Prevalence and factors associated with *Helicobacter Pylori* infection among children with sickle cell anemia attending Mulago hospital, in Uganda

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Abstract

Background Children with sickle cell anemia (SCA) have a high predisposition to a range of infections and gastrointestinal disorders. Studies of children living in low income countries have shown high levels of infection with *Helicobacter Pylori* (H. Pylori), however, there are no reports in children with sickle cell anemia. **Objectives** We aimed to describe the prevalence and factors associated with *Helicobacter pylori* infection among children with sickle cell anemia at Mulago Hospital Sickle Cell Clinic, in Uganda.

Methods A cross sectional design was employed to consecutively enroll 369 children with confirmed sickle cell anemia aged 5-18 years, attending the Mulago hospital sickle cell clinic. Assessments included; abdominal pain (current, recurrent, generalized or epigastric), dyspeptic symptoms, other relevant medical and social histories. Blood and stool samples were collected and an antigen test (test kit SD Bioline) was carried out on the latter to determine H.pylori infection. Ethical approval, consent and assent (for children above 8 years of age) were obtained. Data was entered using EPI DATA version 3.1 and analysed using STATA version 12.0. H. pylori prevalence was determined as a proportion of children with a positive stool test expressed as a percentage. Adjusted Odds ratios (aOR) were used to determine factors associated with H.pylori infection.

Results H.pylori infection was detected in 47.7% (176/379), 95% CI (42.9-53.1) of the cases. Having epigastric pain was independently associated with H.pylori infection; aOR 2.22, 95%CI: (1.1 – 4.6), p-value= 0.03 . Pneumococcal vaccination aOR 0.41, 95% (CI 0.2-0.9; p=0.019) or H.pyroli combination therapy aOR 0.183, 95% (CI 0.1- 0.6; p=0.006) were protective against H.pylori. Recurrent abdominal pain did not predict H.pyroli infection.

Conclusions H.pylori infection was common among children with sickle cell anemia and was independently associated with epigastric pain but not recurrent pain. Pneumococcal vaccination and combination H. pylori treatment were protective against the infection. Screening for H.Pylori should be carried out in sickle cell anaemia children with epigastric pain.

Introduction

Sickle cell disease is the commonest genetic disorder worldwide with the highest frequencies of homozygous (HbSS) occurring in sub-Saharan Africa, where 3– 4% of the population are affected (1). According to the World Health Organization (WHO), 5% of the world population carries the sickle cell gene which is responsible for sickle cell anemia (SCA) and thalassaemia (2). Furthermore an estimated 300,000 infants are born globally each year, 2/3 of these occurring in Africa where the disease has a 5% contribution to the under-five mortality (2).

The genetic defect arises from a substitution of glutamic acid by valine in position 6 of the beta- globin chain resulting in the formation of an abnormal hemoglobin molecule (HbS), which is responsible for the disease presentations. Children with sickle cell anemia have a high predisposition to infections by encapsulated bacterial infections, such as *Streptococcus pneumoniae*, *Haemophilus influenzae*,

salmonella species, viral infections like *Parvovirus B19*, among others (3). This is in part due to the recurrent blood transfusions they get as well as the complication of functional asplenia resulting from infarctions. *Helicobacter pylori* (*H. pylori*) infection, a gram negative, micro aerophilic spiral, bacterial organism associated with peptic ulcer disease, chronic active gastritis and recurrent abdominal pain may also be as or more common than in the general population (3, 4). It is acquired early in life and dwells in the mucous layer of the gastric mucosa of the human stomach overlying the epithelium (5).

Recurrent abdominal pain, a common presentation in sickle cell anemia could be due to several factors including; *H.pyroli* infection, cholecystitis, ischemic bowel injury, paralytic ileus, splenic sequestration, acute hepatic syndromes and or gastritis related to prolonged use of non-steroidal anti-inflammatory drugs (6–9).

