



## Etiological Agents of Health-care associated Surgical Site Infections

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**Abstract:** Surgical site infection is the second most common nosocomial (health-care associated) infection among hospitalized patients and is a significant public health problem worldwide. Infections caused by multiresistant microorganisms are of special concern because of difficulties to treat them. From 1484 clinical samples, we isolated 1117 cultures of different gram-positive and gram-negative microorganisms. The leading agents were *S. aureus* and coagulase-negative *Staphylococci*. Methicillin resistance among *S. aureus* was low, while it exceeded 50% in CoNS. From gram-negative bacteria, representatives of the family *Enterobacteraceae* and non-fermenting rods were isolated in similar amounts. ESBL producers among *E. coli* and *K. pneumoniae* were not registered.

**Keywords:** Nosocomial infections, Gram-positive and gram-negative microorganisms, Methicillin resistance.

### Introduction

Health-care associated infections (HCAI) or nosocomial infections represent an important public health problem worldwide and are of increasing interest not only for medical staff, but also for the general public and politicians. HSAI are a major source of morbidity and mortality of patients in acute-care hospitals. The infection rate varies from 5-25% in different countries and poses medical as well as financial and psychological problems [1, 14, 15, 17].

Surgical site infection (SSI) is the second most common (after urinary tract infections) nosocomial infection among hospitalized patients. The reported SSI rates vary from 2.8 to 20%, depending on the hospital characteristics, patient characteristics and surgical procedures. Even antibiotic prophylaxis not always reduces the occurrence of SSI [2, 5, 7, 10].

Nosocomial infections are caused by a great variety of different gram-positive and gram-negative microorganisms, mainly opportunists. One of their most prominent features is polyresistance to antimicrobials. So, nosocomial infections, particularly those caused by



multiresistant microorganisms, which are difficult to treat, are one of the main causes of concern for modern medicine.

The aim of the present study was to assess the frequency and distribution of health-care associated surgical site infections caused by different gram-positive and gram-negative microorganisms in a surgical hospital with a special reference to multiresistant microorganisms.

### Materials and methods

The study was carried out during 2005-2006 at the Hospital of Traumatology and Orthopaedics, Riga, Latvia. Samples from patients with hospital-acquired purulent surgical site infections were examined. Most of the cultures were isolated from wounds, skin, abscesses, indwelling artificial devices and joints. Cultures of the samples were performed by conventional methods. The BBL Crystal gram-positive and gram-negative ID System (Becton, Dickinson) was used for identification of isolates at the species level. The resistance to a panel of antimicrobials was tested by the disk diffusion method according to CLSI standards. Methicillin resistance in Staphylococci was confirmed by the agar screening method on agar plates supplemented with 6 mg/ml oxacillin. The presence of the *mecA* gene was tested by the PCR technique. As complementary tests, the E-test (AB Biodisk) and Slidex MRSA (Bio Merieux, France) reaction, detecting the production of PBP2a, encoded by the *mecA* gene, were used [16].

### Results and discussion

From 1484 clinical samples, 1117 cultures were isolated (556 and 561 during the years 2005 and 2006, respectively).

The leading nosocomial agents were gram-positive microorganisms (Table 1).

Table 1. Ratio of gram-positive and gram-negative flora isolated from SSI in 2005-2006

Microorganisms	Years	
	2005	2006
Gram-positive flora	388 cultures – 79.67%	429 cultures – 76.47%
Gram-negative flora	99 cultures – 20.33%	132 cultures – 23.53%

The results demonstrate that the situation was rather stable during the two years.

The analysis of gram-positive microorganisms revealed the leading role of Staphylococci, both coagulase-positive and coagulase-negative Staphylococci (CoNS) (Table 2).

Table 2. Isolated gram-positive microorganisms

Microorganisms	Years	
	2005 (abs., % of gram-positive)	2006 (abs., % of gram-positive)
<i>S. aureus</i>	220 cultures – 56.7%	202 cultures - 47.08%
CoNS	141 cultures – 36.34%	155 cultures - 36.3%
Others	27 cultures – 6.96%	72 cultures - 16.62%



From 220 cultures of *S. aureus*, isolated during 2005, 8 occurred to be methicillin-resistant, while from 2002 cultures isolated in the year 2006, 12 were methicillin-resistant.

It is well known that *S. aureus* is a major cause of hospital-acquired infections worldwide, while, since the late 1970s, methicillin-resistant *S. aureus*, has spread. Due to its polyresistance, infections caused by MRSA lead to substantial morbidity and mortality as well as high healthcare costs [3, 11].

