INFANTILE HYPERTROPHIC PYLORIC STENOSIS IN NIGERIA: A MULTICENTER RETROSPECTIVE STUDY.

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ABSTRACT

Background: **Infantile hypertrophic pyloric stenosis (IHPS) is a disease whose incidence varies across the different races worldwide. This study examined the epidemiology, clinical presentation and management of IHPS in Nigeria.**

Patients and Methods: **A retrospective study of cases of IHPS was conducted across six paediatric surgical centres in Nigeria with complements of at least two paediatric surgeons and high patient turn overs. Data collected were analyzed, the results obtained were expressed in simple percentages, mean ± standard deviation while linear relationships were obtained using Spearman's correlation and the level of significance set at $p < 0.05$.**

Results: **One hundred and thirty-one patients were managed across the six centres in Nigeria, their ages ranged from 5 days – 44 weeks with a median of 6 weeks. There were 109 (83.2%) boys and 22 (16.8%) girls (M: F = 5:1). Electrolyte derangement was observed in 63(48.1%) patients (hyponatraemia – 42.0%, hypokalaemia – 35.9%, hypochloraemia – 32.1% and metabolic acidosis – 39.7%). The peri-operative mortality rate in this review was 5.3%. Post-operative complications had statistically significant association with longer duration of symptoms before presentation ($p = 0.037$), presence of jaundice ($p = 0.024$) and raised levels of creatinine at presentation ($p = 0.002$). Longer duration of symptoms before presentation ($p = 0.037$) were significantly associated with mortality.**

Conclusion: **The epidemiology and clinical presentations are still similar to findings from outside Nigeria but comparable to other Low Middle Income Countries and post-operative outcome is also comparably good.**

Keywords: Africans, Incidence, Infantile, Pyloric stenosis.

INTRODUCTION

Infantile hypertrophic pyloric stenosis (IHPS) is a common cause of persistent postprandial, non-bilious vomiting in infancy. It is characterized by hypertrophy of the circular muscles of the pylorus with consequent narrowing and obstruction of the gastric outlet.[1] The incidence varies across different racial and ethnic groups worldwide.[2, 3] It is more common in the Caucasians with an incidence of 5/1000 newborns and least common among Asians and Blacks.[2, 4,5,6] Although there is worldwide variation in the racial and ethnic prevalence of the disease, there appears to be an agreement in the sex incidence as various studies have reported a much higher prevalence in boys than in girls, which makes it the most consistent epidemiologic characteristic of the disease.[2,7,8,9] The etiology of IHPS is not properly understood but genetic and environmental factors have been variously suggested as risk factors in its development.[4,5,7] Non bilious vomiting is a prominent clinical feature of IHPS that has been widely reported with associated severe dehydration and electrolyte derangement (hypokalaemia, hypochloraemia, hyponatraemia, metabolic alkalosis and paradoxical aciduria); however, bilious vomiting and hematemesis have been reported in a small proportion of these patients.[10,11]

Fredet Ramstedt's pyloromyotomy is the treatment of choice for IHPS but this procedure should be delayed until adequate fluid and electrolyte resuscitation have been achieved for good management outcome.[11] The

relative rarity of this disease in Black Africans in comparison to the Whites, [12, 13] and the paucity of published literature from Africa on the disease prompted this multicenter study from Nigeria. This study therefore, examined the prevalence and clinical picture of IHPS in Nigeria.

PATIENTS AND METHODS

This was a retrospective observational cohort study of all cases of IHPS managed over a 20 year period in six randomly selected paediatric surgical centres (University College Hospital, Ibadan; Bowen University Teaching Hospital, Ogbomoso; Lagos State University Teaching Hospital, Lagos; Obafemi Awolowo University Teaching Hospital, Ile-Ife, Osun State; Ahmadu Bello University Teaching Hospital, Zaria, Kaduna State; Aminu Kano Teaching Hospital, Kano) in the Southern and Northern part of Nigeria from January, 2000 to December, 2019. Ethical approval was obtained for the conduct of this retrospective study from the respective six institutions and data collection and analysis were conducted in accordance with the ethical standards of 1964 declaration of Helsinki. Patients were included based on post-operative diagnosis of hypertrophic pyloric stenosis. Information regarding the patients' demography, risk factors for IHPS, clinical presentation, electrolytes levels, radiological investigations, type of surgical access, post-operative complications, length of hospital stay, and final outcome of management were obtained from medical records and entered into a proforma. Data obtained were analysed using the IBM Statistical package for Social Sciences (SPSS) Version 23. Categorical variables were summarized as frequencies and percentages. Continuous data were summarized as mean and standard deviation or median and range, depending on the distribution of the data. The correlation between the pre- and post-operative lengths of hospital stay was tested using the Spearman's rank correlation. The association between categorical variables and mortality was tested using the Fisher's exact test, while association between continuous variables and mortality was tested using the Mann Whitney U test. The level of statistical significance in this study was set at $p < 0.05$.