Global rates of *H.pyroli* infection vary from one region to another but estimates suggest that close to half of the world population is infected with this organism. Higher rates are reported in developing countries (10, 11), and many of the infected individuals are asymptomatic but can present with chronic gastritis associated with recurrent peptic ulcers and cancer (12, 13).

Chronic hypoxia/ infarction, anemia, and the increased use of non-steroidal anti-inflammatory drugs (NSAIDs) for pain management are culpable further promoting the growth and survival of *H. pylori* in children with SCA (4). Some studies have reported *H.pyroli* infection as an independent risk factor for peptic ulceration among chronic NSAID users. Equally anemia has been attributed to peptic ulceration in non NSAID users (14). This then indirectly implicates *H.pyroli* in the causation of gastritis and gastric ulcer pains (15, 16). Both of these could explain recurrent abdominal pain in children with sickle cell anemia.

The burden of bacterial infections has been studied among Ugandan children with sickle cell anaemia (17). The prevalence of *Helicobacter pylori* infection among sick children presenting to Mulago Hospital was found to be 64% in an earlier general study(18). However this was not limited to children with sickle cell anemia who may have more abdominal complaints.

We set out to establish the prevalence and factors associated with *H. pylori* infection among children with SCA at the largest care centre in Uganda given that its effects could mimic an abdominal crisis where appropriate treatment could be missed.

Methods

Study design and setting.

We employed a cross sectional study design to collect data at the Mulago Hospital sickle cell clinic Kampala Uganda between February and May 2016. This is the oldest and largest care centre for sickle cell anemia in Uganda. The clinic runs from Monday to Friday (8:00am to 4:00pm) and attends to an average of 30–40 patients each day.

Study population

This included children aged 5 to 18 years with confirmed sickle cell anemia by hemoglobin electrophoresis. Consent was obtained from the caregivers and assent from children above 8 years. We excluded any child with cognitive impairments secondary to stroke or any other cause because of their inability to describe abdominal pain.

Sample size and sampling procedure

The sample size of 369 children was calculated using Kish Lislle formula (1965) for objective 1 with a 95% confidence level, 5% degree of precision and a prevalence of *H.pylori* infection among children with sickle cell disease of 67.8% (4). This was adjusted by 10% to cater for missing or incomplete data. Fleiss formula was used to calculate a sample size of 206 children with fathers education being a predictor variable. Therefore, the larger sample size of 369 was considered for the study. Children who fulfilled the inclusion criteria were consecutively enrolled into the study. Ethical approval was obtained from the school of medicine research committee and consent obtained from the caregivers by the principle investigator/ research assistant.

Data collection method and procedures

Prospective participants were identified as they presented for routine care at the clinic and informed consent sought inclusion. Study aims, procedures, benefits and potential risks or discomfort were explained as part of the consenting process.

A standardized pretested and pre-coded interviewer administered questionnaire was then administered where consent was obtained and key information included; history of recurrent abdominal pain or presence of dyspeptic symptoms (*epigastric pain, nausea, acute abdominal pain, anorexia amongst others*). Recurrent abdominal pain was considered when a child reported at least three episodes of severe upper abdominal pain that affected normal functioning and required medical attention, within the three months to the clinic visit (19).

Current abdominal pain was considered as abdominal pain at presentation. Patients were also assessed for medication use, and other relevant medical and social history was taken.

Clinical signs included: body weight, height, nutritional status, presence of pallor, jaundice, hepatosplenomegaly, and epigastric tenderness. A calibrated digital weighing scale was used and readings to the nearest 0.1kg recorded. Height was measured using a Kawe height measure tape mounted on the wall and with no shoes to the nearest 0.1cm. Two measurements were taken and if there were any inconsistencies a third measurement was taken. An average of the two closest readings was taken as the correct measurement. Body mass index (BMI) was calculated for each child and BMI percentile for age recorded.

Collection of blood samples

Blood samples were drawn from patients following standard procedures. The skin over the antecubital fossa was cleaned using 70% alcohol followed by the drawing of 1–2mls ml of blood into an EDTA vacutainer for complete blood count assessment at Mulago hospital hematology laboratory using a Hematological analyzer MEK–7222 (UNIT1) celltac E brand.

