PROPHYLACTIC ANTIBIOTICS IN GENERAL SURGERY
GUIDELINES AND PRACTICE

AMRITA R SHRIYAN

Department of Microbiology, Srinivas Institute of Medical Sciences & RC,
Mukka, Surathkal, Mangalore, Karnataka, India

ABSTRACT

Background

Surgical site infections are multi-factorial and hence require a multifaceted approach. Prevention of SSIs involves a number of factors such as skin preparation, surgical technique and specific patient factors. Giving appropriate antibiotic in appropriate dose within one hour of the skin incision has reduced the incidence of SSIs.

Aims

This study was designed to evaluate the use of prophylactic antibiotics which can decrease the incidence of SSIs in elective / clean cases in general surgery.

Methods

This prospective study was undertaken for 100 patients with clean operations in the unit of General Surgery. Cases were analysed with respect to use of the prophylactic antibiotics, timing and duration of administration. Patients were followed up for a period of 30 days to note any SSI’s according to April 2013 CDC, NHSN protocol for Surgical Site Infection Criteria.

Findings

The optimal time for administration of preoperative doses is within 60 minutes before the surgical incision. Out of these, the majority was between 0-15 min (82%). Six different drugs or combinations were used. Most patients (70%) received third generation cephalosporins. However out of 100 cases, 18 patients received prophylactic antibiotic in General Surgery as per recommended guidelines for duration of 24 hours.

Conclusion

There is general consensus that postoperative prophylactic antibiotics should be stopped within 24 hours of most major surgical procedures. However in (82%) cases the duration of antibiotic prophylaxis was continued for more than 24 hours and inappropriate use of antibiotics was found in (26%) of cases. No SSI was noted in our study.

KEYWORDS: NHSN Protocol, Prevention of SSIs & CDC

INTRODUCTION

Surgical site infections (SSIs) are the most common complications following surgery. However, excessive or incorrect antimicrobial use increases costs and favours the emergence of antimicrobial resistance. As many as 1% of patients undergoing clean surgeries (e.g., breast, hernia) and 11% of patients undergoing clean–
contaminated surgeries (e.g., colorectal) experience SSIs\textsuperscript{VIII}.

Optimal prophylaxis ensures that adequate concentrations of an appropriate antimicrobial are present in the serum, tissue and wound during the entire time that the incision is open and at risk of bacterial contamination. The length of a surgical procedure is also generally correlated with the risk of post operative infection.\textsuperscript{IX, X} Patients infected with antibiotic-resistant bacteria experience higher mortality, prolonged hospitalization and increased health care costs compared with those infected with non-resistant organisms.\textsuperscript{XII}

Surgical site infections are multifactorial and hence require a multifaceted approach to reduce the rate of infections.

This study was designed to evaluate the use of prophylactic antibiotics which can decrease the incidence of surgical site infections in elective/clean cases in general surgery.

**Wound Class:** Wounds are classified based on the degree of contamination of a surgical wound at the time of the operation. The wound class system used in NHSN [National Health Safety Network] is an adaptation of the American College of Surgeons wound classification scheme\textsuperscript{III}. Wounds are divided into four classes:

- **Clean:** An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow non-penetrating (blunt) trauma should be included in this category if they meet the criteria.

- **Clean-Contaminated:** Operative wounds in which the respiratory, alimentary, genital or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oro-pharynx are included in this category, provided no evidence of infection or major break in technique is encountered.

- **Contaminated:** This includes open, fresh accidental wounds. In addition, operations with major breaks in sterile technique (e.g., open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered are included in this category.

- **Dirty or Infected:** Includes old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation.

The accepted indications for administering prophylactic antibiotics have been considered for clean, contaminated dirty wound, but new indications are evolving that consider wound contamination together with anaesthetic risk and relative duration of operation. An important patient safety goal is optimizing delivery of surgical antibiotic prophylaxis.\textsuperscript{IX}

The downside to this approach is the fact that prolonged administration of antibiotics carries the certainty of increased cost, the prospect of drug toxicity and the distinct possibility of creating an environment favourable to the development of resistant bacterial strains. Superinfection, particularly with *Clostridium difficile*, is associated with prolonged cephalosporin administration\textsuperscript{XII}. Of these, the issue of bacterial resistance is the most compelling consideration.

