

Bacteremias in patients with severe burn trauma

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Key words: burns, bacteremia, *Staphylococcus aureus*, *Pseudomonas aeruginosa*.

Summary. The aim of the study was to investigate the causative agents of bacteremia in burned patients during 1999–2003.

Material and methods. All case records of 82 burned patients with bacteremia treated at the Department of Plastic Surgery and Burns of Kaunas University of Medicine Hospital were analyzed during 1999–2003.

Results. Mean body surface area burned in bacteremic patients was 29%. Bacteremia was diagnosed, on an average, on the 15th day after hospitalization and the 16th day after the burn. The causative agent of bacteremia in 71% of cases was methicillin-resistant *Staphylococcus aureus*; 11% of bacteremias were caused by *Pseudomonas aeruginosa*, and in 78% of cases *Pseudomonas* was sensitive to gentamicin. In all years, methicillin-resistant *Staphylococcus aureus* was the most common agent of bacteremia. Altogether, 55 patients out of 82 recovered. The mean duration of inpatient treatment was 48 days.

Conclusions. Bacteremia was diagnosed at the beginning of the third week of hospital stay. More than half of bacteremic patients (67%) survived. The most common causative agents of bacteremia were methicillin-resistant *Staphylococcus aureus* and gentamicin-sensitive strains of *Pseudomonas aeruginosa*.

Introduction

Bacteremia is an invasion of the bloodstream by bacteria. Bacteremia develops as a result of damage to the external (skin) or the internal (respiratory tract, digestive tract) barriers of the body. Bacteremia is one of the criteria for the diagnostics of sepsis. Sepsis is very dangerous for burned patients, because it increases the production of inflammatory mediators and cytokines and causes their interaction that predisposes to the development of multiple organ failure (MOF). MOF at present is the main cause of mortality in burned patients (1, 2). According to M. Kurtoulu (a study of 54 severely burned patients, mean body surface area burned (BSAB) – 60%, mortality – 83%) sepsis was the cause of death in 66% of cases (3).

The treatment of severe burns is a long process, and burn centers use a lot of wide-spectrum antibiotics, which results in the development of antibiotic-resistant strains. They are especially dangerous to burned patients due to their weakened immune system. Most authors note that the microorganisms isolated in the departments of burns show an increasing resistance to antibiotics. In the Hospital of Kaunas University of Medicine, *Staphylococcus aureus* was

found in wounds of 47% of the burned patients, and in 45% of these cases *S. aureus* was resistant to methicillin (4).

A gateway for sepsis in case of burns may be wounds, central vein catheters, airways, lungs (5), the digestive tract, etc.

Some authors strictly recommend isolating burned patients in order to prevent “cross-infection” (6). However, there are authors who think that burned patients tend to have autoinfection, and thus strict isolation of such patients is not considered expedient (7). Each health care institution has a characteristic spectrum of microorganisms with certain tendencies of sensitivity to antibiotics. The aim of our study was to investigate the causative agents of bacteremia, their sensitivity to antibiotics, and its changes.

Material and methods

We studied all case records of 82 burned patients with microbiologically confirmed bacteremia treated at the Department of Plastic Surgery and Burns of Kaunas University of Medicine Hospital during 1999–2003. No prophylactic antibiotic was given to patients before the confirmation of bacteremia. More than

three-fourths (78%) of patients had central lines inserted; the lines were inserted for a mean period of 19 ± 16 days. Central lines were changed in cases when sepsis was suspected or when local infection appeared. Wound treatment was similar in all patients. Sulfadiazine and Betadine were used as topical antimicrobials. More than three-fourths (78%) of patients underwent escharectomy and skin grafting. Early escharectomy and skin grafting (during the first week after the burn) were performed in 24% of patients.

