A comparative study of bacterial contamination between open heart surgery wards and neurosurgery wards

Nadia Atalah Hussin
College of Pharmacy, University of Mosul, Mosul, Iraq

Abstract

The main source of the infectious agents of the nosocomial infections is the patients and healthcare workers themselves as well as the environment. It is possible to significantly reduce the nosocomial infections through effective infection prevention and control programs. This study aimed by focus light on the importance of following the standard protocols, assist healthcare workers to improve the quality of the care they deliver. **Materials and methods:** This study took tow surgical departments in the same hospital .The first department was neurosurgery department the second one was the open heart surgery department and compared between the two departments in term of bacterial contamination of the working personnel, the post operative patients and the environment. The bacteria were isolated and identified according to the standard methods. Antibiotic sensitivity testing carried out by Kirby-Bauer disc diffusion method. **The result:** The bacterial contamination of ICU neurosurgery department air, bed heads\bed sheets, and floors were as follow; 47 %, 82 %, and 96.7 % respectively; compared to 0% of that of open heart surgery. The bacterial contamination of the OT of neurosurgery air, floors, beds and bed sheets were 83.3%, 95% and 75% respectively compared to 0% for that of open heart surgery. For the nurses in the ICU of neurosurgery all the samples came positive for bacterial culture. While in open heart department bacterial culture came negative for the nurses. About 23% of the patients in neurosurgery department developed postoperative infection compared to 1% of that of open heart surgery. The most common isolated bacteria were *Coagulase –ve Staphylococcus*. **Conclusion:** The significant low infection rate in the open heart surgery department compared to the neurosurgery department is a direct reflection to the good managing of the department that make full assurance of complete disinfection and complete compliance with standard precautions to prevent infection.

Key words: bacterial contamination, precautions to prevent infection, open heart surgery, neurosurgery.

دراسة مقارنة للتلوث البكتيري بين ردهات جراحة القلب المفتوح وردهات جراحة الجملة العصبية

نادية عطاالله حسين

الخلاصة

المصدر الرئيسي للعوامل المعدية في المستشفيات هم المرضى والعاملون في المستشفى انفسهم.بالاضافة الى بيئة المستشفى (الهواء،الارضيات،رؤوس الاسرة والشراشف....).في الحقيقة من الممكن وبشكل فعال التقليل من الاخماج المكتسبة في المستشفيات من خلال اتباع البرتوكولات الوقائية من الاخماج الوبائية وبشكل فعال. هذه الدراسة هدفت من خلال تسليط الضوء على اهمية اتباع البروتوكولات الوقائية من الامراض المعدية التي تكتسب اثناء الاقامة او العمل في المستشفيات في تحسين نوعية العناية التي يقدمها العاملين في القطاع الصحي. العينات جمعت من البيئة للغرف الجراحية ووحدات العناية الفائقة لقسم جراحة القلب المفتوح وقسم جراحة الجملة العصبية. ثم جمعت عينات اخرى من العاملين في الردهات المذكورة بالاضافة للمرضى الذين اصبح لديهم التهابات مابعد العملية

الجراحية. البكتريا عزلت وعرفت وحسب الوسائل القياسية. اختبار حساسية المضادات الحيوية للعزلات البكتيرية انجزت بطريقة الاقراص المشبعة. التلوث البكتيري في وحدة العناية الفائقة لقسم جراحة الجملة العصبية للهواء ورؤوس الاسرة والشراشف والارضيات كانت كالاتي:47%،82%،و96.7% وبالتتابع،مقارنة مع قسم جراحة القلب المفتوح 0%.التلوث البكتيري للقاعة الجراحية التابعة لجراحة الجملة العصبية للهواء ورؤوس الاسرة والشراشف والهواء كانت كالاتي: 83,3%،95% و75% وبالتتابع. مقارنة لصفر % بالنسبة للقاعة الجراحية التابعة لقسم القلب المفتوح. عينات الممرضين في قسم جراحة الجملة العصبية جاءت كلها ايجابية بالنسبة للنمو البكتيري مقارنة لصفر % بالنسبة لممرضي جراحة القلب المفتوح. حوالي 23% من مرضى جراحة الجملة العصبية الذين خضعوا للجراحة اصبح لديهم اخماج مابعد العملية الجراحية مقارنة ب 1% لمرضى جراحة جراحة القلب المفتوح. البكتريا الاكثر شيوعا كانت العنقوديات سالبة الكواكيوليز.

