Intravascular catheter related infections in children admitted on the paediatric wards of Mulago hospital, Uganda.

Patricia Nahirya[1], Justus Byarugaba[2], Sarah Kiguli[2], Deogratias Kaddu-Mulindwa[3]

1 Kabale Hospital, P. O. Box 7 Kabale
2 Department of Paediatrics and Child Health, Faculty of Medicine, Makerere University, P. O. Box 7072 Kampala, Uganda
3 Department of Medical Microbiology and Molecular Biology, Faculty of Medicine, Makerere University

Abstract

Introduction: Worldwide use of intravascular catheters (IVC) has been associated with both local and systemic infections. No studies have been done in the sub-Saharan region on IVC related infections.

Objective: To determine the prevalence, causative organisms and their antimicrobial susceptibility pattern and the factors associated with infections related to short term peripheral venous catheters in children admitted to the general paediatric wards in Mulago Hospital, Uganda.

Methods: A cross-sectional study of 391 children aged one day to 12 years, on Jelliffe ward in Mulago Hospital, who had short peripheral venous intravascular catheters uncoated with no antibiotic or antiseptic, was done. Social demographic characteristics, anthropometry, clinical examination including the catheter site were determined at enrollment. The children had their blood, catheter tip and hub samples taken off for culture and sensitivity as well as complete blood counts. The data collected was entered using EPI-INFO and analysed with SPSS packages.

Results: Out of the 391 short term peripheral venous catheters collected, 20.7% catheter tips and 11.3% catheter hubs were colonised. Phlebitis was observed in 17.4%. Bacteria isolated from colonised catheter tips were *Staphylococcus aureus* (60.5%), *Staphylococcus epidermidis* (23.5%). The most common organism isolated from the hub was *Staphylococcus aureus* (56.8%) followed by *Staphylococcus epidermidis* (18.1%). Gram positive and negative organisms were sensitive to ciprofloxacin, gentamycin for gram-negative organisms and augmentin, cefuroxime, ceftriaxone for the gram-positive organisms. After logistic regression, factors such oedema, modified Glasgow coma score of <10/15, 6 hourly benzyl penicillin were significantly associated with colonisation of the tip while use of 25% dextrose, chloramphenicol 6 hourly and blood transfusion were significantly associated with colonisation of the hub.

Conclusion: The study showed that infections related to short peripheral venous catheters in paediatric general wards in Mulago Hospital occurs and prevalence was 20.72% for tips and 11.3% for hubs.

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Introduction

Intravenous therapy is an essential part of clinical care used in a wide variety of healthcare settings (CDC&P, 2002/51, Parker 2002). They have, however, been associated with catheter related blood stream infections (CRBSI) (Parker, 2002, Eggimann & Pitet, 2002). With advancing medical technology, the variety of procedures the patient has to undergo has increased, often with some penalty of increased risk of infection (Maki, 1981).

World wide, nosocomial infections occur both in developed and resource poor countries. They are among the major causes of death and increased morbidity among hospitalised patients and significant burden both for the patient and public health (WHO, 2002, Parker, 2002). In a prevalence survey of 55 hospitals in 14 countries representing four WHO regions (Europe, Eastern Mediterranean, South East Asia and Western Pacific) an average of 8.7% of hospitalised patients had nososcomial infections (WHO, 2002). The highest prevalence was in East Mediterranean (11.8%), followed by the South East Asia (10%), Western Pacific 9% and Europe 7.7% (Mayon-White, 1988).

Approximately 5% of these nosocomial infections were bacteremias related to intravenous catheters. Case fatality rates are high, with more than 50% rates for some microorganisms. The incidence is increasing, particularly for certain organisms such multi-resistant coagulase negative, Staphylococcal and *Candida species* (WHO, 2002).

