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Research Article

UTILIZATION PATTERN OF ANTIMICROBIALS AMONG PATIENTS UNDERGONE MIDLINE LAPAROTOMY IN FOUR TERTIARY CARE TEACHING HOSPITALS OF GUJARAT, INDIA: MULTI-CENTRIC RETROSPECTIVE STUDY

HIREN M. CHAWDA[1], MAHENDRA PATEL[1], DIVYESH MANDAVIYA[1], MANISH BARVALIYA[1], TEJAS PATEL[2], C. B. TRIPATHI*[1]

[1]Dept. of Pharmacology, Govt. Medical College, Bhavnagar-364001, Gujarat, India, [2]Dept. of Pharmacology, GMERS Medical College, Gotri, Vadodara - 390021, **Email**: cbrtripathi@yahoo.co.in

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ABSTRACT

Objectives: To analyse utilization patterns of antimicrobials and impact of different wound types and indications of midline laparotomy for its use Materials and Methods: Indoor case papers of the patients undergone midline laparotomy were analysed for demographic variables; type of surgery; wound type; indications; utilization (DDD/100 bed-days) and cost of antimicrobials; wound infections; duration of stay; organism isolated and their antimicrobial sensitivity and outcome of the patient.

Results: Total 466 cases were evaluated with median hospital stay of 11 days. Metronidazole (90.55%), amikacin (64.8%), ceftriaxone (58.8%) and ciprofloxacin (18.66%) were commonly used antimicrobials. Ceftriaxone + metronidazole (52.36%) were the most common empirical regimen used. Most common isolated organisms were *Escherichia coli* 20 (28.17%) out of 71 isolated organisms in 52 cases. Amikacin and pipracillin+tazobactam have shown good sensitivity against all isolated organisms except *A. baumanii*. A significantly higher number of antimicrobials, their cost and duration of stay were noted in surgical site infection (SSI) cases, as especially in small bowel perforation cases.

Conclusion: SSI increases cost, antimicrobial use and resistance. Proper sanitation, hygiene and postoperative care are utmost important tools to deal with growing resistance by preventing SSI.

Keywords: Utilization pattern, Antimicrobials, Midline laparotomy, Surgical site infection, Retrospective study.

INTRODUCTION

In an emergency and exploratory surgery when rapid and whole abdomen assessment is necessary midline laparotomy is the choice for surgeons as it is easy and quick to perform, extension of the incision is possible when required and less blood loss during surgery due to avascular nature of linea alba [1,2]. Most common complication after surgery are surgical site infections (SSI). Its incidence is 1% and 11% in clean and clean-contaminated cases, respectively [3]. Consequences of SSIs are increased cost of treatment, longer duration of hospital stay and increased use of antimicrobials. This can enhance the antimicrobial resistance [3,4].

The World Health Organization defines drug utilization research as "the marketing, distribution, prescription and use of drugs in a society with special emphasis on the resulting medical, social and economic consequences" [5]. It is an important tool to evaluate the use of antimicrobials and development of resistance for it. There is no documentation of any drug utilization research of antimicrobials among patients undergone midline laparotomy in India. Therefore, the present study was carried to evaluate patterns of antimicrobials used, the impact of different wound types and indications on its use and antibiogram of different isolated organisms in midline laparotomy patients of tertiary care teaching hospitals of Gujarat, India.

MATERIALS AND METHODS

This multicentre retrospective study was carried out in four tertiary care teaching hospitals of Gujarat, India - Sir Takhtsinhji General Hospital, Bhavnagar; Guru Govindsingh Hospital, Jamnagar; New Civil Hospital, Surat and Sir Sayajirao General Hospital, Vadodara. A scrutiny of the indoor case papers of the patients admitted between July 2010 and June 2011 for midline laparotomy were performed. The study was started after prior permission from the Human Ethics Committee of each centre. Data were collected for demographic information, type of surgery, operative wound, pre-morbid conditions and antimicrobials prescribed during the hospital stay and antimicrobial sensitivity testing. *In vitro* antibiotic susceptibility testing in all four microbiology laboratories was performed by disc diffusion method (modified Kirby Bauer method) on Muller Hinton Agar [6]. External quality assurance scheme and Clinical and Laboratory Standard Institute (CLSI) guidelines were followed at every centre. Microbiology laboratories of the Sir Sayajirao General Hospital, Vadodara and Sir Takhtsinhji General Hospital, Bhavnagar are accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL).

