ACUTE SEPTIC ARTHRITIS AS IT IS SEEN IN CHILDREN AT KENYATTA NATIONAL HOSPITAL

A DISSERTATION PRESENTED AS PART OF THE FULFILMENT FOR THE DEGREE OF MASTER IN MEDICINE (PAEDIATRICS) IN THE UNIVERSITY OF NAIROBI 1987.

By

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Say not "I have found the truth"

but rather "I have found a truth"

KAHLIL GIBRAN.

DECLARATION:

I certify that this dissertation is my original work and has not been presented for a degree in any other University.

Signed .....

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SUMMARY

A nine-month study was done on children with acute septic arthritis admitted to the Paediatric Orthopaedic and general paediatric wards. The aims of the study were to elucidate the clinical characteristics and aetiological agents of septic arthritis in children admitted to Kenyatta National Hospital. Thirty one children were recruited into the study and of these 58% were infants and 32.3% were school age children. There was a striking male predominance in the school age children - 9:1 while male/female ratio was 1.2:1 in the younger children. Knees and shoulders were the most frequently affected by septic arthritis and together were responsible for 71% of the septic joints. It is of interest that all the septic shoulder joints occurred in infancy. Non-typhoidal salmonella species especially Salmonella typhimurium, Klebsiella species and Staphylococcus aureus were the most frequently isolated bacteria.

The rate of bacterial isolation was as high as 72.2% when both blood cultures and joint aspirate cultures were done. Salmonella species had 75% sensitivity to the aminoglycosides (Gentamicin, Kanamycin) and Chloramphenicol while only two thirds of the Klebsiella species were sensitive to the same antibiotics. Staphylococcus aureus isolated in this study were sensitive to Erythromycin and uniformly resistant to Ampicillin, Cloxacillin and Cotrimoxazole. There was full

recovery in 63.7% of the patients while 23% went home without appropriate follow-up.

The author recommends that blood and joint aspirate cultures should be done in all patients suspected to have septic arthritis. Antibiotic sensitivity testing should be done regularly to facilitate appropriate drug therapy. Clinicians should ensure adequate follow-up of patients following discharge from hospital.

CONTENTS

LIST OF ABBREVIATIONS

1.	dl	-	decilitres
2.	fig.	-	figure
3.	Hb	-	Haemoglobin
4.	KNH	-	Kenyatta National Hospital
5.	L	-	Litres
6.	mls	-	Millilitres
7.	NB	-	Note
8.	PCM	-	Protein Calorie Malnutrition
9.	PMN	-	Polymorphoneutrophils
10.	TWBC	-	Total White Blood Cells Count
11.	WBC	-	White Blood Cells

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INTRODUCTION

Acute septic arthritis also called pyogenic, suppurative or infectious arthritis occurs when pus forming bacteria invade a synovial joint[1]. The infection rapidly progresses with autolysis of the synovial cartilage[1]. Prompt and adequate therapeutic measures are essential for complete recovery. Inadequate therapy results in major complications such as osteomyelitis, ankylosis and prolonged morbidity and suffering to the patient. Septic arthritis closely parallels the incidence of acute osteomyelitis and the two entities coexist[1,2].

Extensive studies on the pattern of acute septic arthritis have been carrried out in North America[1,2,3,4]. Literature on the illness on the African continent is limited[5]. Clinical experience however suggests that between North America and Africa there are some differences in the pattern of the disease.

Septic arthritis is commoner in children under 2 years of age[2]. Septic arthritis may occur in any of the synovial joints but classically certain joints appear to be more vulnerable i.e. knees, hips, elbows and ankles in that order of decreasing frequency [1,2,3,4].

The infection can reach a joint in the following ways;- (i) By direct spread from a metaphysis especially in children under 2 years of age. In this age group the blood vessels of the marrow penetrate into and even through the calcified layer of the articular cartilage to reach the deeper uncalcified layers. (ii) By the blood stream from a distant focus (skin, pneumonia, septicaemia, osteomyelitis, dental infection)[4,5]. (iii) By penetrating wounds.

Staphylococcus aureus has been shown repeatedly to be the most common cause of septic arthritis in all age groups. Various series report rates of 17% - 80%[3,4,5,6]. The infection usually has spread from adjacent metaphyseal osteomyelitis. Beta haemolytic streptococci and gram negative enterobacteriae are the most frequently isolated bacteriae[2].

Haemophilus Influenzae is the most common aetiological agent in children aged 2 months to 4 years[2,3,8,9] followed by type B staphylococci, streptococci, pneumococci and meningococci[1,2]. Gonococci may be recovered in sexually active teenagers[2].

Prior to the advent of antibiotic therapy septic arthritis resulted in considerable mortality and morbidity. Borrela[4] reported on a study done by Robert Smith in 1874 in

"which 13 out of 21 (61.9%) patients with septic arthritis died." Today the mortality of septic arthritis is less than 1%[1,4,5]. However, long term morbidity is still very common and continues to be a challenge to the clinician[1,4,5].

Clinical Presentation

There are significant differences in the presentation of septic arthritis between infants and older children[1,5,9].

Infants

In infants there are very few specific manifestations. Septic arthritis often presents with irritability, tenderness of the affected joint and a pseudoparalysis of the affected limb. In a sick infant a careful examination is needed in order not to miss the septic arthritis[1]. Fever and elevated white cell count are minimal and often misleading.

Older Children

The older children often present complaints of exquisite pain in the affected joint[1]. The pain is acutely aggravated by the slightest movement of the affected joint. The clinical features of high fever, prostration and joint effusion are important[1,2].

Certain clinical characteristics seem to differentiate septic arthritis from other causes of joint swellings.

1. Joint swelling occurs at onset of illness while sympathetic joint effusion in acute osteomyelitis develops 3 - 4 days after disease onset[1].

2. A comfortable range of movement is possible in acute osteomyelitis, while in septic arthritis there is exquisite pain[1].

3. The pain of acute septic arthritis is continuous unlike rheumatoid arthritis whereby the child is fairly comfortable at night[1]. Occasionally the onset of juvenile rheumatoid arthritis may be confused with acute septic arthritis.

The diagnosis of septic arthritis is confirmed by arthrocentesis and blood culture[1,3]. Pus obtained following arthrocentesis usually has low glucose levels and elevated white blood cells ($> 5{,}000$ cells/mm^3). Gram stain and culture will reveal the causative bacteria[10]. Synovial aspirates may be negative due to either prior antibiotic therapy or the antimicrobial activity of the synovial fluid[6]. Blood cultures are useful and a bacterial isolation rate of 40% has been reported[3]. Other useful investigations are total white cell count and erythrocyte sedimentation rate.

Radiological features early in the disease are those of non specific joint affection. X-rays done on the 10th - 12th day? will reveal features of osteomyelitis in those patients who have this complication.

