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# Postoperative Nosocomial Infections in Patients Undergoing Major Heart Surgery

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## Abstract

**Introduction and Aim:** Intensive care units (ICU) are high risk areas for nosocomial infections. The aim of this study was to assess the prospective incidence of infections following major heart surgery in adults in a follow-up period of one month after surgery.

**Results:** Seventy-two patients of which 85% underwent coronary artery bypass grafting were included in the study. Only 5 patients stayed for more than 2 days in the ICU. No postoperative infections were observed during the stay in ICU. After ICU the patients had a median stay of 6 days in the department of cardiology where ten (14%) patients had 14 episodes of nosocomial infection. During the observation period of 30 days, 24 patients were discharged to another hospital and 44 patients were discharged to home. Eleven (15%) patients had 14 episodes of infection after discharge. Twelve episodes of infection in eight (11%) patients fulfilled the CDC definitions for nosocomial infections. Seven of these patients had surgical site infections (six superficial infections) up to three weeks after surgery.

**Conclusion:** Major cardiac surgery carries a high risk not just of wound infections but also other nosocomial infections. All infections were observed after weaning from mechanical ventilation and all SSI after discharge from the hospital. Surveillance should be continued beyond discharge to at least 20 days and probably 30 days to avoid missing episodes of nosocomial infections.

***Keywords:*** *Heart Surgery; Nosocomial Infections; ICU, Surgical Site Infections (SSI); Ventilator Associated Pneumonia (VAP)*

## Abbreviation

BSI: Blood Stream Infection; CDC: Centre for Disease Control; CRP: C-Reactive Protein; CVC: Central Venous Catheter; ICU: Intensive Care Unit; MHS: Major Heart Surgery; NICU: Neonatal Intensive Care Unit; SSI: Surgical Site Infection; UTI: Urinary Tract Infection; VAP: Ventilator Associated Pneumonia; WBC: White Blood Cells

## Introduction

Intensive care units (ICUs) are high-risk areas for nosocomial infections. The most common nosocomial infections in ICUs are ventilator-associated pneumonia (VAP). The attack rates of VAP is between 7 - 30% with a mortality rate of 30-50% [1-5]. Risk factors for nosocomial pneumonia are related both to the patients' comorbidities, age and clinical intervention [4,6-8]. Urinary tract infections (UTI) are also common accounting for more than 40% of all nosocomial infections and 80-90% these are associated with the use of urethral catheters [9,10]. Focus on catheter related UTIs have reduced nosocomial UTIs in general [3,4]. Nosocomial infections related to use of central intravascular catheters (CVC) and blood-stream infections (BSI) accounting for 10 - 20% of nosocomial infections in ICU, with mortality rates of 10 - 25% [3,4,11,12]. The incidence of surgical site infection (SSI) in patients following heart-surgery may be as high as 20% [3,4,15-19]. SSIs may occur several days after the operation [20] and include mediastinitis [18] and graft infections [21] after coronary artery bypass graft operations. Nosocomial gastroenteritis is usually described as a problem in long term care facilities and neonatal intensive care units (NICU) [13-14] but there has been little focus on gastrointestinal infections in adult ICUs [3,4]. Therefore, precautions to prevent nosocomial infections are of key importance in the ICU.

The aim of this study was to assess the incidence of postoperative nosocomial infections in patients who underwent major heart surgery. All patients were monitored to identify those who developed nosocomial infections for 30 days after weaning from mechanical ventilation.

## Material and Methods

### Patients

Seventy-two patients above 18 years who underwent major heart surgery (MHS) for one month were included in this study.

### Patients records

During the stay in the intensive care unit (ICU), the following data were recorded prospectively by daily review of the patients records in the ward: age, sex, date of admission to hospital and ICU, date of surgery, days of mechanical ventilation, nosocomial infections according to CDC definitions and to clinical practice [22,23], microbiological data, treatment and date of discharge or death.

### Follow-up after discharge

Patients were followed for a period of 30 days after extubation and discharge from ICU. Following variables were obtained retrospectively by review of the patients records in the cardiology ward: nosocomial infections according to CDC definitions and to clinical practice, temperature, C-reactive protein (CRP), white blood cells (WBC) at the time of infection, microbiological findings and antimicrobial treatment.

If patients were discharged to other hospitals, the records of the patients were requested retrospectively. The following data recorded: nosocomial infection according to CDC definitions and to clinical practice [22,23] temperature, CRP, WBC at infection time, microbiological findings and antimicrobial treatment.

