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Wound infection rate and its characteristics in single dose prophylactic antibiotics in prevention of surgical site infections - A cost effective approach

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Abstract

Introduction: Postoperative wound infection remains the foremost common complication of surgery. Administration of antibiotics for 7 to 10 days to avoid infection is very expensive so the study is carried out to ensure that the infection is reduced by avoiding unnecessary antibiotic usage thereby practising a cost effective method, less morbidity and hospital stay and assessment of prophylactic antibiotics in prevention of Surgical Site Infection in clean and clean contaminated cases in terms of post-operative wound infection.

Methodology: A total of 175 patients were involved in the study and the status of wound was seen in all 175 patients for two days postoperatively as well as in 168 patients for seven days postoperatively. Inclusion and exclusion criteria were followed according the guidelines. The present study was carried out from 1st January 2019 to 30th June 2020 in general surgery department of National Institute of Medical Sciences & Research and Hospital, Jaipur (Rajasthan).

Results: Out of 175 patients, 3 patients developed post-operative wound infection. Common characteristic was erythema & induration and two patients had discharge with erythema & induration.

Conclusion: From this study we can conclude that Single-dose prophylactic antibiotics are sufficient in preventing wound infection. In surgical practice there is considerable variation in the timing of prophylactic administration of antibiotics and the administration in the 2 hours before surgery reduces the risk of wound infection.

Keywords: surgical site infections; prophylaxis antibiotics; post-operative wound infection; hernia surgery.

Introduction

Infection of the insculped skin or soft tissues may be a common but potentially inescapable complication of any surgery. A certain amount of bacterial contamination during the surgery is unavoidable, either from the patient's own bacterial flora or from the

environment (Balasubramaniam, 2013). Postoperative wound infection remains the foremost common complication of surgery. With the fear of developing wound infection after surgery, many surgeons administer antibiotic for a period of 7-10 days even in clean cases. This practice is not only expensive to the patients but also can results in hospital –acquired infections.

Surgical site infections (SSI) are a dreadful complication in surgery. SSI is one of the most common nosocomial infections accounting for 21.8% of the total in the United States and causes increased morbidity, mortality, readmissions, and prolonged hospital stay (Magill *et al.,* 2014; de Lissovoy et al., 2009). As a result, SSI increase healthcare costs up to 1.6 billion dollar a year (de Lissovoy et al., 2009). However, controlled clinical trials have reported that antibiotic prophylaxis can lower the incidence of infection after certain operations, thereby reducing morbidity, hospital stay and unnecessary antibiotic usage. An antibiotic prophylactic regimen should be directed against the most likely infecting organisms. Infection can be prevented when the effective dose of the drug are induced within the blood and the tissue, during and shortly after the procedure. Therefore, just before the operation, antibiotic prophylaxis should begin. Giving earlier was found to be unnecessary and potentially dangerous, while giving later was found to be less effective. A single dose of prophylaxis before the surgery was found to be sufficient. If surgery is delayed or prolonged (>3 hour), often a second dose is advisable if an antimicrobial agent with short life is employed Post-operative administration makes no sense and harmful (Geroulanos *et al.,* 2001).

The purpose of conducting this study is to ensure that prophylactic administration of antibiotic can decrease postoperative morbidity, shorten hospitalization, reduce the price due to infection and forestall unnecessary use of antibiotics for long periods. The distribution of Health care associated infection per the positioning of infection indicated that the Surgical Site Infections (SSIs) are the foremost frequent among patients undergoing surgical procedures and that they are considered a very important indicator of the standard of the health care. The importance of the prevention and control of SSIs has been well recognized and therefore the effectiveness of interventions has been extensively studied and plenty of them have been demonstrated as being effective, including surveillance systems, pre-operative preparation for the patient, appropriate administration of antibiotics prophylaxis before the initiation of surgery, aseptic procedures within the operating theatre, careful and skilled surgical technique, and postoperative surgical site or wound care. The employment of antibiotics prophylaxis in the prevention and reduction within the incidence of SSIs is widespread and evidences have demonstrated the importance of timing of administration, selection of the agent, and duration of the prophylaxis. Despite this evidence, the recommendations are not routinely followed and antibiotics are used excessively and inappropriately for the prevention of SSIs. Moreover, this is often important in light of the actual fact that the prolonged use of advanced antibiotic agents may promote the adoption of bacterial resistance to antibiotics, so appropriate use of these agents may be a critical issue.

