Research Article

Post operative wound infection in clean and clean contaminated surgery

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Abstract

Introduction: Surgical Site Infections are one of the most important causes of healthcare associated infections and are associated with considerable morbidity and mortality. This study was conducted to analyze postoperative wound infection in clean and clean contaminated surgeries, to determine spectrum of bacteria responsible, study their antimicrobial sensitivity pattern and to identify various factors responsible for them. **Materials and Methods**: Patients suffering from post operative wound infection during the period from January 2013 to December 2013 were included in the study. Patients were randomly selected. Pus samples were collected and processed in Microbiology department for aerobic and anaerobic organisms, according to standard procedures. **Results:** Cases were well spread in all age groups above 31 years. The male: female ratio was 1.4: 1. Clean contaminated cases accounted for more than half the number of cases. Staphylococcus aureus was the single most commonly isolated pathogen, followed by Acinetobacter baumanii and Pseudomonas aeruginosa. Most gram positive organisms were sensitive to Vancomycin, Amikacin and Linezolid, while gram negative organisms showed maximum sensitivity to Imipenem and Cefoperazone - sulbactum. An increase in the isolation of most bacterial species was observed when the duration of surgery and duration of pre operative stay increased. **Conclusion:** Despite intensive attempts at eradication during last 20 years, MRSA continues to be the major nosocomial pathogen worldwide. Antimicrobial prophylaxis is a critically timed adjuvant used to reduce microbial burden of post operative contamination. There is pressing need to reduce indiscriminate use of antibiotics and develop alternatives to reduce SSI.
Keywords: Post operative Wound Infection, Surgical Site infection.

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INTRODUCTION

Surgical infection, particularly Surgical Site Infection (SSI) has always been a major complication of surgery and trauma.[1] Fitzgerald[2] first defined it as, "one that was inflamed and drained purulent material, which was either positive or negative on culture but contained many polymorphonuclear leukocytes on microscopic examination." With passing years, the criteria for defining Surgical Site Infection has changed significantly.[3-10] Today SSI account for nearly 16% of all hospital acquired infections.[11] In India, the rate of SSI is between 4 to 30%.[12-14] These infections may be caused both by exogenous and endogenous micro-organisms.[15] Despite the development of more effective prophylactic antibiotics, advances in implants, surgical techniques and post operative care, wound infection is still a common problem which needs to be resolved.[16] The purpose of this study was to elucidate prevalence of bacteriological isolates which are responsible for post operative wound infection in surgical patients, to study their antimicrobial sensitivity pattern and to identify contributing risk factors.

MATERIAL AND METHODS

Study Population

This study was conducted in the Department of Microbiology at Goa Medical College, from January 2013 to December 2013. The study included patients

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from the surgical wards of our hospital, who had developed Surgical Site Infections after a Clean or Clean Contaminated Surgery. These patients belonged to the age group of fifteen to sixty eight. Ethical committee approval was sought and informed consent was taken.

Inclusion Criteria

A wound infection was identified by the presence of purulent discharge from the incision with erythematous cellulitis, induration or pain, and demonstrable fluid collection noted on ultrasound.

Exclusion Criteria

- Procedure in which healthy skin was not incised, e.g. operation on an abscess.
- Burn injuries and donor sites of split skin graft
- Contaminated and dirty surgeries

Criteria used for anaerobic infection

- Foul smelling discharge
- Deep seated infection
- Surgery related to gastrointestinal tract and genitourinary tract.
- Infections associated with marked tissue necrosis and gangrene.
- Associated with diabetes mellitus and malignancy.

Relevant History

A short clinical history regarding the age, sex, diagnosis, duration of pre operative stay and duration of surgery was obtained from each patient.

Specimen Collection

Purulent exudates were obtained with a sterile cotton swab. Aspirates were obtained by preparing the wound area with alcohol, inserting a sterile needle through the healing incision and aspirating fluid into a sterile syringe. For aerobic cultures the swabs were immediately inoculated on to 5% sheep blood agar and Mac Conkey agar and incubated at 37^0C. The colonial morphologies of the organisms grown were recorded. A presumptive identification of all isolates was made based on morphology; haemolysis, pigments as well as the primary gram stain appearance. Confirmatory biochemical tests were carried out according to standard microbiological procedures.[17] Antibiotic sensitivity was done using standardized disc agar diffusion technique (Kirby Bauer Method) and interpreted according to Clinical and Laboratory Standard Institute criteria.[18] As for anaerobic cultures, the swabs were immediately placed into Roberston cooked meat broth. They were then subcultured onto freshly prepared 10% blood agar plates enriched with vitamin K and Haemin. The plates were incubated in an anaerobic jar with BD GasPak EZ Gas Generating Container Systems (marketed by BD U.S.) and read after 24 hours at 37^0C. Although procedure for primary isolation of anaerobes was undertaken, subsequent identification methodology was not done as no anaerobes were grown in the study.

