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Research Article

Isolation of bacterial pathogens from patients with postoperative surgical site infections and possible sources of infections

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Abstract

Hospital environment is a potential reservoir of bacterial pathogens since it houses both patients with diverse pathogenic microorganisms and a large number of susceptible individuals. The increased frequency of bacterial pathogens in hospital environment is associated with a background rise in various types of nosocomial infections. Surgical site infection is one of the most frequent types of nosocomial infections in developing countries. The infection follows interference with the skin barrier, and is associated with the intensity of bacterial contamination of the wound at surgery or later in wards during wound care. Bacterial pathogens isolated from hospital environments are also known to develop resistance to multiple antimicrobial agents. The emergence of multi-drug resistant organisms in hospital results in difficulty to treat nosocomial infections. The predominant causes of postoperative surgical site infections were S. aureus, Klebsiella and proteus species. Medical equipment, environmental surfaces, air and hands of health personnel were found to be contaminated with various types of bacterial pathogens of nosocomial importance. It is imperative that all professionals should take an active role in infection control within their organization and more resources should be provided to encourage good antibiotic practice and good hygiene in the hospital.

Keywords: Bacterial pathogen, postoperative surgical site infection, Hospital environments

Introduction

Bacterial pathogens still play a considerable role in hospital acquired infections in Ethiopia. Nosocomial infections (also known as hospital associated/acquired infections) are those infections that develop in patients during their stay in hospitals or other type of clinical facilities, which were not present at the time of admission (Girard et al, 2002). The hospital environment is a potential reservoir of bacterial pathogens since it houses both patients with diverse pathogenic microorganisms and a large number of susceptible/ immunocompromised individuals (Rhomberg et al, 2006). The increased frequency of bacterial pathogen in hospital environment is associated with a background rise in various types of nosocomial infections.

Surgical site infection (SSI) is one of the most frequent types of nosocomial infections in developing countries. The infection follows interference with the skin barrier, and is associated with the intensity of bacterial contamination of the wound at surgery or later in wards during wound care (Pryor et al, 2004). Wound infections have been a problem in the field of surgery for a long time. Previous studies from different parts of the Ethiopia showed that *S. aureus*, *Klebsiella* species, *Escherichia coli*, *proteu*s species, *streptococcus* species, *Enterobacter* species, *pseudomonas* species and coagulase negative *staphylococci* were the most common pathogens isolated from wound (Biadglegne et al, 2009; Mulu et al, 2006). Rate of nosocomial infection are markedly higher in many developing countries, especially for

infection that are largely preventable (e.g., those following surgical procedures). For instance the prevalence of post operative surgical site infection was reported as 44.1% of the patients with nosocomial infection from Mekelle, Ethiopia (Tesfahunegn et al, 2009).

Hospital acquired infections (HAIs) are largely preventable with implementation of effective control measures. The center for disease control and prevention (CDC) has pointed out that, "the most important measure for preventing the spread of nosocomial bacterial pathogens is effective hand washing". Most guideline recommends hand washing before and after contact with patients, before invasive procedure and after contact with contaminated inanimate objects (Garner et al, 1996). The objective of this review paper is to assess the distribution of potential bacteria pathogens in patients with postoperative surgical site infection, health personnel & hospital environments

Review Literature

Sources and transmission routes

Many factors are associated with HAIs, and a chain-of-infection model provides the best framework for depicting the relationships among these factors and SSIs. According to the chain of infection model, a causative agent or pathogen survives within a reservoir, exits the reservoir via a mode of transmission, and enters a susceptible host; thereby causing disease. Intervention in any part of this process can stop disease transmission. Reservoir can be, soil, water, and inanimate surfaces. Of these, the most likely exogenous reservoir in the surgical setting is either an inanimate surface or a human. Hospital-acquired infections add to functional disability and emotional stress of the patient and may in some cases, leads to disabling conditions that reduce the quality of life. Nosocomial infections are also one of the leading causes of death. The economic costs are considerable. The increased length of stay for infected patients is the greatest contributor to cost (Girard et al, 2002).

Reviews on postoperative surgical site infections

A cross sectional study was carried out on drug sensitivity patterns of bacterial isolates from septic postoperative wounds in Jinja hospital, Uganda. Pathogenic bacteria were recovered from 58.5% of the specimens. The isolates were: *S. aureus* 45.1%, Coliforms 16.9%, *Proteus mirabilis* 11.3%, *P. aeruginosa* 9.9%, *Klebsiella pneumoniae* 7.0% and *Enterobacter* species 2.82% (Anguzu et al, 2007).