Antibiotic prophylaxis is additionally indicated for clean operations involving insertion of prosthetic devices that has low infection rate and high morbidity. Selection of agent should be supported specific contraindications, local infection surveillance data, and

the results of clinical trials. Newer criteria for determining the danger of site infection (wound and intra cavitary) are in evolution and will ends up in modification of recommendations over next several years (Page *et al.*, 1993).

Haley *et al.*, (1981) indicated that surgical wound infection prolongs hospitalization for one week, leading to additional 10 to 20% of total hospital bill. On the other hand, inappropriate and indiscriminate use of prophylactic antibiotics may increase cost and unnecessary drug use, lab monitoring and selection of resistant organisms those undesirable effects necessitate more expensive infection control measures and antibiotics.

Conventional recommendations for prophylactic administration of antibiotics are for clean and clean contaminated wounds. These wounds characterize 35% to 40% of all operations. In some operations, the employment of prophylactic antibiotics is justifiable in spite of a theoretically small risk of infection. Most of those operations necessitate insertion of prosthetic materials.

Postoperative wound infections have an infinite impact on patients' quality of life and contribute substantially to the financial cost of patient care. The potential consequences for patients range from increased pain and care of an open wound to sepsis and even death. Approximately one million patients have such wound infections every year within the United States, extending the average hospital stay by one week and increasing the cost of hospitalization by 20 percent. This translates to an extra $1.5 billion in health care costs annually.

The occurrence of wound infection requires a local inoculum sufficient to overcome host defences and establish growth. The method is complex and depends on the interaction of varied host, local tissue and microbial virulence factors. Measures intended to forestall wound infection typically attempt to modify the host and native tissue factors and include, for instance, preoperative optimization of comorbid illness, control of the operative environment, proper cleansing of the skin and use of aseptic surgical technique. Antibiotic prophylaxis is simply one relatively minor effort among numerous preventive measures, but the efficacy and impact of antimicrobial prophylaxis has clearly been demonstrated to be significant.

Bacteria may enter the wound while the operation is going on or may be after the operation and could be of endogenous or exogenous origin. Endogenous source may be from mouth, skin, respiratory tract, gastrointestinal tract, biliary tract, perineum or genitourinary tract of the patient. Exogenous origin is probably came from surgeons, assistants, attending nursing staff, and breach in asepsis in operation theatre or in wards. Some organisms are air born. Organisms causing infection depends on quality and quantity of that organism. Less than 10 organisms/ml is unlikely to cause wound sepsis. Factors involving in rapid growth of bacteria depends on virulence of organism, patient’s age, diabetes mellitus, obesity, immunity of the patient, and concurrent disease. Some drugs like steroids and chemotherapeutic agents also decreases the immunity of host body. Local factors in everyday practice causing inhibition of local defence mechanisms for cleaning. Bacteria are perhaps the most important cause of wound infection anything that interferes with the ability of phagocytes to contact directly and kill bacteria potentates wound infection. Use of foreign bodies including sutures, drains or lack of accurate approximation of tissues, strangulation of tissues with sutures that are too tight and presence of any dead

tissue, haematoma or seromas all increase the chance of infection.

Materials and Methods

It was a Hospital based observational & descriptive study conducted in the department of general surgery, National Institute of Medical Sciences & Research and Hospital, Jaipur (Rajasthan) from 1st January 2019 to 30th June 2020. A total of 175 patients were involved in the study was calculated by the formula

$n = 4PQe2$

Where, n = sample size; P = prevalence rate (12.5%) 15; Q = 100-P; e = allowable error.

Mode of selection follows two criteria where, all patients between 18 to 75 years, all kinds of surgeries which involves clean and clean contaminated cases (All types of hernia surgeries, Breast surgeries, Thyroid and parotid surgeries, Hydroceole, varicoceole, varicose vein surgeries) and surgically fit patients fulfils inclusion criteria whereas exact opposite this represents exclusion criteria. Patients were given single dose of antibiotic, 1/2 an hour before to surgery. In this study, injection Ceftriaxone 1g I.V. was used.

