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Study of Various Organisms associated with Surgical Site Infection and their Sensitivity Pattern

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Abstract

Aim: The objectives of this study was to study the various micro-organisms causing surgical site infection, to study their antibiotic sensitivity and resistance pattern. **Setting:** Department of Surgery of a tertiary health care centre with an attached medical college. **Material and methods:** A total of 89 patients with post operative surgical site infection occurring within 30 days of surgery or 1 year of implant were included as subject material after they satisfy inclusion and exclusion criteria. **Results:** *E.coli* is the commonest organism isolated in SSI wounds. Overall Imipenem and Amikacin are the most sensitive antibiotics. Over all gentamycin, cefotaxime and clindamycin are the most resistant antibiotics noted. **Conclusion:** The most common organisms associated with SSI are *E. coli* and *Pseudomonas*. Most of the organisms were sensitive to imipenem, amikacin. Sensitivity pattern of the of the organism is changing with time. The common organisms are now no longer sensitive to routinely used cheaper antibiotics. Newer antibiotics, which are more costly, are required to treat the infection which is a burden to the patient.

Keywords: Antibiotic Resistance Pattern, Antibiotic Sensitivity Pattern, Co-morbidity

1. Introduction

Surgical Site Infections (SSI) are the infections of the tissues, organs, or spaces exposed by surgeons during performance of an invasive procedure.

CDC definition states that only infections occurring within 30 days of surgery (or within a year in the case of implants)[1] should be classified as SSIs. Surgical site infections are characterized by a breach of mechanical/anatomic defense mechanisms (barriers) and are associated with greater morbidity, mortality, and increased cost of care[2].

SSI can increase the length of time a patient stays in hospital and thereby increase the costs of health care, not only the patient but his family also suffers. The additional costs may be related to re-operation, extra nursing care and interventions, and antibiotics . The indirect costs may be due to loss of productivity, patient dissatisfaction and litigation, and reduced quality of life.

A system of classification of SSI for operative wounds that is based on the degree of microbial contamination was developed by the US National Research Council group in 1964[3].

- Class 1 – Clean wounds
- Class 2 – Clean-contaminated wounds
- Class 3 – Contaminated wounds
- Class 4 – Dirty wounds

Depending on the class the chances of wound infection varies[4]. Wound classification is well documented risk factors for SSI[5].

The objective of the study is to study various organisms causing Surgical site infections and study their sensitivity pattern which will help in managing the SSI in more cost effective manner.

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2. Aims and Objectives

- To study the various micro-organisms causing surgical site infection.
- To study the Anti-microbial sensitivity and resistance pattern

3. Materials and Methods

Study Design : Descriptive Study
Study Setting : Department Of Surgery of a Medical College
and Tertiary Health Care Centre
Study Duration: August 2012 to December 2014
Study Participants: Sample Size : 89

4. Eligibility Criteria

4.1 Inclusion Criteria

- Patients who have undergone emergency or elective surgical procedure with evidence of SSI.

4.2 Exclusion Criteria

- Patients below 18 years.
- Patients not willing to give written, informed consent.

5. Methodology

The present study was conducted in the Department of Surgery of a Medical College and Tertiary Health Care Centre. A total of 89 patients with evidence of SSI were included in the study after they satisfy the inclusion and exclusion criteria. Written Informed Consent was taken from all the participants. For the present study surgical site infection is defined as "Infections at the operative site occurring within 30 days of surgery (or within 1 year of Implants)"[1]. The wounds were classified according to the wound contamination class system proposed by U.S. National Research Council in 4 classes as mentioned above[3]

SSIs are divided into (Table 1):
- Superficial incisional SSIs
- Deep incisional SSIs
- Organ/space SSIs

The SSI in all the study participants was evaluated by following parameters :-
- Post operative day of development of SSI
- Clinical symptomatology – Fever, local rise of temperature, tenderness locally, collection at operative site
- Type of SSI – Superficial or Deep or Organs/spaces

Discharge/Aspirate from the infected surgical site was sent to department of microbiology for smear, culture and antibiotic sensitivity.

The pus samples collected were processed for smear, culture & antibiotic sensitivity test.

