Kocatepe Tıp Dergisi
Kocatepe Medical Journal
16:198-203/Temmuz/2015

ARAŞTIRMA YAZISI / RESEARCH ARTICLE

# Cerrahi Alan İnfeksiyonları ve Risk Faktörleri: Türkiye'de Doğu Anadolu Bölgesinde bir Devlet Hastanesinin Sonuçları

## Surgical Site Infections and Risk Factors: Results of a State Hospital in the Eastern Anatolia Region in Turkey

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Geliş Tarihi / Received: 18.07.2014 Kabul Tarihi / Accepted: 12.12.2014

## ÖZET

**Amaç:** Cerrahi alan infeksiyonları (CAİ) cerrahiden sonra görülen major bir problemdir. Hasta konforunun bozulmasına, morbidite ve mortalite artışa, hastanede kalış süresinin uzamasına ve hastane maliyetlerinde artışa neden olurlar. Bu çalışmanın amacı cerrahi alan infeksiyonlarını etkileyen risk faktörlerini araştırmaktır.

**Materyal ve Metod:** Bir devlet hastanesinde Kasım 2007 ile Ağustos 2009 tarihleri arasında cerrahi uygulanan 1040 hasta; CAİ ve onunla ilişkili yaş, cinsiyet, ASA derecelendirmesi, anestezi tipi, cerrahinin zamanlaması ve bölgesi, yara tipi ve altta yatan hastalık açısından retrospektif olarak incelendi.

**Bulgular:** Hastaların yaşları 4 ile 82 yıl (ort. 36,1 ±15,8 yıl) arasında ve kadın/erkek oranı 43/57 idi. 1040 hastanın 53'ünde (% 5,1) CAİ tanısı konmuştu. CAİ gelişen vakaların % 39,2'sinde S. aureus izole edildi. CAİ gelişen hastaların ortalama yatış süresi 7 gün iken, gelişmeyen hastalarda bu oran 2,7 gün idi. Yaş, yara tipi, ASA skoru ve altta hastalıkla CAİ gelişmesi arasında anlamlı fark bulundu ($p<0,05$).

**Sonuç:** Hastaların ameliyat sonrası CAİ oranları literatür ile uyumlu idi. Hastanın yaşı, ASA skoru, yara tipi ve ek hastalık varlığı faktörleri değiştirilmez. Ancak CAİ için risk ameliyat öncesi antibiyotik profilaksisi ile azaltılabilir.

**Anahtar Kelimeler:** Cerrahi alan infeksiyonu, insidans, risk faktörleri.

## ABSTRACT

**Objective:** Surgical site infections (SSIs) are a major problem after surgery. They cause to impairment of patient comfort, increase morbidity, mortality, in hospital stay and costs. The aim of this study is to investigate the risk factors affecting SSIs.

**Material and Methods:** One thousand forty patients underwent general surgery procedures at a single state hospital between 2007 November and 2009 August were retrospectively reviewed for SSIs and its relationship with factors such as age, gender, ASA (American Society of Anesthesiologists) scores, timing and site of surgery, type of wound and underlying diseases.

**Results:** Patients ranged in age from 4 to 82 years (mean 36,1 ±15,8) and female to male ratio was 43/ 57. Of 1040 patients, 53 (5,1 %) had a diagnosis of SSI. The isolated pathogen in the 39,2 % of the patients who developed wound infection was S. aureus. The hospital stay was average 7 days in the patients developed SSI while it was 2,7 days in the patients without SSI. The age, wound type, ASA scores and underlying diseases were found significant in the development of SSIs ($p<0,05$).

**Conclusions:** Postoperative wound infection rates in our patients were in compatible with literature. Patient's age, ASA score, wound type and the presence of additional disease are not changed factors but this risk can be reduced in patients with preoperative antibiotic prophylaxis.

**Keywords:** Surgical site infection, incidence, risk factors.

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## INTRODUCTION

Surgical site infections (SSIs) still remain an important problem after surgery despite recent medical and surgical developments and it has been reported to vary between 2-40 % (1,2).

These infections lead to increase of morbidity, mortality, prolonged duration of postoperative hospital stay and health costs (2,3). Many factors play role in the development of the SSI such as malnutrition, diabetes mellitus, smoking, insufficiency of immune response, prolongation of hospital stay before surgery, inappropriate propyhlaxis, inadequate ventilation of the operating room, inappropriate asepsis and antisepsis techniques, foreign materials in the surgical site and failure of surgical techniques (1,4,5). For optimal prophylaxis, an antibiotic with a targeted spectrum should be administered at suffiently high concentrations in serum, tissue, and surgical wound during the whole time the incision is kept open at risk of bacterial contamination. Effect to antibiotic prophylaxis should be used to reduce the surgical infections, duration of hospital stay, therapeutic antibiotic usage and sepsis- related mortality (3). The aim of this study is to investigate the risk factors affecting SSIs in patients who were operated in hospital.