RESULTS

A total of 131 patients whose clinical records were available were studied from the six centres with a case note retrieval rate of 75%. Their ages ranged from 5 days – 44 weeks with a median of 6 weeks and 67 (51.5%) of the patients presented between the age of 4 – 8 weeks of life (Figure 1). There were 109 (83.2%) boys and 22 (16.8%) girls with a, M: F of 5:1. The mean birth weight of the patients was 3.3 (± 0.5) kg, whereas the mean weight at the time of presentation was 3.4 (± 0.9) kg. The median duration of symptoms before presentation was 4 days (1 – 120 days).

About 50% of the patients presented in the months of January (10, 7.8%), February (16, 12.4%), March (4, 3.1%), November (13, 10.1%) and December (13, 10.1%) [Table1], while seventy three (56.6%) of the total cases seen where during the rainy season. All the patients presented with persistent non-bilious vomiting; other clinical presentations include dehydration (69, 52.7%), visible peristalsis in the upper abdomen in (112, 85.5%), palpable olive shaped mass (98, 74.8%) and failure to thrive in (107, 81.7%) (Table 2).

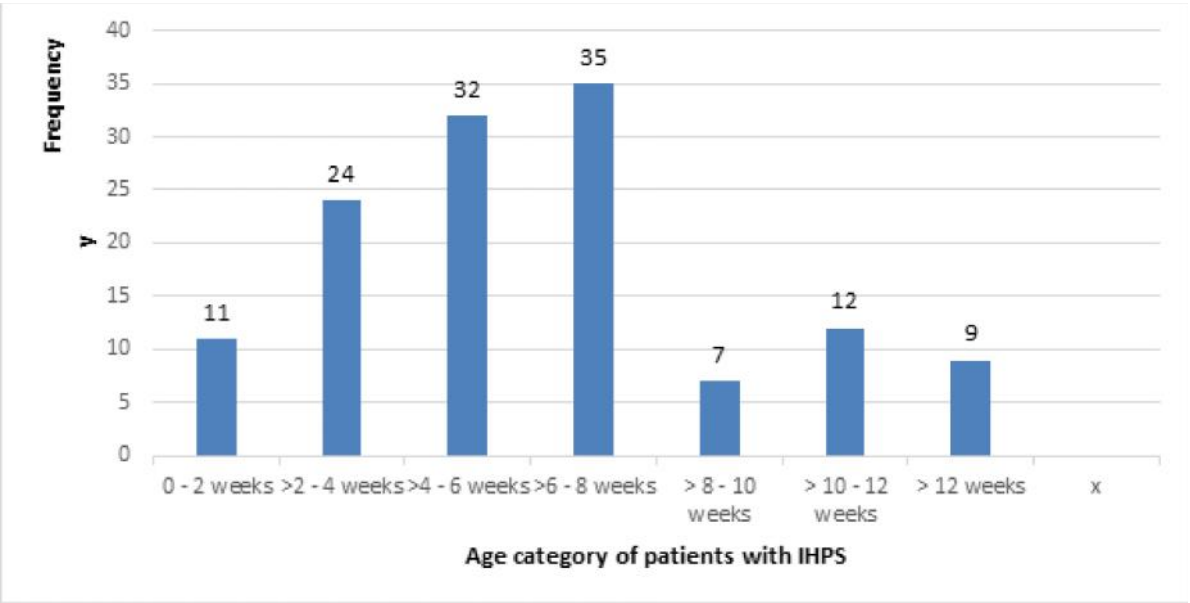

Figure 1: Age distribution of patients with IHPS at presentation.