كلمات مفاتيح: التلوث البكتيري،منع انتشار العدوى، جراحة القلب المفتوح، جراحة الجملة العصبية.

Introduction

The bacterial contamination in Operation Theater (OT) and specialized unit has great effect on both the patients and the medical care workers continued to increase prevalence of nosocomial infections [1, 2, 3]. With resultant effect of high morbidity and mortality rate among patient admitted into these specialized units, especially patients who need post operative care [4, 5, 6]. Nosocomial infections the most common complication affecting patients in hospital. As well as causing unnecessary pain and suffering for patients and their families, prolong hospital stays which lead to increase the cost and expense to both the patients and the health system , even the visitors are also at risk of both infection and transmission [7,8,9]. The source of the infectious agents of the nosocomial infections is the patients and healthcare workers themselves (in the same time they are the most susceptible host) .In healthcare settings, the main modes for transmission of infectious agents are contact (including blood borne), droplet and airborne [7, 10] .Other source of transmission including hospital environment as air, floors, beds …etc [7, 11]. Which are either contaminated by the patient's endogenous flora or other source [11]. Hence, infection control is critical to the effective provision and management of healthcare services [12]. However, healthcare-associated infection is a potentially preventable adverse event rather than an unpredictable complication. It is possible to significantly reduce the rate of nosocomial infections through effective infection prevention and control [7]. This responsibility applies to everybody working in or visiting a healthcare facility, including administrators, staff, patients and visitors [5, 7]. This study concentrated on the importance of the infection prevention protocols in reducing if not the death rate among postoperative patient it would certainly reducing the morbidity of postoperative infection. In the same time it will minimize the risk of transmission of infectious agents both in hospital and in community health care units [7].

The Aim of the study: This study aimed by focus light on the importance of

following the standard sanitation protocols in order to assist healthcare workers in improving the quality of the care they deliver.

Materials and methods

Samples collection: This study took tow surgical departments in the same hospital .The first department was neurosurgery department (NURS). The second department was the open heart surgery (OHS) department and compared between the two departments in term of bacterial contamination of the working personnel , the environment (air, floor, bed\bed sheets), and the post operative patients who developed infection within 48-72 hours of the surgery in OTs and intensive care units (ICUs) of both departments .

The samples were divided into 2 main categories:

➢**Samples collected from the environment of OTs and ICUs for both departments.**

Samples were taken from the floor, air, and bed heads\bed sheets. Air sampling was performed with settle plate's methods. Petridishes containing blood and Mac- Conkey agar were transported to OTs in sealed plastic bags. The plates were placed at four chosen places in the OTs at about 1 meter above the ground, and exposed for 15 minutes. While for floors and bed heads\bed sheets a swab soaked in nutrient broth was used. All the samples were labeled properly and immediately transported to the lab.

➢**Samples collected from the health workers (physicians, nurses, cleaning workers) and the patients.** The samples were collected from hands, cloths, and noses. We did not ask the working staff for washing the hands prior to samples collection because we wanted to see the actual truth about the existence of bacteria on those individual without any interference since in that actual case they came in contact with the patients every day(we kept the usual day practice). Using nasal cultures, which were collected by rotating a sterile swab 4 times in the anterior nares (Transwab; Medical Wire and Equipment Co. Ltd., Corsham, England). For hand samples the healthcare staff was asked to put on sterile, powder-free surgical gloves into which 20 mL of brain heart infusion (BHI) broth had been poured. When the gloves containing the BHI broth were in place on both hands, the hands were rubbed together vigorously for approximately 30 seconds. After the hands had been rubbed all over, the gloves were removed and tied loosely. The samples were transferred to the laboratory within 2 hours. Aliquots of 100 μL of the broth were inoculated onto BHI agar with 5% sheep's blood using the colony count method. While the patient's samples were collected according to the medical cases. Operated patients who developed fever higher than 38 ^{0} C in 48-72 hours after surgery and according to the physician diagnosis. Some of the samples had mixed bacterial infections. All the collected samples (from the environment, the health worker and the patients of both departments) were incubated at 37°C under aerobic conditions for 24 hrs. After incubation the colonies were counted and the identification of the isolates was performed using conventional methods

and biochemical methods, antibiotic sensitivity testing was done by Kirby-Bauer disc diffusion method on Muller Hinton agar [13,14,15,16,,17,18,19,20,21]. Api 20E systems (bioMerieeux, France) was also utilized according to the manufacturer´s instructions.

