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Role of Prophylactic Antibiotics: A Comparative Study between Its Short-Term Use and Traditional Long-Term Use in Clean Contaminated Surgery

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Abstract **Original Research Article**

***Context*:** Antibiotic prophylaxis is provided when an infection is not present but the chance of postoperative infection is high. Antibiotic prophylaxis prevents surgical site infections (SSI). Improper prophylaxis involves unnecessary and prolonged use of broad-spectrum antibiotics. Regrettably, most of our centers follow this pattern. This study compares the use of recommended and improper antibiotic prophylaxis in clean-contaminated surgery to advocate and encourage its use. ***Objectives*:** To see the outcome of short-term prophylactic antibiotics in comparison to prolonged traditional use of antibiotics. Also aimed to identify a proper schedule for prophylaxis, thus reducing costs, side effects and incidence of drug resistance. ***Materials and Method*:** This prospective study was conducted during the period from June 2021 to May 2022 in different surgical units of Sher-E-Bangla Medical College Hospital (SBMCH), Barisal. In this study, 150 patients were selected randomly irrespective of sex who underwent most commonly done clean-contaminated surgery like Appendicectomy for acute or recurrent Appendicitis, Herniotomy and Herniorrhaphy for Obstructed Inguinal Hernia, Open or Laparoscopic Cholecystectomy for Cholelithiasis, Palliative Gastrojejunostomy for Carcinoma Stomach (advanced case) and Choledocholithotomy for Choledocholithiasis. Half of them (group A) received short-term prophylactic antibiotics and another half (group B) received traditional long-term antibiotics. The antibiotic selection, its doses and timing of administration in both groups were selected as per guidelines (study protocol) i.e.; group A - only three doses and group B - traditional prolonged doses. Both groups were followed up at different time periods (POD) and noted their complaints and findings if any in a tabulated form. ***Result*:** It was found that postoperative SSI rate was 6.67% and 8% in the short-term prophylactic and long-term traditional group respectively. Among the infected patient in both groups, the peak age was 61-70 years; older has more chance of infection than younger. It was seen that those stayed more than 7 days in hospital preoperatively had more chance of infection than those stayed less than 3 days and it was found that short term group required less hospital stay postoperatively than those of the long-term group. Long-term group faced more antibiotic-related side effects like nausea, vomiting, loose motion etc., which was minimal in short term group. So, the use of short-term prophylactic antibiotic is cost effective, saves working hours (less hospital stay) and causes minimal changes in body's normal flora and host defenses thus prevents drug resistance. ***Conclusion*:** Prophylactic antibiotics in general surgery are well-established for all clean-contaminated operations. Nonetheless, asepsis, antisepsis, disinfection and sterilization are still necessary for better outcome. This study reveals that short-term three-dose antibiotic prophylaxis is better than long-term antibiotic use in many places of our country, especially in clean-contaminated surgery. Prolonging antibiotics does not improve SSI, postoperative hospital stay, side effects or recovery compared to short-term group. This single-center investigation with minimal resources and sample size yielded results comparable to worldwide publications. Thus, we may confidently use short-term prophylaxis in all clean-contaminated surgeries at our country's center if other acceptable surgical standards are followed.

Keywords: Antibiotic prophylaxis, surgical site infections (SSI), Choledocholithotomy, Inguinal Hernia.

INTRODUCTION

Appropriately administered antibiotic prophylaxis reduces the incidence of surgical Site Infection [1]. Prophylaxis is recommended for all clean-contaminated procedures. It is considered optional for most clean procedures. Treatment, rather than prophylaxis, is Indicated for procedures associated with obvious preexisting infection (i.e., abscess, pus or necrotic tissue) [2]. Timing of antibiotic administration is critical to efficacy. The first dose should always be given before the procedure, preferably within 30 minutes before incision. Re-administration at one to two half-lives of the antibiotic is recommended for the

duration of the procedure. In general, Duration of prophylaxis should not exceed 24 hours [3]. Antibiotic selection is influenced by the organism most commonly causing wound infection in the specific procedure and by the relative costs of available agents. Cephalosporin's (such as cefuroxime) are appropriate first line agents for most surgical procedures, targeting the most likely organisms while avoiding broad-spectrum antimicrobial therapy that may lead to the development of antimicrobial resistance [4].