Data were analysed for demographic variables; type of surgery; wound type; indications for midline laparotomy; pattern of antimicrobials; fixed dose combinations (FDCs); generic and brand drugs; wound infections (clean; clean-contaminated; contaminated and dirty), pre-morbid conditions, duration of stay, organism isolated and their antimicrobial sensitivity and outcome of the patient. Coding of antimicrobials was done as per The Anatomical Therapeutic Chemical (ATC) classification system [5]. Drug utilization was measured in DDD/100 bed-days [5,7]. If any antimicrobial which used via oral and parenteral both routes, we calculated it as a single antimicrobial used in our study. Cost of antimicrobials was calculated from the Indian Drug Review Triple i (2011).

Statistical Analysis

Data were expressed as proportions, mean (95% confidence interval) and median (inter quartile range). Subgroup analysis was done for common indications for midline laparotomy, patients with and without wound infection, patients with different outcomes and according to the type of wound infections. Quantitative data for the two groups were compared with Unpaired t test or Mann – Whitney Test. One – way ANOVA or Kruskal-Wallis test with their post hoc test was used to compare more than two groups in the case of quantitative data. Qualitative data were compared by Chi – Squared Test. GraphPad Instat 3.0 (Trial Version) was used for statistical analysis. $P < 0.05$ was considered as statistically significant.

RESULTS

Midline laparotomy was performed in total 466 patients during the study period. Data on demographics, wound types and indications for midline laparotomy are shown in Table 1. Total 326 (69.96 %) patients were between 12 to 50 years; 140 (30.04%) patients were greater than 50 years. Total 134 (28.75%) patients have pre-morbid condition. Diabetes mellitus 28 (20.89%), hypertension 14 (10.45%), anaemia 14 (10.45%) and chronic obstructive pulmonary disease (COPD) 12 (8.95%) were common pre-morbid conditions. The most common types of the wound were dirty (56.87%) and contaminated (36.69%). Most common conditions requiring midline laparotomy were peptic perforation (36.05%) and intestinal obstruction (24.03%).

Table 1: Demographic data, wound types and indications for midline laparotomy

Characteristics	Value
The total number of patients (n) admitted with midline laparotomy	466
Age	40 (28, 54) years
% of male patients	66.52%
	466 (100%)
• Clean	20 (4.29%)
• Clean-contaminated	10 (2.14%)
• Contaminated	171(36.69%)
• Dirty	265 (56.87%)
% of patients with emergency laparotomy	358(76.82%)
Duration of Stay	11 (8, 15) days
Total number of antimicrobials	4 (3, 4)
Total cost of antimicrobials	` - 2628 (1820, 4061)
Indications for midline laparotomy, n (%)	
• Peptic perforation	168 (36.05%)
• Intestinal obstruction	112 (24.03%)
• Small bowel perforation	40 (8.58%)
• Perforated appendices	30 (6.44%)
• Bladder stone	18 (3.86%)
• Umbilical and para umbilical hernia	17 (3.65%)
• Ca. of esophagus and stomach	13 (2.79%)
• Ruptured liver abscess	10 (2.14%)
• Others	58 (12.46%)

Total 2055 antimicrobials were prescribed in all the patients during the study period; 75.91% were parenteral and 24.09% were oral formulations. Total 76.30% antimicrobials were prescribed as generic names. Minimum and maximum number of antimicrobials prescribed to a single patient was 2 and 11, respectively. Total 14 and 24 different oral and parenteral antimicrobials were prescribed. The number of antimicrobials prescribed per patient was 4 (3, 4). Data were expressed in percentage and median (inter quartile range).