The clinical features of acute septic arthritis so far described have been drawn from clinical studies on North American children. De Wet[5] is one of the few authors who have described acute septic arthritis in African children. In East Africa, Hall reported on polyarthritis in adult Africans mainly[11,12,13]. There are limited reports on the patterns of acute septic arthritis among African children, for example, age, vulnerable joints, and causative bacteria. If there are different patterns from those reported elsewhere[1,2,3,4] what then are the major implications in terms of therapy, morbidity and final outcome? Finally what are the most cost effective laboratory investigations in the diagnosis of acute septic arthritis? These are some of the problems for which the aims and objectives were designed to answer.

AIMS AND OBJECTIVES

The aims and objectives of this study were:-

1. To elucidate clinical characteristics of children with septic arthritis.

2. To determine the aetiological agents of septic arthritis in children admitted to Kenyatta National Hospital.

MATERIALS AND METHODS

The children recruited in this study were from the general paediatric wards and the paediatric orthopaedic ward in Kenyatta National Hospital. The study was carried out continuously over a 9-month period from 1st February to 31st October, 1986. The study patients were selected from those children who initially presented with joint problems, or who presented with other ailments and subsequently developed joint problems. The author reviewed the history and carried out physical examinations on all these children. The patients were admitted into the study if they satisfied the following criteria:-

A. Inclusion Criteria

1. Painful swelling and hotness of a joint of sudden onset and lasting no longer than 4 weeks regardless of presence or absence of fever.

2. Limitation of movement of the affected joint(s) and exquisite pain on even the most gentle examination.

B. Exclusion Criteria

Excluded from the study were the children with:-

1. A history suggestive of a bleeding disorder.

2. A history and clinical features of connective tissue disease (for example, Still's disease, systemic lupus erythromatosus).

The author visited the recruitment area on alternate days and each consecutive child satisfying the laid out criteria was included. Data was collected according to the proforma (Appendix 1). The weights were taken only on admission and were measured to the nearest 0.2 of a kilogramme. The Toledo Spring Scale Model 1361 was used to weigh the children. This was the scale which was most readily available and was used for all those aged under 5 years. Children on traction were not weighed. The measurement of the height and length were made according to methods described by Jellife[14]. Other features of malnutrition, for example, hair and skin changes were recorded.

A venipuncture using a scalp vein needle after sterile preparation of the skin using spirit was done in a standard way as described by Stokes[15]. Nine mls of blood was drawn and separated into 4 aliquots: 3 of 2 mls each and one of 3 mls. The 3 mls aliquot was put into a sequestrene bottle while each of the 2 ml aliquots was put in a sterile manner into each of the 2 bottles containing 10 mls of Trypticate Soy media for aerobic culture and into one bottle containing 10 mls of Trypticate Soy media with thioglycolate for

anaerobic culture. The dilutional effect of the large amount of media would counteract the antimicrobial activity of the added 2 mls of blood[9]. Owing to material shortage in the wards and laboratories two sets of blood cultures half an hour apart as described by Stokes were not done[15]. The anaerobic media bottle was a cross check for any facultative anaerobic bacteria that might have grown. In this study obligatory anaerobes were not strictly looked for because these organisms are not important causes of septic arthritis[2,3,4].

Arthrocentesis of all the affected joints except the hip joint was done using a gauge 19 or 21 needle. To avoid introducing infection into the joint, utmost care was taken in order not to traverse an area of cellulitis[6]. Pus from septic hip joints was collected in theatre following arthrotomy.

In those patients who yielded at least 6 mls of pus, each 2 mls aliquot of pus was introduced in a sterile manner into each of the 2 bottles of aerobic media and into one bottle of anaerobic media. The media composition in each case was similar to that used for blood cultures. In those patients whose joint aspirate yielded only small volumes of pus, the pus sample was plated directly onto each of the two plates of Sheep blood agar and onto one plate of Mackonkey media for culturing aerobic and anaerobic bacteria respectively.

In all cases a gram stain was done.

The specimens thus collected were delivered to the laboratory within half an hour and innoculated at 37°C. Sampling from the culture bottles and subsequent plating on Sheep blood agar and Mackonkey agar was done regularly at 24, 48 and 72 hours up to 3 weeks in the negative cultures. A bacterial growth was considered to be significant if it was obtained in at least 2 media bottles and was obtained from repeated plating from the original cultures. Standard bacteriological methods were then used to identify the various bacteria[17]. Antibiotic sensitivity testing was done using antibiotic discs.

The 3 mls of blood in a sequestrene bottle was taken to the laboratory, where a total white cell count (TWBC) and haemoglobin level were estimated using a Coulter Counter model F. A peripheral smear stained with giemsa was made. A differential white cell count was done from this smear. Haemoglobin electrophoresis using cellulose acetate paper at PH 8.9 was done.

Specimen collection was confined to the times when the laboratories were open to allow delivery of specimens within half an hour of collection. Radiograms of the septic joints were done on the tenth to twelfth day of the disease. Finally the duration of the hospital stay, the condition at discharge and the anticipated plan of follow up were recorded.

RESULTS

During the nine-month period 31 children were recruited into the study.

Age Distribution

The ages of the study population ranged from six weeks to 12 years. As shown in Table 1 and 2, of the 31 children, 18 were infants and 10 were school age children. Thus septic arthritis shows two major peaks one in infancy and one in school age children. Of the 31 children only two and one were toddlers and pre-school children respectively.

Table 1: Age and Sex Distribution

	Infants 0 - 11 months	Toddlers 12-35 months	Pre-School 36 months- 5 years	School Age 5 years- 12 years	Total
Male	10	2	1	9	22
Female	8	0	0	1	9
Total	18	2	1	10	31
%	58	6.5	3.2	32.3	100

Table 2: Age Distribution in Infants

Age Group	Number of Children	Percentage
Infants younger than 6 months	8	44.4
Infants older than 6 months	10	55.6
Total	18	100

The mean age at the onset of septic arthritis in infancy was 5.6 months. The youngest infant was 6 weeks and the oldest was 9 months. The mean age at the onset of septic arthritis in school age children was 8.7 years.

Sex Distribution

Table I shows that of 31 children 22 were males and 9 females. The overall male to female ratio for the total population was 2.4:1. The general paediatric admissions male to female ratio is 1.2:1. Thus there was a male preponderance in the study group. In infants the male to female ratio of the study population was 1.25:1 which was not significantly different from that of the total paediatric admissions. In the school age children studied, the male to female ratio was 9:1 which was much more than the total school age paediatric admissions male to female ratio of 1.7:1.

Clinical Presentation

The main clinical features are summarized in Table 3 below :

Table 3: Summary of the Main Clinical Features

Age	Fever	Joint swelling LJM	Other Associated Illnesses	Preceeding Trauma
Infants	13 (72.2)	18 (100)	9 (50)	0
12 months < 5 years	3 (100)	3 (100)	0	0
5 years - 12 years	9 (90)	10 (100)	1 (10)	9 (90)
Total	28 (90)	31 (100)	10 (32)	9 (29)

LMJ - Limited Joint Morbility

NB: Figures in brackets are percentages

All the children with acute septic arthritis had a swollen joint with limited morbility. This is the complaint most frequently presented to the clinician. Fever occurred in 28 (90%) of the patients. However it is important that only 13 out of 18 (72.2%) of the infants had a fever at presentation. The illness in children under 2 was insidious with a range of three to twenty-eight days (average 8.5 days) before presentation in hospital. None of these younger children appeared prostrate with illness at presentation. 50% of the infants had other associated

illnesses (see Table 10).

