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INFECTION TRANSMISSION POTENTIAL OF REUSABLE PHLEBOTOMY TOURNIQUET IN SELECTED HEALTH FACILITIES IN CALABAR, NIGERIA

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ABSTRACT

Reusable phlebotomy tourniquets are used repeatedly on multiple patients and can harbour numerous pathogenic microorganisms serving as potential source of cross-infection between patients. This study was carried out to determine the transmission potential of reusable phlebotomy tourniquets and the source of tourniquet contamination. Informed consent was obtained from the Phlebotomists and heads of departments/units before sampling their tourniquets. Units sampled were Laboratories, sample collection rooms, wards and outpatient Departments. Fingers and gloves of health care workers were also sampled. Hundred questionnaires were administered to healthcare personnel on hand hygiene, glove utilization and tourniquet usage by healthcare personnel. The bacterial colonization rates in the units of healthcare facility, fingers and gloves were compared using chi-square test. Out of the 19 Health facilities sampled, 8 were public health facilities while 11 were private facilities. Results from the study showed that the overall bacterial colonization rate of the 100 tourniquets was 85%. The highest tourniquet colonization was in the Laboratory (62.4%), followed by the wards (22.4%). The least was found in outpatient department (3.5%). The most prevalent isolate on tourniquets were coagulage-negative *staphylococci* (29.4%) followed by *staphylococcus aureus* (28.2%) while *Escherichia coli* was the least (3.5%) encountered isolate. Bacterial colonization rates on facility surfaces were 51.1% whille those on gloves was (33.1%). The most encountered isolates were Coagulase-negative *Staphylococci* 68(51.1%). The least isolate was *pseudomonas aeruginosa* 5(3.8%). Hand hygiene practice was poor. Hand hygiene should be embraced in totality by healthcare workers. Since, tourniquets are not made of durable materials, a reliable method of decontamination is difficult to achieve. Hence, disposable tourniquets should be used in health facilities.

KEYWORDS: Phlebotomy tourniquet, transmission potential, patients risk.

INTRODUCTION

Phlebotomy tourniquets are compressing devices used by phlebotomist to collect venous blood samples from patients. It is used to apply pressure round the skin and underlying tissues of the limbs. The pressure is transferred to the walls of blood vessels making them temporarily closed off and turgid.[1]

In Nigeria, the most common invasive procedure in hospitals is venous blood sampling. This involves the tying of rubber or elasticized tourniquet around the patient's upper arm. The tourniquets are used consecutively on several patients not minding their infective status and without disinfection between each use.[2] However, the World Health Organization[3] and the National Association of phlebotomists in England[4] recommended that tourniquets and other noncritical items should be disinfected between use.

Reusable phlebotomy tourniquets can become contaminated due to reuse on multiple patients or lack of hand hygiene on the part of the phlebotomist and can serve as a possible source of cross-infection between patients. However, single-use disposable tourniquet is recommended to prevent cross-infection between patients.[5]

Cost is often an important factor for health facilities; some health facilities allocate a tourniquet to each patient upon admission, which will be kept in the patient's room for their exclusive usage. However, without proper hand hygiene, phlebotomists can quickly contaminate the tourniquets.[6] Phlebotomy guidelines have suggested decontamination of reusable phlebotomy tourniquet between each patient.[7] Nevertheless, the practice of decontaminating reusable phlebotomy tourniquet is rarely carried out and the physical nature of tourniquet (the elasticized fabric tourniquet being a more popular one than the rubber ones) makes decontamination difficult to achieve.[8]

Reusable phlebotomy tourniquet can become contaminated through the hands of healthcare personnel or surfaces where it is kept. Thus, they may be potential

vectors for transferring bacteria to patients, including multiresistant organisms. Multi-resistant bacteria such as Methicillin-Resistant *Staphylococcus aureus*, Vancomycin-Resistant *Enterococcus*, Metallo-Beta-lactamases and Extended-spectrum Beta-lactamases producing bacteria have been isolated from tourniquets.[9]

Tourniquets may pose higher risk of cross infection than other formites since they are Applied on patient's skin under pressure.[2] Reusable phlebotomy tourniquets are used repeatedly on multiple patients without cleaning between each patient contact in our locality. This may be a potential source of cross-infection. Phlebotomy guidelines states that tourniquets should be decontaminated between each patient use. Nevertheless, except disposable tourniquets are being used, decontamination between patient contacts is difficult. This cross sectional prospective study was designed to assess the transmission potential of reusable phlebotomy tourniquets in the different The Health facilities in Calabar. The study ran from August, 2015 to December, 2015.

