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The Prevalence and Factors Associated with Musculoskeletal Disorders, in Patients with Sickle Cell Anaemia, at Mulago National Referral Hospital, Uganda

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Background: ***Sickle cell anaemia (SCA) is a condition characterized by a predominance of haemoglobin S (hbss) in the red blood cells. Musculoskeletal involvement is one of the commonest clinical manifestations of SCA. There is limited information on the prevalence, patterns and factors associated with Musculoskeletal (MSK) disorders among SCA patients in African countries.***
Methods: ***This was a descriptive cross sectional study conducted in SCA clinic at Mulago National Referral Hospital, Uganda. It involved 365 SCA patients who attended the clinic between 1st August 2014 and 31st October 2014. These patients were interviewed and assessed to determine the presence of MSK, patterns and factors associated with it. The transient MSK disorders like dactylitis were excluded.***
Results: ***The prevalence of MSK disorders among SCA patients was found to be 11.5%.These disorders include avascular necrosis, spine osteonecrosis, osteomyelitis, leg ulcers, pathological fractures and flexion contractures. The age (11-20 years), highly demanding physical activity status and the annual frequency of painful crises were associated with MSK disorders.***
Conclusion: ***Musculoskeletal disorders are highly prevalent in SCA patients at Mulago National referral hospital. The femoral Avascular necrosis, spine osteonecrosis, leg ulcers and osteomyelitis were the most common MSK disorders.***

Keywords: Sickle cell anaemia, Musculoskeletal disorders, Avascular necrosis

Introduction

Sickle cell anaemia (SCA) is a condition characterized by a predominance of haemoglobin S (hbss) in the red blood cells. In Africa more than 200 000 cases of sickle-cell anaemia are born each year [1]. In Uganda out of nine hundred thousand children born annually approximately 25,000 (2.8%) have sickle cell anemia (SS homozygote) [2, 3]. Bone involvement is one of the commonest clinical manifestation of SCA both in acute and chronic phase of the disease [4]. Bone changes seen in SCA patients can be grouped into two major types: those due to bone marrow hyperplasia caused by profound and prolonged anaemia, and those due to ischaemic necrosis of bone and its complications [5]. Bone marrow necrosis, bone infarcts, osteomyelitis and aseptic necrosis are common complications in patients with sickle cell disease [6].

Prevalence of musculoskeletal disorders is reported to range from 37 to 50% among Sickle cell anaemia patients, with osteonecrosis reported as the most frequent of these complications, followed by leg ulcers in up to 25% of patients[7, 8]. Osteomyelitis is a common MSK disorder in children with a prevalence of 17.8% [9]. Also MSK disorders extend to the spine, that lead to spine osteonecrosis, whereby biconcave and step like depression are seen in the vertebral bodies [10]. These disorders are associated with significant disability and morbidity.

The understanding of prevalence, patterns and factors associated with MSK disorders among sickle cell anaemia patients will facilitate proper interventional planning. This aims at reducing disability and morbidity among these patients.

Patients and Methods

This was a descriptive cross-sectional study, conducted in the sickle cell clinic at Mulago National Referral Hospital, Kampala-Uganda. This Sickle Cell Clinic is attended by paediatric and adult patients who have been confirmed to have sickle cell anaemia (hbss) by haemoglobin electrophoresis. Three hundred and sixty five Sickle cell anaemia patients (adults and children) aged 1 year and above were recruited by systematic random sampling (Every 3rd patient to attend the clinic was recruited if he/she met inclusion criteria) in a period of 3 months from 1st August 2014 to 31st October 2014.

Prior ethical approval was obtained from Mulago Hospital Orthopaedic surgery department, Mulago hospital sickle cell clinic and School of Medicine Research and Ethics Committee-Uganda (SOMREC). Consent form was signed by adult patients and parents/guardians of patients aged less than 18 years. Also assent form was signed by patients aged 8-18 years before commencement of the study.

Data was collected using a standard questionnaire whereby enrolled patient's musculoskeletal history was obtained and examination done. Clinically indicated investigations such as X ray, Complete blood count and necrotic/pus sample culturing and sensitivity were done. The Principal investigator with the assistance of a radiologist interpreted the radiographs. Clinically indicated procedures such as arthrocentesis, arthrotomy, sequestrectomy, incision and drainage were done aseptically in theatre by the orthopaedic surgery team. Transient MSK disorders such as dactylitis were not included among disorders assessed in this study. The diagnosis of MSK disorders were made through history, examination and several investigations as it was indicated.