RESULTS

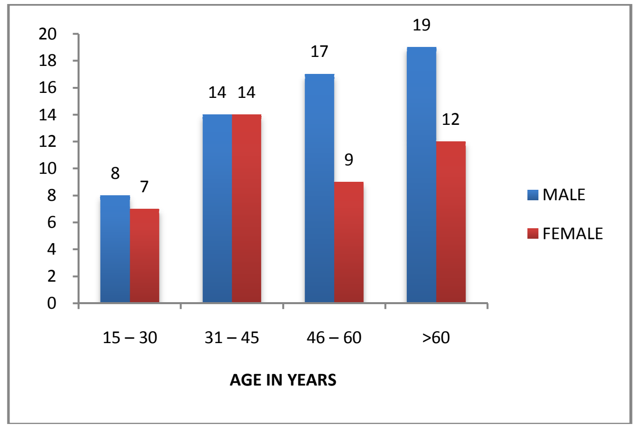

Figure 1: Age group and gender distribution

NB: Figures in parenthesis indicate percentages, Male: Female ratio = 1.4: 1

From the Graph 1, it is evident that the cases were well spread in age groups above 31 years. The male to female ratio in the present study was 1.4:1, thus indicating a male dominance. This male preponderance was observed in all age groups, with the exception of age group 31 to 45 years, where the number of male subjects equaled the female counterparts.

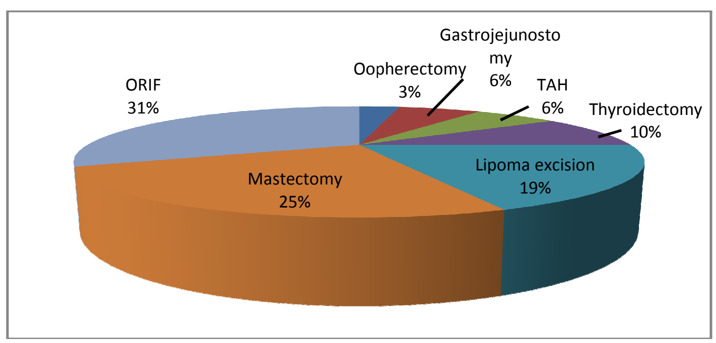

Figure 2a: Type of surgery undertaken on the study subjects clean surgery

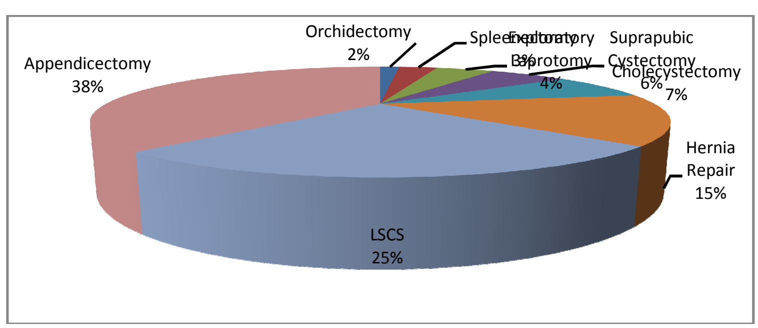

Figure 2b: clean contaminated surgery

Graph 2a and 2b indicate, clean surgery was undertaken in 32% of cases, while the remaining 68% cases were subjected to clean contaminated surgery. Among the clean surgeries conducted, 10% were ORIF, 8% cases of mastectomy and 6% lipoma excision. The most common type in the clean contaminated surgery group was appendicetomy (26%) followed by LSCS (17%) and hernia repair (10%).