Table 1: Month of presentation of cases and seasons

Month of presentation	Seasons	Frequency	Percentage
January	Dry	10	7.8
February	Dry	16	12.4
March	Dry	4	3.1
April	Rainy	9	7.0
May	Rainy	14	10.9
June	Rainy	7	5.4
July	Rainy	12	9.3
August	Rainy	3	2.3
September	Rainy	12	9.3
October	Rainy	16	12.4
November	Dry	13	10.1
December	Dry	13	10.1
Total	**Dry – 5; Rainy - 7**	**129**	**100.0**

Table 2: Presenting symptoms and signs

Symptoms	Frequency	Percentage
Vomiting (non-bilious)	131	100.0
Constipation	21	16.0
Excessive crying	18	13.7
Fever	11	8.4
Refusal of feeds	4	3.1
Jaundice	7	5.3
Dehydration	69	52.7
Visible peristalsis in the upper abdomen	112	85.5
Olive shaped mass	98	74.8
Failure to thrive	101	77.1
Pallor	7	5.3

Overall, 63 (48.1%) patients had at least one electrolyte derangement with hyponatraemia occurring in 55 (42%) patients, hypokalaemia in 47 (35.9%), hypochloraemia in 42 (32.1%) patients and metabolic alkalosis in 52 (39.7%) (Table 3). The mean electrolyte levels of the patients at presentation were Sodium – 133 ± 8 mmol/l, Chloride – 90 ± 12 mmol/l, Potassium – 3.3 ± 0.7 mmol/l and Bicarbonate – 25 ± 3 mmol/l (Table 3). Ultrasonography of the abdomen was performed on 79 (60.3%) patients with abnormal findings of elongated pyloric channel and distended stomach observed in 74 (56.5%) patients, dilated stomach only in 3 (2.3%), whereas 1 (0.8%) patient each had normal finding and inconclusive

Table 3: The mean electrolytes levels and pattern of electrolyte derangement in the patients at presentation.

Electrolytes (reference values)	Mean ± SD	Reduced levels n (%)	Normal levels n (%)	Increased levels n (%)
Sodium (*135 – 144 mmol/L*)	133 ± 8	55 (42.0)	37 (28.2)	4 (3.1)
Chloride (*96 – 109 mmol/L*)	90 ± 12	42 (32.1)	38 (29.0)	4 (3.1)
Potassium (*3.5 – 5.3 mmol/L*)	3.3 ± 0.7	47 (35.9)	48 (36.6)	1 (0.8)
Bicarbonate (*24 – 32 mmol/L*)	25 ± 3	2 (1.5)	41 (31.3)	52 (39.7)
Urea (*18 – 45 mg/dl*)	29.5 ± 22.7	32 (24.4)	42 (32.1)	17 (13.0)
Creatinine *(0.5-0.8mg/dl)*	0.6 ± 0.2	5 (3.8)	11 (8.4)	8 (6.1)

examination. Similar findings of elongated pyloric channel and distended stomach were also observed in 4 (3.1%) patients that had Barium meal performed on them. Plain abdominal X-ray was performed on 33 (25.2%) patients with a finding of distended stomach. All the patients had open Fredet-Ramstedt's Pyloromyotomy with a curvilinear supra-umbilical approach in 105 (80.2%), right upper transverse abdominal incision in 23 (17.6%) patients, transverse supra-umbilical approach in 2 (1.5%) and infra-umbilical incision in one (0.8%) patient.

Post-operative complications include vomiting in 4 (3.1%) patients, complete wound dehiscence, reactionary haemorrhage, and surgical site infection in 2 (1.5%) patients each with a complication rate of 9.2% (Table 5). Five (3.8%) patients had re-operation, including 3 (2.3%) with reactionary haemorrhage and 2 (1.5%) with burst abdomen. Post-operative complications to include mortality had statistically significant association with longer duration of symptoms before presentation (p = 0.037), presence of jaundice (p = 0.024) and raised levels of creatinine at presentation (p = 0.002). There were 7 mortalities

