Complications of Sickle Cell Anaemia in Children in North Western Tanzania

Hamza Saidi[#1], **Luke R. Smart**[#2,3,*], **Erasmus Kamugisha**[4], **Emmanuela E. Ambrose**[5], **Deogratias Soka**[1], **Robert N. Peck**[2,3], and **Julie Makani**[1,6]

[1] Muhimbili Wellcome Programme, Department of Haematology and Blood Transfusion, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania

[2] Department of Medicine, Weill Bugando School of Medicine, Catholic University of Health and Allied Sciences, Mwanza, Tanzania

[3] Department of Medicine, Weill Cornell Medical College, New York, NY, USA

[4] Department of Biochemistry, Weill Bugando School of Medicine, Catholic University of Health and Allied Sciences, Mwanza, Tanzania

[5] Department of Paediatrics, Weill Bugando School of Medicine, Catholic University of Health and Allied Sciences, Mwanza, Tanzania

[6] Nuffield Department of Medicine, University of Oxford, Oxford, United Kingdom

[#] These authors contributed equally to this work.

Abstract

Objectives—Tanzania has the 3rd highest birth rate of sickle cell anaemia (SCA) in Africa, but few studies describe severity of complications or available treatments, especially in North West Tanzania around Lake Victoria where the sickle gene is most prevalent. This is a report of the spectrum of clinical disease and range of interventions available at Bugando Medical Centre (Bugando) in North West Tanzania in Africa.

Methods—A cross-sectional study was carried out in Bugando between August 1, 2012 and September 30, 2012. Children (< 15 years old) with SCA attending Bugando were sequentially enrolled. A trained research assistant completed a Swahili questionnaire with the parent or guardian of each participant concerning demographic information, clinical features of disease, and treatments received.

Results—Among the 124 participants enrolled, the median age was 6 years [IQR 4-8.5], and only 13 (10.5%) were < 3 years old. Almost all participants (97.6%) had a prior history of a vaso-occlusive episode, 83 (66.9%) had prior acute chest syndrome, and 21 (16.9%) had prior stroke. In

[*]**Corresponding Author** Luke R. Smart, Department of Medicine, Weill Bugando School of Medicine, Catholic University of Health and Allied Sciences, P.O. Box 1464, Mwanza, Tanzania, smart.luke@gmail.com.

Conflicts of Interest Statement

The authors declare no conflicts of interest.

the preceding 12 months, 120 (96.8%) had been hospitalized, and a vaso-occlusive episode was the most common reason for hospitalization (35.5%). Prescriptions for folic acid (92.7%) and malaria prophylaxis (84.7%) were common, but only one had received a pneumococcal vaccine, and none had received hydroxyurea or prophylactic penicillin.

Conclusion—Children with SCA receiving care in Tanzania are diagnosed late, hospitalized frequently, and have severe complications. Opportunities exist to improve care through wider access to screening and diagnosis as well as better coordination of comprehensive care.

Keywords

Sickle cell anaemia; Tanzania; Sub-Saharan Africa; Vaso-occlusive episode; Acute chest syndrome; Stroke; Children

Introduction

Sickle cell anaemia (SCA) is a significant problem in Africa. Of 300,000 annual births with haemoglobin SS disease, 75% are born in Africa.[1] By the year 2015, there will be a 50% increase in the number of affected births.[2] Tanzania has the 3rd highest number of SCA births in Africa after Nigeria and the Democratic Republic of Congo.[1] Mortality from SCA in Tanzania is ten-fold greater than high income countries.[3]

The natural history of SCA has been described outside of Africa. Clinical features include painful episodes, infections, anaemia, central nervous system complications such as stroke and increased risk of mortality.[4,5] The introduction of newborn screening (NBS) and early initiation of comprehensive care with penicillin prophylaxis, pneumococcal vaccination, hydroxyurea and transfusion protocols has significantly decreased morbidity and mortality.[6,7] Access to NBS has been limited in Africa, and the severity of disease and available treatments are not well described.

