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THE INCIDENCE OF SURGICAL SITE INFECTION IN A HIGH-VOLUME TERTIARY CARE FACILITY

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Abstract

OBJECTIVE: *To uncover the incidence and respective trends of post-operative infections in the high-volume facility. METHOD and MATERIALS: A Performa was made for the study, in the light of the ethical standard set by the Board of Ethical Governance, encompassing an analysis of the bacterial pathogens encountered from cultures sent for histopathology from cases that had experienced surgical site infections, their respective antibiotic sensitivity, the nature of the procedures, co-morbidities of the patients, their mode of admission, the designated surgeon(s) and staff performing/assisting the cases, time frame, operating theatre, temperature control and wound care by dressers/physicians/attendants, over a period of six months between July 2022 and January 2023. Patients were followed post-operatively and after discharge on follow up during from Outpatient Department.*

RESULTS: *Among approximately 525 Cases Performed in both Units of the Department of General Surgery, 17 Surgical Site Infections were recorded. (Details in Discussion), Rate: Approx = 3.24%*

INCLUSION CRITERIA: *Any surgical case without Gross Contamination warranting keeping wounds open and repeating dressing. Nearly all typical cases including abdominal, neck and breast wounds.*

EXCLUSION: *Cases with Gross contamination where SSI is imminent to warrant avoiding closure of wound; patients with multiple comorbidities were excluded.*

OPERATIVE DEFINATION: *A Surgical Site Infection is defined as infection of any surgical field recently operated upon, elucidated often by erythema or discharge from the wound site*

INTRODUCTION

Surgical site infection (SSI) is a common complication following any surgical procedure. The primary role of aseptic measures is to ensure that the chances of an infection are minimized. It then follows that the adherence to these measures is of utmost importance and the factors that can raise the chances of SSI must be removed. The methodology of "Paint and Drape" is discussed further in AST Standards of Practice for Surgical Drapes.

Bacteria (and fungi) causing such infections have developed increased resistance to antibiotics as well, of which Methicillin Resistant Staphylococcus

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Aureus is one example. Certain strains have been observed in tertiary care setups that are resistant to nearly all conventionally used Broad and Narrow Spectrum Antibiotics leaving behind last-resort antibiotics such as Polymixin-B and Colistin.

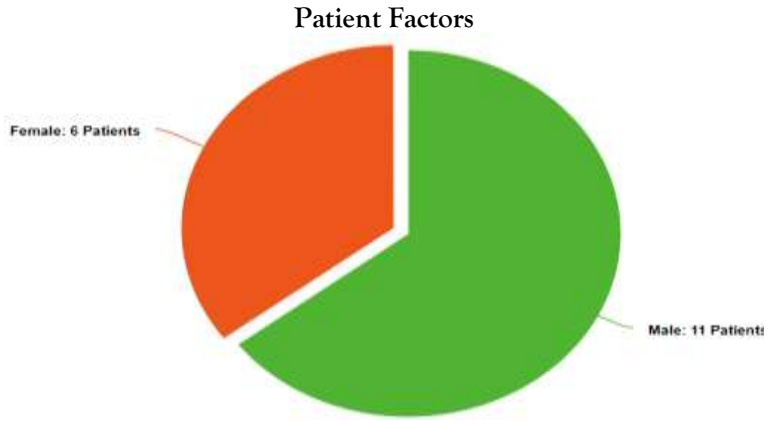
Similarly, individual patients with irregularities in BMI or co-morbidities such as immunosuppression due to Diabetes Mellitus or chronic kidney disease may also be at a greater risk for SSI. Among patient factors includes the illness of the patient, which in turn leads us to the nature of the procedure warranted, be it Emergency or Elective, directly affecting the extent of wound contamination, all factors that may raise or decrease the chances of a surgical site infection. Furthermore, how a wound is treated i.e. dressing and regular wound washes are taken place naturally affect incidence. Taking into account also, the seniority of the surgeon and doctor in question who performed the procedure and closure respectively, as well as the staff present at the time of the procedure, we can further gain insight into what degree performance and experience in all aspect of any surgical procedure may have on the rate of Surgical Site Infections. [1]

