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ACINETOBACTER BAUMANNII: EPIDEMIOLOGY AND ANTIBIOTIC RESISTANCE

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ABSTRACT

A.baumannii is an opportunistic bacterium that has emerged in recent decades as a causative agent of potentially epidemic nosocomial infections. This bacterium has been able to develop an impressive resistance against the majority of antibiotics, which explains the therapeutic difficulties encountered.

The objective of this work is to determine, through a retrospective study, the epidemiological profile, and the antibiotic resistance of *A.baumannii* strains isolated from diagnostic specimens made at Avicenne military hospital of Marrakech, and follow their evolution over 5 years (2012-2017). *A.baumannii* accounted for 3.75% of all isolated organisms during this period (n = 183). All hospital services were concerned, with a predominance of reanimation units (66% of isolates). The results obtained showed that these pathogens originate in 53% of the protected specimen brush and the main infectious sites were pneumopathies and urinary tract infections.

An increase in the resistance of *A.baumannii* isolates for all antibiotics tested was observed (Ceftazidime 87%, Céfépime98%, Imipenem 84%, Ciprofloxacin 96% and Gentamicin 61%). However, all strains remained sensitive to Colistin.

These results confirm the multidrug-resistant nature of *A.baumannii* and its nosocomial nature. This resistance represents a serious therapeutic and epidemiological problem, hence the need for the establishment of a system for monitoring the microbial environment of the hospital and the strict application of preventive measures.

Keywords: *Acinetobacter baumannii*, Reanimation unit, Antibiotic resistance, Colistin

INTRODUCTION

A.baumannii is a frequent cause of serious nosocomial infections. *A.baumannii* emerged in the 80's as a problematic pathogen due to an increase in its virulence, the difficulty of its treatment due to antibiotic resistance as well as the numerous infections for which it is responsible making it one of the most important threats to human health. Among the nosocomial infections for which it is responsible are: pneumonia, bacteremia, lower respiratory infections, urinary tract infections, wound super infections, meningitis, osteomyelitis and endocarditis. *A.baumannii* has a remarkable genetic plasticity conferring it a great capacity to acquire resistance to different classes of antibiotics [1].

The objective of this article is to determine the epidemiology of *A.baumannii* and its resistance profile.

MATERIALS AND METHODS

This is a retrospective descriptive study, based on data from the microbiology laboratory of the Avicenne Military Hospital of Marrakech. This study was conducted on all diagnostic samples from inpatients or outpatients received between January 01, 2012 and December 31, 2017.

Isolation of bacterial strains was performed on enriched and selective agar media incubated at 37°C for 24 to 48 hours.

Bacterial identification was based on the study of morphological, cultural and biochemical characteristics (API 20E and NH galleries), completed by an automated identification by the Phoenix® M50 automated system.

After isolation and identification of the bacterial strain, an antibiotic susceptibility test is performed by an automated method using micro-dilutions in liquid medium with the Phoenix® automated system, which determines MICs, as well as the measurement of inhibition diameters by the diffusion method of antibiotic discs in Mueller-Hinton (MH) agar medium on Petri dishes incubated at 37°C for 24 hours.

MICs and inhibition diameters are thus compared to EUCAST references in order to determine the sensitivity profile of bacterial strains.

RESULTS

1- Overall prevalence of *A.baumannii*

During the study period, *A.baumannii* represented 3.75% (n=183) of all germs isolated during this period (4878 germs). *Enterobacteriaceae* occupied the first place followed by *Staphylococcus aureus*, *Streptococcus*, *Pseudomonas aeruginosa* and finally *A.baumannii*

2- Evolution of *A.baumannii* isolates

The frequency of isolation of *A.baumannii* has experienced a decrease during our study period going from 35 strains in 2012 to 25 strains in 2017. The highest rates were marked during the years 2012 and 2014 (Figure 1).