Antibiotic prophylaxis has some principles and it should be in correct dose, time and schedule and should not be in inappropriate prophylaxis. Antibiotics should be of broad spectrum with appropriate micro biological spectrum, high dose given in a single dose or three-dose regimen and administered before/at induction of anesthesia by IV route. Therapeutic tissue concentration of the antibiotics (minimum inhibitory concentration of the antibiotic, MIC) must be present at the time of skin incision and maintained throughout the duration of operation [4]. In this respect the pharmacokinetics (half-life and protein binding) are important. This MIC of the antibiotics must be maintained throughout the operation. This entails repeated dosing if the half-life of the antibiotic (or combination) used is shorter than the duration of the operation. The antibiotic should, whenever possible, be bactericidal in nature with high tissue penetration ability and low toxicity. But in our country, we use antibiotics for 7-10 days mainly after surgery and often prescribe for another 5-7 days during discharge of the patient in all types of surgery which is contrary to principles of antibiotic prophylaxis. In this study, it has tried to compare the outcome of the use of short-term (Only 3 dose-24hours coverage) prophylactic antibiotic with that of traditional long term (7-10 days or more) use of antibiotics practice in our country in clean-contaminated surgery. Among clean-contaminated surgery Appendicectomy, either acute or recurrent done in emergency or elective setup; Emergency Herniotomy and Herniorrhaphy in Obstructed inguinal Hernia; either open or laparoscopic Cholecystectomy, Palliative Gastrojejunostomy for advanced CA stomach and Choledocholithotomy for Choledocholithiasis was selected as these are the most common operation done in general surgery ward. Among broad spectrum antibiotics second generation cephalosporin-Cefuroxime was selected as this is active against both aerobic and anaerobic gram positive and negative organisms and this is widely available and cost effective. For prophylaxis 3 dose regimen was selected, first dose before or at induction of anesthesia and second & third dose at 8 hours and 16 hours subsequently to cover 24 hours post-operative period because our aseptic techniques are not up to the mark, we can't afford sterilized instruments in emergency settings and our operation theatre, ward environment is not as good as should be. In this context, the author's endeavor is to identify the appropriate schedule of antibiotic prophylaxis for our country and thereby to reduce the cost of antibiotic use, their side effects as well as minimizing the incidence of antibiotic resistance.

OBJECTIVES

- To compare the outcomes of prophylactic antibiotics with the outcomes of traditional long duration use of antibiotics in clean contaminated surgery.

MATERIALS AND METHODS

This prospective study was conducted during the period from June2021 to May 2022 in different surgical units of Sher-E-Bangla Medical College Hospital (SBMCH), Barisal. In this study 150 patients were selected randomly irrespective of sex who underwent most commonly done clean-contaminated surgery like Appendicectomy for acute or recurrent Appendicitis, Herniotomy and *Herniorrhaphy* for Obstructed Inguinal Hernia, Open or Laparoscopic Cholecystectomy for cholelithiasis, Palliative Gastrojejunostomy for Carcinoma Stomach (advanced case) and Choledocholithotomy for Choledocholithiasis. Half of them (group A) received short term prophylactic antibiotics and another half (group B) received traditional long-term antibiotics. The antibiotic selection, its doses and timing of administration in both groups were selected as per guidelines (study protocol) i.e.; group A - only three doses and group B - traditional prolonged doses. Both groups were followed up at different time period (POD) and noted their complaints and findings if any in a tabulated form.

Ethical Consideration:

Informed written consent was then taken from them. The study did not involve any additional investigations as well as any hazards to health of the patient.

Inclusion Criteria:

- Patient undergoing elective and emergency procedures like appendicectomy, Emergency Herniotomy and Herniorrhaphy obstructed Inguinal Hernia, Open or laparoscopic cholecystectomy, Palliative Gastrojejunostomy and Choledocholithotomy.
- Age of the patient more than 15 years. (Patient at or below 15 years is admitted in pediatrics surgery department).
- ASA Physical status 1,2

Exclusion Criteria:

- ASA Physical status 3-5 (Patient of ASA physical status 3-5 needs extra care, extra medication that may alter the result of present study).
- Age less than 15 years.

- Patient who has an allergy to any drugs used in the study.
- Diseases with complication such as appendicular abscess or Gangrenous appendicitis, Uncomplicated or Strangulated hernia, Empyema gall bladder, proximal Gastric carcinoma, Choledocholithiasis with infected, purulent bile etc.
- Patients suffering from severe malnutrition, systemic disease like DM (FBS>10mmol/L), uremia and patients receiving steroid or cytotoxic therapy were not included in this study.