6. Observations and Results

Table 1. Incidence rate of type of SSI

Type of SSI	NO. OF CASES	INCIDENCE RATE
Superficial	58	65.17%
Deep	25	28.09%
Organs, spaces	**6**	**6.74%**

Table 2. Incidence rate of organism isolated

Organism isolated	NO. OF CASES	INCIDENCE RATE
E.coli	29	32.58%
Pseudomonas aeruginosa	17	19.10%
MRSA	6	6.74%
Staph. aureus	16	17.98%
Citrobacter	5	5.61%
Klebsiella	11	12.36%
Others	**5**	**5.62%**

Table 3. Antibiotic Sensitivity Spectrum

Antibiotics	AK	GEN	IPM	CIP	CFS	NET	CTX	PT	CTR	CAZ	LZ	CD	VA	C
Organism isolated with total No.	%	%	%	%	%	%	%	%	%	%	%	%	%	%
E.coli	89.65	6.89	96.55	55.17	51.72	79.31	34.48	68.96	13.79	64.48	62.06	58.62	-	-
Pseudo.aeruginosa	82.35	17.64	100	21.41	35.29	58.82	82.35	70.58	70.58	47.08	-	23.52	-	-
Staph.aureus	43.75	12.51	75	68.75	-	68.75	81.25	68.75	75	75	100	18.75	-	-
Klebsiella	72.72	54.54	100	72.72	54.54	72.72	36.36	45.45	0	54.54	0	27.27	-	0
MRSA	0	0	33.33	0	0	0	0	50	0	0	66.66	0	100.0	66.66
Citrobacter	100	40	100	40	0	100	0	60	60	40	-	80	-	-

Ak- Amikacin, CFS - Cefaperazone-Sulbactum, Caz- Ceftazidime, Net - Netilmycin, Pt- Piperacillin, Tazobactum, C- Chloramphenicol, Ipm- Imipenum, Ctx-Cefotaxime, Cip-Ciprofloxacin, Gen-gentamycin, Ctr-Ceftriaxone, Ln- linezolid, V-Vancomycin, C-Clindamycin

Table 4. Antibiotic Resistance Spectrum

ANTIBIOTICS	AK	GEN	IPM	CIP	CFS	NET	CTX	PT	CTR	CAZ	LZ	CD	VA	C
ORGANISM ISOLATED WITH TOTAL NO.	%	%	%	%	%	%	%	%	%	%	%	%	%	%
E.COLI	10.34	93.10	3.45	44.82	48.27	20.69	65.51	31.03	86.20	65.51	37.93	41.37	-	-
PSEUDO. AERUGINOSA	17.64	82.35	0	70.58	64.70	41.17	17.65	29.41	29.41	52.94	-	76.47	-	-
STAPH. AUREUS	56.25	87.5	25	31.25	-	31.25	18.75	31.25	25	25	0	81.25	-	-
KLEBSIELLA	27.27	45.45	0	27.27	45.45	27.27	63.63	54.54	100	45.45	100	72.72	-	100.0
MRSA	**100**	**100**	**66.66**	**100**	**100**	**100**	**100**	**50**	**100**	**100**	**33.33**	**100**	**0**	**33.33**
CITROBACTER	**0**	**60**	**0**	**60**	**100**	**0**	**100**	**40**	**40**	**60**	**-**	**20**	**-**	**-**

Ak- Amikacin, CFS - Cefaperazone-Sulbactum, Caz- Ceftazidime, Net - Netilmycin, Pt- Piperacillin, Tazobactum, C- Chloramphenicol, Ipm- Imipenum, Ctx-Cefotaxime, Cip-Ciprofloxacin, Gen-gentamycin, Ctr-Ceftriaxone, Ln- linezolid, V-Vancomycin, C-Clindamycin

7. Discussion

Surgical site infection is common in day to day practice. There are many factors which are responsible for SSI which can be broadly classified into factors related to patient, factors related to surgery etc. There are many organisms involved in wound infection. In this study we tried to find out common organisms associated with wound infection and their sensitivity pattern.

The study was conducted at Department of General Surgery, of a tertiary care hospital. This is a descriptive study of 89 cases who underwent surgery and had surgical site infection noted within 30days from the day of operation.

8. Organism Detected

Most common organism isolated from infection in this study was *E.Coli, Pseudomonas aeruginosa, Staphylococcus. aureus, Klebsiella, MRSA, Citrobacter*

Other organisms isolated accounted combinely as 5.62% (Table 2). Mama et al.[6] in 2014 found *S. aureus* was the predominant organism isolated 32.4%, followed by *Escherichia coli* (*E. coli*)20%, *Proteus spps* 16%, coagulase negative *Staphylococci* 14.5%, *Klebsiella pneumonia (K. pneumoniae)* 10% and *P. aeruginosa* 8%.

