Chirurgia (2013) 108: 385-388
No. 3, May - June

The Importance of Early Diagnosis of Sepsis in Severe Burned Patients: Outcomes of 100 Patients

C. Orban[1], D. Tomescu[2]

[1]Fundeni Clinical Institute, Bucharest, Romania
[2]"Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania
"Nicolae Testemițanu" University of Medicine and Pharmacy, Moldova
Department of Anaesthesia and Intensive Care, Fundeni Clinical Institute, Bucharest, Romania

Rezumat

Importanța diagnosticului precoce al sepsisului la pacienții cu arsuri severe: rezultatele obținute în cazul a 100 de pacienți

Introducere: Pacientul cu arsuri are un risc crescut de a dezvolta infecții deoarece leziunea cutanata în sine, tratamentul chirurgical, ventilația mecanică și transfuziile sunt factori ce pot determina o stare de imunosupresie.
Pacienți și Metodă: Un număr total de 100 de pacienți cu arsuri și sepsis au fost tratați în cadrul Spitalului Clinic de Chirurgie Plastică și Arsuri București, în perioada 2009 – 2011. Sunt analizate datele clinice și bioumorale ale acestor pacienți.
Rezultate: Arsura prin flacără a constituit cauza principală (78%). Suprafața corporeală medie arsă a fost de 49.7%. Primul episod septic s-a manifestat în primele două săptămâni de la arsură la majoritatea cazurilor (97%). Cei mai frecvenți germeni implicați au fost bacteriile Gram-pozitive (58%) și Gram-negative (26%). Staphylococcus aureus (32%) și Pseudomonas aeruginosa (21%) au fost cei mai frecvenți germeni identificați. Sensibilitatea bacteriilor Gram-pozitive a fost cea mai mare la imipenem/cilastatin, urmată de amikacin, cefriaxone și ciprofloxacin. Pentru bacteriile Gram-negative sensibilitatea cea mai mare a fost la ciprofloxacin, urmată de imipenem/ cilastatin, amikacin și gentamicin. Rata mortalității a fost de 9%.
Concluzii: Cunoștințele actuale de fiziopatologie, clinică, epidemiologie, aspectele bioumorale și de microbiologie în sepsis permit un diagnostic precis și prompt, împreună cu un tratament eficient, la pacienții cu arsuri. Toate acestea au avut drept rezultat o creștere semnificativă a ratei de supraviețuire a acestor pacienți. Tratamentul fiecărui pacient cu arsuri și sepsis trebuie individualizat cu scopul obținerii celor mai bune rezultate.

Cuvinte cheie: arsură, sepsis, bacterii Gram-pozitive, rezultate

Corresponding author: Carmen Orban, MD
258 Sos. Fundeni, sector 2, 022328
Bucharest, Romania
E-mail: orbancarmen@yahoo.com

Abstract

Background/Aim: The burn-injured patient has a major potential to develop an infection because the wound itself, surgical treatment, mechanical ventilation and blood transfusions may potentially lead to a secondary immunodeficiency syndrome.
Patients and Methods: A total number of 100 consecutive burn-injured patients with sepsis were treated in the Clinical Emergency Hospital of Plastic Surgery and Burns, Bucharest, between 2009 and 2011. Their clinical and bioumoral data were analyzed.
Results: Flame was the main cause of burn injuries in the present series (78%). The mean body surface area burn wound was 49.7%. Most of the patients (97%) experienced the first septic episode within two weeks after burn injury. Sepsis was mainly due to Gram-positive (58%) and Gram-negative (26%) bacteria. Staphylococcus aureus (32%) and Pseudomonas aeruginosa (21%) were the most frequently encountered germs. The susceptibility for Gram-positive bacteria was the best for imipenem/cilastatin, followed by amikacin, ceftriaxone and ciprofloxacin. For Gram-negative bacteria, the susceptibility decreased from ciprofloxacin to

imipenem/ cilastatin, amikacin and gentamicin. Mortality rate was 9%.
Conclusions: The extensive knowledge of physiopathology, clinics, epidemiology, bioumoral and microbiology features of the sepsis in burn-injured patients allows an early and precise diagnosis and an adequate and efficient treatment. All these elements have been associated with a significant improvement of the survival rates. Every patient with burn-injured sepsis must be treated as a different entity in order to obtain the best results.

Key words: burn, sepsis, Gram-positive bacteria, outcome

Introduction

The management of a burn-injured patient is certainly challenging because these patients are usually seriously and severely affected from both medical and surgical point of view. The burn does not affect only one region, but the entire organism. The evolution of the local lesion and the general response of other organs and systems (which are not directly affected) follow certain and specific sequences. These steps of potential evolution must be deeply known in order to anticipate the events and thus, to minimize the complications along with the vital risk (1-3).