Study Procedure:

The sample size was divided into two groups:

Group A: Short-term (3 doses) prophylactic antibiotic group.

Group B: Traditional long-term (10 days) antibiotic group.

Group A: The patient in this group received IV Cefuroxime 750mg 30 minutes before incision or at induction and subsequent 2 doses at 8hrly in the postoperative period.

Group B: The patient in this group received IV Cefuroxime 750mg 30 minutes before incision or at induction and 8hourly for 24hrs. In the postoperative period then Tab. Cefuroxime 500mg 12hourly for another 7-9 days.

Patients of appendicitis in both groups received an additional single dose of IV Metronidazole 500mg 30 minutes before or at induction of operation to cover anerobic gram negative bacteria as the lumen is opened during appendicectomy. Would was observed 3rd -5th POD and check dressing was done. Those of healthy wound were discharged with advice to come at 7th-9th POD for stitch removal and 30th POD for follow up. At 30th POD patient was observed directly in follow up clinic or by telephonic conversations with those whom were not present in follow-up clinic.

Data Collection:

Relevant data from each subject on clinical ground, per-operative, postoperative and microbiological findings were recorded in a pre-designed clinical study sheet. Analysis of data was done and compared with other studies. Appropriate statistical analysis was done using computer-based software SPSS program. Some results are presented in a tabulated form and some are in graphical presentation using pie chart and bar chart.

RESULTS

The patient population of 150 patients consisted of 78 men and 72 women. The average patient age was 35 years. Table 1 show that out of 150 cases, 75 cases are in short term group and 75 cases are in long term group. Among short term group, 40 cases are male and 35 cases are female. Among long term group, 38 cases are male and 37 cases are female. In total 78cases are male and 72 cases are female. The highest 28% was from 21-30 years age group, next was 15-20 years age group as Appendicitis is more common in young age group. Only 2% participants were from older age group (>71 years) whom were mostly diagnosed as carcinoma stomach.

Table 1: Age and sex distribution of the sample size

Age group	Short term group		Long term group		
	Male	Female	Male	Female	Total
15-20 yrs	5	11	5	10	31(20.67%)
21-30 yrs	11	9	8	14	42(28%)
31-40 yrs	4	3	5	6	18(12%)
41-50 yrs	8	7	6	3	24(16%)
51-60 yrs	7	3	8	2	20(13.34%)
61-70 yrs	4	2	5	1	12(8%)
>71 yrs	1	0	1	1	3(2%)
Total	**40(53.33%)**	**35(46.66%)**	**38(50.66%)**	**37(49.33%)**	**100%**
	75		**75**		**150**

Figure 1 shows among short term group 47% (46.66%) were female and 53% (53.33%) were male. Among long term group 51% (50.66%) were female and 49% (49.33%) were male.

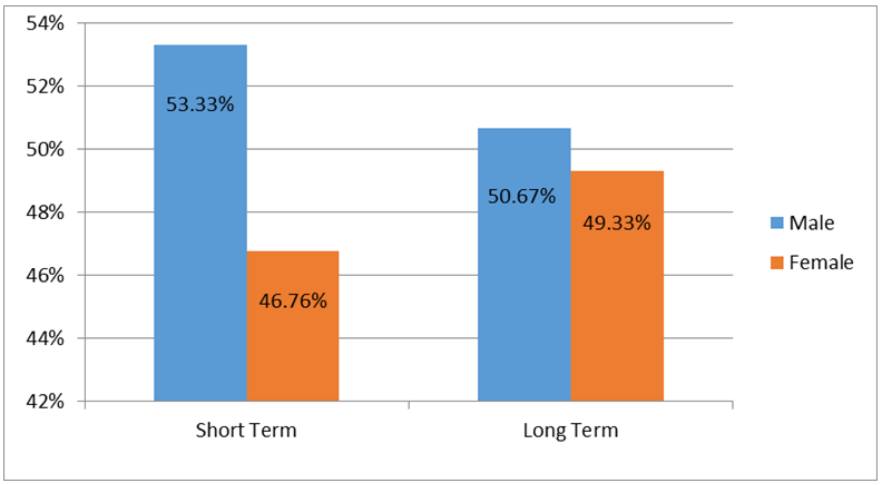

Figure 1: Sex distribution in study sample

Table 2 shows that out of 75 patients who received short-term 3 dose prophylactic antibiotics, only 5 developed SSI postoperatively. Overall infection rate was 6.67%. Choledocholithotomy shows the maximum number of infection (16.67%) among different type of clean-contaminated surgery probably most choledocholithiasis patients present with Obstructive Jaundice and jaundiced patient are immune compromised and liable to infection. Out of 75 patients who received long term traditional dose antibiotics, only 6 developed SSI postoperatively. Overall infection rate was 8%. Here also Choledocholithotomy shows the maximum number of infection (20%) among different type of clean-contaminated surgery probably due to presence of Jaundice.