AVN was diagnosed by history of pain on the hip/shoulder/difficult in walking/using a limb + examination of limping or tenderness along the hip/groin/shoulder + X-Ray/bone scan evidence of osteonecrosis[4] The Ficat's classification of Avascular necrosis is used to determine the patterns [11].

Ficat classification
Stage 0 - No pain, normal radiographic findings, abnormal bone scan or MRI findings
Stage I - Pain, normal x-ray findings, abnormal bone scan or MRI findings

Stage II - Pain, cysts and/or sclerosis visible on x-ray, abnormal bone scan or MRI findings, without subchondral fracture
Stage III - Pain, femoral head collapse visible on x-ray, abnormal bone scan or MRI findings, crescent sign (subchondral collapse) and/or step off in contour of subchondral bone
Stage IV - Pain, acetabular disease with joint space narrowing and arthritis (osteoarthrosis) visible on x-ray, abnormal MRI or bone scan findings

Spine osteonecrosis was diagnosed by clinical history of back pain and confirmed by radiological presentation of "fish mouth" vertebra which is a smooth biconcave deformity secondary to abrupt like lesion due to central infarction and collapse [12].
Acute osteomyelitis was diagnosed by history of pain/swelling along the extremity for 24-48 hours +Fever +/- X-Ray evidence of osteomyelitis + Pus on Incision and drainage/debridement + positive culture
Chronic osteomyelits was diagnosed by history of pain/ swelling along the extremity +/- fever +/- sinus discharging pus + X-Ray evidence of chronic osteomyelitis[13]
Septic arthritis was diagnosed by history of pain/ swelling along the joint typical for septic arthritis+ fever +pus drainage during arthrocentesis with a positive culture [14].
Leg ulcers was diagnosed by history of leg ulcers fail to heal for at least 2 weeks + examination of ulcers[15]. Other long term musculoskeletal disorders like pathological fracture was diagnosed according to clinical and radiological presentations.

Results

Demographic characteristics of participants are shown in Table 1 below. Among participants enrolled for this study, 63.6% were below 10 years of age (mean 9.4 years, standard deviation 7.5) and majority had less demanding physical activity status. The prevalence of patients with musculoskeletal disorders was 42/365 (11.5%). The proportion of MSK disorders (55 MSK disorders were found in 42 patients) is shown in the Table 2 below, the femoral AVN was the most common.

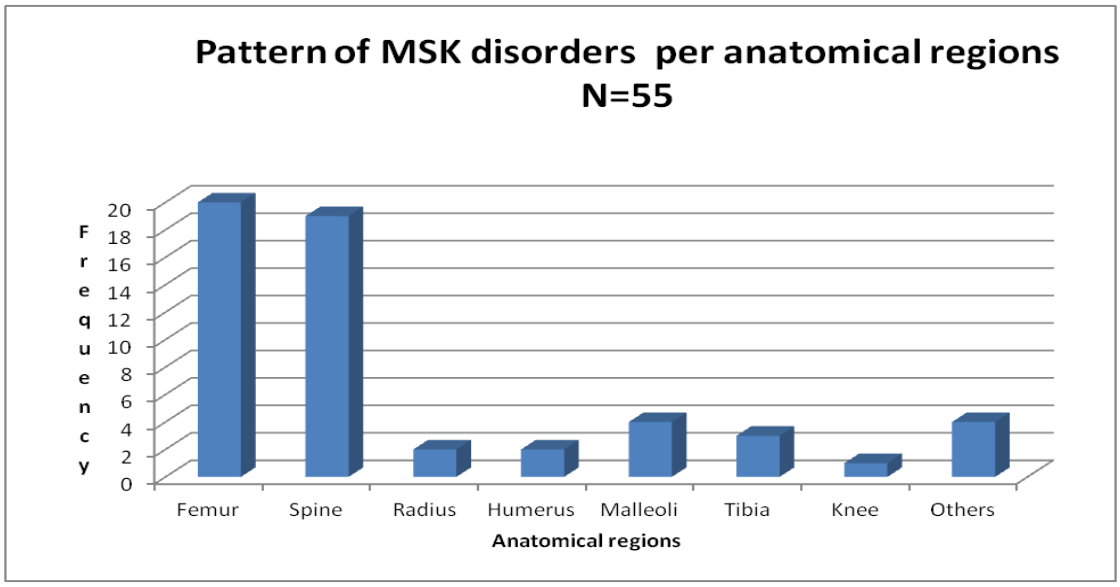

Figure 1. Pattern of MSK per anatomical regions

Table 1. Demographic characteristics of the participants

Characteristic	**Participants distribution (N=365)**	
	Number	Percentage (%)
Age categories (years) ≤10 11-20 >20	 232 105 28	 63.6 28.7 7.7
Sex Male Female	 173 192	 47.4 52.6
Residence Urban Rural Missing	 349 15 1	 95.6 4.1 0.3
Physical activity status Less demanding physical activity Highly demanding physical activity	 357 8	 97.8 2.2