Pseudomonas was most common isolate in other studies like Mofikoya Bo et[7]al. in Lagos Nigeria in 2009. 25(17.4%) of the 144 patients studied developed surgical site infections. Psedomonas was the most frequently cultured aerobic organism in 28% (n=7) of the cultures, while Bacteroids species was the most common anaerobe isolated.

Our findings of a predominance of gram negative bacilli are similar to that of other workers. In most cases of SSI, the organism is usually patient's endogenous flora. In abdominal surgeries the opening of the gastrointestinal tract increases the chances of infections by coliforms, gram negative bacilli. This group of organisms tends to be endemic in hospital environment by being easily transferred from object to object, they also tend to be resistant to common antibiotics and are difficult to eradicate in the long term. This group of organisms play a greater role in the many hospital acquired infections.

We found that *E.coli*, *Pseudomonas aeruginosa, Staph. aureus* and *Citrobacter* are most commonly found in Class1 wounds, whereas *Klebsiella* and MRSA are most commonly isolated in Class 2 wounds.

Table 5. Antibiotic sensitivity and resistance pattern of *E.Coli*

	% Sensitivity	%Resistence
Amikacin	89.65	10.34
Gentamicin	23.89	93.10
Imipenem	96.55	3.45
Ciprofloxacin	55.17	44.82
Cefoperazone-Sulbactum	51.72	48.27
Netilmicin	79.31	20.69
Cephotaxim	34.48	65.51
Piperacillin- Tazobactum	68.96	31.03
Ceftriaxone	13.79	86.20
Ceftazidime	34.45	65.51
Linezolid	62.06	37.93
Clindamycin	**58.62**	**41.37**

E.coli is most sensitive for Imepenem, amikacin and netilmycin followed by piperacillin - tazobactum, Ceftazidime and linezolid. *E.coli* is most resistant to gentamycin, ceftriaxone, cefotaxime and ceftazidime

(Table 3-5).

Table 6. Antibiotic sensitivity and resistance pattern of Pseudomonas aeruginosa

	% Sensitivity	%Resistence
Amikacin	82.35	17.64
Gentamicin	17.64	82.35
Imipenem	100	0
Ciprofloxacin	29.41	70.58
Cefoperazone- Sulbactum	35.29	64.70
Netilmicin	58.82	41.17
Cephotaxim	82.35	17.65
Piperacillin- Tazobactum	70.58	29.41
Ceftriaxone	70.58	29.41
Ceftazidime	47.05	52.94
Clindamycin	**23.52**	**76.47**

Pseudomonas is most sensitive for imipenem, amikacin, cefotaxime, piperacillin-tazobactum and ceftriaxone. *Pseudomonas* is most resistant to gentamycin, ciprofloxacin, clindamycin (Table 3,4,6).

Table 7. Antibiotic sensitivity and resistance pattern of Staph. aureus

	% Sensitivity	%resistence
Amikacin	43.75	56.25
Gentamicin	12.5	87.50
Imipenem	75	25
Ciprofloxacin	68.75	31.25
Netilmicin	68.75	31.25
Cephotaxim	81.25	18.75
Piperacillin- Tazobactum	68.75	31.25
Ceftriaxone	75	25
Ceftazidime	75	25
Linezolid	100	0
Clindamycin	**18.75**	**81.25**

Staphylococcus is most sensitive for linezolid, cefotaxime, ceftazidime, imipenem and ceftriaxone. *Staphylococcus* is most resistant to gentamycin & clindamycin.

Klebsiella is most sensitive for imipenem, amikacin, netilmycin, and ciprofloxacin (Table 3,4,7). *Klebsiella* is most resistant to ceftriaxone and linezolid and chloramphenicol.

MRSA is most sensitive to vancomycin, clindamycin and linezolid (Table 3,4,8). MRSA is resistant to most of the commonly used antibiotics especially gentamycin, netilmicin, ceftriaxone, clindamycin (Table 3,4,9).

Amikacin is used mostly for *Citrobacter* and *E.coli*, followed by *Pseudomonas, Klebsiella*. Resistance of Amikacin is mostly for MRSA [*Staph. Aureus*] followed by other organisms (Table 10).

