

A STUDY OF THE BACTERIOLOGICAL PROFILE OF SURGICAL SITE INFECTIONS AND THEIR ANTIBIOGRAMBala Chandrasekhar P¹, Radhika B², Jyothi Padmaja I³**HOW TO CITE THIS ARTICLE:**

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ABSTRACT: Infections are encountered by all surgeons post operatively. Sometimes post-operative infections lead to death. Death from infection was so common after compound fractures, amputations and gunshot wounds. Now a day's surgical site infections (SSI) are mainly due to hospital acquired infections and irrational use of antibiotics, so bacteriological profile of surgical site infections and their antibiogram is an essential compliment to surgical skills. **OBJECTIVE:** The objective of the present study is to isolate the aerobic bacteria which are associated with the post-operative surgical site infections and to determine the frequency, with which various pathogens are causing surgical site infections and their antibiogram. **MATERIALS AND METHODS:** Swabs were collected from the local wound site of 100 clinically diagnosed cases of surgical site infections in the wards of surgery, orthopedics, gynecology and obstetrics, Andhra Medical College, Visakhapatnam, Andhra Pradesh. They were processed and different bacteria were isolated by using standard bacteriological procedures and biochemical reactions. Antibiotic susceptibility testing was performed by Kirby Bauer disc diffusion test. **RESULTS:** Coagulase positive staphylococci emerged as a commonest organism with an incidence of 32% followed by Pseudomonas, Escherichia coli. Methicillin was found to be the most effective antibiotic against various Staphylococcal strains, followed by Clindamycin. All the staphylococcal strains isolated were resistant to Penicillin and Erythromycin. Amikacin was found to be effective against Pseudomonas with sensitivity of 37.5%. All strains were resistant to Norfloxacin. Several isolates were found to be multi-drug resistant, and it was observed more in Gram negative bacterial isolates.

KEYWORDS: Surgical site infections, Antibiogram.

INTRODUCTION: Infections are encountered by all surgeons post operatively. Sometimes post-operative infections lead to death. Death from infection was so common after compound fractures, amputations and gunshot wounds. Now a day's surgical site infections are mainly due to hospital acquired infections and irrational use of antibiotics, Surgical site infection (SSI) is one of post-operative complications in any surgery. SSI may increase the morbidity and mortality of surgical patients and increase their hospital stay and expense. The risk factors can come from patients, physicians and hospital environments. Improving patient's nutritional status and organ function, appropriate control of blood sugar level and abstinence from smoking can reduce the occurrence of SSI. Compare to current practice, the following recommendations have been identified as priorities for implementation: hair removal done immediately before operation; maintenance of normothermia intra operatively; the abdominal wall should be closed with an absorbable suture and drains should be removed as early as possible. SSI could be diagnosed by symptoms, local signs and lab examinations and confirmed by physician. Source control is the key point in the management of SSI. Ultrasound and CT guided percutaneous abscess drainage is effective in the localized deep spacesurgical site infection

ORIGINAL ARTICLE

and critically ill patients. Antibiotics should be used following clinical assessment and evidence based on local formulary Ren JA et al (2012);¹ Ellett J et al (2015).² So study of bacteriological profile of surgical site infections and their antibiogram is an essential compliment to surgical skills.

MATERIALS AND METHODS: Swabs were collected from the local wound site of 100 clinically diagnosed cases of surgical site infections in the wards of surgery, orthopaedics, gynecology and obstetrics, Andhra Medical College, Visakhapatnam, Andhra Pradesh.

Exclusion Criteria: Patients already started on antibiotics.

Sample Collection: All the swabs were inoculated on Nutrient Agar, Blood Agar and MacConkey's Agar and incubated aerobically at 37^oc for 18 hours and then examined. All organisms including gram positive and gram negative bacteria were subjected to a battery of tests as follows. (Elmer W. Koneman (2006);³ John Gerald Collee (1996);⁴ Topley and Willsons (2005).⁵

1. Gram staining for morphology.
2. Hanging drop for motility.
3. Capsular staining using congo-red.
4. For production of enzymes – Oxidase, Catalase, Nitrate reduction, Urease.
5. For substrate utilization – Citrate utilization test, Malonate utilization test.
6. For metabolism of proteins and aminoacids - Indole production.
7. Tests for specific breakdown products - Methyl red test, Voges - Proskauer test (Acetoin production).
8. Tests for utilisation of carbohydrates of sugar media containing Glucose, Lactose, Xylose, Sucrose, Maltose, Mannitol.
9. Antibiotic sensitivity testing by Kirby –Bauers disc diffusion method.

