

# Hypertrophic pyloric stenosis: Ultrasound diagnosis

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*In the study, we analysed ultrasound (US) findings of 68 patients suspected of having hypertrophic pyloric stenosis (HPS). In 44 out of 45 patients with positive US findings, HPS was surgically confirmed. In 82.6% patients (38 pts), pyloric muscle thickness was 5-7 mm, in 10.9% (5 pts), it was 3-5 mm, and only in 6.4% patients (3 pts), we performed barium study due to doubtful values of pyloric muscle thickness (3.0-3.4 mm) detected by US; barium study confirmed HPS in one patient and excluded in two patients. The pyloric muscle thickness in all patients with HPS was at least 1.5 times thicker comparing to antral muscle thickness. Ultrasound sensitivity was 98%, and specificity 92%. Based on the results of our study, ultrasound examination of the pylorus has proved to be highly recommendable as a routine method of first choice in the diagnosis of HPS.*

*Key words : pyloric stenosis-ultrasonography; hypertrophy*

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## Introduction

With the advent of high resolution real-time ultrasound scanners, ultrasound has become a very important imaging technique, not only in the diagnosis of solid abdominal organ pathology, but also in the evaluation of hollow gastrointestinal tract.<sup>1,2</sup> Hypertrophic pyloric stenosis is the best recognized use of ultrasound in the pediatric gastrointestinal tract.<sup>1,3</sup> Ultrasound has the advantage of providing direct visualization of the pyloric muscle, and it also allows the measurements of muscle thickness.<sup>4,6</sup> The ultrasonographic criteria for diagnosing pyloric stenosis vary from hospital to hospital, but most common

belief is that pyloric muscle thickness of 3.5 mm or more and a pyloric canal length of 17.0 mm or more are diagnostic for HPS.<sup>2,7,8</sup>

## Patients and methods

In our study, we reviewed the findings of US performed in our hospital from 1990 to 1996 of 68 patients suspected of having HPS.

The equipment used was ALOKA 1700 i ACUSON 128 XP, using curved and linear array transducers of 5 i 7-7.5 MHz. No particular preparation of patients was needed. If the stomach was empty, patients were given fluid (tea or water) by bottle to allow adequate examination. In all patients transverse and longitudinal sonograms were made in a supine right posterior oblique position of the

patient's body aided by a rolled towel under his left side. We measured the outer diameter of the pylorus and thickness of the pyloric muscle itself on both, transverse and longitudinal sonograms, as well as pyloric canal length on longitudinal sonogram. We also considered the ratio between pyloric and antral muscle thickness. The measurements of antral muscle thickness were obtained on long axis scans with the antrum distended by fluid to avoid confusing a contracted antrum with an abnormally thickened muscle. The antral muscle thickness was measured from the outer border of the echoic submucosa to the outer border of hypoechoic muscle layer. No time limits for the examination were imposed, and diagnostic criteria of HPS called for the following criterion:

1. pyloric visualization,
2. pyloric muscle thickness > 3.5 mm,
3. pyloric canal length > 17.0 mm.

### Results

During the period of 6 years, 68 patients suspected of having HPS were ultrasonographically examined; of these, we established 45 diagnoses of HPS all of which, except one /false-negative/, were surgically confirmed. In 82.6% patients (38 pts) the diameter of the pyloric muscle was 5.0-6.0 mm, in 10.9% patients (5 pts) it was 3.5-4.0 mm and in 6.5% patients (3 pts) the diameter of the muscle was 3.0-3.4 mm. In all examined patients, the length of the pyloric canal exceeded 17.0 mm. In all patients, the pyloric muscle thickness was at least 1.5 times thicker than the antral muscle thickness.

Only 3 patients underwent radiology, i.e. barium study, because of the borderline pyloric muscle thickness values of 3.0-3.4 mm. Two of these patients were false-positive and one false-negative (confirmed by barium study). Sensitivity of the US examination was 98 %, and specificity 92 %.

