BACTERIAL RESERVOIRS IN A HEALTH CARE ENVIRONMENT: CASE OF THE DOUALA GENERAL HOSPITAL, CAMEROON.

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ABSTRACT

Background

Health care acquired infections are a major cause of morbidity and mortality in hospitals. There is very little documentation of this important problem in our resource limited setting. The aim of our study was to identify bacterial reservoirs and microorganisms with the potential of nosocomial infections in our health care environment

Methods

Bacteriological samples from the air, surfaces, equipment, personnel and patients from six units of the Douala General Hospital, Cameroon were collected for culture according to standardised collection, culture and germs identification techniques.

Results

From our study, 73% of all collected samples were contaminated with pathogenic bacteria. These included 83.3% of fomites, 37.5% of air samples and 100% of hands of health care workers. Pathogenic Staphylococci, gram negative bacilli (*Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa*) and Enterococci were found in 64.7%, 54.1% and 48.7% of specimens respectively. The same bacteria found on the hands of nursing personnel were same as on both surfaces and equipment. The intensive care and neonatal units were the most contaminated with 100% positive cultures. The sterilization unit was bacteria free.

Conclusions

Our health care environment is heavily contaminated and the hands of healthcare workers appear to be the main transmission agent of these bacteria. Guidelines on infection control practices such as hand washing and periodic decontamination must be effectively put in place and continuously evaluated.

Keywords

Health care environment; Microorganisms; reservoir.

RESUME

Abstract

Les infections associées aux soins sont une cause majeure de morbidité et de mortalité dans les hôpitaux. Pour un sujet aussi important, il existe peu de travaux effectués dans un contexte comme le notre avec des ressources limitées.

Le but de notre étude était d'identifier les réservoirs bactériens et les microorganismes susceptibles de provoquer des infections nosocomiales dans notre environnement de santé.

Méthodes:

Des échantillons bactériologiques de l'air, des surfaces, des mains des soignants et des lésions des malades prélevés dans six unités de soins de

suivant les méthodes standard de culture et d'identification.

Résultats:

Dans notre étude, 73% des échantillons prélevés étaient contaminés par des bactéries pathogènes, soit 83,3% des surfaces, 37,56% des échantillons d'air, et 100% des mains des soignants. Les staphylocoques pathogènes, les bacilles gram négatif (E coli, Klebsiella pneumoniae, Pseudomonas aeruginosa), et les entérocoques ont

été isolés respectivement dans 64,7%, 54,1% et 48,7% des cas. Les espèces bactériennes retrouvées sur les mains du personnel soignant étaient les mêmes que sur les surfaces et les équipements. Le service des soins intensifs et la néonatalogie étaient les unités les plus contaminées avec 100% de cultures positives. Aucun germe n'a été isolé dans les échantillons prélevés à la stérilisation centrale.

Conclusion:

Notre environnement hospitalier est fortement contaminé, et les mains du personnel soignant apparaissent comme le vecteur principal de transmission des microorganismes isolés. L'application des mesures de contrôle de la transmission des infections comme le lavage des mains et la décontamination périodique des locaux doit être effective et leur évaluation continuelle est recommandée.

Mots clés : environnement de soins, microorganismes, réservoir.

INTRODUCTION

Health care associated infection (HCAI) is one of the biggest risks facing health care providers and users in the western world [1]. These infections are potentially life threatening, contributing to more deaths than road traffic accidents, drug related deaths and AIDS [2]. In order to control HCAIs, there are three inter-related elements that should come to play: surveillance, infection control practices to prevent transmission of organisms and responsible use of antibiotics [3]. Reducing the risk of infection is an integral part of provision of quality health care [4]. Though it is true that hand washing is the single most important measure for preventing transmission of infection from one person to the other, removal of microorganisms from the health care environment is essential to prevent and control this spread during routine clinical care [5]. Health care settings, given the diversity of patients seeking care, can be a good reservoir of micro-organisms from different origins. This reservoir can be a person, a surface or equipment. For this reason adequate prevention and control of HCAI must consider not only the patient, staff and visitors but also the environment and all equipment in use [6]. This requires adequate periodic bacteriological swabbing, cultures and decontamination of these potential reservoirs. However, in resource constrained settings with a high burden of tropical and communicable diseases like Malaria, HIV and tuberculosis, health systems allocate their limited available resources to the fight against these diseases with little or no resources set aside for preventing HCAI, thereby masking the impact that this might have on morbidity and mortality. It is therefore important to define the magnitude of this problem by analysing samples from health care institutions so that evidence based infection control practices aimed at preventing transmission of microorganisms to hospitalised patients could be implemented. To the best of our knowledge, no such studies have been carried out in Cameroon. This prompted us to collect and analyse bacteriological samples from different units, equipment and staff of the Douala General Hospital with the aim of identifying potential HCAI-associated microorganisms, defining their reservoirs and transmission agents so as to propose means of controlling and preventing their transmission.