The stool antigen test for *Helicobacter pylori*

Stool was collected either at the time of contact or later in the day for those who were unable to provide stool immediately and transported to the microbiology laboratory of Makerere University in cold boxes within 2 hours of collection at a temperature of 2 to 8⁰C until the analysis.

Helicobacter pylori infection was determined by using a stool antigen test kit SD Bioline brand from the republic of Korea. The kit was 98.4% sensitive and 100% specific. For the process, 50mg of the stool sample was mixed with the assay diluents at room temperature and after complete dissolution, 3 drops of the prepared sample were added into the sample well of the test device. A positive test was considered when both the test band and the control band appeared within the result window of the test device while a negative test was considered if only the control band appeared.

Data Management and analysis

All questionnaires were cross checked for completeness, data audited using frequency distributions and cross tabulated to detect missing and out of range/ illogical values.

The questionnaires and laboratory results were stored under lock and key to maintain confidentiality.

EPI DATA version 3.1 was used for data entry and STATA 12.0 for analysis. Baseline characteristics were summarized in proportions, means and medians. Continuous variables were analyzed using means or medians and their measures of dispersion while categorical variables were summarized using frequencies and percentages. The prevalence of *H. pylori* was determined as the proportion of children with a positive stool test reported as a percentage with its confidence intervals.

The factors associated with *helicobacter pylori* infection were analyzed; at the bivariate level basing on the outcome of the *H.pylori* test. A students t–test was used for continuous and the chi-square or Fisher's exact test for categorical data. Variables with p-values of less than 0.2 were considered for multivariate analysis where those with a *p-value* of less than 0.05 were considered significant. Analysis at this level was performed using the stepwise logistic regression model.

Research assistants included two nurses and one medical officer all trained prior to study commencement. The questionnaire was pretested, standardized and translated into the commonly

spoken local language before the data collection which was closely supervised by the Principal Investigator.

Laboratory quality was observed by; having inbuilt positive controls, double checking with prior established positive controls and storing the stool samples at temperatures of 2–8⁰ C before the analysis. In addition, two technicians conducted the analysis for quality.

Results

Descriptive statistics

A total of 375 children attending the sickle cell clinic were screened for enrolment into the study. Five children did not meet the inclusion criteria. Three of these children were below the age of 5, one was above 18 and one did not have a confirmed diagnosis of sickle cell anemia. Of the 370 children who met the study inclusion criteria, only one child was excluded because of cognitive impairment secondary to multiple strokes. Three hundred sixty nine children were eventually consented and enrolled into the study.

Demographic and baseline characteristics of the study participants

Girls constituted the majority at 199 (54%) and the mean age was 9.3 years, standard deviation SD (3.3), ranging between 5 and 18 years. Majority of the study participants came from Wakiso (45%) and Kampala (39%) districts. Ninety three percent of the caretakers were females, largely mothers. The mean age of the care takers was 35.4 SD (8.4) ranging between 12 and 80 years, 74% of them were married. Majority (61%) had obtained secondary education and half of them were self employed. Other demographic characteristics are shown in table 1.

Clinical findings

The commonest presenting symptoms of the study participants included; generalized body pain, weight loss, fever, loss of appetite, perception of abdominal fullness/gas, cough, vomiting, nausea, diarrhea, epigastric pain and abdominal pain in reducing order of frequency. Details are shown in figure 1.

Prevalence of *H.pylori* infection and associated factors

The overall prevalence of *H.pylori* infection among these children was 47.7% (176/369) {95% Confidence Intervals CI (42.9–53.1)}. This was based on the presence of positive *H.Pylori* test done on the stool samples.