Nine out of the ten school age children presented with a very high fever, general malaise and prostration. The average duration before hospitalization was 3.7 days. In those children who developed osteomyelitis the duration of illness before treatment in school age children was four days and seventeen in children under 2 years of age.

Nine (90%) of the school age children sustained trauma preceeding their acute septic arthritis. All nine were boys. Three had fallen from a height and subsequently developed septic arthritis of the hip joint, 5 had direct penetrating injury into the joint while one had an injury on the same limb but at a distance from the affected joint.

Pattern of Joint Involvement

The pattern of joint involvement in different ages in the study population is illustrated in Tables 4a and 4b. The knee and shoulder together were responsible for 71% of the septic joints. The shoulder was marginally more frequently involved than the knee in infants. There were no septic shoulders in children aged 2 years and above.

Table 4a: Pattern of Joint Involvement In Different Ages

Joint	Infants	12 months - < 5 years	5 years - 12 years	Total	Percentage
Knee	9	3	7	19	45
Shoulder	10	1	0	11	26
Elbow	0	0	2	2	4.8
Ankle	4	0	0	4	9.5
Hip	0	0	3	3	7.3
Small joints of the hand	2	0	0	2	4.8
Small joints of the feet	1	0	0	1	2.4
Total	26	4	12	42	100

Table 4b shows the various combinations of joints in polyarthritis. The five children with polyarthritis had a total of 16 affected joints. There was variety of joint combination without any predominant pattern.

Table 4b: Joints Involved in Polyarthritis

Age of child	5 months	6 months	6 months	3 years	10 years
Joint Involved	2 shoulders 2 knees	small joints of hands and feet	2 ankles 2 shoulders 1 knee	2 knees	2 knees 1 elbow

BACTERIAL ISOLATION

Twenty-eight members of the study population had blood cultures done while twenty-five had a successful arthrocentesis. Overall eighteen (58%) members of the study population had bacteriological diagnosis of their septic arthritis.

Table 5 compares the rate of bacterial isolation from blood or joint aspirate alone to those who had both blood and joint aspirate cultures done. It is important to note that isolation rate by blood culture alone was 39% and 64% by joint aspirate. When blood culture and joint aspirates were combined, the bacterial isolation rate was as high as 72.2%.

Table 5: Bacterial Isolation Rate

Site of cultures	Number of Specimens done	Positive Bacterial Isolation	Isolation Rate %
Blood Culture	28	11	39
Joint Aspirate culture	25	16	64
Complete Joint Aspirate and Blood Cultures	18	13	72.2

NB: In five patients who had arthrocentesis, there was no fluid obtained.

Site of Bacterial Isolation

The Salmonella species which included nine Salmonella typhimurium, one group D salmonella and two untyped salmonella were isolated both from joint and blood cultures. Klebsiella were marginally more frequently isolated from blood cultures while Staphylococcus aureus and other bacteria were isolated from joint aspiration (see Table 6). Other bacteria comprised of one each of Streptococci faecalis, Alkaligens faecalis, Citrobacter species, Escherichia coli and Acenetobacter species. Seventeen out of the twenty-four bacteria isolated (70%) were gram negative bacteria.

Table 6: Site of Bacterial Isolation

Bacterial	Total Number Isolated	Blood	Joint
Salmonella Species	11	11	10
Klebsiella Species	4	2	2
Staphylococcus Aureus	4	1	3
Others	5	0	5

NB. The second column gives the total number of patients with the particular bacteria isolated. For example 11 patients had salmonella species isolated, and of these, 10 had an isolation in both blood and joint aspirate while one had an isolation in blood only.

Table 7: Bacterial Isolate in Various Age Groups

Bacteria	Infants	1 year to <5 years	5 years to 12 years	Total	Per-centage
Salmonella Species	9	1	1	11	60
Klebsiella Species	4	0	0	4	16.7
Staphylococcus aureus	1	1	2	4	16.7
Others	1	1	3	5	20.8
%	62.5	12.5	20.8	100	

The distribution of the various bacteria was not even throughout the different age groups. Nine out of the eleven (81%) salmonella organisms were recovered in infants who composed 58% of the total study population. The numbers were small and hence statistical tests were not applicable. The four patients in whom Klebsiella species were isolated had ages ranging from five months to nine months. In three of them Klebsiella species was isolated in association with other bacteria.

Five patients out of eighteen patients with bacterial isolate had multiple bacteria isolated. Salmonella

typhimurium was isolated in four of the patients in association with other bacteria. In three patients several bacteria were isolated from one specimen (pus) while in two patients different bacteria were isolated in different specimens (pus & blood).

Antibiotic Sentivity of the Bacteria Isolated

In vitro testing of antibiotic sensitivities was done inspite of the major lack of uniformity of antibiotic sensitivity testing discs. With the exception of Staphylococcus aureus most organisms were sensitive to aminoglycosides as illustrated in Table 8.

Table 8: Antibiotic Resistance of the Bacteria

Antibiotic	Antibiotic Resistance			
	Salmonella Sp.	Klebsiella Sp.	Staphylococcus aureus	others
Ampicillin	9/9 (100)	2/2 (100)	2/3 (66.6)	4/4 (100)
Gentamicin	2/8 (25)	1/3 (33.3)	0/4 (0)	0/4 (0)
Kanamycin	2/8 (25)	1/3 (33.3)	-	-
Chloramphenicol	2/8 (25)	-	-	0/3 (0)
Tetracycline	5/8 (62.5)	1/3 (33.3)	2/3 (66.6)	4/4 (100)
Cotrimoxazole	7/10 (70)	2/3 (66.6)	3/4 (75)	1/3 (333)
Cloxacillin	-	-	3/3 (100)	-
Erythromycin	-	-	1/4 (25)	-

(Figures in brackets are percentages)

Staphylococcus aureus isolated in this study was resistant on in vitro testing to ampicillin, cotrimoxazole and cloxacillin. The same organisms were sensitive to erythromycin (see Table 8). 75% of Salmonella species in this study were sensitive to chloramphenicol as well.

Gram Stains

In seven patients bacteria were seen on gram stains. Six of these patients had a positive culture. Nine patients out of seventeen who had a negative gram stain were positive on culturing.

White Blood Cell Counts

Twenty-eight patients had a complete white blood cell count done. Fig.1 illustrates the distribution of the total WBC. Twenty-three (82%) had a total WBC above 10 x 10^9 cells/L Three patients with a total WBC in the normal range of 5-10 x 10^9 cells/L had bacteria isolates while the other two developed radiological evidence of osteomyelitis. Actual values of TWBC are in Appendix 2.