A study was carried out to determine the prevalence of different pathogens in surgical wounds. Out of a total of 45 surgical wound specimens analyzed, *Staphylococcus aureus* was isolated from 33(42.30%), *Pseudomonas aeruginosa*, *Proteus mirabilis* and *Escherichia coli* from 25(32.90%), 10(12.80%), and 10(12.80%), respectively. The antibiotic susceptibility of *Staphylococcus aureus* were; ciprofloxacin 60%, erythromycin 40%, gentamicin 60%, streptomycin 60%. Resistance to beta-lactam antibiotics was common among gram negative bacteria. Some isolates of Pseudomonas aeruginosa were resistant to Gentamicin 18.70% and *Streptomycin* 35.70 % (Nwachukwu et al, 2009).

Another survey was conducted in logos Nigeria, to determine the prevalence of *Pseudomonas aeruginosa* in Postoperative wound. Swab samples were collected from patients who had undergone operation, sinks, washbasins, floor and nursing staff. Out of the 60 bacterial isolates found in postoperative wound infection, 20 (33.3%) were Pseudomonas aeruginosa, followed by *Staphylococcus aureus* 13 (21.7%), *Klebsiella* species 10 (16.7%), *Escherichia coli* 7 (11.7%), Atypical Coliforms 4 (6.7%), *Proteus* species 4 (6.7%), *Streptococcus pyogenes* 1 (1.7%) and *Enterococcus faecalis* 1 (1.7%). The in vitro sensitivity pattern of 20 isolates of *Pseudomonas aeruginosa* showed colistin 100%, gentamicin 75%, streptomycin 30%, and tetracycline10% were sensitive (Oguntibeju et al, 2004).

A prospective study was done in Addis Ababa to determine the magnitude of nosocomial infections and isolate the bacterial etiologic gents in a tertiary hospital. Two hundred fifteen patients admitted in surgical ward and intensive care unit were included in the study. Of these patients 35.8% of them developed different forms of nosocomial infections. Surgical site infection comprised of 23(29.8%). Bacterial pathogens identified as cause for SSI were *Escherichia coli* 11.4%, *P. aeruginosa* 22.7%, *K. pneumoniae* 15.9%, *P. vulgaris* 13.6%, *E. cloacae* 2.3%, *K. oxytoca* 4.5%, *C. braakii* 4.5%, *S. aureus* 15.9% and CNS 9.1% (Endalafer et al, 2011).

A laboratory based retrospective study of wound swabs was conducted in the microbiology department at Bahir Dar Regional Health Research Laboratory. From the total of 379 wound swabs, bacterial isolates were found on 201 patients with an isolation rate of 53.0%. *Staphylococcus aureus* was the predominant isolate 140 (69.7%) followed by *proteus* species 19 (9.5%) and *Klebsiella* species 10 (5.0%). The overall multiple drug resistance patterns in ten antibiotics was 97.5% (Biadglegne et al, 2009). Another laboratory based retrospective study of 151 wound swabs was conducted in Gondar University Teaching Hospital. In the study bacterial pathogens were isolated from 79 wound swabs. *Staphylococcus aureus* was the predominant isolate 51 (65%) followed by *Escherichia coli* 8(10%) *Klebsiella* species 7(9%). *Proteus* species 3(4%) and the overall multiple drug resistance patterns in ten antibiotics was 78.5%. Single and multiple drug resistance to the commonly used antibiotics were very high among bacterial isolates from wound (Mulu et al, 2006).

Contamination Of Hospital Environments

Different studies in various parts of the world had assessed the extents of bacterial contamination of hospital environments. For example, a cross sectional study to analyze the distribution of probable nosocomial pathogens in a government hospital in Nigeria was conducted. Samples were obtained from doctors, nurses, orderlies, patients, air, and fomites like beds, cannula, oral thermometer, and table. A total of 56 bacteria were isolated. Gram positive cocci were the highest number of isolates of which *Staphylococcus epidermidis* (22; 39.2%), *Staphylococcus aureus* (16; 28.5%) and *Streptococcus* spp. (5; 8.9%). Among the Gram negative bacilli, *Escherichia coli* were the highest (4; 7.1%). Others were *Klebsiella pneumoniae* (3; 5.3%), *Proteus* spp. (2; 3.5%) and *Enterobacter aerogenes* (2; 3.5%). Orthopedic ward (22 isolates) had the highest number of isolates followed by pediatric ward (15 isolates). Surgical and medical wards had 10 and 9 isolates, respectively (Chikere et al, 2008).

Another study aimed to investigate the hygienic conditions of air at delivery and nursing rooms in three hospitals in Khartoum was also conducted. Seventy nine samples from delivery room and 60 samples from nursing rooms were collected, while 63.3% air samples from delivery and 66.7% from nursing rooms were positive for bacterial growth. The isolated species were identified as *S. aureus*, *Escherichia coli*, *Klebsiella* species and *P. aeruginosa.* *Staphylococcus aureus* and *P. aeruginosa* were the most dominant organisms isolated from the delivery rooms at all examined hospitals, while S. aureus showed the highest percentage from nursing rooms at two of the examined hospitals (Sana et al, 2010).

