A. Khatami MD[1]
J. Ghoroubi MD[2]
F. Imanzadeh MD[3]
F. Attaran MD[4]
M. Mehrafarin MD[4]
M.R. Sohrabi MD, MPH [5]

Olive Palpation, Sonography and Barium Study in the Diagnosis of Hypertrophic Pyloric Stenosis: Decline in Physicians' Art

Background/Objective: Hypertrophic pyloric stenosis (HPS) is the commonest indication of pediatric surgery in neonatal period and early infancy. There are some clinical and radiological methods for the diagnosis of HPS. As an example, a positive "olive sign" in the abdominal examination is diagnostic; however, it seems that performing physical examination for the detection of this sign has been abandoned and that this practice has been replaced by sonography and other paraclinical tests. The aim of this study was to assess the ability of our physicians in finding the palpable olive in clinical examination and the accuracy of sonography and the true positive rate of barium study.

Patients and Methods: We evaluated 84 patients admitted to our hospital during a 7-year period in which the final surgical report was HPS. Clinical examination for the right upper quadrant (RUQ) olive like mass, barium study and ultrasound findings of HPS were evaluated. Pediatric residents (junior and senior residents) examined all these cases. Twenty-one patients had a barium study and 81 had a sonography, which was performed by an attending radiologist. Data were evaluated for the diagnostic yield (DY) of all these diagnostic tools.

Results: The mean age of the patients was 36.1 days on admission and the male/female ratio was 5.4/1. All the patients had a clinical examination, in which the olive sign was detected in only 13 cases (DY= 15.5%, 95% CI: 12%-19%); 81 patients had a sonography, in 71 of whom HPS was detected (DY = 87.7%, 95% CI: 85%-92%); barium study revealed HPS in 16 of 21 patients (DY = 76.2%, 95% CI: 71.4%-82%).

Conclusion: Sonography was more precise than clinical examination and barium study in detecting HPS. Due to the crying baby and the distended stomach, less time is spent for clinical examination. Therefore, paraclinical studies such as imaging become the first step in diagnosis and are requested earlier and even as the first diagnostic study on admission. This leads to reduction of doctors' experience in finding the olive sign.

Keywords: Infantile Hypertrophic Pyloric Stenosis, Ultrasound, Clinical Examination

1. Assistant Professor, Department of Radiology, Mofid Children's Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
2. Assistant Professor, Department of Pediatric Surgery, Mofid Children's Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
3. Associate Professor, Department of Pediatric Gastroenterology, Mofid Children's Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
4. Mofid Children's Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
5. Assistant Professor, Department of Community Medicine, Faculty of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Corresponding Author:
Alireza Khatami
Address: Department of Radiology, Mofid Children's Hospital, Shariati Ave.,Tehran, Iran.
Tel: +9821-2225-1737
Fax: +9821-22220254
Email: alireza_khatami31@yahoo.com

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Introduction

Hypertrophic pyloric stenosis (HPS) which is caused by thickened antropyloric muscle, is a disease which causes gastric outlet obstruction.[1-3] It is the most common surgical condition in infants that begins between two and 10 weeks of age.[4-6] This disease was not known until 1887 when Hirschsprung reported two fatal cases in a German pediatrics congress.[7] This disease is presented with projectile non-bilious vomiting which may be blood thinned if it is prolonged and may cause hypochloremic hypokalemic alkalosis and death in more than 50% of the affected patients.[1]

Palpation of an olive-like mass in the right upper quadrant (RUQ) is considered as a diagnostic sign with no need for further evaluation.[1-8] Because clinical examination of a crying infant is difficult and time consuming, nowadays, paraclinical and imaging findings have been used increasingly to better detect

HPS.[2] An elongated pyloric canal outlined by a string of contrast material, the so-called "string sign" or separate multiple linear tracts of contrast material in barium study are diagnostic signs.

The "double-track sign", first described by Haran et al. in 1966,[9] reveals a sensitivity up to 95%[10] for the detection of HPS. Barium study was the most important imaging modality until the late 1970's. The first ultrasound (US) finding was introduced by Teele and Smith in 1977[11] and US became the modality of choice in the diagnosis of HPS.[10,12-14] An increase in the sensitivity and specificity of US to (89%–100%)[15-17] and an accuracy of 100% in some studies[10] is the reason why US is widely used. The measurements which are accepted are a muscle thickness >3 mm and a canal diameter >15 mm.[18] Although endoscopy has been introduced by some authors as a successful diagnostic means for the diagnosis of HPS in the recent years,[19] its invasiveness and the associated expenses reduce the feasibility and routine use of this modality.

