The Role of Ultrasonography in Infantile Hypertrophied Pyloric Stenosis

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ABSTRACT:

BACKGROUND:

To evaluate the different parameters used in the diagnosis of infantile hypertrophied pyloric stenosis (pyloric canal length, muscle thickness and pyloric canal diameter).

METHODS:

The study group consisted of 29 patients presented with projectile vomiting, 28 patients were diagnosed as pyloric stenosis and only one patient with pylorospasm using linear probe 7.5-10 MHz.

RESULTS:

The male infants were 23 (82%) and, the female infants were 5 (18%) with male to female ratio of 4.5:1. The age ranged between 18 days and 90 days with a mean of 34.2 days. The age at presentation mostly was between 20-39 days (67.8%). Family history was positive in 5 patients (17.8%). In 16 patients (57.1%) the parents were relative while in 12 (42.8%) patients the parents were not relative. The length of the canal ranged from 15mm to 26mm with a mean of 19.13mm. The muscle thickness ranged from 3-8 mm with a mean of 5.8mm. The diameter of the canal ranged from 11mm to 17mm with a mean of 13.8mm. Only one patient (3.6%) had associated congenital abnormality which was ectopic kidney. And only one patient had pylorospasm.

CONCLUSION:

The length of the pyloric canal was the most reliable measurement in the diagnosis of infantile hypertrophied pyloric stenosis.

KEYWORDS: Hypertrophied pyloric stenosis, Ultrasonography .

INTRODUCTION:

Hypertrophic pyloric stenosis :

Infantile Hypertrophic pyloric stenosis (HPS) is the most common cause of gastric outlet obstruction in childhood and is one of the most frequent conditions requiring surgery in the newborn[(1)].

Normal Ultrasonographic anatomy [(2)] :

Longitudinal scans obtained slightly to the right of midline demonstrate the characteristic "bull's-eye" appearance of the antrum of the stomach as it sits anterior to the pancreas and superior mesenteric vein. On cross section, the bull's-eye pattern of the antropylorus consists of the following**:** (a) a "pencil-thin" essentially nonmeasurable, anechoic outer rim representing the normal circular or Torgenson's muscle, (b) an inner echogenic layer representing the mucosa and submucosa ; and (c) an inner most anechoic center (representing fluid in the canal). (Figure 1) It is best and easiest, however, to evaluate the normal antropylorus in its longitudinal axis.

This is most important for it is in this plane that the overall length of the canal, its peristaltic activity, muscle layer and passage of gastric contents are best assessed.

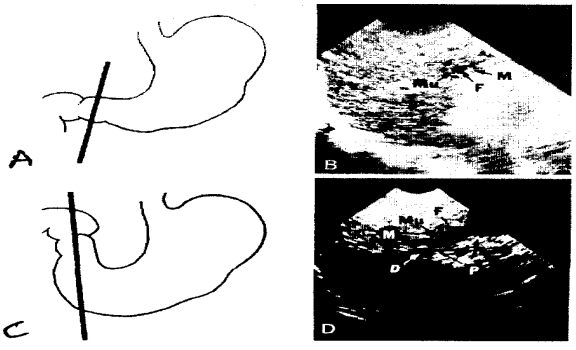

Figure 1: Normal gastric antral anatomy. A. and C. Diagrammatic representation of the level of the sonographic cut illustrated in B. and D. B is cross section and D is longitudinal section. (M) muscular layer, (Mu) is submucosa and (F) fluid in the canal, Fluid in the duodenum (D)[(2)].

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Incidence: HPS occurs in 1-3 of every 1000 live birth in USA. There are reports that the incidence is increasing [3] and other reports that it is decreasing [4]. Male to female ratio is 4:1 [4]. HPS is more common in Caucasian descent and is rare in Asian children [5]. The belief that first born neonates are more frequently affected has been disputed [6]. A genetic contribution is supported by the fact that 19% of boys and 7% of girls whose mother had pyloric stenosis as an infant also have pyloric stenosis.[7] Pyloric stenosis occurs in only 5% of boys and 2.5% of girls whose father had the disease[7]. The risk is lower with older maternal age, higher maternal education and low birth weight[3]. As high as 7% of pyloric stenosis have associated malformation. Three major malformations include: intestinal malrotation, obstructive uropathy and esophageal atresia [8].

Other anomalies associated with pyloric stenosis include hiatal hernia and a deficiency in hepatic glucovenyl transferase activity similar to Gilbert syndrome[8].