Table 2. Proportion of Musculoskeletal Disorders

Musculoskeletal disorders	Frequency N=55	Proportion (%)	95% Confidence interval
Femoral avascular necrosis	20	20/55 (36.4%)	23.81 - 50.44
Spine osteonecrosis	19	19/55 (34.5%)	22.24 - 48.58
Osteomyelitis	6	6/55 (10.9%)	4.11 – 22.23
Leg ulcers	4	4/55 (7.3%)	2.02 – 17.59
Septic arthritis	1	1/55 (1.8%)	0.04 – 9.72
Pathological fracture	2	2/55 (3.6%)	1.05-12.50
Recurrent patella dislocation	1	1/55 (1.8%)	0.04 – 9.72
Flexion contracture	1	1/55 (1.8%)	0.04 – 9.72
Knee stiffness	1	1/55 (1.8%)	0.04 – 9.72

The study participants had variable haematological characteristics as shown in Table 3, Most of the participants had moderate anaemia, with haemoglobin level between 5g/dl and 7g/dl and raised white blood cells. Patterns of MSK per anatomical regions among these participants were as shown in Figure 3, femur was frequently involved.

Table 3. Haematological Characteristics

Characteristic	Participants distribution (N=365)	
	Number	Percentage (%)
Haemoglobin level for anaemia		
Normal (>10g/dl)	7	1.9
Mild (8-10g/dl)	117	32.1
Moderate (5-7.9g/dl)	206	56.4
Severe (<5g/dl)	11	3.0
Missing	24	6.6
White blood cell counts		
Norma	112	30.7
Raised	226	61.9
Missing	27	7.4
Neutrophil cell counts		
Normal	157	43.0
Raised (> 7.7 X 10^3 /µl)	183	50.1
Missing	25	6.9
Lymphocyte cell counts		
Normal	74	20.3
Raised (>4.4 X 10^3 /µl)	266	72.9
Missing	25	6.8
Eosinophil cell counts		
Normal	161	44.2
Raised (>0.6 X 10^3 /µl)	179	49.0
Missing	25	6.8

Table 4. Pattern of Femoral Avascular necrosis

Grading by Ficat's classification	Femoral head N=20		
	Right N (%)	Left N (%)	Bilateral N (%)
1	0	0	0
2	6(40.0)	7(58.3)	4(57.1)
3	5(33.3)	4(33.3)	1(14.3)
4	4(26.6)	1(8.4)	2(28.6)
Total	15(100.0)	12(100.0)	7(100%)

The femoral AVN grade 2 by Ficat's classification was most frequently found, as shown in the Table 4.