### Discussion

The pylorus region can be easily located by US, specially when there is a positive finding of HPS. The gallbladder is used as a landmark to locate the region of the pylorus. According to our experience, it is harder to locate normal pylorus and exclude the diagnosis of HPS. In our hospital, we first locate the pylorus with a curved transducer of 5 MHz and then, for more detailed examination of pyloric region and the subsequent measurements, we use a linear array transducer of 7.0-7.5 MHz.

Although the most important diagnostic criterion for HPS is the length of the pyloric canal 9-11, it is not always possible to show it in its entire length due to its awkward position. Problems in diagnosis may arise if the stomach is overdistended, because the pylorus may then be displaced which makes its identification and measurements more difficult.<sup>1,12</sup>

Thus, we believe that the thickness of the pyloric muscle measured on transverse and longitudinal sonograms is a better criterion for diagnosing HPS (Figure 1,2). It is also useful to follow gastric outlet ultrasonographically. In order to be more accurate in diagnosing HPS, the thickness of antral muscle can be measured and compared with the pyloric muscle thickness. Normal pyloric muscle is usually <2 mm thick, and thickness between 2 and 3 mm may be seen in pylorospasm.<sup>13</sup> In all patients with HPS in our study, the pyloric muscle thickness was at least 1.5 times thicker than the antral muscle thickness, ranging between 1.4 and 2.3 mm.

According to our experience, the pyloric muscle thickness of the patients with HPS is in most cases 5.0-7.0 mm and in fewer cases 3.0 - 3.4 mm. In doubtful muscle thickness values (3.0-3.4 mm), some other diagnostic criteria should be considered (the length of the pyloric canal) and, in other doubtful cases, the patient should be reexamined in

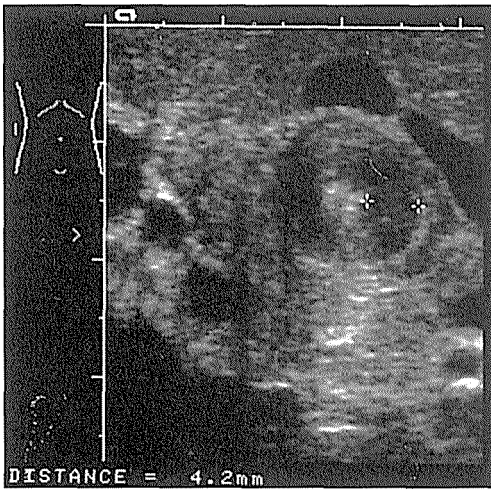


Figure 1. HPS- short-axis scan - central echogenic mucosa of pyloric canal surrounded by thickened pyloric muscle.

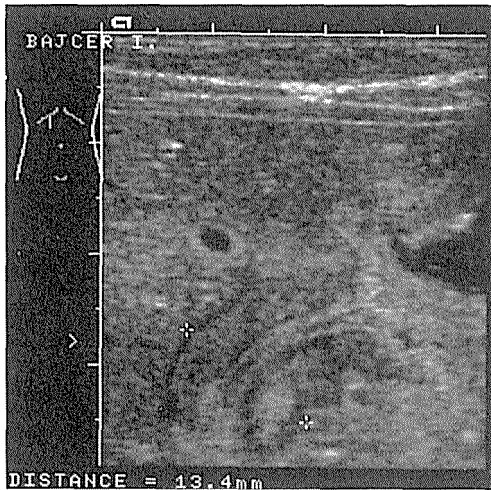


Figure 2. HPS-long-axis scan- abnormally thickened hypoechoic pyloric muscle (6mm).

24-48 hours or other diagnostic procedures should be performed (barium study).

In conclusion, the real real-time ultrasound is currently a method of choice; it is safe, painless diagnostic imaging technique for the diagnosis of HPS and, in experienced hands, it can almost completely replace con-

ventional barium studies. The barium study should be reserved for those cases in which HPS is not considered the most likely cause of vomiting and in children with borderline measurements.

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