ORIGINAL ARTICLE

ROLE OF ULTRASONOGRAPHY IN EARLY DIAGNOSIS OF INFANTILE HYPERTROPHIC PYLORIC STENOSIS

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Background: Infantile hypertrophic pyloric stenosis (IHPS) is a common cause of gastric outlet obstruction in infants. This study was conducted to identify the accuracy of ultrasonography in the diagnosis of infantile Hypertrophic pyloric Stenosis. **Methods**: This cross-sectional descriptive study was conducted in Department of Paediatric Surgery, Children Hospital Complex & the Institute of Child Health, Multan during two year period from 1st July, 2010 to 30th of June, 2012. Fifty patients <8 weeks of age who presented with complaints of non-bilious vomiting were included in the study. Abdominal ultrasound was performed in all the cases. On ultrasonography pyloric canal length, diameter and pyloric muscle wall thickness was measured. Open surgery was performed as per indications and after informed consent. The pre-operative findings were compared with ultrasongraphic findings. Study variable were male to female ratio, percentage of cases in which pyloric mass was palpable. We also compare the duration of onset of symptoms with pyloric canal length, diameter and muscle thickness. **Results**: In this study, out of 50 patients, 46 (92%) were male and 4 (8%) were females. Gastric peristalsis was visible in 100% patients and mass was palpable in 14 (28%) patients. Pyloric canal length was more than standard in 98% cases; canal diameter was more than the standard in 87% cases and pyloric muscle thickness in 60% of cases. Ultrasonographic findings remained 98% accurate in this study. **Conclusion:** Ultrasonography is an investigation of choice for early diagnosis of IHPS before significant fluid and electrolyte imbalance occur. It is cost effective, harmless, freely available and easier to perform. Pyloric canal length and diameter are more specific for the diagnosis of IHPS than pyloric muscle thickness.

Keywords: Ultrasonography, Infantile hypertrophic pyloric stenosis
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INTRODUCTION

Infantile hypertrophic pyloric stenosis (IHPS) is a common cause of gastric outlet obstruction in infants. Prevalence of infantile hypertrophic pyloric stenosis ranges from 1.5 to 4.0 per 1000 live births among whites but is less common in Africans Americans and Asians. Reports have suggested that incidence is increasing. IHPS was first described two hundred years ago but still exact cause is poorly understood.[1] Pyloromyotomy first described by Ramstedt in 1912 is still accepted as curative operation of choice without any modification.[2] Non bilious vomiting is the initial symptom of the disease. Diagnosis is usually made on the basis of history, examination, ultrasonography and barium study. On the basis of history alone it is difficult to differentiate between infantile hypertrophic pyloric stenosis and gastroesophageal reflux. During clinical examination, palpable olive in right hypochondrium or epigastrium is diagnostic but it needs calm and quite infant and expert examiner. Jildi S mentioned in his study that pyloric tumour was palpable in 19.7% patients only.[3] Barium study helps in the diagnosis of IHPS by showing delayed gastric emptying, string sign or double track sign.[4] Barium study can be hazardous because there is risk of aspiration of barium after vomiting and exposure to X-rays.

Ultrasonography is useful, non-invasive and accurate technique to diagnose infantile hypertrophic pyloric stenosis. In few studies role of ultrasonography was extended to measure the morphologic resolution of the pylorous after Ramstedt pyloromyotomy.[5,6] Ultrasonography is freely available everywhere. By measuring length, muscle wall thickness and diameter or pyloric mass, we can easily diagnose infantile hypertrophic pyloric stenosis. Most commonly used criteria for positive ultrasound study is pyloric muscle wall thickness 4 mm or more and pyloric canal length 16 mm or more. Some centres also measure pyloric diameter and considered 14 mm or more as positive. Lamaki mentioned in his study muscle wall thickness 3 mm or more as positive finding for IHPS in infants less than 30 days of age.[7] Different criteria have been mentioned in different studies. In our study, we tried to establish diagnostic criteria in our setting by comparing ultrasonographic and operative findings.

MATERIAL AND METHODS

This was a cross-sectional descriptive study, conducted at department of Paediatric Surgery,

Children Hospital Complex & the Institute of Child Health, Multan during two year period from 1st July, 2010 to 30th of June, 2012. Fifty patients <8 weeks of age were included in this study who came to paediatric surgery department during this time period with complaints of non-bilious vomiting. After admission, resuscitation was done by keeping the patient nil per orally, nasogastric suction and by giving intravenous fluids and Ranitidine/ proton pump inhibitors. Laboratory investigations like Complete Blood Count, serum Na^+, K^+, Cl^- and HCO_3^- were performed. Abdominal ultrasound was done in all the patients after resuscitation. On ultrasonography, canal length, diameter and pyloric wall thickness were measured. Following criteria selected for the diagnosis of IHPS on ultrasonography.

