Study on Risk Factors and Antibiotic Use Pattern in Surgical Site Infections

Submitted by:

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M.Pharm ID: 2010-3-79-002

Submission Date: July 2012

Department of Pharmacy

East West University

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A thesis presented in partial fulfilment for the degree of Master of Pharmacy in Clinical Pharmacy and Molecular Pharmacy

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This thesis paper was submitted to the department of Pharmacy, East West University, on “Study on Risk Factors and Antibiotic Use Pattern in Surgical Site Infections” in partial fulfilment of the requirement for the degree of Master of Pharmacy (M. Pharm) carried out by Zeenat Akter (ID: 2010-3-79-002).

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Certificate

This is to certify that the research work on "Study on Risk Factors and Antibiotic Use Pattern in Surgical Site Infections" submitted to the department of Pharmacy, East West University, Aftabnagar, Dhaka in partial fulfilment of the requirements for the degree of Master of Pharmacy (M. Pharm) was carried out by Zeenat Akter (ID: 2010-3-79-002) under our guidance and supervision and that no part of the thesis has been submitted for any other degree. We further certify that all the sources of information in this connection are duly acknowledge.

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Abstract

Surgical Site Infection (SSI) has an enormous impact on patients' quality of life and contributes significantly to the financial cost of patient care. The study was conducted to find how the risk factors influence the rate of SSI and to know about the use pattern of antibiotics in the management of SSI. In the study, data of 100 surgical patients were collected from two different hospitals namely Gonoshasthaya Nagar Hospital, Dhaka (GSNH) and Sher-E-Bangla Medical College Hospital, Barishal (SMCH).

The study population consisted of 38% male and 61% female. The analysis done by SPSS 13, found that the maximum frequency of surgical patients was within the age of 40-45 for both male and female patients. Overall rate of SSI was found to be 13% in 100 patients. Individually, 9.7% surgical patients of GSNH and 18.4% of SMCH had SSI. Nearly 6% of the total patients had diabetes mellitus. About 50% of them developed SSI. The rate was 11.24% for those who did not have diabetes mellitus. Out of 100 patients, 12 patients had coexisting infection and rate of SSI with coexisting infection was 33.3%. Rate of infection increased with the order of wound class being highest 42.9% at 'Contaminated' class. Almost similar trend of 43% SSI rate was found in case of ASA Score 3. On average, patients in SMCH stayed for 2 times longer duration than GSNH patients. 21% surgical patients were given Ciprofloxacin as prophylaxis. In 19% cases Cefuroxime was used. In combination form, Ciprofloxacin and Metronidazole were given to 27% patients. Ciprofloxacin prevented the development of SSI for 92% surgical patients.

Therefore, the study showed that Ciprofloxacin was the most effective antibiotic in SSI management; SSI rate was higher for the patients with Diabetes Mellitus than those who did not have it and longer duration of hospitalization in SMCH increased the SSI rate than the patients at GSNH. This study emphasized on antibiotic used and risk factors associated with SSI. However further study on etiological agents is suggested which may be required for making precise selection of antibiotics.

Chapter 1
INTRODUCTION

1.1 Overview

Wound infection is a common post-operative complication. Surgical site infections (SSI), formerly called surgical wound infections, are found in the incision site after surgery. Postoperative wound infections have an enormous impact on patients' quality of life and contribute significantly to the financial cost of patient care. Postoperative wound infection is a health care burden as it increases the length of hospital stay, drains resources and decreases productivity. In the context of Bangladesh health system, where average postoperative environment and care is presumably not up to the mark, the risk of postoperative infection is high. So it is very important to ensure rational use of antibiotics. The proposed study will not only provide a detailed account of how the present practice of prescribing antibiotics are influencing the rate of postoperative infections but also describe other risk factors associated with postoperative infections.

Surgical site infection may be prevented by controlling the risk factors before the surgery. Even when sterile procedures are adopted, surgical techniques can introduce bacteria and other microbes in the blood, which can lead to infect different parts of the body. Preoperative antibiotic prophylaxis administration inhibits growth of contaminating bacteria (SIGN, 2008) and thus reducing the risk of infection. Prophylaxis antibiotic are used to reduce the incidence of postoperative wound infections and it is indicated for procedures associated with high infection rates, those involving implantation of prosthetic material, and those in which the consequences of infection are serious. Surgical site infection increases the length of hospital stay (Plowman, 2000). The additional length of stay is dependent on the type of surgery. Prophylaxis has the potential to shorten hospital stay.

However, irrationalized prophylaxis administration may reduce the efficacy of the antibiotic as micro organism offers resistance when the prophylaxis is not used in proper way. Therefore, one of the aims of rationalising surgical antibiotic prophylaxis is to reduce the inappropriate use of antibiotics thus minimising the consequences of misuse.

1.2 Surgical Site Infection

A post operative wound infection or surgical site infection (SSI) is an infection of a wound from a surgery. Many micro-organisms live in and on our bodies and also in our environment. The bacteria may come from the skin; from the air, soil or water; or from the object used during the surgery (Plowman, 2000). Likewise, it may be caused by complications from surgical hypothermia; contamination of the incision area by skin flora; surgical instrument contamination; and bacterial cross–contamination. Our bodies have natural defenses against the few germs that can cause harm. Our skin, for example, prevents germs from entering our bodies. A surgical wound infection occurs when germs enter the incision that the surgeon makes through patient's skin in order to carry out the operation. . Most surgical wound infections are limited to the skin, but can spread occasionally to deeper tissues. Infections are more likely to occur after surgery on parts of the body that harbor lots of germs. It may affect closed wounds or wounds left open to heal; superficial or deep tissues; and in severe cases, the internal organs. A surgical wound infection can develop at any time from two to three days after surgery until the wound has healed (usually two to three weeks after the operation). Very occasionally, an infection can occur several months after an operation. An early infection presents within 30 days of a surgical procedure, whereas an infection is described as intermediate if it occurs between one and three months afterwards and late if it presents more than three months after surgery. A wound infection is described as minor if there is discharge without cellulitis or deep tissue destruction, and major if the discharge of pus is associated with tissue breakdown.

CDC (Centers for Disease Control and Prevention) (Horan *et al.*, 1992) provides guidelines and tools to the healthcare community to stop surgical site infections and resources to help the public understanding these infections and take measures to safeguard their own health when possible (CDC, 2012).

1.3 History of management of post operative infection:

History of SSI dates back to the mid-19th century, when surgical patients commonly developed complexity in form of postoperative “fever,” followed by purulent discharge from their incisions, intensive sepsis and often death. In the late 1800s Joseph Lister, a British surgeon and pioneer of antiseptic surgery, introduced new principles of cleanliness which transformed surgical practice. This is popularly known as principles of antisepsis (Conte, 1994) and it substantially reduced postoperative infectious morbidity. However, Erichsen, from University College Hospital in London was not convinced by this principle. Erichsen used the phrase ‘hospitalism’ for what we now call healthcare-associated infection’. He provided 13 recommendations for its prevention - many of which remain valid to-day (Newsom, 2008). The incidence of postoperative infections decreased after 1941 and reached a low level until 1954. In the 1960s, before the correct use of antibiotics and the advent of modern preoperative and postoperative care, as much as one quarter of a surgical ward might have been occupied by patients with wound complications. As a result, wound management, in itself, became an important component of ward care and of medical education (Meakins, 2008).

However, the incidence then began to increase due to many factors besides the use and misuse of antimicrobics (Reimann, 1963). The incidence probably cannot be reduced greatly because of the hazards of operations performed now-a-days in vital areas, the extensive use of antimicrobic agents, and immunosuppressive drugs.

1.4 Sign and Symptoms of SSI

Postoperative infection often presents with nonspecific pain and swelling and can be difficult to diagnose accurately. Timely detection and accurate localization of infectious processes have important clinical implications and are critical to appropriate patient management..

Specific sign and symptoms of surgical site infection could be the following

- A wound that is painful, even though it does not look like it should be.
- High or low body temperature, low blood pressure, or a fast heart beat.
- Increased discharge (blood or other fluid) or pus coming out of the wound. The discharge or pus may have an odd color or a bad smell.
- Increased swelling that goes past the wound area and does not go away after five days. Swollen areas usually look red, feel painful, and feel warm when you touch them.
- Wounds that do not heal or get better with treatment.

1.5 Type of SSI

According to the Centers for Disease Control and Prevention (CDC)'s guideline, SSIs are separated into three types, depending on the depth of infection penetration into the wound (Mangram *et al.*, 1999). By these criteria, SSIs are classified as being

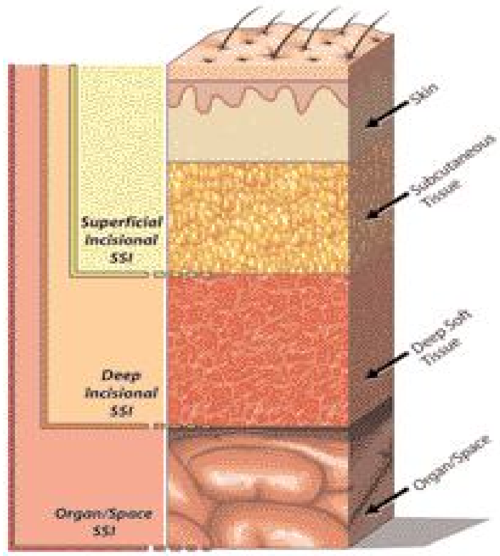

Figure 1.1 Types of SSI relating to infection penetration depth (Pear, 2007).