METHODS

Study setting

This study was carried out at the Douala General Hospital a tertiary health institution with a capacity of 320 beds, situated in Douala, the largest city and economic capital of Cameroon. It is the main reference hospital in the sub region and has almost all of the major specialties. It has a yearly patient turnover of over 65 000 consultations.

Sample collection and bacteriological analysis

From February 8th to 15th 2011, bacteriological samples for culture were collected from six units (sterilisation unit, Onco-Haematology unit, intensive care unit (ICU), operating theatre, neonatology unit and burns unit) of the hospital were chosen. These units were chosen based on the risk of infection to which patients are exposed. Samples were collected from the air, fomites (equipment and surfaces) and persons (staff and patients). These samples were collected by a bacteriologist and a laboratory technician, both from the "Centre Pasteur du Cameroun" (CPC), the national reference laboratory, situated, in Yaoundé, the headquarters of Cameroon. This team was locally assisted by a laboratory technician specialised in health care environmental hygiene.

All samples were collected following standardised collection techniques [7]. Samples from surfaces were collected by swabbing, using sterile hydrophilic cotton swabs from a demarcated surface area of about 100cm^2 The surface was first humidified using distilled water, then with the tip of a sterile cotton swab, numerous to-and-fro rubbing movements were done, while rotating the swab in half-turns to ensure maximum use of its surface area after which the swab was replaced

into its protective casing. These surfaces were wash hand basins, bath tubs, toilet seats and an operating table. Samples from hands of four staff (two from intensive care unit and two from neonatology unit), and a patient's wound were equally collected by swabbing with sterile hydrophilic cotton swabs. Equipment were, anaesthetic trolleys, incubators and aspiration tubes. Air samples were collected by passive gravitational sedimentation whereby containers of culture media were opened and left on a surface for about 20 minutes so that ambient or confined air could contaminate them naturally by gravity. After collection, each sample was labelled and recorded on a form designed for this purpose on which was stated: the collection site, the date and time of collection, the name of the collector and other relevant information necessary for interpreting culture results.

All samples were immediately put into coolers with temperatures regulated at 4°C and transported by road the same day to the reference bacteriology laboratory at the "Centre Pasteur du Cameroun" in Yaoundé where they were cultured and the microorganisms identified.

Bacteriological procedures

Once in the bacteriology laboratory, each cotton swab was aseptically placed in a tube containing 2ml of sterile physiologic solution, from which 0.1 to 0.4ml were pipetted into suitable culture media (trypocasein soy agar for total flora, eosin methylene blue agar for enterobacteriacae and mannitol salt agar for *Staphylococcus* species) and incubated at 30°C for a minimum period of 48hours for aerobic microorganisms and at 37°C for 24hours for specific germs. After incubation, bacterial isolates were identified using standard biochemical methods. Antimicrobial susceptibility testing was not done. The study was approved by the ethics committee of the Hospital.

Statistical analysis

Statistical analysis was done using STATA 11.2 statistical package. The main outcome of interest was the number of samples found to grow bacteria on culture, expressed as a proportion of total samples collected.

RESULTS

A total of 37 samples were collected of which 64.8% (24) were from fomites (surfaces and equipment), 21.6% (8) from air and 13.5% (5) from persons (four pairs of hands from nurses and one patient's wound). Out of the 37 samples cultured, growth of at least one bacterial type was observed in 73% (24) (Table 1). 37.5% (3/8) of air samples, 81.3% (13/16) of swabbed equipment, 87.5% (7/8) of swabbed surfaces and 100% (4/4) of swabbed hands of personnel were found to harbour bacteria. Culture of the sample taken from a patient's wound swabbed in the burns unit was sterile.

