Abstract

**Background:** Wound infection is one of the major health problems that are caused and aggravated by the invasion of pathogenic organisms where empiric treatment is routine. **Objective:** To isolate and identify the bacteria causing wound infection and to determine the antimicrobial susceptibility pattern. **Materials and method:** A total of 263 wound swab and pus samples were collected during the period of January to December 2012 from Delta Medical College and Hospital, Dhaka, Bangladesh. Swabs from the wound were inoculated on appropriate media and cultured and the isolates were identified by standard procedures as needed. Antimicrobial susceptibility testing was performed by disk diffusion method according to ‘The Clinical Laboratory Standard Institute’ guidelines. **Results:** In this study 220 bacterial isolates were recovered from 263 samples showing an isolation rate of 83.65%. The predominant bacteria isolated from infected wounds were Staphylococcus aureus 89 (40.45%) followed by Escherichia coli 62 (28.18%), Pseudomonas aeruginosa 34 (15.45%), Enterococci 18 (8.18%), Acinetobacter 5 (2.27%), Klebsiella 9 (4.09%) and Proteus 3 (3.36%). Staphylococcus aureus was sensitive to linezolid (94.38%), fusidic acid (91.01%), vancomycin (87.64%), amikacin (74.15%) and gentamicin (73.03%). Among the Gram negative isolates Escherichia coli was predominant and showed sensitivity to imipenem (93.54%), amikacin (83.87%) and colistin (53.22%) and piperacillin and tazobactum (53.22%) and pseudomonas showed sensitivity to amikacin (73.52%), imipenem (70.58%) and colistin (70.58%). **Conclusion:** Staphylococcus aureus was the most frequently isolated pathogen from wound swab and the antibiotic sensitivity pattern of various isolates help to assist the clinician in appropriate selection of empirical antibiotics against wound infection.

**Key words:** Wound swab; isolation of bacteria; antimicrobial sensitivity pattern.

Introduction

A wound is the disruption in the continuity of soft parts of the body structures. Development of wound infection depends on the many factors including preexisting illness, length of operation, wound class and contamination. Infection of the wound is the invasion and proliferation by one
or more species of microorganisms sometimes resulting in pus formation. Wound can be infected by a variety of microorganisms ranging from bacteria to fungus and parasites.

The common organisms that have been associated with wound infection include Staphylococcus aureus which from various studies have been found to account for 20-40%. Infection with Pseudomonas aeruginosa mainly following surgery and burns account for 5-15%. Other pathogens such as Enterococci, Escherichia coli, Klebsiella species and Proteus species have been implicated especially in immunocompromised patients and following abdominal surgery. The fungal organisms are Candida species also responsible for wound infection. Different microorganisms can exist in polymicrobial communities especially in the margins of wounds and in chronic wounds. The resistance of the hospital strains of S. aureus to methicillin remains a global problem so the control of wound infections has become more challenging. As a result of indiscriminate use of antimicrobial agents, significant changes occur in microbial genetic ecology. So spread of antimicrobial resistance is now a global problem.

The aim of the present study was to find out common bacterial pathogens responsible for wound infection and to determine their antimicrobial susceptibility pattern in our community. It would assist the clinicians in appropriate selection of antibiotics especially against hospital acquired infections.

Materials and method

This study was carried out by collecting wound swabs and pus samples from patients attending at Delta Medical College and Hospital, Dhaka, Bangladesh from January to December 2012. All the samples were cultured on blood agar and MacConkey agar media incubated overnight at 37°C. Organisms were identified by standard microbiological procedures including colony characters, Gram staining and biochemical reactions. All the isolates were tested for antimicrobial susceptibility by the disc diffusion technique according to the Clinical Laboratory Standards Institute (CLSI) guidelines.

Results

Out of 263 cases 174 (66.15%) were male and 89 (33.84%) were female and the age ranged between 3 months to 91 years. A total number of 220 isolates were obtained, among which 185 (70.34%) were culture positive cases.

Among the isolated organisms predominant bacteria was Staphylococcus aureus 89 (40.45%) followed by Escherichia coli 62 (28.18%), Pseudomonas aeruginosa 34 (15.45%), Enterococci 18 (8.18%), Klebsiella 9 (4.09%), Acinetobacter 5 (2.27%) and Proteus 3 (3.36%) (Table I).

