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Research Article

Epidemiology And Bacterial Ecology Of Burn Wound Infection In Marrakech: A Three-Year Retrospective Study

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ABSTRACT

Introduction : The prognosis of burns is often depending on infectious complications, which are responsible of 28% to 65% of mortality. The loss of the cutaneous barrier, the invasive devices and the immunosuppression associated with burn injuries, are three mechanisms contributing to the development of burn wound infection.

Objective: To study the epidemiological and bacteriological profile of the infection in burn patients at Marrakech's Mohammed VI University Hospital.

Methods: We carried out a retrospective study over a 36 months period (2016-2018) in the microbiology and virology department of Marrakech's Mohammed VI University Hospital, in collaboration with the department of plastic, reconstructive and aesthetics surgery and burns.

Results: 797 non-redundant bacterial strains were identified during the period study. The prevalence of documented infection in burn patients was 68.6%. Skin infections were the most common (68%) followed by bacteraemia (24%) and catheter-related infections (8%).The main organisms found were coagulase-negative Staphylococci (33.5%), enterobacteria (23.9%), Acinetobacter baumannii (13.4%), Pseudomonas aeruginosa (8.1%) and Staphylococcus aureus (7.6%). The prevalence of Methicillin resistance among Staphylococcus aureus was 9.8%. Third-generation cephalosporin resistance in enterobacteria by extended-spectrum beta-lactamase producing (ESBL) was 72.6%. Strains of carbapenem-reduced susceptibility in ESBL isolates accounted for 9.4% of isolates. Acinetobacter baumannii was resistant to imipenem in 54.3% of cases.

Conclusion: This study reports the high prevalence of infection in burn patients and the problematic of multi-resistant germs infections requiring the use of a very broad-spectrum antibiotic therapy and the implementation of specific hygiene.

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INTRODUCTION:

Burn is defined as partial or complete destruction of the skin or underlying tissues by a thermal, electrical, or chemical agent or ionizing radiation. The severity of a burn depends on the causal agent, the circumstances of occurrence, its extent, depth and location which may involve functional and / or vital prognosis. Burn injury creates a breach in the surface of the skin, which is the natural barrier of the body's protection, that favored infection due to microbial invasion. The prevalence of infection among burn patients is very variable in the literature (13% of all patients hospitalized in the US between 2003 and 2012, 19% of patients hospitalized in the Burn Treatment Centers - CTB - in France during the summer 2006) [1,2]. Infection generates additional cost, extension of the length of stay, work overload favoring nosocomial infection and is responsible of a mortality rate ranged from 28% to 65% [3]. In our context, a microbiological study is needed to identify the local epidemiology and the means to implement to avoid the emergence and the epidemic spread of nosocomial germs. In this context, the bacteriological profile of isolated bacteria should be a subject of regular epidemiological surveillance. This will allow an adaptation of probabilistic antibiotic therapy and infection prevention policy.

OBJECTIVE:

To study the epidemiological and bacteriological profile of the infection in burn patients at the University Hospital of Marrakech.

MATERIALS AND METHODS:

Retrospective study over a 36 months period (2016-2019) in the microbiology-virology department of Marrakech's Mohammed VI University Hospital, in collaboration with the department of plastic reconstructive and aesthetics surgery and burns. All documented infections in the burn patient were included in the plastic surgery department during the study period. Bacterial identification of bacteriological specimens was based on conventional methods: culture, morphological and biochemical traits or automated methods (Phoenix BD). Antibiotic susceptibility was determined by the Mueller-Hinton agar medium diffusion method (supplemented with 5% sheep blood for demanding germs) following the recommendations of the CASFM-EUCAST antibiogram committee, or by automated method (Phoenix BD) with determination of MICs.

RESULTS:

During the study period, 1091 samples from 153 patients were treated including 478 samples from the burn area, 297 pairs of blood cultures, 48 catheters and 277 urine samples (Table I).