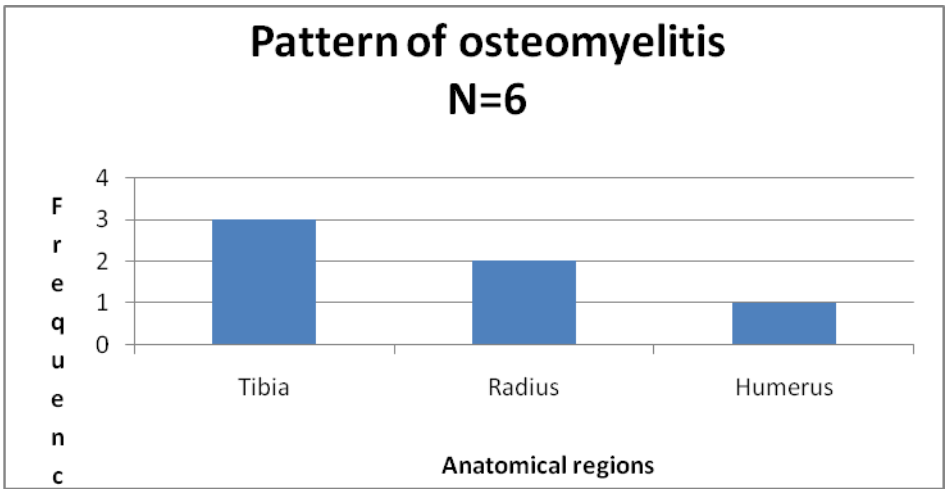

Figure 2. Pattern of osteomyelitis

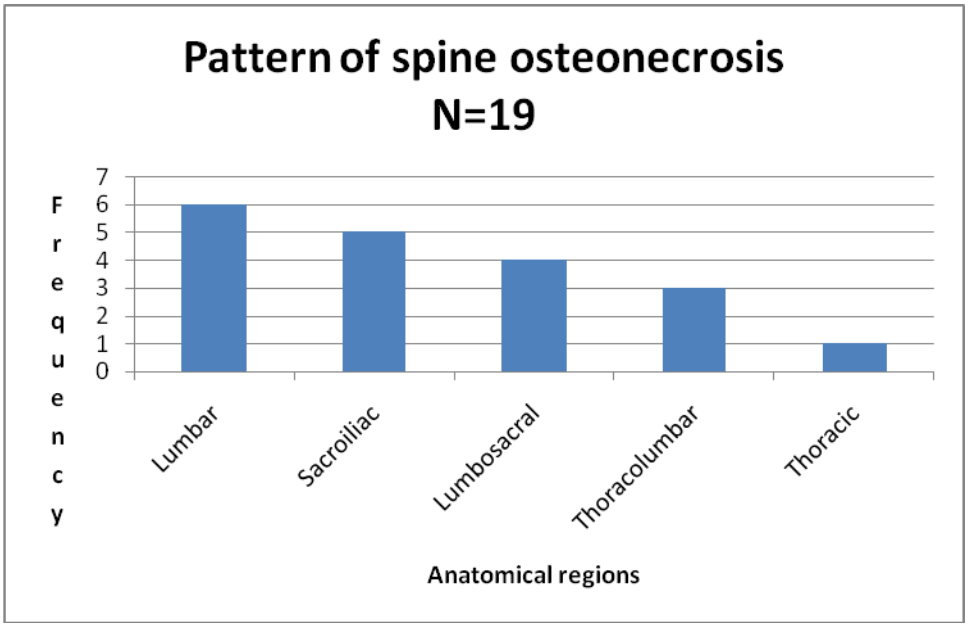

Figure 3. The pattern of spine osteonecrosis

Among these participants, osteomyelitis involved the tibia most frequently. As shown in the Figure 4. Among osteomyelitis samples cultured, various organisms were identified, including Salmonella species (1 participant), Staphylococcus aureus (1 participant) and Citrobacter species (2 participants). The Salmonella species were sensitive to ampicillin, chloramphenicol and cotrimoxazole. The Staphylococcus aureus were sensitive to Chloramphenicol, Augmentin, Ceftiraxone, Cefuroxime, Gentamycin and Imipenem but resistant to Ampicillin and Cotrimoxazole. The Citrobacter species were sensitive to Ampicillin, Ceftriaxone, Cefuroxime, Gentamycin, Amikacin, Imipenem and Piperacin but resistance to Cotrimoxazole, Chloramphenicol and Augmentin.

Four patients had leg ulcers, which involved medial/lateral malleoli or dorsum of the foot.

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Table 5. Factors Associated with Patients with Musculoskeletal Disorders

Variable	Patients with MSK disorders N=42		
	N (%)	Odds ratio	P-value
Age categories (years)			
≤10	8(19.0)	Reference	
11-20	23(54.8)	7.85(3.38-18.25)	0.001
>20	11(26.2)	18.12(6.43-51.04)	0.001
Sex			
Male	20(47.6)	Reference	
Female	22(52.4)	0.99(0.52-1.89)	0.976
Residence			
Urban	40(95.2)	Reference	
Rural	1(2.4)	0.55(0.07-4.33)	0.566
Missing	1(2.4)		
Physical activity status			
Less demanding physical activity	37 (88.1)	Reference	
Highly demanding physical activity	5 (11.9)	12.19(2,62-56.70)	0.001
Haemoglobin level			
Normal (>10g/dl)	2 (4.8)	Reference	
Mild (8-10g/dl)	15 (35.7)	0.37 (0.07-2.07)	0.256
Moderate (5-7g/dl)	20 (47.6)	0.27 (0.05-1.48)	0.131
Severe (<5g/dl)	1 (2.4)	0.25 (0.02-3.47)	0.301
Missing	4 (9.5)		
White blood cells			
Normal	15(35.7)	Reference	
Raised	22(52.4)	0.70 (0.35-1.41)	0.311
Missing	5 (11.9)		
Neutrophils			
Normal	22 (52.4)	Reference	
Raised (> 7.7 X 10^3 /µl)	16(38.1)	0.59(0.30-1.17)	0.125
Missing	4 (9.5)		
Lymphocytes			
Normal	15 (35.7)	Reference	
Raised (> 4.4X 10^3 /µl)	23 (54.8)	0.37(0.18-0.76)	0.005
Missing	4 (9.5)		
Eosinophils			
Normal	24(57.2)	Reference	
Raised (> 0.6 X 10^3 /µl)	14(33.3)	0.48 (0.24-0.98	0.039
Missing	4 (9.5)		