The Operating Theatres were also considered. Among four rooms, two used more often for major cases and, two others used more often for cases requiring local or spinal anaesthesia. In the light of the Surgical time frame, divided into Morning (8AM to 2PM), Evening (2PM to 8PM) or Night (8PM to 8AM), due to the hypothesis that there may be less care taken to ensure sterility in time periods when Senior staff or Surgeons are unavailable or that there may be less resources in Evening or Night hours. In addition, the nature of the organisms that may inhabit the institute may be of special interest to us when discussing surgical site infection. Therefore, the organisms isolated from every case was noted as well as specific antibiotic resistance. So as to further decipher the role of nosocomial infections, patients' stay in the Intensive Care Units were also documented, alongside the presence of Sepsis at any time during Illness or Treatment.

It is in the light of these factors, bearing the mean incidence of most of Pakistan's healthcare institutions (approximately 7.32%) and poses a dilemma for hallmark institutions and patients alike, that we progress now to uncover through this observational-longitudinal research the extent these hypothesised factors may affect the outcome of incidence of Surgical Site Infections and hopefully help define local guidelines in Shaikh Zayed Hospital's HighVolume Department of General Surgery. [9]

RESULTS AND DISCUSSION

As discussed previously, this study is observational-longitudinal research for a period of six months, therefore the number of infections reported was limited. Among 17 cases that suffered Surgical Site infections as per the Inclusion Criteria, the following are the hypothesised factors and the quantity of cases exposed to these factors:



As seen, while it is true most patients who suffered surgical site infections are male, this does not lend concrete evidence that male patients are generally less careful about their surgical wounds than female, however it does imply it, considering that the ratio of male to female patients is roughly equal (M:F ::

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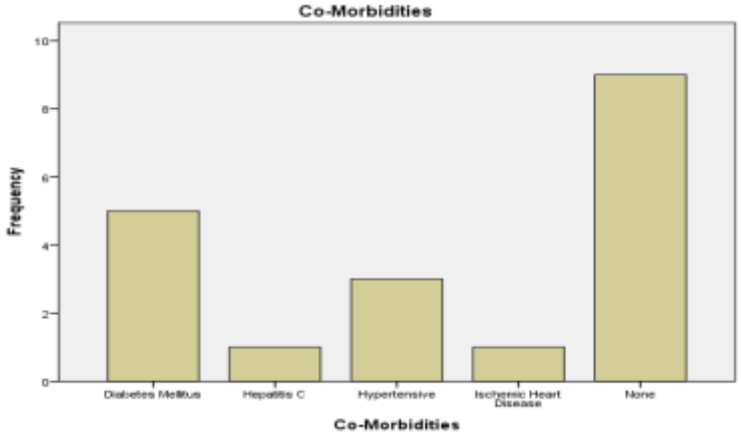
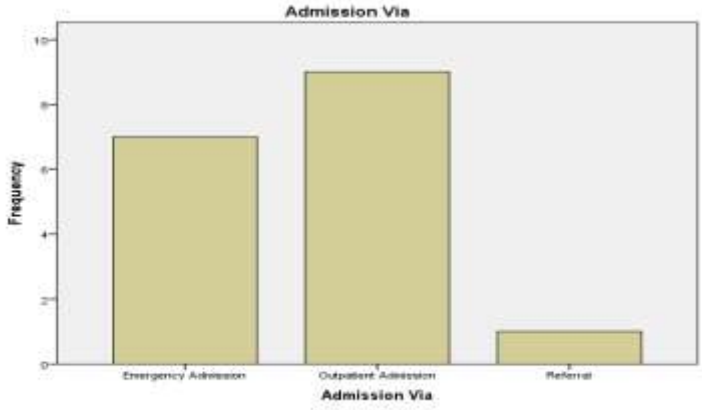
117:108) it directly seems to contradict the German National Nosocomial Infections Survey [2] as well as other publications from the same demographic. However, the variation of cases from institute to institute should be noted as well as differing demographics are also present. Further analysis from dressing sources can be complied to show how patients lean to treating their wounds once discharged, will require data from patients with healthy wounds as well. This analysis was attempted, but the data acquired was too biased due to patients' perception to be considered for presentation (mentioned in limitations).