Etiology: The etiology remains unknown. The lesion may be congenital or acquired. Theories explaining the etiology include; gastric hyperactivity leading to muscle spasm and hypertrophy [9], abnormal pyloric innervation [10].

Pathology: The musculature of the pyloric antrum is always hypertrophied proceeding distally, the hypertrophy increases to reach its zenith in the circular fibers of the pylorus. Here the muscle layer is so thick that the mucosa is compressed and often the lumen admits only a fine prob. As estimated at operation, the size of the pylorus (lump) is proportional to the duration of the symptoms. The hypertrophy terminates abruptly with the duodenum being normal.[11] .

Clinical presentation :

Usually full term with the onset of projectile vomiting between 2-8 weeks of age [2]. Premature infants compromise about 10%, whereas less than 4% of patients develop symptoms after the age of 3 months.[8]Although rare, an infant with prolonged vomiting can present with significant weight loss, dehydration, hypochloramic alkalosis and failure to thrive [8]. The vomittus is always non-bilious but may be streaked with blood; in one study, 66% of patients presented with hematemesis from acid induced esophagitis or gastritis [12].

Ultrasound of Hypertrophic pyloric stenosis:

Ultrasonography is now considered as an accurate method for the diagnosis of HPS and has replaced barium meal in vomiting infants [13, 14].

The criteria for the ultrasonographic diagnosis of HPS should include: (a) the demonstration of thickening of the pyloric muscle on both cross section and longitudinal section (4-7 mm thickness), (b) demonstration of elongation of pyloric canal (14 mm or over) (cervix sign) and (C) the demonstration of gastric outlet obstruction (i.e., the pyloric canal never opens normally) [2].

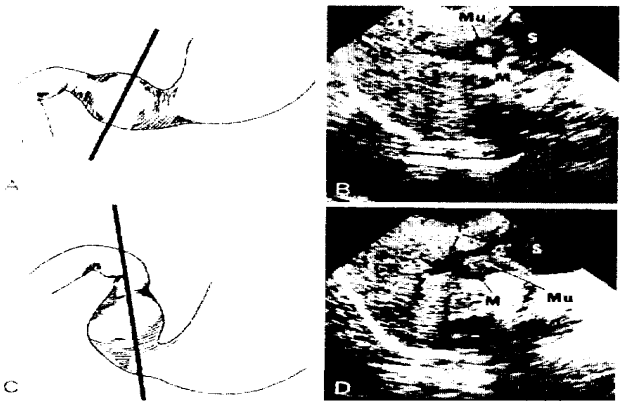


Figure 2: Hypertrophic pyloric stenosis. A. and C are diagrammatic representation of B and D respectively. B. cross section and D is long axis. Where M (mucosa), Mu (submucosa), GB (neck of the gall bladder), P (pyloric canal), S (stomach [2]

Pylorospasm:

In these patients, there is often a sharp step of at the antropyloric junction and by US "cutting" the muscle at this point, the muscle is sectioned obliquely and an erroneous impression of muscle thickening results [2] but the measurements vary in pylorospasm with time which can help distinguish it from HPS [13].

AIM OF THE STUDY:

To establish the relative precision of different criteria for diagnosing HPS by ultrasound.

PATIENTS AND METHODS:

This is a prospective study of 29 infants presented with projectile vomiting and diagnosed by ultrasound examination, conducted at Al-Mansour Pediatric Teaching Hospital, Baghdad for the period between October 2003 to July 2004. The data collected from the patients' parents include age, number in the family, positive family history, maternal age, are the parents relative or not, duration of illness.

Technique of examination: The infant should not be fed for at least 3 hours, if possible. Ultrasound examination was performed using superficial probe (7 MHz) real time examination (Kretz Voluson). Distension of the stomach with clear fluid is essential as it provides acoustic window through the pylorus and its environs can be visualized more readily, thus the infant is allowed to take glucose water which can otherwise be introduced through a nasogastric tube. The patient is placed supine and scan obtained slightly to the right of midline and by rocking the transducer back and forth, both cross section and longitudinal axis of the pylorus can be easily obtained. It is best and easier to evaluate the longitudinal axis as for it is in this plane that the overall length of the canal, its peristaltic activity, muscle layer and passage of gastric contents are best assessed. There is no need for the baby to be restrained or sedated and the examination can be performed rapidly [15].