Tanzania has recognized the public health significance of SCA and is introducing appropriate interventions,[8] but research describing SCA mortality rates and the burden of malaria in this population has been limited to the coastal city of Dar es Salaam.[3,9] The sickle gene is most prevalent in North Western Tanzania, particularly around Lake Victoria,[10,11] and few studies have described the morbidity and mortality of SCA in this region.

We conducted a cross-sectional study at a tertiary-level hospital in Mwanza, the largest town in North Western Tanzania on the shore of Lake Victoria. Our primary aim was to assess the lifetime prevalence of SCA-related complications as well as the interventions used to treat children with SCA. We hypothesized that painful vaso-occlusive episodes would be the most common cause of hospitalization, that at least half of children would have been diagnosed at least once with acute chest syndrome,[12,13] and that less than 10% were receiving either penicillin or pneumococcal vaccine. Our secondary aim was to evaluate factors associated with stroke because it is a common cause of long term morbidity and acute chest syndrome because it is a common cause of mortality.[14–16]

Methods

Study Design

This was a cross-sectional study designed to evaluate the lifetime prevalence of SCA-related complications in children attending a tertiary care centre in Tanzania as well as the interventions used to treat children with SCA.

Study Area/Setting

This study was conducted in the outpatient paediatric clinic of Bugando Medical Centre (BMC) in Mwanza, Tanzania. Mwanza is the second largest city in Tanzania located on the shores of Lake Victoria, in North Western Tanzania (see Figure 1). The Sukuma tribe is the most prevalent ethnic group, making up more than 50% of the population in Mwanza region, and approximately 15% of the population nationally.[17] The prevalence of sickle cell trait (SCT) is high, reaching 27%.[11]

BMC is a 900-bed referral and teaching hospital. It serves a catchment area of 13 million people. The department of paediatrics has a capacity of 121 inpatient beds with approximately 10 hospitalizations daily. Daily clinics provide outpatient care to children. One day each week is designated for follow up of children with SCA. Approximately 225 children with SCA are registered in the clinic.

Study Population and Procedures

From August 1, 2012 until September 30, 2012, all children < 15 years of age with SCA who attended the BMC paediatric clinic were serially enrolled. After informed written consent was obtained from the parent or guardian, a trained research assistant interviewed the parent or guardian in Swahili and completed a questionnaire containing demographic information, the reason for most recent hospitalization in the past 12 months, lifetime prevalence of having experienced SCA complications, and prior therapies received by participants in the clinic or during prior hospitalization.

Ethical approval for the study was obtained from the ethical committees of Muhimbili University of Health and Allied Sciences and Bugando Medical Centre, as well as the Institutional Review Board of Weill Cornell Medical College. Informed written consent was obtained in Swahili from the parent or guardian of participants before participation. Patient care was managed by health workers according to BMC management protocols.

Definitions

Complications of SCA were based on those proposed by the Comprehensive Sickle Cell Centers in 2010.[18]

- Acute chest syndrome: acute respiratory illness with fever and/or respiratory symptoms such as cough, dyspnea, tachypnea, or hypoxia requiring hospitalization.

- Dactylitis: a new episode of acute pain and swelling in the fingers or toes with no clear source other than vaso-occlusion.

- Hyperhaemolysis: an episode of marked anaemia with evidence of increased red blood cell destruction.

- Leg ulcers: ulceration of the skin of the legs with prolonged wound healing requiring medical attention for wound treatment, debridement, or dressings.

- Priapism: painful persistent, prolonged erection of the penis.

- Sequestration crisis: an episode of marked anemia and enlargement of the spleen requiring hospitalization.

- Stroke: acute focal neurological deficit in a pattern consistent with a stroke syndrome.

- Vaso-occlusive episode: a new episode of acute pain with no clear source other than vaso-occlusion that requires hospitalization.

- Vision problem: participant complaining of vision problem that was confirmed by any defect in visual field testing.