Co-morbidities are notorious for causing a range of complications in the post-operative period.[3] Especially for major cases, diseases such as diabetes have been shown by multiple surveys, to raise the chances of Surgical Site Infection. [4] As per the data recorded, and since there were no noted disparity of selection of cases to be performed in the department (those with co-morbidities as per standard procedures are screened and referred to relevant departments for management prior to surgical intervention when delay is possible e.g. Uncontrolled Hypertensive patients are sent to Cardiology department until fitness is granted hence frequency of those with comorbidities and those without were comparable) and that most of the infections occurred in patients without any underlying illnesses.

This, and the frequency of Diabetic patients being significantly higher than other comorbidities, elucidates, once again, the potential lack of care in patients who have no other diseases during any time among the operative time and post-operative period and diabetic patients still showing a greater degree of immunocompromise. The Audit performed after this study may in turn further help show the competency of wound care in post-operative period.

Admission and Case Nature



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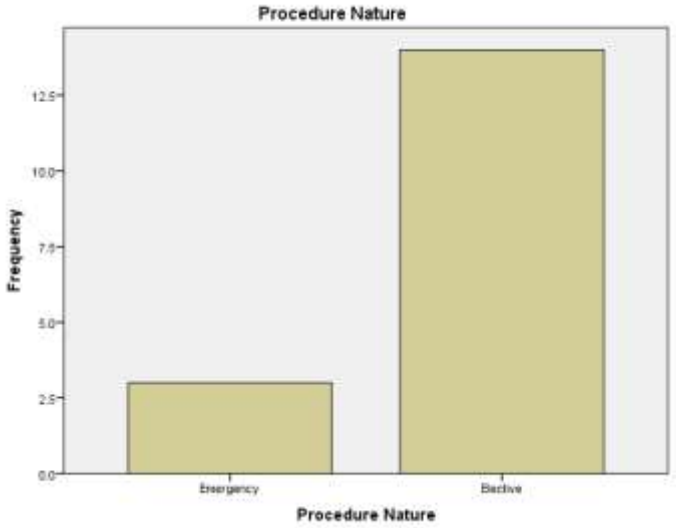
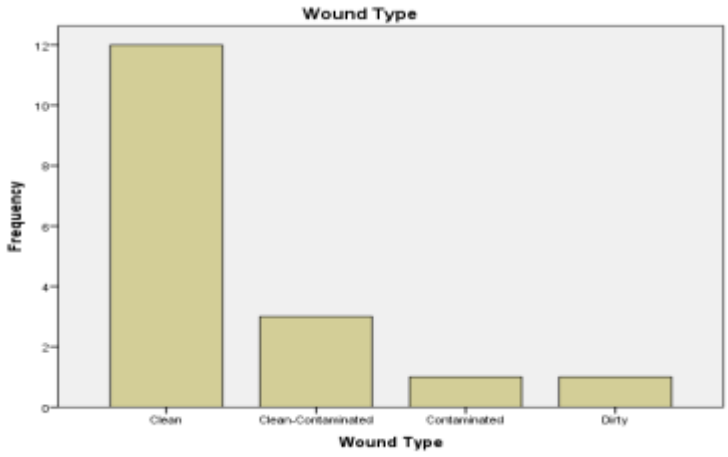


The hypothesis in case of Admission Modality does not always reflect the nature of the case (Discussed below). For example, a patient with clinically diagnosed appendicitis may present in the Outpatient Department due to prior knowledge of particular surgical hearsay they may have and would be treated as such, just as simply as a patient with Cholelithiasis may present with Right Hypochondrial tenderness in the Emergency room. The chart on the left hence tells us the state any patient may be admitted in, be they rushed through emergency or timely through Outdoor (or as per booked Admission). The frequency of Surgical Site Infections is only slightly higher among outdoor patients, however, this may be due to the fact that Outpatients are higher in quantity among not just the sample, but also among cases operated in the Department as a whole by a large factor (Approximately 5.5:1, noted on 6 separate occasions over Six months in the department and a mean calculated). This can also be used to extrapolate the lower incidence of Referrals that have suffered SSI. There are simply that few.

Also, while admissions from the ER can be of both elective and emergency nature, proportionally, the higher incidence of emergency procedures may warrant a greater risk of SSI hence the comparable statistics here,[5] however, the nature of the procedures to the occurrence of SSI is counterintuitive too this, and is actually higher among Elective cases as shown by the graph on the right, explained once again by the total proportion of actual Emergency Procedures performed to be lesser than the total Elective.