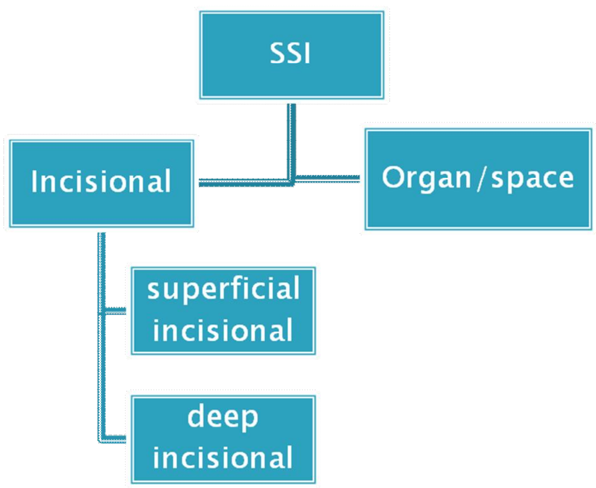

Figure 1.2 Classification of SSI

either incisional or organ/space. Incisional SSIs are further divided into those involving only skin and subcutaneous tissue (superficial incisional SSI) and those involving deeper soft tissues of the incision (deep incisional SSI). Organ/space SSIs involve any part of the anatomy (e.g., organ or space) other than incised body wall layers that was opened or manipulated during an operation (Figure 1.1 & 1.2).

1.5.1 Superficial incisional infection

Superficial incisional infection defined as a surgical site infection that occurs within 30 days of surgery and involves only the skin or subcutaneous tissue of the incision, and meets at least one of the following criteria:

- Purulent drainage from the incision.
- Organisms isolated from an aseptically obtained culture of fluid or tissue from the incision
- At least one of the following signs or symptoms of infection - pain or tenderness, localised swelling, redness or heat

1.5.2 Deep incisional surgical site infections

Deep incisional surgical site infections must meet the following three criteria: it occurs within 30 days of procedure (or one year in the case of implants); it is related to the procedure and this involves deep soft tissues, such as the fascia and muscles. Besides deep incisional surgical site infections may involve any of the following criteria:

- Purulent drainage from the incision but not from the organ/space of the surgical site

- A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms - fever (>38°C), localized pain or tenderness - unless the culture is negative

- An abscess or other evidence of infection involving the incision is found on direct examination or by histopathologic or radiological examination

- Diagnosis of a deep incisional SSI by a surgeon or attending physician.

1.5.3 Organ/Space SSI

In Organ/Space SSI occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and infection involves any part of the anatomy (e.g., organs or spaces), other than the incision, which as opened or manipulated during an operation and at least one of the following:

- Purulent drainage from a drain that is placed through a stab wound into the organ/space.
- Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.
- An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by
- Histopathology or radiologic examination.
- Diagnosis of an organ/space SSI by a surgeon or attending physician.

1.6 Rates of infection:

In various studies, the rate of infection has been found out base on different influencing factors. These factors include, Type of surgery, surgical classification, Area of surgery, Patient's ASA physical status, length of operation, prophylaxis use of antibiotic and also some patient related risk factors like- age, Diabetes Mellitus, Obesity, Smoking, Pre-existing Remote Body Site Infection etc.

According to the NNIS (National Nosocomial Infections Surveillance by US Centres for Disease Control) system reports, SSIs are the third most commonly reported nosocomial infection, accounting for 14% to 16% of all nosocomial infections among hospitalized patients (Emori and Gaynes, 1993).

In Bangladesh the incidence of Surgical Site Infections (SSIs) ranged from 11% to 30% (Saha and Ashrafuzzaman, 2008) and accounts for 38% among various types of nosocomial infections (Atai *et al.*, 2000).

Before the systematic use of prophylactic antibiotics infection rates were 1-2% or less for clean wounds, 6-9% for clean-contaminated wounds, 13-20% for contaminated wounds and about 40% for dirty wounds(Cruse and Foord, 1980). But now infection rates in US National Nosocomial Infection Surveillance (NNIS) system hospitals were reported to be: clean 2.1%, clean-contaminated 3.3%, contaminated 6.4% and dirty 7.1%(Culver *et al.*, 1991). So since the introduction of routine prophylactic antibiotic use, infection rates in the most contaminated groups have reduced drastically. There is, however, considerable variation in each class according to the type of surgery being performed.

A research was carried out over a two year period in Cumhuriyet University Medicine Faculty Hospital in Sivas, Turkey. Where, High infection rates were noted after colon resection (32·1%), gastric and oesophageal operations (21·1%), cholesystectomy (17·2%), and splenectomy (10·2%) and Low infection rates were noted after thyroidectomy, mastectomy, caesarean section and abdominal hysterectomy.(YalÃ§in *et al.*, 1995).

1.7 Sources of infection

Sources of infection are widely varied. Infections may be primarily acquired from a community or endogenous source such as that following a perforated peptic ulcer or secondarily from exogenous sources such as from the operating theatre with inadequate air filtration or the ward (e.g. poor hand washing compliance) or from contamination at or after surgery (such as an anastomotic leak). Wound infection is caused by exogenous or endogenous bacteria; infection is influenced not only by the source of the infecting inoculum but also by the bacterial characteristics (Meakins, 2008).

1.7.1 Endogenous factors or sources of bacteria:

- Co-existing infection in other site of body
- Skin
- Bowel
- Nature and site of operation (Clean, Clean-contaminated, contaminated, and Dirty)

1.7.2 Exogenous factors or sources of bacteria

- Operating team–related – Comportment; Use of impermeable drapes and gowns; Surgical scrub.
- Operating room–related - Traffic control; Cleaning; Air

Surgical wound infections are also strongly influenced by the risk factors related to patients - extremities of age, obesity, diabetes mellitus, smoking habit, coexisting infection at other site etc.

1.8 Etiological agents:

Many different bacteria, viruses, fungi and parasites may cause wound infections. Infections may be caused by a microorganism acquired from another person in the hospital (cross-infection) or may be caused by the patient's own flora (endogenous infection). Some organisms may be acquired from an inanimate object or substances recently contaminated from another human source (environmental infection).

The skin is colonised by various types of bacteria, but up to 50% of these are Staphylococcus aureus (Eriksen *et al.*, 1995). The most common postoperative superficial wound infection often presents with localised pain, redness and slight discharge, occurring within the first week, usually caused by skin staphylococci. According to data from the national nosocomial infection surveillance system, the distribution of pathogens isolated from SSIs has not changed markedly during the last decade where Staphylococcus aureus, Coagulase-negative Staphylococci (CoNS), Enterococcus spp. And Escherichia coli remain the most frequently isolated pathogens (Mangram *et al.*, 1999). Furthermore, nosocomial blood stream infections are usually caused by Gram-positive organisms including Coagulase negative Staphylococcus, S. aureus, Enterococci (Samuel *et al.*, 2010) (Chinnial, 2009) and these microorganisms nearly always represent true bacteremia such as E. coli and other members of the Enterobacteriaceae, Pseudomonas aeruginosa, and Streptococcus pyogenes (Chinnial, 2009).

In analyses of contamination rates after cholecystectomy, the main source of wound contamination was found to be the skin of the patient. So post operative SSI can be most commonly occur due to *Staph. Aureus*. However, a research conducted by YalÃ§in, A.N., *et al* (YalÃ§in *et al.*, 1995) showed slightly different output. According to their findings the commonest causative organisms in surgical wound infection are coagulase-negative staphylococci 21·7%, *Staphylococcus aureus* 19·7%, *Escherichia coli* 19·7%, *Enterobacter* spp. 17·6%, and *Pseudomonas* spp. 10·7%.

Patients undergoing colorectal operations, the degree of contamination was assessed by the recovery of Enterobacteriaceae spp. or *Staphylococcus aureus* in peritoneal irrigation fluid using dip-slides. Intraoperative contamination was strongly associated with postoperative infection (Claesson and Holmlund, 1988).

Another study in Bangladesh in 1992, showed that *Esch. Coli* was the major pathogen (60.0%) in the postoperative infection followed by *Staph. Aureus.*

1.9 Risk factors of SSI

Patient and operation characteristics that may influence the risk of SSI development may be listed in order. These characteristics are useful in two ways: (1) they allow systematic approach of operations, making surveillance data more comprehensible; and, (2) knowledge of risk factors before certain operations may allow for targeted prevention measures. For example, if it is known that a patient has a remote site infection, the surgical team may reduce SSI risk by scheduling an operation after the infection has resolved. A guideline (Mangram *et al.*, 1999) lists the other risk factors which substantially affect the surgical infection in different way. These are shown in Table 1.1

Table 1.1 List of Risk Factors

Age
Nutritional status
Diabetes
Smoking
Obesity
Coexistent infections at a remote body site
Colonization with microorganisms

Altered immune response
Length of preoperative stay
Operation
Duration of surgical scrub
Skin antisepsis
Preoperative shaving
Preoperative skin prep
Duration of operation
Antimicrobial prophylaxis
Operating room ventilation
Inadequate sterilization of instruments
Foreign material in the surgical site
Surgical drains
Surgical technique
Poor hemostasis
Failure to obliterate dead space
Tissue trauma

The US Centres for Disease Control's (CDC) NNIS (National Nosocomial Infections Surveillance) risk index is the method of risk adjustment most widely used internationally (Culver *et al.*, 1991). Risk adjustment is based on three major risk factors:

1. The patient's state of health before surgery is reflected The American Society of Anesthesiologists (ASA) score, reflecting
2. Wound class, reflecting the state of contamination of the wound
3. Duration of operation, reflecting technical aspects of the surgery.

1.9.1 ASA Score

The ASA physical status classification (Table 1.2) is a system for evaluate the fitness of patients before surgery.

Table 1.2 ASA classification of physical status

ASA score	Physical status
1	A normal healthy patient
2	A patient with a mild systemic disease
3	A patient with a severe systemic disease that limits activity, but is not incapacitating
4	A patient with an incapacitating systemic disease that is a constant threat to life
5	A moribund patient not expected to survive 24 hours with or without surgery

An ASA score >2 is associated with increased risk of wound infection.

1.9.2 Wound Class:

A system of classification for operative wounds that is based on the degree of microbial contamination was developed by the US National Research Council group in 1964. This classification include four classes with an increasing incidence of bacterial contamination and subsequent incidence of postoperative infection (Berard and Gandon, 1964). Definitions of four classes are provided below:

1.9.2.1 Clean

The wound is considered to be clean when the operative procedure does not enter into a normally colonized viscus or lumen of the body. Not emergency, non-traumatic, primarily closed; no acute inflammation; no break in technique; respiratory, gastrointestinal, biliary and genitourinary tracts not entered. SSI rates in this class of procedures are less than 2.1%, depending upon clinical variables, and often originate from contaminants in the OR environment, from the surgical team or most commonly from skin.

