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Osteoarticular Infections on Osteosynthesis Material at Marrakech University Hospital from 2018 to 2020

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Abstract **Original Research Article**

A retrospective and descriptive study over a period of 3 years (2018-2020) and relating to a series of 54 patients admitted for infections on microbiologically documented osteosynthesis materials in the microbiology laboratory of the CHU Mohamed VI in Marrakech. Bone and joint infections are a serious public health problem. The average age of the patients was 39 years (17-77), with a male predominance (sex ratio M/F=2.6). Bacterial epidemiology was represented by staphylococci, including 16% S.aureus with 2% resistance to oxacillin and 10% coagulase-negative staphylococcus. Management was medico-surgical with an antibiotic strategy dominated by polytherapy. The bacterial epidemiology of bone and joint infections is dominated by Staphylococcus aureus, the first responsible species in all studies. However, the frequency of certain species deemed nosocomial such as Acinetobacter baumannii and Pseudomonas aeruginosa encourages more effort in the fight against nosocomial infection. The irrational use of antibiotics has led to a major problem which is resistance to C3Gs and the emergence of resistance to carbapenems.

Keywords: Arthritis, bacterial arthritis, osteoarticular infection, osteosynthesis, Staphylococcus.

INTRODUCTION

Infection on orthopedic material is linked to the presence of microorganisms in the replication phase, generating a local and then a general immune reaction. The colonization of the material corresponds to a simple presence of bacteria without any anti-infectious reaction of the host. This infectious process can evolve towards a generalization and cause an alteration of the expected functional result. Very small bacterial inocula (less than 1000 germs) can generate an infection on material [1].

Despite measures aimed at minimizing its incidence, superinfection of osteosynthesis material remains a dreaded complication, especially when the patient's condition is precarious (polytrauma, geriatric patients, immunocompromised patients, etc.). Early or late, acute or torpid, the diagnosis of osteoarticular infections (OAI) on material is based on a set of clinical, biological, radiological, histological and bacteriological arguments, variously associated. In order to limit the complications due to these infections, the patient's management must be rapid and optimal. To do this, the diagnosis must be accurate.

The cost of the treatment is major, since it combines interventions and hospitalizations that are often iterative, long-term antibiotic therapy, work stoppages and severe after-effects for the youngest patients. Such an infection may occur throughout the patient's life. However, there is no consensus concerning the diagnostic and therapeutic management of these infections because of the multiple factors influencing the cure, it seems difficult to propose a single attitude towards the infection of osteoarticular material.

The objective of this study is to evaluate the prevalence of osteoarticular infections on material within the hospital services of the university hospital Mohamed VI and to study its demographic and bacteriological profile.

PATIENTS AND METHODS

This is a descriptive study covering a period of 3 years from 2018 to 2020.Were included over this period all infections on osteosynthesis material documented microbiologically within the microbiology laboratory of the university hospital Mohamed VI of Marrakech.

Bacterial identification was done according to standard morphological, cultural, biochemical and antigenic characteristics. The study of antibiotic sensitivity was carried out according to the recommendations of the French Society of Microbiology (EUCAST-CA-SFM) depending on the germ involved and the antibiotics with good bone diffusion.

An evaluation form was used to record the following for each sample: age, sex, bacterium isolated and its sensitivity to antibiotics. Statistical analysis and data entry were performed using Microsoft Office Excel.

RESULTS

During this period from January 2018 to December 2020, a total of 54 infections on osteosynthesis devices were collected.

The culture identified 41 strains, with positivity rate of 75%. The average age of the patients was 39 years with extremes ranging from 17 to 77 years. A male predominance was found with a sex ratio of 2.6.

Staphylococcus aureus was the most frequently isolated germ (16%) in infections on osteosynthesis material in our context, followed by coagulase-negative Staphylococcus (10%), Enterococcus feacalis (8%), Streptococcus spp (5%) and Enterococcus casseliflavus (2%), with a total of 41% of gram-positive cocci isolated.

Enterobacteriaceae represented 24% of the isolates: Enterobacter cloacae was found in 10% of the patients, Escherichia coli (4%), Klebsiella pneumoniae, Proteus mirabilis, Enterobacter aerogenes, Enterobacter hormanchei and Providencia rettgerii in 2% of the patients respectively.

Among the non-fermentative gram-negative bacteria isolated: Pseudomonas aeruginosa was found in 7% of patients and Acinetobacter baumannii in 2% of patients. Cultures came back sterile in 24% of patients.