Wound Status of Contamination



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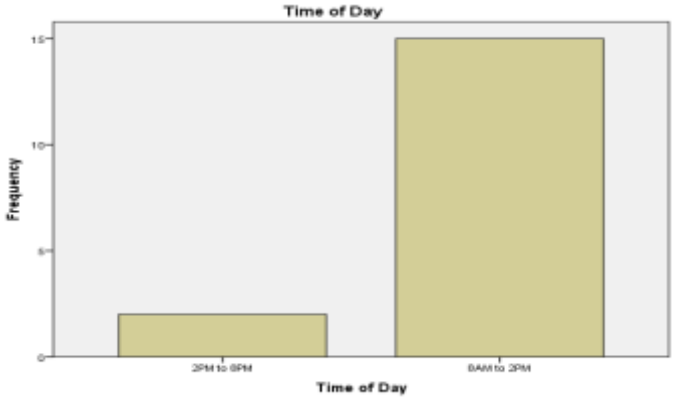
As shown by the results, the high rate of wounds, that were otherwise thought to be clean naturally after procedures that may have had no form of visible contamination during or after the procedure may lend credence to the idea that some of contamination takes place only after the procedure is competed. The performance of wound closure, the subsequent dressings and the wound care the patient receives after discharge may all factor into play.[6] In the light of this study, a simultaneous audit was also carried out to discover the potential cause of infections of cases during post-operative period.

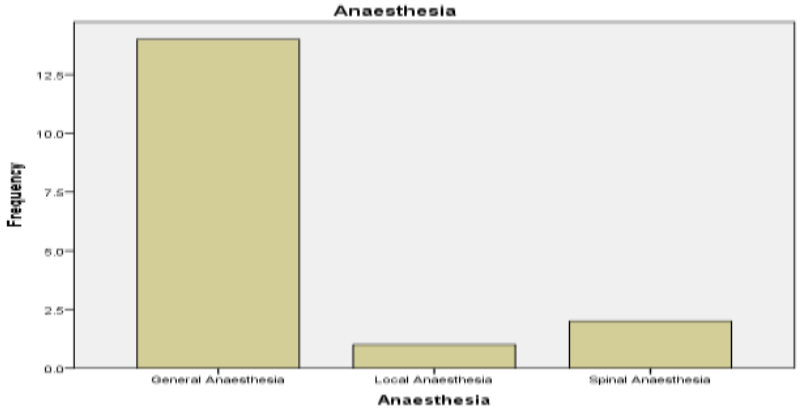
Furthermore, the rigorous cleaning of wounds with potential contamination (such as the Clean-Contaminated Laparoscopic/Open Cholecystectomy) may help alleviate the chances of acquiring surgical site infection, and is regularly carried out in such procedures and is avoided in clean procedures may account for this vast difference. The lower occurrence of SSI in contaminated and dirty procedures, may simply be due to lower proportion of such cases. However, the disparity between Clean and Clean-contaminated may be explained by the lack of adequate sanitation of wounds prior to closure, or any lack thereof in post-operative period.

OPERATIVE TIME FRAME



As shown, no recorded procedures that acquired surgical site infections during the 8pm to 8am time-frame due to the sheer low numbers of the cases performed that fit the inclusion criteria, and taking into account that most cases are usually performed in the morning time frame and few are left to after 2pm taking into account availability of the Anesthesia team as well as surgical sets and drapes. Therefore, the disparity between greater number of incidences of wound infection in the morning is merely a reflection of the greater proportion of the cases performed in the morning time frame.