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Table 6. Annual Frequency of Painful Crises

	Mean (Standard deviation)				
	Overall mean (std)	Without MSK disorders	With MSK disorders	Mean difference	P-value
Annual frequency of painful crises	3.66 (4.48)	3.42 (4.10)	5.66 (6.59)	2.24	0.004

Figure 4. Avascular necrosis right hip Ficat's grade 3 in 18 years girl.

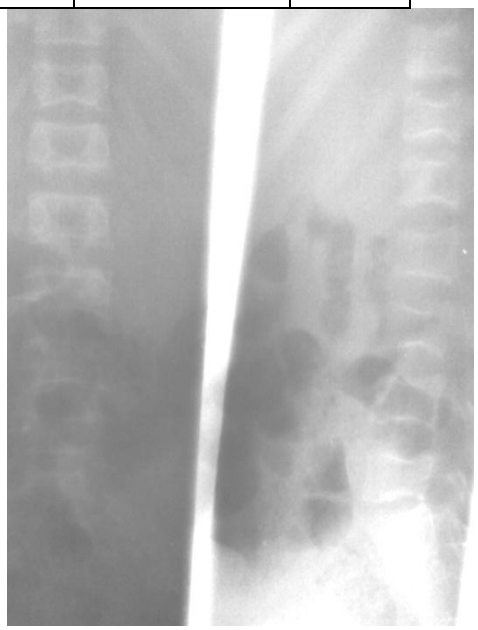

Figure 5. Spine osteonecrosis along lumbosacral region in a 16 years boy with a "fish mouth" shaped vertebra

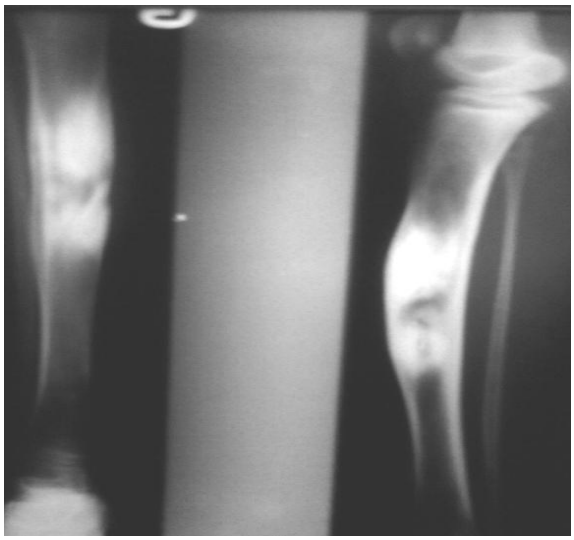

Figure 6. Chronic osteomyelitis along the left tibia in a 13 years girl

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Figure 7. Chronic Osteomyelitis along the Left humerus with sequestra in a 13 years bo

Figure 8. Spine osteonecrosis along the lumbar region in a 16 years girl with "fish mouth" shaped vertebra.

Figure 9. A leg ulcers of the lateral malleolar region in 38 years old male on preparation for surgical debridement.

Spine osteonecrosis was found frequently in the lumbar region as shown in Figure 3. Several factors were associated with MSK disorder among SCA patients, including age, highly demanding physical activity status and lymphocytosis as shown in the table 5 below.

Also annual frequency of painful crises was statistical significantly associated with MSK disorders as shown in table 6 below.

Discussion

Prevalence and patterns of Musculoskeletal disorders

Sickle cell anaemia is common particularly in African countries. The prevalence of patients with MSK disorders found to be high in this study (11.5%). In the other countries like Nigeria this prevalence is even higher (31.4%)[16]. A study done in Belgium showed a prevalence of 28.9%[17], this Belgium study contain participants mainly from Demographic republic of Congo. The higher prevalence of MSK disorders in Belgium is reflected by improved patient services which improved their life expectancy, as a result more MSK disorders has been manifested, for instance femoral AVN.