- Pyloric canal length: 16 mm or more.
- Pyloric canal diameter: 14 mm or more.
- Pyloric muscle wall thickness: 3 mm or more.

The patients diagnosed as IHPS on ultrasonography were considered for surgery. The condition was explained to their parents/guardians and after informed consent surgery was performed. The surgical findings of each patient were compared with the ultrasonography findings and assessment was made regarding conformity of surgical with ultrasonography findings.

RESULTS

A total of 50 patients were admitted during the study period with complaints of non-bilious vomiting. Out of fifty, 46 (92%) were male and 4 (8%) were female. All the patients were above 2 weeks of age. One was between 2–3 weeks, 15 (30%) were between 3–4 weeks, 14 (28%) between 4–5 weeks, 10 (20%) between 5–6 weeks and 10 (20%) above the age of 6 weeks. Table-1 showed duration of vomiting at presentation and table-2 showed comparison of duration of vomiting and pyloric canal length, diameter and pyloric muscle wall thickness. Pyloric canal length was more than the standard in 98%, canal diameter in 87% and pyloric muscle thickness in 60% cases. Ultrasound findings were confirmed per-operatively and found to be 98% accurate in this study.

Table-1: Duration of vomiting at presentation (n=50)

Duration of Vomiting	Patients	% age
1 Week	15	30.0%
2 Weeks	15	30.0%
3 Weeks	5	10 %
4 Weeks	10	20 %
5 Weeks	1	02 %
6 Weeks	4	08 %

Table-2: Comparison of duration of vomiting & pyloric canal length, diameter and muscle thickness (n=50)

Duration of vomiting	(n)	No. of Patients with +ve Canal length (%age)	No. of patients with +ve pyloric canal diameter (%age)	No. of patients with +ve pyloric muscle thickness (%age)
1 Week	15	14 (93%)	10 (67%)	2 (13%)
2 Weeks	15	15 (100%)	12 (80%)	7 (47%)
3 Weeks	5	5 (100%)	5 (100%)	4 (80%)
4 Weeks	10	10 (100%)	10 (100%)	10 (100%)
>4 Weeks	5	5 (100%)	5 (100%)	5 (100%)

DISCUSSION

A total 50 patients were included in this study who presented with the complaint of non-bilious vomiting. Out of 50, 92% were male and 8 % were female with sex ratio 11.5:1 whereas Assefa[8] mentioned in his study total 39 patients with male to female ratio of 12:1, Doyle D[9] mentioned male to female ratio of 4.06:1 in his study and Jerzy Niedzielski[10] mentioned ratio of 8.6:1.

Babies of different age groups came to our unit with pyloric stenosis during the study period. No patient was below the age of 2 weeks. Maximum number (58%) of patients was between 3–5 weeks of age and 20% patients were above 6 weeks of age. Haahr[11] mentioned in his study of 147 patients that 70% patients were 1–4 weeks of age and 28% between 5–12 weeks of age. Jerzy Niedzielski[10] mentioned median age of 40 days (range 13–111 days) and Doyle D[9] mentioned median age of 4 weeks (range 1–8 weeks) respectively in their studies.

In our study, we noticed early presentation of the patients. Thirty patients (60%) came to our hospital with 1–2 weeks duration of non–bilious vomiting whereas 4 patients came with 6 weeks history of vomiting. During examination, only in 28% patients, palpable pyloric tumour was found in our study which was comparable to 19.7% mentioned by Jildi S[1] in his study.

Ultrasonography was done in all the patients after the admission and ultrasound findings were confirmed per operatively. During ultrasonography, we measured pyloric canal length, diameter and pyloric muscle thickness and label the case as infantile hypertrophic pyloric stenosis if following criteria was fulfilled.

1-Pyloric canal length: 16 mm or more.
2-Pyloric canal diameter: 14 mm or more.
3-Pyloric muscle wall thickness: 3 mm or more.