At bivariate level we included; social demographic characteristics, clinical characteristics and laboratory findings as variables for association with the *H.pylori* infection. Clinical variables including; having had epigastric pain at presentation, use of morphine for pain relief were positively associated with *H.pylori*

infection whereas pneumococcal vaccination, prior treatment with “anti-helicobacter medicines” involving any combinations of amoxicillin, metronidazole, omeprazole or magnesium trisilicate, were negatively associated with *H.pylori* infection. Stable state hemoglobin concentrations of more than 7g/dl were associated with *H.pylori* infection however this was not found to be statistically significant, (OR 1.344, 95%CI: (0.9–2.0) *p*- values 0.165). Of note there was no association between *H.pylori* infection and recurrent abdominal pain. At multivariate analysis, presence of epigastric pain at presentation remained significantly associated with *H.pylori* infection aOR 2.222, 95%CI: (1.1–4.6), *p*-value 0.03. Children who had epigastric pain at presentation were 2.2 times more likely to be infected with *H.pylori* when compared to those who did not have epigastric pain at presentation. Protective factors against *H.pylori* infection included; pneumococcal vaccination aOR 0.410, 95%CI: (0.2–0.9), *p*- value 0.019 and recent history of use of anti *H.Pyrol*i medicines aOR 0.183, 95%CI: (0.1–0.6), *p*- value 0.006. Children who had been on these drugs within 2 weeks of presentation were 82% less likely to be infected with the bacteria and those who had pneumococcal vaccination were 59% less likely to be infected. Details of these analyses are summarized in table 2.

Discussion

This study determined the prevalence of *H.pylori* among children with sickle cell anemia aged 5–18 years attending Mulago National Referral Hospital. It also sought to establish the factors that are associated with this infection in the same population.

The prevalence of *H.pylori* infection among children with sickle cell anemia attending Mulago Hospital was 47.7%. This is a high prevalence of *H pylori* and is consistent with findings from studies in the same setting and in the Mulago community(18, 20).

Helicobacter pylori is a common infection of the gastric mucosa that occurs early in childhood and tends to vary with age. Whereas the prevalence was anticipated to be higher in SCA, this was not the case. The most likely explanation could be because 24% of the children had been recently treated with at least one of the drugs which included amoxicillin, metronidazole, omeprazole and magnesium trisilicate. These drugs are commonly used in the eradication for *H. pylori* infection. Karimi et al (2008) reported similar findings in Iran where the prevalence was 55% among children with sickle cell disease and recurrent abdominal pain (9).

Higher rates were found in those studies that excluded patients who had received prior treatment with the *anti H.pyroli* medicines such as the study by Sembanjo et al in Nigeria. In this study a high prevalence of 67.8% was reported (4). We employed the more reliable stool test for an active *H.pyroli* infection in our study compared to the serum ELISA based antibody test used by Sembanjo et al that tests positive for antibodies from infections for longer spells (2 or more months) irrespective of treatment status. This could have contributed to the differences in the prevalence rates between the two studies. An Egyptian and Iranian study also reported higher rates of 79.2% and 68 % among adult patients with sickle cell disease and beta thalassaemia, respectively (8, 21).

Mugaba et al's study which reported higher rates of 64% in a similar setting as ours was not limited to sickle cell anemia and used the *H.pylori* stool antigen test like the current study. For better comparisons we need to consider studies that used similar tests to ours.

Regarding the factors associated with *H.pyroli* infection, having had epigastric pain at presentation was found to be independently associated with *H.pylori* infection among children with sickle cell anemia at Mulago Hospital. This was not surprising since epigastric pain has previously been reported as a common dyspeptic symptom also associated with *H.pylori* in the general population. The other protective predictors included; having received pneumococcal vaccination and or used *anti H.pyroli* medicines by the time of presentation to the clinic. The prior use of anti *H.pylori* medicines as being protective is biologically plausible however the protective role of pneumococcal vaccine may need to be studied further as limited data is available on the protective role of vaccines against *H. pylori* (22).

We did not find any positive association between low socioeconomic statuses that featured prominently in Sembanjo et al's Nigerian study (4). This could have been contributed to by the relatively high education levels of caretakers in the current study, majority of whom had obtained secondary education and probably in fairer socioeconomic state. In another study done on children in Kampala by Hestvik et al, low socioeconomic status of the family was not associated with *H.pylori* infection (20).