Ultrasonographic measurements taking in consideration in this study were**:**

1. The length of pyloric canal .
2. The muscle thickness.
3. and the muscle diameter.

RESULTS :

Twenty-nine patients were studied carefully by ultrasound, 28 (93.3%) patients were diagnosed as having Hypertrophic pyloric stenosis (underwent surgery and proved to have pyloric stenosis), while one patient was diagnosed as pylorospasm by serial follow up examinations and the patient was treated medically and did not need any surgical interference. Regarding the 28 patients with proved Hypertrophic pyloric stenosis. All the patients were full term.

The male infants were 23 (82%) and the female infants were 5 (18%) with male to female ratio of 4.5:1. Figure 3 shows the sex incidence among our patients . The youngest patient was 18 days old while the oldest was 90 days old with mean of 34.2 days. The presentation of the disease seen between the age of 20-39 days (19 cases, 67.8%) (Table l).

Family history was positive in 5 patients (17.8%), while it was negative in the remainder 21 patients (82%). In 16 patients (57.1%) the parents were relative while in 12 (42.8%) patients the parents were not relative. First born baby was the commonest in this series, 10 patients (35.7%) followed by the second (8 patients) (28.5%) (Table 2) .

Duration of the symptoms (projectile vomiting) ranged from 7 days to 65 days with mean of 21.6 days. Ultrasound findings (table 3) . The length of the canal ranger from 15mm to 26mm with a mean of 19.13mm.

The muscle thickness ranger from 3-8 mm with a mean of 5.8mm. The diameter of the canal ranged from 11mm to 17mm with a mean of 13.8mm. All the patients had a pyloric canal length of > 15mm with a sensitivity of 100%. Twenty-six patients had muscle thickness of >3 mm with a sensitivity of 92.8%. While only 23 patients had a pyloric canal diameter of >: 13mm with a sensitivity of 82.1 %.

Only one patient (3.6%) had associated congenital abnormality which was ectopic kidney.

Only one patient with pylorospasm was having measurements equivocal between normal and abnormal so serial follow up was conducted and the patient responded to medical treatment and did not need any surgical interference (table 4).

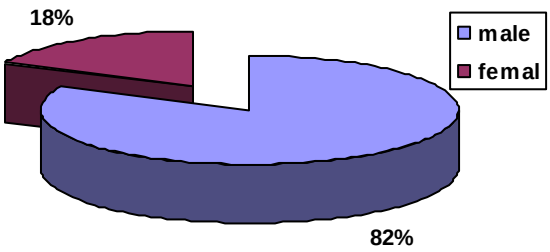


Figure 3: Sex distribution of HPS patients

Table 1: The incidence of HPS regarding the age

Age (in days)	No. of patients	%
0-9	0	0
10-19	1	3.5
20-29	9	32.2
30-39	10	35.7
40-49	4	14.2
50-59	1	3.5
>60	3	10.7

Table 2: The number of the patients in the family

Location	Number of patients	%
First	10	35.7
Second	8	28.5
Third	6	21.4
Fourth	3	10.7
Fifth	0	0
Sixth	1	3.5

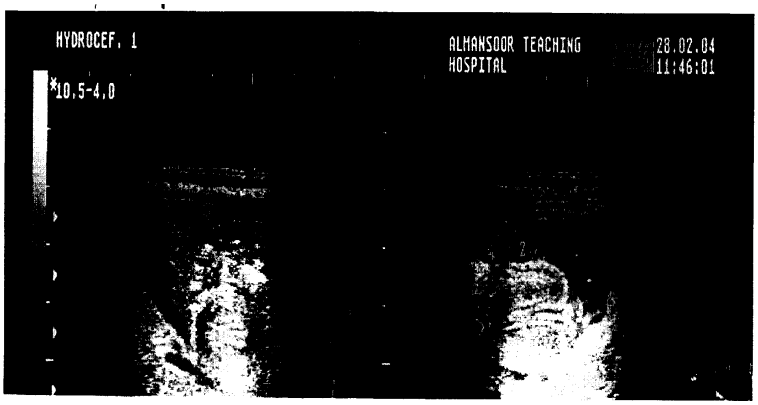
Table 3: The ultrasound findings of HPS

U/S finding	Lowest value	Highest value	Mean
Pyloric canal length	15mm	26mm	19.13
Muscle thickness	3mm	8mm	5.8
Pyloric diameter	11mm	17mm	13.8

Table 4: One patient with pylorospasm

	Age	Pyloric canal length (mm)	Muscle thickness (mm)	Pyloric diameter(mm)
Patient 1	26 days	13.2	3.9	11

Figure 4: infantile hypertrophied pyloric stenosis, transverse and longitudinal section .