MSK disorders in this study occurred frequently in lower limbs, spine and upper limbs. This patterns is reflected in a study done in Nigeria whereby 84/118 (71.2%) occurred in lower limbs, 33/118 (28.0%) in upper limbs and 1/118 (0.8%) in the spine[16]. The higher prevalence of MSK disorders in lower limbs is attributed by higher occurrence of femoral AVN. This may be accounted by a precarious blood supply on the femoral head and increased intraosseous pressure due to frequent vaso-occlusive crisis[18].

Femoral Avascular necrosis

Femoral AVN in this study occurred most frequently. This higher occurrence of femoral AVN with almost the same proportion 21/57 (36.4%) is reflected in a study done in Saudi Arabia[19]. This pattern is also shown by the other studies, however with a low proportion, particularly in Nigeria is 28/131 (21.4%)[16] and Belgium is 12/79 (15.2%) [17]. The proportion shown in these studies was lower compared to the current study; this may be due to the fact that they included transient MSK disorders like dactylitis in their assessment. The same pattern has been reflected in other study done in Cameroun[9]. This may be accounted by a precarious blood supply on the femoral head and increased intraosseous pressure due to frequent vaso-occlusive crisis, as already explained previously[18].

In this study bilateral femoral AVN found in 7/20 (35%), less compared to a study done in Belgium where they found to occur in 7/12 (58.3%). Femoral AVN by the Ficat's classification in the current study showed that majority were in grade 2 and grade 3, few were in grade 4 and no one diagnosed as grade 1 due to inability to identify femoral AVN grade 1 on plain radiograph. The Ficat's grading system determines severity, condition worsen as grades are getting higher. This finding is in keeping with a study done in Cameroun whereby they found AVN by Ficat's classification, grade 1 was 6/25 (24%). Grade 2 was 4/25 (16%), grade 3 and grade 4 was 11/25 (44%) and 4/25 (16%) respectively[9]. However in that study grade 1 was easily diagnosed because they used Computed tomography for the investigation.

The findings of the current study is not in keeping with a study done in Nigeria which showed avascular necrosis by Ficat's classification, grade 2 was 1/28 (3.5%), grade 3 was 7/28 (25%), grade 4 was 20/28 (71.5%) and no patient diagnosed as grade 1 [16]. The higher proportion of Grade 4 in that study is explained by the author that, first line medical care givers would have missed the diagnosis at earlier stages. It may also be due to patients presenting first to traditional bone setters, churches and mosques only to come to hospitals at late stages. Lack of modern diagnostic facilities and/or relatively high cost of orthodox medical care in Nigeria for most of these patients may have contributed to this[16].

Osteomyelitis

Osteomyelitis is the common complication among SCA patients. In this study osteomyelitis occurred in 6/55 (10.9%). This is reflected in a study which showed the proportion of 15/116 (12.9%)[9], and the other study done in Belgium showed the proportion of 12/79 (15.2%)[17]. The higher proportion of osteomyelitis has been found in some studies, particularly the one in Nigeria which showed 49/131 (37.4%) of all MSK disorders. This higher proportion compared to the current study may be contributed to by the study population in Nigeria, who reported to come from environment with higher prevalence of communicable diseases, poor sanitary conditions, low educational background, and limited access to medical facilities.

In this study osteomyelitis affected the tibia, radius and humerus. These findings are comparable to a study done in Nigeria whereby they found out the femur affected in 40.8%, tibia affected in 28.6%, humerus affected in 22% and radius affected in 8.2%[16].

Another study in Nigeria found osteomyelitis affected humerus by 5/27 (18.5%), radius by 2/27(7.4%), femur by 5/27(18.5%), tibia by 11/27 by (40.7%), first metatarsal by 1/27 (3.7%) and spine by 2/27 (7.4%)[20]. Diaphysis was involved in 5/6 (83%) of osteomyelitis affected patients. This may be due to scarce blood supply on the diaphyseal region with higher risk of thrombosis and infection following vasoocclusive crises compared to metaphyseal region. Tibia found with higher predilection to osteomyelitis, may be due to the subcutaneous anatomical position of tibia that is at risk of minor injury and subsequently developed osteomyelitis.

