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STUDY OF A SILENT EMERGENCY IN PUBLIC HEALTH - THE MENACE OF ANTIMICROBIAL RESISTANCE IN SURGICAL PRACTICE

General Surgery

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KEYWORDS

INTRODUCTION

Surgical site infections (SSIs) remain a common and wide spread problem that contributes to significant morbidity and mortality, prolongs hospital stay and consequently increasing health care cost. Globally, SSI is reported to be the third most common nosocomial infection and the incidence of SSI may range from 1.5-20%.(1)

A surgical wound may get infected by the exogenous or endogenous bacterial flora. A spectrum of microorganisms with varied antimicrobial susceptibility patterns have been identified as causative agents of SSIs, which vary with time, hospital location, and with the type of surgical procedure performed.(2,3) A summation of several factors contribute to the development of SSIs such as the inoculum of bacteria introduced into the wound during the procedure, the virulence of the contaminants, the micro-environment of each wound and the integrity of the patient's host defence mechanisms(4). Apart from bacterial contamination of the wound there are many other factors like hematomas, seromas, suture material, poor surgical technique, patient and his environment (both local and general), which ultimately determine the outcome.

SSIs surveillance with feedback of appropriate data to surgeons has been shown to be an important component of strategies to reduce SSI risk. To create an effective hospital infection control programme, information about local patterns is essential. This type of data is useful for both individual, hospitals and national health care planners in setting programme priorities, monitoring effects of different preventive actions and in setting goals for their infection control efforts. The antimicrobial therapy, optimized based upon the antibiotics resistance of the bacterial strain, will improve the quality of medical care by discarding the antibiotics which have lost their efficacy.

The aim of this investigative work was to conduct a study of SSIs to assess their incidence, identify risk factors, identify causative aerobic bacteria and establish effective antibiotic therapies with aim to minimize the risk of developing SSIs.

Material and methods

This prospective study was carried out in single Surgical unit in the Department of General Surgery at Rabindranath Tagore medical college, Udaipur (Rajasthan) over a period of 10 months.

INCLUSION CRITERIA:-

1. Patient of either sex who underwent surgery (emergency/elective) in single Surgery unit in R.N.T.M.C, Udaipur.
2. Cases were included according to the definition of wound infection.
3. All patients uniformly received prophylactic antibiotic (ceftriaxone in our hospital) before incision and a combination of antibiotics (ceftriaxone ± amikacin ± metronidazole) postoperatively.
4. Wound infection was suspected if there was a serous, non purulent discharge with or without sign of inflammation, pus discharge or visible wound dehiscence at the wound site.

EXCLUSION CRITERIA:-

1) Previously infected wound site.
2) Surrounding inflammation without microorganism.
3) Patients with diabetes, anemia (Hb<10 mg/dl), HIV and HbsAg positive.
4) Patients who were admitted to other surgical units and surgical speciality units such as pediatric surgery, urosurgery, neurosurgery, orthopedic surgery, cardiothoracic and vascular surgery, plastic surgery and burn ward were not included in the study.

Surgical wound was inspected at the time of opening of dressing for first time and subsequently at the time of next dressing. All information was collected with routine dressing and follow up until complete wound healing occurred or the patient was discharged from the hospital.

The source of data was collected in a specially designed pro-forma from the patient by relevant clinical history, duration of preoperative and total hospitalization stay, antibiotics chemoprophylaxis, type of surgery, class of surgical wound, average duration of surgery, drain usage, routine blood investigations, intra-operative blood transfusion, duration of postoperative antibiotics, Gram's stain result, culture and sensitivity pattern of infected wound sample and outcome.