Statistical Analysis

The primary study outcome was the lifetime prevalence of individual SCA-related complications. Secondary outcomes included the cause of most recent hospitalization in the past 12 months, and interventions received by participants during hospitalization and at clinic. Possible explanatory variables for stroke and acute chest syndrome were sex, age, tribe, age at diagnosis, number of hospitalizations in the past 12 months, or a family member with SCA. The tribe of the patient was selected as a possible explanatory variable because a tendency to marry within one's own tribe may perpetuate a higher prevalence of SCA among one tribe and may also perpetuate genetic modifiers of disease phenotype within one tribe.

Data were entered into Microsoft Excel and analysed using STATA version 13 (San Antonio, Texas). Categorical variables were described as proportions (percentages), and continuous variables were described as medians [interquartile range]. Differences between proportions were calculated using Fisher's exact test. P-values of less than 0.05 were considered statistically significant. Univariable and multivariable logistic regression were used to identify factors associated with stroke and acute chest syndrome. For associated factors, odds ratios (OR) were determined with 95% confidence intervals [95% CI].

Results

Baseline characteristics

Among the 124 participants, 72 (58.1%) were male, and the median age was 6 years [IQR 4-8.5] (see Table 1). Only 13 (10.5%) were under 3 years old (see Figure 2). More than ten different ethnic groups were represented. Sukuma was the most prevalent (55.7%). The proportion of Sukuma in the participants was similar to the proportion in the general population. The median age at diagnosis was 3 years old [IQR 1-4]. A family member diagnosed with SCA was reported by 69 (55.7%), and 23 (18.6%) reported the death of a family member from SCA.

Hospitalizations

All but 1 of the participants (99.2%) reported a history of being hospitalized at least once for the management of their disease (see Table 1). Within the preceding 12 months, 86 (69.4%) had been hospitalized once and 34 (27.4%) had been hospitalized 2 or more times. The number of hospitalizations in the preceding 12 months did not differ according to the age (P=0.636) or the sex (P=0.655) of the participant. In the participants' lifetimes, 50 (40.3%) had been hospitalized 5 times, and 1 subject (0.8%) had been hospitalized > 10 times. As expected, the number of hospitalizations in participants' lifetimes was significantly higher if the subject was older (P<0.001), but did not differ according to sex (P=0.736).

Lifetime Prevalence of Complications and Reason for Most Recent Hospitalization

The most prevalent prior complication of SCA was a vaso-occlusive episode which had been diagnosed in 121 participants (97.6%) (see Table 2). Acute chest syndrome had been diagnosed in 83 participants (66.9%), and stroke had been diagnosed in 21 participants (16.9%). Of the 21 participants who had been diagnosed with a stroke, 17/21 (81.0%) also reported a history of seizure. The lifetime prevalence of complications was similar across age groups for dactylitis (P=0.175), sequestration crisis (P=0.488), and vaso-occlusive episodes (P=0.548). The prevalence of all other complications increased in successive age groups.

Among children hospitalized in the past 12 months the most common cause of hospitalization was a vaso-occlusive episode in 43 (34.7%). Fever was the reason for hospitalization in 39 (31.5%), and acute chest syndrome was the reason for hospitalization in 24 (19.4%). The cause of most recent hospitalization in the past 12 months did not differ significantly according to sex (P=0.861) or age group (P=0.063).

Interventions

At the clinic, folic acid and instructions to drink extra fluids were frequently provided (92.7% and 93.6%) (see Table 3). Malaria prophylaxis in the form of chloroquine once per week was prescribed to 105 (84.7%). Pneumococcal vaccination was only given to one subject, and neither prophylactic penicillin nor Hydroxyurea were given to any participants. During hospitalization, analgesics, IV fluids, antibiotics, and blood transfusion were provided to > 90% of all participants.

Factors Associated with Stroke & Acute Chest Syndrome

Using univariable logistic regression, several factors were found to be associated with stroke. Family history of SCA had the strongest association (OR 4.17, 95% CI 1.31-13.24, P=0.015) (see Table 4). Increasing age (OR 1.49 per year of increased age, 95% CI 1.24-1.79, P<0.001), and a higher number of lifetime hospitalizations (OR 1.85 per hospitalization, 95% CI 1.34-2.54, P<0.001) were also associated with stroke. Using multivariable logistic regression adjusted for age, sex, Sukuma tribe, age at diagnosis, number of lifetime hospitalizations and family history of SCA, only two factors remained significantly associated with stroke: the age of the participant and the age at diagnosis. Older age increased the odds of stroke (OR 1.75 per additional year of age, 95% CI 1.31-2.35,

p<0.001) and older age at diagnosis decreased the odds of stroke (OR 0.62 per every year delay in diagnosis, 95% CI 0.40-0.94, P=0.025).