WBC differential count

Ten out of the eleven infants whose differential WBC was completed had an increase of PMN in the PBF while three of the eight children over one year of age did not have an increase of PMN in the PBF. This distribution of PMN in infants and children over one year of age is shown in Fig.2 and 3 respectively. Actual values are in Appendix 3.

FIG 1: T.W.B.C COUNT IN STUDY POPULATION

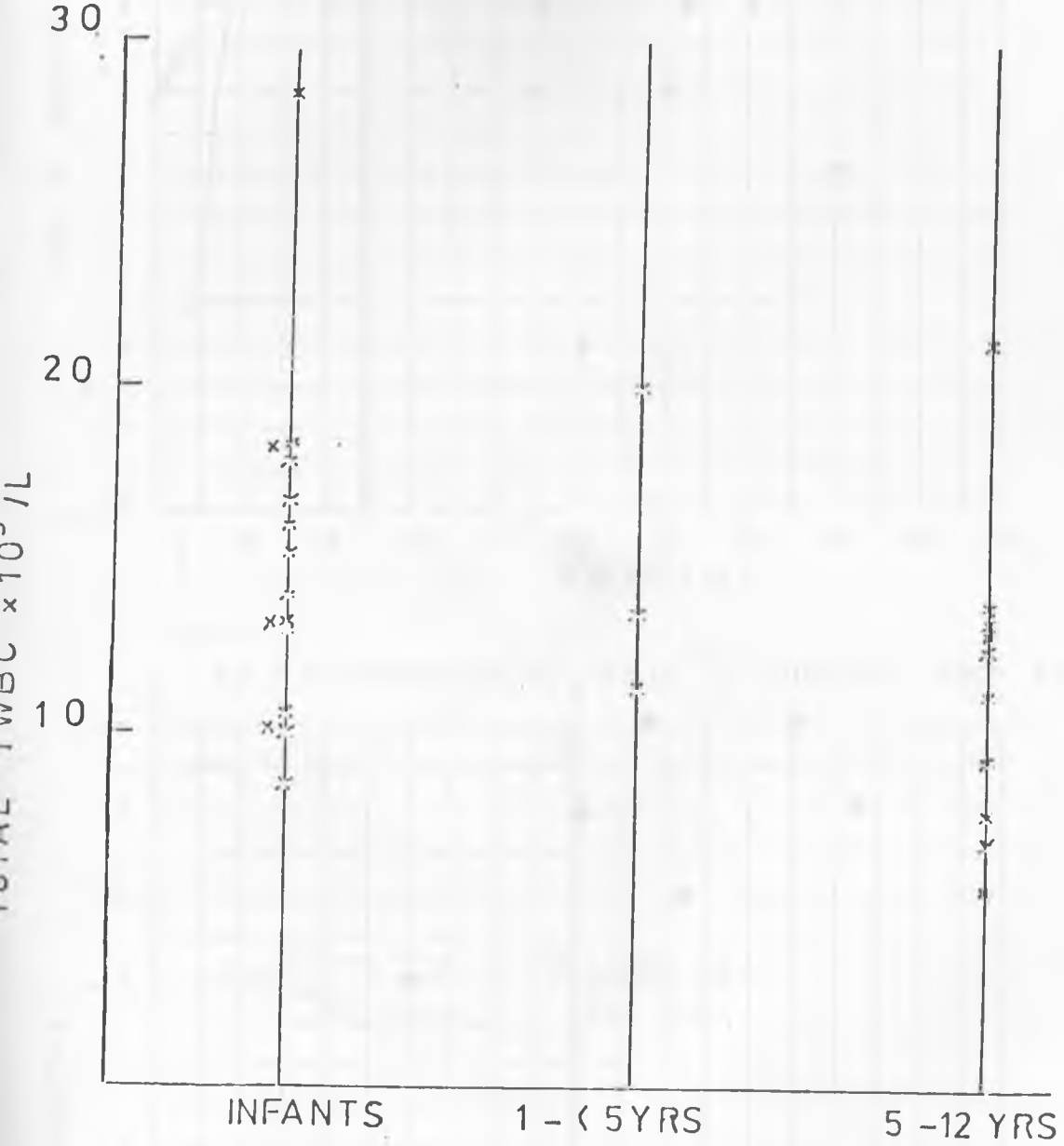


FIG 2. DISTRIBUTION OF PMN OF INFANTS

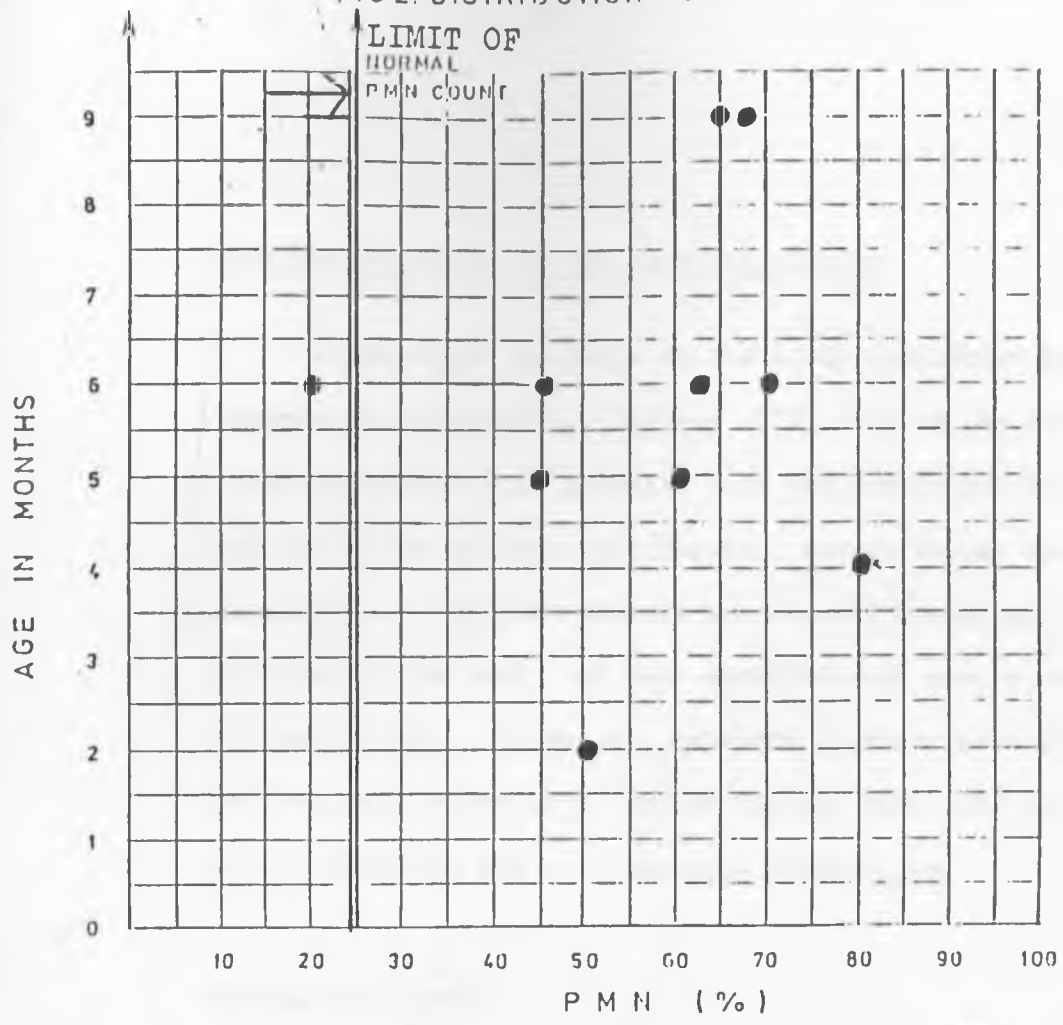
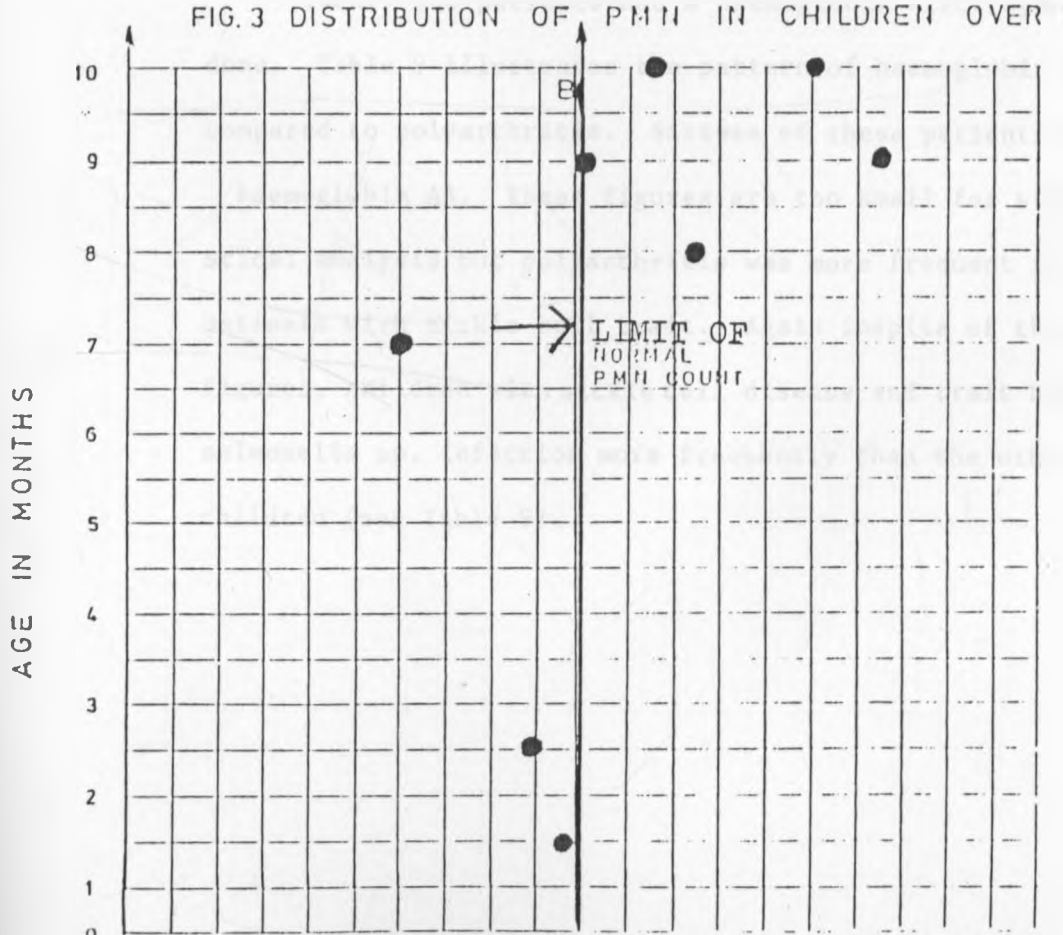


FIG. 3 DISTRIBUTION OF PMN IN CHILDREN OVER 1 YEAR



Haemoglobin Values in the study population

Twenty-eight patients in the study population had a haemoglobin estimation. Sixteen (57%) were in the normal range, seven had mild anaemia, four moderately severe anaemia and one severe anaemia (see Fig.4). Actual values are in Appendix 4. Two patients who had a normal haemoglobin at the time of the study had been admitted with severe anaemia and had transfusion. These two patients together with the five patients with moderate or severe anaemia were affected by septic arthritis due to Salmonella Typhimurium.

Haemoglobin Types

Twenty-one patients had a haemoglobin electrophoresis done. Table 9 illustrates the pattern of haemoglobin type compared to polyarthritis. Sixteen of these patients had haemoglobin AA. These figures are too small for statistical analysis but polyarthritis was more frequent in those patients with sickle cell trait. Again inspite of the small figures, children with sickle cell disease and trait had salmonella sp. infection more frequently than the other children (see Table 9).