Table 8. Antibiotic sensitivity and resistance pattern of Klebsiella

	% Sensitivity	%Resistance
Amikacin	72.72	27.27
Gentamicin	54.54	45.45
Imipenem	100	0
Ciprofloxacin	72.72	27.27
Cefoperazone- Sulbactum	54.54	45.45
Netilmicin	72.72	27.27
Cephotaxim	36.36	63.63
Piperacillin- Tazobactum	45.45	54.54
Ceftriaxone	0	100
Ceftazidime	54.54	45.45
Linezolid	0	100
Clindamycin	27.27	72.72
Chloramphenicol	**0**	**100**

Table 9. Antibiotic sensitivity and resistance pattern of MRSA

	% Sensitivity	% Resistence
Amikacin	0	100
Gentamicin	0	100
Imipenem	50	50
Ciprofloxacin	0	100
Cefoperazone- Sulbactum	0	100
Netilmicin	0	100
Cephotaxim	0	100
Piperacillin- Tazobactum	50	50
Ceftriaxone	0	100
Ceftazidime	0	100
Linezolid	66.66	33.33
Clindamycin	0	100
Vancomycin	100	0
Chloramphenicol	**66.66**	**33.33**

Table 10. Spectrum of Amikacin

	%Sensitivity	%resistance
E.coli	89.65	10.34
Pseudomonas aeruginosa	82.35	17.64
Staph.aureus	43.75	56.25
Klebsiella	72.72	27.27
MRSA	0	100
Citrobacter	**100**	**0**

Overall gentamycin, cefotaxime and clindamycin are the most resistant antibiotics noted. Mama et al[6]. showed *S. aureus* was highly resistance to ampicillin (95.7%), penicillin (91.5%) and tetracycline (51%) and highly sensitive to amikacin (100%), vancomycin (100%), ciprofloxacin (96%), norfloxacin (96%) and gentamicin (96%). Also 100% of the E.coli isolates were resistant to cephalothin, ampicillin (96.6%), tetracycline (79%), chloramphenicol (65.5%), ceftriaxone (62%), sulphamethoxazole trimethoprim (55%) and gentamicin (51.7%) and *K. pneumoniae* was 100% resistance to ampicillin, 85.7%in chloramphenicol, sulphamethoxazoletrimethoprim andcephalothin, (71%) in ceftriaxone. However it indicates low resistance to ciprofloxacin (35.7%) and doxycycline.

Umesh S. Kamat 2008[8] had pseudomonas species 21.4% sensitive for Cephoperazone-sulbactum combination. The proportion of bacteria resistant to all antibiotics for which tested was as high as 63.93% (39/61).

B.Kakati et al. in 2012[9] had all the *Pseudomonas aeruginosa* isolates sensitive to imipenem and polymyxin B (100%), while all isolates were found to be resistant to aminoglycosides (100%)except one that was sensitive to netilmicin.

Most of the study showed that virtually all of the pathogens were resistant to the commonly prescribed antibiotics such as Ampicillin and Doxycycline. The cultured aerobes also demonstrated less than 50% sensitivity to the cephalosporins tested

(Ceftaxidime, Cefuroxime and Ceftriaxone) in over 80% of the infected patients. This finding further supports the well known high prevalence of multiple antibiotic resistant nosocomial pathogens in our environment and may reflect the widespread abuse of antibiotics in the general population.

The relative frequency of different isolates also varied between different studies. Thus, it can be concluded that the organisms that cause SSIs change from place to place and from time to time in the same place. The antibiotic sensitivity testing of different isolates showed multidrug resistance by most of the isolates. The review of literature indicates that there is gradual increase in drug resistance to many antibiotics in most of the organisms which are isolated from surgical patients. Our study reveals that though SSIs are caused by many organisms which are resistant to commonly prescribed antibiotics,the steps taken to reduce SSIs are still not adequate. Proper infection control measures and a sound antibiotic policy should be implemented reduce SSIs in the future.

9. Conclusion

Most of the study showed that virtually all of the pathogens were resistant to the commonly prescribed antibiotics such as Ampicillin and Doxycycline. The cultured aerobes also demonstrated less than 50% sensitivity to the cephalosporins tested

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The study includes 52.80% are male and 47.20% are female. Majority of patients in the study belong to age group of 41-50 years which account for 29.21%.

- *E- coli* was the commonest organism isolated.
- Most of the organisms were isolated from the clean and clean contaminated .
- Overall imipenem and amikacin were the most sensitive antibiotics.
- Over all gentamycin, cefotaxime and clindamycin are the most resistant antibiotics noted.

10. Summary

The organisms causing wound infections are changing. Their sensitivity pattern is also changing. The common organisms are now not sensitive to the commonly prescribed cheaper antibiotics. The cost of the treatment is increasing.

To avoid this, surveillance programme for SSI should be conducted by hospitals for infection rate, organisms associated with SSI and their sensitivity pattern. Depending on this every hospital should adopt an antibiotic policy and strict adherence to the same is necessary.

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