Data on nosocomial infection rates in intensive care units (ICU) in developing countries is limited, because of lack of an infection control infrastructure (Ponce de-Leon, 1991). Furthermore, in a setting of extremely limited resources, more basic issues such as

Correspondences:
D.H.Kaddu-Mulindwa
Faculty of Medicine, Department of Medical Microbiology
P.O. Box 7072, Kampala - Uganda
Tel. +256 772 457 831
Email: dhkmulindwa@med.mak.ac.ug

control of over-population, malnutrition and childhood diseases take a priority (Forder, 1993). In Trinidad and Tobago, the prevalence of blood stream infections in a rural hospital was 8% of which 80% had intravascular lines (Orett, 1998). In Brazil, the central-line associated blood stream infection rate was 10.2 per 1000 central line catheters in Paediatric intensive care units and contributed to 17.3% of nosocomial infections (Abramczyk, 2003). A study in Egypt, where peripheral intravenous lines were studied over a period of five months, in which 261 lines placed in 83 patients, 45 episodes of sepsis were, diagnosed both clinically and by blood cultures (Bakr, 2003).

The overall risk of catheter related septicemia is less than 1%. However, patients with catheter related infection have significant morbidity and mortality (Corona et al, 1990). Studies in the USA showed attributable mortality rate of 25 - 35% especially in patients who were critically ill secondary to catheter related blood stream infections (Bentley et al 1968; Pittet et al 1994).

The diagnosis of catheter related bloodstream infections, (CRBSI) is often difficult because there are frequently no signs of inflammation around the catheter. Diagnosis depends either on positive quantitative catheter culture yielding the same microorganisms recovered from the blood stream or differential quantitative blood cultures with significantly greater colony counts from blood drawn through the vein (Salzman and Rubin, 1995). Catheter related infections (CRI) include colonisation of the device, skin exit-site infection and device related blood stream infection (Eggimann and Pittet, 2002; Berg et al, 1995)

Rates of semi quantitative cultures and catheter related septicemia increase significantly with increasing duration of catheter placement. In a study by Maki (1977), 67% of the catheters positive on semi quantitative culture for *Staphylococcus epidermidis*, were significantly associated with local inflammation. It was concluded that a positive semi quantitative culture usually denotes infection, usually only local, but the precursor of catheter related septicemia.

In a one year prospective study of 56 catheters , the rate of systemic infection was 5.3%, insertion site infection 3.6% and contamination without infection 25% (Schmidt et al, 1989). Callingnon et al (1994) showed that central vein catheters caused more sepsis (23 episodes /1000 catheters) than peripheral catheters (0.36/1000 catheters). Therefore with greater use of catheters, the problem of intravenous sepsis is likely to increase. In a review of 30 prospective clinical studies by Hampton et al, (1988) in the US the evaluated risk of infection per day of catheterisation of peripheral arterial catheters was 1.9%, 1.3% for short peripheral venous and 3.3% for central venous catheters. Several complications, however, prevent the prolonged maintenance of intravascular catheters, infection is one of the leading complications and catheter related septicemia represents one of the most frequent life threatening complications of vascular catheters (Maki et al, 1973, Ryan et al, 1974).

There is virtually no information available on this problem in the sub-Saharan region of Africa. We therefore undertook to do a cross sectional study to find out about the intravascular related infections in children aged one day to 12 years admitted to the general paediatric wards in Mulago Hospital in Uganda.

Methods

The study was a cross sectional descriptive study carried out on Jellife ward, which is one of the general paediatric wards in Mulago Hospital, which is the National Referral and Teaching Hospital of Makerere University Medical School, Kampala,Uganda.

The inclusion criteria to participate in the study was children one day to 12 years, admitted to Jellife, a general ward via Acute Care Unit (ACU), a child who had a short peripheral venous catheter inserted in ACU, and children whose parents, guardians or otherwise caretakers consented to participate in the study.

Excluded were children with clinical features such as petechiae suggestive of a bleeding disorder, children with skin sepsis prior to insertion of the intravascular catheter.