The results

In this study we had divided the research into two main categories; open heart surgery (OHS) department and neurosurgery department (NURS). Following the same protocol for each department. Some samples had mixed bacterial infections.

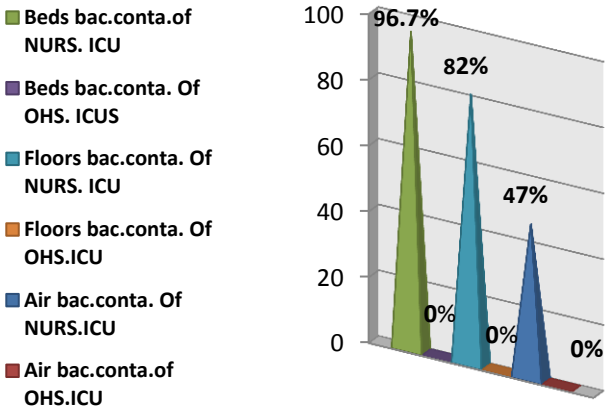

Fig. (1):-The percentage of bacterial contamination of ICUs environment of both departments.

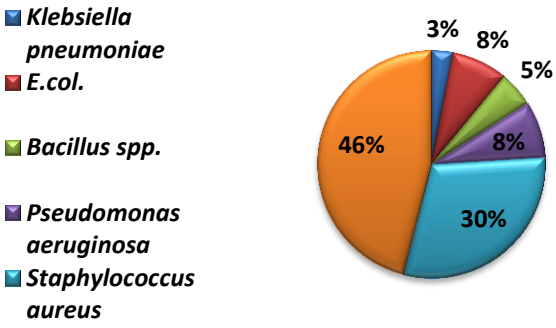

Fig.(2):-The percentage of isolated bacteria from the ICUs environment of neurosurgery department.

Table (1):- Bacterial culture obtained from OT environment of both departments

	Neurosurgery OT	Open heart surgery OT
Air	**83.33%(50\60)**	**0%(0\60)**
Bed heads\bed sheets	**75%(15\20)**	**0% (0\60)**
Floors	**95%(19\20)**	**0%(0\60)**

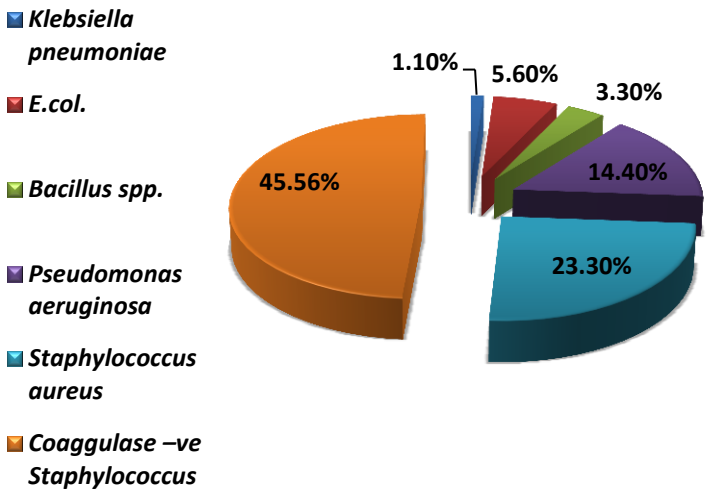

Fig. (3):-The percentage of isolated bacteria from the OT environment of neurosurgery department.