Ten milliliters of the blood of patients with suspected sepsis (body temperature being more than 38°C), preferably during shaking chills, were taken for each BACTEC aerobic and anaerobic media. In the microbiology laboratory, the media were incubated in an automatic thermostat BACTEC 9240. When the growth of bacteria was confirmed by microscopy, bacteria were inoculated into selective media, and the grown bacteria were identified by their biochemical properties, and their sensitivity to antibiotics was determined according to the recommendations of the National Committee for Clinical Laboratory Standards.

The term of the diagnosis of bacteremia from the burn and from the hospitalization was determined. The causative agents of bacteremia and their sensitivity to antibiotics were identified, and the sensitivity of the causative agents to antibiotics at different years was compared. In addition, the patients' age, sex, BSAB, and treatment results – mortality and duration of in-patient treatment for survivors – were analyzed. These indicators were compared after determining different causative agents of bacteremias.

The results are presented as mean values and standard deviation (mean \pm SD).

Results

During 1999–2003, 1,386 burned patients were treated in the Department of Plastic Surgery and Burns, Kaunas University of Medicine Hospital. The blood of 308 patients was tested due to suspicion of sepsis; in total, 559 blood samples were taken. Bacteria grew in 156 cases. Bacteremia was biologically confirmed in 82 of 1,386 treated patients (5.9%). In 403 blood cultures, microorganisms did not grow.

During 1999–2003, the number of cases of microbiologically confirmed bacteremia was stable – on the average 16.4 cases per year (Fig. 1).

More than half of patients (76%) were males, and 24% – females. Patients' age ranged from 12 to 76 years; mean – 49.87 ± 6.18 years, median – 44.

The BSAB ranged from 1% to 90%, the mean being $28.8 \pm 18.6\%$. More than three-fourths of burns (79%) were full-thickness ones.

Bacteremia was found within the period of 1 to 63.5 days after the burn (mean 16.0 ± 11.0 days) and within 1 to 63 days after hospitalization (mean 14.7 ± 10.8 days).

One episode of bacteremia occurred in 57.3% of patients. Repeated episodes of bacteremia were detected in 42.7% of patients. One patient had six episodes of bacteremia.

Of the 82 patients with confirmed bacteremia, 27 died. The duration of patients' survival from hospitalization to death ranged from 5 to 93 days (mean 27.0 ± 22.7 days).

Altogether, 55 patients recovered. The mean duration of in-patient treatment was 48.33 ± 21.94 days. The mean duration of in-patient treatment in patients with *S. aureus*-induced bacteremia was 48.0 ± 22.5 days and in those with *P. aeruginosa*-induced bacteremia – 77.0 ± 28.0 days.

The most common causative agent of bacteremia was methicillin-resistant *S. aureus* (70.7%); *S. aureus* sensitive to methicillin made up 29.3%, and MRSA – 70.7%. The second most common cause of bacteremias was *P. aeruginosa* (11%, nine cases), with seven strains being sensitive and other two strains being resistant to gentamicin (Fig. 2). Other causative agents made up 18.3%. One microorganism from a blood sample grew in 64 blood cultures (78%), and polymicrobial flora – in 18 blood cultures (22%).

Discussion

According to the data published in 2003 by R. Rimdeika *et al.*, the mean age of patients treated for burns in the Kaunas University of Medicine Hospital was 41.3 ± 17.0 years (8). According to our findings, bacteremic patients were older (mean 49.87 ± 16.18 years). Mean BSAB in all burned patients treated in the Kaunas University of Medicine Hospital was $13.3 \pm 11.3\%$ (8). Bacteremic patients had larger BSAB (mean $28.8 \pm 18.6\%$). According to R. Bang, 76% of patients had one episode of bacteremia, and 24% of patients had repeated bacteremia. In 68% of cases, the first bacteremia was confirmed within the first two weeks after the burn, usually on the 6–10th day after the burn, and in 13% of cases bacteremia was confirmed on the third day after the burn (9). According to our data, bacteremia was detected later: on the average, on the 16th day after the burn (SD 11.0). The most common causative agent of bacteremia in burned patients was methicillin-resistant *S. aureus* (70.7%), and the second – *P. aeruginosa* (11%). According to R. Bang, in 41% of cases bacteremia was caused by MRSA, in 14% – by methicillin-resistant *Staphylococcus epidermidis*, in 13% – by *P. aeruginosa*, in 10% – by *Acinetobacter*,