1.9.2.2 Clean-contaminated

When the operative procedure enters into a colonized viscus or cavity of the body, but under elective and controlled circumstances. It's a emergency case that is otherwise clean; elective opening of respiratory, gastrointestinal, biliary or genitourinary tract with minimal spillage (e.g. appendectomy) not encountering infected urine or bile; minor technique break. SSI rates in this class of procedures range from 3.3%.

1.9.2.3 Contaminated

When gross contamination is present but no infection is obvious, a surgical site is considered to be contaminated. As with clean-contaminated procedures, the contaminants are bacteria that are introduced by soilage of the surgical field. SSI rates in this class of procedures can exceed 6.4%.

1.9.2.4 Dirty

If active infection is already present in the surgical site, it is considered to be a dirty wound. Pathogens of the active infection as well as unusual pathogens will likely be encountered. SSI rates in this class of procedures can exceed 7.1%.

In a survey performed by Ortega, G. *et al* (Ortega *et al.*, 2011) between 2005 and 2008 using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) dataset where a total of 634,426 cases were analyzed and when classified according to the wound classification the results were obtained as shown in Table 1.3.

Table 1.3 Percent of different types of SSI depending on wound classes (Ortega *et al.*, 2011)

Type of SSI	Wound classes			
	Clean	Clean-Contaminated	Contaminated	Dirty
Superficial	1.76%	3.94%	4.75%	5.16%
Deep incisional infections	0.54%	0.86%	1.31%	2.1%
Organ/space infection	0.28%	1.87%	2.55%	4.54%

However, the researchers concluded that substantially lower rates of surgical site infections in the contaminated and dirty wound classifications were found when compared with literature prior to their research.

1.9.3 Duration of the operation

Duration of surgery is positively associated with risk of wound infection and this risk is additional to that of the classification of operation. The duration of the operation exceeds the 75^{th} percentile of operation time (T point) as determined from the NNIS database. See Table 1.4 for the length of time in hours that represents the 75th percentile for some common surgical procedures

Table 1.4 Duration of Operation

Operation	T Point (hrs)
Coronary artery bypass graft	5
Bile duct, liver or pancreatic surgery	4

Craniotomy	4
Head and neck surgery	4
Colonic surgery	3
Joint prosthesis surgery	3
Vascular surgery	3
Abdominal or vaginal hysterectomy	2
Ventricular shunt	2
Herniorrhaphy	2
Appendectomy	1
Limb amputation	1
Cesarean section	1

In this study operations that lasted longer than the 75th percentile for the procedure were classified as prolonged.

1.9.4 Length of hospital stay before surgery

Another vital factor is the length of hospital stay before surgery. A hospital might not be free from germs if the environment is not properly maintained and if visitors are not controlled. Prolonged preoperative hospital stay is frequently suggested as a patient characteristic associated with increased SSI risk. More days a patient passes in the hospital before operation, the more the patient is under the increased risk of post operative infection. Therefore, increased length of hospital stay jeopardizes the patient's physical status to point where surgery may inflict infections.

1.10 Patient-Related Risk Factors for Surgical Site Infection

There are several patient-related variables that affect a patient's risk of developing an SSI. Some variables, such as age and gender, are obviously not amenable to change or improvement. Fortunately, however, a number of other potential factors, such as nutritional status, smoking, proper use of antibiotics and intraoperative technique, can be improved to support the possibility of a positive surgical result. Some of the more commonly identified patient risk factors for surgical site infection include: pre-existing diabetes and/or perioperative hyperglycemia, obesity or malnutrition, co-existing infection, recent tobacco use, contaminated or dirty wound etc.

1.10.1 Diabetes mellitus

Diabetes mellitus is a risk factor for deep wound infection. There were 183 DM patients included in a study, where 28 (15%) of whom developed SSI(Sehgal *et al.*). In another study, where the Patients were divided into two groups: those with relatively "good" perioperative glucose control (all values ≤220 mg/dL) and those with "poor" control (at least one value >220 mg/dL). In patients with hyperglycemia (>220 mg/dL) on POD 1, the infection rate was 31.3% which was 2.7 times then the infection rate 11.5% in diabetic patients with all serum glucose values <220 mg/dL(Pomposelli *et al.*, 1998). So for diabetic patients the serum glucose level is highly recommended to maintain before surgery.

1.10.2 Obesity

Obesity, usually defined as having a body-mass index greater than or equal to 30 kg/m,2 is another patient risk factor for SSI that has proven difficult to pin down. Often there is insufficient time prior to the surgery to significantly reduce the patient's degree of obesity.

1.10.3 Smoking

Nicotine use delays primary wound healing and may increase the risk of SSI. Cigarette smoking has been associated with inhibited wound healing and decreased circulation to the skin due to microvascular obstruction from platelet aggregation and increased non-functioning hemoglobin. In addition, smoking has been found to compromise the immune system and respiratory system.

1.10.4 Pre-existing Remote Body Site Infection

Not infrequently, patients harbor indolent dental, urinary or skin soft tissue infections at the time of surgery. The major concerns about the presence of a pre-existing infection are that it may: 1) be the source for hematogenous spread, causing late infections to joint prostheses or cardiac valves, or 2) be a contiguous site for bacterial transfer. These infections at a site remote from the wound have been linked to increasing SSI rates three- to five-fold.

1.10.5 Extreme of Age

A recent study examined risk factors for SSI among patients who were aged >64 years; the study included 569 patients with SSI and 589 control subjects (Kaye *et al.*, 2004). The procedures most commonly performed for the study subjects were cardiothoracic procedures (31.5% of all procedures) and orthopedic procedures (22.2% of all procedures).

In Japan a large scale survey was conducted to examine risk factors for surgical site infections. One of the purposes of the study was to investigate age as a risk factor for SSIs in gastrointestinal surgery. patient age is a significant predictor for SSIs in some gastrointestinal procedures(Utsumi *et al.*).

1.11 Diagnosis of SSI

1.11.1 Physical exam:

Caregivers will look closely at the wound, including the area around it. He will check for swelling, discharge, and how much tissue is infected. He will also look for other problems or signs of spreading infection.

1.11.2 Blood tests:

The blood may be taken from the patient's hand, arm, or IV to find out the present of microorganism in to the blood.

1.11.3 Imaging tests:

Pictures of bones and tissues in the wound area may be taken using different imaging tests. Tests may include x-rays, magnetic resonance imaging (MRI), or bone scan. Caregivers use the pictures to look for broken bones, injuries, or foreign objects in the wound area.

1.11.4 Tissue biopsy and wound culture:

This is when a small piece of tissue is removed from wound. This sample is then sent to the lab for tests. The sample taken will also be checked to identify the germs in patient's wound. This helps caregivers learn what kind of infection the patient has and what medicine is best to treat it.

1.12 Treatment of SSI

There are many methods

1.12.1 Wound care:

1.12.1.1 Cleansing:

This may be done by rinsing the wound with sterile (clean) water. It may be done using high pressure with a needle or catheter and a large syringe. Germ-killing solutions may also be used to clean your wound.

1.12.1.2 Debridement:

This is done to clean and remove objects, dirt, or dead skin and tissues from the wound area. Caregivers may cut out the damaged areas in or around the wound. Wet bandages may be placed inside the wound and left to dry. Other wet or dry dressings may also be used. Caregivers may also drain the wound to clean out pus.

1.12.1.3 Wound cover:

This may also be called a wound dressing. Dressings are used to protect the wound from further injury and infection. These may also help provide pressure to decrease swelling. Dressings may come in different forms. They may contain certain substances to help promote faster healing.

1.12.2 Medicines:

Caregiver may give antibiotic medicine to fight infection. Patient may also be given medicine to decrease pain, swelling, or fever.

1.12.3 Hyperbaric oxygen therapy:

This is also called HBO. HBO is used to get more oxygen into body. The oxygen is given under pressure to help it get into the patient's tissues and blood. The patient may need to have this therapy more than once.

1.12.4 Negative pressure therapy:

This is also called vacuum-assisted closure (VAC). A special foam dressing with an attached tube is placed inside the wound cavity and tightly covered. The tube is connected to a pump which will help suck out excess fluid and dirt from the wound. VAC may also help increase blood flow and decrease the number of bacteria in the wound.

1.13 Use pattern of antibiotics:

Appropriately administered antibiotic reduces the incidence of surgical wound infection. Antibiotics have two uses in surgery: (1) To treat established infections. (2) To prevent postoperative infection. Management of antibiotic in the treatment of surgical infection covers a broad aspect. It is important to recognize the difference between Therapeutic, prophylactic and empiric therapy. Therapeutic antimicrobial therapy prescribed to clear infection by an organism or to clear an organism that is colonising a patient but is not causing infection. Prophylactic antibiotic should cover the most likely contaminating organisms and be present in the tissues when the initial incision is made and must be given 30-60 minutes before incision. The goal of prophylactic antibiotics is to reduce the incidence of postoperative wound infection. Empiric therapy is the continued use of antibiotics after the operative procedure based upon the intra-operative findings. Patients undergoing high infection rates should receive perioperative antibiotics.

However, treatment, rather than prophylaxis is required in case of preexisting infection. So Timing of antibiotic administration is critical to efficacy.

1.13.1 Prophylactic antibiotics

Prophylactic antibiotics decrease the risk of infection and represents important components of most favourable management of the surgical patient. So errors in antimicrobial prophylaxis for surgical patients remain one of the most frequent types of medication errors in hospitals. The antibiotics selected for prophylaxis must cover the expected pathogens responsible for infection, should achieve adequate tissue levels during operation, cause minimal side effects and be relatively inexpensive (WOODS and DELLINGER, 1998).