Table 4: Post-operative complications

Complication	Frequency	Percentage of study population, n = 131
Post-operative vomiting	4	3.1
Burst abdomen	2	1.5
Hemorrhage	2	1.5
Surgical site infection	2	1.5
Mucosal perforation	1	0.8
Disseminated Intravascular Coagulopathy	1	0.8
Incisional hernia	1	0.8
Total	**13**	**10.0**

giving a mortality rate of 5.3%. Mortality was not significantly associated with the age of the patients at presentation (p = 0.386), gender (p = 1.000), weight of the patients at presentation (p = 0.932), hyponatraemia (p = 0.453), hypokalaemia (p = 1.000), hypochloraemia (p = 1.000), metabolic alkalosis (p = 0.701) and the pre-operative length of hospital stay (p = 0.932). However, the presence of clinical pallor (p = 0.012) and visible peristalsis in the upper abdomen (p = 0.041), longer duration of symptoms before presentation (p = 0.037) were significantly associated with mortality. The pre-operative length of hospital stay ranged from 0 – 23 days with a median of 3 days due to timing for adequate resuscitation, stabilization, nutritional rehabilitation, and financial readiness by parents for surgery whereas, the post-operative length of hospital stay ranged from 1 – 29 days with a median of 4 days. There was a weak positive correlation between the pre-operative hospital stay and the post-operative stay in days, and this was found to be statistically significant (r = 0.222, p = 0.013). The length of hospital stay ranged from 1 – 34 days with a median of 7 days. The median duration of follow-up was 2 weeks (0 – 8 months) and only one patient presented with a complication (incisional hernia) during long-term follow-up.

DISCUSSION

IHPS is an acquired condition involving the hypertrophy and hyperplasia of the circular muscles of the pylorus. The low number of patients recruited can be associated in part by the retrieval rate of 75% in this study. The ages of patients ranged from 5 days – 44 weeks with a median of 6 weeks and 67 (51.5%) of the patients presented between the age of 4 – 8 weeks of life. These observations are similar with findings in Benin, Enugu, both in Nigeria and by Chalya *et al.*, in Tanzania.[14,15,16] The median duration of symptoms before presentation was 4 days (range: 1 – 120 days), and agrees with the finding by Osifo et al in Benin. [14]

There is variation in the trend of presentation of IHPS across the regions of the world.[6,12] Non bilious vomiting, dehydration, failure to thrive and dehydration are the major presentations in over two-third of patients in this review. This is similar with findings from a retrospective review by Chalya *et al.* in Tanzania.[16] the incidence of cases recorded in this retrospective review is low compared to other regional studies in like 105 cases recorded over a five year period in Tanzania,[16] and even lower among Caucasians.[2] Previous studies have reported a higher incidence of IHPS amongst the Caucasians in North America and Europe with a lower incidence observed in Asians and Black Africans.[1,2,4,13] The recent decline in the incidence has been variously explained to be due to the association of Sudden Infant Death Syndrome (SIDS) with high incidence of IHPS in the Caucasians,[1,4] and the protective effect of exclusive breastfeeding of infants which tends to reduce the incidence of IHPS in blacks.[14,15] The relatively few numbers of cases reported from the six paediatric surgical centres in this study may be attributed to the widespread practice of exclusive breastfeeding in Nigeria as reported by Osifo *et al.*[14] In spite of the variations in the prevalence of IHPS between Caucasians and Blacks, there is considerable agreement in the sex incidence and age at presentation from previous reports,[3,12,13,16,17] with the sex incidence (M:F) ranging from 4.3:1 to 5.6:1 and the age at presentation from 3 weeks to 9 weeks. [3,12,13] The age range at presentation in this study follows a different pattern of being wide apart, however the median age at presentation is still similar to findings from previous studies.[3,18]

The aetiology of IHPS is unknown but genetic factors and environmental factors,[13,19] have been suggested with some risk factors like bottle feeding,[14] and seasonal distribution.[13] Although the seasonal distribution of IHPS has not been fully established, this study revealed that of the two major seasons in Nigeria, the incidence of IHPS was more in the dry season that span from November to March 56

(43.4%), and is characterized by little or no rainfall compared to the rainy season which covers about 7 months in a year. The dry season is a period when allergy is more pronounced during the year with associated upper respiratory tract infection.[5,6,8,9] Allergy resulting from the introduction of milk and other feeds to the child, may also play similar role by triggering type I or type IV hypersensitivity reaction with resulting inflammatory mediators causing increase vascular permeability and smooth muscle contractility leading to mucosal edema and pyloric spasm. This repeated spasm and edema may transiently thicken the pylorus wall. [13,14]