FIG 4: HB Distribution in the study population

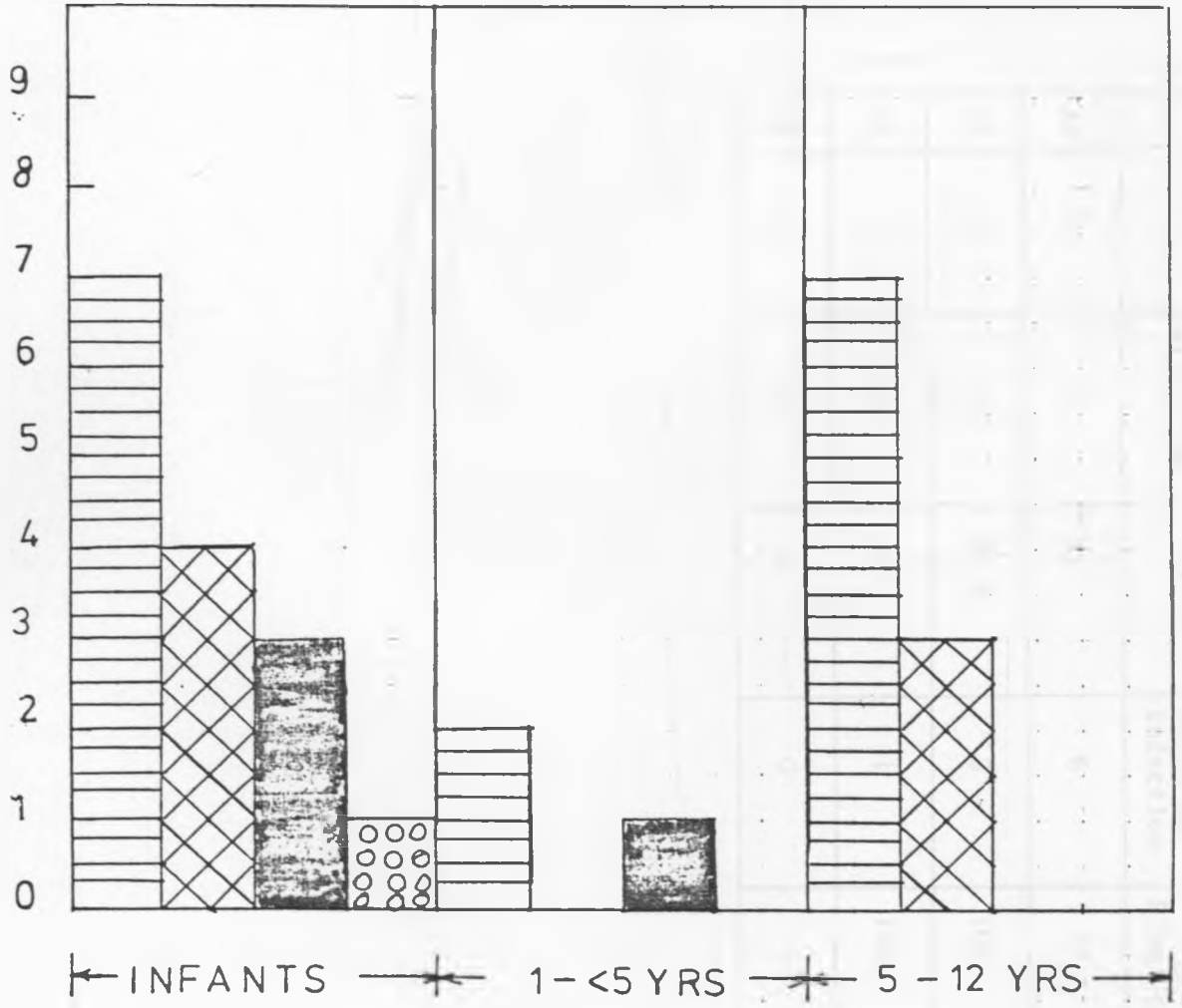


Table 9: Polyarthritis and Salmonella Sp. Infection in Patients with Different Haemoglobin Types

Hb	Number of Children	Number of Children with Polyarthritis	Percentage with Polyarthritis	Number of Children with Salmonella sp. infection	Percentage of Children with Salmonella
AA	16	4	25	6	37.5
AS	3	2	66.6	3	100
SS	1	0	0	1	100
SF	1	0	0	0	0

Associated Illnesses

Eleven children (35.5%) were also affected by other illnesses which were the initial causes of admission in ten of these children. Nine of these eleven children were infants, one was in the age group 1-5 years and one was of school age. Thus 50% of infants, 33.3% of children 1-5 years and 10% of school age school age children had an associated illness. These illnesses included pneumonia, meningitis, malaria, diarrhoea, vomiting and anaemia. Often the children had multiple problems as shown in Table 10.

Table 10: Bacteria Isolated from Children with Associated illnesses

	Bacteria Isolated				
	Salmonella Sp.	Klebsiella	Staph. aureus	Others	Total No. of Patients
Broncho-pneumonia Meningitis+ Anaemia + CCF	2	-	-	1	2
Diarrhoea & Vomiting	3	-	-	-	3
Malaria	1	-	-	-	1
Pneumonia	1	-	-	-	1
Pneumonia+ Anaemia	1-	1	1	-	2
Anaemia+ Malaria+Measles	1	-	-	-	1
SCD	1	-	-	-	1
Total No. of bacteria	9	1	1	1	*

NB: There were multiple bacterial isolates hence number of bacterial isolates do not tally with numbers of individuals.

Salmonella species were isolated in 9 out of the 11 (82%) children with other illnesses.

Nutritional Status

Children who were 0-5 years of age had their nutrition status assessed in terms of weight for age. Only one child was underweight by the Wellcome Classification (19). All other children's weights were in the normal range.

Children over 5 years of age had their nutrition assessed in terms of height for age. Five children's heights were measured. Other children were on traction and as such accurate measurements could not be made. However one aged 10 years had clinical PCM. Of these 5 children, 2 had their heights below the 5th percentile, 1 below the 10th percentile, 1 above the 10th percentile and one at the 60th percentile. height for age.*

*The standards used for comparison were from National Centre for Health Statistics for American Children (2)

Radiological Features

Twenty-four Xrays from an equal number of patients were reviewed. The other seven Xrays could not be traced. Nineteen (79%) had radiological evidence of a joint effusion. Only nine out of twenty-four (29%) had radiological evidence of osteomyelitis in association with acute septic arthritis (see Table 11).

Table 11: Radiological Features

Age of Children	Increased Joint Space	Features of Osteomyelitis
Infants	10	4
1 - 5 years	3	1
5 - 12 years	6	4
Total	19	9
Percentage	79	29

Mode of Therapy

Four children were treated with arthrotomy together with antibiotics. Their average hospital stay was 18 days. The remaining 27 patients were treated conservatively and their length of hospital stay was 20 days longer.

Table 12: Outcome of Septic Arthritis

Outcome	Septic Arthritis Only	Septic Arthritis + Osteomye-litis	Total	Percentage
Full Recovery	16	3	19	61.3
Stiff Joint	2	0	2	6.5
Home on Treatment without follow-up	2	5	7	22.6
Absconded	1	1	2	6.5
Died	1	-	1	3.2

Outcome

The outcome of the septic arthritis study population is detailed out on Table 12. Twenty one out of the thirty one patients (61.3%) recovered fully in the hospital while two (6.5%) had stiff joints. Of the remaining nine children it is of great concern that seven of them were sent home on treatment with no follow up. Five out of these nine children had septic arthritis complicated by acute osteomyelitis. One child died from complicated measles acquired in the ward while on treatment for acute septic arthritis.

DISCUSSION

Septic arthritis is not a very frequent illness in children admitted to K.N.H. It is however important in terms of morbidity and long term hospital stay. A retrospective count of children with septic arthritis in the past 6 years showed an average of 14-15 cases per year. That the author recruited thirty one cases in nine months can be explained by the fact that patients who do not have a primary diagnosis of septic arthritis are usually left out of retrospective studies. Various North American series have reported varying numbers of patients; Nelson [3] 221 cases over 15 years, Borella [4] 52 cases over 16 years and Sequeira[7] 32 cases over 10 years.