No outbreaks of the MRSA infection in our hospital were registered. Bloodstream infection, caused by MRSA, was documented in 1 patient in 2006.

A different situation was observed in coagulase-negative Staphylococci. The average methicillin resistance was more than 50%, especially high in *S. haemolyticus*, *S. hominis*, *S. Saprophyticus* (Table 3).

Table 3. Methicillin resistance in CoNS, isolated in 2005

Microorganisms	Number of cultures	Methicillin-resistant	Methicillin-sensitive
<i>S. epidermidis</i>	79	31	48
<i>S. haemolyticus</i>	20	18	2
<i>S. hominis</i>	17	15	2
<i>S. capitis</i>	3	1	2
<i>S. simulans</i>	5	2	3
<i>S. intermedius</i>	1	0	1
<i>S. vitulinus</i>	2	0	2
<i>S. saprophyticus</i>	8	7	1
<i>S. cohnii</i>	3	2	1
<i>S. felis</i>	1	0	1
<i>S. saccharolyticus</i>	1	1	0
<i>S. warneri</i>	1	1	0

In the year 2006, the situation was similar.

The average incidence rate of methicillin resistance among CoNS in the years 2005 and 2006 was 53.9% and 51.23%, respectively.

Other gram-positive organisms were isolated rarely. The following species were isolated: *Enterococcus faecalis* (2.9%), *Enterococcus faecium* (2.6%), *Streptococcus agalactiae* (1.8%), *Corynebacterium* spp. (0.7%), *Lactococcus* spp. (0.7%), *Micrococcus* spp. (1.1%), etc.

Vancomycin-resistant Enterococci were not registered.

Over the past 25 years, gram-positive infections have become a serious clinical problem because of an unrelenting increase in antimicrobial resistance. The emergence of pathogens such as methicillin-resistant Staphylococci and vancomycin-resistant Enterococci has had a significant impact on the treatment of diseases and created a substantial economic burden.



*S. aureus* causes a wide spectrum of infections – skin/soft tissue infections, bone/joint infections, prosthetic valve and other infections [8, 9, 12].

Coagulase-negative Staphylococci, particularly *S. epidermidis*, the most frequently isolated member of the CoNS group, are involved in catheter-related and bloodstream infections, infections of the ear, nose, throat, eye, etc. [13, 18].

From gram-negative microorganisms causing SSI, mainly non-fermenting rods and representatives of the family *Enterobacteriaceae* were isolated (Table 4).

Table 4. Isolated gram-negative microorganisms

Microorganisms	Years	
	2005 (abs., % of gram-negative)	2006 (abs., % of gram-negative)
Family <i>Enterobacteriaceae</i>	51 cultures – 52.52%	54 cultures - 40.9%
Non-fermenting microorganisms	48 cultures – 48.48%	78 cultures – 59.1%

From the family *Enterobacteriaceae*, the most often isolated were *Enterobacter* spp. (16.2%), followed by *Klebsiella* spp. (10.1%), *E. coli* (8.1%) and *Serratia*, *Morganella*, *Citobacter* spp.

Extended spectrum beta-lactamases (ESBL) producers among *E. coli* and *Klebsiella pneumoniae* were not registered.

During 2 years, there had been a tendency in increasing of isolates belonging to non-fermenting rods in our hospital – from 48.48% in the year 2005 to 59.1% in 2006. The leading agents were *Pseudomonas* spp. and *Acinetobacter baumannii*. Their ratio changed insignificantly – 52.9% and 41.2% in the year 2005, and 48.7% and 43.5% in the year 2006, respectively.

Changes in the epidemiology of non-fermenting gram-negative rods, especially *A. baumannii*, have been witnessed in recent years in many countries. The infections caused by these microorganisms have become increasingly common among critically ill patients in intensive care units (ICU) [4, 6].

In our hospital, we also isolated *A. baumannii* mainly from patients in ICU.

## Conclusions

Surgical site infections were caused mainly by gram-positive microorganisms – the leading agents were *Staphylococcus aureus*, followed by coagulase-negative Staphylococci. Methicillin resistance among *S. aureus* was low, and outbreaks were not registered. Methicillin resistance among CoNS was more than 50%.

Gram-negative agents of SSI, representatives of the family *Enterobacteriaceae* and non-fermenting genera *Pseudomonas* and *Acinetobacter* were registered in similar amounts.

ESBL producers among *E. coli* and *K. pneumoniae* were not documented.



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