Factors associated with the complication of acute chest syndrome were also analysed using univariable logistic regression (see Table 5). Male gender (OR 0.44, 95% CI 0.20-0.99, P=0.047) was negatively associated with acute chest syndrome. Older age (OR 1.39 per additional year of age, 95% CI 1.18-1.64, P<0.001), and higher number of lifetime hospitalizations (OR 1.97 per an additional hospitalization, 95% CI 1.43-2.71, P<0.001) family history of SCA (OR 4.46, 95% CI 2.00-9.96, P<0.001), and family history of death from SCA (OR 6.60, 95% CI 1.47-29.74, P=0.014), were significantly associated with acute chest syndrome. Using multivariable logistic regression adjusted for age, sex, Sukuma tribe, age at diagnosis, number of lifetime hospitalizations and family history of SCA, three factors remained associated with acute chest syndrome: older age (OR 1.35 per additional year of age, 95% CI 1.04-1.75, P<0.001), a higher number of lifetime hospitalizations (OR 1.69, 95% CI 1.17-2.48, P=0.005), and a family history of SCA (OR 2.92, 95% CI 1.13-2.75, P=0.026).

Discussion

This study describes the demographics, range of SCA complications and available treatments for children with SCA living in North Western Tanzania where the highest prevalence of haemoglobin S has been reported.[10,11] A slight majority of the participants were male (58.1%), and the median age of children attending clinic was six years. There were only 6 children less than 2 years old, and no children less than 12 months old. A similar age distribution has been described in sickle cell clinics within other African countries. In Nigeria, the median age was 5.9 years, but there were a higher number of children under 1 year of age (3.8%).[19] In a clinic in Democratic Republic of Congo (DRC), the median age of children was even higher at 10 years old.[13] At the initiation of a non-birth prospective cohort in Dar es Salaam, Tanzania, only 10% of children were less than 2 years old.[3] The lack of a newborn screening program, the lower incidence of complications during the first year of life, and poor community awareness about the early symptoms of sickle cell disease likely contribute to the older age of those attending the sickle cell clinic.

The median age of diagnosis was 3 years old [IQR 1-4] for children at our centre. Only 4 children (3.2%) were diagnosed in infancy (before 12 months of life). This is largely due to the lack of newborn screening in the country. A sickling test is the primary method of diagnosis and is unreliable in the neonatal period, yielding many false negatives. Haemoglobin electrophoresis is available only at the national hospital in Dar es Salaam. Children are typically diagnosed after having one or more SCA related complications. Other countries without newborn screening report an age of diagnosis at or above one year of age. In Brazil, the median age of diagnosis was 2 years old for those in their second decade of life.[20] Studies from Nigeria, report a median age of diagnosis from 2-2.4 years old, but in contrast to our study, approximately 20% of children were diagnosed before their first birthday.[19,21] Even in Toronto, Canada, those who were not screened at birth were diagnosed at a median age of 2 years old.[22]

Approximately half of the participants had a family history of SCA (69/124, 55.7%), but their median age of diagnosis (3 years [IQR 1-4]) was not significantly different than those without a family history of disease (2 years [IQR 1-5], P=0.654). Having multiple family members with the same disease is expected to increase awareness of symptoms and prompt higher quality care for subsequent children, but this effect depends on proper education of patients and their family members as well as good access to health care services. In the DRC only 67% of patients reported that their family members had an awareness of sickle cell anaemia.[13] A thorough family history should always be obtained for children and, in areas where haemoglobin S is highly prevalent, ought to specifically include family history of sickle cell disease and the death of any family members from sickle cell disease. A vigilant family history may be the only way to identify individuals who are at risk of developing stroke and/or acute chest syndrome. Family education is also an essential intervention in this setting where early recognition of symptoms may be the fastest way to diagnose a child with SCA.

