within the appendix testis.
the appendix testis is helpful in the diagnosis of torsion of the appendix testis, in which, if the appendix testis is 5 mm or larger, it is indicative of a torsed appendix testis.

Most of the torsed appendix testes were spherical. However, there was a significant difference in shape between torsed and normal appendix testes, and most of the normal appendix testes were ovoid or pedunculated. It is possible that swelling, which was induced by necrosis, may be a factor in the change of shape of the appendix testis from ovoid or pedunculated to spherical. Thus, the shape of the appendix testis can be a useful tool for diagnosing a torsed appendix testis.

Color Doppler sonography provides a simultaneous display of tissue morphologic characteristics in gray scale and blood flow in the lesion.10,11 In our study, there was no blood flow within both the torsed and normal appendix testes. In contrast, an increase in periappendiceal blood flow was seen in 7 of 11 cases of torsed appendix testis, but this increase was not seen in cases of normal appendix testis. There was a significant difference in periappendiceal blood flow between torsed and normal appendix testes. A necrotic appendix testis induces a local inflammatory change in the surrounding epididymis, testis, and tunica vaginalis.12,13 Therefore, color Doppler sonography may aid in the differential diagnosis between torsed and normal appendix testes.

Figure 2. Torsed appendix testis in a 10-year-old boy. A, Longitudinal gray scale sonogram showing an enlarged hyperechoic, spherical appendix testis (7.1 × 6.5 mm) between the testis and the head of the epididymis (arrow). There is minimal fluid in the tunica vaginalis. B, Longitudinal color Doppler sonogram showing increased periappendiceal blood flow (arrowheads), but there is no blood flow within the appendix testis. C, Specimen showing the enlarged appendix testis with vascular congestion and edema (arrowheads). Hemorrhage is also seen at the peripheral portion (arrows).

Figure 3. Longitudinal color Doppler sonogram of a torsed appendix testis in an 11-year-old boy showing an enlarged ovoid appendix testis (9.2 mm) between the testis and the head of the epididymis (arrow). The echogenicity of the appendix testis is isoechoic to the testis. It also shows increased periappendiceal blood flow (arrowheads), but there is no blood flow within the appendix testis.
The normal appendix testis is isoechoic to the head of the epididymis.6 A torsed appendix testis usually appears hyperechoic on sonography.6 However, the echogenicity of the torsed appendix testis may be variable according to the stage of the condition.5–9 In our study, most of the torsed and normal appendix testes were isoechoic to the ipsilateral testis. Therefore, the echogenicity of the appendix testis is not useful in differentiating between torsed and normal appendix testes.

A number of limitations in this study should be considered. First, the study had a small sample size. Thus, further studies with larger sample sizes will be necessary to more fully examine the differentiation between torsed and normal appendix testes. Second, this study focused only on the usefulness and limitations of sonography for differentiating between torsed and normal appendix testes. However, the torsion of the appendix testis should also be differentiated from other diseases, such as epididymitis and epididymo-orchitis. In addition, the torsion of the appendix testis may be diagnosed falsely as epididymitis or epididymo-orchitis. Further investigations are required to differentiate between the torsion of the appendix testis and other scrotal diseases.

In conclusion, for the differentiation between torsed and normal appendix testes, the size, shape, and periappendiceal blood flow may be helpful. A size of 5 mm or larger, a spherical shape, and increased periappendiceal blood flow are indicative of a torsed appendix testis.

Figure 4. Longitudinal color Doppler sonogram of a torsed appendix testis in a 13-year-old boy showing an enlarged isoechoic, spherical appendix testis (5.3 mm) between the testis and the head of the epididymis (arrow) and increased periappendiceal blood flow (arrowheads), but there is no blood flow within the appendix testis.

References