However, in all literatures, when we focus on clinical examination to find the olive sign, we face too many US requests for finding the etiology in a vomiting infant without any impression about the cause of the disease from the referring doctors. In our evaluation, although we found many HPS in these cases, no clinical suspicions were presented. We hypothesized that availability of US in academic clinics may be the cause of lack of patiently clinical examination by physicians. Therefore, we conducted this study to evaluate our doctors' ability in finding HPS by physical examination and compare the results with other reports.

Patients and Methods

We retrospectively evaluated 84 patients referred to our hospital in a 7-year period from 2001 to 2008 with surgically proved HPS. The clinical findings on admission including palpation of RUQ olive mass, and the positive imaging findings in barium meal (*i.e.*, delayed passage, double track sign, elongation and upward turn of pylorus) and sonographic findings of HPS (*i.e.*, muscle thickness >3 mm, canal diameter >15 mm) were noted. These patients were brought in by their parents or were referred to us by pediatricians for prolonged vomiting, dehydration or severe reflux; none of them had a note or document from the referring physician suggesting HPS or palpation of an abdominal mass. All these patients were examined by a pediatric resident in the emergency department (junior residents who were supervised by senior residents). Data were analyzed by SPSS version 11.0 using McNemar test for comparing clinical examination with sonography in detecting HPS. Also, the kappa statistic was calculated to show the agreement between them. Chi square and t tests were used for subgroup analysis. In this study, we calculated the diagnostic yield of the accompanying barium studies of our patients, which were included in their file. Of course, when there are diagnostic sonographic findings there is no need for additional barium study and vice versa.

Results

Sonographic and barium study findings in these patients were reviewed from their files. The findings were then compared with the clinical examination performed by the pediatric residents in our hospital. Out of 84 studied patients, we detected 71 boys and 13 girls with a male:female ratio of 5.4:1. The mean age of the patients was 36.1 (range: 10–92) days on admission. The mean age of the patients on admission was 36.1±13.7 days (10-92), this figure was 37.1 for boys and 30.8 for girls. The mean age at symptom presentation was 26.8±11.3 (8-76), 27.4±14.9 days for boys and 23.9±7.3 days for girls which shows an earlier presentation of symptoms in girls. The mean time between the beginning of symptoms and presentation to the physician was 9.3±8.3 days.

All 84 patients were examined clinically. RUQ olive mass was noticed in 13 of these patients with a diagnostic yield of 15.5% (95% CI: 12%–19%). Barium study was performed in 21 of the 84 studied patients. HPS was revealed by barium sudy in 16 patients with a diagnostic yield of 76.2% (95% CI: 71.4%–82%). Finally, US was performed in 81 of 84 patients which revealed HPS in 71 patients with a diagnostic yield of 87.7% (95% CI: 85%–92%).

The relationship between gender of patients and positive findings in clinical examination, barium study and US findings were evaluated which had no

significant difference (p=0.11) (Tables 1 and 2). According to our study, there was significant difference between US and clinical examination in finding HPS (p<0.001). No agreement was observed between the two techniques (kappa=0.00±0.039 CI 95%: -0.075-0.076); US had a significantly higher diagnostic yield. Moreover, barium study was more than clinical examination in detecting HPS (p<0.05). There was no significant difference between US and barium study in finding HPS (p=0.24).

Discussion

Projectile vomiting in early infancy is a sign of HPS. However, periampulary duodenal stenosis, pylorospasm, hiatal hernia and reflux are other differential diagnoses in this age group.[1,20] The incidence of HPS is 1-8 per 1000 live births with a male:female ratio of 4:1.[21-24] With the frequency of one-third to one-fifth of the white population, HPS is less common in the Indian, Black, and Asian populations.[24,25] Infants of mothers or fathers who had a positive history of HPS have a higher risk for developing HPS. If the mother has a positive history of HPS, 20% and 7% of the male and female infants are likely to develop HPS, respectively. If the father has HPS, involvement of his boys and girls are 5% and 2.5%, respectively.[1] Although the etiology of this disease is not well understood, some environmental conditions[24] and genetic predispositions are proposed. Several associated genetic syndromes, such as Smith-Lemli-Optiz and Cornelia de Lange, and some chromosomal abnormalities such as trisomy of chromosome 9, have been reported.[4] Male:female ratio is 2.5–5.7:1 [26,27] which was the same as our findings (5.4:1). In this study, the mean age at presentation was 36.1 (range: 10–92) days; it was 38.3 (range: 12–140) days in the study by Godbole et al.[27]