A prophylactic antibiotic should be used where evidence of benefit exists. Choice of antibiotic depend on type of surgery, area of surgery, etiological agents mostly responsible for wound infections, patient's physical status and wound class.

According to the Antibiotic prophylaxis in surgery (A national clinical guideline) Scottish Intercollegiate Guidelines Network, Prophylaxis antibiotics are highly recommended for Appendicectomy , Colorectal surgery, Caesarean section, Transurethral resection of the prostate, and Arthroplasty surgery to reduces major morbidity, hospital costs (SIGN, 2008). In gynaecology, For prophylaxis, first generation cephalosporins are suitable choices to prevent postoperative sepsis, by E. coli, S. aureus and B. fragilis (Houang, 1994).

Many systematic studies were carried out to measure the relative efficacy of antimicrobial prophylaxis for the prevention of postoperative wound infection in different surgery.

1.13.2 Selection of Antibiotic

1.13.2.1 Spectrum.

The antibiotic chosen should be active against the most likely pathogens. Single-agent therapy is almost always effective except in colorectal operations, small bowel procedures with stasis,emergency abdominal operations in the presence of polymicrobial flora, and penetrating trauma; in such cases, a combination of antibiotics is usually used because anaerobic coverage is required.

1.13.2.2 Pharmacokinetics.

The half-life of the antibiotic selected must be long enough to maintain adequate tissue levels throughout the operation.

1.13.2.3 Administration

Dosage, route, and timing

A single preoperative dose that is of the same strength as a full therapeutic dose is adequate in most instances. The single dose should be given IV immediately before skin incision. Administration by the anesthetist is most effective and efficient.

Duration

A second dose is warranted if the duration of the operation exceeds either 3 hours or twice the half-life of the antibiotic. No additional benefit has been demonstrated in continuing prophylaxis beyond the day of the operation, and mounting data suggest that the preoperative dose is sufficient. When massive hemorrhage has occurred (i.e., blood loss equal to or greater than blood volume), a second dose is warranted. Even in emergency or trauma cases, prolonged courses of antibiotics are not justified unless they are therapeutic. (Oreskovich *et al.*, 1982), (Boxma *et al.*, 1996)

1.14 Efficacy of Prophylaxis Antibiotic

The combination of ciprofloxacin plus metronidazole as well as several ß-lactum based regimens are commonly used regimens for the treatment of patients with such infections.

A study, performed on 509 patient of abdominal surgery, evaluated the efficiency of co-amoxiclav compared with cefuroxime plus metronidazole for the prevention of postoperative wound infections .In the study, 230 patients were given co-amoxiclav with and this came up with a total wound infection rate of 5.6%. Additionally, 225 patients were given cefuroxime plus metronidazole and that resulted in a total wound infection rate of 3%. It is noteworthy that the difference between infection rates was not significant (Palmer *et al.*, 1994).

In a Prospective study on 580 patients undergoing arterial surgery involving the groins was done to evaluate the efficacy of oral ciprofloxacin compare with IV cefuroxime as a prophylaxis. The patients were divided into two groups , and on the day of surgery one group was given ciprofloxacin 750 mg × 2 p.o. and the other one taken cefuroxime 1.5 g × 3 i.v. The wound infection rate in the ciprofloxacin group was 9.2% (27 patients) and in the cefuroxime group 9.1% (26 patients). The infection rate was similar in the two groups. Thus, oral administration of ciprofloxacin is an attractive, cost-effective and safe alternative to prophylaxis in vascular patients capable of taking oral medication on the day of surgery(Risberg *et al.*, 1995).

1.15 Impact of SSI

Infection is an important cause of morbidity in postoperative patients even though surgical procedure and antibiotic therapy keep on improving. Surgical site infections have many adverse effects on patient's health and economy. Surgical site infections (SSIs) result in up to $10 billion in costs every year. Compared to an uninfected patient, the patient with an SSI:

- Stays hospitalized 7 days longer;
- Is 60% more likely to spend time in the ICU;
- Is 5 times more likely to be readmitted within 30 days of discharge;
- Is twice as likely to die (Perencevich *et al.*, 2003)

The likelihood of infection varies by type of surgical incision site and the physical status of the patient. The wound classification system designed by the CDC classifies the increased risk and extent of bacterial contamination during the surgical procedure depends on four separate classes of procedures, which are Clean, Clean-contaminated, contaminated, and Dirty. Prophylaxis is uniformly recommended for all clean-contaminated, contaminated and dirty procedures. It is considered optional for most clean procedures, although it may be indicated for certain patients and clean procedures that fulfil specific risk criteria.

A wide variety of risk factors for surgical site infection after operations have crucial influence on patient's health. The percentage of surgical patients with diabetes can be much higher, depending on the type of surgery being performed. Surgical site infections are not uncommon to the patients with diabetes following operations, and they can be associated with serious morbidity, mortality, and increased resource utilization. The accurate identification of risk factors is essential to develop strategies to prevent these potentially devastating infections

Another vital factor is the length of hospital stay before surgery. A hospital might not be free from germs if the environment is not properly maintained and if visitors are not controlled. Prolonged preoperative hospital stay is frequently suggested as a patient characteristic associated with increased SSI risk. More days a patient passes in the hospital before operation, the more the patient is under the increased risk of post operative infection. Therefore, increased length of hospital stay jeopardizes the patient's physical status to point where surgery may inflict infections.

In Bangladesh, some hospitals are surely ensuring state-of-the art surgery procedure and environment to reduce the risk of post-operative infections but there are many instances in many parts of the country that hospital-environment are not up to the mark to restrain the spread of germs which in turn can increase the risk of post-operative infection rates. A recent study revealed that in Bangladesh, the occurrence of SSI ranged from 11% to 30% (Saha and Ashrafuzzaman, 2008). The present study addresses the issue regarding use of antibiotic as pre-operative, peri-operative and post-operative medication in the management of post-operative surgical site infection in the context of Bangladesh.

Aim and Objectives

The aim of the research is to study the risk factors associated with surgical site infection and the current trends of antibiotics use in addressing postoperative infections in Bangladesh by analyzing data from two hospitals situated in different geographical locations.

.Specific objectives required to achieve the goal are:

- Researching and appraising the current knowledge by reviewing the literature on postoperative site infections and administration of prophylaxis to manage them.
- Collecting surgical patients' data regarding their physical status, surgery, SSI (if any), duration of hospital stay and administration of antibiotic before and after surgery from at least two hospitals.
- Performing data analysis to obtain detailed account of different parameters
- Finding and comparing frequency of risk factors, incidence of SSI, types of antibiotics used
- Deriving a comprehensive suggestion of reducing risks and administration of antibiotics in SSI management.

Rationale of the study

Post-surgical infections are polymicrobial and it is an important cause of morbidity and mortality. If it is not properly diagnosed and treated a post operative site infection could be as deadly as to bring death to the patient. In most of the cases the postoperative infections depends on the surgery types and procedure; hospital environment and patient related factors. In spite of the use of prophylactic antibiotics, SSIs are still a real risk of surgery and represent a substantial burden of disease for both patients and healthcare services in terms of morbidity, mortality and economic cost. Most post-operative wound infections are hospital acquired and vary from one hospital to the other and even within a given hospitals and they are associated with increased morbidity and mortality. Increasing antibiotic resistance of pathogens associated with nosocomial infections also becomes a major therapeutic challenge for physicians.

There are many instances in different parts of our country that hospital-environment are not up to the mark to restrain the spread of germs. Increased number of visitors to the patients is not prohibited in most instances in a typical hospital in Bangladesh. Germs from outside is not controlled. This in turn can increase the risk of post-operative infection rates. A recent study revealed that in Bangladesh, the occurrence of SSI ranged from 11% to 30% (Saha and Ashrafuzzaman 2008).

Existing study and survey data on post operative infections, their risk factors and addressing SSI by antibiotics in Bangladesh are few. A new study will surely fill the voids to some extent in the field of SSI research in Bangladesh. Current rates of post operative infections in two specific yet typical hospitals shall give a generalized idea of rates of infections in Bangladesh. An investigation also required to find the risk factors influencing SSI in Bangladesh and types of antibiotics used to manage post operative infections. This shall provide a ground to select the best option of SSI management. Therefore, by considering the mentioned causes altogether the necessity of the present study is justified.

Scope of the thesis

Scope of the present research covers a comprehensive management of antibiotics in surgery detailing on information regarding antimicrobials prescribed, name of antibiotics, duration of antimicrobial therapy and incidence of postoperative infection .Variables to be recorded in the study are – age of the patient, gender, ASA physical status, wound class, type of antibiotic used, occurrence of infection, duration of hospital stay etc. The scope is limited to the data of surgical patients from two hospitals one of which is privately owned and the other is governmental. This variation in ownerships provides a substantial base for rational comparison in terms of antibiotic administration in surgery.

Chapter 2

METHODOLOGY

2.1 Type of Study

The study is based on retrospective data analysis. That is, the analysis used the patients' previous data which had been recorded as accounts of the conditions and treatment already the patient had undergone.

2.2 Place and duration of the Study

For the retrospective analysis, patients' data were collected from two hospitals, namely: Gonoshasthaya Nagar Hospital, Dhaka and Sher-E-Bangla Medical College Hospital, Barishal. These two hospitals, situated at two different geographic locations of Bangladesh, represent the common features of majority of general hospital spread across the country. The ownership style of these two hospitals also provides ground for comparing surgical infection rates and antibiotic administration. The study was carried out from March to June 2012.

2.3 Study Population

Number of observation was 100 of which 62 patients were from Gonoshasthya Nagar Hospital and 38 from Sher-E-Bangla Medical College Hospital.

2.4 Inclusion Criteria

Since the subject of interest was surgical infection therefore only the surgical patients of GSNH and SMCH were considered. Surgical Patients both male and female with age range 12-85 years constituted the sample population

2.5 Exclusion Criteria

General patients of medicine who did not go through surgery were not included. Child patients below 12 years of age were excluded from the study.