Utilization pattern of parenteral antimicrobials with their DDD/100 bed-days in respect to different centres were shown in Table 2. Total 17 different antimicrobials including 4 FDCs were used. Metronidazole (90.55%), amikacin (64.80%), ceftriaxone (58.80%) and ciprofloxacin (18.66%) were commonly used antimicrobials. Ceftriaxone + sulbactum (18.88%) was most commonly used FDCs. Ceftriaxone + metronidazole (52.36%), Ceftriaxone + metronidazole + amikacin (35.62%), Ciprofloxacin + metronidazole (17.38%), ceftriaxone + sulbactum + metronidazole (17.16%) and ceftriaxone + sulbactum + metronidazole + amikacin (12.87%) were the commonly used empirical regimens.

Table 2: Utilization pattern of antimicrobials in patients of midline laparotomy in wards, ATC code, and DDD/100 bed-days

Antimicrobial drugs	**ATC code**		**DDD/100 bed days (**parenteral route)			
			Bhavnagar	**Surat**	**Vadodara**	**Jamnagar**
Third generation cephalosporins						
Ceftriaxone	J01DD04	274(58.80)	0.0625	0.043141	0.02618	0.047547
Cefotaxime	J01DD01	78(16.74)	0.016909	0.004733	0.007179	0.003986
Ceftazidime	J01DD02	11(2.36)	0	0.000047	0.000507	0.000689
Aminoglycosides						
Gentamicin	J01GB03	73(15.66)	0.02397	0.001807	0.010418	0.00058
Amikacin	J01GB06	302(64.80)	0.05214	0.035293	0.019863	0.049431
Tobramycin	J01GB01	2(0.42)	0	0	0.000271	0
Fluoroquinolones						
First generation Fluoroquinolones						
Ciprofloxacin	J01MA02	87(18.66)	0.057877	0.007801	0.004972	0.059578
Ofloxacin	J01MA01	51(10.94)	0.004452	0.012842	0.004668	0.007828
Second generation Fluoroquinolones						
Levofloxacin	J01MA12	12(2.57)	0.002568	0.000476	0.002029	0.000507
Moxifloxacin	J01MA14	4(0.85)	0.007363	0	0	0
Nitromidazoles						
Metronidazole	J01XD01	422(90.55)	0.124315	0.063071	0.047776	0.055495
Other Antimicrobial drugs						
Vancomycin	J01XA01	4(0.85)	0	0.000571	0.000228	0.000217
Linezolid	J01XX08	2(0.42)	0	0.000476	0	0
Meropenem	J01DH02	2(0.42)	0	0	0.000647	0
Fixed dose combinations (FDCs)						
Piperacillin+Tazobactum	J01CR05	64(13.73)	0.014585	0.003975	0.008007	0.008061
Cefoperazone+Salbactum	J01DD62	11(2.36)	0.008733	0	0	0.000272
Amoxicillin+Clavulanic acid	J01CR02	22(4.72)	0.00089	0.002207	0.000731	0.00632

Among the cases of wound infection 61, organisms were detected in 52 cases. Overall culture positive wound infection rate was 11.16%. Total numbers of organisms isolated were 71. Most common isolated organisms were *Escherichia coli* (*E. coli*) 20 (28.17%), *Klebsiella pneumoniae* (*K. Pneumoniae*) 18 (25.35%), *Acinetobacter baumannii* (*A. baumanni*) 11 (15.49%), *Pseudomonas aeruginosa* (*P. aeruginosa*) 10 (14.08%), *Proteus vulgaris* (*P. vulgaris*) 5 (7.04%), *Staphylococcus aureus* (*S. aureus*) 4 (5.63%), *Proteus mirabilis* (*P. mirabilis*) 2 (2.82%) and coagulase negative *Staphylococcus* 1 (1.41%). Sensitivity pattern of antimicrobials for gram negative isolates are presented in Table 3 and Figure 1.