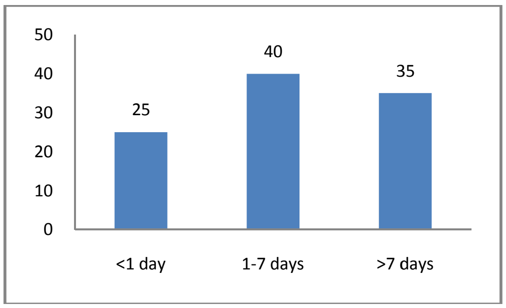

Figure 3: Duration of pre operative hospitalization

As seen in Graph 3, out of 100 patients with post surgical wound infection, 25 had preoperative stay of less than 24 hours and 40 patients had preoperative stay of 1-7 days while 35 patients were admitted for more than 7 days prior to surgery.

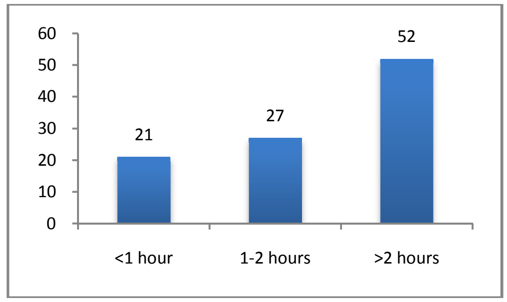

Figure 4: Duration of Surgery

From Graph 4 it is seen that, among 100 cases of SSI, 21 cases occurred when duration of surgery was less than 1 hour, 27 cases occurred when duration of surgery extended between 1-2 hours, while 52 cases occurred when duration of surgery prolonged beyond 2 hours.

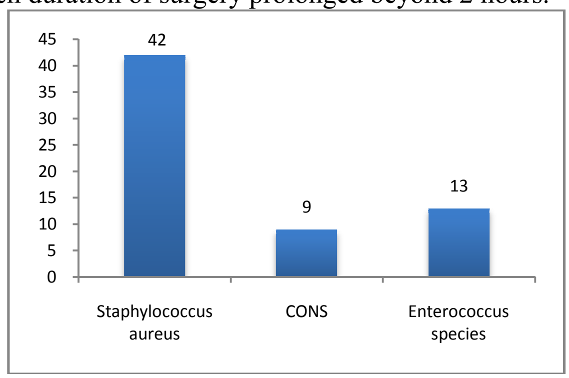

Figure 5a: Bacterial pathogens isolated in the present study

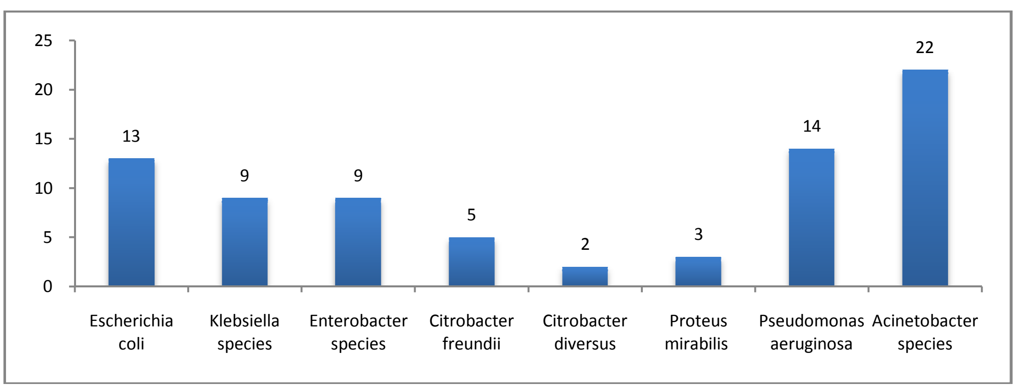

Figure 5b: Gram Negative BACILLI

A total of one hundred and forty one bacterial pathogens were isolated from the 100 study subjects. All isolates were aerobic pathogens. Although samples were also processed anaerobically for isolation of anaerobic organisms, none of them yielded anaerobic bacteria. Gram negative bacilli encountered were 54.61% (77 out of 141) while Gram positive cocci accounted for 45.39% (64 out of 141) of the total. The single most commonly isolated organism was Staphylococcus aureus (29.79%), followed by Acinetobacter baumanii and Pseudomonas aeruginosa (9.93%). (Graph 5a and 5b)