RESULTS: Swabs collected from 100 cases of clinically diagnosed surgical site infections from the post-operative wards of surgery, orthopedics, gynecology and obstetrics were examined.

Out of the 100 cases studied 74 were males and 26 were females. The infection rate is 21.6% in males and 31.0% in females in age group of 31-40 years. The infection is less in the age group of 10-20 years and 21-30 years, as shown 10.8% in males and 23.0% in females which is very less compared to the age groups of 31- 40 years.

Again the infection rate is more and equal to that of 31- 40 years in the male persons with 61 years and above age. At the same time the infection rate is less in females compared to males in the age group of 61 and above. (Table - I)

Distribution of etiological agents, in 82 culture positive samples - Staphylococci, Pseudomonas, Escherichia coli, Proteus mirabilis, Klebsiella species and Citrobacter were isolated in pure culture which has come up to 74%. Out of 40 isolated Staphylococcal strains 28 isolates are coagulase positive, 4 isolates are coagulase negative.

The next predominantly isolated organism is Pseudomonas aeruginosa about 28% of isolates. The percentage of Escherichia coli isolated is 5%, Proteus mirabilis and Citrobacter isolation is 4%, Klebsiella species 1%. In 4 samples, mixed cultures were obtained which has come up to 8% of isolates, which includes Staphylococcus aureus with Escherichia coli 4%; coagulase negative Staphylococci with Pseudomonas 4%, 9 samples were culture sterile.

ORIGINAL ARTICLE

Antibiogram of Staphylococci: All the strains of Staphylococcus isolated were tested with same set of antibiotics which are: Penicillin G, Methicillin, Clindamycin, Erythromycin, Tetracycline, Ciprofloxacin, Ampicillin All the isolates were resistant to Penicillin and Erythromycin followed by Ampicillin 80% and Ciprofloxacin 65%. Methicillin emerged as most effective antibiotics with sensitivity of 70% followed by Clindamycin 60% and Tetracycline 55%. (Table -3)

Antibiogram of Pseudomonas Aeruginosa: The antibiogram of Pseudomonas species is tested by using the antibiotics were Norfloxacin, Ofloxacin, Ciprofloxacin, Ceftazidime, Amikacin, Gatifloxacin, Piperacillin with Tazobactam.

All the strains were resistant to Norfloxacin. Amikacin emerged as most effective antibiotic with a sensitivity rate of (37.5%) followed by Gatifloxacin and Ceftazidime (31.25%), Piperacillin with Tazobactam (25%), Ofloxacin (19%), Ciprofloxacin (12.5%). (Table-VII)

DISCUSSION: In the present study 100 cases of clinically diagnosed surgical site infections (SSIs) from the post-operative wards of Surgery, Orthopedics, Gynecology and Obstetrics were studied for the bacteriological profile and their anitbiogram.

Out of 100 cases 70 cases are from Surgery, 20 cases are from Orthopedics, 10 cases are from Gynecology and Obstetrics.

The predominant age group is 31-40 years; the least is between the age group of 10-20 years. In the present study microorganisms isolated were Staphylococci alone (32%), Pseudomonas aeruginosa alone (28%), Escherichia coli alone (5%), Proteus alone (4%), Citrobacter frefudii alone (4%), Klebsiella species (1%), Coagulase negative Staphylococci with Pseudomonas (4%), Staphylococcus aureus with Escherichia coli (4%).

In this study the isolation of Staphylococci is consistent with the results of Muktanjali Arya et al (2005)⁶, which shows (32.2%), however the incidence of Pseudomonas is more than that of their study.

The results are also consistent with the work done by Aggarwal et al in which Staphylococcal isolates is (34.78%).

In the study of bacteriology of wound infections by Borker S S et.al (2006)⁷, Staphylococci isolation was reported as (43.6%) which is slightly higher than that of present study.

In the study by S C Atri et al (1990)⁸ isolation of microorganisms in surgical site infections was Staphylococci (20.7%), Pseudomonas (16.5%), Escherichia coli (39.5%), Proteus (4.1%). In the present study the rate of infection with Coagulase negative Staphylococci & Pseudomonas is higher than that of S C Atri et al (1990)⁸.