Table 3: Antibiogram of Gram Negative infections in midline laparotomy patients

Antimicrobials	**Sensitivity in percentage (Sensitive isolates/ tasted isolate)**				**Proteus**	
	***E. coli* (n=20)**	***K. Pneumoniae* (n=18)**	***A. baumanni* (n=11)**	***P. aeruginosa* (n=10)**	***P. vulgaris* (n=5)**	***P. mirabilis* (n=2)**
Gentamicin	61.11 (11/18)	52.94(9/17)	0(0/11)	33.33(2/6)	NT	100(1/1)
Amikacin	88.88 (16/18)	81.25(13/16)	27.27(3/11)	100(8/8)	NT	100(1/1)
Tobramycin	64.28(9/14)	60(6/10)	40(2/5)	44.44(4/9)	0(0/3)	100(1/1)
Ciprofloxacin	18.75(3/16)	47.05(8/17)	0(0/11)	44.44(4/9)	100(5/5)	100(2/2)
Ofloxacin	30.77(4/13)	50(6/12)	27.27(3/11)	25(2/8)	0(0/3)	100(2/2)
Levofloxacin	16.66(2/12)	71.42(5/7)	0(0/6)	75(6/8)	80(4/5)	100(1/1)
Moxifloxacin	25(2/8)	83.33(5/6)	NT	NT	100(3/3)	100(2/2)
Ceftriaxone	8.33(1/12)	10(1/10)	0(0/6)	50(1/2)	NT	NT
Cefotaxime	12.5(2/16)	0(0/15)	0(0/5)	16.66(1/6)	NT	NT
Ceftazidime	14.28(2/14)	18.18(2/11)	11.11(1/9)	100(4/4)	NT	100(1/1)
Cefoperazone	30.77(4/13)	0(0/6)	0(0/6)	50(1/2)	NT	NT
Piperacillin+Tazobactam	76.92(10/13)	100(8/8)	36.36(4/11)	100(9/9)	100(3/3)	100(1/1)
Meropenem	50(6/12)	85.71(6/7)	60(3/5)	50(2/4)	100(5/5)	100(2/2)
Imipenem	71.43(10/14)	91.66(11/12)	80(4/5)	87.5(7/8)	100(5/5)	50(1/2)

NT = Not Tested.

Amikacin and pipracillin + tazobactam have shown good sensitivity against all isolated organisms except *A. baumanii*. Only imipenam has shown good sensitivity against *A. baumanii*. All third generation cephalosporins were poorly sensitive to isolated organisms. Among fluoroquinolones only levofloxacin has shown some sensitivity against *K. Pneumoniae*, *P. aeruginosa* and *P. vulgaris*.

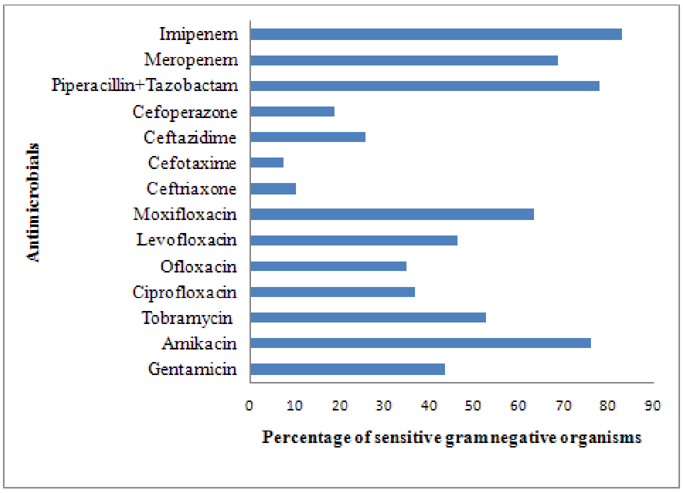

Figure 1: Sensitivity pattern of gram negative organisms to various antimicrobials

As shown in Table 4, there was no significant difference in the median duration of hospital stay for different midline laparotomy indications ($p > 0.05$). Small bowel perforation was associated with significantly higher number of use of antimicrobials, their cost and percentage of wound infection cases ($p < 0.05$). It also showed trends for higher mortality than other indications.