Preoperative preparation

The patient was admitted in department of surgery and all necessary investigations done. The operative area was shaved on the night prior to the operation and patient told to take a bath using soap in the morning on the day of operation.

Aseptic precautions in the operation theatre

All the required aseptic precautions were followed such as using autoclaved gown, sterile disposable gloves, sterile instruments and drapes. Standard surgical scrub for 5 to 10 minutes was practiced before performing operations.

Operative techniques

The operative area was cleaned with povidine iodine and with spirit. Drain to be used wherever necessary; closure done with suture material and clips.

Postoperative care

The patients were followed up daily. A temperature chart maintained and also the patients observed for systemic infections like respiratory tract infection and urinary tract infection. Wound dressings were opened on the second postoperative day and checked for signs of wound infection like local erythema, induration, and local rise of temperature or discharge. All the sutures removed on the seventh postoperative day if there were no wound infection and stitch abscesses or gaping. When an infection noted, the sutures removed earlier, discharge was sent for culture and sensitivity testing and daily betadine dressings was done. Antibiotics started with respect to culture and sensitivity. The various criteria for the assessment of Surgical Site Infections will be tabulated, analysed and discussed.

The wound will be post operatively examined on 3rd, 5th, 7th, and 9th day to detect the signs of inflammation. Within the presence of inflammation, swab are going to be taken from culture and sent for bacteriological examination. Patient will be followed for 30 days for any local or systemic complaints. Total hospital stay for the patient and complications other than surgery will also be recorded and analysed. Mortality if any will be analysed.

Statistical Analysis

The data collected was analysed for validity statistically with the software SPSS version 20 (Statistical Package for the Social Sciences).

Results

The status of wound was seen in all 175 patients (two days postoperatively) and in 168 patients (seven days

postoperatively). 44 patients (25.14%) were in age group 18-34years, 54 patients (30.85%) in age group 35-54 years and 77 patients (44.00%) were in age group 55-75 years. Maximum number of patients were in age group 55-75 years and minimum number of patients were in 18-34 years (Table 1, Fig. 1). Out of 175 patients 85 were males and 90 were females. Sex distribution was almost same (Table 2 and fig. 2). Distribution of patients according to different type of surgeries is showed in Table 3. Of the total patients, the greatest percentage of patients were those undergoing hernia (44.57%), breast surgeries (26.28%), thyroid surgeries (6.85%), Hydroceole (4.57%), varicose vein surgeries (8.00%), Swelling and Cysts surgeries (8.00%) and other clean surgeries were 1.71% (figure 3).

Total infection rate in patients who received preoperative antibiotic prophylaxis in clean surgeries was 1.71%. Individually, in hernia surgeries infection rate was 1.28% and in breast surgeries 4.34%. No other infected case was reported (Table 4; figure 4). Distribution of patients according to characteristics of wound infection is reported in table 5 (figure 5). Of the three patients with wound infection, only one patient required additional dose of antibiotics and two patients required secondary suturing after drainage (Table 6; figure 6). Wound status and wound characteristics of operated patients from day 2 to day 7 is given in table 7 and table 8 respectively (figure 7 and 8).

Table 1: Distribution of patients according to age.

Sn.	Age range	No. of patients out of 175	No. of patients (%)	No. of infected patients	% of infected patients
1	18-34	44	25.14	0	0
2	35-54	54	30.85	3	5.55
3	55-75	77	44.00	0	0