MATERIALS AND METHODS

The study was carried out in selected Health facilities in Calabar, Cross River State. Health facilities were; Federal Neuro Psychiatric Hospital, General Hospital, University of Calabar Medical Centre, University of Calabar Teaching Hospital, and sixteen private health facilities.

Informed Consent

Consent was sought from the Phlebotomists and other health workers verbally before sampling the tourniquets and Other work areas.

Sample collection

One hundred reusable phlebotomy tourniquets were swabbed using sterile swab sticks. Swabs were also collected from gloves of phlebotomists and table tops where tourniquets were kept. A structured questionnaire was administered to the Health care workers who had used the tourniquets for information on hand hygiene, glove utilization and tourniquets usage. The Departments and Units sampled included; Laboratories, Sample Collection Rooms, Wards and Outpatient Department.

Data Analysis

Data obtained were analyzed with Epi Info CDC, 2010 statistical software. Descriptive statistics were carried out. Frequencies (prevalence, etc.) were calculated for categorical variables. Interactions between specific categorical clinical variables were tested for significance using the χ^2 test.

Processing of sample

The swab samples were enriched by placing in Brain Heart Infusion Broth. The broth was incubated at 37ºC for 24 hours. A loopful of the broth was inoculated on Cysteine Lactose Electrolyte Deficient Agar (CLED) and Chocolate Agar. Plates were incubated at 37ºC for 48 hours. Plates were examined daily for growth and plates without growth were discarded after 48 hours as negative. Pure cultures of every isolate were obtained before performing biochemical test. This was done by sub-culturing individual isolates onto fresh CLED or Nutrient agar depending on the isolates. These plates were incubated at 37ºC for 24 - 48 hours.

Isolates Identification

Gross morphological characteristics, microscopic and biochemical features of isolates were carried out. Microscopy was done using Gram's technique. Culture media were examined after 24 hours up to 48 hours for growth. The biochemical tests carried out include; Coagulase test, catalase test, oxidase test, Sugar fermentation on Kligler Iron Agar (KIA), urease and indole test.[10]

RESULTS

Figure 1 shows the type of tourniquet sampled. Out of the 100 used tourniquets sampled, only 3.0% were elastic in nature the others were rubber tourniquets.

The distribution of bacteria on tourniquets in various units of the health facilities is shown in Table 1. The study revealed an overall bacterial colonization rate of 85% from sampled tourniquets. Tourniquets from the Laboratory harboured most bacterial isolates 53(62.4%), followed by the wards tourniquet 19(22.4%). The least was found in outpatient department, 3(3.5%). The most isolated bacteria were Coagulase-negative *Staphylococci* with (29.4%) colonization rate followed by *Staphylococcus aureus* 28.2% and *Bacillus species* 17.6%. There was no statistically significant difference in bacterial distribution on tourniquets from various units (x^2 =26.5, p=0.88).

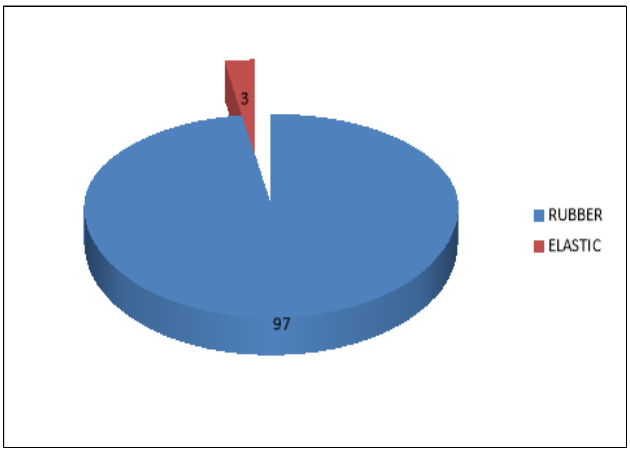

Fig. 1 Types of tourniquet sampled in the study

Table 1 Distribution of Bacteria on tourniquets in healthcare facility units.