Female gender has previously been reported to have a slightly higher risk for *H.pylori* similar to what we found. However age association was not in tandem with findings in other studies that found a decline in prevalence after 10 years of age attributed to spontaneous elimination of *H.pylori* infection (4). There was no difference in the prevalence of *H.pylori* infection among those less than 12 years and those aged 12 years and above. We also excluded those below 5 years of age for the challenges relating to the patient description of abdominal pain.

Recurrent abdominal pain had no independent association with *H.pylori* infection just as reported by Sembanjo et al in 2010. In contrast, Karimi et al 2008 found 54% of recurrent abdominal pain in sickle cell anemia patients attributable to *H.pylori* infection (9), and Taghriid et al in 2011 reported significant positive association between *H.pylori* infection and recurrent abdominal pain among SCD patients (8). A similar description of recurrent abdominal pain was used in these studies but ours was a larger, epidemiological study.

Strengths of the study

This is among the few studies that have studied *H.pylori* infection among sickle cell disease patients in Uganda. The study also evaluated one of the commonest /major symptoms of sickle cell anemia which is abdominal pain. We used a highly sensitive (100%) and highly specific (98.4%) *H.pyroli* stool antigen test to detect active infection among our patients. This implies a true reflection of the infection status compared to previous studies that may have exaggerated the magnitude of the infection based on the high sensitivity and poor specificity of the tests used.

Limitations of the study

We were unable to perform endoscopy with biopsy and histology of gastric specimen which is the gold standard test for presence of *H. pylori* infection. However the stool antigen test used is highly sensitive at 100% and highly specific at 98.4% and been used in other similar studies.

Conclusions And Recommendation

Conclusion

The prevalence of *H.pylori* among children aged 5–18 years with sickle cell anemia attending Mulago Hospital is high at 47.7%. Epigastric pain was strongly associated with *H.pylori* infection among children with sickle cell anemia attending Mulago Hospital. However; recurrent abdominal pain was not. Pneumococcal vaccination, recent use of any combination of, amoxicillin, metronidazole, omeprazole or magnesium trisilicate, were protective against *H.pylori* infection.

Recommendations

Children with sickle cell anemia presenting with dyspeptic symptoms particularly epigastric pain should be routinely assessed for presence of *H. Pylori*.

A longitudinal or cohort study should be done to establish the role of pneumococcal vaccination in protecting against *H.pylori* infection among SCA patients.

Abbreviations

aOR

Adjusted odds ratio

BMI

Body Mass Index

CI

Confidence Intervals

ELISA

Enzyme-linked Immunosorbent assay

HbS

Sickle cell hemoglobin

HbSS

Homozygous Sickle Cell Disease

H. pylori

Helicobacter pylori

NSAIDs

Non-steroidal anti-inflammatory drugs

SCA

Sickle Cell Anemia

SD

Standard deviation

WHO

World Health Organization

Declarations

Ethics approval and consent to participate

Ethical approval was sought from the Makerere University School of Medicine Research and Ethics Committee and administrative clearance from the clinic was obtained. In addition, informed consent was obtained from the caretakers and assent from children aged 8 years and above. Confidentiality was maintained in all the cases. The exception was when the test results were needed for patient care and at which time they were communicated to the physicians through the children's caretakers. For the majority results were obtained at least 2 weeks after the sampling and *H.pylori* treatment by Selgrad et al. 2009 was recommended (23).

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interest

The authors declare that they have no competing interest.

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Authors' contributions

ISM was the principal investigator for this work, developed the proposal, designed the data collection tool, spear headed the data collection process, involved in data entry, analysis and final writing of the manuscript.

PGK as the first supervisor was involved in proposal development, guiding in interpretation and analysis, drafting and revising the work.

HH as a co-supervisor was also involved in proposal development, guiding in interpretation and analysis, drafting, revising the work and provision of updated literature on the subject.

GN as a co-supervisor was also involved in proposal development, guiding in interpretation and analysis, drafting, revising the work and provision of statistical advice.