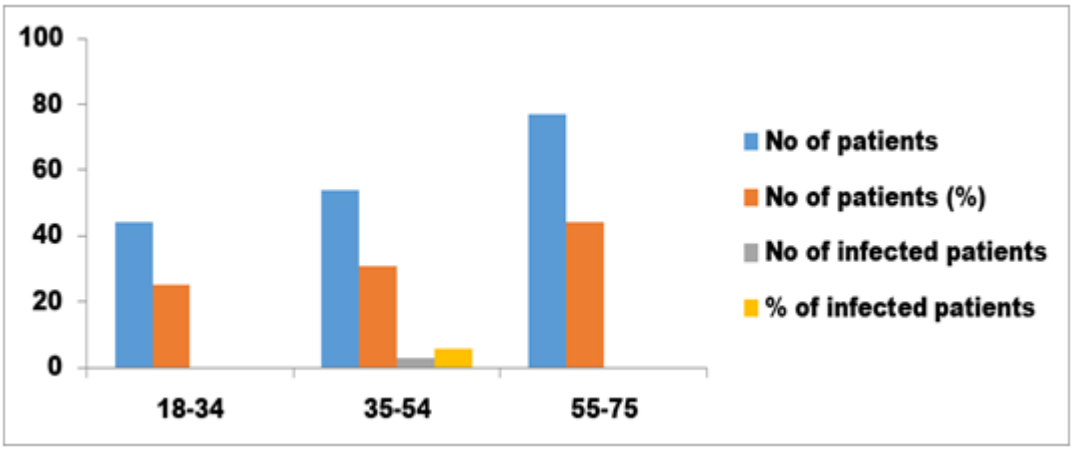

Figure 1: Distribution of patients according to age.

Table 2: Distribution of patients gender-wise.

Gender	No. of patients	Infection in patient (%)
Male	85	1(1.17)
Female	90	2(2.22)

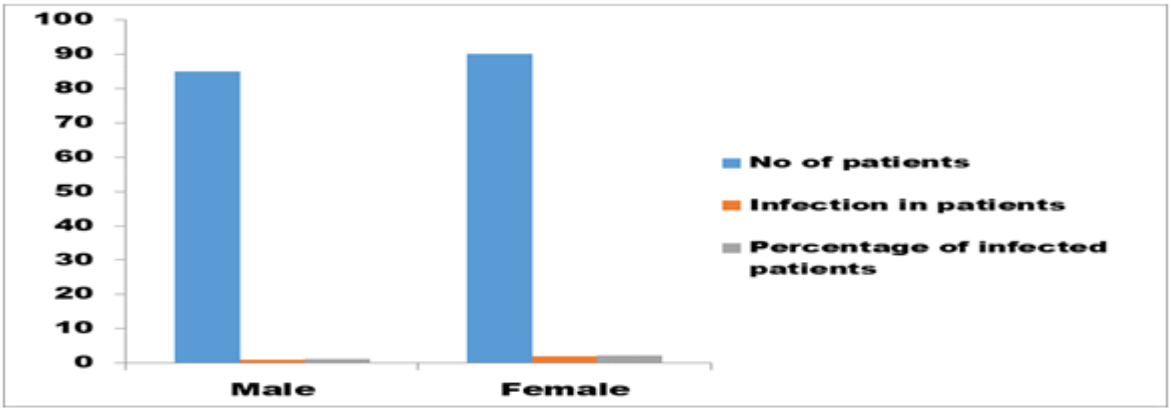

Figure 2: Distribution of patients gender-wise.

Table 3: Distribution of patients according to surgical procedures performed.

Sn.	Type of Surgery	No. of patients	Infected patients %
1	Hernia surgeries	78	44.57
2	Breast Surgeries	46	26.28
3	Thyroid Surgeries	12	6.85
4	Hydroceole	8	4.57
5	Varicose Vein Surgeries	14	8.00
6.	Swelling and cysts	14	8.00
7	Others (thyroglossal cyst, ovarian cyst & UDT)	3	1.71