2.6 Study Approach

Data were collected directly from surgical patients file using a detailed questionnaire. Later, these data were analyzed for in which risk factors the patient went trough, surgery types and antibiotic use.

2.7 The Questionnaire

The questionnaire was designed in such way that the patients' data can be easily recorded from patients file. The questionnaire was majorly divided in several sections. The first section is for general information regarding the patient's gender, age, height, weight, and admission date. The second section deals with the ASA score and the wound class in which the patient falls into. The next section records the risk factors the patient is vulnerable to. Last two sections were designed to collect data related to surgery and antibiotics.

2.8 Analysis of Data

All data were systemically entered into excel sheet under various categories. Analysis is done by SPSS 13 using descriptive statistics. The variables used in analysis were shown in table 2.1.

Comparisons were made between the age range at which male and female patient had surgery. The post operative site infections in two hospitals were also compared statistically. The most common antibiotic used in two hospitals was found by frequency analysis. Relation between different risk factors with rate of surgical site infection was found by crosstabs analysis. The risk factors considered ASA score, Wound Class, Duration of hospitalization before surgery and Diabetes Mellitus.

Table 2.1 List of variables

Hospital code	Patient's gender	Age in month	Height in cm	Weight in Kg	ASA physical status
Wound class	No. of antibiotic	Name of the Preoperative antibiotic	Route of administration of Preoperative antibiotic	Duration of Preoperative antibiotic	No. of Prophylaxis antibiotic in OT
Name of the antibiotic in OT	Route of administration in OT	Extremes of age	Obesity	Diabetes mellitus	Smoking
Coexisting infection-other site	Operation done in days	Type of surgery	Area of surgery	Length of operation	Surgical drains
SSI(surgical site infection)	Name of the Postoperative antibiotics	Route of administration of Postoperative antibiotic	Duration of antibiotic postoperative antibiotics	Operation to discharge (days)	Duration of staying in hospital

Chapter 3

RESULTS

3.1 Gender Distribution

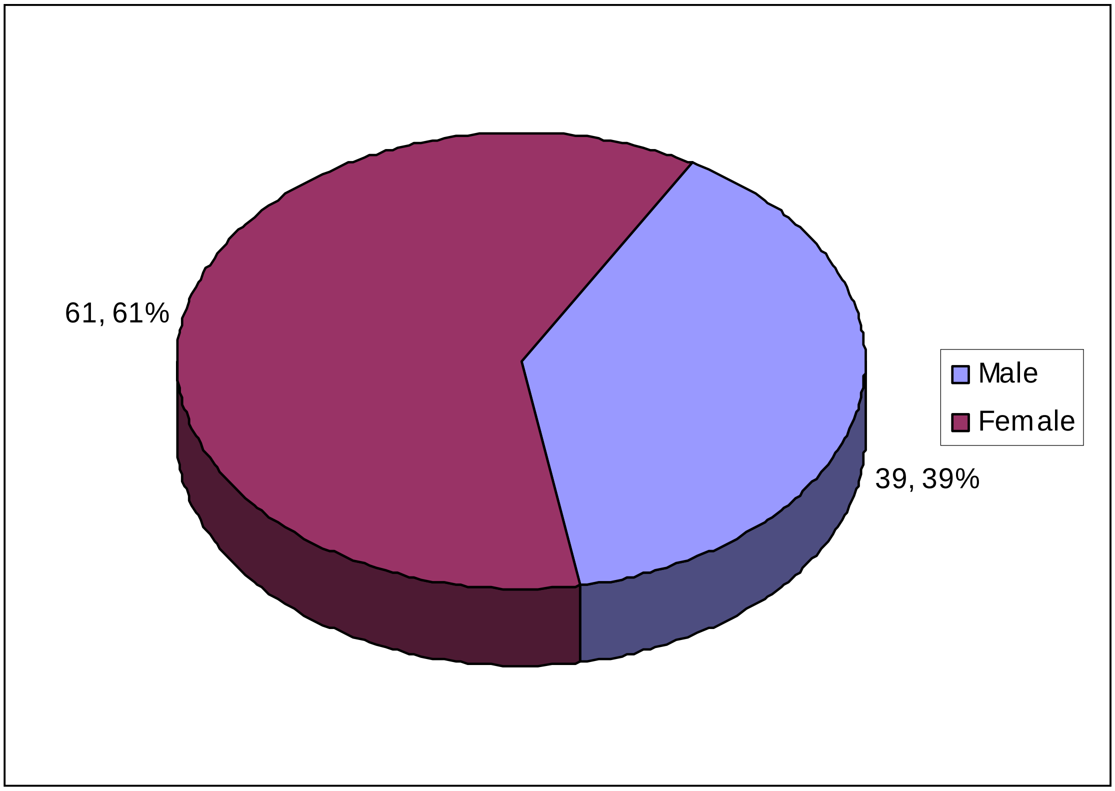

Figure 3.1 Ratio of male and female

In the study out of total 100 patients 61.6% were male and 39.4% were female.

3.2Age distribution

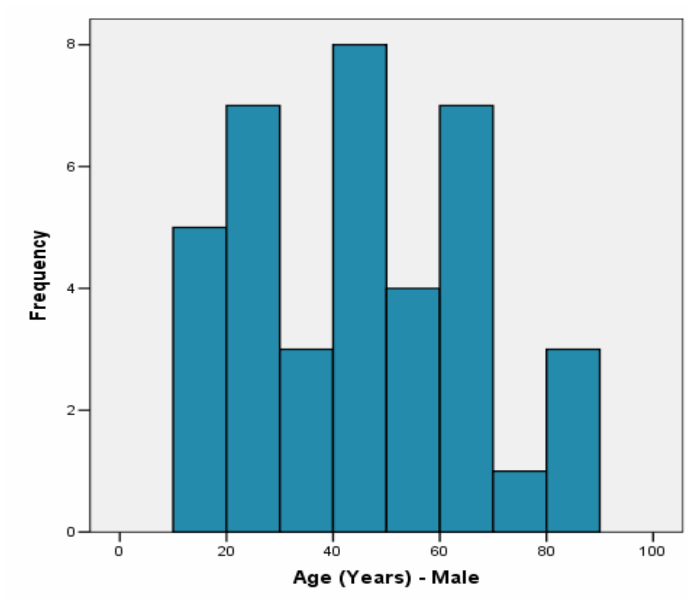

Figure 3.2 Age distribution of male patients

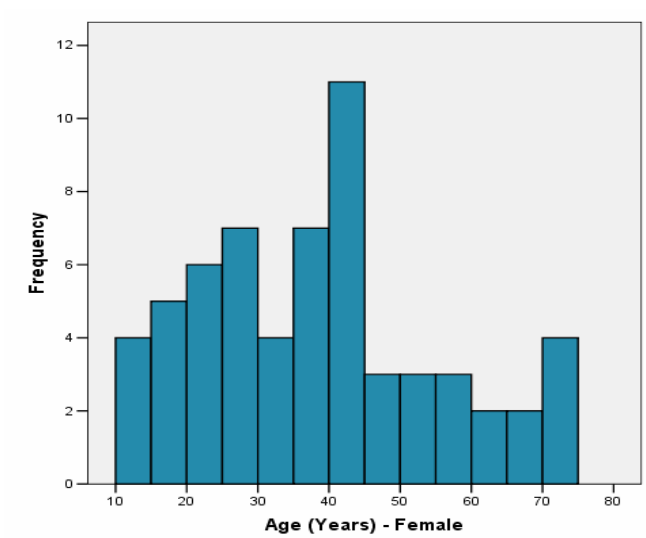

Figure 3.3 Age distribution of female patients

In the case of male patients highest number of patients operated between age group 40 to 50 years (24%). The highest number of female patients who underwent surgery fell between 40 to 45 years (23%).

3.3 Surgery types

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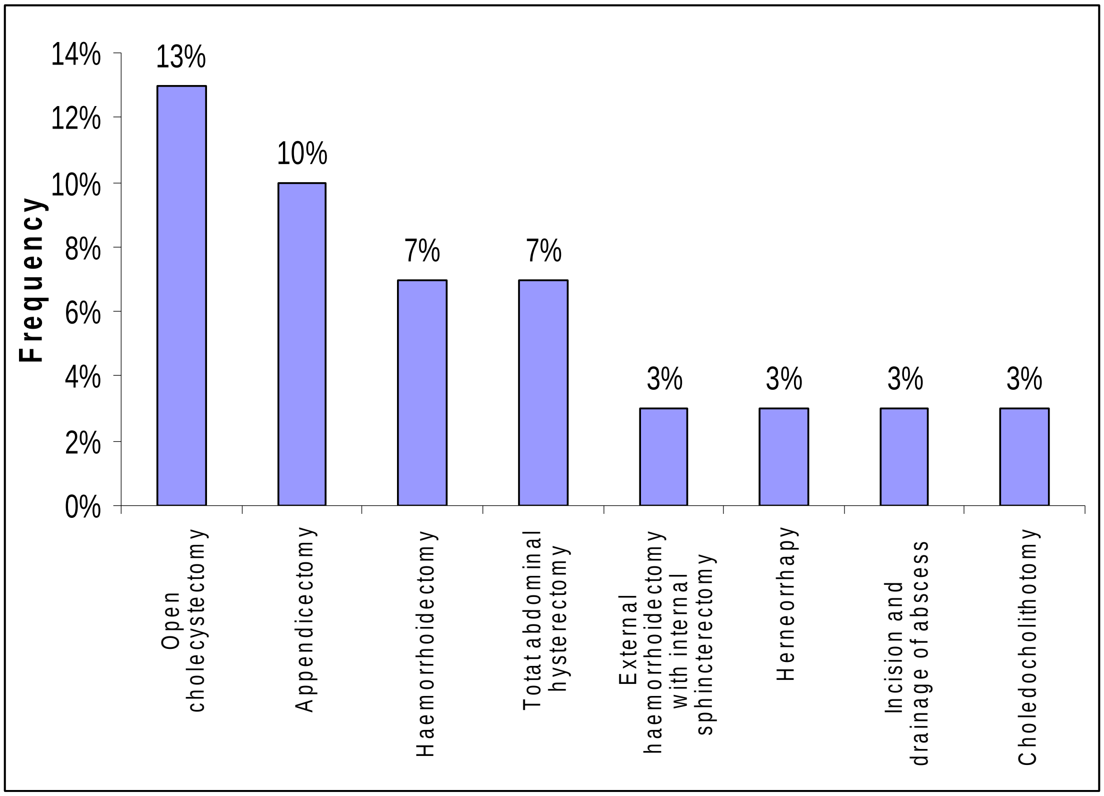

Figure 3.4 Frequency of Surgery Types

The major surgery type was Open Cholecystectomy which was found in 13% cases. Other significant types included Appendicectomy (10%), Haemorrhoidectomy (7%), Total Abdominal Hysterectomy (7%) and other being at 3% to 1%.