Table I: Distribution of bacteria isolated from infections on osteosynthesis materials at the University Hospital of Marrakech (n=41)

		Species	Number	Percentages
GNB	**Enterobacteriaceae N=13 (24%)**	**Klebsiellapneumoniae**	1	2%
		Enterobactercloacae	6	10%
		Escherichia coli	2	4%
		Proteus mirabilis	1	2%
		Enterobacteraerogenes	1	2%
		Enterobacterhormanchei	1	2%
		Providenciarettgerii	1	2%
	non-fermentative GNB N=5 (9%)	**Pseudomonas aeruginosa**	4	7%
		Acinetobacterbaumanii	1	2%
GPC	**STAPHYLOCOCCI N=14 (26%)**	**Staphylocoque aureus**	9	16%
		CNS	5	10%
	STREPTOCOCUS N=8 (15%)	**Enterocoquefaecalis**	4	8%
		Enterocoquecasseliflavus	1	2%
		Streptocoques	3	5%
GPB	**Corynebacteriumspp N=1 (2%)**		1	2%

Meticillin resistance in Staphylococcus aureus was 2% and all strains were susceptible to glycopeptides.

Enterobacteriaceae resistant to C3G by production of an extended-spectrum Betalactamase (ESBL) presented 30% of isolates with high co-resistance to other antibiotic families compared to C3G-susceptible strains. This resistance profile mainly affected Enterobacter cloacae, which was found in 75% of C3G-resistant isolates, followed by Klebsiella pneumoniae (25%). Within the antibiotics tested, ESBL strains showed 100% resistance to Fluoroquinolones, 100% to Gentamicin, 100% to Trimethoprim sulfamtoxazole. Strains with decreased susceptibility to carbapenemes represented 23% of ESBL isolates with 15% resistance to Imipenem. All Enterobacteriaceae isolates remained susceptible to Amikacin (Figure 1).

Monitoring of resistance trends in isolated Enterobacteriaceae showed that C3G resistance in all species increased by 38% between 2018 and 2020.

For non-fermenting NGB: Acinetobacter baumanii was resistant to ceftazidime, imipenem and ciprofloxacin and remained susceptible only to amikacin.

Pseudomonas aeruginosa strains (4 isolates), remained sensitive to ceftazidime and to the other antibiotics tested.

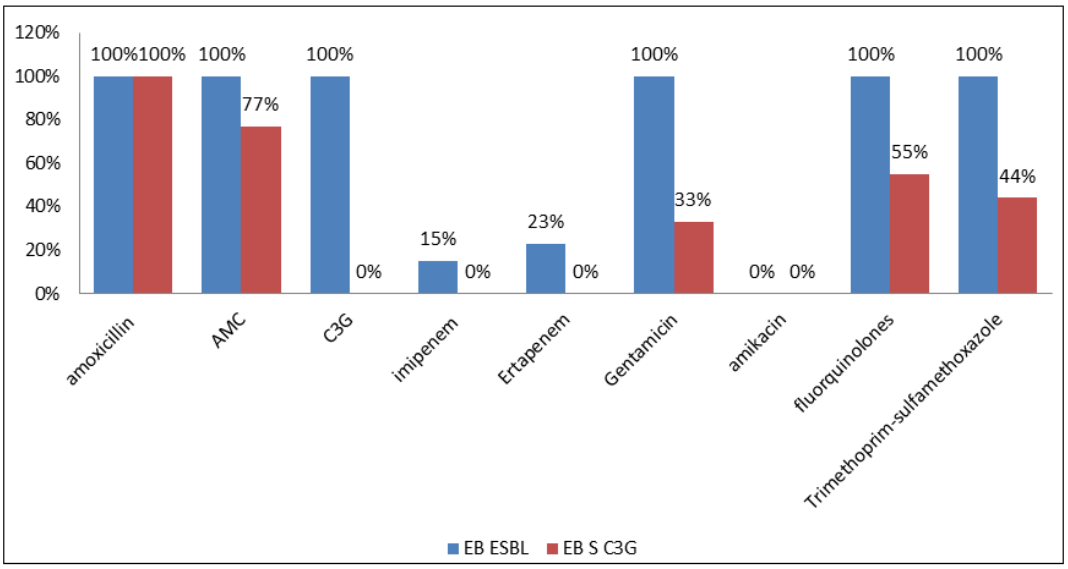

Figure 1: Percentage of antibiotic resistance of C3G-susceptible and ESBL species of Enterobacteriaceae isolated from osteoarticular infections

Probabilistic antibiotic therapy based on the combination of penicillin M and gentamicin was started after removal of the material for cytobacteriological study, while waiting for the results of the antibiogram.

DISCUSSION

Osteoarticular infection is a severe infectious pathology and represents a diagnostic and therapeutic emergency.

In this series, the average age of the patients was 39 years and the most affected age category was 20 to 30 years. These results can be explained by the fact that the young population is the most active and the most exposed to all types of trauma. Our result is similar to those of Rhatous and Belgassi [3, 4, 6]. The sex ratio M/F of the patients was 2.6. This male predominance has been found in the literature [5, 7, 8].