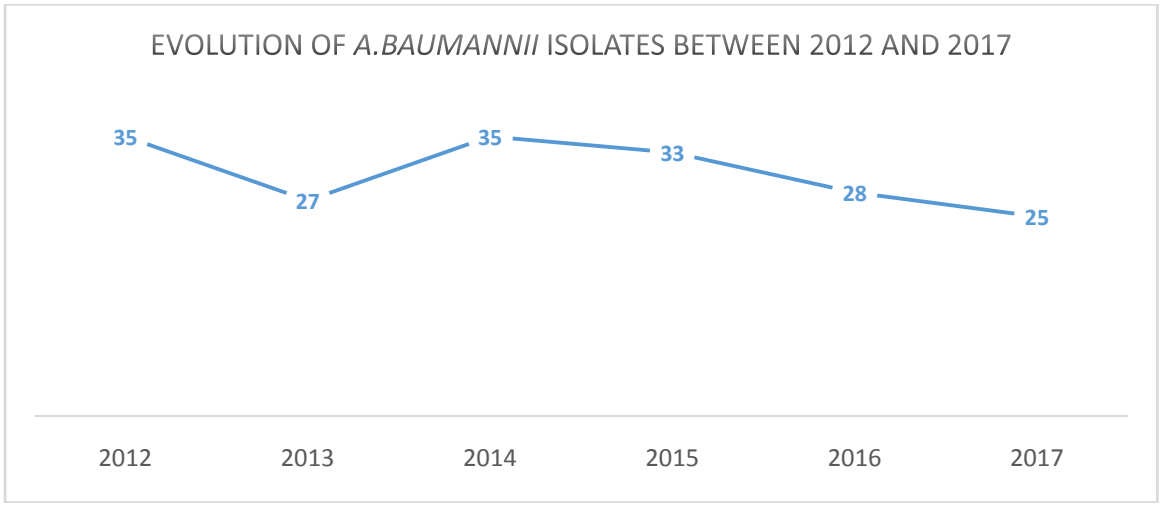

Figure 1: Evolution of *A.baumannii* isolates between 2012 and 2017.

3- Sex distribution

The distribution of *A.baumannii* isolates by sex showed a male predominance with 128 isolated strains, i.e. a sex ratio of 2.3.

4- Distribution according to hospital departments

A.baumannii was found in the different activity sectors of the AMH with a clear predominance in the resuscitation units which constituted the origin of 66% of the *A.baumannii* isolates, followed by the surgery services with 5% of the isolates, and the medical services with 4% of the isolates, the remainder of the isolates (25%) came from outpatients consulting the AMH's emergency room.

5- Distribution according to the nature of the samples

The distribution of *A. baumannii* isolates according to the nature of the samples revealed the predominance of strains from PSBs with 54% [n=99], followed by UCBE 21% [n=38], pus 8% [n=15], haemocultures 6% [n=11] and venous catheters 5% [n=9]

6- Distribution according to infection site

The majority of *A.baumannii* strains isolated came from pneumonia (56%), followed by urinary tract infections (22%), then bacteremia (13%) and finally suppurative infections (9%).

7- Antibiotic resistance profile of *A.baumannii*

Of the 183 strains of *A.baumannii* isolated in the microbiology laboratory of the AMH between 2012 and 2017, 93% of the isolated strains were resistant to Ticarcillin, 87% of the strains were resistant to Ceftazidime, 98% were resistant to Cefepime. 84% of the *A.baumannii* isolated were resistant to Imipenem (ABRI). 61% of the isolates remained sensitive to Amikacin, 75% of the strains were resistant to Cotrimoxazole and all the isolated strains remained sensitive to Colistin (Figure 2).