Table 4: Comparison of most common indications for midline laparotomy

Variable	**Peptic perforation (n= 168)**	**Intestinal obstruction (n= 112)**	**Small bowel perforation (n= 40)**	**Perforated appendices (n= 30)**	P value
% of male patients	72.61%	59.82%	72.50%	66.66%	0.13
Duration of hospital stay (days)	10(8,13)	10.5(8,14)	11.5(8.75,26)	9.5(7,11.75)	0.06
Commonly used empirical regimen	Ceftriaxone, Metronidazole, Amikacin	Ceftriaxone, Metronidazoe Amikacin	Ceftriaxone + sulbactum, Metronidazole, Gentamicin	Ceftriaxone, Metronidazole, Amikacin	---
Total number of antimicrobials	4(3,4)	4(3,4)	4.5(4,5)*	3(3,4)	0.0003
Total cost of antimicrobials (`)	2662 -18,834,076	2351 -16,053,612	3763# -27,785,526	2265 -18,553,086	0.0093
Most common isolated organism	E. Coli	E. Coli	K. Pneumoniae	K. Pneumoniae	---
% of wound infection cases	25(14.88%)	10(8.92%)	10(25%) **	1(3.33%)	0.0219
% of expired patients	27(16.07%)	12(10.71%)	9(22.5%)	4(13.33%)	0.305

Data expressed as Median (inter quartile range) *P < 0.05 as compared to intestinal obstruction, peptic perforation and perforated appendices, #P < 0.05 as compared to intestinal obstruction and perforated appendices, **P < 0.05 as compared to intestinal obstruction, peptic perforation and perforated appendices. Duration of hospital stay, total number of antimicrobials and total cost of antimicrobials in intestinal obstruction, peptic perforation, small bowel perforation and perforated appendices cases were compared by Kruskal-Wallis test followed by Dunn's multiple comparison test. % of male patients, % of wound infection cases and % of expired patients were compared by Chi-square test.

Patients with wound infection have shown a significantly higher number of uses of antimicrobials, their cost, duration of stay than patient without infections. Dirty wounds had 2.15 times higher odds for wound infection. Cases of emergency surgery were also associated with higher rates of wound infection (Table 5). Cost of antimicrobials and duration of stay was significantly higher in dirty and contaminated wound respectively (p < 0.05). Significantly higher mortality was observed in patients with dirty wounds (p < 0.05; Table 6).

Table 5: Comparison of midline laparotomy cases between wound infection and without wound infection cases

Variable	With Wound Infection n= 61	Without wound infection n=405	
Clean (%)	1 (1.64%)	19 (4.69%)	OR: 0.33
Clean-contaminated (%)	3 (4.91%)	7 (1.72%)	OR: 2.94
Contaminated (%)	13 (21.31%)	158 (39.01%)	OR: 0.42
Dirty (%)	44 (72.31%)	221 (54.57%)	OR: 2.15
No. of Antimicrobials	5(4,6)	4(3,4)	P < 0.0001
Cost of Antimicrobials (`)	5032(3340,14829)	2458(1685,3610)	P < 0.0001
Duration of stay (days)	19(14,30)	10(8,13)	P < 0.0001
Cases of emergency surgery	54(88.52%)**	304(75.06%)	P < 0.03

Data expressed as Median (inter quartile range) and percentage; Number of Antimicrobials, cost of Antimicrobials, duration of hospital stay and cases of emergency surgery in wound infection and without wound infection cases were compared by Mann – Whitney Test. **P < 0.05 as compared to without wound infection. Cases of emergency surgery were compared by Chi-square test. OR = Odd Ratio.

Total number of antimicrobials used were significantly higher in survived than expired patients [4 (3, 5) vs. 3 (3, 4); p<0.05]. Duration of stay were significantly higher in survived than expired patients [11 (9, 16) vs. 6 (4, 11); p < 0.05]. Cost of antimicrobials in survived and expired cases were 2626(1849, 3834) and 2755(945, 6643), respectively (p > 0.05).