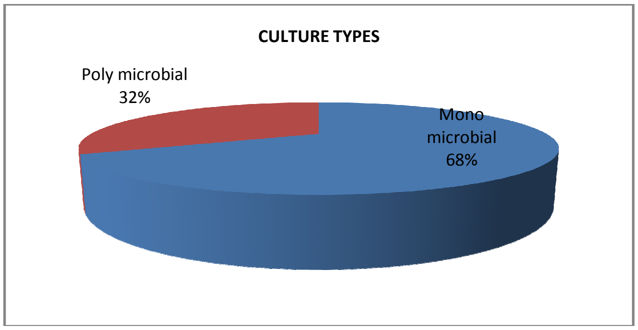

Figure 6a: Monomicrobial and polymicrobial etiology among culture positive cases

Mono bacterial etiology was seen in 68% cases, while poly bacterial growth was encountered in 32% cases. (Graph 6a)

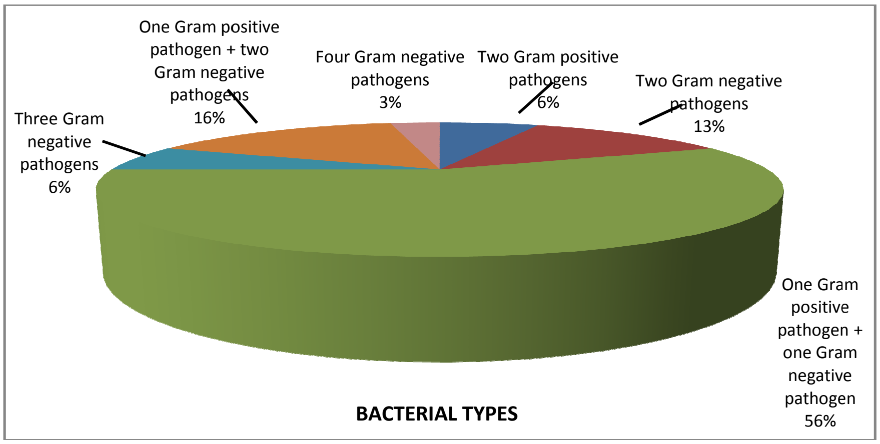

Figure 6 b: Distribution of bacterial types in polymicrobial etiology cases

From Graph 6b, it is evident that two pathogens were isolated concomitantly in an overwhelming number of cases (75%).

Among the double pathogens, a single Gram positive pathogen with a Gram negative organism was isolated in 18 cases (56.25%), while two Gram negative bacilli and two gram positive cocci were isolated in 4 cases and 2 cases respectively (12.5%; 6.25%). Three or more bacterial pathogens were isolated together in a low number of cases i.e. 8 out of 32 (25%). Three Gram negative organisms were isolated concomitantly in 2 (6.25%) cases, while one Gram positive pathogen along with two Gram negative bacteria was grown together in 5 (15.63%) cases. One single case grew four different Gram negative bacteria (3.12%).