All the 37 samples were collected from 6 units of which 83.3% (5) had signs of contamination (table 1). The neonatology unit was heavily contaminated and was the only unit where *Pseudomonas aeruginosa* was found on samples collected from the wash hand basin of the parents' waiting room. Pathogenic S*taphylococcus aureus* was the most commonly found pathogen in the culture media (64.7%) (Table 1)

DISCUSSION

The aim of our study was to identify bacterial reservoirs and microorganisms with a potential to cause infections at the Douala General Hospital. From our study, at least one bacterial type grew in 73% of all collected samples. These included 83.3% of fomites, 37.5% of air samples and 100% of hands of health care workers. Pathogenic Staphylococci, Enterobacteriacae (*Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa*) and Enterococci were found in 64.7%, 54.1% and 48.7% of specimens respectively. The ICU and neonatal units were the most contaminated with 100% positive cultures. The sterilization unit was bacteria free.

In a similar study carried out in Oman in 2006, 61% of all 100 cultured samples from door handles, toys, sinks, telephone sets and flowers on some wards grew a variety of bacteria [8]. This is comparable to the 73% found in our study. Out of all the air samples collected, 37.5% were contaminated with a variety of microorganisms expressed as mixed growth in culture media all of which came from the ICU and neonatal units. Ortiz et al. in 2009 in a hospital in Spain, showed that airborne transmission is an important route for many microbes in hospital milieu when they found that the air in the operating theatre had the highest germ count per volume after analyzing air samples from numerous units in the hospital [9]. Operating theatres, ICU and neonatology units which most of the time are closed confined areas, appear to be a risk factor for nosocomial infections [10]. Given that these units are where most invasive reanimation procedures are done, the risk of infection is very high most especially as more than 80% of the commonly used equipment and the hands of all four sampled nursing staff were found to harbour microorganisms. More so, *Pseudomonas aeruginosa* was found in the wash tub in the neonatology unit thereby increasing the risk of severe neonatal sepsis as demonstrated by

Vochem et al. in 2001 where they found severe sepsis in a new born due to *Pseudomonas aeruginosa* from a bath tub [11].

Though there is not much data linking the presence of microorganisms on surfaces to the transmission of infection [12], the presence of the same organisms on hands of health care personnel in our study is suggestive of such a link. Paul et al. in an Indian study in 2011 found that 59.1% of doctors had contaminated hands on entry into the wards and 90% on exit, with the most predominant germ being *Staphylococcus aureus* in 85% of hands on exit[13]. Their findings are similar to ours where we found that 100% of the personnel sampled while at work, had contaminated hands, with *Staphylococcus aureus* and other bacteria equally distributed at 80% on the hands. Surfaces and equipment may therefore serve as a reservoir of bacteria, the hands of health care workers serving as transmission agents [14]. This implies the relevance of hand hygiene compliance before and after patient contact.

There were two major limitations in our study and these were partially due to financial constraints. Firstly, the small sample size. More hands should have been analysed and categorized according to different health personnel in the services as this could have also tested compliance with set nosocomial infection control protocols. Secondly, antibiotic sensitivity testing of identified microorganisms was not done. It could have defined the resistance profile of nosocomial infection associated-microorganisms. Nevertheless, we have demonstrated that our health care institution is highly contaminated. This warrants the reiteration of guidelines on specific infection control practices which must be put in place and adhered to with significant administrative and financial support. This must include strategies to improve hand hygiene compliance and use of performance indicators. The publication of these findings is scientifically relevant evidence that brings to light the magnitude of the problem linked with the risk of HCAIs that needs urgent attention in our setting.

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Table 1: Proportion of positive cultures according to sample types and hospital units

	N	Proportion of positive cultures (%)	Proportion of samples with colonies present (%)		
			Pathogenic staphylococcus	Enterococci	Enterobacteria (*Escherichia coli, Klebsiella pneumonia)*
Sample types					
Air	8	37.5	mixed growth	mixed growth	Mixed growth
Fomites	24	83.3	83.3	58.3	66.7
Persons	5	80.0	80.0	80.0	80.0
Units					
Sterilisation	3	0.0	0.0	0.0	0.0
Onco-Haematology	3	66.7	66.7	66.7	66.7
Intensive care unit	8	100.0	87.5	87.5	87.5
Neonatology	11	100.0	81.8	81.8	81.8
Theatre	5	60.0	60.0	0.0	0.0
Burns	7	42.9	42.9	0.0	25.6
Total	**37**	**73.0**	**64.7**	**48.7**	**54.1**