Table 6: Comparison of wound type for midline laparotomy

Variable	Wound Type				P value
	Clean	Clean-contaminated	Contaminated	Dirty	
No. of Antimicrobials	3(2,3)*	4(3,6)	4(3,4)#	4(3,5)	P<0.0001
Cost of Antimicrobials (`)	1367(760,3102)	2104(1619,3176)	2415(1722,3615)	2902(1957,4555)$^{\$}$	P<0.0008
Duration of stay(days)	8.5(7,11)	10(10,15)	12(9,16)^	10(8,14)	P < 0.003
No. of Expired cases	0	2	17	47**	P< 0.03

Data expressed as Median (inter quartile range) *P < 0.05 as compared to clean- contaminated, contaminated and dirty wound types, #P < 0.05 as compared to dirty wound type, $^{\$}$P < 0.05 as compared to clean wound type, ^P < 0.05 as compared to clean and dirty wound types, **P < 0.05 as compared to clean, clean-contaminated, contaminated wound types, No. of Antimicrobials, cost of Antimicrobials and duration of hospital stay in clean, clean-contaminated, contaminated and dirty wound types cases were compared by Kruskal-Wallis test followed by Dunn's multiple comparison test. No. of Expired cases were compared by Chi-square test.

DISCUSSION

Surgical site infection (SSI) plays a critical role for extended treatment and complications, reduced quality of life after midline laparotomy similar to open abdominal surgery. Higher economic burden on the patient and social health system have been due to increase hospital duration [8-10].

In our study, we had a number of males (66.52%) than female patients (33.47%) with mean age of patients 41.41 years. Male - female ratio is in accordance but, mean age of patients is less than reported by Mallol M et al [11]. Midline laparotomy was mainly performed as an emergency procedure (76.82%) than elective surgery (23.17%). Percentage of dirty wound (56.87%) was higher in our study as similar to previously reported study [12]. The most common indication for midline laparotomy was peptic perforation. Peptic perforation was six times more commonly observed than small bowel perforations in contrast to studies from the United States, Greece and Japan where small bowel perforation was more common [13-17]. Use of antimicrobials and its economic burden were higher in small bowel perforations than other indications. This is due to the higher percentage of wound infections than other indications. Observed percentage of wound infection (25%) for small bowel perforation cases was in range (9.5 to 95%) of other reported studies [18]. It could vary from hospital to hospital.

The median hospital stay was 11 (8, 15) days found in our study accordance with the previous study [11]. Higher median hospital stay in patients with wound infection in comparison to patients without wound infection (19 vs. 10 days) is similar to other studies [9,19]. Longer duration of hospital stay in contaminated wounds in comparison to clean and dirty wounds (12 vs. 10 & 8.5 days) suggests increased morbidity because of infection. However, shorter hospital stay in patients with dirty wounds is observed in comparison to contaminated wounds (12 vs. 10 days). This is because of higher mortality (17.73% vs. 9.94%) in dirty wounds. Duration of hospital stay in survived cases was higher than expired cases; this was due to survived patients also including elective surgery treated cases with pre-operative hospital stay.

In our study, 2055 antimicrobials were prescribed with 75.91% parenteral formulation. Use of higher number of antimicrobials and parenteral formulations is related to indication, general condition of the admitted patients for midline laparotomy. The most common empirical regimens were ceftriaxone + metronidazole and ceftriaxone + metronidazole + amikacin in contrast to ampicillin + cloxacillin and ampicillin + cloxacillin + gentamicin in previous reported study. Ceftriaxone + sulbactum was most commonly prescribed FDCs in contrast to ampicillin + cloxacillin in other study [20]. In our study, piperacillin + tazobactum, amoxicillin + clavulanic acid, meropenem, linezolid, vancomycin, moxifloxacin was used as second line antimicrobials.

