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A Retrospective Study on the Timing of Perioperative Antimicrobial Interventions in Class I Incisions

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Abstract: This retrospective case-control study was conducted to provide reference for the timing of antimicrobial drug use for clinical prevention. Cases of patients with type I incision surgery of 2019 at a 3A hospital were selected for statistical analysis, and 336 cases each with surgical duration ≥3h and equivalent surgical duration <3h of the same type were selected as the case and control groups, respectively. The focus was on the type of surgery, length of surgery, timing of medication, days of medication, and the occurrence or not of surgical site infection (SSI)in patients. There was a significant difference in the incidence of SSI between the case and control groups (18.15% Vs. 6.15%, P<0.001). The number of cases of intraoperative additional antimicrobial drugs for surgical duration ≥3h was 155 (57.83%), of which the number of cases with SSI was 40 and the number of cases with SSI without additional 113 was 21 (25.81% Vs. 18.58%, P=0.145). Additional intraoperative antimicrobial drugs for surgery ≥3 h were not effective in reducing the incidence of SSI, but significantly reduced the number of days patients were hospitalized. The occurrence of SSI is related to many factors and should not be overly dependent on the use of antimicrobial drugs.

Keywords: Class I Incision; Perioperative Period; Antimicrobial Prophylaxis; Surgical Site Infection

Introduction

The main purpose of perioperative prophylaxis with antimicrobial drugs is to prevent surgical site infection (SSI). SSI is the most common postoperative complication [1], accounting for 15% of hospital-acquired infections. The rate of infection in Class I surgical incisions is only about 1% according to Cruse[2]. The first core strategy for the prevention of SSI is surgical prophylaxis, in which the timing of antimicrobial use in surgical prophylaxis is important. The half-life of cephalosporins in the general prophylaxis category is relatively short, and the effective concentration may not be maintained beyond 3h. NNIS confirmed that the duration of surgery is one of the risk factors for the occurrence of surgical site infection, and the duration of surgery beyond 2h is already a high risk factor for postoperative infection [3]. However, it is worth noting that no significant difference in the incidence of hospital-acquired infections has also been reported for perioperative prophylaxis with antibiotics for class I incisions. It is also true that there are clinical examples of patients who grew older than 3 hours during surgery and did not develop infections without additional intraoperative antimicrobial drugs. It is worthwhile to consider whether the timing of antimicrobial intervention, especially the addition of intraoperative drugs at three hours, has any effect on the incidence of postoperative SSI.

1. Materials and Methods

1.1 Sources of information

Using EMR and HIS, "incision type" was used as search terms to extract the cases of category I incision surgery, and 336 cases as the experimental group. Then an equal number of cases with the same type of type I incision were randomly

selected from the cases with less than 3h as the control group.

1.2 General method

The general information of patients (ID number, gender, age, department, discharge time); information of surgery (main diagnosis, name of surgery, date of surgery, duration, incision healing, hospitalization days); information of antimicrobial drug application (name of drug, dosage, route of drug, timing of drug, duration of drug, combination of drug) and incision infection were counted according to the extracted case record information. The information is entered and summarized according to the extracted case records.

1.3 SSI judgment basis

Any incision with localized redness, swelling, heat, pain, purulent exudate above the fascial tissue, or localized pus exudation after stitch removal, regardless of whether there is bacteriological evidence, is an incisional infection.

1.4 Statistical methods

Statistics and analysis were performed using SPSS 19.0 computer software. The data were expressed as mean ± SD, and t Test and Chi-Square Test were used for comparison between groups, and logistic regression method was applied for multi-factor analysis. $P < 0.05$ was considered as significant difference.

2. Results

A total of 336 patients meeting the ≥3h inclusion criteria were selected from 2019, while 336 cases in the <3h control group were randomly selected, for a total of 672 cases. Among them, 280 cases (41.67%) were male. The youngest of the patients was 2 years old and the oldest was 90 years old with a mean age of 51.46 ± 14.19 years.

2.1 SSI situation

Of the 672 patients included in the survey, 88 were infected. The overall incidence of SSI was 13.09%, and the infection rate in the case group was 18.15% (61/336) significantly higher than that in the control group, which was 8.04% (27/336) (χ^2=15.116, P<0.001). Surgical infections were mainly concentrated in surgical times longer than 2h-5h. The mean number of hospital days in the case group was 17.57±11.04 days, which was higher than the mean number of hospital days in the control group, which was 12.99±6.70 days, and the difference in the number of hospital days between the two groups was statistically significant (P<0.001).