Bacterial isolates	Units of healthcare facility No (%) colonization				Total Statistics
	Laboratory (n=62)	Sample collection room (n=11)	Wards (n=22)	Outpatient department (n=5)	
Coagulase-negative *Staphylococci*	13(24.5)	6(60)	4(21.0)	2(66.7)	25(29.4)
Bacillus species	11(20.8)	2(20)	2(10.5)	0(0)	15(17.6) x^2=26.5
Staphylococcus aureus	18(33.9)	2(20)	4(21.0)	0(0)	24(28.2) P=0.88
Proteus Species	2(3.8)	0(0)	5(26.3)	0(0)	7(8.2)
Escherichia Coli	2(3.8)	0(0)	1(5.3)	0(0)	3(3.5)
Pseudomonas aeruginosa	5(9.4)	0(0)	2(10.5)	0(0)	7(8.2)
Klebsiella Species	2(3.8)	0(0)	1(5.3)	1(33.3)	4(4.7)
Total	53(62.4)	10(11.8)	19(22.4)	3(3.5)	85(85.0)

Table 2 Shows the bacterial colonization rates on health facility work areas, fingers and gloves of health personnel. Out of the 200 work surfaces, fingers and gloves of health personnel sampled, 66.5% were colonized by bacteria. Coagulase-negative *staphylococci* 68(51.1%) was the most prevalent isolate from the surfaces, fingers and gloves, followed by *Staphylococcus aureus* 19(14.3%), while *Pseudomonas aeruginosa* 5(3.8%) was the least encountered isolate. There was a statistically significant difference in the colonization rate of facility surfaces, fingers and gloves (χ^2=38.1, p=0.0).

Table 2 Bacterial colonization rates on facility surfaces, fingers and gloves.

Bacteria Isolated	No.(%) of isolates				Statistics
	Surfaces (n=100)	Fingers (n=24)	Gloves (n=76)	Total =200	
Coagulase-negative *Staphylococci*	20 (29.4)	18(85.7)	30 (68.1)	68(51.1)	χ^2=38.1
Bacillus species	10 (14.7)	0(0)	4(9.0)	14(10.5)	P=0.00
Staphylococcus aureus	15(22.1)	2 (9.5)	2(4.5)	19(14.3)	
Proteus species	10 (14.7)	1(4.7)	0(0)	11(8.2)	
Escherichia coli	2(2.9)	0(0)	4(9.0)	6(4.5)	
Pseudomonas aeruginosa	4(5.8)	0(0)	1(2.3)	5(3.8)	
Klebsiella species	7(10.2)	0(0)	3(6.8)	10(7.5)	
Total	68 (51.1)	21(15.8)	44(33.1)	133(66.5)	

Table 3 Shows the Glove utilization and Hand hygiene practice of Subjects. Out of the 100 healthcare personnel enrolled in the study, Medical Laboratory Scientist were the highest (73%), followed by Nurses (20%) and Doctors (2%). However, 5% were Students undergoing training in the health facilities. Survey of hand hygiene showed that 88% of the healthcare workers did not wash/disinfect hands between each patient contact. Only 12% wash/disinfect hands between each patient contact. Also, majority (92%) of healthcare workers did not change gloves between each patients contact, only 8% wore fresh gloves between each patient contact.

Table 3 Glove Utilization and Hand hygiene Practice of Healthcare personnel

Variables	No. (%) examined
Healthcare personnel	
Medical Laboratory Scientist	73(73.0)
Nurses	20(20.0)
Doctors	2(2.0)
Students	5(5.0)
Gloves utilization	
Fresh gloves worn between each patient contact	8(8.0)
Same glove worn between each patient contact	92(92.0)
Hand hygiene practice	
Those that washed /disinfected hands between each patient contact	12(12.0)
Those that don't wash /disinfect hands between each patient contact	88(88.0)

Table 4 Shows the Tourniquet usage by Healthcare Personnel on patients. Majority of healthcare workers (65%) used one tourniquet for more than 20 patients per day. Healthcare workers gave different reasons for using reusable tourniquet; 97% said due to unavailability of tourniquet while 3% had no reason.