Sample processing

Samples collected from infected wounds were processed for Gram's and ZN staining by microbiologist. Aerobic cultures were performed using blood agar/ muller hinton agar/ glucose soya broth with subsequent overnight incubation at 37°C. These were analysed for presence of turbidity and checked by Gram's staining every subsequent for 5 days. Final identification of bacteria was done on the basis of primary Gram's stain appearance, colony morphology, production of hemolysis or pigment and interpretation of biochemical tests. Antimicrobial susceptibility testing was performed as per standardized Clinical Laboratory Standards Institution (CLSI) guidelines using Kirby Bauer disc diffusion technique. The size of zones of inhibition for test strain was compared with those mentioned in the standard interpretative charts provided by the antibiotic disc manufacture (Himedia Laboratories). The results was interpreted as sensitive (S), intermediate sensitive (I) or resistant (R) for each isolate identified.(5)

Results

The study group comprised of 628 patients of which 392 (62.42%) were men with mean age 43.96 years and 236 (37.58%) were women with mean age 43.96 years. Overall mean age was 43.5 years (minimum 6 and maximum 95 years). Out of total 392 male patients, 65 (16.58%) had SSIs, whilst 15 (6.35%) out of 236 female patients had SSIs. Overall mean age was 46.91 years in SSI patients (minimum 18 and maximum 85 years) while it was 47.35 years for male SSI patient and 45 years for female SSI patient.

Table 1 Association of clinico-demographic characteristics of patients

		No. of SSIs pt	Non SSI pts	Total no. of pts	P value
Duration from admission to operation	≤1day	34 (24.81%)	103 (75.18%)	137 (21.81%)	<0.001 (HS)
	>1day	46 (09.36%)	445 (90.63%)	491 (78.18%)	
Duration from admission to discharge	≤14days	29 (06.48%)	418 (93.51%)	447 (74.50%)	<0.001 (HS)
	>14days	39(25.49%)	114 (74.50%)	153 (25.50%)	

Antibiotics chemoprophylaxis				<0.001 (HS)
CRO	24 (05.64%)	401 (94.35%)	425 (67.67%)	
CRO+MZ	42 (33.07%)	085 (66.92%)	127 (20.22%)	
CRO+AP+MZ	05 (20.00%)	020 (80.00%)	025 (03.98%)	
Others	09 (17.64%)	042 (82.35%)	051 (08.12%)	
Wound Class				<0.001 (HS)
I	04 (2.37 %)	165 (97.63 %)	169 (26.91 %)	
II	37 (11.82 %)	276 (88.18 %)	313 (49.84 %)	
III	11 (16.41 %)	056 (83.58 %)	067 (10.67 %)	
IV	28 (35.44 %)	051 (64.56 %)	079 (12.58 %)	
Surgery				<0.001 (HS)
Laparoscopic	00 (00.00 %)	081 (100.0 %)	081 (12.90 %)	
open	80 (14.62 %)	467 (85.38 %)	547 (87.10 %)	
Procedure				<0.001 (HS)
Elective	33 (07.24 %)	423 (92.76 %)	456 (72.61 %)	
Emergency	47 (27.33 %)	125 (72.67 %)	172 (27.39 %)	
Duration of surgery				<0.001 (HS)
< 1 hr	08 (04.02 %)	191 (95.98 %)	199 (31.69 %)	
1-2 hr	41 (13.48 %)	263 (86.52 %)	304 (48.40 %)	
>2 hr	31 (24.80 %)	094 (75.20 %)	125 (19.90 %)	
Drain usage				<0.001 (HS)
Yes	69 (21.63 %)	250 (78.37 %)	319 (50.80 %)	
No	11 (03.56 %)	298 (96.44 %)	309 (49.20 %)	
Duration of postoperative Antibiotics				<0.001 (HS)
≤7days	10 (02.77%)	350 (97.22%)	360 (57.32%)	
>7days	70 (26.11%)	198 (73.88%)	268 (42.67%)	
Outcome				<0.001 (HS)
Improved	68 (11.33%)	532 (88.66%0	600 (95.54%)	
Died	12 (42.85%)	016 (57.14%)	028 (04.45%)	
Total	**80** (12.74 %)	**548** (87.26 %)	**628** (100 %)	