Data Collection

Using the Kirsh and Leslie formula (1965), a minimum sample size of 384 was calculated. One of us (PI) consecutively enrolled children fulfilling the selection criteria until the sample size was reached. Time of insertion of cannules was indicated in ACU. Peripheral intravenous removal was done after completion of treatment or for any other reason such as tenderness or swelling. These findings of tenderness, swelling and warmth as well as the physical findings at the time of removal of the catheters were recorded in the questionnaire. Samples of the catheter tips and catheter hubs were aseptically removed and each placed in a separate sterile labeled container, and 1 - 3 ml of blood for blood culture was also taken at the same time. These specimens were then placed in a closed transport box and delivered to the Department of Medical Microbiology of the Faculty of Medicine where the culture investigations were done.

Study instrument

The study instrument used was a structured pretested and precoded questionnaire in a language the parents or guardians understood best. However, the standard procedure was that the questionnaire waas translated from English to Luganda for the guardians or parent to understand, and back into English. This was done by a qualified translator from the department of languages of Mekerere University Faculty of Arts.

Measurement.

The variables measured included information from clinical history, physical examination, catheter examination, anthropometry and laboratory investigations and all were recorded on the questionnaire.

The patient's information regarding socio-demographic characteristics, past antibiotic use, documented or known HIV status and symptoms such as fever, diarrhoea, cough were obtained and recorded as well as the underlying diagnosis given from the admission files. A thorough physical examination was done including the nutritional status as per WHO criteria (1999).

Intravenous catheter examination

At the time of removal: the appearance of the site, duration of use of intravascular catheter, intravenous drugs used how often they were given, size of catheter in gauges, infusions given, blood products used and the cadre of personnel who inserted the catheter were recorded.

Laboratory investigations

Intravenous catheter hub

The external surface of the hub was cleaned with 2% povidone-iodine and the junction disconnected. Using sterile gloves, a sterile swab for culture was taken from the inner surface of the hub and placed in a labeled Stuart's transport medium, and transported to the laboratory.

Intravenous catheter tip culture

The catheter was removed under aseptic conditions using sterile gloves after the insertion site had been thoroughly cleaned with 2 % povidone-iodine. About 2 cm of the catheter tip was cut with a sterile surgical blade and the piece put into a labeled sterile container and then transported to the laboratory within 2 hours for culture and sensitivity. In the laboratory, the catheter tip was removed carefully using sterile forceps and then directly used to inoculate the agar plates. Both the swab and the catheter tip were separately inoculated onto Chocolate agar with 5% sheep blood agar and MacConkey agar with crystal violet and incubated at 35° - 37°C for 18 - 24 hours after which the plates were evaluated for any growth. Further the tip after inoculation on to the plates, it was placed into 5 ml of Brain Heart Infusion broth and incubated under the same condition after which it was subcultured onto the similar set of agar plates (Chocolate & MacConkey).

Blood

The venipuncture was carried out on the children by one of us (PI) in a supine position after the catheter removal according to standard aseptic procedure. Six ml of blood were drawn and 2ml of blood under negative pressure were inoculated into each of the two blood culture bottles containing 20mls of Brain Heart Infusion broth and taken to the laboratory within two hours.

The culture bottles were then incubated at 35° - 37°C for 18 - 24 hours after which a Gram-stain as well as subcultures on Chocolate agar with 5% sheep blood agar, MacConkey agar and Schaedler Agar were done and incubated at 35° - 37°C, except the Schaedler Agar plates which were incubated at the same temperature range but placed in Becton & Dickinson anaerobic jars and evaluated after 48 and 72 hours for any growth. All culture bottles showing no growth after 24 - 48 hours were incubated for up to 7 days and subcultures made at intervals of 3, 5 and 7 days.