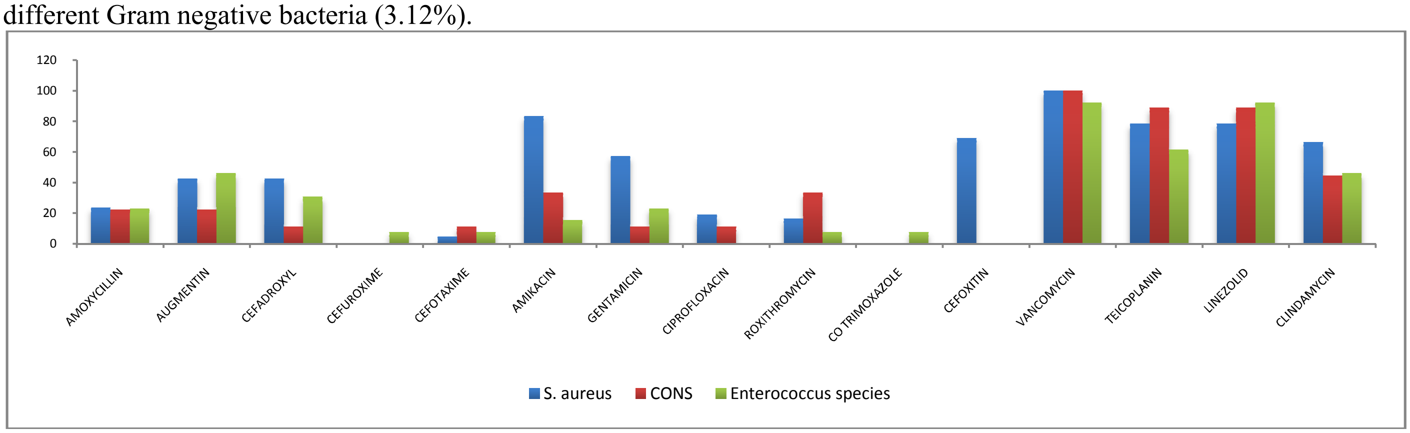

Figure 7: Antibiotic Sensitivity Pattern of Gram Positive Bacteria

The Graph 7 reveals that the incidence of MRSA was 30.96%. Staphylococcus aureus was most sensitive to Vancomycin (100%) followed by Amikacin (83.33%), Linezolid (78.57%) and Teicoplanin (78.57%). CONS was found to be most sensitive to Vancomycin (100%), followed by Linezolid and Teicoplanin (both 88.88%). Among Enterococcus species, 92.3% of the organisms were inhibited by Linezolid and Vancomycin each while Teicoplanin was sensitive in 61.53% cases. Gentamicin was effective against 57.14% of Staphylococcus aureus and 23.07% of Enterococcus species isolated in the present study. Only 11.11% of CONS were sensitive to Gentamycin. About 42.86% of Staphylococcus aureus, 30.76% of Enterococcus species and 11.11% of CONS were susceptible to Cefadroxyl. CONS (33.3%) were more susceptible to Roxithromycin than Staphylococcus aureus (16.6%) and Enterococcus species (7.6%). All the Gram positive bacteria isolated in the study were equally sensitive to Amoxycillin (22-23%). Cotrimoxazole and Cefuroxime were found to be not effective against the Gram positive bacteria.