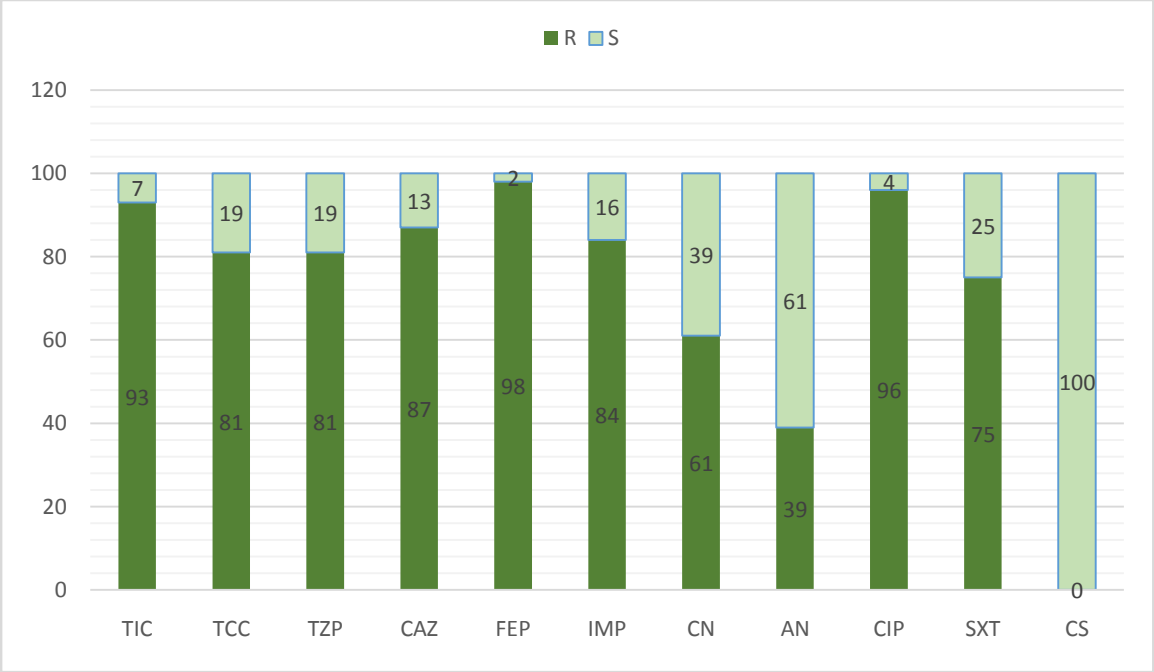

Figure 2: Percentage of antibiotic resistance of *A.baumannii* isolates at AMH.

Among the 183 strains of *A.Baumannii*, 153 multidrug-resistant strains were isolated, i.e. 84% of the strains.

DISCUSSION

1-Overall prevalence of *A.baumannii*

During the study period, *A.baumannii* strains represented 3.75% of all bacteria isolated in the AMH laboratory. This rate remains relatively low compared to that reported by a study conducted at the University Hospital of Marrakech in 2015 which is 7%, at the University Hospital of Rabat in 2017 with a rate of 6.94% and at the University Hospital of Fez with a rate of 5.8% in 2015 [2,3,4].

However, this percentage remains high compared to that reported by a study done at the MHMI of Meknes in 2017 which is 1.71% and in Algeria in 2016 with a rate of 1.67% [5,6].

The highest rates are reported in Pakistan in 2016 with a rate of 15.3%, and in Iran with a rate of 24.2% by a study done in 2016 [7,8].

2- Sex distribution

A.baumannii infections were more frequent in the male population than in the female population with a sex ratio of 2.33. This male predominance is reported by several national, Maghrebian and international studies (Table I) [5, 2, 8, 3, 9, 10].

The male predominance can be explained by the fact that *A.baumannii* is often associated with underlying conditions such as smoking, alcoholism, diabetes and other chronic lung diseases [11].

Table I: Comparison of sex ratio

	MHMI Meknès 2017 [5]	UHC Marrakech 2015 [2]	Rabat 2017 [3]	Tunisia 2017 [9]	Poland 2016 [10]	Pakistan 2016 [8]	Our study
Sex Ratio	2.07	1.70	1.87	1.77	1.90	1.30	2.33

3- Distribution according to hospital departments

A.baumannii strains isolated came in large proportion (66%) from patients hospitalized in the reanimation unit. These results are in line with the literature, as the reanimation unit is always the most frequent source of *A.baumannii* infections, but with variable rates (Table II).

The rate found in this study is close to that reported in the University Hospital of Marrakech in 2015 (62%) and that of India in 2016 (68.1%) [2,12], but remains higher than that reported in the University Hospital of Rabat (2017) ,Greece (2016) and Spain(2014) where the rate was respectively (54.9%),(54%),(43.9) [3 ,13,14].

Table II: Comparison of A. baumannii distribution by hospital Departments

	UHC Marrakech 2015 [2]	Rabat 2017 [3]	FES 2015 [4]	Greece 2016 [13]	India 2016 [3]	Spain 2014 [14]	Our study
Reanimation unit	62%	54,90%	82%	54,00%	68,10%	43.9%	66%
Medicine Department	20%	36,70%	12%	27,50%	8,50%	30.9%	4%
Surgery Department	18%	8,40%	6%	18,50%	23,40%	21.1%	5%

4- Distribution according to the nature of the samples

PSBs represented the main site of isolation of *A.baumannii* (54%). This result is consistent with several studies that report a predominance of *A.baumannii* in PSBs, with rates similar or lower than ours. 33% in Marrakech University Hospital in 2015, 44% in Rabat in 2017, 28% in Pakistan in 2016 [2, 3, 12]. In contrast to a study that was done at the MHMI of Meknes where it reports that the main site of isolation of *A.baumannii* is at the level of UCBE with a rate of 42.5% [5] (Table III).