In terms of our bacterial isolates, we noted the predominant of Staphylococcus (26%), followed by Enterobacteriaceae (24%), then Streptococci (15%), then non-fermentative NGB (9%). In the study by ELOUENNASS [9], staphylococcus isolates accounted for 46.4%, followed by enterobacteria (25.2%) and non-fermenting gram-negative bacilli (12.9%).

Staphylococcus aureus was the most common bacterial agent found in our series, with a frequency of 16%. The predominance is also consistent with data from the literature [10, 11]. Its frequency seems to be better justified by the molecular mechanisms of adhesion to metallic material and necrotic tissue [12, 13], and also by its particular adaptation to bone infection due to the presence of surface receptors for fibrinogen, collagen, fibronectin and type II sialoprotein [14]. Coagulase-negative staphylococci are also common and are more related to bone infections with or without orthopedic hardware [10]. Streptococci are rarely isolated in our study (15%). They are considered as bacteria of cutaneous origin, and are often, according to the literature, dominant in case of intraoperative infection [15].

Gram-negative bacilli, whether enterobacteria or non-fermenting gram-negative bacilli (Acinetobacter, Pseudomonas Aeruginosa) represent24% in our study, 7% and 2% respectively for enterobacteria, P.aeruginosa and Acinetobacter baumannii. Data from the literature emphasize that enterobacteria are often isolated in elderly patients because of the frequency of bacteremia of digestive or urinary origin in this population [15]. For Pseudomonas and Acinetobacter baumannii, they are agents of nosocomial infections resistant to many antibiotics, and also are ubiquitous and colonize hospitalized patients. The isolates in this series are probably of nosocomial origin. They are an epidemic problem in all university hospital structures.

Cytobacteriological examination is essential and must be performed before any antibiotic therapy to allow an adapted prescription of antibiotics guided by the results of the antibiogram.

Among the staphylococcal isolates, 2% of staphylococcus aureus were resistant to meticillin. The low rates of resistance in our institution are indicative of its community origin. Our results are not very different from those found by ELOUENASS [16] and BENYASS [17]. Coagulase-negative staphylococci form a heterogeneous group and their behavior towards antibiotics varies according to the species. They are generally more resistant to antibiotics than Staphylococcus aureus. With regard to glycoproteptides, Staphylococcus aureus isolates were sensitive to vancomycin and teicoplanin.

Resistance of enterobacterial isolates was 30% for C3G by production of an extended spectrum Betalactamase (ESBL). The extended spectrum betalactamase phenotype was found in three Enterobacter cloacae isolates and one Klebsiella pneumoniae isolate. Imipenem expressed good activity against C3G-susceptible Enterobacteriaceae isolates with 100% susceptibility, while among ESBL isolates 23% of the strains had decreased susceptibility to carbapenems with 15% resistance to Imipenem. None of the Enterobacteriaceae isolates were resistant to Amikacin. These results are not very different from those found by ELOUENASS [16] and BENYASS [17].

Non-fermenting NGB are Gram-negative bacilli that do not ferment glucose. They represent the prototype of opportunistic pathogenic bacteria, especially in subjects with impaired defence mechanisms and are frequently isolated during hospital infections, with natural and acquired multiresistance responsible for therapeutic difficulties. For Acinetobacter baumanii, its acquired resistance to antibiotics frequently results from the simultaneous production of different enzymes, but resistance to certain antibiotics (imipenem) may be non-enzymatic due to a decrease in affinity for these antibiotics [18]. The resistance rates found in our study are very high. This multiresistance shows the seriousness of the problem posed by the resistance of this species in our training. Resistance to imipenem is currently increasing at an alarming rate; this evolution is probably linked to its empirical and uncontrolled prescription as well as that of 3rd generation cephalosporins [18].

Pseudomonas aeruginosa has a natural resistance to many antibiotics and over time, strains develop acquired resistance. This resistance results from impermeability of the outer membrane, efflux, alteration of the sites of action or production of enzymes that degrade beta-lactams and aminoglycosides. We note in this series the absence of resistance to antibiotics (ceftazidime, imipenem, gentamicin and ciprofloxacin) which is in line with the data of the microbial ecology of the University Hospital over the last few years where Pseudomonas aeruginosa is rather problematic by its virulence than by its multiresistance.

CONCLUSION

Osteoarticular infections on osteosynthesis materials require a rapid and sensitive diagnosis, and a treatment adapted to the germ involved.

The bacteriological profile is dominated by staphylococcus aureus but other germs may be involved. Cytobacteriological examination of the material is essential in order to isolate the germ and study its sensitivity to antibiotics. Their management is complex and requires a multidisciplinary approach.

Nevertheless, the irrational use of antibiotics has led to a major problem which is resistance to C3G and the emergence of resistance to carbapenems.

Conflict of Interest: None.

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