The basic principle of antimicrobial prophylaxis in surgery is to achieve adequate serum and tissue drug levels that exceed, for the duration of the operation the minimum inhibitory concentration (MIC) for the organisms that are likely
to be encountered during the operation\textsuperscript{XI}.

\textbf{Aims:} To assess the current antibiotic prophylaxis practice in clean cases of General Surgery and to know the occurrence of surgical site infection within 30 days of surgery.

\textbf{Objectives:} To evaluate compliance with the choice of pre and post operative antibiotics, their dosages, timing and duration of administration and to find out the incidence of postoperative surgical site infection in clean cases.

\section*{MATERIALS AND METHODS}

This prospective study was undertaken for a period of 2 months from 1\textsuperscript{st} May to 31\textsuperscript{st} June 2013. 100 patients with clean operations in the unit of General Surgery were analysed with respect to use of the prophylactic antibiotics, timing and duration of administration at A.J. Institute of Medical Sciences, Mangalore. A structured data collection as per CDC guidelines was used to evaluate the data collected. The criteria for inclusion in the study were the following:

\begin{itemize}
\item All elective surgical cases.
\item All surgical cases classified as clean operations.
\end{itemize}

Other categories of surgical wound cases were excluded. The operations were performed by different surgeons during a period of two months. Files were reviewed with the consent of the patients while they were in the post-operative ward and still in hospitals to note any signs of SSI. The collection of data for every patient was obtained from the first day of admission, pre-operatively and post-operatively. The patients were followed up for a period of 30 days to note any surgical site infection because superficial incisional SSIs are only followed for a 30 day period for all procedure types according to April 3013 CDC, NHSN protocol for Surgical Site Infection Criteria\textsuperscript{III}

Superficial incisional SSI must meet the following criterion:

Occurs within 30 days after any NHSN operative procedure, and involves only skin and subcutaneous tissue of the incision site and patient has at least one of the following

\begin{itemize}
\item Purulent drainage from the superficial incision
\item Organisms isolated from an aseptically-obtained culture of fluid or tissue from the superficial incision
\item Superficial incision that is deliberately opened by a surgeon and is culture-positive or not cultured and a culture negative finding along with at least one of the following signs or symptoms
\end{itemize}

Pain or tenderness; localized swelling; or heat. Diagnosed as superficial incisional SSI by the surgeon or attending physician.

The appropriateness of antibiotic prophylaxis was determined by ‘Guidelines for Antimicrobial Prophylaxis and Therapy for hospitalised patients’ put forth by Ministry of Health 2011 Delhi\textsuperscript{XIV} along with Hospital Infection Control Committee guidelines in our hospital.

The course of antimicrobial drugs were evaluated. If more than one drug was prescribed for a single operation, all parameters for each drug were evaluated separately. Any deviation from the guidelines in the prescription of one of the drugs led to a final assessment of the prophylactic course as discordant with the guidelines. If an antibiotic was administered while it was not indicated, the parameters such as antibiotic choice, dose, duration, dosing interval and timing
RESULTS

This prospective study was conducted from the month of May to June 2013, and 100 patients were included in the study. Only clean surgical operations were included, as summarised in Table 1.

The most frequent surgery performed was inguinal hernia repair (24%).

The duration of operation did not exceed two and half hours as shown in Table 2. Hence, there was no intraoperative re-dosing.

Antibiotic prophylaxis was received by all 100 patients (100%) intravenously within one hour of induction of anaesthesia as per our hospital guidelines as shown in Table 3.