Culture and sensitivity

Microorganism causing osteomyelitis in this study included Citrobacter species, Salmonella species and Staphylocuccus aureus. However due to few participants found with osteomyelitis in this study, it cannot be generalized to all SCA patients with osteomyelitis. A study done in Nigeria showed myriads of organisms that cause osteomyelitis including Staphylococcus aureus -58.8%, Citrobacter species-5.9%. Klebsiella species- 11.8%, Escherichia coli-11.8%, Proteus species-5.9% and Pseudomonas aeruginosa-5.9% and no Salmonella species were found[20].

Different levels of drug sensitivity on the osteomyelitis causing microorganisms were revealed in this study; The salmonella species were sensitive to Ampicillin, Chloramphenicol and cotrimoxazole. The Staphylococcus aureus found sensitive to Chloramphenicol, Augmentin, Ceftriaxone, Imipenem, Cefuroxime and Gentamicin, while resistance to Cotrimoxazole and Ampicillin. The Citrobacter species found sensitive to Ampicillin, Ceftriaxone, Imipenem Cefuroxime and Gentamicin, while resistance to Chloramphenicol. Generally Staphylococcus aureus and Citrobacter species were most sensitive to ampicillin, Augmentin and gentamicin. These findings are comparable with a study done in Nigeria which showed that Staphylococcus aureus and Citrobacter species were sensitive to the third generation cepholosporins followed by gentamycin and erythromycin. They were more resistance to cloxacillin[20]. This wider resistance may be due to antibiotic abuse, whereby its misguided overuse leads to the bacteria developing resistance.

Spine osteonecrosis

The spine osteonecrosis was the second most common MSK disorders after femoral AVN in this study 19/55 (34.5%). A study done in Belgium showed spine osteonecrosis occurred in 6/79 (7.6%) of all patients with MSK disorders[17]. This lower proportion may be explained by the fact that they included MSK disorders like diaphyseal necrosis which could be easily diagnosed, as they also used MRI for making diagnosis. Another study done in Cameroun showed the proportion of spine osteonecrosis was 20/116 (17.2%) of all MSK disorders[9]. In this study their sample population involved patients aged 16 to 51 years, which may lead to the observed difference compared to the current study.

The spine osteonecrosis in this study included the following regions; Isolated Lumbar spine involvement accounted for 31.5% while thoracic spine was 5.3%. Also spine osteonecrosis affected contiguous levels including Lumbosacral spine that was 21.1%, Thoracolumbar spine was affected by 15.8% and Sacroiliac region by 26.3%. The

common occurrence of spine osteonecrosis in the lumbar spine is also reflected in some studies[9]. The spine osteonecrosis seen is the result of distribution of infarcts and ischaemic changes with subsequent formation of the characteristic of "fish mouth" vertebrae. This is highly dependent on the anatomy of the blood supply to endplates. The center of the endplate receives its major blood supply from long branches of the vertebral nutrient arteries which is at risk of thrombosis following vaso-occlusive crises. The peripheral portion receives its blood supply from short perforating branches of periosteal vessels which is at low risk of thrombosis following vaso-occlusive crises[12, 21].

Leg ulcers

Leg ulcers occurred in 4/55 (7.3%) of all MSK disorders in this study. These findings is reflected in a study done in Nigeria which showed 14/131 (10.7%) of all MSK disorders presented with leg ulcers[16]. Another study done in Nigeria found leg ulcers to occur in 1/25 (4%) of all patients with MSK disorders[9]. This lower proportional compared to the current study is attributed to the study population who were children aged 9 months to 17 years, different from the current study whereby participants aged 1 year to 41 years were studied. The majority of patients who presented with leg ulcers in this study had history of local trauma. Leg ulcers among SCA patients are thought to be vascular in nature. Vaso-occlusive crises and thrombotic events lead to ischaemia along the extremity which is followed by poor healing and further ischemia[22]. Local trauma may initially caused skin breakdown, due to poor perfusion and healing difficulties leading to persistent leg ulcers.

Other Musculoskeletal disorders

In this study we found MSK disorders which occurred rarely among SCA patients. These disorders include Knee septic arthritis 1/55 (1.8%). These findings is reflected in a study done in Belgium whereby knee septic arthritis occurred in 2/79 (2.5%) of all patients with MSK disorders[17]. In Nigeria showed 5/131 (3.8%) of all patients with MSK disorders to have knee septic arthritis[16]. This higher proportion compared to the current study may be attributed to by the study population who reported to come from environment with higher prevalence of communicable diseases, poor sanitary conditions, low educational background, and limited access to medical facilities.

Also rare MSK disorder found in this study include Pathological fracture 2/55 (3.6%), flexion contractures occurred in 1/55 (1.8%), recurrent patella dislocation occurred in 1/55 (1.8%) and knee stiffness occurred in 1/55 (1.8%) among all MSK disorders.