NATURE OF ANAESTHESIA



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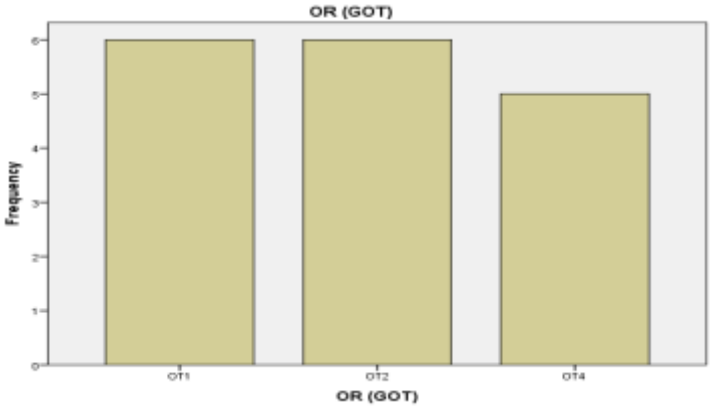
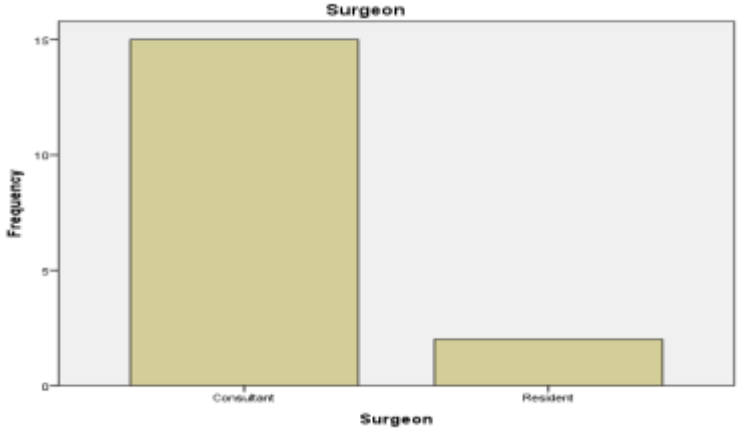
The nature of anaesthesia can indeed have an effect on the degree of oxygenation a patient is given. Prior to intubation, per-operatively and during extubation, the patient may encounter several moments of hypoxia that can in turn inhibit healing. It should also be noted that providing oxygen rich air to the patients via nasal cannula in the post-operative period is a widely accepted method of reducing surgical site infection. Considering the disparity in the incidence of SSI in cases receiving general anaesthesia as opposed to Local and Spinal, leads us to deduce that the nature of these cases receiving G.A. changes wounds towards greater degrees of contamination, or aids to strengthen the need for adequate oxygenation during and after cases receiving General Anaesthesia. [10]

OPERATING ROOM



Among the 4 Operating Rooms, each one has been designated roles based on the facility available. Due to the adequacy of OR1 and OR4, both have been reserved primarily for Consultants' major cases while OR2 and OR3 have been kept for Spinal cases initially and once concluded, onwards to cases with gross contamination, such as Perianal Cases, especially OR3. Hence, since most cases performed in OR3 had gross contamination, they fell into the exclusion criteria. However, aside from the theatre used primarily for contaminated cases, the remaining rooms show an almost equal rate of SSI occurrence. In Shaikh Zayed Hospital, Lahore, the practice of performing clean cases first and moving on to contaminated cases is upheld with rare exceptions due to emergencies (such as perianal abscesses) warranting Cydex cleaning fluid for floors, UV irradiation and sealing for 30 minutes prior to any relatively cleaner case for any such theatre. [7] Therefore, no such culprit can be identified in between the Operative Theatres and respective sterilization with this data.