A cross sectional study to determine the extent of contaminations of patient's medical file in Taiwan demonstrated the following. Ninety percent of charts in surgical ward and 72% in ICU were contaminated with bacteria pathogens. Coagulase negative staphylococcus was the predominant isolate in both surgical ICU 44% and surgical ward 53.3%. Other bacterial isolates were Klebsiella species, Acinetobacter species. In the study it had be concluded that that patients char may be the source for cross infection in surgical unites (Sing-on et al, 2009).

A study aimed to identify the nosocomial bacteria commonly found on x-ray equipment and accessories and assess the effectiveness of some common chemical disinfectants used in x-ray units. Bacterial agents were isolated in 142 swabs representing 47.2% of all the swab samples.

Staphylococcus aureus, Klebsiella species, Coliforms and Staphylococcus epidermidis were the bacteria isolated from the swab samples. Klebsiella species were isolated most often (49 times; 34.5%) and staphylococcus epidermidis were isolated the least number of times (18 times; 12.7%). The x-ray cassettes recorded the highest number of times bacteria were isolated (54times; 38%) with Coliforms being isolated most often (45 times; 31.7%) (Ochie et al, 2009).

A study conducted in An-Najah University Hospital operating room demonstrated contamination of various inanimate objects with potential pathogenic bacteria. *Pseudomonas aeruginosa*, *Escherichia coli* and *Staphylococci* were isolated from saline solution kept in glass bottles for washing and cleansing wounds, suction machines, respirators, endotracheal tubing oxygen pumps and sinks. Alcaligenes odorans was isolated from the suction machines. Aeromonas species were isolated from deionized water and sinks, the implications of these findings were also discussed as the hospital environment becomes the source of

hospital acquired infection. Proper disinfection of equipments was suggested as solution in this study (Yahya et al, 1995).

Reviews on health professionals

A one year prospective study to ascertain the prevalence of nasal carriage of potentially pathogenic bacteria in health care workers and the antibiotic susceptibility profile were conducted in Pakistan. The prevalence of Staphylococcus aureus, coagulase negative *staphylococci* and methicillin resistant *Staphylococcus aureus* were 48%, 46% and 14% respectively. The most effective antibiotic for S. aureus was found to be vancomycin with 100% efficacy, then cephalothin 92%, ciprofloxacin 91%, amikacin 77%, erythromycin 55%, ampicillin 11% and penicillin 3%. Coagulase negative staphylococci were 100% sensitive to vancomycin and cephalothin. Oxacillin showed 78% effectiveness, while ampicillin and penicillin, demonstrated 64% and 59% respectively. Doxycycline 93%, amikacin 93%, fusidic acid 90% and erythromycin 92% were effective antimicrobials (Kalsoom et al, 2008).

The contamination rates of Health Care Worker's (HCW) mobile phones and resistance to commonly used antimicrobials were evaluated in three teaching hospitals in Kerman, Iran. One hundred fifty swab specimens were taken from HCWs dominant hand and their mobile phone. A total of 48 (32.0%) mobile phones and 59(39.3%) of dominant hands had bacterial contamination and Staphylococcus epidermidis was the most commonly cultured organisms from all sites. The resistance rates to commonly used antimicrobials in isolated bacteria from phones and dominant hand varied from 6.7% for cephalothin to 25% for amoxicillin, respectively. Therefore, mobile phones and hands of health care workers could be an important source of nosocomial infections and the spread of bacterial resistance bacteria in medical healthcare settings (Gholamreza et al, 2009).

Based on the study findings, the following recommendations are forwarded to hospital administrator, other interested governmental and nongovernmental organization and for all health professionals of the hospital.

• Postoperative wounds should not be exposed for prolonged period unduly during the course of dressing.
• If incase laboratory tests are not available, It is recommended that ceftriaxone and ciprofloxacin be used in preference to ampicillin, penicillin, tetracycline and other commonly used antibiotics in the area.
• There is need for hospitals to encourage periodic review of the microbial flora of their environment and the antibiotic sensitivity pattern.
• Regarding *S. aureus* nasal carriage rate a comprehensive study involving all the health personnel should be conducted to represent the Gondar University Hospital population.
• It is imperative that all professionals should take an active role in infection control within their organization and more resources should be provided to encourage good antibiotic practice and good hygiene in hospitals.
• Samples of disinfectants and antiseptics used in wards and surgical theatres should be checked for efficiency against microbial pathogens.
• Future studies should be extended to include cultures under anaerobic conditions to establish presence of other organisms that require such environment for growth.

In order to confirm the role of contaminated inanimate surfaces as real source of bacterial cross-infection in hospitals, further study with the aid of molecular technique and phage typing is unavoidable.

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