Table 4 Tourniquet Usage on patients by Healthcare Personnel

Variables	No. of Health personnel (n=100)
Tourniquet use on patients/day	
1-5	6
6-10	3
11-15	11
16-20	15
≥ 20	65
Reasons for repeat	
Unavailability of tourniquet	97
No reason	3

DISCUSSION

The total bacterial colonization rate on sampled tourniquets in this study was 85.0%. This was higher than the 51.0% reported by Zara *et al*[11] in Karachi, Pakistan. The higher bacterial colonization rate in this study may be due to the broth enrichment method used for bacterial isolation. Zara *et al*[11] did not use enrichment methods in their isolation process. Also, poor hand hygiene practice by healthcare personnel and poor hospital environmental hygiene may have likely contributed to the higher rate of bacterial colonization in this study.

This study revealed that 85.0% of reusable tourniquets were colonised with various bacterial species out of which 45.0% would not be considered as normal skin flora and could be associated with hospital acquired bacteraemia. Pinto *et al*[2] in Australia reported 61.0% colonization by pathogenic bacteria including Methicillin resistant *Staphylococcus aureus* (MRSA). Although antibiotic susceptibility testing was not carried out in our study, 28.2% of the isolates were *Staphylococcus aureus.*

In this study colonisation rates by gram negative bacteria was 24.6%. These included *Pseudomonas aeruginosa* 8.2%. Pinto *et al*[2] also reported colonization by multiresistant gram-negative organisms with transmissible β-lactamase enzymes. The presence of such enzymes can result in infections that are virtually untreatable with available antibiotics. These have previously been shown by Peleg *et al*[12] in Australia to be transmitted readily throughout the hospital environment.

Nearly all the tourniquets sampled (97%) were rubber tubing tourniquets. This shows that most of our isolates were from the rubber tourniquets. Our findings is different from the report of Mehmood *et* al[13] in Pakistan which showed that elastic tourniquets were more colonized than the rubber tourniquets since they have a larger surface area than the later. We could not relate the colonization rates of the different tourniquet in this study since most of the health facilities were using rubber tourniquets. Rubber tourniquets may have been preferred in the health facilities because they are cheap, readily available, and cost-effective whereas elastic tourniquets were more costly and not readily available.

Infection control practices are emphasized in most health facilities in Calabar, Nigeria. These practices include; hand hygiene and decontamination between procedures yet the control of nosocomial infections has continued to pose difficulty. The highest colonization rates was recorded among Laboratory tourniquets 53(62.4%), followed by tourniquets in the Wards 19(22.4%) but there was no statistically significant relationship between colonization rates and departments or units. This point to the fact that colonization occurred in the units or departments where proper disinfection or hand hygiene was not practiced.

Healthcare workers are possible sources of hospital acquired infections by transmission from formites. The bacterial colonization rate on fingers of healthcare personnel and other formites including surfaces and gloves has demonstrated that contamination of tourniquets and possible transmission to patients could be via formites and the user`s hand rather than the patient's skin. The colonization rate on surfaces 68(51.1%) where tourniquets were kept was higher than the rates on gloves 44(33.1%) and fingers 21(15.8%). There was a statistically significant effect of colonization on formites and fingers (χ^2=38.1, p=0.00). This may be due to the fact that disinfection of the surfaces was not carried out properly and regularly or that hand hygiene is inefficiently done. This study is in agreement with the work done by Leitch *et al*[14] in Wishaw, NHS Lanark shire, United Kingdom. They demonstrated that tourniquets are contaminated through the user's hands. With current high colonization rates, continued use of reusable phlebotomy tourniquets may not be justified in the hospital setting.

Although, reusable phlebotomy tourniquets act as potential formites and can harbour pathogenic organisms from the surrounding hospital environment none of the

healthcare personnel made attempt at cleaning their tourniquets between each patient contacts as recommended by World Health Organization,[15] but majority (80.0%) of the Health personnel disinfected the tourniquet daily before use. The reason for not disinfecting between each patient contact may be because of work pressure or negligence. On the other hand, none of the healthcare facilities sampled had a single-use policy for tourniquet.

CONCLUSION

This study has demonstrated that reusable phlebotomy tourniquets may serve as vehicles for transmission of pathogenic bacteria including *Staphylococcus aureus* and *Pseudomonas aeruginosa*. It has also shown that tourniquets may be contaminated from the phlebotomist hands and the surfaces where they are kept which pose a risk to patients. Hand hygiene is an important means by which transmission of pathogens can be reduced.

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