Table I: Distribution of documented infections in burnt patient by infectious site

Infectious site	Number	%
Cutaneous Surinfection	478	27.2
Bacteremia	297	43.8
Urinary infection	277	25.4
Central Pathway Catheter infection	48	3.6

The seasonal distribution of burns showed two important peaks: one in summer and the other one in autumn with respective percentages of 35.6% and 31.2%. Thermal burns were found in 142 patients (92.8%) dominated by butane flame burns in 123 cases (86.6%) followed by scalding in 19 cases (13.4%).11 patients (7.2%) had electric burns.91 patients had associated comorbidities: 36 patients (39.5%) were tobacco users, 29 patients (31.8%) were diabetic, 12 patients (13.1%) were alcoholics, 8 patients (8.8%) had cardiovascular disease

and 7 patients (7.69%) were epileptic. The study showed a predominance of household burns (56.9%) followed by work accidents (20%), (9%) following an assault and (4.1%) following a suicide attempt. The average body surface area burned (SCB) was 37.5%. The length of stay in the hospital in our study was 42 days, with extremes ranging from 1 day up to 87 days. During the study period, 1091 samples were collected. These treated samples allowed the isolation of 797 strains. Gram-positive cocci predominated with 48.4% of isolates, followed by Gram-negative bacilli 45.7%, yeasts 5.9% and gram-positive bacilli 0.25% (Table II).

Table II: Distribution of bacterial species responsible for infections in the burned patient

	Number	%
Gram negative bacillus		**45.7 %**
Non-fermentative BGN	**174**	**21.8%**
Stenotrophomonas maltophilia	2	0.25
Pseudomonas aeruginosa	65	8.15
Acinetobacter baumannii	107	13.42
Enterobacteriaceae	**190**	**23.9**
Escherichia coli	55	6.9
Enterobacter cloacae	40	5
Serratia marcescens	4	0.5
Klebsiella pneumoniae	78	9.8
Pantoea spp	1	0.125
Proteus mirabilis	10	1.25
Providencia stuartii	2	0.25
Gram-positive COCCI	**384**	**48.1**
Entérocoques fæcalis	29	3.63
Enterococcus faecium	13	1.63
S. aureus	61	7.65
SCN	267	33.5
Streptococcus spp	14	1.75
Gram positive bacillus	**2**	**0.25**
Bacillus	1	0.125
Corynebacterium	1	0.125
OTHER	**47**	**5.9**
Candida albicans	27	3.4
Candida non albicans	20	2.5

Staphylococcus coagulase negative, Acinetobacter baumannii, Klebsiella pneumoniae and Pseudomonas aeruginosa were the most common species, accounting for 33.5%, 13.42%, 9.8% and 8.15% of isolates, respectively. Methicillin resistance was observed in 9.8% of S. aureus strains isolated from the burn patient. The frequency of some resistance phenotypes is shown in Tables III and IV and Figures 1 and 2.

Figure 1: Antibiotic resistance profile (%) of Acinetobacter baumannii isolates (n = 107)