Table 2: Name of operation and their number with % of infection in short-term prophylactic group & long-term traditional group

		No. of operation		No. of infection		% of infection	
Indication	**Name of operation**	**Short Term**	**Long Term**	**Short Term**	**Long Term**	**Short Term**	**Long Term**
Acute Appendicitis or Recurrent appendicitis	Emergency Appendicectomy	24	25	1	2	4.17	8
	Elective Appendicectomy	5	4	0	0	0	0
Obstructed inguinal Hernia	Herniotomy and Herniorrhaphy	15	13	1	1	6.67	7.67
Ch. Cholecystitis with cholelithiasis	Open Cholecystectomy	10	11	1	1	10	9.09
	Laparoscopic Cholecystectomy	8	9	0	0	0	0
Carcinoma Stomach (Advanced)	Palliative Gastrojejunostomy	7	8	1	1	14.28	12.50
Choledocholithiasis	Choledocholithotomy	6	5	1	1	16.67	20
	Total n=	**75**	**75**	**5**	**6**	**6.67**	**8**

Table 3 shows that in both short-term and long-term groups, the postoperative SSI rate is more in elderly aged group. Highest rate is 16.67% among 61-70 years ages in both short term and long- term group but in long term group, age> 71, infection rate is 50%.

Table 3: Rate of infection in different ages of both groups:

Age in yrs	**Short term 3 dose**			**Long term traditional**		
	No. of cases	**No. of infection**	**% of infection**	**No. of cases**	**No. of infection**	**% of infection**
11-20	16	0	0	15	0	0
21-30	20	1	5	22	2	9.09
31-40	7	0	0	11	0	0
41-50	15	2	13.33	9	1	11.11
51-60	10	1	10	10	1	10
61-70	6	1	16.67	6	1	16.67
>71	1	0	0	2	1	50
Total	**75**	**5**	**6.67**	**75**	**6**	**8**

Figure 2 shows that infection rate are varies with duration of operation. It is 4.08% and 4.35% respectively in short term and long-term group when duration of operation is 1 hour but it is 11.54% and 13.79% respectively when operation time is >1 hour. In total the average surgical time was 69.33 minutes.

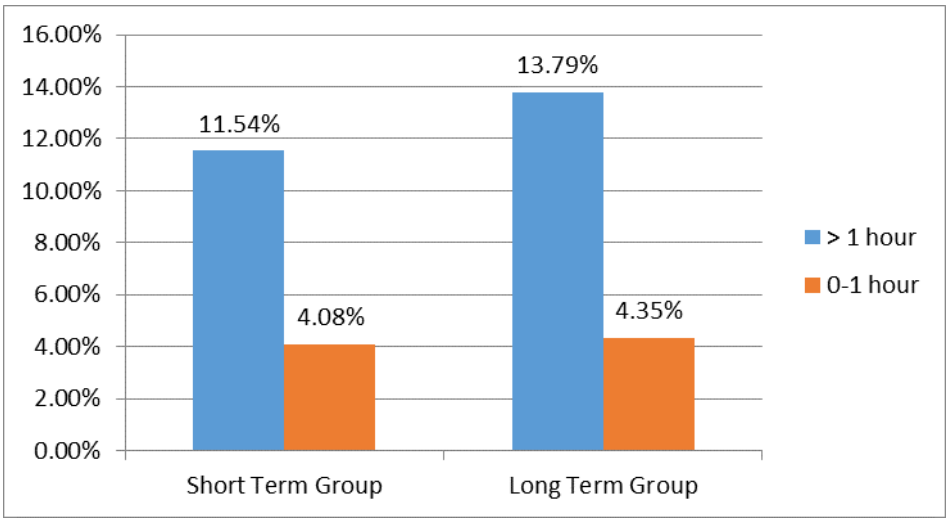

Figure 2: Duration of operation with % of infection

Table 4 shows that the number of infection rate is high in those who resided more than 7days than those who resided in shorter period (<3days) as chance of nosocomial infection decreases with less hospital stay.