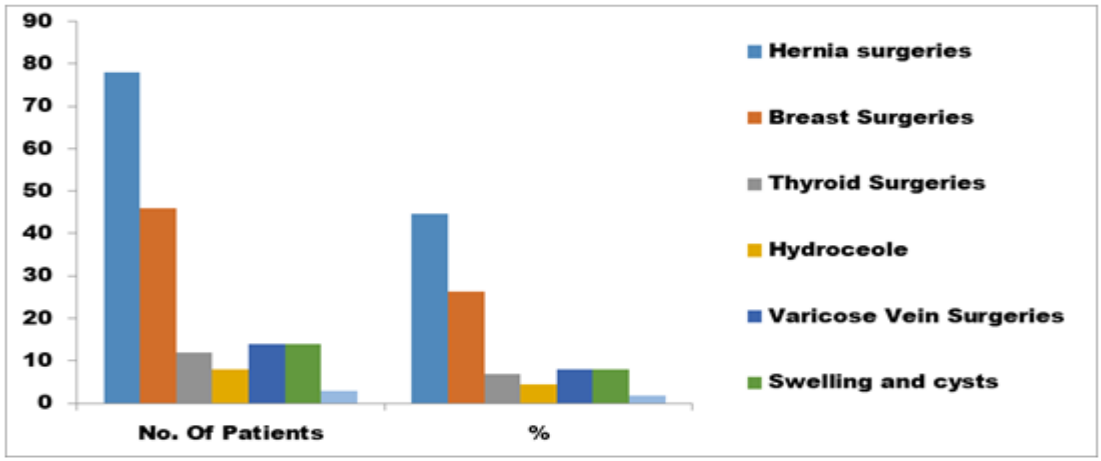

Figure 3: Distribution of patients according to surgical procedures performed.

Table 4: Distribution of patients according to infection rate.

Sn.	Type of Surgery	Total cases	Infected Cases (%)
1	Hernia	78	1
2	Breast	46	2
3	Thyroid	12	0
4	Varicose Veins	14	0
5	Swellings	14	0
6	Thyroglossal cyst	1	0
7	Ovarian cyst	1	0
8	Undescended testis	1	0

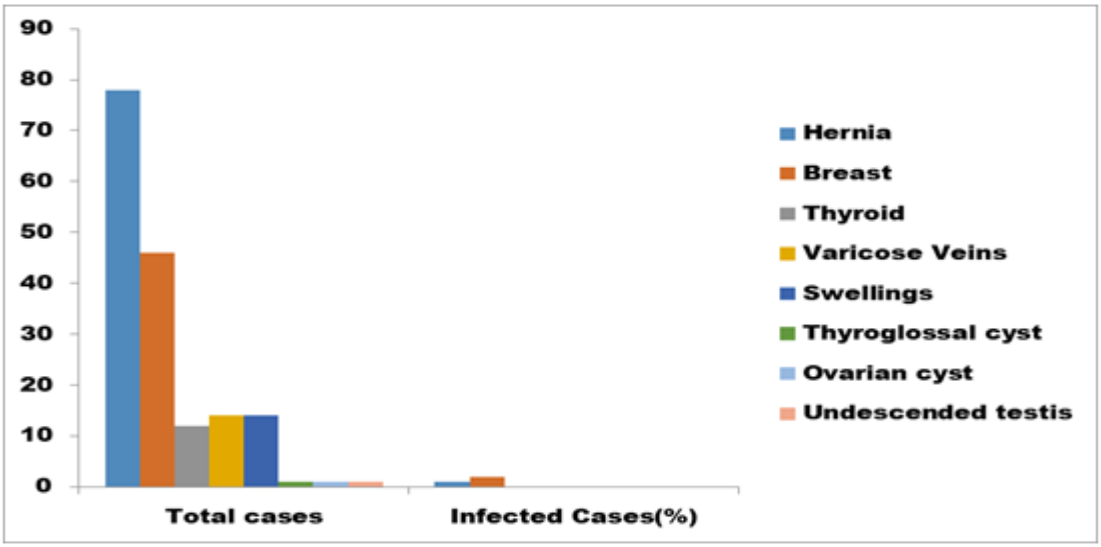

Figure 4: Distribution of patients according to infection rate.

Table 5: Distribution of patients according to characteristics of wound infection.