Age Distribution

Infants as reported elsewhere[2,4,5] are the most frequently affected by septic arthritis. In this study 18/31 (58%) of the patients were infants. However, unlike in other studies neonates[1,4] were not encountered among the children studied. The rarity of the disease in neonates is a true reflection of the disease pattern in children seen at K.N.H. and is supported by retrospective count done by the author and other workers[20]. In one of the North American series[5] toddlers accounted for one-third of the population with acute septic arthritis. In this study toddlers were a mere 6.5% (3/31) of the study population. Haemophilus Influenza which

is an important cause of acute septic arthritis in toddlers and pre-school children in North America is rarely encountered here as a cause of acute septic arthritis. This may be one of the reasons why acute septic arthritis is uncommon in toddlers and pre-school children. Joints of toddlers and pre-school children do not have communication between the metaphyseal and synovial blood vessels[7]. This reduces their vulnerability to acute septic arthritis evolving secondary to acute osteomyelitis. In addition the younger child is usually closely supervised and restricted from handling tools such as barbed wire, pitch fork jembe and nails. These latter items were shown to be closely associated with the injuries that preceeded acute septic arthritis in the older children. Older children are often required to participate in adult activities in the home even though their motor skills and awareness of safe handling of the tools is limited.

Sex Distribution

In this study septic arthritis affected boys and girls equally in infancy whereas in school age children there was definite male preponderance. Septic arthritis in school age children was strongly associated with a preceeding injury especially penetrating injuries into the joint. This may explain the male preponderance since it is well known that male children are more accident prone[2]. This association of septic arthritis with penetrating joint injuries has been reported[21].

Pattern of Joint Involvement

In this study monoarticular septic arthritis occurred in up to 80% of the study population. This is similar to others reported in literature[1,2,4,10,21]. In children younger than 2 years certain joints have metaphysis that are intrarticular e.g. hip, elbow. These joints have been reported to be more vulnerable to septic arthritis as a result of spread of infection from an adjacent septic bone focus[1,2]. This fact has not been borne out in this study in which the shoulder was marginally ahead of the knee as the most frequently affected joint in infants. The three children with septic hip joints were all of school age and not neonates as reported in literature[1,3,5,6]. What is even more interesting is that septic arthritis of the shoulder was found only in children younger than 2 years. It is then clear that other factors are operative. The author postulates that the method of placing children on the back has a role.

Usually the mother or the mother substitute grips the upper arm and slides the child onto her back. At some point during this procedure the baby's whole weight may be supported on the shoulder joint and it may get damaged. /this is in the /If setting of a septicaemia or bacteraemia, infection may localize there. Six out of ten of the septic shoulders occurred in children with other associated illnesses preceeding the acute septic arthritis. Joints of small children can be

damaged easily. An analogy to this would be the dislocation of the olecranon joint in a child whose whole weight is supported by a handgrip only. Such an injury would render the joint less resistant to infection.

A similar pattern of joint involvement in septic arthritis as in this study was reported by Wilkens[22] in a study done on septic arthritis in the aged and chronically ill. This group of elderly people were similar to infants in that 72.2% of them had a focus of infection in another part of the body for example, empyema. In addition many had prior joint damage from chronic arthritis[22]. Therefore in the presence of a bacteraemia or septicaemia infection was more likely to settle in a damaged joint. Alternatively depressed or low immunity is often found in the elderly and very young.

Others report septic arthritis of the hip and elbow[1,6] and hip and knees[4,3,5] to be most frequently affected joints in children. The youngest infant with septic arthritis in this study was 6 weeks old. Early institution of oral feeding in new borns as opposed to prolonged parenteral nutrition, and the extremely infrequent use of femoral venipunctures may have contributed to the relative lack of neonates in the study population.

Clinical Features at Presentation

In infants the condition developed insidiously and often the child was not very ill. This may explain the delay there was in presenting in hospital compared to older children. Only 13/18 (72%) of the infants were running a fever. This insidious onset of disease in infants is well described[1].

In older children septic arthritis is a more acute illness. Nine out of ten children came in with an acute febrile illness and very toxic. The one exceptional child had received antimicrobial therapy in a nearby Health Centre. This pattern of presentation is well documented[1,2,16].

Associated Illnesses

The phenomena of acute septic arthritis being associated with other illness is well reported[2,4,6,7,16] and the respiratory system and skin have been the most frequently implicated sites of infection. De Wet reporting on the work of Badgleys and Blanche found 55% and 38% of the study population respectively had anteceeding infections.[5] In the current study ten out of 31 (32.2%) had an antecedent infection observed. Often these patients had a multiplicity of problems. Of the two patients with diarrhoea and vomiting this was probably the enteric phase of their salmonella infection.

Nutritional Status

The nutritional status of the children as measured by weight for age was normal in the infants. This is unlike De Wet's report on African children with septic arthritis[6]. In older children data on weight for age was not adequate and therefore reasonable conclusions cannot be made.

Bacterial Isolation

In this study bacterial isolation from blood 39% and joint aspirate 64% compared extremely well with those reported from North America children - blood 37% and joint aspirate 62%[3]. In 18 out of 31 patients both blood culture and joint aspirate was done. There was an isolate in 13 out of 18 (72.2%) which was very similar to the North American figures of 73%[3]. Hence the practice of drawing both blood cultures and joint aspirates is to be recommended in order to improve bacterial diagnosis.

Five of the joint aspirates were dry taps. These types of joints have been described in association with juvenile rheumatoid arthritis. However these five patients had haematological evidence pointing towards acute septic arthritis and one had osteomyelitis of the adjacent bone.

A whole variety of bacteria were isolated. Multiple bacterial isolation from pus was a feature of this study

like in others reported elsewhere [4,21,22]. Gram negative bacteria accounted for 60% of the total isolation. They were most frequently isolated in infants. Salmonella typhimurium was an important cause of septic arthritis in this study population as shown in Table 7. This is similar to other studies done in Kenyatta National Hospital[24].

Salmonella Typhimurium was associated with anaemia in this study. Haemolysis has been cited as a risk factor for Salmonella Typhimurium septicaemia[2] and infections in children may be preceeded by a severe anaemia requiring urgent transfusion. Once the anaemia is corrected the characteristic fever of salmonella infection develops[25]. It is no wonder that 7 our of 11 patients with salmonella infection had severe and moderately severe anaemia. Two of these seven patients had presented with very severe anaemia and congestive cardiac failure requiring urgent transfusion. The characteristic fever of salmonella infection developed immediately afterwards.

Klebsiella and Staphyloccocus aureus occurred with equal frequency though the former was in infants only and the latter more in older children. Haemophilus influenza was not isolated from the children studied for several possible reasons. Firstly toddler and pre-schoolers who are at most risk of Haemophilus Influenza infection do not frequently have acute septic arthritis as seen from retrospective

counts done by the author and also findings of this study. Secondly it may be a reflection of the infrequency of Haemophilus Influenza as cause of septic arthritis[20]. In North America declining frequency of Haemophilus Influenza septic arthritis has been reported[23]. This probably reflects both a natural decline and possibly the increased use of vaccination.

Laboratory Investigations

Various laboratory investigations were important in establishing the aetiology of acute septic arthritis. Blood cultures together with joint aspirate cultures had a definite superiority over other investigations done in establishing a bacteriological diagnosis of the acute septic arthritis (see Table 5). A bacteriological diagnosis was possible in 72.2% of those patients who had both blood and joint aspirate cultures.