3.4 Use of Antibiotic

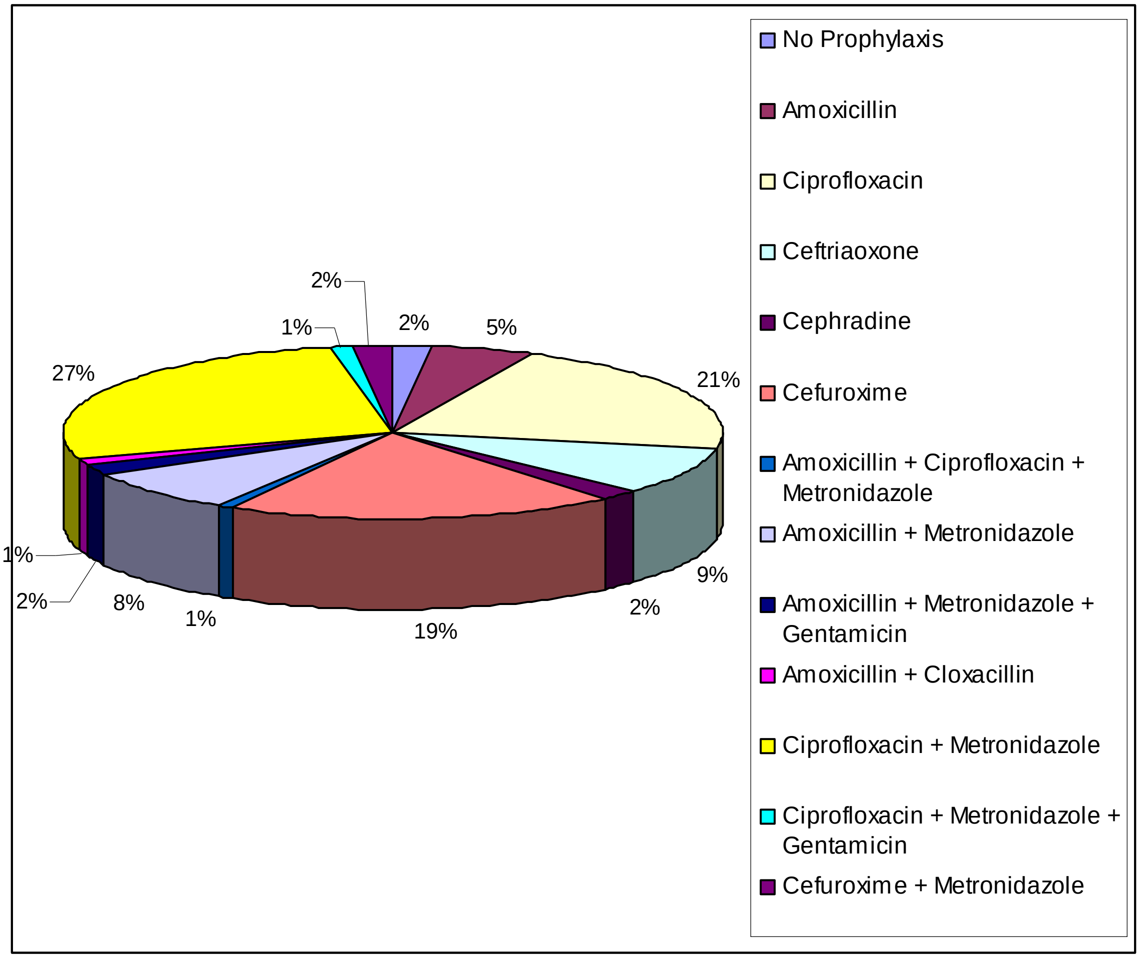

Figure 3.5 Prophylaxis Antibiotic

Among 100 surgical patients 98 patients were given prophylaxis antibiotics. Figure 3.5 shows that most common antibiotic is Ciprofloxacin. 21%. Second highest used (19%) antibiotic is Cefuroxime. When given in combination with Ciprofloxacin, Metronidazole stands at 27%.

3.5 Rate of SSI

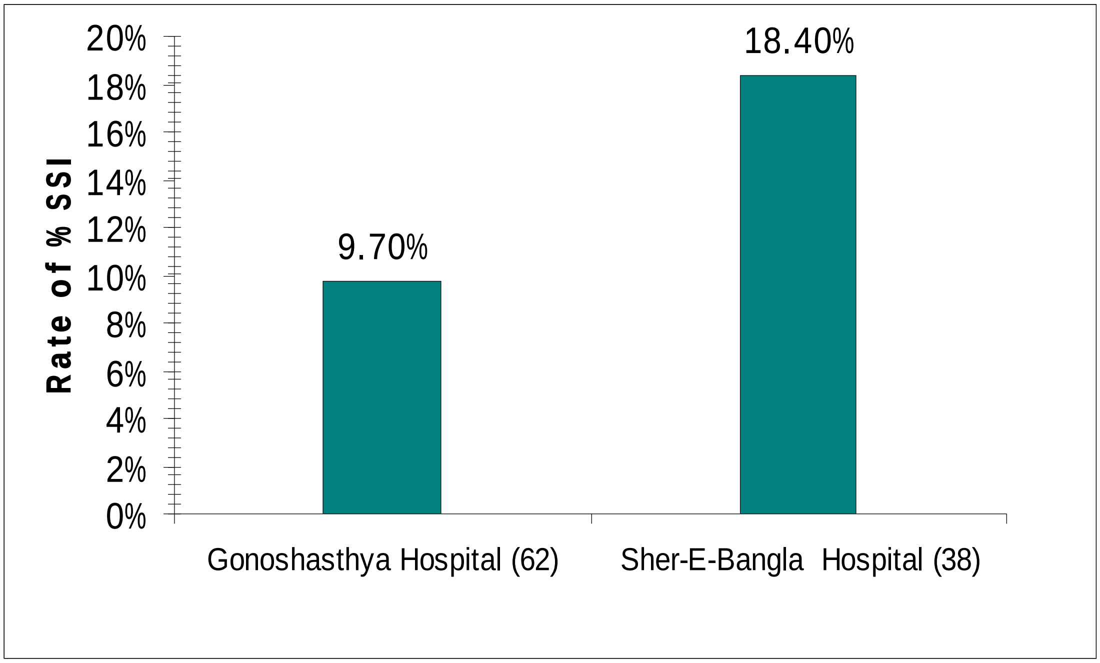

Figure 3.6 Rate of SSI in two hospitals

Figure 3.6 shows the percentage of Overall rate of SSI was found to be 13% in 100 patients. 6 out of 62 patients (9.7%) from Gonoshasthya Hospital and 7 out of 38 patients (18.4%) from Sher-E-Bangla Medical College had

3.6 Risk factors and SSI

3.6.1 Diabetes Mellitus

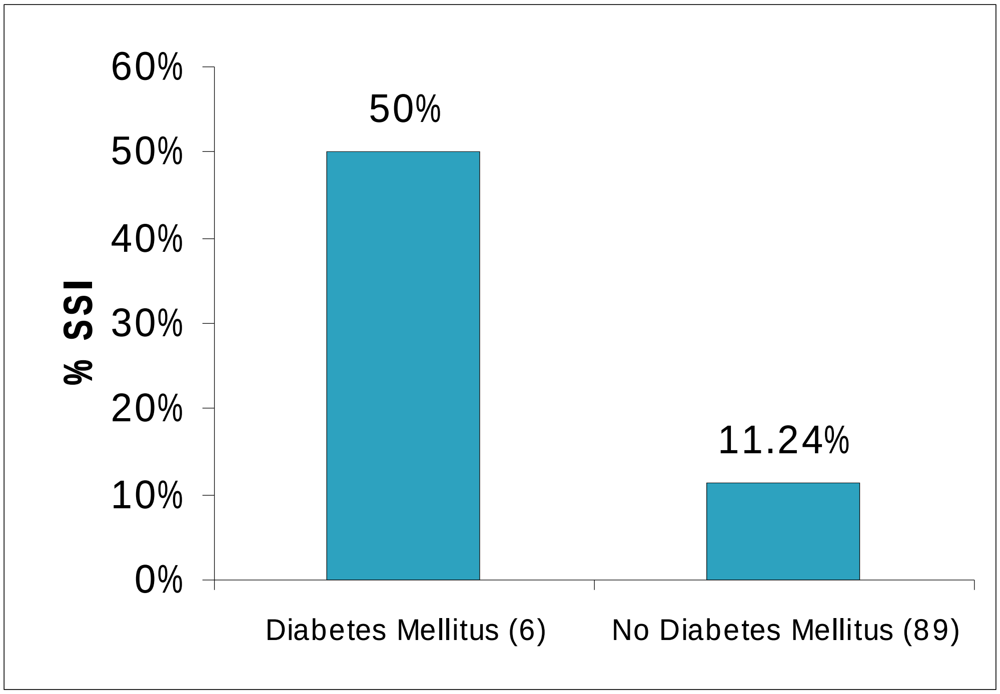

Figure 3.7 Diabetes mellitus and SSI rate

3 of the 6 diabetic patients developed SSI after surgery which stands at 50%. Whereas, the rate is lower to 11.24% for the patients who had no diabetes. Figure 3.7 shows the details.