Sn.	Wound characteristics	No. of patients
1	Erythema, Induration (Inguinal Hernia)	1
2	Erythema induration with discharge(MRM)	2
3	Total	3

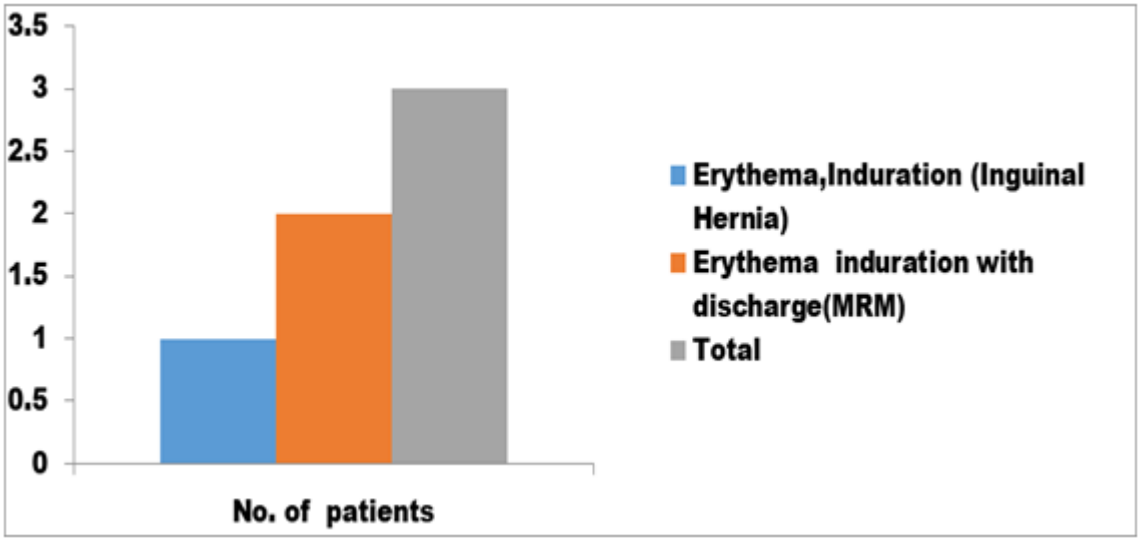

Figure 5: Distribution of patients according to characteristics of wound infection

Table 6: Distribution of patients with additional dose of antibiotics.

Sn.	Additional treatment required	No. of patients
1	None	172
2	Antibiotics only	1
3	Antibiotics with drainage	0
4	Secondary suturing after drainage	2
5	Total	175

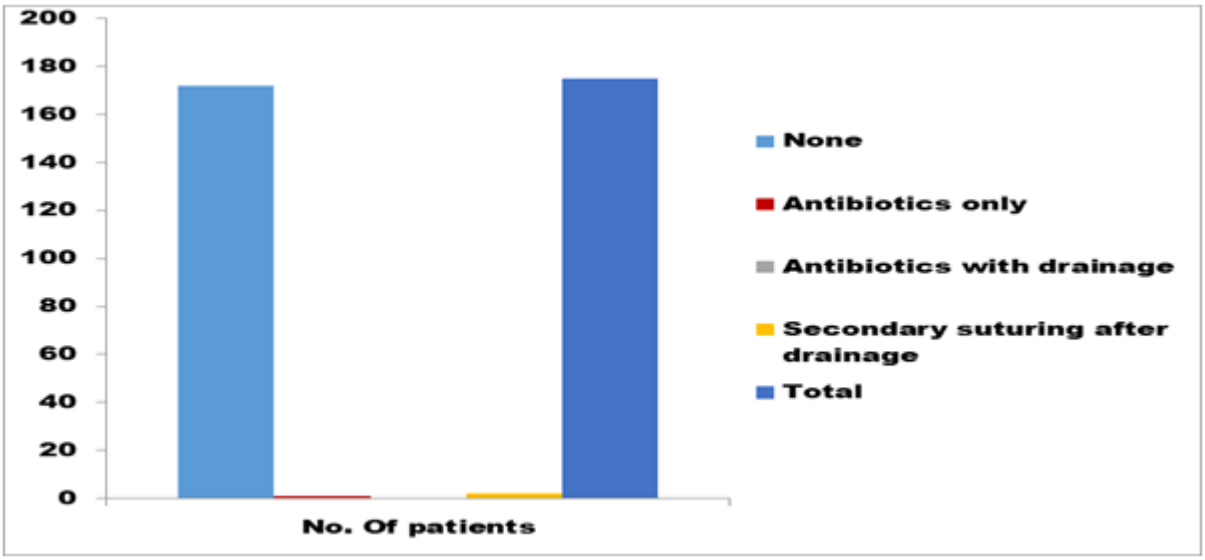

Figure 6: Distribution of patients with additional dose of antibiotics.