If patients were discharged to home, a short questionnaire was sent to the patients for retrospective self-reporting upper or lower airway infections and wound infections, the time that the infection occurred and whether they were treated with antibiotics for this infection.

### Data handling and statistical methods

Demographic data are described by median, range and mean values. The incidences of nosocomial infections are described as incidence rates. The level of significance was set at $p = 0.05$.

## Results

The demographic data for the 72 patients are shown in table 1 together with the duration of mechanical ventilation. The follow up of patients was 32 days except for five patients who were mechanical ventilated for more than two days (observation time up to 42 days) and eight patients who could not be followed after discharge from Rigshospitalet (observation time from 14 to 21 days). About 82% of the patients were males, five of the 72 patients (6.9%) stayed in ICU for more than 2 days and the mean stay in ICU was about 1.5 day (Range 1-7 days). Two patients were re-admitted for urgent operations because of endocarditis. Eight patients could only be followed during their stay at Rigshospitalet and had a follow-up period of 1-3 weeks. The mode of operation included 56 (78%) elective operations, 13 (18%) urgent and 3 (4%) emergency operation. Sixty-one of 72 (85%) patients had a coronary artery operation, six (8.3%) had cardiac valve operation, two were heart transplanted and three had other heart operations. One patient died in the ICU because of heart failure after elective operation. No infections were observed during the stay in ICU after surgery (Table 2).

| | Number | Age | | | Time of intubation (days) | | |
|---|---|---|---|---|---|---|---|
| | | Median | Range | Mean | Median | Range | Mean |
| Males | 59 | 64 | 18 - 86 | 62.4 | 1 | 1 - 12 | 1.44 |
| Females | 13 | 68 | 28 - 89 | 65.2 | 1 | 1 - 8 | 1.63 |
| Total | 72 | 66 | 18 - 89 | 60.4 | 1 | 1 - 12 | 1.47 |

***Table 1:*** *Demographic data of 72 patients undergoing major heart surgery during December 2002 at Rigs Hospitalet, Copenhagen.*

Seventy-one patients were transferred from ICU to the department of cardiology. Forty-four of these patients were discharged to their home within 3 - 27 days (median 5 days). Two patients stayed throughout the observation period and one died of heart failure without infection in the department of cardiology. Twenty-four (32%) patients were transferred to their local hospital within 2 - 21 days (median 6.5 days). Sixteen patients were discharged to their home from the local hospital during the observation period. Three patients stayed at the local hospital throughout the observation period and the last five patients were only observed 1 - 3 weeks during their stay.

Two patients discharged to their home had nosocomial infections during their stay in the department of cardiology: one with gastroenteritis caused by *C. difficile* and one patient with VAP and CVC infection without significant pathogens. Six patients had a nosocomial infection before they were transferred to the local hospital: one patient had VAP caused by *M. catarrhalis*, SSI in graft site (crus) caused by *S. aureus* and gastroenteritis caused by norovirus, one patient with gastroenteritis without significant pathogens, three patients with VAP without significant pathogens and one had a CVC infection with coagulase negative staphylococci. One patient who stayed in the department throughout the observation period had gastroenteritis caused by norovirus, CVC infection caused by *E. cloacae* and UTI caused by yeast. Nine (64%) of 14 episodes of infections in six (60%) of these 10 patients fulfilled the CDC definitions (Table 2).

| Infection | In ICU | In Cardiological Department | After discharge | Total |
|---|---|---|---|---|
| Post-operative mediastinitis | 0 | 0 | 1 | 1 |
| Post-operative superficial thorax infection | 0 | 0 | 2 | 2 |
| Post-operative superficial crus infection (graft site) | 0 | 1 | 4 | 5 |
| CVC infection | 0 | 3 | 0 | 3 |
| VAP | 0 | 5 | 0 | 5 |
| UTI | 0 | 1 | 3 | 4 |
| Gastroenteritis | 0 | 4 | 1 | 5 |
| Upper airway infections | 0 | 0 | 3 | 3 |
| Episodes of infections | 0 | 14 | 14 | 28 |
| Patients with nosocomial infection | 0 (0%) | 10 (14%) | 11 (15%) | 21 (29%) |
| Episodes fulfilling CDC definitions | 0 | 9 | 3 | 12 |
| Patients fulfilling CDC definitions | 0 | 6 (8%) | 2 (3%) | 8 (11%) |