Early death may contribute to both the older age of participants and older age of diagnosis in our study. Before the use of antimalarials, SCA in sub-Saharan Africa was almost universally fatal before the age of five.[23] This may still be true in malaria endemic areas with poor access to health care. Children may present multiple times with anaemia and fever and be misdiagnosed with malaria. Despite their higher morbidity, they may not be referred to a tertiary care centre. More recent studies have demonstrated that children with SCA in Africa can survive childhood,[24] but the mortality rates are still ten times higher than those found in high-income countries, and the highest rates are found in those younger than 5 years old.[3] In the USA the greatest improvement in mortality after implementation of comprehensive care was in the youngest age group,[25] providing a major impetus for similar programmes in sub-Saharan Africa where substantially more people with SCA reside. Newborn cohort studies are needed to better understand the natural history of SCA in Africa, particularly in rural areas that are malaria endemic with poor access to advanced medical care.

All but 4 participants in our study were hospitalized in the past 12 months, and the median number of hospitalizations among these children was 1 [IQR 1-2]. The most common causes of hospitalization were pain (35.5%), fever (33.1%) and ACS (19.4%). Pain is more common cause of hospitalization in high income countries accounting for up to two-thirds of hospitalizations.[26,27] The lower prevalence of hospitalization for pain is likely due to the elevated prevalence of fever. Malaria and bacterial infections are common causes of fever in people with SCA in sub-Saharan Africa. Both are important contributors to morbidity and mortality among people with SCA in this setting and likely contribute to the higher frequency hospitalization for fever.[9,28]

The lifetime prevalence of complications related to SCA was significant. Almost all of the participants (97.6%) had experienced a prior vaso-occlusive episode, regardless of age. This is much higher than the amount of vaso-occlusive episodes reported in cohort studies from developed countries. In the USA, for example, only half of children with SCA have experienced a vaso-occlusive episode by 5 years old,[12] and the rate of vaso-occlusive episodes steadily increases from 0.4 per person year in those younger than five to a peak of

1.21 per person year in those 25-29 years old.[29] The higher prevalence of vaso-occlusive episodes in our study is similar to other hospitals in Africa.[13] Risk factors that are more prevalent in sub-Saharan Africa and can trigger a vaso-occlusive episode include malaria, as well as arboviruses. Until eradication of these risk factors, clinicians should strive for early, aggressive, treatment of pain.

Half of the participants had experienced an episode of acute chest syndrome by the age of five years, and prior stroke was reported by 1/6 of all participants and in almost half of those older than 9 years old. This prevalence of acute chest syndrome is twice as high as the USA,[30] and may be due to lack of immunization, late presentation, and concomitant malnutrition.[31] The incidence of stroke in children with SCA is much lower in the USA, with only 11% having stroke before age 20 and 24% before age 45.[16] Despite the high prevalence of stroke in our study, no one had undergone screening transcranial Doppler to identify a higher risk of stroke. Such a screening protocol would provide an opportunity to initiate children on chronic transfusion protocols that have successfully been used in developed countries for both primary prevention in high-risk individuals and secondary prevention in those with prior stroke.[32] If a screening program were implemented and a transfusion protocol started, the current blood supply system might struggle to support chronic transfusion protocols for multiple children with SCA. More practical approaches, such as the use of hydroxyurea for primary stroke are currently being investigated in Africa.[33]

In the paediatric clinic, a large majority of participants received instructions about how to prevent vaso-occlusive disease (93.6%) as well as treatment with folic acid (92.7%). Many also were given antimalarial for prophylaxis (81.5%), and more than a quarter (28.2%) were given medication to treat intestinal worms. The local clinic staff successfully counsel and educate families about these basic preventive measures for SCA. However, at the time of the study, no children were receiving either prophylactic penicillin or pneumococcal vaccine despite their effectiveness in improving mortality[34,35] and the fact that fever was the cause of one third of hospitalizations. The same bacteria affecting children in high income countries are present in East Africa[28] suggesting a role for both of these preventive measures in this setting.