It has been emphasized repeatedly the importance of a gram stain in guiding the initial antibiotic selections[4,16,26]. However, a gram stain is not a substitute for culturing as emphasized in this study whereby 9/24 bacteria were isolated from pus which was gram stain negative. White blood cell counts were elevated in the majority of the children with increases of PMN in the peripheral blood film. In Kenyan children a peripheral blood film with lymphocytes

up to 75% is normal in infants while in the age group 6-12 years lymphocytes in peripheral blood film are equal to PMN[27]. Figures 1,2, and 3 clearly illustrate that the total white cell count and PMN were elevated in children with acute septic arthritis. The gram stain and white cell counts support the diagnosis of an inflammatory process while awaiting the more lengthy process of culturing.

Radiology

It is pertinent to note that in this study even in those children who do not develop osteomyelitis there is usually an increased joint space indicating an effusion. The author did not see any reference to this in literature. Workers in areas of acute shortages would best make use of their resources by doing X-rays on the 10th - 14th day of illness by which time any changes of acute osteomyelitis would have become radiologically visible. This is very important because treatment would then be required for as long as six weeks preferably with parenteral antibiotics for the greater part of that time.

MANAGEMENT AND OUTCOME

It is difficult to discuss how these children were managed because they were under the care of very many different physicians. It is important to note infants were admitted late into hospital. Many of the children had presented to a health delivery point before this and probably the attending health worker did not attach much importance to the swollen joint in the absence of a high fever. Complications of septic arthritis are related to the duration of illness before commencement of treatment. Some of these complications develop immediately while others may take a long time[21]. In this study 23% of the patients went home on treatment without appropriate plans of follow-up. This is a very serious omission. Health workers need to be alerted about the seriousness of septic arthritis and it should be treated promptly and adequately. A child under 2 years of age with septic arthritis most probably has a gram negative bacterial infection. Salmonella typhimurium should be strongly suspected in septic polyarthritis. The aminoglycosides (Gentamicin, Kanamycin) and Chloramphenicol are useful in the treatment of acute septic arthritis.

In older children there is a larger variety of organisms. Erythromycin is recommended for staphyloccocus infection while for infection with other bacteria, aminoglycosides were more uniformly useful. During the time

period of this study resistance of staphyloccocus aureus to cloxacillin on invitro testing was noted in 75% of the bacteria isolated in KNH[28].

One would like to compare surgical and conservative methods of treating septic arthritis. The numbers of the study patients are too small for a reasonable comparison. However, the suggestion that conservative treatment results in a longer hospital stay is very pertinent. Modern antibiotics especially the penicillins and cephalosporins penetrate into the joint cavity in adequate therapeutic levels while aminoglycosides are less diffusable generally[16]. Hence it is strongly recommended that adequacy of antibiotic diffusion into the joint is assessed[10,16,29]. Relatively simple,accurate and inexpensive methods are available for doing this in an average laboratory[10,16]. Such studies would form a useful basis of recommending the most appropriate antibiotics for use in our environment especially if oral therapy is to be recommended[10,26].

CONCLUSIONS

1. Septic arthritis in the children studied occurred most frequently in infants older than one month and in school age children.

2. Boys of school age were more frequently affected than girls.

3. Trauma especially penetrating joint injury was associated with septic arthritis in all school age boys in this study.

4. The shoulders and knees were the most frequently affected joints. Septic arthritis of the shoulder was found in infants only.

5. 32.2% of the study population had an illness preceeding the septic arthritis[6].

6. Gram negative bacteria (Salmonella species and Klebsiella species) were most frequently isolated in infants while Staphyloccus aureus was most frequently isolated in older children.

RECOMMENDATIONS

1. All joint swellings should be adequately investigated.

2. Blood cultures and joint aspirates should always be done on first contact with a patient with suspected acute septic arthritis in order to improve the bacteriological diagnosis. This should be done before institution of antibiotic therapy.

3. The K. N. H. should have appropriate arrangements for culturing and incubating bacteriological material at all times.

4. Patients who have had acute septic arthritis especially those with a complicated course and those sent home on oral antibiotics for completion of treatment should be followed up.

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APPENDICES

Page

APPENDIX 1

ACUTE SEPTIC ARTHRITIS AS IT IS SEEN IN CHILDREN AT KENYATTA NATIONAL HOSPITAL

QUESTIONNAIRE

1. Name .....(2) IP.No.....

3. Date of Admission.....

4. Date of Discharge .....

   Duration of hospital stay.....days

5. Age .....years.....months.

6. Weight .....grammes.

7. Height..... cm (8) Upper arm circumference.....cm

9. Evidence of skin or hair change.....

   .....

10. Duration of illness before current hospital admission

    .....days.

11. Any history of trauma Yes [ ] No [ ]

12. Any prior treatment (antibiotics etc) Yes [ ] No [ ]

13. Details of any associated illness .....

.....

.....

14. Blood Cultures:

a) Bacteria isolated

b) Antibiotic sensitivity

Sensitivity	Resistance
.....	.....
.....	.....
.....	.....
.....	.....

15. Joint Aspirate.

a) Gram Stain

b) Bacteria isolated

c) Antibiotic sensitivity

Sensitivity	Resistance
.....	.....
.....	.....
.....	.....

16. Radiological report at 10-12 days

.....

17. Haemoglobin .....g/dl.

18. TWBC .....Cells/L

19. WBC differential count .....

20. Haemoglobin electrophoresis

21. Outcome at the time of discharge

.....

.....

22. Plan of follow up from home

Follow up planned ☐ No follow up planned ☐

APPENDIX 2

TOTAL WHITE CELL COUNTS

Infants	12 months - 5 years	5 years -12 years
15.1 x 10^9/L	11.4 x 10^9/L	13.3 x 10^9/L
13.2 x 10^9/L	13.5 x 10^9/L	11.3 x 10^9/L
17.8 x 10^9/L	20.5 x 10^9/L	21.5 x 10^9/L
12.9 x 10^9/L		12.5 x 10^9/L
8.6 x 10^9/L		7.1 x 10^9/L
18.3 x 10^9/L		13.0 x 10^9/L
14.9 x 10^9/L		13.8 x 10^9/L
18.1 x 10^9/L		9.5 x 10^9/L
15.9 x 10^9/L		7.9 x 10^9/L
10.1 x 10^9/L		5.8 x 10^9/L
10.6 x 10^9/L		
16.7 x 10^9/L		
13.1 x 10^9/L		
28.3 x 10^9/L		

APPENDIX 3

PMN

INFANTS

Age/Months	PMN
2	50
4	81
5	44
5	60
6	63
6	71
6	46
6	20
9	68
9	65

OLDER CHILDREN

Age/Years	PMN
1½	48
2½	44
7	30
8	62
9	51
9	83
10	58
10	77

APPENDIX 4

HAEMOGLOBIN DISTRIBUTION

	Infants	12 Months-5 years	5 years 12 years
Normal	7	2	7
Mild Anaemia	4	0	3
Moderate Anaemia	3	1	0
Severe Anaemia	1	0	0