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Surveillance of antibiotic susceptibility in a Swedish Burn Center 1994–2012

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ABSTRACT

Patients with burn trauma are at risk for infections caused by antibiotic resistant bacteria (ABR) with subsequent increase in morbidity and mortality. As part of the Swedish strategic program against antibiotic resistance in intensive care (ICU-Strama), we have surveyed the distribution of species and ABR in isolates from patients admitted to a Swedish burn center at Linköping University Hospital from 1994 through 2012. In an international comparison Strama has been successful in reducing the antibiotic consumption among animals and humans in primary care. The aim of this study was to investigate the antibiotic consumption pressure and resistance rates in a Swedish burn unit.

Methods: Microbiology data, total body surface area (TBSA), patient days, and mortality were collected from a hospital database for all patients admitted to the Burn Center at the University Hospital of Linköping from April 1994 through December 2012.

Results: A total of 1570 patients were admitted with a mean annual admission rate of 83 patients (range: 57–152). 15,006 microbiology cultures (approximately 10 per patient) were collected during the study period and of these 4531 were positive (approximately 3 per patient). The annual mean total body surface area (TBSA) was 13.4% (range 9.5–18.5) with an annual mortality rate of 5.4% (range 1–8%). The MRSA incidence was 1.7% (15/866) which corresponds to an MRSA incidence of 0.34/1000 admission days (TAD). Corresponding figures were for *Escherichia coli* resistant to 3rd generation cephalosporins (ESBL phenotype) 8% (13/170) and 0.3/TAD, *Klebsiella* spp. ESBL phenotype 5% (6/134) and 0.14/TAD, carbapenem

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Abbreviations: R, Resistant; I, Intermediary Resistant; S, Susceptible; ABR, Antibiotic Resistant Bacteria; C CVC, Central Venous Catheter; CNS, Coagulase-negative staphylococci; DDD, Defined Daily Dose; ESBL, Extended Spectrum Beta-lactamase; EUCAST, European Committee on Antimicrobial Susceptibility Testing; (B)ICU, (Burn) Intensive Care Unit; ICU-STRAMA, (Intensive Care Unit) Swedish strategic program against antibiotic resistance; LOS, Length of Stay; MRSA, Methicillin resistant *Staphylococcus aureus*; Pip-Taz, Piperacillin-Tazobactam; Sp(p), Species; STRAMA, Swedish Strategic Program Against Antibiotic Resistance; TAD, Thousand Admission Days; TBSA, Total Body Surface Area; TMX, Trimethoprim/Sulfamethoxazole; VRE, Vancomycin resistant *Enterococcus*.

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resistant *Pseudomonas aeruginosa* 26% (56/209) and 1.28/TAD, and carbapenem resistant *Acinetobacter* spp. 3% (2/64) and 0.04/TAD.

Conclusions: Our results show a sustained low risk for MRSA and high, although not increasing, risk for carbapenem resistant *P. aeruginosa*.

1. Introduction

Infections are still a major problem in severe burns receiving intensive care [1–9]. The overall morbidity and mortality of burn patients has decreased over the years, much due to improvements in early surgical intervention, wound care, and intensive care treatment [10–15].

Since approximately 75% of burn mortality is related to infections [1–3,16–19], epidemiologic surveillance of these, including antibiotic resistance, is important to guide empiric treatment. Unwarranted usage of broad-spectrum antimicrobial agents leads to increased selection of resistant microbes. This is seen globally [20–31] with increasing numbers of reports on antibiotic resistant bacteria (ABR) such as methicillin resistant *Staphylococcus aureus* (MRSA), vancomycin resistant *Enterococcus* (VRE), extended spectrum beta-lactamase (ESBL) producing enterobacteriaceae, and multidrug resistant Gram-negative bacilli. These bacteria occur frequently on ICUs [27–29] and BICUs [11,20,22,23,25,26,28]. The Swedish strategic program against antibiotic resistance (STRAMA), which started in 1994 reported recently that invasive infections caused by ESBL-producing *E. coli* and *Klebsiella* spp. have increased also in Sweden, but the proportion of pathogens resistant to 3rd generation cephalosporins causing invasive infections is still rather low from the European and international perspective [32]. Scandinavian countries and the Netherlands have been more successful in ''search and destroy'' actions against MRSA. The incidence of MRSA in Sweden is approximately 1% among invasive isolates compared to a 20-fold higher mean incidence in European countries [32]. Within ICU-Strama we have surveyed distribution of microbial species, and antimicrobial resistance (AMR), in isolates from patients admitted to the Burn Center at Linköping University Hospital, Sweden, from 1994 through 2012.

2. Aim

The aim of this study was to investigate the antibiotic consumption pressure and resistance rates in a Swedish burn unit.

3. Materials and methods

Setting: The Burn Center, Department of Hand-, Plastic-, and Burn Surgery, University Hospital of Linköping, Sweden. This is one of two national burn centers and has a catchment population of approximately 4.5 million inhabitants.

Patient data: Data were collected from patient records at the Burn Center in Linköping from April 1st 1994 through December 31st 2012. The following patient data were collected and aggregated: admission, discharge, age, gender, mean % total body surface area (TBSA%), mortality, number of admission days on ventilator, and number of admission days on dialysis.

Microbiological data acquisition: A search of the database of the Department of Clinical Microbiology Laboratory, University Hospital of Linköping was performed, looking for positive bacterial and yeast cultures of samples taken from all sources, in patients admitted to the Burn Center between April 1st 1994 and December 31st 2012. Data on species and antimicrobial susceptibility were entered into a secondary database. Only initial isolates of bacteria and yeasts were considered, and thus repeat isolates of the same species and with the same antibiogram from the same patient were excluded.

Microbiological cultures: All samples were taken on clinical indication from burn wound surfaces, tracheal secretions, intraluminal catheters, urine, and blood using conventional culture techniques. Microbiology diagnostics including species determination of all isolates were performed at the Clinical Microbiology Laboratory, University Hospital of Linköping. Data are presented here as ''all samples'' or ''blood samples''. Trend analysis was performed for the whole study period.

Susceptibility testing and breakpoints: Susceptibility testing was performed at the Clinical Microbiology Laboratory, University Hospital of Linköping, according to the Swedish Reference Group for Antibiotics (SRGA) from 1994 to 1999 and the European Committee on Antimicrobial Susceptibility Testing (EUCAST) from 1999 until 2012 [33]. Antibiotic resistance was interpreted as susceptible (S), intermediate (I), or resistant (R). Decreased susceptibility was defined as the sum of I and R. *E. coli* and *Klebsiella* spp. ESBL-phenotype was defined as resistant to 3rd generation cephalosporins (cefotaxime). No major changes in breakpoints have been made for species-antibiotic combinations that affect the susceptibility testing results.

Antibiotic consumption: Sales statistics on antibiotic consumption at the Burn Center were collected. These figures were based on the anatomical therapeutic chemical (ATC) classification system and were obtained from the County of Östergötland Pharmacy Department, Sweden. Antibiotic consumption was expressed as defined daily doses (DDD) per 1000 occupied bed days (DDD/TAD). We used the annually updated DDD as calculated using the WHO Collaborating Centre for Drug Statistics Methodology; the average maintenance dose per day in adults for the main indication of the drug [34].