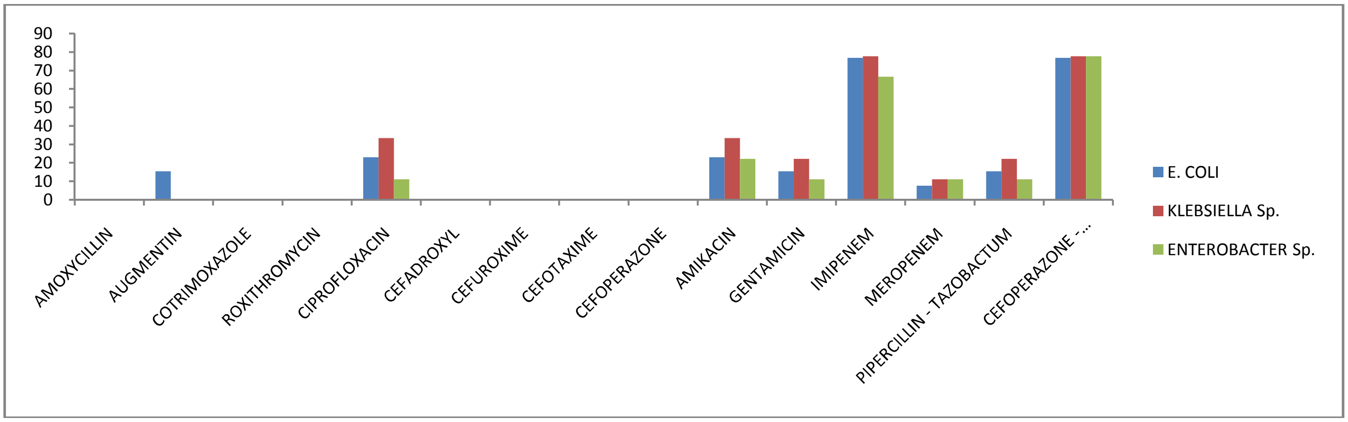

Figure 8 a: Antibiotic sensitivity of gram negative organisms

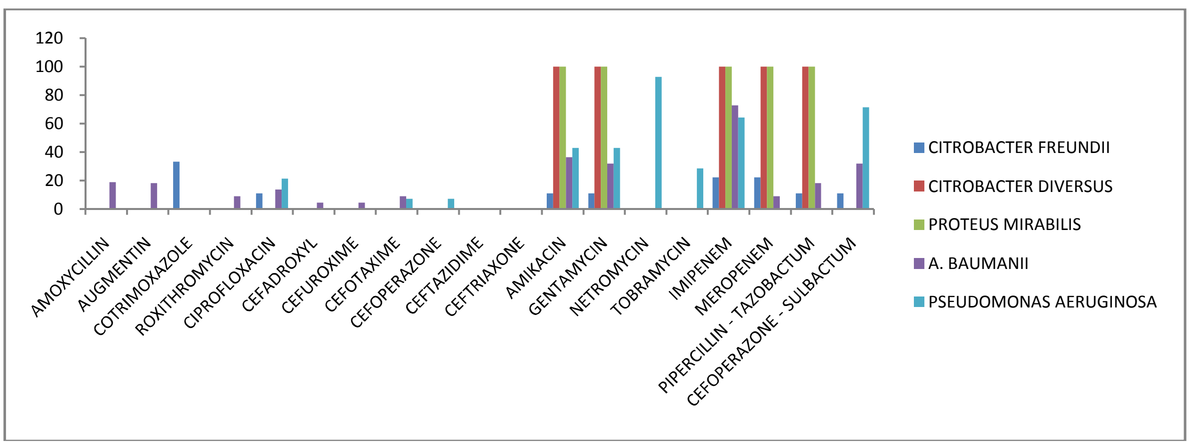

Figure 8 b: Antibiotic sensitivity of gram negative organisms

Majority of Gram negative bacilli were inhibited by Imipenem. The sensitivity varied from 64% to 100%. (Graph 8a, 8b)

Next in the order of effectiveness was Cefoperazone – sulbactum. About 77.77% of Klebsiella species, 77.77% of Enterobacter species, 76.92% of Escherichia coli and 71.42% of Pseudomonas aeruginosa were inhibited by Cefoperazone – sulbactum. In comparison, Acinetobacter baumanii and Citrobacter freundii were less sensitive (31.81% and 33.33% respectively). Ciprofloxacin was more effective against Citrobacter freundii (33.33%) and Klebsiella species (33.3%) than Pseudomonas aeruginosa (21.42%), Escherichia coli (23.07%) and Acinetobacter baumanii (13.63%). Enterobacter species were least susceptible to Ciprofloxacin (11.11%). Sensitivity to Netromycin, Tobramycin, Ceftazidime, Ceftriaxzone and Cefaperazone were also tested in Pseudomonas aeruginosa isolates. It was seen that, while the strains of Pseudomonas aeruginosa were resistant to Ceftazidime, Ceftriaxzone, they showed maximum sensitivity to Netromycin (92.85%). All Gram negative bacteria were resistant to Cephalosporins with the exception of Acinetobacter baumanii which showed a very low sensitivity.

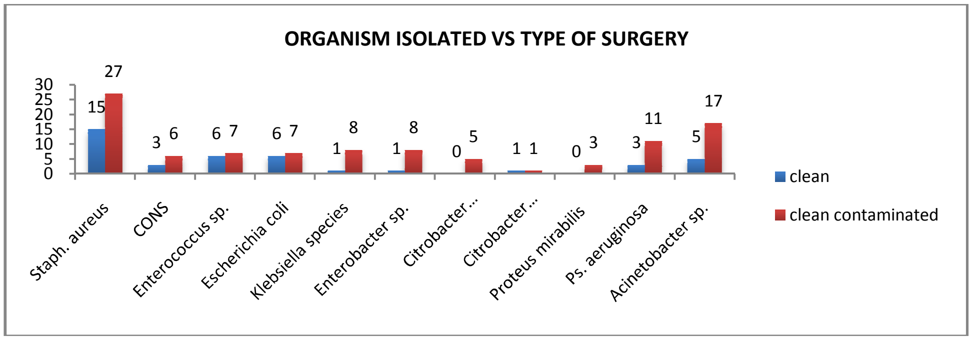

Figure 9: Correlation of bacterial pathogens isolated with type of surgery

In the Graph 9, among the clean operations which were infected, Gram positive cocci were the main causative agents (58.5%; 24 out of 41), while Gram negative bacilli accounted for 41.5% (17/41).

Staphylococcus aureus was most commonly isolated in this category (36.58%), followed by Acinetobacter baumanii (22.73%) and Klebsiella species and Enterobacter species (21.95% each). Among the clean contaminated infected cases, gram negative organisms predominanted (60%), while the Gram positive cocci were isolated in 40% cases. Staphylococcus aureus still remained the most commonly isolated pathogen (27%) in this category also, followed by Acinetobacter baumanii (17%) and Pseudomonas aeruginosa (11%).