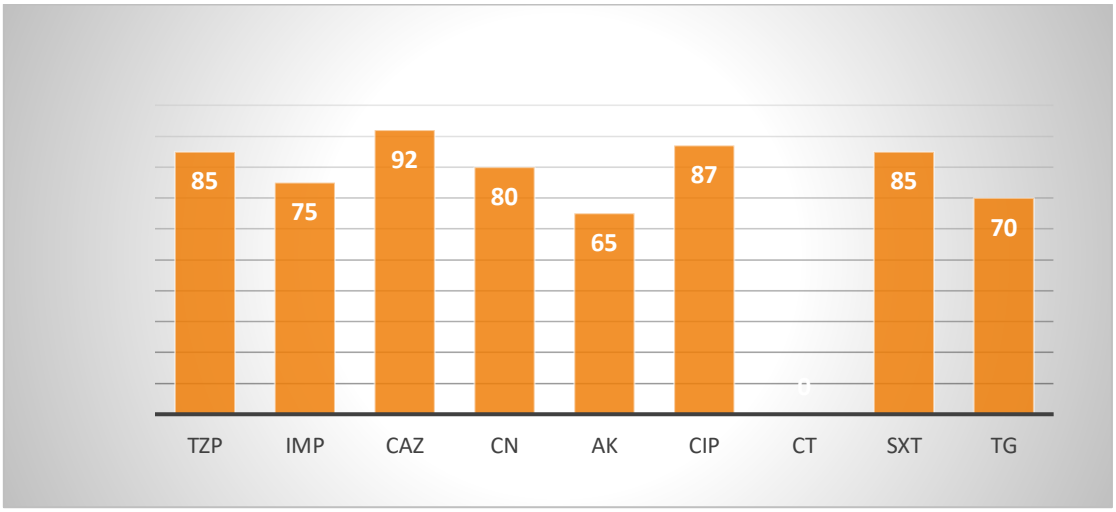

Figure 2: Antibiotic resistance profile (%) of P. aeruginosa isolates (n = 65)

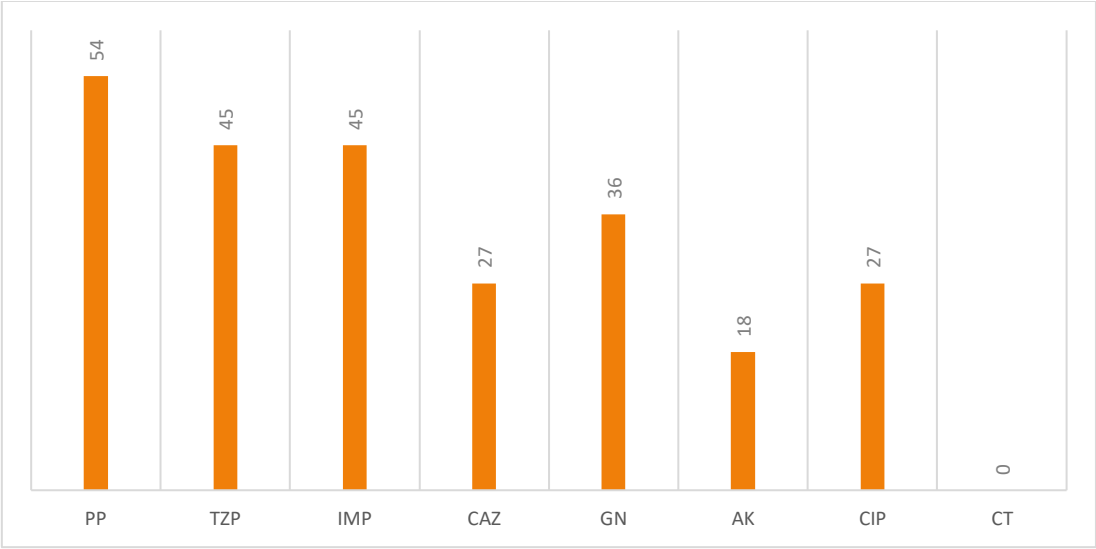

Table III: Prevalence of ESBL-producing enterobacteria in the burned patient

	Number	%
Enterobacteriaceae ESBL	138	72.6
K. pneumoniae	77	40.5
E.coli	30	15.7
Enterobacter cloacae	31	16.4
Enterobacteriaceae C3G sensitive	52	27.4
TOTAL	190	100

Table IV: Resistance to imipenem of Gram-negative bacilli in the burned patient

Resistance to Imipenem	Number	%
A. baumannii	81	72.3
P. aeruginosa	15	13.4
Klebsiella pneumoniae	8	7.1
Enterobacter cloacae	2	1.8
Serratia marcescens	2	1.8
Escherichia coli	2	1.8
Proteus mirabilis	1	0.9

Fifteen patients in this series died during their hospitalizations. There were ten men and five women. 33.4% of the deaths occurred as a consequence of septic shock due to S. aureus (SASM) alone or associated with S. pneumoniae producing ESBL in two cases, E. cloacae in one case, A. baumannii associated with K ESBL producing pneumoniae in one case and E. pneumoniae (ESBL) associated with K. pneumoniae (ESBL) in one case.