Table 4: Duration of preoperative hospital stay with chance of infection

Preoperative Hospital stay	Short term group			Long term group		
	No. of cases	No. of infection	% of infection	No. of cases	No. of infection	% of infection
0-3 days	29	1	3.03	27	1	3.70
4-7 days	22	2	9.09	21	2	9.52
>7 days	24	2	8.33	27	3	11.11

Table 5 shows that the duration of postoperative hospital stay is less in a short-term prophylactic group than in a long-term traditional group. Here 22 +31 = 53 patients stayed<7 days in the short-term group in comparison to 17+ 26 = 43 patients in the long-term traditional group.

Table 5: Duration of postoperative hospital stay in the short-term and long-term group

Postoperative hospital stays	Short-term prophylactic group	Long-term traditional group
0-3 days	22 pt	17 pt
4-7 days	31 pt	26 pt
>7 days	22 pt	32 pt

Table 6 shows the number of infections with their causative organism. In both groups, E. coli was the most prevalent organism. In both groups, two infected cases were not present at follow-up for documentation of bacteriological examination but they were diagnosed as having infection by telephonic conversation with them and with their local attending physician.

Table 6: Organisms isolated from postoperative SSI

Organism isolated	Short-term group (n=75)	Long-term group (n=75)
	No. of infection-5	No. of infection-6
Escherichia coli	2	1
Staphylococcus aureus	1	2
Pseudomonas	0	1
Coliform bacilli	1	0
Mixed (E. coli and vulgarism)	0	1

Figure 3 shows that only 6.6% patient was suffering from adverse effects of antibiotic in Short-term 3 dose user but it was high, 25.3% in long term antibiotic users.

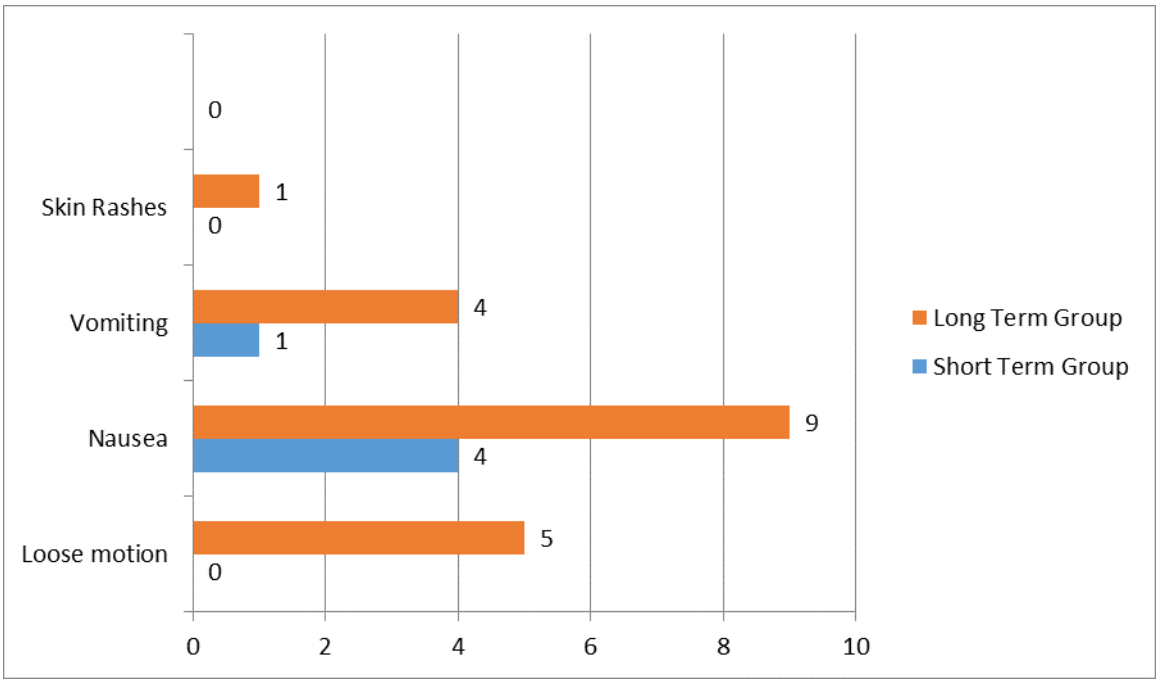

Figure 3: Postoperative adverse effects of Antibiotics

DISCUSSION

Antibiotic prophylaxis, combined with patient's general condition, age, asepsis, antisepsis, adequate sterilization and disinfection in wards and operating rooms reduces postoperative SSI. High-dose broad-spectrum antibiotics given before or during surgery should be microbiologically sensitive. Usually, one to three doses, given to cover 24 hours post-operative period. Yet, most hospitals in our country employ prophylactic antibiotics for 7-10 days, which costs a lot of money and causes postoperative morbidity and antibiotic resistance. Long-term prophylaxis increases SSI risk. Appropriate Prophylactic antibiotic use has been discussed by several experts.