Culture evaluation

Growth was signified in all cases by presence of one or more colonies seen on the plate. For suspected *Staphylococcus* the following identification scheme was followed: Gram stain, growth on mannitol salt agar, catalase, DNAse and both slide and tube coagulase tests. For E.coli the IMViC reactions characteristic of E. coli (++—) as well as cellobiose and KCN tests were carried out. For all other gram negative rods identification was done using either API 20E or API 20NE (bioMeriuex, France). The antibiotic susceptibility testing was done according to NCCLS (now CSI) 2003 guidelines with the following antibiotics depending on the isolate: Ampicillin, Augmentin, Chloramphenicol, Cetriaxone, Amoxycillin, Gentamycin, Erythromycin, Co-Trimoxazole, Ciprofloxacin, Piperacillin and Cefuroxime. This was done on Muller-Hinton Agar-2, incubated at 35° - 37°C for 24 hours after which the zones of inhibition were measured.

Qualitative methods

One of us (PI) conducted key informant interviews to further identify factors associated with intravascular catheter related infections on the wards such as antiseptic

measures used, knowledge on catheter care. Seven resource people were identified on the various wards and these included nurses and intern_doctors after consent to participate in the_interview had been sought. Each participant was interviewed individually on a face-to-face basis. Data obtained was analysed using a thematic content analysis in which the text was sorted, coded by themes and the analysed mainly focusing on factors associated with infections related to short peripheral venous catheters.

Data Management.

Quantitative data collected was sorted out, coded and entered into the computer using EPI INFO version 6.04 software package. It was subsequently transferred into a statistical programme SPSS version 12 software package for analysis with the help of a statistician.

Ethical considerations

Institutional consent was obtained from the Department of Paediatrics and Child Health, Faculty of Medicine Research Committee, Mulago Hospital Research and Ethics committee and from the Uganda National Council of Science and Technology.

Results

Three hundred and ninety one children aged one day to 12 years admitted on Jellife ward of Mulago hospital with short peripheral catheters inserted in ACU were enrolled. Of these 319 (81,6%) were less than 5 years and 72 (18.4%) more than 5 but less than 12 years. The mean age was 34.3 months, a median age of 20 months and a standard deviation of 36.5 months. The socio-demographic characteristics are shown in table 1.

Table 1:Sociodemographic characteristics of children (n = 391)

Characteristic		Frequency N = 391	Percentages
Age group	<2 months	15	3.8
	>2/12<5 years	304	77.8
	e"5 years	72	18.4
Sex	Male	195	49.9
	Female	196	50.1
Relationship of caretaker	Mother	327	83.6
	Father	27	6.9
	Aunt	10	2.6
	Brother/sister	8	2.1
	Other	19	4.8
Tribe	Baganda	263	67.3
	Basoga	26	6.6
	Banyankole	21	5.4
	Banyarwanda	10	2.6
	Langi	12	3.1
	Others	59	15.1
Who referred?	Health units	165	42.2
	Self referred	226	57.8
Antibiotics before admission	Yes	70	17.9
	No	321	82.1

Two hundred thirty seven (60.6%) children had one diagnosis, which was Malaria, 140 (35.8%) had bronchopneumonia and severe anaemia, while 14 (3.6%) had three diagnoses, namely malaria, bronchopneumonia and anaemia.

Colonisation

The overall prevalence of colonisation of the catheter and bacteremia was 27.1% OR 0.2710, CI 0.2330 - 0.3180. Of the 391 catheter tips collected and cultured, 81 (20.72% with OR 0.2072, CI 0.1670 - 0.2473) were colonised with organisms. Of these one had two organisms (0.26%). Fourty-four hubs (11.25%, CI 0.0812 - 0.1439) of the 391 intravenous catheters were colonised and again only one had two organisms. Nineteen catheter tips (4.86%, OR 0.0486 CI 0.0273 - 0.0699) had the same organisms as in the hub. Sixteen catheter tips (4.09% OR 0.0409, CI 0.0213 - 0.0606)

had the same organisms as in blood. Seven (1.79%, OR 0.0179, CI 0.0048 - 0.0310) catheter tips had the same organisms in the hub and blood.