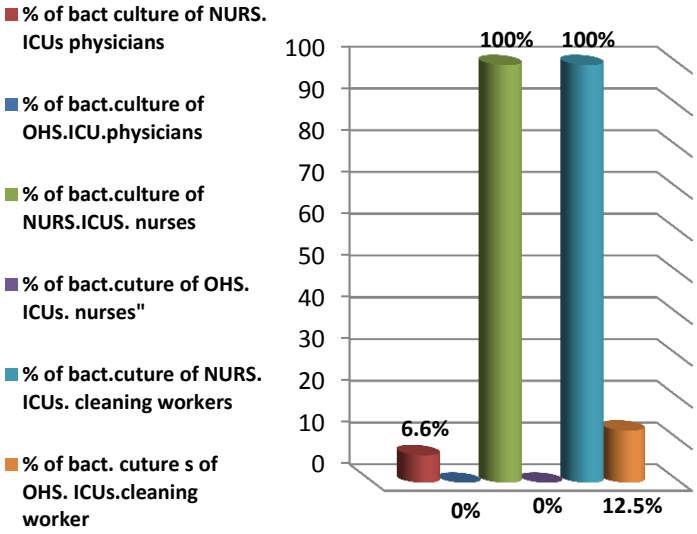

Fig.(4):-Percentage of positive bacterial culture obtained from the health care workers of ICUs of both departments.

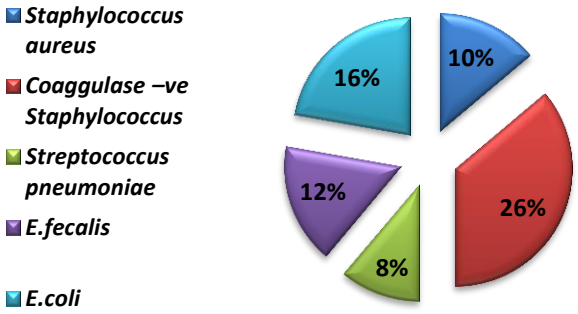

Fig.(5):-The percentage of isolated bacteria from the health care workers of ICUs of neurosurgery department.

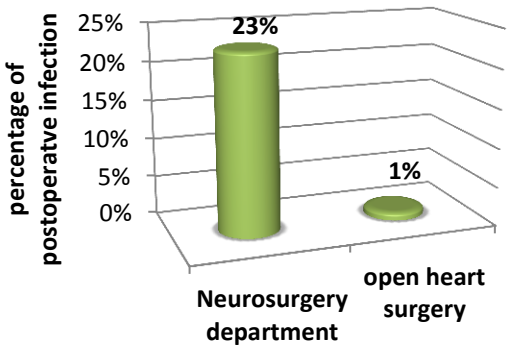

Fig. (6):-Comparison between the percentages of patients who develop postoperative infection in both departments.

Table (2):-The type and percentage of postoperative infection among patients in both departments.

The Departs.	% of infection	Wound Site infect.	Septecemia	Pneumonia	UTI
NURS. Depart.	23% (23\100)	19% (19\100)	2% (2\100)	1% (1\100)	1% (1\100)
OHS. Depart.	1% (1\100)	0% (0\100)	1% (1\100)	0% (0\100)	0% (0\100)

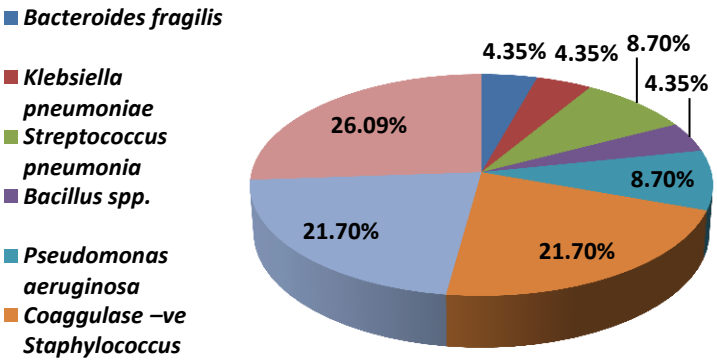

Fig.(7):-The percentage of isolated bacteria from patient with post operative infection in neurosurgery depart.

Table (3):-Resistance patterns of the common isolated bacteria in this study.