## MATERIAL and METHOD

One thousand forty patients underwent general surgery procedures at a single state hospital between 2007 November and 2009 August were retrospectively reviewed for SSIs. The relationship between SSIs and factors such as age, gender, ASA (American Society of Anesthesiologists) scores, timing and site of surgery, type of wound, underlying diseases and antibiotic prophylaxis administration according to the protocol recommended by the control committee infectious of hospital. Patients were divided into four groups **(Table 1)** according to the risk of contamination during surgery (6-10).

The statistical analysis was done with using the SPSS (13.0) program. Mann-Whitney U test was used for age and length of hospital stay analyze because of the lack of normal distribution of these parameters and all others parameters were analyzed with the Chi-Square Pearson test. P< 0,05 was considered significant.

## RESULTS

Patients ranged in age from 4 to 82 years (mean 36,1±15,8 ) and female to male ratio was 43/57. Patient age was assessed as a categorical variable (younger than 65 years, older than 65 years) There were nine hundred eighty-two (94,4 %) younger than 65 and fifty-eight (5,6 %) older than 65 years old.

Of 1040 patients, 379 (36,4 %) in emergency condition and 661 (63,6 %) in elective condition were operated. There were three hundred ninety-seven (38,2 %) patients in the clean group, 558 (53,6 %) in the clean contamined group, 34 (3,3 %) in the contaminated group, and 51 (4,9 %) of the patients were in the dirty wound group.

According to preoperative scoring, 765 patients (73,6 %) of them had ASA-I, 222 patients (21,3 %) had ASA-II, 52 patients (5 %) had ASA-III and 1 patients (0,1 %) had ASA-IV.

Of 1040 patients, 53 (5,1 %) had a diagnosis of SSI. When surgical wounds were classified as clean+clean-contaminated and contaminated+dirty, it was found that SSIs rate was 4,3% in clean+clean-contaminated wound and 14,1% in contaminated+dirty wound.

The age, wound type, ASA scores and underlying diseases were found statistically significant in the development of SSIs (p<0,05).

The isolated pathogen in the 39,2 % of the patients who developed wound infection was S. aureus. The average hospital stay was 7 days in the patients developed SSI while the average was 2,7 days in the patients without SSI. The average length of hospital stay after surgery was 2,81± 2 days **(Table 2)**. In our study, age, wound type, ASA scores and the presence of additional diseases were found statistically significant for the development of SSIs. The statistical information is presented in **Table 3**.

**Table 1:** Use of antibiotics in our hospital.

| Type of operation | Antibiotic | Dose and application form |
|---|---|---|
| Clean | Cefazolin | 1 gr İ.V. during induction of anesthesia |
| Clean-contaminated | | |
| Nonelective hernia | Cefazolin | 1 gr İ.V. during induction of anesthesia |
| Gastroduodenal | Cefazolin | 1 gr İ.V. during induction of anesthesia, 8 th and |
| Biliary | Cefazolin | 16 th hours |
| Elective colorectal | Cefoxitin | 1 gr İ.V. during induction of anesthesia, 8 th and |
| Appendectomy | Cefoxitin | 16 th hours |
| | | 2 gr İ.V. during induction of anesthesia and 1 gr |
| | | İ.V. 6th,12th,18th hours |
| | | 1 gr İ.V. during induction of anesthesia |
| Contamined | | |
| Biliyer* | Cefazolin | 1 gr İ.V. during induction of anesthesia, 8 th and |
| Peptic ulcer perforation | Cefazolin | 16 th hours |
| Non-elective colorectal | Cefoxitin | 1 gr İ.V. during induction of anesthesia, 8 th and |
| | | 16 th hours |
| | | 2 gr İ.V. during induction of anesthesia and 1 gr |
| | | İ.V. 6th,12th,18th hours |
| Dirty or infected | | |
| Perforated acute | Cefoxitin | 2 gr İ.V. during induction of anesthesia and 1 gr |
| cholecystitis | Cefoxitin | İ.V. 6 hours intervals for 5 days |
| Perforated appandisit | | 2 gr İ.V. during induction of anesthesia and 1 gr |
| | Cefoxitin | İ.V. 6 hours intervals for 5 days |
| Perforated colorectal | | 2 gr İ.V. during induction of anesthesia and 1 gr |
| | Cefazolin+ | İ.V. 6 hours intervals for 5 days |
| İntra abdominal | Gentamicin+ | Cefazolin 1 gr İ.V,gentamicin 1.5 mg/kg İ.V, |
| absescess | Metronidazol | metronidazol 1 gr İ.V. during induction of |
| | | anesthesia and seriatim 1 gr İ.V, 1.5 mg/kg, 500 |
| | | mg İ.V. 8 hours intervals for 5 days |

***** Uncontrolled spread of infected bile in patiens during surgery.

**Table 2:** Demographic information of patients.

| | | Number of patient (n) | Value of % |
|---|---|---|---|
| Age | <65 | 982 | 94,4 |
| | >65 | 58 | 5,6 |
| Gender | Male | 593 | 53,0 |
| | Female | 447 | 47,0 |
| SSI | Yes | 51 | 4,9 |
| | No | 989 | 95,1 |
| ASA | I | 765 | 73,6 |
| | II | 222 | 21,3 |
| | III | 52 | 5,0 |
| | IV | 1 | 0,1 |
| Timing of surgery | Emergency | 379 | 36,4 |
| | Elective | 661 | 63,6 |
| Type of wound | Clean | 397 | 38,2 |
| | Clean-contamined | 558 | 53,6 |
| | Contamined | 34 | 3,3 |
| | Dirty or infected | 51 | 4,9 |
| Add disease | Positive | 60 | 5,6 |
| | Negative | 980 | 94,4 |

