



Prevention of combat-related infections: Antimicrobial therapy in battlefield and barrier measures in French military medical treatment facilities

Audrey Mérens ^{a,*}, Christophe Rapp ^b, Deborah Delaune ^a, Julien Danis ^c, Franck Berger ^d, Remy Michel ^d

^a *Biology Department and Infection Control Unit, Bégin Military Hospital, 69 avenue de Paris, 94160 Saint-Mandé, France*

^b *Infectious Diseases Department, Bégin Military Hospital, 69 avenue de Paris, 94160 Saint-Mandé, France*

^c *Orthopaedic Surgery Department, Percy Military Hospital, 101 avenue Henri Barbusse, 92140 Clamart, France*

^d *Epidemiology and Public Health Department CESPA, Camp de Sainte-Marthe, 408 rue Jean Queillau, 13014 Marseille, France*

Received 24 December 2013; received in revised form 16 March 2014; accepted 7 April 2014

Available online 11 May 2014

KEYWORDS

Standard precautions;
Combat-related infection;
War wounds;
Multidrug resistant organisms;
Post-injury antibiotics

Summary Infection is a major complication associated with combat-related injuries. Beside immobilization, wound irrigation, surgical debridement and delayed coverage, post-injury antimicrobials contribute to reduce combat-related infections, particularly those caused by bacteria of the early contamination flora. In modern warfare, bacteria involved in combat-related infections are mainly Gram-negative bacteria belonging to the late contamination flora. These bacteria are frequently resistant or multiresistant to antibiotics and spread through the deployed chain of care. This article exposes the principles of war wounds antimicrobial prophylaxis recommended in the French Armed Forces and highlights the need for high compliance to hygiene standard precautions, adapted contact precautions and judicious use of antibiotics in French deployed military medical treatment facilities (MTF).

© 2014 Elsevier Ltd. All rights reserved.

* Corresponding author. Tel.: +33 1 43 98 49 98; fax: +33 1 43 98 54 61.
E-mail address: merens-a@wanadoo.fr (A. Mérens).

1. Introduction

Since World War II, advances in the personal protective equipment, in field medicalization (self-aid, transportation, damage control, forward resuscitative and stabilization surgical care, rapid evacuation) as well as the systematic use of antimicrobials have contributed to an improved survival of soldiers injured on the battlefield [1]. However, the more numerous surviving soldiers, with complex and destructive wounds, are exposed to potentially lethal infections. In modern conflicts, the overall incidence of wound infections is estimated between 5.5% and 30%, depending on the study and the localization and severity of wounds [2–6]. It can reach 40% for critically ill patients. Thus, war wound infections remain a frequent cause of morbidity and the second cause of death in combat after multiorgan failure by haemorrhagic shock. In contemporary warfare (Vietnam, the Yom Kippur War, Iraq and Afghanistan), the typology of combat-related infectious complications gradually changed with: 1) an increase of limb injuries characterized by multiple lesions due to explosive munitions [7], 2) the emergence of infections by multidrug-resistant organisms [8–12] and more recently, 3) the emergence of invasive fungal infections [13,14]. Infection prevention of combat-related injuries in the French Armed Forces relies, as in some other NATO medical services, on three interrelated and complementary strategies:

- rapid surgical management with large debridement of necrotic tissue and irrigation,
- rapid delivery of antibiotics after injury,
- control of direct and indirect transmissions in deployed military medical treatment facilities (MTFs).

Control and prevention of combat-related infections require standardized protocols, personnel emphasis and compliance at each level of the deployed French military MTFs. When a French soldier is wounded in a conflict area, a chain of support is deployed, according to two principles: bringing medical and surgical means closer to the wounded and repatriating him as soon as possible to the French military hospitals. At the point-of-injury, closer to the wounded, emergency care is provided by medical posts and by mobile medical teams (Role 1). The military surgical team, devoted to the first vital emergency surgical procedures, constitutes the light manoeuvre Role 2 facilities. The Role 3 facilities are organised on a modular basis in a medical and surgical combat support hospital, with a capacity of 2 surgical areas and 50 hospital beds. The 9 armed forces teaching hospitals located in France represent the Role 4 facilities, offering specialized units and rehabilitation program.

2. Combat-related infections: microbiology and determinants

2.1. Early contamination

Any war wound is by definition contaminated at the time of the injury by the endogenous flora (skin, oropharyngeal or

gastrointestinal flora depending on the type of lesion). Skin flora is essentially composed of Gram-positive bacteria, as coagulase-negative or coagulase-positive staphylococci, corynebacteria, streptococci including *Streptococcus pyogenes* [15]. A lesion of the hollow viscera is a source of contamination by intestinal flora (enterobacteria, enterococci, and anaerobic bacteria such as *Bacteroides fragilis*), while a lesion of the upper airways promotes the involvement of streptococci or staphylococci usually present in the flora of the upper tract airway. A war wound is also mostly contaminated by a telluric environmental exogenous flora (*Clostridia*, *Bacillus cereus*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Pseudomonas stutzeri*...) [15–19]. Mechanisms of explosion-related injury drive dust, debris of clothing, foreign material deep into the tissue, contributing to the heavy initial contamination of wounds. More recently, invasive fungal infections have been reported among UK and US military personnel suffering from combat-related traumatic injuries. Mold species (*Mucor* sp, *Aspergillus* sp, *Fusarium* sp...) are particularly prevalent in the soil of agricultural areas and can consequently contaminate wounds at the time of injury [13,14].

Till now, bacteria of the early contamination flora almost always have a wild-type susceptibility phenotype to antibiotics, as shown by Murray et al. [17]. In this study conducted in Baghdad in 2004, insertion of culture swabs into the war wounds within 40 min of the injury recovered a large majority of Gram-positive skin bacteria (93%), with only 2 MRSA. Gram-negative bacteria were rarely found at the time of injury and none was multidrug resistant.

2.2. Late contamination

Besides this initial contamination of war wounds and burns, secondary contamination can occur throughout the chain of care at each level of the deployed military MTFs. The microorganisms most frequently involved in these secondary care-associated contaminations are classically *Pseudomonas aeruginosa*, *Acinetobacter baumannii*–*calcoaceticus* complex, *Enterobacteriaceae*, *Staphylococcus aureus*, enterococci or yeasts [5,16,19,20]. Unlike the early contamination bacteria, these bacteria often have a high level of natural antibiotic resistance (*P. aeruginosa*, *Acinetobacter baumannii*) or have acquired resistance to antibiotics [21–26]. Among 29 French soldiers belonging to the FORPRONU and repatriated from former Yugoslavia between 1992 and 1994, bacteriological cultures of wound samples were positive for 31%. 25% had combat-related infections. Bacteria most frequently isolated were *P. aeruginosa* and *Enterobacter cloacae*, both species having a high level of natural antibiotic resistance [25]. More recently, 25% of injured soldiers repatriated from Kabul Role III hospital, Afghanistan and admitted in the Intensive Care Unit of Percy Role 4 hospital in France were infected with multidrug resistant organisms (MDRO) [26]. According to the definitions edited by the European Center for Disease Prevention and Control [27], MDRO includes methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus faecium* (VRE), extended-spectrum beta-lactamase producing enterobacteria (ESBLE), carbapenemase-producing enterobacteria (CPE), carbapenem-resistant *A. baumannii*

Download English Version:

<https://daneshyari.com/en/article/3392904>

Download Persian Version:

<https://daneshyari.com/article/3392904>

[Daneshyari.com](https://daneshyari.com)