Table 7: Wound status of operated patients from day 2 to day 7.

Sn.	Surgery	Stay in Days	Wound Status on Day 2	Wound Status on day 3	Wound Status On Day 7
1	Hernia	2	Induration in One case	Induration in One case	Healthy
2	MRM	2	Blackening in two cases others healthy	Blackening in two cases others healthy	Tissue necrosis in two cases others healthy
3	Fibroadenoma	1	Healthy	Healthy	Healthy
4	Varicose vein & Hydrocoele	2	Healthy	Healthy	Healthy
5	Thyroid	2	Healthy	Healthy	Healthy
6	Swelling & Cysts	1	Healthy	Healthy	Healthy
7	Other Clean sugeries	2	Healthy	Healthy	Healthy

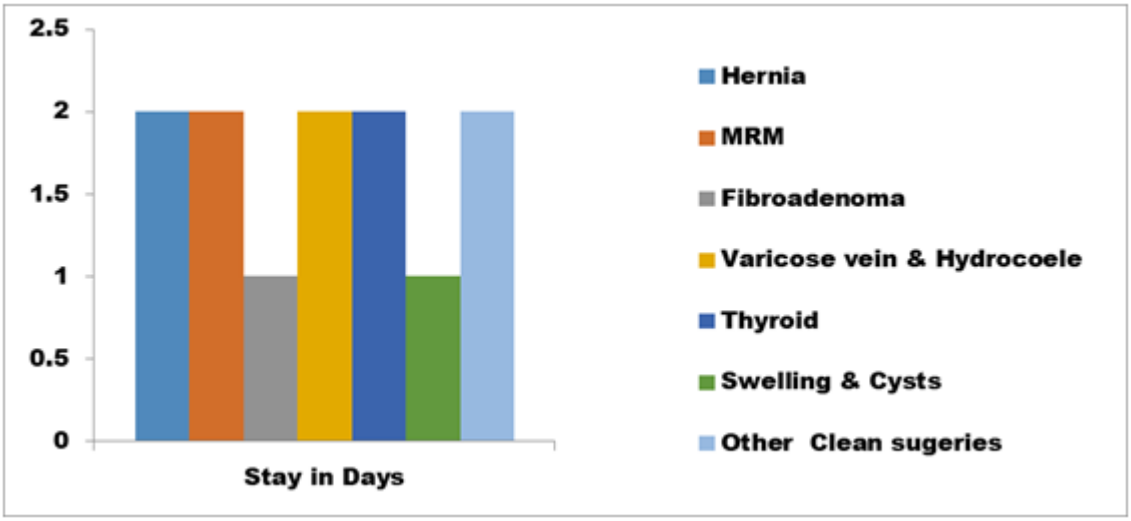

Figure 7: Wound status of operated patients from day 2 to day 7.

Table 8: Characteristics of wound in operated patients from day 2 to day 7.

Wound Character	No. of patients on day 2	No. of patients on day 7	Absent
Erythema & induration	3	3	172
Discharge& Discolouration	2	0	173
Stitch Abscess	0	2	173