Antibiotics	Resistant percentages of the isolates				
	Organisms				
	CONS	*Staph. aureus*	*Pseud. aerog*	*E. coli*	*Kleib. Pneu.*
Amoxicillin	**80.4**	**85.6**	**100**	**96**	**100**
Ciprofloxacin	**40.3**	**42.4**	**74.7**	**76.4**	**68.4**
Gentamicin	**48.3**	**45**	**69.2**	**83.4**	**76.3**
Augmantin	**0%**	**33%**	**75%**	**67%**	**58%**
Cephalothin	**0%**	**50%**	**83%**	**73%**	**74%**

Discussion

There are several standard protocols and guidelines for infection prevention [22, 23, 24] which are vital and found to be a leading point in reduction of nosocomial infections [25, 26]. Nosocomial infections can cause considerable morbidity, mortality and cost [11, 25, 27, 28]. Implying standard protocols in healthcare facilities help in reducing nosocomial infections rates [26]. This study was carried out to show the effectiveness of these protocols in the practical field, by comparing between two surgical departments in the same hospital, in reduction of nosocomial infections. Both were surgical departments and both considered very critical operation but the open heart surgery department followed the book (the standard protocols of infection control for both the personals and the places) with good management follow up. On the other hand the neurosurgery department showed no restriction for sterilization protocols neither follow up of the disinfection or personal hygiene (minimum follow up if any). The bacterial contamination of ICUs

neurosurgery department air, bed heads\bed sheets, and floors were as follow; 47 % (14\30), 82 % (27\33), and 96.7 % (29\30) respectively; as shown in fig. 1.This was almost agreed with Gupta *et al* , and Brady *et al* [29, 30] and disagreed with Boyce *et al* [31]**.** Several factors could contribute to the environmental various surface contamination in hospitals of which; the inpatients (the silent reservoir) who mostly carrying resistant bacteria, staff hand contaminated with respiratory secretions through cough, sneezing that could contaminate the air ,bed heads\bed sheets that were neglected furniture during routine disinfection and cleaning (made them as a big petridish for bacterial growth, this furniture is continuously touched by the patients, visitors and health workers). In turn they made indirect contact with the patients and for prolong period of time. Some time the patients refused to change bed sheets because he was in pain. Hand-mediated transmission is the major contributing factor to infection associated with healthcare [32]. Effective hand decontamination immediately before every direct contact with the patient will result in a significant reduction in the transfer of potential pathogens and a decrease in the incidence of preventable nosocomial infections [24]. On the contrarily the open heart surgery ICU air, bed\bed sheets and floors showed no bacterial growth throughout the study period. This might be related to the good management and continuous follow up. In addition the open heart surgery received less numbers of patients, use positive air pressure system, using UV light for sterilization and daily education for the staff. All the workers and visitors wearied the disposable shoes inside the department. All the workers changing the clothes twice daily some time more when it is necessary. Many of these practices were adapted by Beggs *et al* [33], Cosgrove *et al* [34] , Pratt *et al* [35]and Teare *et al* [36] . While the bacterial contamination of the OTs of neurosurgery air, floors, beds and bed sheets were 83.3%, 95% and 75% respectively (shown in table 1). The most common isolated bacteria were *Coagulase –ve Staphylococcus* spp. (as shown in fig.3). These results were more or less in agreements with Gebremariam *et al* [37] and Singh *et al* [38] and much higher than that reported by Ensayef *et al* [39] and less than that reported by Brady *et al* [30]**.**Compared to zero % of that of open heart surgery. Again this high percentage of bacterial contamination in neurosurgery OT also might contributed to the fact that health care personal that getting in and out from the wards, the high load of emergency patients that been received daily by the neurosurgery department. No sufficient sterilization in between the operation was carried on. The long distance between the emergency room (in another hospital) and the OTs of neurosurgery on one hand and on the other hand the long distance between the OTs (the first floor) and the ICUs