This series had 150 cases, randomly chosen. From June 2021 to May 2022, SBMCH, Barisal they were admitted to different surgical units. Among them 75 received short-term three-dose prophylactic antibiotics before induction, at 8 hours and at 16 hours after Operations. Rest 75 patients received oral and intravenous antibiotics for 7-10 days per indication.

In this study short term group and long-term group according to nature and name and numbers of patients only 5 out of 75 short term group develop SSI and 6 in long term patient develop SSI (group-B). Short term and long-term infection rates are 6.67% and 8% respectively. So clean contaminated surgery, three prophylactic antibiotics doses are enough.

In this study, SSI rates in different age groups, duration of preoperative hospital stay, duration of operation, and postoperative adverse effects with short-term prophylactic and traditional long-term antibiotic groups were examined, along with bacteriological studies of infected cases to document infection. Only 11 people had infection in both groups, however only 9 were available for swab culture and were proven to have infection. The other 2 infected cases claimed their infection by telephone at 30th POD follow-up, diagnosed by their local physician.

The result of the present study can be compared with others result of some studies published and quoted in different journals [5-8].

The overall SSI rate 8.6% of 697 patients underwent clean contaminated procedure in prophylactic group and 9.2% of 716 patients underwent clean-contaminated procedure in traditional group [5]. The incidence of SSI was 26.7%. It was 15.9% in all type of surgery for traditional group and 12.6% for prophylactic group [8]. The overall infection rate was 10% and 12% respectively for short term prophylactic and long-term traditional group [6]. In both of the above- mentioned study infection rate was counted in all type of surgery and compared between prophylactic and inappropriate prophylactic group, so the infection rate was little bit higher. In this series, the infection rate was counted in clean contaminated procedures and it was only 6.67% for prophylactic group and 8% for traditional group. Antibiotic may not be needed to prevent wound infection in clean surgical procedure but it may be used only prophylactically in all clean-

contaminated cases [7]. So, in this study author included only clean contaminated procedure.

In this series the SSI rates in different age group was studied and it has been shown that postoperative SSI is more prevalent in elderly patient in both short term and long-term group that is consistent with the result of the study where infection was more and highest in patients aged over 70 [9]. So, age is an important factor in post-operative SSI as host defense or immunity to infection decline with ageing process.

Duration of operation time affects SSI rate. In this series procedure lasting less than an hour had lower rate of SSI. Infection risk increases with operation time [10]. They recommended intra operative antibiotics for prolonged surgeries. Bacterial contamination grows over time; wounded tissues are damaged by drying and by exposure to air and retraction. Longer procedure is more liable to be associated with blood loss and shock; thereby reducing general resistance of the patients.

Short term prophylactic antibiotics patients spend less than 7 days in the hospital pre and post-operative and most patients on long term antibiotics stay in the hospital longer than 7 days due to adverse effects such as nausea vomiting and diarrhoea. This study shows long term antibiotics treatment extends post-operative hospital stays.

In this study prolong antibiotics caused higher post-operative adverse effects like nausea Vomiting loose motion and skin rash than three doses of prophylactic antibiotics. So, it's hazardous for the patients than benefits for prolonged use of antibiotics.

CONCLUSION

The role of prophylactic antibiotic in general surgical practice is well documented. It is recommended for all clean-contaminated procedures. But it is not an alternative to good surgical practices including strict asepsis, antisepsis, disinfection and sterilization techniques. This study shows that short term three dose prophylactic use of antibiotic is superior to long term traditional use of antibiotics practiced in many centers of our country in surgery especially in clean-contaminated surgery. There are no advantages in prolonging antibiotics in terms of SSI, postoperative hospital stays, adverse effects and postoperative recovery in comparison to short term group. Though this study was done in a single center with limited resources and minimal sample size, its results are almost near to international publications. So, we can be unhesitant to adopt the short-term prophylaxis in all cases of clean contaminated surgery in all the center of our country provided the other good surgical practices maintained.

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