Preoperative hospital stay with incidence of SSI was not found to be statistically significant in the study. Out of 628 patients, total duration of hospital stay was more than 14 days in 153 patients, out of which 39 (25.49%) patients developed SSIs as compared to only 29 (06.48%) patients in those hospital stay less than 14 days. All patients uniformly received prophylactic antibiotic dosage before incision. Out of 628 patients, only prophylactic antibiotic ceftriaxone was received by 425 patients, out of which 24 (05.64%) patients developed SSIs. The incidence of surgical site infections among the clean surgical procedure was 2.37% (4 out of 169), among the clean contaminated procedure, it was 11.82% (37 out of 313), among the contaminated procedure, it was 16.42% (11 out of 67) and among the dirty procedure, it was 35.44% (28 out of 79). Out of 628 patients, open surgery was done in 547 patients, out of which 80 (14.62%) patients developed SSIs as compared to 0 patient from 81 laparoscopic surgeries. The infection rate was found to be higher with emergency surgeries (27.33%) than with elective planned surgeries (7.24%). 8 patients (4.02%) developed SSIs in surgeries duration less than 1 hour, 41 patients (13.48%) between 1-2 hours and 31 patients (24.8%) developed SSIs in surgeries lasting for more than 2 hours. It was observed that duration of surgery had a direct influence on the development of SSI. Out of 628 patients, surgical drain was post-operatively used in 319 patients, out of which 69 (21.63%) patients developed SSIs as compared to only 11 (3.56%) patients in those without surgical drains. The SSI rate was found to be higher with postoperative antibiotics used >7 days (26.11%) than with <7 days (02.77%). 28 out of 628 patients were died during this period, in which 12 (42.85%) patients were died with SSI. **[Table 1]**

Table 2 Factors associated with Surgical site infections

Factors		**SSIs(80)**	**Non SSI(548)**	**Total no. (628)**	**P value**
S. Albumin	<3.5g/dl	54 (44.62%)	067 (55.37%)	121 (19.26%)	<0.001 (HS)
	≥3.5 g/dl	26 (05.12%)	481 (94.87%)	507 (80.73%)	
Haemoglobin	<12 g/dl	37 (18.78%)	160 (81.21%)	197 (31.36%)	0.02 (S)
	≥12g/dl	43 (09.97%)	388 (90.02%)	431 (68.33%)	
RBS	<140mg/dl	72 (12.18%)	519 (87.81%)	591 (94.10%)	0.09 (NS)
	≥140mg/dl	08 (21.62%)	029 (78.37%)	037 (05.89%)	
Urea	<45mg/dl	58 (10.15%)	513 (89.84%)	571 (90.92%)	<0.001 (HS)
	≥45mg/dl	22 (38.59%)	035 (61.40%)	057 (09.07%)	
Creatinine	<1.3mg/dl	66 (11.49%)	508 (88.50%)	574 (91.40%)	<0.001 (HS)
	≥1.3mg/dl	14 (25.92%)	040 (74.07%)	054 (08.59%)	
T. bilirubin	<1mg/dl	63 (11.01%)	509 (88.98%)	572 (91.08%)	<0.001 (HS)
	≥1mg/dl	17 (30.35%)	039 (69.64%)	056 (08.91%)	
D. Bilirubin	<0.4mg/dl	66 (10.89%)	540 (89.10%)	606 (96.49%)	<0.001 (HS)
	≥0.4mg/dl	14 (63.63%)	008 (36.36%)	022 (03.50%)	
ALP	<136 U/L	71 (12.15%)	513 (87.84%)	584 (92.99%)	<0.001 (HS)
	≥136 U/L	09 (20.45%)	035 (79.54%)	044 (07.00%)	
Urine	Normal	61 (11.19%)	484 (88.80%)	545 (86.78%)	<0.001 (HS)
	Infected	19 (22.89%)	064 (77.10%)	083 (13.21%)	