Since the completion of this study, Tanzania has broadened its national immunization policy to include pneumococcal conjugate vaccine. In addition the sickle cell centre at the national hospital has started and maintained a centre for comprehensive sickle cell care[3] and lain the groundwork for a national sickle cell health policy.[8] A national guideline for sickle cell treatment has been published and disseminated for use by physicians around the country[36] that includes instructions for both prophylactic penicillin and appropriate vaccination of all children with SCA.

Hydroxyurea was not prescribed to any children at our centre. As the primary disease modifying drug for SCA, hydroxyurea is proven to decrease vaso-occlusive episodes, acute chest syndrome, and mortality[37–39] in high income countries. Prescription of this life saving therapy in Africa has been hampered by the cost of the drug, the ability to monitor its side effects, and compliance problems. In addition, prior studies sparked debate about its safety

in areas with high malaria prevalence.[40,41] Several clinical studies are underway in Africa to help answer these questions, clearing the way for access to this important therapy.

During hospitalization, more than 90% of participants received antibiotics and blood transfusions, regardless of the reason for their most recent hospitalization. In addition to using antibiotics for children with objective fever at time of hospitalization, antibiotics are frequently prescribed to children who report subjective fever when they are hospitalized for a vaso-occlusive crisis. Physicians are concerned about infections precipitating painful crisis since historically, few children have been appropriately immunized or received prophylactic penicillin. The use of transfusion at our centre is also much higher than among children with SCA hospitalized in the USA where only 28.8% receive blood transfusions.[42] The frequent use of blood transfusions is likely related to the severity of anaemia in hospitalized children with SCA. At our centre, almost two thirds of hospitalized children with SCA have a haemoglobin less than 7 g/dL.[43]

This study has several limitations. Since the study site was a tertiary care centre, enrolled participants may have better access to medical care in general or may have a higher prevalence of complications that provoked them to seek medical attention. Since the data was collected retrospectively, diagnoses and treatments could not be confirmed. As with other questionnaire based studies, parental education and recall bias may influence the reported presence and number of events and hospitalizations. The short duration of enrolment may have led to an unrepresentative sample, although the results are consistent with our experience. Mortality was not assessed since participants were only included if they were alive at the time of interview.

Conclusion

Children with SCA in Tanzania are diagnosed late and do have access to many basic preventive measures. They have a high burden of complications, are frequently hospitalized for vaso-occlusive episode and fever and commonly receive both antibiotics and blood transfusions. Opportunities exist to improve the care of children with SCA through wider access to newborn screening and diagnosis, better coordination of comprehensive care, and provision of proven preventive therapies such as prophylactic penicillin, pneumococcal vaccination, and hydroxyurea. The burden of stroke is high and could be decreased through the implementation of transcranial Doppler screening and transfusion therapy..

Acknowledgments

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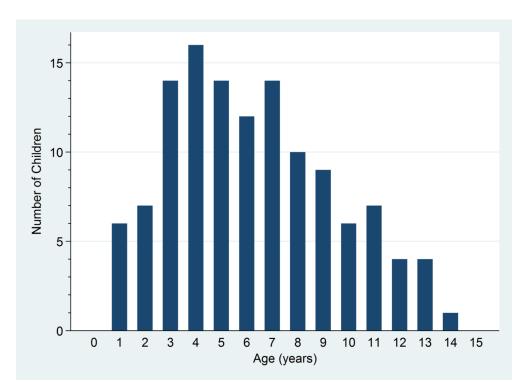
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Figure 1. Map of Tanzania
Derived from http://commons.wikimedia.org/wiki/File:Tanzania_location_map.svg ©
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Figure 2.
Age distribution of 124 children with sickle cell anaemia seen at Bugando Medical Centre in Mwanza, Tanzania between August and September 2012

Table 1

Characteristics of 124 children with sickle cell anaemia seen at Bugando Medical Centre in Mwanza, Tanzania, between August and September 2012