The criteria which Keller *et al*[12] used for positive ultrasound study was pyloric mass thickness of 4 mm or more and pyloric canal length of 16 mm or more. Some centres also determined pyloric diameter and consider more than 14 mm as abnormal. Lamki[7] reviewed their experience and conclude that

muscle thickness of 3 mm should be considered as positive finding for infantile hypertrophic pyloric stenosis in infants less than 30 days of age.

In this study, we studied relationship between duration of vomiting and ultrasonographic findings in IHPS like pyloric canal length, diameter and pyloric muscle thickness. Changes in pyloric canal length compared with duration of vomiting. Fifteen patients came with 1 week duration of vomiting, among these 14 had positive pyloric canal length (16 mm or more), 15 patients came with 2 weeks duration of vomiting and all had positive pyloric canal length (100%). Five patients came with 3 weeks duration of symptoms and 100% were positive for pyloric canal length, similarly 10 patients came with 4 weeks duration of vomiting and 5 with duration more than 4 weeks and all were positive for pyloric canal length. It showed that pyloric canal length became positive very early in case of IHPS, so we can diagnose IHPS in very early stage with the help of ultrasonography. Tamura and Nagea[13] showed same criteria in their study to diagnose IHPS by ultrasonography.

Diameter of pylorous was compared with duration of vomiting. Fifteen patients came with 1 week duration of vomiting and pyloric diameter on ultrasound was found to be positive in 10 (66.6%). In patients with duration of vomiting 2 weeks, pyloric diameter was positive in 80% cases. Pyloric diameter was 100% positive in patients who came with the history of vomiting for 3 weeks or more. It showed that pyloric canal diameter had intermediate sensitivity in early detection of IHPS. Ozsvath[14] determined the pyloric volume in his study by measuring pyloric diameter and pyloric length and applied following formula.

Pyloric Volume=¼pi×(pyloric dia)^2×pyloric length

He divided the patients in two groups, those with and those without palpable pyloric mass. His results showed that infants with palpable pyloric mass had an average pyloric volume of 3.33±1.76 mm^3 which was statistically larger than those whose hypertrophied pylorus could not be palpated.

In our study, we also compared the duration of vomiting and pyloric muscle wall thickness. Fifteen patients came with 1 week duration of vomiting and pyloric muscle thickness was positive only in 2 patients (13.3%), similarly 7 out of 15 patients (46.6%) were having positive pyloric muscle thickness who presented with 2 weeks duration of vomiting. In patients with 3 weeks duration of vomiting, rate of positive muscle thickness was 80% (4 out of 5), 4 weeks duration of vomiting, rate of positive muscle thickness was 100% (10 out of 10) and in >4 weeks of duration of vomiting, rate of positive pyloric muscle thickness was 100% (5 out of 5). It showed that pyloric muscle thickness is least important in early detection of disease as compared to the pyloric canal length and diameter.

Only one patient's was not diagnosed by ultrasonography, otherwise it was accurate in 98% cases. Reason for negative ultrasound finding in one patient was report given by junior resident in radiology department without consulting his senior. Jerzy Niedzielski *et al*[10] mentioned in his study, ultrasonographic imaging had a sensitivity of 98%, specificity of 100% with a positive predictive value of 100% and 90% respectively. Foster N[15] mentioned in his study ultrasonographic criteria for the positive diagnosis, pyloric muscle thickness ≥3 mm and pyloric muscle length ≥17 mm. The sensitivity and specificity of pyloric muscle thickness was 91 and 85% respectively and for pyloric muscle length was 76 and 85% respectively.

Haahr[11] and Nelson mentioned in his study that out of 147 patients, 105 were diagnosed clinically; upper GI radiography was done in 23 and ultrasound in 21 cases. False negative in 4. Riccabona[16] and Weitzer concluded in their study that ultrasonography (including colour Doppler) is a valuable tool for the monitoring infants with hypertrophic pyloric stenosis undergoing conservative treatment; however initial sonogram cannot predict the further course of the disease. Hernaz *et al*[17] showed in his study that ultrasonography is the most sensitive test to diagnose pyloric stenosis in the absence of a palpable olive. Mullassery D mentioned 1% rate of negative exploration in IHPS and that can be overcome by positive feed test and in house ultrasound in an alkalotive infants.[18]

CONCLUSION

Ultrasonography is the investigation of choice for early diagnosis of IHPS before significant fluid and electrolyte imbalance occur. It is cost effective, harmless, freely available and easier to perform. Pyloric canal length and diameter are more specific for the diagnosis of IHPS than pyloric muscle thickness.

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