Out of 628 patients, serum albumin was <3.5 g/dl in 121 patients, out of which 54 (44.62%) patients developed SSIs as compared to 26 (5.12%) patients in those serum albumin >3.5 g/dl. In our study 54 (67.5%) out of 80 SSI patients had hypoalbuminemia making it the most common and important preoperative risk factors. After excluding those patients, in which Hb <10g/dl, an arbitrary point was taken Hb 12 g/dl. Surprisingly 197 patients were below this point, 37 (18.78%) patients out of them developed SSIs as compared to 43 (9.97%) patients from above this point. Out of 628 patients, hyperglycemia (>140 mg/dl) was present in 37 patients, out of them 8 (21.62%) patients developed SSIs compared to 72 (12.18%) patients from euglycemia. (p value 0.09, which was not significant due to excluding diabetic patient). The infection rate found to be higher with urea >45mg/dl (38.59%), creatinine >1.3mg/dl (25.92%), total bilirubin >1mg/dl (30.35%), direct bilirubin >0.4mg/dl (63.63%) and alkaline phosphatase >136U/L (20.45%) than with normal urea (10.15%), creatinine (11.49%), total bilirubin (11.01%), direct bilirubin (10.89%) and alkaline phosphatase level (12.15%). Out of 628 patients, urinary infection was present in 83 patients, out of which 19 (22.89%) patients developed SSIs as compared to 61 (11.19%) patients from non infected urine. **[Table 2]**

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Table 3 Correlation between Gram's stain and culture results of samples obtained Distribution of SSIs in the study from patients with and without SSIs

Samples	Gram's stain results		Culture results		Total no. of samples
	Positive	negative	Positive	negative	
Pus	61	13	61	13	74
Wound swab	19	08	19	08	27
Blood	-	-	00	03	03
Urine	-	-	00	06	06
Total	**80**	**21**	**80**	**30**	**110**
	0.18 (NS)		**<0.001 (HS)**		

Table 4 Bacterial isolates obtained from sample of SSIs (n= 80)

Bacteria	Number of patients	Percentage
Escherichia coli	43	53.75 %
Staphylococcus aureus		
Coagulase positive	11	13.75 %
Coagulase negative	04	05.00 %
Klebsiella	10	12.50 %
Citrobacter	04	05.00 %
Pseudomonas	03	03.75 %
Proteus	03	03.75 %
Enterococcus faecalis	01	01.25 %
Non-haemolytic streptococcus	01	01.25 %
Total	**80**	**100 %**

Seventy four samples of pus, 27 samples of wound swab, 3 blood samples and 6 urine sample from 80 suspected SSI patients were collected. Gram negative bacilli were found in 63 (78.75%) samples and Gram positive cocci were found in 17 (21.25%) samples. None of samples were positive for ZN staining. Only pus and wound swab samples showed bacterial growth. Out of 110 samples, 80 were culture positive and E.coli was the commonest bacteria isolated (53.75%) **[Table 3 and 4]**

Table 5 Multidrug resistant bacterial isolates from Surgical site infections:-

Bacteria	R3	R4	R5	R6	Total no. of multidrug resistant	Total no. of isolate (n)
E.coli	19 (44.18%)	05 (11.62%)	02 (04.65%)	00 (00.00%)	26 (60.46%)	43
S.aureus	02 (13.33%)	01 (06.66%)	09 (60.00%)	00 (00.00%)	12 (80%)	15
Klebsiella	02 (20.00%)	03 (30.00%)	02 (20.00%)	00 (00.00%)	07 (70%)	10
Citrobacter	02 (50.00%)	00 (00.00%)	00 (00.00%)	00 (00.00%)	02 (50%)	04
Pseudomonas	00 (00.00%)	01 (33.33%)	01 (33.33%)	01 (33.33%)	03 (100%)	03
Proteus	02 (66.66%)	00 (00.00%)	00 (00.00%)	00 (00.00%)	02 (66.66)	03
Enterococcus faecalis	00 (00.00%)	00 (00.00%)	00 (00.00%)	01 (100.0%)	01 (100%)	01
Non-haemolytic Streptococcus	00 (00.00%)	00 (00.00%)	00 (00.00%)	01 (100.0%)	01 (100%)	01
Total	**27** (33.75%)	**10** (12.5%)	**14** (17.5%)	**03** (03.75%)	**54** (67.5%)	**80**