Five of the seven patients with same organisms in the tip, hub and blood had malaria and severe anaemia at the time of admission. The other two patients had diarrhea with severe dehydration. Of the 15 neonates recruited only one tip and hub (6.67) were colonised.

Phlebitis

Seventy seven patients (17.14%, OR 0.1714 and CI 0.1340 - 0.2087) had phlebitis. Three of the patients (0.8%) had necrosis at the catheter site and two of these patients had a discharge. However, 59 (15%) patients had a discharge at the catheter site. Of the neonates recruited only one had phlebitis.

Causative microorganisms isolated related to short peripheral venous catheter.

The commonest organisms colonizing both tips and hubs was *Staphylococcus aureus* followed by *Staphylococcus epidermidis*. Others found were *Salmonella enteritidis*, *Pseudomonas aeruginosa, Klebisiella pneumoniae, E. coli* and *Candida albicans*, as shown in table 2.

Table 2: Causative microorganism of infection related to short peripheral intravenous catheters

CausativeOrganisms	TIPS N = 81(%)	HUBS N = 44(%)	TIP+HUBN = 19(%)	TIP+ BLOOD N = 16(%)	TIP+HUB+BLOOD N=7(%)
StaphylococcusAureus	49(60.49)	25(56.8)	15(78.95)	12(75)	6(85.7%)
StaphylococcusEpidermis	19(23.45)	8(18.1)	1(5.26)	2(12.5)	0
Esherichia coli	4(4.93)	4(9.1)	1(5.26)	1(6.25)	1(14.3)
Klebsiella spp	3(3.7)	3(6.8)	1(5.26)	1(6.25)	0
PseudomonasAeruginosa	1(1.2)	0	0	0	0
SalmonellaEnteritidis	0	1(2.3)	0	0	0
StreptococcusPyogenes	0	1(2.3)	0	0	0
Candida albicans	3(3.7)	0	0	0	0

Sensitivity patterns of the microorganisms isolated from short peripheral venous catheters.

The sensitivity patterns of the isolated organisms from the tips and hubs are shown in tables 3 and 4 respectively.

Table 3: Drug sensitivity patterns of the microorganisms related to catheter tips.

Drugs tested	*S.aureus*%	*S.epid*%	*E.coli*%	*Kleb.spp*%	*Ps.aeru*%
Cotrimoxazole	4/34(14)	3/1520	1/2(50)	NT	0/1(0)
Ciprofloxacin	24/26(93.4)	10/10(100)	1/1(100)	2/2(100)	**NT**
Ampicillin	6/2524	2/9(22.2)	1/4(25)	**NT**	**NT**
Augmentin	28/28(100)	15/16(93.8)	4(100)	1/3(33.3)	**NT**
Chloramphenicol	14/24(36.8)	3/11(27.3)	2/4(50)	0/2(0)	0/1(0)
Ceftriaxone	3/3(100)	**NT**	**NT**	**NT**	1/1(100)
Cefuroxime	4/5(80)	1/1(100)	**NT**	0/1(0)	**NT**
Gentamicin	13/19(68.4)	9/14(64.3)	4/4(100)	2/3(66.7)	1/1(100)
Oxacillin	15/21(71.4)	6/8(75)	**NT**	**NT**	**NT**
Erythromycin	17/40(43.9)	8/13(61.5)	**NT**	**NT**	**NT**
Piperacillin	0/4(0)	0/4(0)	**NT**	**NT**	**1/1**(100)
Amoxicillin	6/8(75)	3/3100	**NT**	**NT**	**NT**

NT: - not tested: these drugs are not used normally tested during susceptibility testing for these organisms.