**Table 3:** Statistical analysis of the risk factors for SSI.

| | | SSI (+) | | SSI(-) | | P value |
|---|---|---|---|---|---|---|
| | | N | % | n | % | |
| Age | <65 | 46 | 4.7 | 936 | 95,3 | |
| | >65 | 7 | 12,1 | 51 | 87,9 | 0,001 |
| Gender | Male | 29 | 4,9 | 564 | 95,1 | |
| | Female | 24 | 5,4 | 423 | 94,6 | 0,72 |
| ASA | I and II | 43 | 4,4 | 944 | 95,6 | |
| | III and IV | 10 | 18,9 | 43 | 81,1 | 0,001 |
| Timing of surgery | Emergency | 26 | 6,9 | 353 | 93,1 | |
| | Elective | 27 | 4,1 | 634 | 95,9 | 0,05 |
| Add disease | No | 39 | 4 | 941 | 96 | |
| | Yes | 14 | 23,3 | 46 | 76,7 | 0,001 |
| Type of wound | (Clean)+(Clean-Contamined) | 41 | 4,3 | 914 | 95,7 | |
| | (Contamined)+(Dirty) | 12 | 14,1 | 73 | 85,9 | 0,001 |
| Lenght of stay hospital after surgery | | 7±3 days | | 2,7±1,7 days | | 0,001 |

## DISCUSSION

Despite considerable progress in the areas of prevention, diagnosis, and therapy, postoperative infections continue to be associated with high morbidity and mortality (6). SSI is one of the most common complications after operation, and its prevelance has been reported to vary between 2-40 % in the literature (1,2,11,12). These infections result in an increase in morbidity, duration of hospital stay, health-care expenses, diminishes personal income by delaying the individual's return to work and mortality (2,11,13,14). For prevention of postoperative SSIs antibiotic prophylaxis is used for many years (15). The benefit of antimicrobial prophylaxis was reported as far back as the 1960s from randomised trials and this practice has had a marked impact on surgical practice (16).

In our study, overall the rate of SSI was found 5,1 % and this rate is consistent with the literature (2,11,12). In the literature, rates of SSI have been reported to 2-40 % depending on the surgical procedures and surgery centers (1). When patients were examined according to the extent of bacterial contamination during the surgical procedure SSIs were most often seen in the dirty group with rate of 13,2 %. In the literature, S.Brown et all reported similar results in their study (17).

In our study, Staphylococcus aureus was the most isolated agent with 39,2 % rate. According to the data of National Nosocomial Infections Surveillance (NNIS), S. aureus, coagulase negative staphylococci, enterococci and Escherichea coli are the most seen pathogens causing SSIs in the last ten years (18).

In our study, the age was found to be the risk factor for SSIs. SSI rate in adult group was 4,7 % while this rate was found to 12,1 % in advanced age group ($p<0,001$). In the other studies the rate of SSI was also significantly higher in the patients aged over 65 (1,19).

The degree of contamination is one of the most important factors for SSI. According to the NNIS report, SSI rate varied between 3-10 % in contamined wound and 7 % in dirty wound group (18). In other studies, this ratio is up to 40 % in the dirty wound type (20). The type of wound being contamined or infected is expressed as an important risk factor for SSI in Center for Disease Control and Prevention's (CDC) data (21).

In this study, we found that the risk of SSI increased in patients with ASA score III-IV ($p<0,001$). In parallel to our study, the various publications have been reported that ASA scores as an increased risk factor for SSI (17,19).

As a result of the chronic diseases and immunocompromised states at the time of surgery, defensive mechanisms weaken and at last the infection rates increase. In our study with an additional disease SSI rate is 23,3 %. Likely in the other studies we found increased risk of SSI in the presence of DM. DM is the most frequent additional disease with the rate of 56,7 % (22,23).

In our study, surgical operation timing, electivity or emergency, was not found to be one of the risk factors. However in literature emergent intervention was an risk factor for SSI (19,24,25). Our results were inharmonious with the literature.

In the presence of SSI, length of hospital stay after the operation was 7±3 days. This period was significantly shorter in the non SSI patients ($p<0,001$).

The prolonged hospital stay, increased morbidity and mortality risk and considerably increase hospital costs are seen in the SSI group. In the presence of SSI, hospitality duration prolonges to about 7 days, hospital costs increase about $3000, morbidity and mortality rates doubles (1,12,26).

## CONCLUSION

Postoperative wound infection rates in our patients were in compatible with the literature. Patient's age, ASA score, wound type and the

presence of additional disease are factors that can not be changed but this risk can be reduced in patients with suitable preoperative antibiotic prophylaxis.

**Acknowledgments:** The authors have no conflict of interest.

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