Of all isolates 67.5% (54 out of 80) were MDR strains, overall prevalence of MDR strain was 63.49% among Gram negative and 82.35% among the Gram positive. MDR status were displayed in all Pseudomonas, Non-haemolytic Streptococcus and Enterococcus faecalis

Table 6 Overall Sensitivity and Resistant pattern of Gram +ve and Gram -ve isolates from SSIs

	Gram +ve isolates (n=17)			Gram -ve isolates (n=63)		
Antibiotics	**R**	**I**	**S**	**R**	**I**	**S**
Amikacin	10 (58.81%)	01 (05.88%)	06 (35.29%)	33 (52.38%)	01 (01.58%)	29 (46.03%)
Gentamicin	12 (70.58%)	00 (00.00%)	05 (29.41%)	43 (68.25%)	01 (01.585)	19 (30.15%)
Cefadroxil	10 (58.81%)	00 (00.00%)	07 (41.17%)	18 (100.0%)	00 (00.00%)	00 (00.00%)
Cefotaxime	07 (41.17%)	00 (00.00%)	10 (58.81%)	60 (95.23%)	03 (04.76%)	00 (00.00%)
Cefuroxime+Sulbactam	12 (70.58%)	02 (11.76%)	03 (17.64%)	18 (100.0%)	00 (00.00%)	00 (00.00%)
Cefoperazone+Sulbactam	-	-	-	24 (38.09%)	08 (12.69%)	31 (49.20%)
Ceftazidime	08 (47.05%)	04 (23.52%)	05 (29.41%)	51 (80.95%)	07 (11.11%)	05 (07.93%)
Ceftriaxone+Sulbactam	-	-	-	36 (57.14%)	07 (11.11%)	20 (31.74%)
Cefixime+Clavulanic acid	16 (94.11%)	00 (00.00%)	01 (05.88%)	49 (77.77%)	06 (09.52%)	08 (12.69%)
Cefepime+Tazobactam	07 (41.17%)	01 (05.88%)	09 (52.94%)	28 (44.44%)	05 (07.93%)	30 (47.61%)
Vancomycin	00 (00.00%)	01 (05.88%)	16 (94.11%)	-	-	-
Teicoplanin	02 (11.76%)	03 (17.64%)	12 (70.58%)	-	-	-
Clindamycin	06 (35.295)	02 (11.76%)	09 (52.94%)	-	-	-
Azithromycin	-	-	-	50 (79.36%)	10 (15.87%)	03 (04.76%)
Erythromycin	16 (94.11%)	00 (00.00%)	01 (05.88%)	-	-	-
Ampicillin+Cloxacillin	11 (64.70%)	02 (11.76%)	04 (23.52%)	-	-	-
Piperacillin+Tazobactam	07 (41.17%)	05 (29.41%)	05 (29.41%)	35 (55.55%)	12 (19.04%)	16 (25.39%)
Amoxyclav	15 (88.23%)	00 (00.00%)	02 (11.76%)	60 (100.0)	00 (00.00%)	00 (00.00%)
Ofloxacin	06 (35.29%)	08 (47.05%)	03 (17.64%)	33 (52.38%)	21 (33.33%)	09 (14.28%)
Levofloxacin	04 (23.52%)	07 (41.17%)	06 (35.29%)	12 (19.04%)	10 (15.87%)	41 (65.07%)
Doxycyclin	06 (35.29%)	07 (41.17%)	04 (23.52%)	-	-	-
Tigecycline	-	-	-	00 (00.00%)	05 (07.93%)	58 (92.06%)
Meropenem	-	-	-	05 (07.93%)	03 (04.76%)	55 (87.30%)
Imipenem+Cilastin	-	-	-	00 (00.00%)	01 (01.58%)	62 (98.41%)
Colistin	-	-	-	01 (01.58%)	00 (00.00%)	62 (98.41%)
Linezolid	01 (05.88%)	00 (00.00%)	16 (94.11%)	-	-	-