***Table 2:*** *Nosocomial infections observed in 72 patients undergoing major heart surgery within 30 days after weaning from mechanical ventilation. In total 28 episodes were observed in 21 patients.*

*ICU: Intensive Care Unit; CVC: Central Venous Catheter; VAP: Ventilator Associated Pneumonia; UTI: Urinary Tract Infection.*

Data were obtained from 19 of 24 (79%) patients discharged to a local hospital. Five (26%) of these patients had probably a nosocomial infection after discharge to a local hospital. One patient had both mediastinitis caused by *S. aureus* three weeks after operation and superficial wound infection caused by *E. coli* in the lower limb four weeks after operation. Two patients had superficial wound infections five to 17 days after the lower limb operation. One of these patients also had UTI and the other patient had upper airway infection and gastroenteritis. One patient had an upper airway infection and one had UTI (Table 2). Sixteen of these 24 patients were discharged to home during the study period.

Sixty patients received a questionnaire after discharge to home. Fifty-seven (95%) patients responded on the questionnaire. One patient had a superficial sternal infection caused by *S. aureus* 11 days after operation and one had a superficial sternal infection with negative culture results at 13 days after operation. One patient had a superficial wound infection after the lower limb operation without any positive microbiological findings, one patient had UTI (without any positive microbiological findings) and two patients had upper respiratory tract infections treated with antibiotics (Table 2).

Overall, twenty-one (29%) patients had one or more confirmed or suspected nosocomial infection after major heart operation. No patients had nosocomial infection during the stay in ICU but 10 (48%) of the 21 patients with nosocomial infection had 14 episodes of nosocomial infection during their stay in the cardiologic department and 11 (52%) patients had 14 episodes of nosocomial infection after discharge from the hospital (Table 2).

## Discussion

We found a surprising low rate of nosocomial infections in the ICU compared to reports from the literature [3,4,16,17]. This can be at least in part explained by use of per- and postoperative antibiotic prophylaxis for two days and a short stay at the ICU, with an average stay of only 1.5 days. Thus, most patients may not be at risk of developing a nosocomial infection in this short period.

Twenty-one (29%) of the patients had 28 episodes of clinical confirmed nosocomial infection within the observation period. Five patients had more than one nosocomial infections. All cases of clinical confirmed nosocomial infections were treated with antibiotics (except gastroenteritis caused by norovirus) and therefore regarded as a true infection by the clinicians. Data from the ICU were collected prospective and additional data could be obtained by the observer, whereas the majority of data from the Department of Cardiology and after discharge from the hospital were collected retrospectively. Better diagnosis and recording of data on infections by clinicians would

help to obtain a more accurate estimate of the actual rates of nosocomial infections in studies based on retrospective data. In this study it was observed that microbiology sampling was not done systematically in all patients and when samples had been taken they were frequently not noted in the patient's records.

Fourteen episodes of clinical confirmed nosocomial infection in ten (14%) patients were observed during the stay in the Department of Cardiology. After discharge from Department of Cardiology 14 episodes of clinical confirmed nosocomial infections in 11 (15%) of the patients, were observed. This shows the half of the clinical confirmed nosocomial infections occurred after discharge from the Department of Cardiology and would not have been recorded if the study only had been done while the patients were at the hospital. It might be questioned whether or not the three patients with UTI and the three patients with upper airway infections are true nosocomial infections. If they are excluded eight episodes of clinical conformed nosocomial infections in six (8%) were observed after discharge from the Department of cardiology. However, seven of eight SSI were observed after discharge from the Department of cardiology. Even though six of the seven SSI were superficial this underlines the importance of registration of nosocomial infections after discharge from the hospital. This is in accordance with other studies [20]. The relatively high number of superficial SSI infections in the graft-site on the legs resulted in a change of operating technique with two small incisions instead of one long.

Thus, no nosocomial infections were seen in the ICU probably because of the extended per-operative antibiotic treatment and the short time of ventilation. However, nosocomial infections related to ventilation (pneumonia) and uses of intravascular catheters applied in the ICU were seen in the Department of Cardiology and thus only be a delayed registration caused by the antibiotic therapy.

## Conclusion

Major cardiac surgery carries a high risk not just of wound infections but also other nosocomial infections. All infections were observed after weaning from mechanical ventilation and all SSI after discharge from the hospital. Thus, it is important that surveillance is to be continued beyond discharge up to 30 days to avoid missing episodes of nosocomial infections. Prolonged antibiotic prophylaxis does not prevent nosocomial infection or reduce the use of antibiotics but only delay the use of antibiotics.

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