SURGEON AND ASSISTANTS



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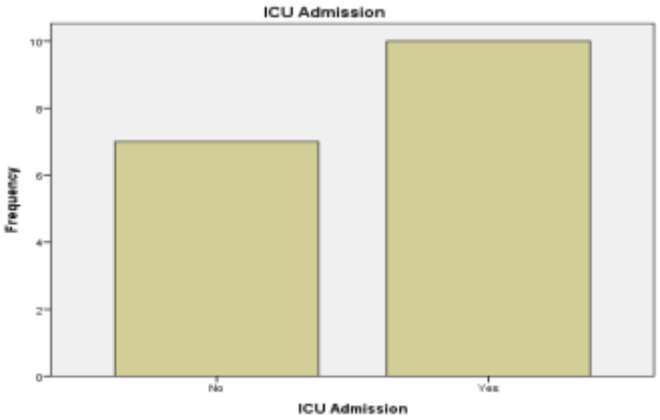
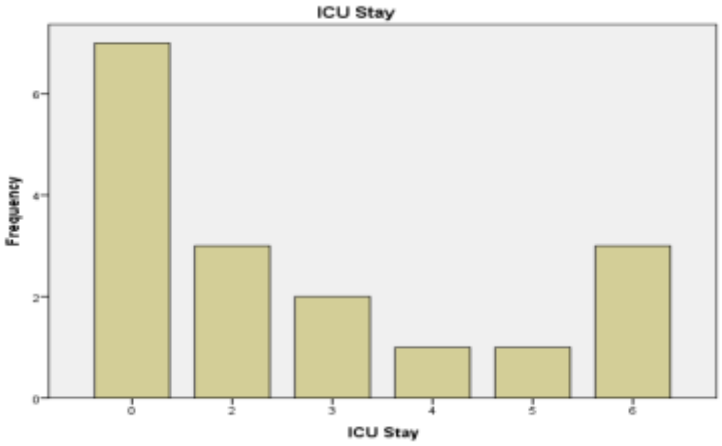
Primary surgeons among most cases, and among those noted (Hernia repair and Cholecystectomy) in the department are usually consultants. Trainees are initially kept in assisting roles until, depending on the nature of the case (e.g. open or laparoscopic) they are allowed to practice under supervision and then assume the role of primary surgeon in due time. Also to be noted, is that through this system, closure of the skin (or muscular wall) is usually assumed by the residents or rarely house surgeons. Both data, then show no significant disparity between cases closed or performed between residents, house surgeons or consultants. As seen in the Closure Chart, consultants' closure cases are only 2 lesser out of the total 17 and therefore insignificant.

ICU Admission





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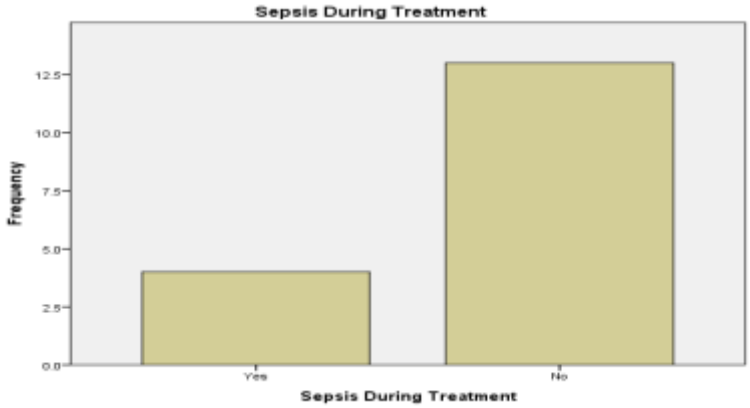
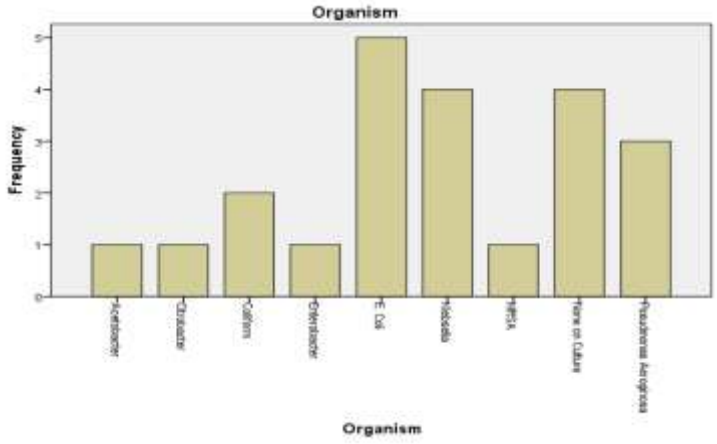
Intensive care units have routinely been considered a source for Nosocomial infections and therefore this warrants retrospective analysis of patients that have acquired wound infections. [12] As per the data, any time spent in the Intensive care unit carries a greater risk of acquiring wound infection. The graph of the ICU stay seems to exhibit a trend. From no time spent in the ICU until 4 days, shows us that the incidence of infection actually seems to decrease. However, it seems to increase beyond five days. This curve may be due to the fact that ICU Admission may raise one's chance of acquiring wound infection (as per left chart), but prolonged stay is usually associated with more aggressive treatment regimens such as broad spectrum antibiotics, oxygen and fluid therapy (explaining the downward trend up until 4 days of admission). However, the rising trend beyond 5 days may be associated with moribund patients becoming immunocompromised due to increased morbidity. Lack of direct care may be a factor, however no such evidence of this is shown by the data. [8] A Surgical audit may help elucidate individual care of patients. Sepsis frequency during treatment of cases that suffered a Surgical Site infection was also recorded (as shown below).