2.2 Problems related to the timing of antimicrobial drug use

Antimicrobial drugs were used in 481 of 672 cases of type I incision surgery, with a utilization rate of 71.58% and 191 cases without antimicrobial drugs, with a non-utilization rate of 28.42%. The types of surgery without prophylactic use of antimicrobial drugs were mostly thyroid adenoma, mastectomy, and inguinal hernia repair. The use of antimicrobial drugs was mostly first and second generation cephalosporins, accounting for 77.33% of prophylactic use, and only 8 cases of other types; 31 cases of combined use accounted for 6.45%.

The duration of surgery was longer than 3h in 336 cases. Among them, perioperative medication was used in 268 cases. Intraoperative additional antibiotics were applied in 155 cases, accounting for 57.83% of the medications used and 46.13% of the overall cases. The analysis showed that there was no significant difference in the rate of infection with or without additional intraoperative antibiotics for surgery longer than 3 h (P=0.145). In cases where the duration of surgery was ≥3h, the mean number of days in hospital was 16.12±5.48 for patients on medication was significantly less than 19.75±11.816 for patients operated on without medication *(*P=0.037).

3. Discussion

3.1 Procedure length and SSI

The current study focused on the effect of operative length on the incidence of SSI and found that the incidence of postoperative SSI tended to increase with longer operative time, increasing the mean length of stay of patients, and all of them were significantly increased (P<0.001). The incidence of SSI in the present study was 18.15% significantly greater than the incidence of SSI in surgery longer than 3h (P<0.001) than 6.25% (P<0.001), which is generally consistent with the literature. Analysis of this may be due to the fact that prolonged duration of surgery may increase the time of straining at the surgical site, bleeding, and increase the time of tissue exposure, which aggravates tissue ischemia and hypoxia at the incision site and tissue damage, and also the sensitivity of antimicrobial drugs may decrease after 3h, and the effective concentration of drugs decreases, increasing the likelihood of infection.

3.2 Timing of antimicrobial prophylaxis use and SSI

In surgical procedures, it is important to use antimicrobial drugs for reasonable perioperative prophylaxis, and many scholars point out that the timing of antimicrobial drug use is the key. Exactly why antimicrobial drugs in the intraoperative additional to choose 3h this intervention time, analyzed part of the literature found that, first of all, the timing of 3h use is based on pharmacological theory, generally used for prophylaxis of cephalosporin antibiotics are short half-life, generally 30-40min, there are data to support that the sensitivity of antibacterial drugs will also change with the increase of time [1], in order to ensure the effectiveness of drugs, clinical generally use 3h to go additional antibacterial drugs. Further related to the contamination colonization of bacteria, the critical period for effective preventive medication is within 4 h of the germ invasion into the wound, and it is difficult to achieve the desired effect with medication after the bacterial colonization time [4], which reflects the importance of antimicrobial drug use before bacterial colonization. Whereas after two hours is a risk factor for the occurrence of SSI, between 2-4h, 3h may be a more appropriate time.

In this study, we observed the use of additional intraoperative antimicrobial drugs at the time of surgery older than 3h. We found no significant difference between the use of additional intraoperative drugs and the occurrence of postoperative SSI (P=0.145). However, it was also found that the number of days of hospitalization was significantly less in patients who were administered medication after 3h than in those who were not, indicating that the use of antimicrobial drugs was significant to some extent.

3.3 Other factors of SSI

Relevant literature related to surgical factors have pointed out that age, impaired immune system, diabetes mellitus, infection in non-operative areas, wound classification, malnutrition, smoking, obesity, excessive preoperative hospital days and hormones, and prolonged operative time, skin preparation, surgical hand washing, operating room environment, and surgical technique are factors associated with postoperative SSI. In this study, the proportion of cases with intraoperative implantation of artificial joints, prostheses, and internal fixation materials was large, and the concentration of surgical susceptibility factors was high, which to a certain extent also led to a high rate of prophylaxis. Deep surgical incisions, mostly complex surgeries, long exposure time of incisions, more severe strains and tissue damage, and mostly having built-in materials are all factors associated with SSI. Therefore, the importance of the use of antimicrobial drugs in reducing the occurrence of SSI is not significant under the influence of the combined condition factors. Even if additional intraoperative antimicrobial drugs are used, they are not effective in reducing the incidence of postoperative SSI.

In summary, although the additional use of antimicrobial drugs effectively shortened the number of days of hospitalization, the correlation with surgical site infection was not significant and was not an independent influencing factor in reducing the incidence of postoperative SSI. The incidence of SSI should not rely solely on the use of antimicrobial drugs to prevent and treat SSI.

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