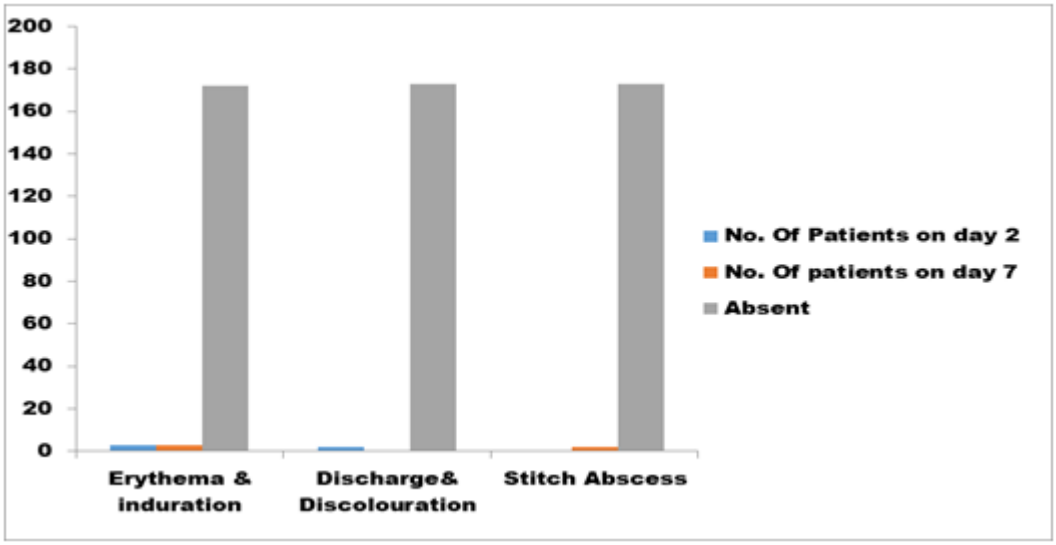

Figure 8: Characteristics of wound in operated patients from day 2 to day 7.

Discussion

Perioperative administration of antibiotics has become a cornerstone in modern medicine in order to prevent post-operative infections. With the advent of antibiotics and their widespread use, the reports of wound infection has drastically reduced.

We conducted a hospital based observational and descriptive study with view to clarify this issue on scientific basis. Total 175 patients being evaluated to have single dose perioperative antibiotic prophylaxis. In total 3 cases (1.71%) with infections were detected. In one case erythema noted in hernia and in two breast surgery cases flap necrosis noted.

In these three cases additional treatment required. In hernia (erythema & induration) case additional five days antibiotic given. In MRM (erythema, induration & flap necrosis) cases antibiotic given and secondary suturing done. In our study, mean hospital stay was two days and in flap necrosis cases 7 days. Our study is not comparative study so we can't prove significant difference between antibiotic and no antibiotic groups. But there are many studies including seed article shows expected proportion of cases with postoperative wound infection was 2.66% and in our study it is 1.92%.

To find out the economical saving achieved with the right prophylaxis to prevent surgical wound infections, a study was done by Arjona *et al.,* (1996). He operated a total of 5260 patients during 1990-93. Making all variables constant, i.e immunodeficiency, incorrect healing, re-operated patients, type of surgery and wrong prophylaxis, the percentage of infection prevented by right prophylaxis and the expenses was evaluated including the number of extra days of infection. Cost benefit ratio was 1/17 in 4 years. Therefore, in order to avoid the development of infections, the right prophylaxis is very important.

Similarly, Chen *et al.,* 2002 investigated the amount of surgical prophylaxis in order to determine the appropriate course of action to control the usage of antibiotics and reduce the burden of resistance, a study was conducted at the Medical centre in Southern Taiwan. They reported that the average duration of antibiotic use was 6.4 days and Prophylaxis was extended for one day in 80% of patients and three days in 68.2%. The most common regimen was cefazolin and gentamycin used in 75.3% of procedures. They suggested that if a single dose of cefazolin was used for all patients, the expenses might have epontentionally

declined by 92.1%. This particular study documented the excessive use and often inappropriate timing of administration of antibiotics for surgical prophylaxis resulting in increased cost and emergence of resistant micro-organisms. Considering the above data, the present study was carried out using single dose antibiotic approach which not only proved cost effective method but also showed less morbidity and hospital stay.

Conclusion

We conclude that single-dose antibiotics are sufficient in preventing wound infection. Prolonged administration of antibiotics is unnecessary and costlier. Wound infection is equally seen in both males and females without being associated with sex predominance. Prolonged use of antibiotics is associated with emergence of resistant strains and superinfections, which can be prevented by cost-effective short-term antibiotic prophylaxis.

Similarly, the population is not large enough to provide, conclusive assessments of the individual procedures considered in isolation. However, the proportional reduction in risk of infection was about the same for all the procedures studied and there was no statistically significant difference in prophylactic effect among the procedures.

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