Table I: Organisms isolated from wound swab

| Organisms            | Number (N=220) | Proportion (%) |
|----------------------|----------------|---------------|
| **Gram positive cocci** |                |               |
| Staphylococcus aureus | 89             | 40.45         |
| Enterococci          | 18             | 8.18          |
| **Gram negative bacilli** |             |               |
| Escherichia coli     | 62             | 28.81         |
| Pseudomonas aeruginosa | 34           | 15.45         |
| Klebsiella           | 9              | 4.09          |
| Acinetobacter        | 5              | 2.27          |
| Proteus              | 3              | 1.36          |

All the bacterial isolates were tested for antimicrobial susceptibility. Among the Gram positive isolates Staphylococcus aureus was the predominant organism and were found highly sensitive to linezolid (94.38%), fusidic acid (91.01%), vancomycin (87.64%), amikacin (74.15%), and gentamicin (73.03%) and low sensitivity were found in commonly used antibiotics like ciprofloxacin (32.58%), cloxacillin (28.08%), ceftriaxone (28.08%), cefazidime (24.71%) and cotrimoxazole (21.34%). Enterococci showed highest sensitivity to linezolid, vancomycin and fusidic acid and which was 88.88%. Lowest sensitivity was found
to cephalexin (17.97%), cephradine (15.73%) and cefixime (10.11%) (Table II).

### Table II: Antibiotic susceptibility pattern (percent sensitive) of gram positive cocci

| Antibiotics     | Staphylococcus aureus (%) | Enterococcus (%) |
|-----------------|---------------------------|------------------|
| Amikacin        | 74.15                     | 16.66            |
| Imipenem        | 22.47                     | 66.66            |
| Gentamicin      | 73.03                     | 27.77            |
| Cloxacillin     | 28.08                     | 72.22            |
| Ciprofloxacin   | 32.58                     | 55.55            |
| Cefixime        | 10.11                     | 66.66            |
| Ceftriaxone     | 28.08                     | 66.66            |
| Cefazidine      | 24.71                     | 66.66            |
| Cephradine      | 15.73                     | 66.66            |
| Cephalexin      | 17.97                     | 66.66            |
| Co-trimoxazole  | 21.34                     | 38.38            |
| Linezolid       | 94.38                     | 88.88            |
| Vancomycin      | 87.64                     | 88.88            |
| Fusidic acid    | 91.01                     | 88.88            |

Among the Gram negative isolates Escherichia coli was the predominant organism followed by Pseudomonas aeruginosa and Klebsiella. The sensitivity of Escherichia coli to imipenem was 93.54%, amikacin 83.87%, colistin 53.22% and piperacillin + tazobactum 53.22% and low level of sensitivity was found to co-trimoxazole (30.64%) and ciprofloxacin (29.03%). Other drugs like ceftriaxone, cefixime, cefazidime and cephradine showed lowest sensitivity below 10%. Pseudomonas showed lowest sensitivity to almost all of the drugs except amikacin which was 73.52% sensitive. Almost similar sensitivity was shown to imipenem and colistin which was 70.58%. Klebsiella showed 77.77% sensitivity to amikacin and imipenem and 55.55% sensitivity to gentamicin, piperacillin + tazobactum and colistin (Table III).

### Table III: Antibiotic susceptibility pattern (percent sensitive) of gram negative bacilli

| Antibiotics     | E. coli (%) | Pseudomonas aeruginosa (%) | Klebsiella (%) |
|-----------------|-------------|---------------------------|----------------|
| Amikacin        | 83.87       | 73.52                     | 77.77          |
| Imipenem        | 93.54       | 70.58                     | 77.77          |
| Gentamicin      | 48.38       | 44.11                     | 55.55          |
| Tazobactum+Pipracillin | 51.61   | 35.29                     | 55.55          |
| Colistin        | 53.22       | 70.58                     | 55.55          |
| Ciprofloxacin   | 29.03       | 47.09                     | 44.44          |
| Co-trimoxazole  | 30.64       | 14.7                      | 33.33          |
| Cephalexin      | 12.90       | 5.88                      | 11.11          |
| Cephradine      | 3.22        | 0                         | 11.11          |
| Cefixime        | 6.45        | 0                         | 11.11          |
| Cefazidime      | 6.45        | 5.88                      | 0              |
| Ceftriaxone     | 8.06        | 0                         | 11.11          |