Factors associated with Musculoskeletal disorders

Age

The age between 11-20 years was statistical significantly associated with MSK disorders. This age group is commonly affected by AVN. A study done in Jamaica showed a consistent result where by age of 11 to 15 years was highly associated with AVN[23]. Another study showed the age of 10 years or younger to be highly associated with osteomyelitis [19]. Also age greater than 20 years was significantly associated with musculoskeletal disorders. This age group commonly is affected by leg ulcers and

femoral AVN. This is in consistent with a study published in 1989, that showed age of 20 years or above is highly associated with leg ulcers[15].

Gender
Gender in this study was not significantly associated with musculoskeletal disorders. Male and female were equally affected. These study findings were in consistent with several studies which showed that sex was not related to femoral AVN[17, 23, 24].

The haemoglobin level
Most of patients with MSK disorders in this study had a moderate anaemia (5-7.9g/dl). The haemoglobin level found was not significantly associated with musculoskeletal disorders. Some studies showed different findings where by Haemoglobin level among sickle cell patients with AVN were higher with an average of 11g/dl, compared to patients without avascular necrosis with an average of 9.1g/dl [25]. Another study showed that the incidence of leg ulcers decreased from 43.2 events per 100 person years in patients having haemoglobin levels below 6g/dl to 2.4 events per 100 person years in patients having haemoglobin levels above 12g/dl[15].

These differences may be due to the large samples of these specific MSK disorders in those studies, which enabled statistical association to specific MSK disorders to be computed.

White blood cells
In this study white blood cell counts were not significantly associated with musculoskeletal disorders. This finding is different from what was observed in one study where by WBC exceeding 15 X 10^3 /µl was associated with septic arthritis [26]; however in the current study we found one case of septic arthritis.

Higher number of lymphocytes was found statistical significantly associated with musculoskeletal disorders (P-value 0.005). The lymphocytosis may be reflected by infection or necrosis among these affected patients.

Mean frequency of painful crises
The mean annual frequency of painful crises among patients with MSK in this study was 5.7. This was significantly associated with MSK disorders. These findings are in consistent with a study done in Nigeria, which showed that the higher the rate of painful crises the more the occurrence of AVN. Patients who developed AVN had mean frequency of painful crises 5.8 ±1.6, compared to 2.1± 1.3 for patient who did not develop AVN[27].

Physical activity status
Most of patients with musculoskeletal disorders in this study had less demanding physical activity status. Less demanding physical activity status was not significantly associated with MSK disorders. Highly demanding physical activity status was significantly associated with MSK disorders. These may be due to increased frequency of vaso-occlusive crises and mechanical stresses precipitated by highly demanding physical activities such as sports and military works that may lead to hypoxia and

dehydration. Local trauma was not associated with MSK disorders. The current study is comparable to a study in which job status showed no significant association with leg ulceration, however local trauma reported to be associated with leg ulceration[15].

Conclusion

The prevalence of musculoskeletal disorders among sickle cell anaemia patients in Mulago Sickle cell anaemia clinic is high.
The most common musculoskeletal disorders among sickle cell anaemia patient in Mulago sickle cell anaemia clinic were femoral avascular necrosis followed by spine osteonecrosis. The least common musculoskeletal disorders include septic arthritis, pathological fractures and others like flexion contractures, recurrent patella dislocation and knee stiffness.

The majority of patients with femoral avascular necrosis were grade 2, grade 3, followed by grade 4 by Ficat's classification.
Factors associated with musculoskeletal disorders among sickle cell anaemia patients in Mulago sickle cell anaemia clinic include age between 11 and 20 years, annual frequency of painful crises, lymphocytosis and highly demanding physical activity status.

Recommendation

- A high index of suspicion and early diagnosis of musculoskeletal disorders among Sickle cell anaemia patients is of paramount importance. This should be achieved meticulously by the physician/paediatricians, who manage these patients.
- Sickle cell anaemia patients with suspected/diagnosed musculoskeletal disorders should be referred immediately for orthopaedic surgeon's review. This will avoid delay of special orthopaedic care required at the beginning.
- Proper management should be advocated in order to reduce the frequency of painful crises amongst these patients. The reduction of the frequency of painful crises facilitates the reduction of musculoskeletal disorders
- Further research needs to be done on factors associated with specific musculoskeletal disorders among sickle cell anaemia patients. This will enable factors which are associated with each specific disorder to be tested statistically.

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