Gram positive isolates were maximum sensitive to Linezolid and vancomycin (94.11%). Gram positive isolates showed a high level of resistance to Cefixime + Clavulanic acid and Erythromycin (94.11%) and to Amoxyclav (88.23%). Gram negative isolates were found to be maximum sensitive to Imipenem + Cilastin and Colistin (98.41%), to Tigecycline (92.06%) and to Meropenem (87.3%). All Gram negative isolates showed 100% resistance to Amoxiclav, Cefuroxime + Sulbactam and Cefadroxil. Most of Gram negative isolates showed resistance to Cefotaxime (95.23%) and to Ceftazidime (80.95%). **(Table 6).**

Table 7 Global SSI rates relation to the class of wounds

Class of wound	Our study	Canada[6]	Japan[11]	Peru[12]	Brazi[14]	India[2]	India[3]
[a].Clean	2.37	1.5	1.2	13.9	3.1	4.04	3.03
[b].Clean contaminated	11.82	7.7	7.4	15.9	5.2	10.6	22.41
[c].Contaminated	16.42	15.2	35.7	13.5	11.2		
[d].Dirty	35.44	40	66.7	47.2	20.7		

DISCUSSION

The overall SSI rate determined in this study was 12.74%. Data from other studies performed at various periods of time, report an overall infection rate ranging from 1.5-20%.[2,3,4,6,11,12]

It was evidence that SSI increases with an increase in the degree of contamination of wounds operated upon. The infection rate was found to be almost 4 times higher following emergency procedures than planned elective procedures. Cruse and Foord in his study found that the infection rate encountered in emergency surgeries was double the rate of elective surgeries.[6] Several other studies also corroborate the evidence that emergency surgeries are more prone to wound infections.[9,13] More chances of SSI were attributed to poor patient hygiene. The emergency condition itself have detrimental effect due to the course of acute illness as well as delayed presentation etc. In emergency surgeries, surgical wound is not well secured from contaminated contents.

In present study open surgery was done in 547 patients, out of which 80 (14.62%) patients developed SSIs as compared to 0 (0.0%) patient from 81 laparoscopic surgeries due to decrease wound size, limited use of cautery in the abdominal wall, and diminished stress response to tissue injury.

Eight patients (4.02%) developed SSI in surgeries of duration less than 1 hour, 13.77% between 1-2 hours and 24.19% patients developed SSI in surgeries lasting for more than 2 hours. Cruse and Foord,[6] National Research Council[14] and Public Health Laboratory Service[15] showed the existence of a direct relationship between operative time and postoperative infectious risk. These authors showed that risk doubled with each additional operative hour.

In this study, wounds in which drains were used showed a higher incidence of SSI (21.63%) as compared to those without usage of drains (3.56%). Other scientific reports exploring such a correlation have also emphasised that drain usage potentiated the development of SSI.[8,12] It can be at the origin of retrograde bacterial colonization.

In our study 54 (67.5%) out of 80 SSI patients had hypoalbuminemia making it the most common and important preoperative risk factors.

On culture, the most common bacteria isolated was E.coli (53.75%) followed by S.aureus (18.75%). Data from other studies performed at various periods of time, reported that E.coli was most common bacteria isolated from SSI.[8,16,17,18,19,20,21,22] In our study exploratory laparotomy was associated with the highest incidence 52 (65%) out of 80 SSI among all the surgical procedures. Gram negative bacilli as causative bacteria of SSI have been frequently reported by infection surveillance workers[2,3,23,24,25,11] and this is in agreement with our study as we found predominance of Gram negative bacilli as the aetiological agents for SSI.