### Discussion

Bacterial contamination of wounds is a serious problem in the hospital especially in surgical practice where the site of a sterile operation can become contaminated and subsequently infected.16

Inspite of proper application of the basic principles of wound care a number of patients develop infections needing proper identification of the organisms for appropriate management.17 A changing pattern of isolated organisms and their antimicrobial sensitivity varies from hospital to hospital and region to region is a usual feature. In our study, Staphylococcus aureus was the most predominant pathogenic bacteria from wound sample which was similar to the other studies done by Shriyan et al.18, Noroozi et al.19, Isibor et al.20, Siguan et al.17 and Anbumani et al.21 Predominance of Staphylococcus aureus is however not surprising as it forms the bulk of the normal flora of the skin and nails.20 In our study, Staphylococcus aureus showed 94.38% sensitive to linezolid, 91.01% to fusidic acid followed by 87.64% to vancomycin, 74.15% to amikacin, and 73.03% to gentamicin and less sensitivity were found in commonly used antibiotic like ciprofloxacin (32.58%), cloxacillin (28.08%), ceftriaxone (28.08%), ceftazidime (24.71%) and cotrimoxazole (21.34%). Lowest
sensitivity was found to cephalexin (17.97%), cephradine (15.73%) and cefixime (10.11%). A study had shown 100% sensitivity to linezolid and vancomycin followed by gentamicin (88.88%).22-24 Another study showed complete sensitivity to vancomycin, linezolid, fusidic acid and amikacin24,25 and low activities against co-trimoxazole, ciprofloxacin, tetracycline and erythromycin.26-29 Above two findings are near about similar to our findings.

Remarkable susceptibility of Staphylococcus aureus to vancomycin, linezolid, fusidic acid, amikacin and gentamicin may be due to lesser use of these antibiotics as a result of their less availability, cost and toxic effect.30 Low activities of commonly used antibiotics such as cotrimoxazole, cloxacillin, ceftriaxone, ceftazidime, cephalixin, cephradine and cefixime may be due to increased consumption of a particular antibiotic which leads to the development of resistance resulting from mutation at drug target sites, or from the disturbance of drug accumulation in cytoplasm due to cell wall or cell membrane rearrangement.31-34 As a result, they have lost their efficacy in the treatment of wound infection.

E. coli were sensitive to amikacin 85.87%, imipenem 93.54%, tazobactam + piperacillin 51.61% and colistin 53.22% which was similar to the study done by Mahmood et al.25 Ranjan et al.35 reported that Gram negative isolates were found to be most susceptible to imipenem (90.76%) followed by piperacillin + tazobactam (68.46%) and amikacin (73.84%). Pseudomonas aeruginosa isolates were susceptible to imipenem (70.58%), amikacin (73.52%), colistin (70.58%). But the study done by Anbumani et al.21,22 had shown variable susceptibility pattern with imipenem 100%, piperacillin + tazobactum (87.71%), levofloxacin (85.71%), cefotaxime (71.42%) for Pseudomonas aeruginosa.

Klebsiella showed highest sensitivity to amikacin and imipenem (77.77%), gentamicin, piperacillin + tazobactum and colistin (55.55%) and lowest sensitivity to ceftriaxone, cephradine, Cephalexin and cefixime (11.11%) and 100% resistance to ceftazidime which was similar to the study done by Anbumani et al.21 and Anderl et al.36

The findings of our study show that Staphylococcus aureus was found to be the predominant among all of the isolates of wound infections and showed highest sensitivity to vancomycin, linezolid and fusidic acid followed by amikacin. Most of the Gram negative isolates were highly sensitive to imipenem followed by amikacin, piperacillin + tazobactum and colistin. We should use these drugs rationally so that they remain effective for treatment of wound infection. As the commonly used drugs shows less sensitivity, further study is needed for newer drugs to fight against wound infection.

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