of neurosurgery (in the sixth floor) with no enough elevators. No positive air pressure was used. Not using UV for sterilization. The bacteria had been left behind on floors, bedrails, tables, and other surfaces by patients already discharged as was reported by Hardy *et al*[40]. The most probable routes for transmission of infection between successive patients are airborne or on items and surfaces that had been in contact with the patient. To reduce airborne contamination, general traffic in and out of the operating theatre itself should be kept at a minimum [41]. For the nurses and the cleaning workers in the ICU of neurosurgery all the samples came positive for bacterial culture. Some of the samples showed mixed bacterial infection. The most common isolated bacteria were (as shown in fig.4 and 5) *Coagulase –ve Staphylococcus* this was agreed by Pitt *et al* [42] and Larson *et al* [43]. *Coaggulase –ve Staphylococcus* are part of the normal microflora of the skin, nasal mucosa, and lower respiratory tract. They are transmitted amongst patients via the hands. Normally they are of low pathogenisity but because the patients in these unit were postoperative immunocompromised and had an open surgical wound make them very dangerous [44]. Followed by *E.coli, E.fecalis* this was in agreement with that of Ansari *et al* [45].These bacteria among the microorganisms that are commonly isolated from hands indicates fecal contamination**.** The cleaning workers in ICU of neurosurgery came and went freely. They were of low education, poor personal hygiene even their equipment might be a source of infection. In the open heart surgery only one cleaning workers had positive bacterial culture (fig.4). This proved that continues education of the workers made them more compliance with standard programs. It was obvious example of the good manager would change the situation into the standard levels. Now to have full evaluation of the bacterial contamination impact on the postoperative patients of the 2 departments. This study took samples from patients who developed infections 48-72 hrs after surgery and found that 23 patients of 100 of neurosurgery patients had developed infection and was categorized as in table 2. About 23% of the patients developed postoperative infection (as shown in fig.6) this was in agreement with that of Lilani [46] and disagreed with Taye [47]. Compared to only 1% in open heart surgery (fig.6 and table 2) .The most common post operative infection was wound site infection (19\23) followed by septicemia (2\23) table 2. This was in agreement with that of Mulu *et al* [48]. The most isolated bacteria were *Staphylococcus aureuos* (fig.7) and this was in agreement with Mulu *et al* [48], Bullock *et al* [49], Rimoldi *et al* [50], and Young *et al* [51]. This pathogen is carried in the nares of 20% - 30% of healthy humans as part of their normal flora. The infection with this bacteria

may be associated with contamination from the environment, surgical instruments [52, 53, 54]. It is a complete circle, the inpatients is the silent reservoir that contaminate the surfaces and air come in contact with him in the same time the health care workers come in contact with the patients and other surfaces in the hospital as bed\bed sheets. The healthcare worker came in contact wither patient and so..on. When the proper sterilization protocols neglected will result in spread of infection to others. The microbial level in operating room air is directly proportional to the number of people moving about in the room [55, 56]. Therefore the adherence and full compliance with the standard infection control programs prevent any type of infectious agent from being transmitted [7, 41, 57]. The significant low infection rate in the open heart surgery department compared to the neurosurgery department is a direct reflection into many reasons: The good managing of the department that make full assurance of complete disinfection and complete compliance with standard precautions to prevent infection that is well documented[7,22,23, 58].Using graduated nurses in the department. The graduate nurses are better equipped with knowledge and practice with regards to prevention and control of infections than diploma nurses. This complies with several researches in this field as Taneja [59].Also continuous education of the patients and their visitors. Patients and visitors were aware of their role in minimizing risks by following basic hand hygiene, respiratory hygiene and cough etiquette [7,58]. The use of simple and low cost measures as cleaning the hand in between patients contact had result in decrease the percentage of infection .The same result was obtained from several other study of which; Malik *et al* [60] Pittet *et al* [61] and Larson *et al* [62]. The department used laminar airflow and UV radiation as additional measures to reduce hospital acquired infection risk [57].The beds in the open heart surgery department were separated by at least 3 meter distance. This distance is required by many protocols [27,58]. A sterile upper clothes wearied on entrance ,contaminated clothing changed and safely discarded into an appropriate receptacle at the earliest opportunity at the entrance and the out of the department even the shoes were left outside the department on entrance[41].

Conclusion

Continuous education of the staff, cleaning workers, the patients and their visitors should be a central focus of an infection control program.

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