Characteristic	Frequency (%) or Median [IQR]
Male	72 (58.1)
Age (years)	6 [4-8.5]
0-2 years	13 (10.5)
3-5 years	44 (35.5)
6-8 years	36 (29.0)
9 years	31 (25.0)
Tribe	
Sukuma	69 (55.7)
Jita	16 (12.9)
Muha	11 (8.9)
Kurya	7 (5.6)
Jaluo	4 (3.2)
Kerewe	4 (3.2)
Nyamwezi	4 (3.2)
Other	9 (7.3)
Age at diagnosis (years)	3 [1-4]
Ever hospitalized	123 (99.2)
Hospitalizations in the past 12 months	1 [1-2]
0	4 (3.2)
1	86 (69.4)
2	26 (21.0)
3	7 (5.7)
4	1 (0.8)
Lifetime hospitalizations	4 [3-5]
0-4	74 (59.7)
5-9	49 (39.5)
> 10	1 (0.8)
Family history of SCA diagnosis	69 (55.7)
Family history of SCA death	23 (18.6)

SCA: sickle cell anaemia

Table 2

Cause of most recent hospitalization within the past 12 months and lifetime prevalence of any complication stratified by age group among 124 children with sickle cell anaemia seen at Bugando Medical Centre in Mwanza, Tanzania between August and September 2012

	0-2 years old (n=13) Frequency (%)	3-5 years old (n=44) Frequency (%)	6-8 years old (n=36) Frequency (%)	9 years old (n=31) Frequency (%)	Total (n=124) Frequency (%)	P-value by Fisher's exact test
Lifetime Prevalence of Complications						
Acute chest syndrome	5 (38.5)	22 (50.0)	29 (80.6)	27 (87.1)	83 (66.9)	**<0.001***
Dactylitis	11 (84.6)	35 (79.6)	22 (61.1)	20 (64.5)	88 (71.0)	0.175
Hyperhaemolysis	2 (15.4)	34 (77.3)	33 (91.7)	29 (93.7)	98 (79.0)	**<0.001***
Leg ulcers	0 (0.0)	0 (0.0)	0 (0.0)	3 (9.7)	3 (2.4)	**0.043***
Priapism [†]	0 (0.0)	5 (15.6)	9 (40.9)	8 (66.7)	22 (30.6)	**0.002***
Sequestration crisis	4 (30.8)	20 (45.5)	12 (33.3)	9 (29.0)	45 (36.3)	0.488
Stroke	0 (0.0)	3 (6.8)	5 (13.9)	13 (41.9)	21 (16.9)	**<0.001***
Vaso-occlusive episode	12 (92.3)	43 (97.7)	35 (97.2)	31 (100.0)	121 (97.6)	0.548
Vision problem	0 (0.0)	0 (0.0)	0 (0.0)	0.0 (0.0)	0 (0.0)	N/A
Cause of most recent hospitalization in past 12 months						
Acute chest syndrome	0 (0.0)	10 (22.7)	7 (19.4)	7 (22.6)	24 (19.4)	0.063
Anaemia	3 (23.1)	2 (4.6)	0 (0.0)	2 (6.5)	7 (5.7)	
Fever	5 (38.5)	18 (40.9)	11 (30.6)	5 (16.1)	39 (31.5)	
Stroke	0 (0.0)	0 (0.0)	1 (2.8)	3 (9.7)	4 (3.2)	
Vaso-occlusive episode	4 (30.8)	12 (27.3)	15 (41.7)	12 (38.7)	43 (34.7)	
Other	1 (7.7)	0 (0.0)	1 (2.8)	1 (3.2)	3 (2.4)	
Not hospitalized	0 (0.0)	2 (4.6)	1 (2.8)	1 (3.2)	4 (3.23)	

[†] **Out of 72 males**

Table 3

Interventions received by 124 children with sickle cell anaemia seen at Bugando Medical Centre in Mwanza, Tanzania, between August and September 2012