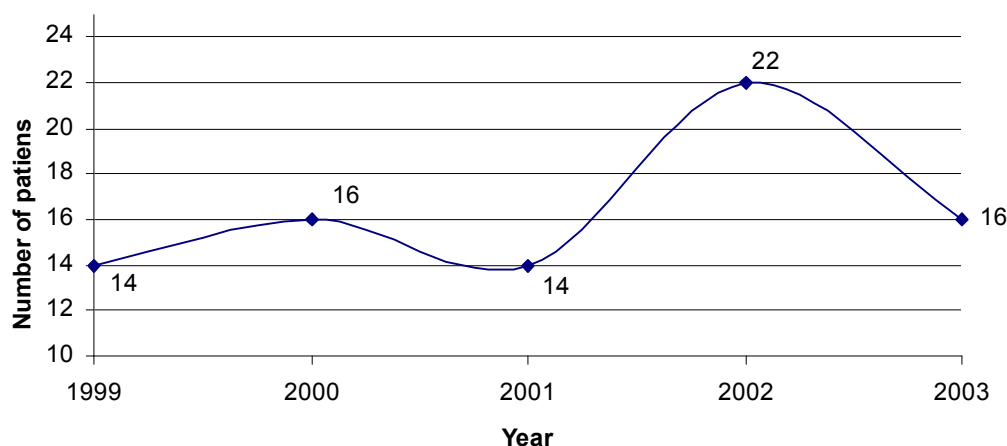


Fig. 1. The number of cases of bacteremia during 1999–2003

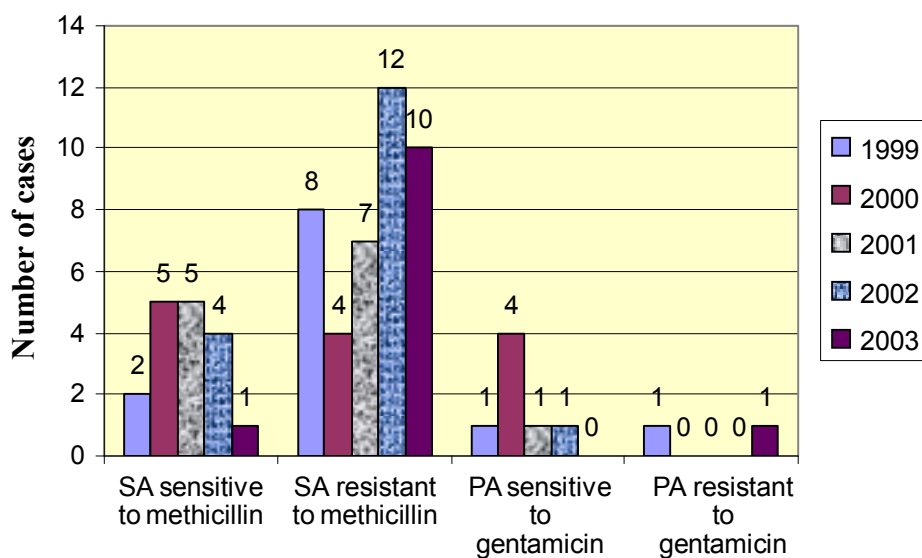


Fig. 2. The dynamics of the sensitivity to antibiotics of *Staphylococcus aureus* (SA) and *Pseudomonas aeruginosa* (PA) during 1999–2003