The optimal time for administration of preoperative doses is within 60 minutes before the surgical incision. [According to American Society of Health Report (ASHP) of 2013. Out of these, the majority was between 0-15 min (82%). Six different drugs or combinations were used. Most patients (70%) received third generation cephalosporins. The single drug that was most frequently prescribed was Ceftriaxone (70%). Antibiotics usage in surgical operations is shown in Table 4.

In our study for evaluating the appropriateness of antibiotic prophylaxis the parameters that were used was antibiotic of choice, time of administering the first dose, time and duration of surgery. It was observed that 74% patients received the antibiotic which was recommended by guidelinesIII.

However out of 100 cases 18 patients received prophylactic antibiotic in General Surgery as per recommended guidelinesIII for duration of 24hours and the duration of antibiotic prophylaxis is continued for more than 24hours in (82%) cases. There is general consensus that postoperative prophylactic antibiotics should be stopped within 24 hours of most major surgical proceduresIV,V. The prolonged duration of antibiotic prophylaxis was the main parameter of interest in our study as shown in Table 5.

DISCUSSIONS

The evidence of effectiveness of pre-operative antibiotic prophylaxis is well established. Despite this, surveys have shown that optimal practice is not achieved in many hospitalsXV.

Misuse of antibiotics in surgical prophylaxis is still quite common. In a prospective multi-site study of elective procedures done in 13 Dutch hospitals, wherein before the intervention, 1763 procedures were recorded and 2050 thereafter. Antimicrobial use decreased from 121 to 79 DDD (defined daily doses)/100 procedures and costs reduced by 25% per procedure. After the intervention, antibiotic choice was inappropriate in only 37.5% of the cases instead of in 93.5% expected cases had the intervention not occurred. Prolonged prophylaxis was observed in 31.4% instead of 46.8% expected cases and inappropriate timing in 39.4% instead of the expected 51.8%. Time series analysis showed that all improvements were statistically significant (P < 0.01) and that they could be fully attributed to the intervention. Surgical site infections result in a number of costs to the patient, healthcare system and to the community.

The principal finding in our study was that adherence to guidelines for antibiotic prophylaxis was 100% and this success was attributed to the routine of initiation of prophylaxis by anaesthesiologists at the time of induction of anaesthesia. Overall, only (18%) patients received one or two doses of antibiotics whenever it was necessary, according to
guidelines. Although existing evidence fails to support longer duration of usage of prophylactic antibiotics, prolonged administration beyond 24 hour is common\textsuperscript{XVI}. No SSI was noted in our study. The misconception among surgeons about the need for prolonged administration of antimicrobial prophylaxis\textsuperscript{I} was analysed by Dr. Barie during a round table discussion about ‘Antibiotic Prophylaxis in Surgery-2005 and Beyond’ and, he clearly stated that ‘even though we have strong data, nothing seems to have changed. We cannot get surgeons to give up their post operative prophylactic antibiotics’\textsuperscript{XVII}. Surgeons were encouraged to administer prophylactic antibiotics for no more than 48 hours. But, 1,139 (43\%) of the 2,641 patients received prophylactic antibiotics for more than 48 hours\textsuperscript{XVIII}. This result was in ordinance with our present study suggesting prolonged use of prophylactic antibiotics. However, today there is mounting evidence of important disadvantages to prolonged prophylaxis. Emerging antibiotic resistance was once regarded as an ill-defined notion that received only passing notice\textsuperscript{XIX}. There is now considerable evidence that this problem is real, clinically important, directly linked to the duration of prophylactic antibiotic administration.

This fact alone is enough to prompt a reassessment of our practice, but in addition we now phase the introduction of quality matrix linked to third party pay for performance initiatives\textsuperscript{XX}. In other surgical specialities there is evidence that a single dose of prophylactic antibiotic is sufficient to optimally reduce SSI\textsuperscript{XX}.

Having the anaesthesiologists administer the antibiotic at the time of introduction of anaesthesia resulted in a significant improvement of the pre operative dose of prophylactic antibiotic and a decrease in the median interval between antibiotic administration and incision (0-15 min). Although there may be some reluctance on the part of the anaesthesiologists to assume this task, this method has also been shown to improve antibiotic administration in other studies too (Matuschka et al.1997; web et al. 2006; White and Schneider 2007).