All patients as per the data, who suffered Sepsis were given ICU Admission temporarily, a total of 4. Among 13 patients who did not suffer from Sepsis, 6 were admitted to the ICU, the remaining 8 were not attributed to the nature of the case. Admission in ICU was therefore reserved for patients who either underwent major cases, had comorbidities (such as Ischemic Heart Disease) or had sepsis, showing us protocol was adhered to.

Bacteria Isolated in Culture



As shown, the predominant strains of bacteria causing Surgical Site Infection are E. Coli, P. Aeruginosa and Klebsiella species. It should be noted also, that several strains may have been missed as shown by negative cultures from several cases, and therefore cannot be fully grounded evidence for the

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predominant strains. [9] The low frequency of Methicillin Resistant Staphylococcus Aureus may be attributed to this negative culture; as perhaps broad spectrum antibiotics may have been underway after most surgical procedures (usually Ceftriaxone). Despite the random error, the trend shown does fall in line with commonly observed rates of organisms isolated from cultures.

LIMITATIONS

Total tally of cases to calculate proportion of exposure (and hence Odd's ratio and conversion into Case Control) would have yielded a more accurate estimation as to the effect of any factor in question. As it stands, the study is limited in its foundation as an observational-longitudinal and its generalized approach towards the individual cases, even though it covers several factors on each case that may raise the chances of a Surgical Site Infection. The study also hence lacks a comparative approach between confounding factors such as blood loss, operative time and temperature control (since good temperature control was maintained through the study time frame and for nearly all cases).

Furthermore, the study may have also benefitted from a greater sample size spread across a longer period of time to better elucidate the disparity observed. As with any study, loss of data due to lack of patient follow up is an issue, despite having consented to participate, withdrawal stands as the right of every patient. During the study, patients were also asked to elaborate on how their dressings were performed after discharge from the hospital. Recall bias and patients' own lack of knowledge regarding the standard procedures of dressing inhibited relevant information from being provided to residents and house surgeons collecting the data to properly derive tangible conclusions as to the adequacy of the wound care.

It is due to these limitations, that multiple Surgical Audits were conducted simultaneously that will help to shed greater light onto the patients' path through every department. The goal was to correlate the findings from the study to help better understand the sources of wound infection in the light of standard procedure set by the W.H.O. [10]

CONCLUSION

With an approximate wound infection rate of 3.24%, the Department of General Surgery and Surgical Oncology continues its endeavors in maintaining a steady flow of treatment and healthcare, just as typical hallmark institutes in Pakistan have maintained. [11]

As discussed in great detail through the study, Surgical Site Infections, and the factors that increase their risk pose a great deal of complications to patient healthcare. While no one research can truly elucidate the causative factors on a larger scale, it should be noted every institution may possess their own strengths and weaknesses in insuring the best patient healthcare outcome.

Shaikh Zayed Bin-Khalifa Al-Nayan Hospital, being a high volume, multidisciplinary institute boasts several such strengths as shown, including adequate sanitation of Operating Theatres, adequate wound washing preoperatively and post-operatively, a competent order of cases from least to most contaminated, good temperature control preventing hypothermia for patients and adequate ICU care that improves upon rates of wound infections with time (up to a degree).

In the future, a Surgical Audit, Case Control or perhaps even Cohort study with use of "Infection Performas" made routine in the departments with a more focused approach may further enlighten the potential sources of wound contamination, as would a database of all cases would certainly prove useful to observe proportions and better highlight limiting factors to better healthcare. Nevertheless, this study has aimed to provide a conduit for future endeavors to attempt such measures.

While certain aspects of SSI prevention can certainly be improved upon, such as provision of oxygen rich nebulization post operatively, standardized post-operative wound care guidelines for patients and dressing facilities available into evenings as well for previously operated cases, it stands to reason that vigilance in the prevention of contamination is the price of safety in all aspects of healthcare, and should be observed in the most basic order of the day for surgeons.

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