Salm. Group D*- Salmonella Group D,* ***Ps. aeru****-Pseudomonas aeuruginosa,* ***E.coli*** *–Eschericia-coli* ***S.epid****- Staphylococcus epidermidis,* ***S. aureus****-Staphylococcus aureus,*

Table 4: Drug sensitivity pattern of microorganisms related to catheter Hubs

Drugs tested	S.aureus (%)	S.epid (%)	E.coli (%)	Ps.spp (%)	Kleb.spp (%)	Salm. Group D (%)	S.pyogenes (%)
Cotrimoxazole	3/23(13)	1/7(14.3)	0/1(0)	0/1(0)	NT	**NT**	**NT**
Ciprofloxacin	16/17(94.1)	16/17 (94.1)	2/2(100)	2/2(100)	0/1(0)	1/1(100)	0/1(0)
Ampicillin	7/17(41.2)	2/7(28.6)	1/4(25)	**NT**	0/2(0)	**NT**	**NT**
Augmentin	10/10(100)	3/3(100)	4/4100	**NT**	1/2(50)	**NT**	**NT**
Chloramphenicol	5/17(29.4)	4/7(57.1)	1/4(25)	2/2100	0/2(0)	0/1(0)	1/1(100)
Ceftriaxone	1/2(50)	**NT**	**NT**	0/1(0)	NT	**NT**	**NT**
Cefuroxime	4/5(80)	1/19100)	**NT**	NT	0/1(0)	**NT**	**NT**
Gentamicin	7/8(87.5)	1/2(50)	3/3100	1/1(100)	1/1(100)	1/1(100)	**NT**
Oxacillin	3/6(50)	3/3(100)	**NT**	**NT**	**NT**	**NT**	**NT**
Erythromycin	12/22(54.4)	3/6(50)	**NT**	**NT**	**NT**	**NT**	½(50)
Piperacillin	0/4(0)	0/1(0)	**NT**	1/1(100)	**NT**	**NT**	**NT**
Amoxicillin	2/4(75)	1/2(50)	**NT**	**NT**	**NT**	**NT**	**NT**

NT: - not tested, these drugs are not used in susceptibility tests for these organisms.
Salm. Group D*- Salmonella Group D,* ***Ps.spp****- Pseudomonas. Spp,* ***Ps.aeru****-Pseudomonas aeuruginosa,*
E.coli *–Eschericia-coli* ***S.epid****- Staphylococcus epidermidis,* ***S. aureus****-Staphylococcus aureus*
Kleb. spp*- Klebsiella spp,* ***Strep.Pyogenes****- Streptococcus pyogenes.*

The presence of oedema (pedal, facial or generalised) at the time of catheter removal, findings of coma score less than 10 out of 15 in a patient with tip and abnormal respiratory system in case of hub colonisation were significantly associated with the clinical features as shown in table 5.

Table 5: Comparison of tip colonization with clinical features and underlying diagnosis

Clinical features		Colonised	Not colonized)	OR(95% CI	P-value
Fever	Yes	18	75	0.9 (0.5-1.6)	0.711
	No	63	235		
Difficulty in breathing	Yes	3	28	0.4(0.1-1.3)	0.114
	No	78	282		
Pallor	Yes	45	166	1.1(0.7-1.8)	.747
	No	36	144		
Oedema	Yes	5	54	(1.1-14.2)	**0.021***
	No	76	305		
Abnormal resp.system	Yes	14	60	0.9(0.46-1.65)	0.672
	No	67	250		
MGCS	<10/15	4	1	16(1.8-145.2)	**0.007#**
	≥ 10/15	77	309		
Diagnosis malaria	Yes	59	179	2.0(1.2-3.4)	**0.013***
	No	22	131		
Severe anaemia	Yes	22	56	1.7(1.0-3.0)	0.068
	No	59	254		

*Chi-square test used, significant p – value <0.05. # Fishers exact test.

Use of intravenous antibiotics for treatment such as chloramphenicol and gentamycin, transfusion with blood were significantly associated with colonization of the catheter tip as shown in table 6.

Table 6: Comparison of hub colonization with clinical features and underlying diagnosis.