etc. (9). Thus, the frequency of *P. aeruginosa*-induced bacteremias is similar in the findings of other physicians and in our study. However, MRSA-induced bacteremias were significantly less numerous in other studies (10, 11). This can be explained by the fact that early necrectomies and enteral feeding result in the recovery and survival of an increasing number of patients with severe burned traumas, but due to severe injury, their treatment is prolonged and depleting the organism's reserves, thus making it very difficult to avoid bacteremias. According to B. Nagoba *et al.*, the most common causative agent of sepsis was *P. aeruginosa* (53.8%), the second one being *S. aureus* – 38.4% of cases, followed by *Klebsiella* – 27.6%, *Proteus* – 18.4%, *E. coli* – 10.7%, and others. Our findings showed that *S. aureus* was detected nearly

seven times more frequently than *P. aeruginosa*, and *P. aeruginosa* was detected significantly less frequently than B. Nagoba stated. According to B. Nagoba *et al.*, polymicrobial flora was detected in 61.5% of cases (12). In our study, polymicrobial flora was detected significantly less frequently – in 22% of cases.

Total mortality of patients with confirmed bacteremia was 33%. R. Bang *et al.* reported a somewhat lower mortality of patients with bacteremia – 29.1%. Authors explained such low mortality by effective antibiotic therapy, sufficient nutrition, early removal of necrosis, and covering of wounds (13). We hope that successful application of early escharectomies, early enteral nutrition, and adequate antibiotic therapy will help further to reduce the mortality rate in such patients (14).

Conclusions

The most common causative agents of bacteremias in burned patients treated at the Department of Plastic Surgery and Burns of Kaunas University of Medicine Hospital during 1999–2003 were *Staphylococcus*

aureus and *Pseudomonas aeruginosa*. Antibiotic-resistant strains of *Staphylococcus aureus* and antibiotic-sensitive strains of *Pseudomonas aeruginosa* were predominant.

Sunkų nudegimą patyrusių pacientų bakteriemijos ypatybės

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Raktažodžiai: nudegimas, bakteriemija, *Staphylococcus aureus*, *Pseudomonas aeruginosa*.

Santrauka. Tyrimo tikslas. Ištirti sunkų nudegimą patyrusių pacientų, gydytų Kauno medicinos universiteto klinikose 1999–2003 m., bakteriemijų sukėlėjus.

Metodika. Išanalizuotos visos nudegimą patyrusių pacientų, gydytų Plastinės chirurgijos ir nudegimų skyriuje 1999–2003 m., kuriems mikrobiologiškai buvo patvirtinta bakteriemija, ligos istorijos. Jų buvo 82.

Rezultatai. Nudegimą patyrusių pacientų, kuriems nustatyta bakteriemija, vidutinis nudegusio kūno paviršiaus plotas – 29 proc. Bakteriemija nustatyta vidutiniškai 15-ąją parą po hospitalizavimo ir 16-ąją parą po nudegimo. 71 proc. atvejų bakteriemiją sukėlė *Staphylococcus aureus*, 71 proc. – auksinis stafilokokas buvo jautrus meticilinui. 11 proc. atvejų bakteriemiją sukėlė *Pseudomonas aeruginosa*, 78 proc. – *Pseudomonas* padermės buvo jautrios gentamicinui. Visais nagrinėtais metais auksinis stafilokokas, jautrus meticilinui, buvo dažniausias bakteriemijų sukėlėjas. Pasveiko 55 iš 82 pacientų, kuriems nustatyta bakteriemija. Išgyvenusiųjų gydymo ligoninėje trukmė vidutiniškai 48 paros.

Išvados. Bakteriemija nudegimą patyrusiems ligoniams dažniausiai nustatyta trečiosios savaitės pradžioje ligoninėje. Išgyveno 67 proc. pacientų, kuriems patvirtinta bakteriemija. Nudegimą patyrusiems ligoniams bakteriemijas dažniausiai sukėlė auksinis stafilokokas, jautrus meticilinui, ir gentamicinui jautrios *P. aeruginosa* padermės.

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