The burned patient has a major potential to develop an infection (4). It is the prototype of an immune suppressed patient; wound itself, surgical treatment, mechanical ventilation and blood transfusions are considered as risk factors that may potentially lead to a secondary immunodeficiency syndrome. The severity of the infection depends also on the extent of burned area; local injury allows bacterial, fungal and viral penetration of the host immune barrier. The burned patient is known by its unique capacity: to be infected with exogenous environmental microorganisms and to infect the environment with germs. Despite the increasing effort of the specialists and recent advances in the development of antibiotics, sepsis remains the main cause of death in burn-injured patients (5-7).

The aim of the present study is to assess the sepsis treatment in a series of burn-injured patients from a single medical centre.

Patients and Methods

A total number of 100 consecutive burn-injured patients with sepsis were treated in the Clinical Emergency Hospital of Plastic Surgery and Burns, Bucharest, between 2009 and 2011. Sepsis was suspected when the burned patient showed signs of disorientation, hyper or hypothermia, circulatory system abnormalities, hemorrhages, elevated blood leucocytes, thrombocytopenia. The presence of the infection was confirmed in all patients by a blood culture.

The emergency medical treatment for these patients consisted of:

- Hidro-electrolitic and acid-base re-equilibration with crystalloids (ringer lactate, sodium chloride 0.9% solution, glucose 5%),colloids and fresh frozen plasma;
- Antibiotics with ceftriaxone, imipenem/ cilastatin, amikacin or ciprofloxacin;
- Gastric protection (ranitidine, omeprazole, pantoprazole);
- Inotropic and bronchodilator support (dobutamine, aminofillin);
- Oxygen therapy, vitamins, analgesics.

Decompression incisions were the surgical emergency treatment in the appropriate patients.

Results

The patients were predominantly males (63%) with a mean age of 33 years.

The causes of burn injuries in the present series are shown in *Fig. 1*. The burn-injured patients with flame were predominantly males, while all the patients with contact burn injuries were females.

The mean body surface area burn wound was 49.7%.

The main clinical and bioumoral findings of the patients in the present series are shown in *Table 1*.

The microbial spectrum of the sepsis in the present series is shown in *Fig. 2*. Thus, Staphylococcus aureus was encountered in 32 patients (32%) and Pseudomonas aeruginosa in 21 patients (21%); Klebsiella pneumoniae, E. coli, Acinetobacter baumanii and Candida albicans were other isolated germs from the blood cultures.

In the present series, in 63 patients (63%) the first septic episode occurred during the first week after the burn injury. In 34 patients (34%) the first septic episode occurred during the second week, while in the remaining 3 patients (3%) the first septic episode occurred after more than two weeks after burn injury.

The susceptibility for Gram-positive bacteria was the best for imipenem/ cilastatin, followed by amikacin, ceftriaxone and ciprofloxacin. For Gram-negative bacteria, the susceptibil-

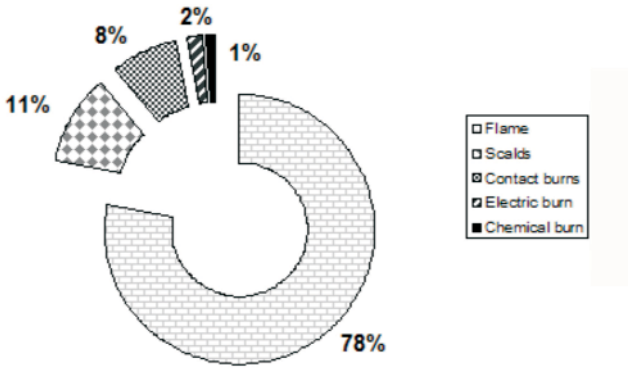

Figure 1. *Causes of burn injuries in 100 burn-injured patients with sepsis*

Table 1. *Clinical and bioumoral characteristics in 100 burn-injured patients with sepsis*

Clinical signs and symptoms	Bioumoral parameters
Fever – 95 patients (95%)	Decreased serum hemoglobin level < 10g /dl in 78 patients (78%)
Dyspnea – 63 patients (63%)	Elevated leucocytes count > 12.000 cells /ml in 75 patients (75%)
Hypotension – 58 patients (58%)	Thrombocytopenia < 100.000 cells /ml in 64 patients (64%)
Alteration of mental status – 33 patients (33%)	Decreased serum albumin level < 2.5 g/dl in 43 patients (43%)
Oliguria – 29 patients (29%)	Increased serum creatinine level > 2 mg/dl in 15 patients (15%)
Hemorrhage – 22 patients (22%)	Elevated total serum bilirubin level > 2 mg /dl in 8 patients (8%)
Jaundice – 8 patients (8%)	
Hypothermia – 2 patients (2%)	

ity decreased from ciprofloxacin to imipenem/ cilastatin, amikacin and gentamicin. Thus, the antibiotic treatment in the present series of patients was conducted according to the above mentioned results

A total number of 9 patients of the present series died, despite the intensive care treatment (mortality rate – 9%). All the deaths occured in patients with burn injuries covering more than 50% of their body surface.