Table 1. Olive Palpation on Clinical Examination

Olive palpation on clinical examination	Boys	Girls	Total
Positive	11 (13%)	2 (2%)	13 (15%)
Negative	60 (71%)	11 (13%)	71 (84%)
Total	71 (84%)	13 (15%)	84 (100%)

Table 2. Sonographically Confirmed HPS in this study

Sonographic finding of HPS	Boys	Girls	Total
Positive	59 (73%)	12(15%)	71 (88%)
Negative	9 (11%)	1 (1%)	10 (12%)
Total	68 (83%)	13 (16%)	81 (100%)

Palpation of the RUQ olive mass was considered as the diagnostic hallmark, with no need for further evaluation.[1,8] In some studies [23] about 70% of the patients had an epigastric mass (olive sign) and some of them revealed peristaltic waves. However, in the study by Tunell et al.[28] and Scharli et al.[29] the sensitivity of clinical examination in finding the pyloric mass by an experienced hand was 75%–85%. In an evaluation by Macdessi et al.,[30] finding a RUQ mass in abdominal examination by a physician was reported in 87% of patients during 1974-7. The rate, however, reduced to 49% from 1988 to 1991. It was also mentioned that referring patients to imaging studies like barium meal and US was increased from 20% of cases during 1974-7 to 61% during 1988-91. He concluded that the more use of imaging modalities causes reduction in the doctors' experience. In van der Schouw's study, 57% of patients with vomiting who had a negative clinical abdominal examination had sonographically proven HPS.[31]

In this study, 81 (96%) of 84 patients underwent sonography and 21 (25%) of 84 patients underwent a barium meal study, which was more common than Macdessi's study.[30] The diagnostic yield of olive palpation decreased to 15.5% in this study, which shows marked reduction compared to what was reported by Macdessi et al.

We conclude that more availability and good resolution of US with its high diagnostic yield [10] lead to the increased request for using this modality in infants with vomiting even before performing an exact clinical examination or asking for other imaging modalities.

Gentle examination of a calm and not crying baby with a relaxed abdomen and a non-distended stomach is necessary for palpation of an olive mass. This procedure is time-consuming, so many physicians prefer to send the patient to imaging departments without careful examination. This problem, however, has reduced the physicians' ability to recognize the olive sign, which has also been noted by other authors.[1,10] Macdessi's study[30] revealed that use of imaging modality has no benefit in the earlier diagnosis or

change in the management of patients with HPS. Although like other studies[26] we did not evaluate these differences, physicians, junior medical staff and residents will not be encouraged to become experienced in clinical examination. This, in turn, results in our lower expected ability than other centers in finding the olive sign.

One of the most important limitations in this study which caused some kind of information bias was related to the clinical examination of the patients. More than 10 physicians examined the patients in this study. In order to minimize the bias, these physicians were trained and their senior resident completed their examination. However, radiographic findings and sonography was performed by two radiologists expert in finding HPS sonographically, and familiar with the radiographic appearance.

In conclusion the feasibility and accessibility of US, which has no need for sedation or premedication, in spite of a crying, non-cooperative infant with a distended stomach, leads to more and earlier requesting sonography. This causes a reduction in the skills of our physicians, which is not promising. In this study, which was similar to other studies, the diagnostic yield of barium study was high. However, with the increased sensitivity and accuracy of US and the risk of radiation associated with barium study for infants, this modality has little place in the diagnosis of HPS. This technique is performed rarely when the sonographic finding is confusing or when US is normal in severely vomiting infants.[32]

It is necessary to encourage our physicians to examine a child carefully and patiently to enhance their experiences, and to re-examine the child with sonographic findings of HPS; if possible, which is very useful in improving physicians' ability in finding the olive sign.

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