However the percentage of Proteus infections is consistent with their result which shows the prevalence of coagulase negative Staphylococci and Pseudomonas strains are more prevalent in Andhra Medical College.

The present study shows out of 40 isolates of Staphylococci, 32 (80%) strains are coagulase positive, 8(20%) strains are coagulase negative. In the present study incidence of coagulase positive Staphylococci much higher than that of the coagulase negative Staphylococci.

70% Staphylococci strains were Methicillin sensitive. Aroma Oberoi et al (2006)⁹ also reported, 65% to be Methicillin sensitive.

ORIGINAL ARTICLE

Uma chaudhary et al (1999)¹⁰ reported 23% of the Staphylococci strains to be resistant to Methicillin. In the present study Methicillin resistant Staphylococci has come up to 30% which is almost consistent with Uma chaudhary et al (1999).¹⁰

In the present study 60% of the Staphylococcal isolates are observed to be sensitive to Clindamycin. Appalaraju. B and Jayakumar. S in their report has given 39.3% Clindamycin sensitive, which is higher than that of the present study. Metha A.P et.al (1998),¹¹ reported 29% of Methicillin resistant Staphylococci and the present study shows 30% of the Staphylococci to be Methicillin resistant.

In the present study Staphylococci resistant to Ciprofloxacin (60%), Ampicillin (80%), Erythromycin and Penicillin (100%). Uma chaudhary et al (1999)¹⁰ in their study has reported 100% resistance to Ampillicin.

Vidhani S et al (2001)¹² reported most of the Methicillin resistant Staphylococci are found to be resistant to Penicillin, Erythromycin, Tetracycline and Ciprofloxacin. The present study also shows Staphylococcal strains are resistant to Penicillin, Erythromycin and Ampicillin.

A study by Suru Cuoglu S et.al (2005)¹³ showed different bacterial isolates which included Staphylococcus (50%), Pseudomonas (7%), and Proteus (3%). Staphylococcal isolation in the present study is 44.5%, which includes Staphylococci isolation in pure and associated with E. Coli and Pseudomonas aeruginosa.

In the present study Methicillin resistant Staphylococci are 30%, which is almost in parallel with Suru Cuoglu S et.al (2005)¹³ However isolation of Pseudomonas alone and with Staphylococci has come up to 35.5% which is more than that of Suru Cuoglu S et.al (2005).¹³

This shows a higher rate of prevalence of Pseudomonas aeruginosa in Andhra Medical College and a probable cause of nosocomial infection.

Pseudomonas aeruginosa isolate in the study showed 100% resistance to Norfloxacin and most of the strains exhibited resistance to Ofloxacin, Ciprofloxacin and Piperacillin with Tazobactam as well. Antibiogram shows Escherichia coli to be 100% resistant to Cephelexin, Ceftazidime and 89% resistant to Norfloxin, Ofloxacin and Co-Trimoxazole and only 11% are resistant to Amikacin which shows Escherichia coli multi drug resistant in this study.

Proteus is 100% sensitive to Ofloxacin and Ceftazidime whereas 100% resistant to Co-Trimoxazole, Cephelexin and 50% resistant to Norfloxin and Amikacin. Citrobacter shows 100% resistance to all the antibiotics tested expects Ofloxacin (50%). This study shows Citrobacter to be multi drug resistant when compared to other organisms.

CONCLUSION: The present study has shown that penicillin resistant staphylococci was the most common organism causing surgical site infection followed by Norfloxacin resistant Pseudomonas and Cephalosporin resistant Escherichia coli.

Guideline for Prevention of Surgical Site Infection: The “Guideline for Prevention of Surgical Site Infection” presents the Center for Disease Control and Prevention (CDC)’s recommendations for the prevention of surgical site infections (SSIs), formerly called surgical wound infections. This two-part guideline updates and replaces previous guidelines. Part I, “Surgical Site Infection: An Overview,” describes the epidemiology, definitions, microbiology, pathogenesis, and surveillance of SSIs.

