



## REVIEW

# Infections in critically ill burn patients



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**Abstract** Severe burn patients are one subset of critically patients in which the burn injury increases the risk of infection, systemic inflammatory response and sepsis. The infections are usually related to devices and to the burn wound. Most infections, as in other critically ill patients, are preceded by colonization of the digestive tract and the preventative measures include selective digestive decontamination and hygienic measures. Early excision of deep burn wound and appropriate use of topical antimicrobials and dressings are considered of paramount importance in the treatment of burns.

Severe burn patients usually have some level of systemic inflammation. The difficulty to differentiate inflammation from sepsis is relevant since therapy differs between patients with and those without sepsis. The delay in prescribing antimicrobials increases morbidity and mortality. Moreover, the widespread use of antibiotics for all such patients is likely to increase antibiotic resistance, and costs. Unfortunately the clinical usefulness of biomarkers for differential diagnosis between inflammation and sepsis has not been yet properly evaluated.

Severe burn injury induces physiological response that significantly alters drug pharmacokinetics and pharmacodynamics. These alterations impact antimicrobials distribution and excretion. Nevertheless the current available literature shows that there is a paucity of information to support routine dose recommendations.

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### PALABRAS CLAVE

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Infección;  
Descontaminación  
digestiva selectiva;  
Aposición oclusivo

### Infecciones en los enfermos quemados críticos

**Resumen** Los pacientes con quemaduras graves son un subgrupo de pacientes críticos en los que la lesión por quemadura aumenta el riesgo de infección, de respuesta inflamatoria sistémica y de sepsis. Las infecciones suelen estar relacionadas con los dispositivos y la quemadura. La mayoría de las infecciones, al igual que en otros pacientes críticos, están precedidas por la

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colonización del tracto digestivo y de medidas preventivas que incluyen la descontaminación digestiva selectiva y las medidas de higiene. La escisión precoz de las quemaduras profundas y el uso adecuado de los antimicrobianos tópicos y apósitos se consideran de suma importancia en el tratamiento de las quemaduras.

Los pacientes con quemaduras graves suelen tener un cierto nivel de inflamación sistémica. La dificultad para diferenciar inflamación de sepsis es relevante debido a que la terapia difiere entre los pacientes con y sin sepsis. El retraso en la prescripción de antimicrobianos aumenta la morbimortalidad. Además, el uso generalizado de antibióticos en todos estos pacientes es probable que aumente la resistencia a estos y los costes. Desafortunadamente, la utilidad clínica de biomarcadores para el diagnóstico diferencial entre inflamación y sepsis aún no ha sido adecuadamente evaluada.

La lesión por quemadura severa induce una respuesta fisiológica que altera significativamente la farmacocinética y farmacodinámica de los fármacos. Estas alteraciones afectan a la distribución y excreción de los antimicrobianos. Sin embargo, la literatura disponible actual muestra que hay una escasez de información para apoyar las recomendaciones de dosis rutinarias.

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## Introduction

Critically ill burn patients are more susceptible than other critically ill patients to acquire infections as traditionally reported in infection surveillance systems surveillance in the Intensive Care Units (ICU).<sup>1</sup> This increased susceptibility has been attributed to four facts: a non-specific immunosuppressive state induced by burns, frequent use of invasive devices (tracheal intubation, intravascular catheters, urinary catheters), loss of skin protection related to burn injury and in some cases respiratory injury from smoke inhalation. In addition surgery carried out in areas with bacterial contamination is associated with transient bloodstream infection caused by the flora colonizing burn wounds.

Another characteristic to tackling infections in burn patients is the low value of clinical criteria, i.e. fever, and biomarkers to differentiate systemic inflammatory response syndrome (SIRS) from sepsis.<sup>2</sup> The severe burn patient, i.e. burns >20% of the body surface, in adults, usually shows signs of inflammation without a proven infection. This difficulty differentiating inflammation from infection can lead in some cases to excessive use of antibiotics with associated costs and the possibility to select resistant flora. On the other hand delay in the administration of appropriate antibiotics may be associated with increased morbidity and mortality.

The pharmacokinetics and pharmacodynamics (PK/PD) of antimicrobials are other differentiating factors of burn patients over other critically ill patients. The antibiotic volume of distribution are often very high, especially in the first two weeks after injury because the accumulated oedema during resuscitation, and the increase in glomerular filtration rate.<sup>3</sup>

Finally it should be noted that recommendations on the clinical management of severe burn patients, including prevention and treatment of infections are almost always supported by the expert opinion and the assumption that critically ill burn patients should be treated similarly to other critically ill patients.<sup>4</sup> There is little relevant clinical research to support an adequate level of evidence for any specific recommendation in this population group.

## Pathogenicity

In 1979, van Saene et al.<sup>5</sup> in a prospective study of 32 patients showed that the flora that colonizes the digestive tract of patients often infects the burn patient. More recently Barret et al.<sup>6</sup> studied digestive, respiratory and burn wounds colonization in 30 burn children treated in an ICU with a nurse/patient ratio 1.5:1 without strict preventative measures beyond those recommended for contact with biological fluids. At ICU admission, digestive and skin flora was the flora usually carried by healthy subjects: *Escherichia coli*, *Enterococcus* spp. in rectum and *Staphylococcus epidermidis* in skin. After 6–7 days this flora is replaced by Enterobacteriaceae and *Pseudomonas aeruginosa* acquired in the ICU, that colonized burn wounds and respiratory system later (Fig. 1). In other studies, non-fermenting Gram-negative bacilli and methicillin-resistant *Staphylococcus aureus* are part of ICU acquired flora.<sup>7</sup>

This pattern of colonization-infection has been previously described in critically ill patients<sup>8</sup> and shows two characteristics:

1. The flora colonizing and sometimes infecting critically ill patients changes during ICU stay. At admission patients without previous illnesses potentially pathogenic microorganisms (PPM) carried in digestive tract and skin are similar to those usually carried by healthy subjects. Later that flora is replaced by the ICU acquired flora. The digestive tract of other patients is the most important reservoir.
2. Ninety nine percent of infections in critically ill patients, including severe burn patients are caused by PPM previously isolated in the digestive tract of the patient. They are considered endogenous.<sup>8,9</sup>

## Infection prevention

### Selective digestive decontamination

Selective digestive decontamination (SDD) is a strategy to prevent infections in critically ill patients.<sup>10</sup> It was

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