Clinical features		Colonised Hub N=44	Not colonized Hub N=37	OR(95% CI	P-value
Fever	Yes	11	82	1.08(0.5-2.2)	0.841
	No	33	265		
Difficulty in breathing	Yes	4	27	1.2(0.4-3.6)	0.762
	No	40	320		
Pallor	Yes	28	183	1.6(0.8-3.0)	0.172
	No	16	164		
Oedema	Yes	0	101.	1(1.09-1.2)	0.254
	No	44	337		
Abnormal resp.system	Yes	2	72	0.18(0.04-0.77)	**0.007#**
	No	42	275		
MGCS	<10/15	0	5	1.1(1.09-1.17)	0.422
	≥ 10/15	44	341		
Diagnosismalaria	Yes	29	169	2.04(1.1-3.9)	**0.032***
	No	15	178		
Severe anaemia	Yes	17	61	3.0(1.5-5.8)	**0.001***
	No	27	286		
Acute diarrhea	Yes	9	32	2.5(1.1-5.8)	**0.022***
	No	35	315		
Bronchopneumonia	Yes	3	102	0.18(0.05-0.58)	**0.001#**
	No	41	245		
Dysentery	Yes	2	0	9.2(6.9-12.3)	**0.012#**
	No	42	347		

*Chi-square test used, significant p-value <0.05. #Fishers exact test.

Blood transfusion, use of 6-hourly, scalp site, tenderness at the site, more than one diagnosis, Ringer's lactate and 25% dextrose were significantly associated with hub colonisation as shown in table 7.

Table 7: Comparison of phlebitis with clinical features.

Clinical features		Phlebitis N=67	No Phlebitis N-324	OR(95%CI)	P-value
Fever	Yes	19	74	1.3(0.7-24)	0.334
	No	48	250		
Difficulty in breathing	Yes	1	30	0.15(0.01-1.1)	**0.026#**
	No	66	294		
Diarrhoea	Yes	4	47	0.4(0.13-1.1)	0.059
	No	63	277		
Pallor	Yes	41	166	1.4(0.8-20.4)	0.192
	No	26	145		
Oedema	Yes	3	7	2.1(0.5-8.4)	0.274
	No	64	315		
Capillary refill<2 secs	Yes	56	299	0.4(0.2-0.9)	**0.025***
	No	11	25		
Splenomegaly	Yes	23	78	1.7(0.9-2.9)	0.081
	No	44	246		
MGCS	<10/15	0	5	1.2(1.15-1.27)	0.305
	≥10/15	67	319		

*Chi-square test used, significant p – value <0.05. #Fisher exact test.

Colonisation of the same organism in both tip and hub was significantly associated with abnormal respiratory system (p - 0.031), swelling at the catheter site (p - 0.001), use of Ringer's lactate (p - 0.002), blood transfusion (p - 0.049), having more than two diagnoses (p - 0.008), and catheterisation of more than 2 days (p - 0.028).

Colonisation of the same organism in tip, hub and blood was significantly associated with the use of Ringer's lactate (p - 0.036).

Multivariate analysis was done using the logistic regression model to identify variables independently associated with colonisation of the catheter. Oedema, MGCS < 10/15, X-pen 6 - hourly was independently associated with colonisation of the tip, p - values varying from 0.005 to 0.034. Likewise, the variables that were independently associated with colonisation of the hub were use of 25% Dextrose, Chloramphenicol 6-hourly and blood transfusion, p - values varying from 0.001 to 0.037.

Discussion

In this study, the prevalence of colonisation of the tip was found to be 20.7% while for the catheter hub it was 11.3%. Of the catheter tips colonised, only 19 out of the 81 (23.4%) had the same organism as the hub. Sixteen out of 81 tips (19.8%) had bacteremia with the same organisms. Bacteremia of the same organism as the catheter tip and hub occurred in 7 out of the 81 patients (8.6%).