Most common isolated organisms in our study were *E. coli* whereas; *S. aureus* was most commonly isolated organism in previous published reports which were against our study [21-23]. Ceftriaxone, metronidazole and amikacin were commonly used as an empirical regimen in peptic perforation, intestinal obstruction and perforated appendices. However, ceftriaxone + sulbactum, metronidazole and gentamicin were used for small bowel perforation. Widespread resistance to third generation cephalosporins may be because of its frequent use. If the initial antimicrobials do not provide adequate coverage infection with resistance organism can be associated with poor prognosis. Third generation cephalosporins should not be used as a first-line empirical drug. Ceftrixone and ceftriaxone + sulbactam can be replaced by levofloxacin. No cross resistance was observed between amikacin and gentamicin. Gentamicin can be replaced by amikacin in small bowel perforation patients because of its poor sensitivity against all gram negative organisms. Piperacillin + tazobactam and meropenam can be used as a reserve drugs along with other antimicrobials like linezolid, vancomycin and 4th generation cephalosporins. There is a need to enhance the utilization of antimicrobial sensitivity testing for the better selection of antimicrobials. Isolation of carbapenam resistance gram negative organisms and widespread resistance of *A.baumanii* for almost all antimicrobials tested are worrying features. Antimicrobial therapy, both therapeutically and prophylactically will only be defined when other factors like patient's systemic host defences, local wound environment and the interaction of the microbial burden are under control [24].

In our study, the median cost of antimicrobials used was ` - 2628 (1820, 4061). Higher economic burden of antimicrobials was observed in patients with wound infection in comparison to without wound infection. This is due to use of costlier drugs like piperacillin + tazobactum, meropenem, amoxicillin + clavulanic acid, moxifloxacin and linezolid in patients with wound infection. Similarly economic burden of antimicrobials is higher in patients with dirty wounds than clean wounds. Impact of wound infection has been less in elective than emergency abdominal surgery [9]. Cost of antimicrobials is higher in small bowel perforation than intestinal obstruction and perforated appendices. Previously reported studies shown that the incidence of wound infection ranging from 19.5 to 95%. In our study, wound infection was occurred in 25% cases which were explained increased hospital duration as well as the cost of antimicrobials in small bowel perforation cases [18,25-31]. We did not calculate incidence of wound infection in patients with pre-morbid condition like diabetes mellitus, hypertension, anaemia, COPD and obesity. But, it can increase the probability of wound infection in any surgery [32]. Total numbers of antimicrobials were significantly higher in survived than expired cases, because we calculated oral and parenteral antimicrobial both. Hence, oral antimicrobials were also included in survived cases. However, for the same antimicrobials we ignored the formulation for total counting.

There are various ways to stem further increase in resistance of antimicrobials and extent of infection in the hospital setup. It includes: replacing of age old IV catheter drug delivery systems with novel drug delivery systems as the former is the common source of hospital acquired infection in itself; modern niche vaccine systems to replace vaccine resistant bacterial infections; shortest and most effective course of antimicrobials in common and serious infections. Development of immune based antimicrobials and cytokine agonists which do not kill the bacteria but alter their ability to cause disease or trigger inflammation, can be the other way for overcoming of bacterial resistance [33]. Ongoing surveillance and regular review of empirical antimicrobials used can be the important tool for reducing isolation of resistant organisms [34,35]. Every tertiary care hospital should adopt their antimicrobial policy according to their own institutional microbiological data. It can also help in the appropriate use of reserved antimicrobials. When this is united with proper sanitation and infection control of hospital by fumigation, misting, vaporization and irradiation, it will helpful to stop the further antimicrobial resistance.

Study Limitation

This study has several limitations. Pattern of antimicrobial utilization and sensitivity reflects the scenario in tertiary care teaching hospital only. Infection rates may vary with hospital settings because of the use of antimicrobials and infection control practices. Being a retrospective nature of our study, no follow up data were available to detect patients which develop SSIs after discharge from the hospital. The rationality of the prescriptions could not be assessed. For many parameter comparison was done with the studies from developing countries which are having different economic and social conditions.

CONCLUSIONS

Gram negative bacilli were commonly responsible for wound infection. Metronidazole, amikacin, ceftriaxone and ciprofloxacin were commonly used antimicrobials. Third generation cephalosporins and ciprofloxacin should not be used as first-line empirical regimen because of its widespread resistance. SSI increases cost, antimicrobial use and resistance. Proper sanitation, hygiene and postoperative care are utmost important tools to deal with growing resistance by preventing SSI.

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