3.6.2 Wound Class

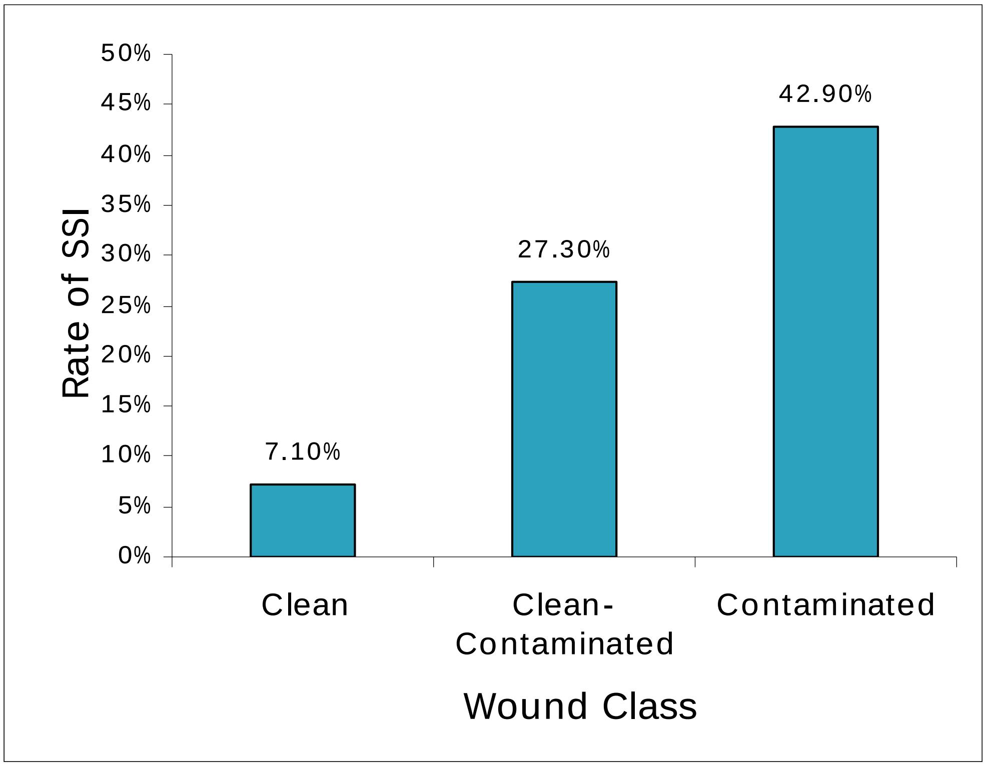

Figure 3.8 Wound Class and SSI Rate.

Figure 3.8 shows a total of 56 patients were found to have Wound Class – 'Clean'. 4 (7.1%) among them had SSI. 11 patients had Wound Class – 'Clean Contaminated' and 3 of them (27.3%) developed SSI; 7 patients had Wound Class – 'Contaminated' and 3 patients (42.9%) had SSI. No data available on Wound Class – 'Dirty'.

3.6.3 ASA Physical Status

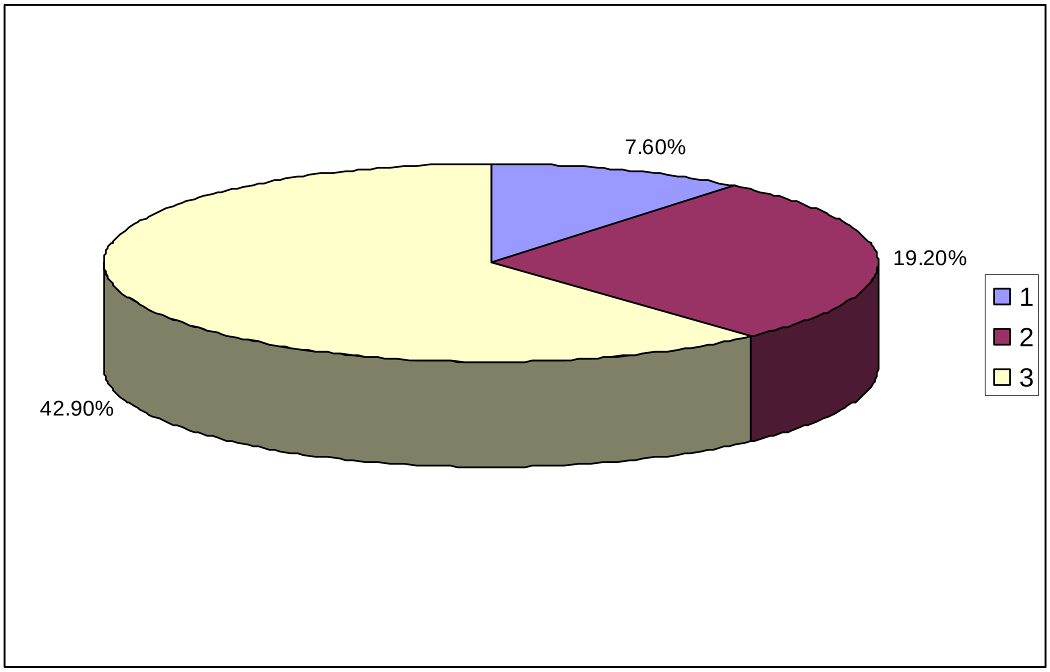

Figure 3.9 ASA Score and SSI rate

Table 3.1 ASA score and SSI Rates

ASA Score	Number of Patients	Patients with SSI	% SSI
1	66	5	7.6%
2	26	5	19.2%
3	7	3	42.9%

Table 3.1 shows that most of the patients had ASA score of 1 and their SSI rate was the minimum. Less number of patients with increasing ASA score had increasing SSI rate. Figure 3.9 shows 42.9% patients who had ASA score 3 developed SSI.

3.6.4 Coexisting infection in other site

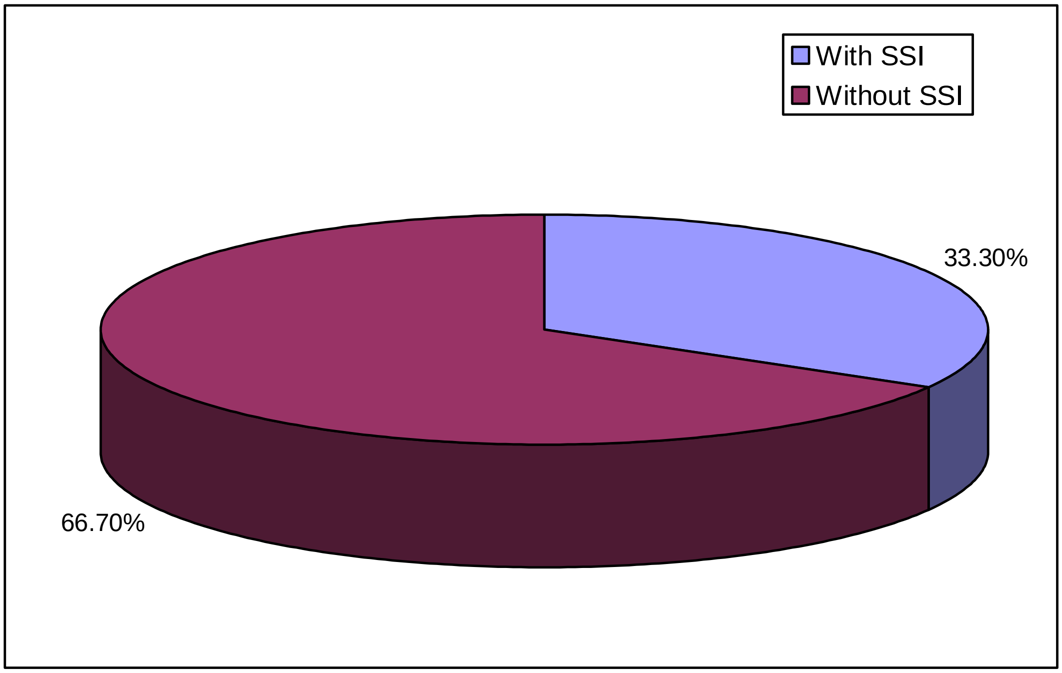

Figure 3.10 SSI rate in patients with Coexisting infection

Out of 100 patients, 12 patients had coexisting infection. Figure 3.10 shows that rate of SSI with coexisting infection was 33.3%

3.6.5 Duration of Hospital Stay before surgery

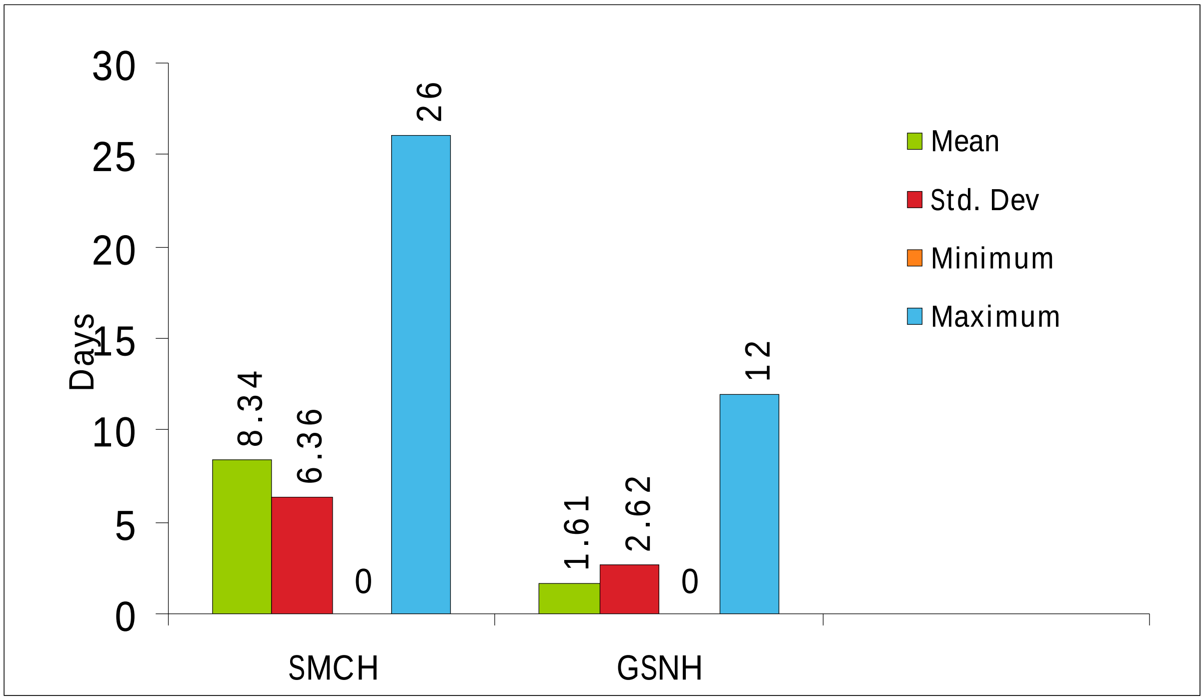

Figure 3.11 Duration of Hospital stay before surgery

While compared, it was found that patients stays more in Sher-E-Bangla Hospital (SMCH) than Gonoshasthya Nagar Hospital (GSNH) and this increased the rate to nearly 2 times in case Sher-E-Bangla hospital. Figure 3.11 describes.