The prevalence of colonisation of the tip falls within the range of 11.8 - 23.7% in comparison to other studies in children and adults (Barbut et al, 2003; Fan et al, 1988; Garland et al, 1992; Bouza et al, 2004). The lower prevalence in this study compared to Bakr et al (2003) could be due to the fact that they enrolled only neonates in intensive care unit who were very ill whereas in this study we considered all children on general paediatric ward. In Bently et al's study (1968) the higher prevalence of 43% was probably because of the narrow spectrum of patients chosen who had to fit criteria of possible hospital acquired septicemia. This study considered every child with a cannula irrepective of presence of fever. Bouza et al (2004) and Schimandle et al (2000) looked at a large number of patients greater than 600, and could possibly explain their higher catch rate of colonisation of 23.7% and 26.4% respectively. Prevalence found in this study was not very far from theirs.

The prevalence of colonization of the hub was lower in this study than that of Bakr et al (2003) of 12.7%. Again this could be attributed to the difference in the age of patients where only neonates on ICU were considered in their study and therefore more likely required frequent intravenous drug administration. In their study more than one cannula per patient was studied compared to one per patient in this study hence different episodes of hub colonisation in each patient could have contributed to an increase in the prevalence I their study.

In this study the commonest pathogen in both colonised tips and hubs was *Staphylococcus aureus* accounting for 60.5% and 56.8% of isolates respectively. Where *Staphylococcus aureus* colonised both tips and hubs, it accounted for 78.9% and 75% of the isolates from blood. These findings are almost similar to those of Bently et al, (1968) where they found 68% of the isolates to be *Staphylococcus aureus*. The prevalence of *Staphylococcus aureus* is significantly higher as compared to other studies done elsewhere (0.9% - 31% Barbut et al, (2003); Arnow et al, (1992);

Bouza et al (2004). This was probably because in this study, antimicrobial ointments of povidone-iodine were not applied to the cannula site after insertion, there was no gauze dressing at the site that could be changed every 24 hours and no orientation sessions for new senior house officers (residents) on guidelines for use of intravenous catheters as in Arnow et al's study (1993).

The second commonest organism in both tips and hubs was *Staphylococcus epidermidis* at 23.45% and 18.1% respectively. This is lower than in other studies (Barbut et al, 2003; Arnow et al,1993; Gerland et al 1992; and Shimandle et al, 1999).

Other organisms isolated included *Escherichia coli* 4.93% and 9.1% for the tips and hubs respectively. In the tip, hub and bacterimia the colonisation rate was 14.1% and *Klebsiella pneumoniae*, 3.7% and 6.8% for the tip and hub respectively and these findings were much lower than in studies by Bakr et al, 2003 and Bently et l, 1968.

In the current study it was shown that the useful drugs to be used in children with colonisation of the tip and hub were ciprofloxacin, gentamycin, augmentin, cefuroxime and ceftriaxone, the choice of treatment regime depended on whether the isolate was Gram negative or Gram positive, however, ceftriaxone, cefuroxime and augmentin were found good for both gram positives as well as gram negatives. The use of ciprofloxacin in children below 18 years has been questioned because of presumed cause of arthropathy and osteochndrosis extrapolated from studies in juvenile animals. However, it has been used widely in children without reports of arthropathy or any severe adverse effects.

Colonisation of the tip with various microrganisms was significantly associated with more than one blood transfusion, swelling at the catheter site, 6 hourly chloramphenicol, gentamicin given once a day, oedema, modified Glasgow coma score of <10/15 and having malaria. Whereas colonistaion of the hub was significantly associated with use of ringers lactate, 25% dextrose, 6 hourly chloramphenicol, blood transfusion, swelling, tenderness having more than one diagnosis e.g. malaria, severe anaemia, acute watery diarrheoa, and bronchopneumonia.

In conclusion, this being the first study of its kind in Sub-Saharan Africa, more studies should be done and in particular to evaluate the quantitative culture method to document catheter-related bloodstream infection and also to evaluate the use of impregnated catheters with antiseptics or antibiotics. Guidelines should also be established on for the care of catheters not only in infants and children but in all patients in this region.

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