Table III: Comparison of the distribution of *A. baumannii* isolates according to the nature of the samples

	UHC Marrakech 2015 [2]	MHMI Meknès 2017 [5]	Rabat 2017 [3]	Pakistan 2016 [8]	India 2016 [12]	Our study
PSB	33%	7,50%	44,67%	28%	_	54%
UCBE	15%	42,50%	12%	0,60%	12,70%	21%
Pus	14%	20%	21,47%	4,20%	27,60%	8%
Heamocultures	14%	2,50%	14,15%	11,60%	2,10%	6%

5- Distribution according to the infectious site

The main infections caused by *A.baumannii* isolated in the hospital were pneumopathies (56%) followed by urinary tract infections (22%).However, a study conducted in Meknes in 2017 reports different results to ours in which it notes the predominance of urinary tract infections with a rate of 50% [5].

6- Antibiotic resistance profile of *A.baumannii*

The results in terms of antibiotic resistance found in this study are alarming. Resistance rates are very high for beta-lactam antibiotics and reached 93% for Ticarcillin, 87% for Ceftazidime, 98% for Cefepime, and 84% for Imipenem. Recent national and international studies have reported similar results of resistance to beta-lactam antibiotics as well as to other antibiotic families with similar higher or lower rates (Table IV).

To note that in our study, all *A.baumannii* strains are sensitive to Colistin, which is in line with the data from the Marrakech University Hospital in 2015 [2] and the MHMI of Meknès 2017 [5]. Contrary to an Indian study done in 2016 [12] showing high rates of resistance to Colistin.

Table IV: Comparison of resistance rates of *A.baumannii*

	UHC Marrakech 2015 [2]	MHMI Meknès 2017 [5]	Rabat 2017 [3]	Greece 2016 [13]	Egypt 2018 [15]	India 2016 [12]	Iran 2016 [7]	Our study
TIC	_	87.5%	89%	94,42%	_	_	_	93%
CAZ	82%	85%	86.03%	95%	_	100%	_	87%
FEP	_	85%	86.17%	94,09%	_	90,60%	100%	98%
IMP	78%	72.5%	76.19%	88,95%	100%	100%	100%	84%
GM	71%	77.5%	_%	83,59%	100%	93,75%	_	61%
AN	36%	45%	52.28%	60,28%	100%	96,87%	100%	39%
CIP	82%	77.5%	87.78%	93,33%	95%	96,87%	96%	96%
CS	0%	0	1.7%	2,95%	5%	53,12%	8 %	0%

CONCLUSION

A.baumannii occupies an important place in hospital pathology because of its great capacity to colonize and persist in the hospital environment, its increasing frequency, its pathogenic potential and its capacity to continuously acquire resistance. Therefore, it is imperative that this bacterium be the subject of national surveillance programs in all countries.

Our study allowed us to describe the epidemiological and resistance profile of *A.baumannii* at the AMH of Marrakech during 2012 and 2017, based on data available at the microbiology laboratory registers.

Faced with the development of resistance phenomena in the world, research and development of new antibiotics are insufficient, however prevention remains the solution of choice to fight against these infections.

POTENTIAL CONFLICT OF INTEREST

None declared.

AUTHORS CONTRIBUTION

All authors have contributed to the conduct of this work. All authors also declare that they have read and approved the final version of the manuscript.

ETHICAL CONSIDERATION

All the data has been collected anonymously following patient confidentiality.

LIST OF ABBREVIATIONS

A.baumannii: *Acinetobacter baumannii*
ABRI :*Acinetobacter baumannii* resistant to Imipenem
AMH: Avicenne military hospital
AN: Amikacin
CAZ : Ceftazidime
CIP : Ciprofloxacin
CN : Gentamicin
CS: Colistin
EUCAST: European committee on antimicrobial susceptibility testing
FEP: Cefepime
IMP: Imipenem
MHMI: Mlilitary Hospital Moulay Ismail
MH: Mueller-Hinton
MIC: Minimum inhibitory concentration
PSB: Protected specimen brush
R: Resistant
S: Sensible
SXT: Trimethoprim- Sulfamethoxazole
TCC: Ticarcillin- Clavulanate
TIC: Ticarcillin
TZP: Piperacillin –Tazobactam
UCBE: Urine cytobacteriological examination
UHC: University Hospital Center

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