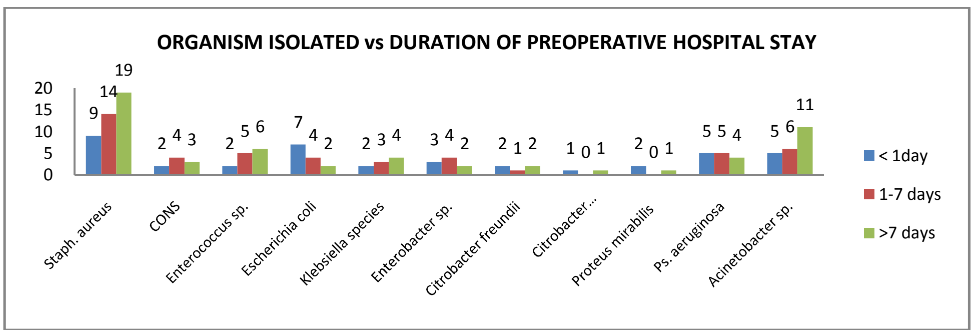

Figure 10: Correlation of bacteria isolated with duration op pre operative hospitalization

Staphylococcus aureus, Enterococcus species, Klebsiella species and Acinetobacter baumanii showed an increasing rate of isolation as duration of pre operative hospitalization increased. (Graph 10) Isolation of Staphylococcus aureus increased from 21.42% (when pre operative hospitalization stay was <1 day) to 45.23% (when pre operative hospitalization stay was >7 days). Similarly, incidence of Enterococcus species (15.38%), Klebsiella species (22.22%), CONS (22.22%) and Acinetobacter species (22.72%) increased to 46.15%, 44.44%, 33.33% and 50.00% respectively.

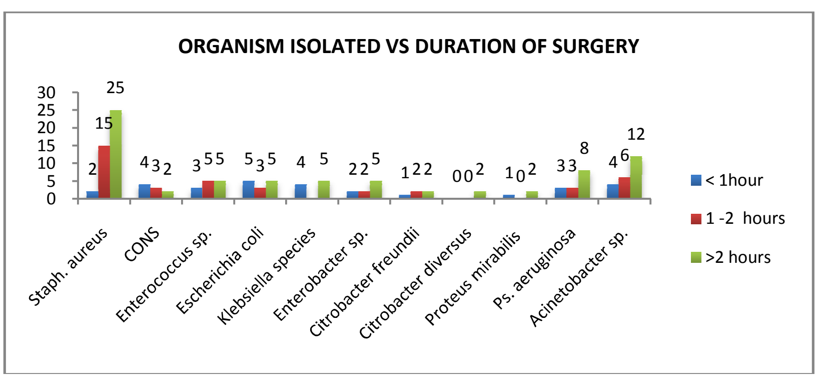

Figure 11: Comparison of bacteria isolated with duration of surgery

It was observed that the isolation of most bacterial species increased with an increase in the duration of surgery. However, a decreasing trend was observed with CONS, wherein their isolation decreased from 44.4% (when surgery took less than 1 hour) to 22.2% (when surgery was prolonged for more 2 hours). (Graph 11)

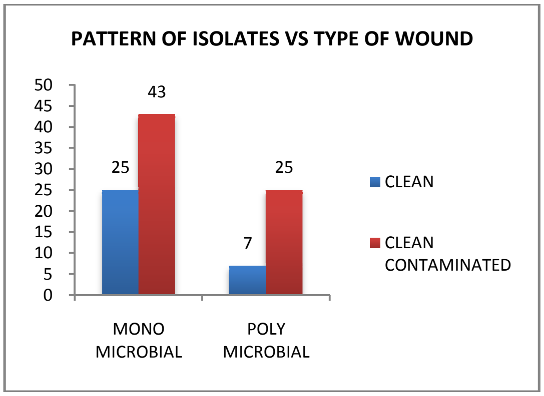

Figure 12 a: Association of polymicrobial isolation with type of surgery, duration of preoperative hospitalization and duration of surgery