DISCUSSION:

Pyloric stenosis remains a common surgical disease. With the evolution of ultrasonography, it became universally accepted as the gold standard for diagnosis of pyloric stenosis when physical examination was unrevealing.

Not only was this a simple test, but also the avoidance of barium led to a safer induction of anesthesia with the knowledge that barium retained in the stomach would not be vomited and aspirated [16]. In our study, male patients were more affected than females with male to female ratio of 4.5:1 which is similar to other studies and slightly higher that that with Stunden (1986) [15] who reported male:female ratio of 3:14 and Neilson (1994) [17] who reported a ratio of 2.3:1. The mean age of our patients was 34.2 days which is similar to that reported by Murtagh et al (l992) [18] and less than that with Stunden (1986) [15] who reported a mean of 45 days.

Positive family history was present in 5 patients (17.8%) which is less than that done by Haider et al (2002) [19] in which family history was present in about 25%, and much more than what reported by Nadom (l999) [20] (2%). In our study, first born baby was affected in 10 (35.7%) which is against that of Roger (1997) [9] but similar to Chio et al (l994) [21] with an incidence of 32%. The peak presentation in our study was between 20-39 days (67.8% of patients) which is in agreement with Murtagh et al (l992) [18] with age of presentation between (14-60 days) but larger than that reported by Breivi (1996) [22] in which the onset of presentation was between 14-21 days. The duration of symptoms was about 21 days in average which is quite long but could be explained by the ignorance and neglection by the parents and improper evaluation and management of a child presented with vomiting.

The associated congenital anomaly in our study was 1 case (3.6%) which is less than that found by Nadom (1999) [20] who reported an incidence of 6% but almost similar to that done by Bidair (1993) [23] with an incidence of 2.6%. The associated congenital anomaly was left sided ectopic kidney which was not found in Nadom (1999) [20]. In our study, the mean pyloric canal length was 19.13mm which is similar to Haider et al (2002) [19] and slightly higher than Al-Mussawii (1998) [11] who reported a mean length of 18.6mm and 16mm respectively.

But much higher that that done by Deeg et al (1985) [24] who reported a mean of 12.9mm.

The mean muscle thickness was 5.8mm in our study, which is higher that what reported by Ito - et al (2000) [16] and Spinelli et al (2003) [25] (4.5mm and 4.1mm respectively). But similar to Koczynski (1984) [26] with a muscle thickness ranged between 5-9mm. While the mean pyloric canal diameter in our study was 13.8 which is similar to Al-Mussawii (l998) [11] (13mm) and Stunden (1986) [15] (13.3mm). It is less than that reported by Ito et al (2000) [16](15.8mm) and disagreed with Koczynski (1984) [26] who considered a pyloric diameter of 10-15mm as normal. But it is higher than that reported by Hallam (1995) [27] (10mm). In our study, the most accurate parameter in the diagnosis of pyloric stenosis was the pyloric canal length with accuracy of 100% which is slightly higher than that reported by Rohrschneiden (1998) [28] in which the accuracy was 94%.

While the accuracy of muscle thickness in our study was 92.8% which is slightly less than that reported by Rohrschneider (1998) [28] (100%) but similar to Al-Musawii (1998) [11](92%).

The accuracy of ultrasound in measuring the pyloric canal diameter was 89.1% which is slightly less than Al-Mussawii 1998 [11] (92%) and Rohrschneide (1998) [28].

Pylorospasm :

Only one case was diagnosed as pylorospasm with a pyloric canal length of (13.2mm) which is less than that reported by Cohen (1999) [29] with pyloric canal length of 14.4mm. Muscle thickness was 3.9mm which is similar to Cohen (l999) [29] (3.8mm).

The diagnosis is confirmed by subsequent ultrasonic examination with alteration of the measurement (the length reduced to 12mm). So, in pylorospasm, alteration of the image or measurement is an important clue for the diagnosis [29].

Conclusion:

1. Ultrasonography remains the main diagnostic tool in hypertrophic pyloric stenosis.
2. The most accurate parameter in the diagnosis of pyloric stenosis was the pyloric canal length.
3. The least accurate parameter was the pyloric canal diameter.

Recommendations:

1. Further studies should be conducted to have more information about the disease.
2. . Attention should be made to every child presented with vomiting.

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