CONCLUSIONS

The findings are accurate and valid as this was a prospective study under direct observation. Our study showed no cases of SSI suggesting strict adherence to guidelines for antibiotic prophylaxis in general surgery, however inappropriate use of antibiotics was found in (26\%) of cases, where combinations such as Piperacillin and Tazobactam, Cefoperazone and Sulbactum was administered for clean operations.

This finding was in ordinance with study done at Belgium where 234 different regimens were used in the antimicrobial prophylaxis of 19,746 surgical patients\textsuperscript{XXII}. In our study, we observed that all the patients received appropriate dose of prophylactic antibiotic as per the guidelines\textsuperscript{III}.

The important patient safety goal is to optimize delivery of prophylactic surgical antibiotics. The findings in our study demonstrate that significant improvement in the dosing can be achieved through quality improvement efforts involving multidisciplinary collaboration. Quality improvement interventions should be evaluated rigorously for effectiveness and for compliance of guidelines.

REFERENCES


3. April 2013 CDC/NHSN Protocol Corrections, Clarification, and Additions http://www.cdc.gov/nhsn/pdfs/pscmanual/9pscscsicurrent.pdf [Date: July 07 2013].


Table 1: Clean Surgical Operations

<table>
<thead>
<tr>
<th>Clean Operations</th>
<th>N (number of cases)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inguinal hernia repair</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Varicose vein surgical treatment</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Laparoscopic Inguinal Hernia repair</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Herniotomy</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Thyroidectomy</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Soft tissue excision</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Umbilical hernia repair</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>N=100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Duration of Operations

<table>
<thead>
<tr>
<th>Duration</th>
<th>Number of Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 30 min</td>
<td>11</td>
</tr>
<tr>
<td>30 – 1hr</td>
<td>34</td>
</tr>
<tr>
<td>1hr – 1hr 30min</td>
<td>24</td>
</tr>
<tr>
<td>1hr 30min – 2hr</td>
<td>11</td>
</tr>
<tr>
<td>2hr – 2hr 30min</td>
<td>20</td>
</tr>
<tr>
<td>&gt;2hr 30 min</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3: Time of First Dose of Pre Operative Antibiotic Administered

<table>
<thead>
<tr>
<th>Time of First Dose</th>
<th>Number of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15</td>
<td>82</td>
</tr>
<tr>
<td>15-30min</td>
<td>14</td>
</tr>
<tr>
<td>30-45min</td>
<td>4</td>
</tr>
<tr>
<td>45-1hr</td>
<td>0</td>
</tr>
<tr>
<td>&gt;1hr</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4: Antibiotics Utilized in Surgical Operations

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Number of Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceftriaxone</td>
<td>74</td>
</tr>
<tr>
<td>Ampicillin + Gentamicin</td>
<td>1</td>
</tr>
<tr>
<td>Piperacillin + Tazobactum</td>
<td>8</td>
</tr>
<tr>
<td>Cefoperazone + Sulbactum</td>
<td>11</td>
</tr>
<tr>
<td>Ampicillin + Cloxacillin</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 5: Duration of Antibiotic Prophylaxis

<table>
<thead>
<tr>
<th>Duration of Prophylaxis</th>
<th>Number of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 dose (Day of surgery)</td>
<td>1</td>
</tr>
<tr>
<td>2 doses</td>
<td>17</td>
</tr>
<tr>
<td>2-3 days</td>
<td>65</td>
</tr>
<tr>
<td>4-5 days</td>
<td>8</td>
</tr>
<tr>
<td>6-7 days</td>
<td>5</td>
</tr>
<tr>
<td>8-9 days</td>
<td>2</td>
</tr>
<tr>
<td>&gt;10 days</td>
<td>2</td>
</tr>
</tbody>
</table>