Included is a detailed discussion of the pre-, intra-, and postoperative issues relevant to SSI genesis. Part II, “Recommendations for Prevention of Surgical Site Infection,” represents the consensus

ORIGINAL ARTICLE

of the Hospital Infection Control Practices Advisory Committee (HICPAC) regarding strategies for the prevention of SSIs which needed to be scrupulously followed Alicia J. Mangram et al, (1999).¹⁴

Sl. No.	Age (years)	Male	Male (%)	Female	Female (%)
1.	10 to 20	8	10.8	2	7.6
2.	21 to 30	8	10.8	6	23.0
3.	31 to 40	16	21.6	8	31.0
4.	41 to 50	14	19.0	-	-
5.	51 to 60	12	16.3	6	23.0
6.	61 & above	16	21.6	4	15.4
	Total	74		26	

Table 1: Age and Sex Wise Distribution

Sl. No.	Organisms	No .of Cases	Percentage (%)
1.	Coagulase negative staphylococci	4	4
2.	Coagulase positive Staphylococci	28	28
3.	Pseudomonas aeruginosa	28	28
4.	Escherichia coli	5	5
5.	Proteus mirabilis	4	4
6.	Citrobacter freundii	4	4
7.	Klebsiella Species	1	1
8.	Coagulase negative Staphylococcus & Pseudomonas aeruginosa	4	4
9.	Staphylococcus aureus & Escherichia coli	4	4
10.	Sterile	18	18
	Total	100	

Table 2: Distribution of organisms in 50 Cases of Surgical site of infections

Sl. No	Organisms	Total No	Penicillin G		Methicillin		Clindamycin		Erythromycin		Tetracycline		Ciprofloxacin		Ampicillin	
			S	R	S	R	S	R	S	R	S	R	S	R		
1	Coagulase positive Staphylococci	32	0 (0)	32 (100)	4 (12.5)	28 (87.5)	18 (56.2)	14 (43.7)	0 (0)	32 (100)	14 (43.7)	18 (56.25)	12 (37.5)	20 (62.5)	6 (18.7)	26 (81.2)
2	Coagulase negative Staphylococci	8	0 (0)	8 (100)	4 (50)	4 (50)	6 (75)	2 (25)	0 (0)	8 (100)	8 (100)	0 (0)	2 (25)	6 (75)	2 (25)	6 (75)

Table 3: Antibioqram of staphylococci

S - Sensitive, R - Resistance, () - Percentage (%)

ORIGINAL ARTICLE

Sl. No	Organism	Total No	Norflaxacin		Ofloxacin		Ciprofloxacin		Ceftazidime		Amikacin		Gatifloxacin		Piperacillin with Tazobactam	
			S	R	S	R	S	R	S	R	S	R	S	R	S	R
	<i>Pseudomonas aeruginosa</i>		0 (0)	32 (100)	6 (18.75)	32 (81.25)	4 (12.5)	28 (87.5)	10 (31.2)	22 (68.7)	12 (37.5)	20 (62.5)	10 (31.2)	22 (68.7)	8 (25)	24 (75)

Table 4: Antibiogram of *Pseudomonas aeruginosa*

S - Sensitive, R - Resistance, () - Percentage (%)

Sl. No	Organisms	Total No	Norflaxacin		Ofloxacin		Amikacin		Co-Trimoxazole		Cephelexin		Ceftazidime	
			S	R	S	R	S	R	S	R	S	R	S	R
1	<i>Escherichia coli</i>	9	1 (11)	8 (89)	1 (11)	8 (89)	8 (89)	1 (11)	1 (11)	8 (89)	0 (0)	9 (100)	0 (0)	9 (100)
2	<i>Proteus mirabilis</i>	4	2 (50)	2 (50)	4 (100)	0 (0)	2 (50)	2 (50)	0 (0)	4 (100)	0 (0)	4 (100)	4 (100)	0 (0)
3	<i>Citrobacter freundii</i>	4	0 (0)	4 (100)	2 (50)	2 (50)	0 (0)	4 (100)	0 (0)	4 (100)	0 (0)	4 (100)	0 (0)	4 (100)
4	<i>Klebsiella</i>	1	0	1 (100)	0	1 (100)	1 (100)	0	1 (100)	0	0	1 (100)	0	1 (100)

Table 5: Antibiogram of *Escherichia coli*, *Proteus mirabilis*, *Citrobacter freundii*, *Klebsiella* species

S - Sensitive, R - Resistance, () - Percentage (%)

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ORIGINAL ARTICLE

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