Resistance of isolated micro-organisms from surgical patients is an emerging problem worldwide.[2] In our study Gram positive isolates showed a high level of resistance to Amoxyclav (88.23%) and Cephalosporin (60-94%). This was comparable to study reported by Trojan et al[19], that reported a high resistance to amoxyclav and ciprofloxacin. Gram positive isolates in our study showed high level of resistance to Erythromycin (94.11%) similar high level of resistance (100%) reported by Shanmugan et al.[21]

In our study, Gram positive isolates were maximum sensitive to Linezolid and vancomycin (94.11%) compares with similar data from various other studies.[2,,8,17,18,19,26.] In this study 35.29% of the Gram positive isolates were sensitive to amikacin, whereas only 29.41% of isolates exhibited sensitivity to gentamicin. An even lower susceptibility of only 1.1% has been reported in India by Anvikar et al.[2] In the present study, all Gram negative isolates were found to be resistant to Amoxyclav (100%) which holds in agreement to the findings of various other studies from India.[2,19,20]

Most of the Gram negative isolates in our study showed resistance to Cephalosporin (>60%); however, 49.2% of them were sensitive to Cefoperazone + Sulbactam and 47.61% for Cefipime + Tazobactam. This was comparable to other studies, that reports 88% resistance to a third generation Cephalosporin.[13,19] We noted that about 90% of patients received Ceftriaxone alone or with combination as prophylaxis, thus favoring the emergence of resistant bacteria. Azithromycin (79.36%), Piperacillin + Tazobactam (55.55%) and Ofloxacin (52.38%) were found to be resistance against Gram negative isolates in this study.

In this study, it was determined that 30-46% of isolates were sensitive to Aminoglycosides group of drugs. Of all Aminoglycosides drugs, maximum resistance was found against Gentamicin (68.25%), corresponding to a reported Gentamicin resistance ranging from 60-89% in other indian hospitals.[2]

All the Gram negative isolates were found to be sensitive to Imipenem + Cilastin (98.41%) comparable to similar effectiveness as reported by other studies (90-100%).[16,18,19,26] Colistin (98.41%), Tigecycline (92.06%) and Meropenem (87.3%) were found to be effective against Gram negative isolates in this study.

In addition to the high rate of resistance to individual antibiotics, we also found significant number of MDR isolates. The overall proportion of MDR was 67.5%, among Gram negative bacterial isolates it was 63.49% and among Gram positive isolates it was 82.35%, this finding is in agreement with recent other studies.[16,23,24,25] We found that, all Pseudomonas, Non-haemolytic Streptococcus and Enterococcus faecalis were MDR strains, this might be not reflect true due to limited sample of all above three.

Variations in drug resistance patterns in different studies are due to variations in the local pattern of drug prescriptions, availability of drugs, to inappropriate use of antimicrobial agents affects both cost and efficacy, thus favoring the emergency of resistance bacteria. Overall resistance in our study was more common for commonly prescribed drugs such as Amoxyclav, whereas good susceptibility pattern was seen against newer, lesser used drug like Vancomycin, Linezolid, Imipenem, Colistin, Tigecycline and Meropenem.

This study showed that longer duration from admission to discharge, longer duration of postoperative antibiotics and outcome (death) were associated with bacterial isolation from SSIs. These findings also as reported by Seni et al.[16]

Conclusions

Total duration of hospital stay, type of surgery, emergency or elective procedure, meticulous surgical techniques, duration of the operation, usage of drain, proper sterilization, the judicious use of antibiotics, preoperative or intra-operative predisposing factors, hygienic operation theatre and ward environments, the control of malnutrition and the treatment of infective foci and diseases help in controlling the morbidity of the surgical wound infections. The study suggests that although surgical site infections cannot be completely eliminated, a reduction in the infection rate to a minimal level could have significant benefits, by reducing postoperative morbidity and mortality and wastage of health care resources.

The spectrum of bacteria most frequently involved in surgical infections has changed over a period of time. Streptococcus being the most frequent and feared pathogen nearly a century ago was replaced by Staphylococcus about eight decades later and Gram negative isolates as principal offenders in recent years. E.coli was the commonest bacteria (53.75%) isolated from SSIs in this study.

Ongoing surveillance on a long-term follow up basis and a higher degree of collaboration between surgeons and microbiologists is necessary for formulating newer definitions and adapting control measures.

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