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Tables

Table 1 Baseline characteristics of the study participants

Variable	Frequency(N=369)	Percentage (%)
Age of the child (years)		
<12	275	75
> =12	94	25
Sex of the child		
Male	170	46
Female	199	54
Age of the caretaker (years)		
<30	79	21
31-40	213	58
>40	77	21
District of residence		
Kampala	143	39
Wakiso	167	45
Other	59	16
Home setting		
Rural	89	24
Urban	280	76
Caretaker gender		
Male	26	7
Female	343	93
Employment status of caretaker		
Professionally employed	51	14
Self Employed	184	50
Peasant Farmer and others	31	8
Housewife	103	28
Level of education of the care taker		
At most primary	141	38
Post primary	228	62

Table 2: Factors associated with *H.pylori* Infection among the study participants

	H.pylori		OR(95% C I)	P-value	aOR (95% CI)	P-value
	Negative	Positive				
Age of the child (years)						
<12	145(75)	130(74)	1			
>=12	48(25)	46(26)	1.069(0.7-1.7)	0.780		
Sex of the child						
Male	89(46)	81(46)	1			
Female	104(54)	95(54)	1.004(0.7-1.5)	0.986		
Gender of the household head						
Male	141(94)	131(98)	1			
Female	9(6)	2(2)	0.239 (0.1-1.1)	0.071	0.255 (0.1-1.3)	0.093
Main water source						
Tap	119(62)	113(64)	1			
Well	30(16)	23(13)	0.807 (0.4-1.5)	0.485		
Borehole	19(10)	18(10)	0.998 (0.5-2.0)	0.995		
Spring	14(7)	16(9)	1.204 (0.6-2.6)	0.634		
Tank	11(6)	6(3)	0.574 (0.2-1.6)	0.290		
Toilet facility used						
Water closet	21(11)	19(11)	1			
Pit latrine	172(89)	157(89)	1.009 (0.5-1.9)	0.979		
Current Epigastric pain						
No	168(87)	138(78)	1			
Yes	25(13)	38(22)	1.850 (1.1-3.2)	0.029	2.222 (1.1-4.6)	0.030
Recurrent Abdominal Pain						
No		117(66)	1			
Yes	128(66)	59(34)	0.993 (0.6-1.5)	0.975		
Pneumococcal vaccination						
No	156(81)	160(91)	1			
Yes	37(19)	16(9)	0.422 (0.2-0.8)	0.007	0.410 (0.2-0.9)	0.019
Penicillin prophylaxis use						
No	170(88)	155(88)	1			
Yes	23(12)	21(12)	1.001(0.5-1.9)	0.997		
Morphine use						
NO	165(93)	135(84)	1			
YES	12(7)	25(16)	2.546(1.2-5.3)	0.012		
Frequency of painkiller use						
Less than a month	31(17)	21(13)	1			
At intervals longer than 1	147(83)	141(87)	1.416(0.8-	0.256		

month			2.6)			
Combination treatments (MMAO*)						
No	175(91)	169(96)	1			
Yes	18(9)	7(4)	0.403(0.2-1.0)	0.047	0.183 (0.1-0.6)	0.006
Mean Cell Volume (fl)						
<75	34(18)	21(12)	1			
75-99	145(75)	148(84)	1.653(0.9-3.0)	0.095	1.503 (0.8-3.0)	0.239
>=100	14(7)	7(3)	0.810(0.3-2.3)	0.695	0.285 (0.1-1.2)	0.091
Hemoglobin Concentration (g/dl)						
<7	85(44)	65(37)	1			
>=7	108(56)	111(63)	1.344(0.9-2.0)	0.165		

MMAO = Use of Any combination of Magnesium trisillicate, Metronidazole, Amoxicillin and omeprazole within 2 weeks of Clinic visit.*

Figures

Frequency (%)

RAP; *Recurrent Abdominal Pain*

Figure 1

A stacked column bar graph showing the distribution of the common dyspeptic symptoms and other common presenting symptoms among the study participants