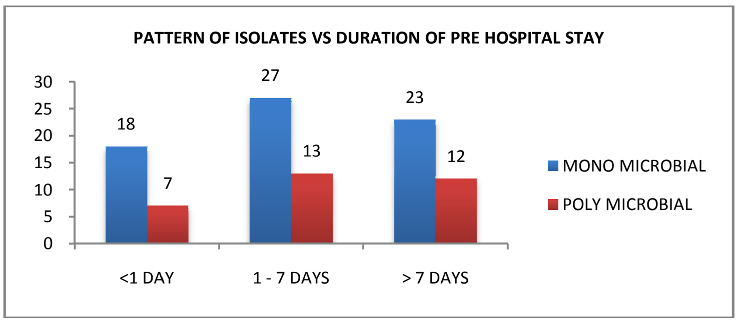

Figure 12 b:

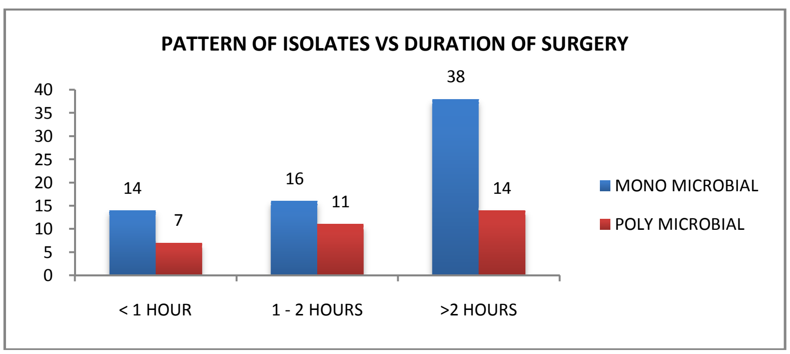

Figure 12 c: Pattern of isolates Vs duration of surgery

It can be observed from the above Graphs 12a, b and c that, the type of surgery, duration of pre operative hospitalization and duration of surgery did not influence the number of bacteria isolated.

DISCUSSION

It is evident from our study, that clean contaminated surgeries are more prone to develop post operative infection as compared to clean surgeries. It can therefore be inferred from this study, that wound contaminated risk class is independently predictive of infection. There is evidence that with increasing ages the host's defense mechanisms, both cellular and humoral, is less effective.[19-21] The present study confirms the understanding that there is a gradual rise in the incidence of wound infection with advancing age. The reason for the gender difference is unclear. It is probably due to possibility that in a country like ours, males present themselves voluntarily and immediately as compared to the females who will seek medical attention only when an ailment becomes unbearable. It is a common observation that a longer pre operative hospitalization is associated with wound infection.[22-24] The present study included only clean or clean contaminated cases. This probably explains the lower number of infected cases, when surgery took place more than 1 week after admission. As the duration of surgery increases there is increased contamination of the wound by bacteria[25], sedimented from exogenous sources and this is evident from our study, Our study shows that the pathogens isolated from surgical wounds vary depending primarily on type of surgical procedure. In clean and clean contaminated surgery, gram positive cocci mainly Staphylococcus aureus from exogenous environment or patient's skin flora were found to be the usual cause of infection. Similarly, in contaminated and dirty surgeries, gram negative organisms predominated, clearly suggesting endogenous contamination from the bowel and hollow muscular organs to be the likely source. Also it is clear that there is a constant change in the bacterial etiology of surgical infection from time to time. Gram negative organisms are now replacing Gram positive organisms as the most frequent pathogens causing wound infection. However, Staphylococcus aureus still continues to be the single most important bacterial species in the primary etiology of surgical site infections since past 30 years. The reasons behind the change of bacterial etiology are many. The complexities of modern medicine, with the use of broad spectrum antibiotics, corticosteroids, prolonged surgical procedures and mechanical instrumentation have all played a contributing role. As duration of surgery is prolonged, there is increased contamination of wound by prolonged contact with operating staff and equipments. Antibiotic prophylaxis can decrease postoperative morbidity, shorten hospital stay, and reduce overall costs attributable to infection.[26] But indiscriminate use of antibiotics has resulted in increased costs, adverse effects and emergence of multidrug resistant pathogens. The percentage of sensitivity has shown a decline over the years when tested for commonly used antibiotics.[15, 27, 28] All the patients in this study were on prophylactic antibiotics. The condition in our overcrowded general wards and in adequately equipped operation theatres are such that the surgeon will not be satisfied unless he has put the patient on prophylactic antibiotics. This probably also explains why anaerobic organisms were not isolated on culture.

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