3.7 Comparison of duration operation to discharge

The length of hospital stay after surgery had increased more than 3 times for the patient with SSI than the patients who did not have SSI. It imposes increased cost burden to the patient.

Table 3.4 Duration of operation to discharge depending on present of SSI

	Mean	Std. Deviation	Minimum	Maximum
Operation to discharge (SSI)	22.08	8.005	11	43
Operation to discharge (No SSI)	7.01	4.384	2	18

Summary of results

- In both male and female the maximum frequency of surgical patients are within the age of 40-45.
- Ciprofloxacin is the most common prophylactic antibiotic used in Bangladesh.
- Ciprofloxacin success rate stands at 92%
- The rate of SSI is 9.7% and 18.4% in Gonoshasthya and Sher-E-Bangla Medical College Hospital respectively
- Diabetes Mellitus patients are more likely to have SSI than the normal patients
- Rate of infection increases with the order of Wound Class being highest 42.9% at 'Contaminated' class
- Similar trend of SSI rate was found in case of influence of ASA Score on SSI.
- Duration of hospital stay before surgery is also a vita risk factor of SSI. 2 times longer stay in Sher-E-Bangla Medical Hospital resulted in 2 times higher rate of SSI
- Rate of SSI with coexisting infection was 33.3%

Chapter 4

DISCUSSION AND CONCLUSION

4.1 Discussion on results

The ratio of male to female is 39:61 in total observations of 100 patients. Number of female patients is greater as some portion of sample data were collected exclusively from Gynaecological ward. Age group of the patients ranges from 12 to 85.

Among 100 surgical patients 98 patients were given prophylaxis antibiotics. Most common prophylaxis antibiotic was Ciprofloxacin. 50 Patients were treated with Ciprofoxacin either exclusively or combined with other antibiotics. 41 patients were treated with Metronidazol which was always given in combination with other antibiotic. The success rate of ciprofloxacin with meronidazole was 92.6%, whics is almost similar to the efficacy study done by Shusmita Saha and Syed Ashrafuzzaman (2008) where they got the result between 89.4% - 92%. Cefuroxime which is a common antibiotic in Cephalosporin group was mostly used (21 patients) in Sher-E-Bangla Medical College Hospital in Barishal. This may be due to supply of this type of antibiotic very regular in that hospital.

Total of 50 patients who took Ciprofloxacin as prophylaxis separately or in combination with other antibiotics and 46 of them did not suffer from post-operative infections. So the success rate of ciprofloxacin was 92%. The remaining 4 patients (8%) developed SSI which might be result of microbial resistance or other strong risk factors.

The risk factors considered in this study are diabetes mellitus, wound class, ASA score and duration of hospital stay. Risks offered by diabetes mellitus still not fully established in literature, nonetheless, a notable significance was found in the study. 6% of the total patients had diabetes mellitus. It has been observed from the analysis that risk of SSI is higher for the patients with diabetes mellitus than the patients with no diabetes mellitus. In the study, the rate of SSI in Diabetes

Mellitus patients was 50%. It was comparatively higher than the study performed on 183 DM patients ,the infection rate was 31.3% (Pomposelli *et al.*, 1998).

Wound class and ASA score increase the risk with increasing order. Length of hospitalization also threatens patient's susceptibility to SSI. The rate of SSI according to the US National Nosocomial Infection Surveillance (NNIS) system hospitals were reported to be: clean 2.1%, clean-contaminated 3.3%, contaminated 6.4% and dirty 7.1%(Culver *et al.*, 1991) which was comparatively lower than the study result, which were 7.1% in clean class; 27.3% in clean-contaminated class and 42.9% in contaminated class.

According the present study the SSI rate of the patients having coexisting infections in other site was 33.3% but the surgical wound infection was found to be 61.3% for the patients associated with remote site infection in a study by L.D Edward (1976) and 75.8% observed in the study by W.E. Birkenstock (1973).

The percentage rate of surgical site infection of SMCH was higher than that of GSNH. The increased rate of SSI in Sher-E-Bangla Medical College was due to prolonged stay in hospital.

Rate of SSI increased with increasing severity of the wound class. Highest rate was found to be 42.9%..

4.2 Conclusion

Postoperative surgical patients are at risk of developing multiple types of hospital-acquired infections. These include surgical site infections which are relatively common can prolong hospital stay, cause morbidity, increase the cost of health care, and even lead to mortality.

All surgical wounds are likely to become contaminated, usually by resident bacterial flora from skin or viscera. This may not be of clinical significance and contaminated wounds may go unnoticed. Despite considerable research on best practices on surgical techniques, technological advances and environmental improvements in the operating room (OR), and the use of prophylactic preoperative antibiotics, infection at the surgical site remains the second most common adverse event occurring to hospitalized patients and a major source of morbidity following surgical procedures.

Surgical site infection risk depends upon a number of patient factors, including pre-existing medical conditions, amount and type of resident skin bacteria, perioperative glucose levels, and preoperative, intraoperative and postoperative care. Therefore, it is difficult to predict which wounds will become infected. For that reason, caregivers should strive for early identification of patients with risk factors amenable to intervention to minimize the risk of wound contamination in all surgical cases and to support host defenses throughout the continuum of care.

Therefore, in a nutshell the overall conclusions are:

- Post operative infection is common nosocomical infection and responsible for serious post operative complications not only in terms of patient’s health but also in cost and social issues.

- Various risk factors associated with post-operative infections include wound class, physical status, diabetes mellitus, coexisting other site infection and duration of hospital stay are found to be highly influential.
- Steps should be taken to reduce these factors
- Ciprofloxacin is proved to be effective in prevention of postoperative infections. Gentamycin, Flucloxaciline and Ceftriaxone are good options for healing SSI.

4.3 Limitation of the study

However there are some limitations in this study like:

- Etiological agents responsible for SSI were not considered due non-availability
- Relation between surgery types and incidence of SSI could not be established as the study considered broad category of surgery.
- 100 observations might not represent the total scenario of Bangladesh.

4.4 Recommendations for further research

- Greater number of observations and hospitals may be included for more decisive outcome
- Considering specific type of surgery the rate of SSI may be related to surgery risks.
- Study on etiological agents may be performed to make precise choice of antibiotics to manage SSI

Chapter 5

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Appendix

Risk Factors and Administration of antibiotic in Postoperative infection

Study ID: Date:

	Gender	
	Age	
	Patient's height	
	Patient's weight	
	Diabetes	Yes / No
	Smoker	Yes / No
	Smoking – Stick per day	
	Coexisting infection at other site	Yes / No
	Admission in hospital	
	Did the patient take any prophylaxis antibiotic?	Yes / no
	Preoperative prophylaxis antibiotic	
	Starting date of antibiotic	
	Dose and frequency of administration	
	Route of administration	
	Duration of prophylaxis antibiotic	
	ASA physical status	
	1. A normal healthy patient. 2. A patient with mild systemic disease. 3. A patient with severe systemic disease. 4. A patient with severe systemic disease that is a constant threat to life. 5. A moribund patient who is not expected to survive without the operation	1 | 2 | 3 | 4 | 5
	Wound class	
	1. Clean **2.** Clean-contaminated **3.** Contaminated **4.** Dirty	1 | 2 | 3 | 4
	During admission in hospital	
	Admission date in hospital	
	Name of antibiotics	
	Starting date of antibiotic	
	Dose and frequency of administration	

	Route of administration	
	Duration of antibiotic use	
	Risk factor	
	Extremes of age	Yes / no
	Poor nutritional state	Yes / no
	Obesity (>20% ideal body weight)	Yes / no
	Diabetes mellitus	Yes / no
	Smoking	Yes / no
	Immunosuppression (steroid or other immunosuppressive drug use)	Yes / no
	Coexisting infections at other sites	
	Operation	
	Operation date	
	Type of surgery	
	OT Antibiotic	
	Area of surgery	
	Length of surgical scrub	
	Skin antisepsis	
	Preoperative shaving	
	Preoperative skin preparation	
	Length of operation	
	Operating theatre ventilation	
	Foreign material in surgical site	
	Surgical drains	
	SSI(surgical site infection) after surgery	Yes / no
	Etiologic agent	
	Any nosocomial infection	Yes / no
	Etiologic agent	
	Any adverse drug reaction due to antibiotic.	Yes / no

	Adverse drug reactions are	
	Other medication being taken except antibiotic	Yes / no
	What are other medication?	
	Duration of staying in hospital	
	Releasing date from hospital	
After release from hospital		
	Any infection	Yes / no
	date of infection identified	
	antibiotic	
	Starting date	
	Dose and frequency of administration	
	Route of administration	
	Duration of antibiotic	