The diagnosis of IHPS used to be made clinically with persistent non-bilious vomiting and palpable pyloric mass during feeding however, the advent of ultrasonography has improved early diagnosis with contrast study often used to diagnose borderline or equivocal cases. Early diagnosis of IHPS was made in this review with the help of abdominal ultrasonography in the majority of the patients which and this is comparable to findings by Vinycomb *et al.*[20]

The management of IHPS has undergone a process of evolution from medical management to surgical management over a period of time in the developed countries.[21] Historically, medical management involved the use of antispasmodics like atropine and scopolamine with some results and surgical management was only reserved for cases of failed medical management.[21] This has even been recommended in a resource poor setting.[21,22] However, surgical management using the Fredet-Ramstedt's pyloromyotomy is the surgical treatment of choice, and was employed in all cases managed in these six centres.[15,19,20] Prior to surgery, patients with IHPS often have severe electrolytes abnormalities (hyponatraemia, hypokalaemia, and hypochloraemia) with metabolic alkalosis, due to the delay in making a diagnosis, which may have stemmed from the fact that IHPS is not a common problem in Nigeria and Africa.[21,23,24] Metabolic alkalosis noted in this study is similar to findings from other studies.[15,16,23] Furthermore, fluid and electrolytes correction may delay surgical intervention in resource poor setting, and this was responsible for a third of patient with prolonged pre-operative stay in this review.[23,24] Surgery can be open or laparoscopic pyloromyotomy. The laparoscopic procedure is known to have a comparable outcome but with superior cosmetic outcome to the open approach.[16] The open procedure is still commonly used in most centres in sub-Saharan Africa due to lack of laparoscopic equipment and expertise for the procedure,[14,15,16] and all patients in these series had open approach. A number of surgical approaches have been described for open pyloromyotomy in a bid to achieve good cosmetic outcome. The circum-umbilical technique is most favored as it is safe, has minimal complications and gives superior cosmetic outcome compared to the other approaches.[16,25,26] Majority of the patients in this study underwent the curvilinear supra-umbilical approach in 105 (80.2%) across the six centres showing its wide acceptance.

Overall mortality of 5.3% observed in this series is comparable to findings from other reports from Cameroon and Ethiopia.[3,19] The fact that the mortality was significantly associated with pallor in this study may suggest a possibility of inadequate resuscitation, and perhaps association with severe protein energy malnutrition.[27,28] The nutritional status of the patients were, however, not investigated in this review. However, the predictors of outcome as observed in this study disagree with findings of Chalya *et al.*[16] who reported that age below two weeks at presentation, longer duration of symptoms before presentation, prolonged preoperative hospital stay, surgical site infection, severe dehydration and electrolyte derangement were the main predictors of poor outcome.[16] The median length of hospital stay observed in this study is comparable to reports,[12,13,29,30] from other parts of the world despite the fact that all the patients had open pyloromyotomy compared to laparoscopic pyloromyotomy with apparent faster recovery.

Limitations

This study is limited by its retrospective nature as it did not allow for proper investigation of the aetiology of IHPS with regards to genetic and environmental factors in relation to the rarity of the disease in Africans. Future studies could investigate the nutritional status of the patients to establish if it could predict outcome as it was not done in this retrospective review.

The study limitations include; the blood gas analysis were not available for these patients and so were not included.

CONCLUSION

Post-operative complications had statistically significant association with longer duration of symptoms before presentation, presence of jaundice at presentation. The perioperative mortality noted where amongst those who presented with features of failure to thrive, sepsis, intractable hypokalemia; and were statistically significant with the presence of clinical pallor and longer duration of symptoms before presentation.

The epidemiology and clinical presentations are still similar to findings from outside Nigeria but

comparable to other Low Middle Income Countries and post-operative outcome is also comparably good. It remains to be seen whether a different picture would be obtained with a larger sample size.

Recommendations

1. The fact that this was a tertiary hospital-based study might have excluded patients that could not get to the hospital from the peripheral centres due to inadequate diagnosis and resuscitation. Hence, strengthening of secondary level of care in Nigeria will be a right step in the right direction.

2. All the patients studied had open pyloromyotomy, efforts should be made to provide laparoscopic method of care for future cases in the country to improve cosmetic outcome.

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