DISCUSSION :

The objective of this work is to determine the bacteriological profile and antibiotic resistance of the strains responsible of the burned patient's infections. This study was not intended to be a decision-making tool but for the development of the management of burns in our context.

Description of the studied population

During the study period, 153 burned patients were enrolled with a sex ratio of 2.26. In the literature, most studies have concluded prevalence dominance in men [4-7] and few studies report female dominance [8]. This ratio is explained by a tendency of men to adopt risky behaviors and to exercise exposed professions. The average age of 38.4 years in this series is comparable to others in Rabat and Iran [4.9] and at least 10 years higher than other studies [10].

In this study, burns occurred primarily during the fall and summer. Burns in autumn can be explained by the need for hot water for bathing and housework. This water heating is generally done without any safety device: use of pressure cooker, pots and small gas cylinders, mounting in closed spaces unventilated.

The Frans study conducted in the Caribbean shows a significant incidence of burns in spring and winter: 28% and 27%, respectively [11]. The percentage of patients with a medical history (diabetes, renal insufficiency, cardiovascular disease) or surgery is low, compared to data presented in the international literature [12]. In this study, the mean SCB was 37.5% which is similar to results found by Essayagh and Marco [4,13]. However, it is considerably higher than in other studies [10]. In this work, the length of stay in hospital was 42 days which is higher than 10 days reported by Moutaouakkil [5] and 26 days for the 184 patients in Lumenta's study [15].

A "good" hospital stay, as reported in the literature, ranges from 13 to 21 days [16,17]. The length of stay in this work is explained by severity of burns, the SCB rate above 20% and the complications encountered during the stay, mainly due to infections and patient's state . Domestic burns are mainly found in women. This is explained by the socio-cultural context and the lack of security measures in the kitchens. With regard to the causes of burns, the literature shows that there is no rules wile describing etiologies of burns. This variability is explained by the diversity of its terminology , some authors classify fuel bruns in a distinct category and do not belong to flame burns [18]. In this study, a predominance of thermal burns caused by butane flame was found, followed by those produced by boiling liquids and by contact. The abundance of explosive burns of the small gas cylinder (3kg) is explained by our socio-economic and cultural context, by its use for lighting and heating in unventilated closed spaces. It is also explained by the structure of the small gas cylinder which should stick to more stringent safety standards.

Epidemiology of infection in burned patient : During this period, 1091 bacteriological samples were analyzed. A total of 797 non-redundant bacterial strains were identified and 342 samples were sterile. In this series, infections or skin colonizations were the most common (54.7%) followed by bacteremia (32.7%), and urinary tract infections (11.7%). The predominance of skin infections has been reported by many authors [9,19].

Apart from coagulase-negative Staphylococcus, A. baumannii was the predominant strain in this series. This germ can be found in various sites in the patient's environment [20,21]. However, the most common mode of contamination remains the hands of health care teams. Patients infected with this strain can carry it to different parts of their body for a few days [22]. P. aeruginosa was the second most common of the non-fermenting gram-negative bacilli; it was characterized by its resistance to antibiotics. This finding is corroborated by other authors [4,20]Cremer explains the abundance of P. aeruginosa by the practice of early balneotherapy [23]. In this study, balneotherapy is not used, which could explain why P. aeruginosa comes in second place. Enterobacteria represent 23.9% of isolated organisms and are mainly represented by Klebsiella pneumoniae, Escherichia coli, Enterobacter cloacae, Proteus mirabilis and Serratia marcescens, in order of decreasing prevalence. These results are consistent with those reported by some authors (Table VI).