	Frequency (%)
Interventions during hospitalization	
Analgesics	123 (99.2)
Antibiotics	120 (96.8)
Blood transfusion	112 (90.3)
IV fluids	122 (98.4)
Interventions at clinic	
Folic acid	115 (92.7)
Hydroxyurea	0 (0.0)
Malaria prophylaxis	101 (81.5)
Mebendazole	35 (28.2)
Penicillin prophylaxis	0 (0.0)
Pneumococcal vaccine	1 (0.8)
Told to drink extra fluids	116 (93.6)

Table 4

Baseline characteristics associated with stroke among 124 children with sickle cell anaemia seen at Bugando Medical Centre in Mwanza, Tanzania between August and September 2012 by univariable logistic regression

Variable	Stroke	No Stroke	Univariate		Multivariate	
	n (%) or median [IQR]		OR [95% CI]	P-value	OR [95% CI]	P-value
Total	21 (16.9)	103 (83.1)				
Gender						
Female	6 (11.5)	46 (88.5)				
Male	15 (20.8)	57 (11.5)	2.02 [0.73-5.61]	0.179	2.94 [0.73-11.80]	0.104
Age (years)	10 [8-12]	5 [3-7]	1.49 [1.24-1.79]	**<0.001***	1.75 [1.31-2.35]	**<0.001***
Tribe						
Other	6 (10.9)	49 (89.1)				
Sukuma	15 (21.7)	54 (78.3)	2.27 [0.82-6.31]	0.116	0.96 [0.26-3.54]	0.952
Age at diagnosis (years)	3 [2-3]	3 [1-5]	0.94 [0.74-1.19]	0.622	0.62 [0.40-0.94]	**0.025***
Hospitalizations past 12 month	1 [1-2]	1 [1-2]	1.66 [0.88-3.14]	0.121	0	
Lifetime hospitalizations	5 [4-7]	4 [3-5]	1.85 [1.34-2.54]	**<0.001***	1.32 [0.89-1.98]	0.169
Family history of SCA diagnosis						
SCA not in family	4 (7.3)	51 (92.7)				
SCA in family	17 (24.6)	52 (75.4)	4.17 [1.31-13.24]	**0.015***	3.06 [0.69-13.60]	0.141
Family history of SCA death						
No death in family	14 (13.9)	87 (86.1)				
Death in family	7 (30.4)	16 (69.6)	2.72 [0.95-7.79]	0.062		

Table 5

Baseline characteristics associated with acute chest syndrome among 124 children with sickle cell anaemia seen at Bugando Medical Centre in Mwanza, Tanzania between August and September 2012 by univariable logistic regression

Variable	Acute Chest	No Acute Chest	Univariate		Multivariate	
	n (%) or median [IQR]		OR [95% CI]	P-value	OR [95% CI]	P-value
Total	83 (66.9)	41 (33.1)				
Gender						
Female	40 (76.9)	12 (23.1)				
Male	43 (59.7)	29 (40.3)	0.44 [0.20-0.99]	**0.047***	0.38 [0.14-1.04]	0.061
Age (years)	7 [5-9]	4 [3-6]	1.39 [1.18-1.64]	**<0.001***	1.35 [1.04-1.75]	**0.023**
Tribe						
Other	34 (61.8)	21 (38.2)				
Sukuma	49 (71.0)	20 (29.0)	1.51 [0.71-3.21]	0.116	1.15 [0.45-2.95]	0.776
Age at diagnosis (years)	3 [1-5]	2 [1-4]	1.13 [0.93-1.37]	0.214	0.88 [0.65-1.19]	0.409
Hospitalizations past 12 month	1 [1-2]	1 [1-1]	1.95 [0.99-3.83]	0.054		
Lifetime hospitalizations	5 [4-6]	3 [3-4]	1.97 [1.43-2.71]	**<0.001***	1.69 [1.17-2.48]	**0.005***
Family history of SCA diagnosis						
SCA not in family	27 (49.1)	28 (50.9)				
SCA in family	56 (81.2)	13 (18.8)	4.47 [2.00-9.96]	**<0.001***	2.92 [1.13-2.75]	**0.026**
Family history of SCA death						
No death in family	62 (61.4)	39 (38.6)				
Death in family	21 (91.3)	2 (8.7)	6.60 [1.47-29.74]	**0.014***		