Discussions

Burn injuries are associated with dramatic anatomic, physio-pathologic, endocrine and immunological changes; all these consequences of burns may severely affect the health status of the patients (3).

Cutaneous injury, with loss of epidermis and partially /totally loss of dermis, results in loss of physical barrier, significant quantity of fluids as well as release of numerous inflammatory mediators. Respiratory tract injuries affect the normal defense mechanisms – inhibits muco-cilliary clearance and movements of the white blood cells. Furthermore, intubation and ventilation is a well known source for infections. The defense mechanisms at the digestive tract level are affected by the shock, the alteration of the permeability, the disruption of the normal flora and the naso-gastric tube. The urinary tract is also affected by the urinary catheterization (8).

In the present series, flame was the main cause of burn injuries, followed by scalds and contact burns. The majority of septic burns produced by flame can be explained by the fact that this agent produces deeper and more extensive lesions than other agents. Thus, there is a potentially increased rate of bacterial colonization of the burn wound and an increased risk for sepsis. Similar data were previously reported in other centers(1,3).

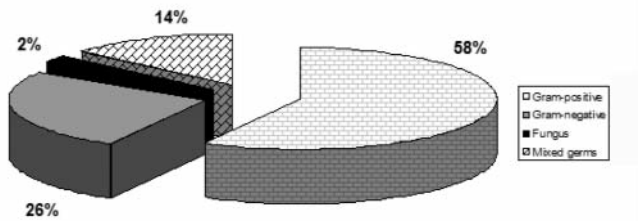

Figure 2. *The microbial spectrum in 100 burn-injured patients with sepsis*

In the present series, it was observed that most of the patients (97%) experienced the first septic episode within two weeks after burn injury; a large part of the patients (63%) experienced the first septic episode within the first week. These results showed that an early detection of sepsis signs is vital for the patient's prognosis and survival. The early detection can be made by continuous observation of the clinical signs (fever, dyspnea, hypotension, mental disorientation, oliguria and hemorrhage are the most frequent ones) and bioumoral parameters (serum hemoglobin level, serum leukocytes and thrombocytes number, serum albumin and creatinine levels), together with regular inspection of the wounds and repeated blood cultures for detection of the pathogenic agents.

In the present series, sepsis was mainly due to Gram-positive (58%) and Gram-negative (26%) bacteria. Staphylococcus aureus (32%) and Pseudomonas aeruginosa (21%) were the most frequently encountered germs. Similar data were previously reported by other groups (3,9). Most of the agents that cause infections in burn-injured patients are multi-resistant microorganisms, which are ubicuitary in the Burn Units departments; these units are the main sources for Staphylococcus, as it was previously shown (3,9). The increasing occurrence of the Acinetobacter infections was reported in the last 30 years as a result of the extensive use of broad spectrum antibiotics and it is well known that this germ is frequently multi-resistant (10,11).

The low mortality rate in the present series of patients (9%) is probably due to the early diagnostic, continuous monitoring and aggressive management. An early emergency treatment, including antibiotics like imipenem/ cilastatin, ciprofloxacin or amikacin (which appeared to be effective against the majority of microorganisms detected in blood cultures) may potentially explain the good results obtained in the present study, as previous studies already highlighted (12). Overall mortality in burn-injured patients (including patients without septic complications) ranges between 5% and 15% (13).

Antibiotics administration in severe burn-injured patients must take into consideration the fact that pharmacokinetics is different from other patients with sepsis. Thus, for aminoglycosides, the conventional doses differently act in each patient.

Moreover, in most of the cases they are not effective. That is the reason why, for a correct and efficient treatment, pharmacokinetics must be established for each patient, based on the first dose. If this measurement is not possible, the recommended dose for aminoglycosides is 1-1.7 mg /kg (14). For ciprofloxacin, it was observed that in burn-injured patients with sepsis the clearance was higher and half-life was shorter than in patients with severe sepsis of other causes. Thus, the recommended dose of ciprofloxacin for severe burned patients is 400 mg every 8 hrs (1.200 mg /day), instead of every 12 hrs (15). For Carbapenems (imipenem/ cilastatin and meropenem) the clearance is not very different between burn patient sepsis and other types of sepsis, but there is a great variability among individuals, and is strongly correlated with creatinine clearance. Thus, an adjustment of dosage must be taken into account when the creatinine clearance is abnormall (8,16).

Conclusions

The extensive knowledge of physiopathology, clinics, epidemiology, bioumoral and microbiological features of sepsis in burn-injured patients allows an early and precise diagnosis and an adequate and efficient treatment. All these elements have been associated with a significant improvement of the survival rates. Although there are several principles of administration of the antibiotic treatment in these patients, pharmacokinetics presents great variability among individuals. Thus, every patient with burn-injured sepsis must be treated as a different entity in order to obtain the best results.

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