Table V: Distribution of Isolated Sprouts in Burns by Authors

	Types of Total	Sample seeds isolated	*S. aureus*	*P. aeruginosa*	*A. baumannii*	Enterobacteriaceae
S. HemingtonGorse et al [33]	skin sample	**216**	**31**	**4**		**21**
Qader A.R et al [34]	blood culture	**633**	**33**	**18**	**11**	**21** -Kp 15% -E.cloacae 4% -E.coli 2%
Chaibdraa A. et al [35]	skin sample blood culture urinary sampling Catheter		**58**	**20**	**2**	**13** Kp 5% P.mirabilis 4 E.coli 2%
Alireza E. et al [09]	urinary sampling blood culture Biopsy	**173**	**20.2**	**37.5**	**10.4**	**22.3** -E.coli 5.7% -P.mirabilis 5.2% -E.aerogenes5.2% -Kp 3.4%
This study	skin sample blood culture urinary sampling Catheter	**797**	7.65 %	8.15 %	13.42%	**23.9** -Kp 9.8% - E.coli 6.9% -E.cloacae 5%

In this series, 9.8% of S. aureus strains were resistant to oxacillin (MRSA). The associated Resistance complicates the management of S. aureus infection, justifying then the use of glycopeptides. This rate of MRSA is significantly lower than what was reported in a

multicenter study of isolates of skin and soft tissue's S. aureus in both the USA (44.4%) and Europe (32.4% in Spain, 34.7% in France, 41.8% in Italy ...) [24]

MRSA is nowadays considered as the major cause of nosocomial infections and its prevalence is increasing in burn centers [25,26]. In the last two decades, antibiotic's sensibility towared P. aeruginosa has been studied in various studys [27,28]. In the report of Shahid et al. [27] The most effective antibiotic was ceftazidime (87.8%), followed by ciprofloxacin and gentamycin (67.3%). In contrast, the study by Yildirim et al. [28] demonstrated a high level of resistance to gentamycin (94.8%) and ceftazidime (79.1%), while piperacillin / tazobactam was the most effective antibiotic against P. aeruginosa. For this study, the most effective antibiotic was colistin, followed by amikacin, ciprofloxacin, and ceftazidime (Figure 2), and according to the Ganapathy et al [29] it was shown that the systemic and repetitive use of colistin in burned patients for the treatment of gram negative multi-resistant for a long time is safe, so it will .be fine To put it into its therapeutic arsenal bécasse of its proven effectiveness. The resistance of Acinetobacter baumannii to imipenem was 72.3%. This high rate of resistance is a real problem in our context and also in all Moroccan university hospitals. This situation is linked to, among other things, an uncontrolled prescription of this molecule selecting resistant strains and an lack of control of nosocomial infection, especially in hight risq services. The role of cross-transmission of A baumannii's multi-resistant strains and the lack of control of the environment are two major factors explaining this situation [30]. In this work, colistin remains the most effective antibiotic against A. baumannii with a sensitivity of 100%. These results are compatible with many authors who emphasize the multi-resistance of Acinetobacter baumannii with a higher or lower resistance to imipenem. This synthesis shows that 72.6% of enterobacterial strains are secreting a large spectrum betalactamases. Some authors report an ESBL rate higher than ours, specialy the study of G. Khorasani et al [31] who found the ESBL rates of 80.4%. The study of the evolution of the proportion of ESBL enterobacteria shows a clear recrudescence of ESBL strains from 5.9% in 2007/2008 and 35.4% in 2009/2010 to 48% in 2016 / 2017. The level of resistance of enterobacteria to Imipenem was 14.4%. At this alarming rate, soon doctors will face a real challenge to treat these multi-resistant pathogenic bacteria with antibiotics.

It would be advisable to regularize the prescription of the antibiotics which must be madein front of a documented infection. Patients carrying these germs should be isolated to avoid their transmission in the intensive care unit.The rate of lethality in this study was 3.22%. This value remains lower compared to other countries [3,32] this can be explained by the severity of the cases supported.

CONCLUSION

This study reports the high prevalence of infection in burned patients and the problematic of multi-resistant germs infections involving the use of a very large spectrum antibiotic therapy and the Follow of specific hygiene measures to limit the spread of these infections. multi-resistant germs.front of the severity of infections in burned patients ,a better knowledge of the bacterial ecology and resistance profiles of different bacteria is essential for better management. A preventive strategy must be put in place. It includes the strict application of hygiene and asepsis, and the rationalization of the prescription of antibiotics to prevent the selection of multi-resistant germs.

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