ORIGINAL ARTICLE

Bali Journal of Anesthesiology (*BJOA*) 2019, Volume 3, Number 1: 50-54
E-ISSN: 2549-2276

Published by DiscoverSys

Antimicrobial susceptibility patterns of *Acinetobacter baumanii* isolates from ICU and non-ICU wards

Nyoman Sri Budayanti,[1,3*] I Wayan Suranadi,[2] Made Adi Tarini,[1] Gusti Ayu Dianti Violentina,[3] I Dewa Gde Sathya Deva[3]

ABSTRACT

Introduction: *Acinetobacter baumanii* is the most common agent of hospital-acquired infection with the increasing fatality rate due to multidrug-resistant (MDR) strain infection. The magnitude of the problem in Indonesia is unknown. Here, we provide data regarding susceptibility pattern of A. baumanii isolated from a tertiary referral hospital in Bali, Indonesia between 2012 and 2014.

Methods: Data were collected retrospectively from culture-based records in the Clinical Microbiology department, Sanglah General Hospital during 2012-2014. A. baumanii was isolated from clinical specimens. Identification and antimicrobial susceptibility test were conducted using micro-dilution method (Vitek-2 Compact system). Isolates that resistant to ≥ 3 antibiotic classes were categorized as multi-drug resistant (MDR) *A. baumanii*.

Results: *A. baumanii* collected from sputum in intensive care unit (ICU) wards were 7.9%, 11.1%, and 7.0%, while the isolates from sputum in non-ICU wards were 13.1%, 15.6%, and 19.9% in 2012, 2013, and 2014, respectively. There was a reduced susceptibility of *A. baumanii* to ciprofloxacin, levofloxacin, ceftazidime, aztreonam, imipenem, ampicillin-sulbactam, and piperacillin-tazobactam in ICU ward. Meanwhile, the susceptibility of *A. baumanii* to Cotrimoxazole remained high in both ICU and non-ICU ward. MDR *A. baumanii* is found to be resistant to fluoroquinolones, cephalosporins, aztreonam, aminoglycosides, beta-lactamase inhibitors, and carbapenem. Data were analyzed and presented in a descriptive manner.

Conclusion: Three years surveillance showed that the susceptibility of *A. baumanii* to most common antibiotics was decreasing. MDR *A. baumanii* was found to be resistant to all classes of common antibiotics mostly from ICU ward isolates.

Keywords: *Acinetobacter baumanii*, antimicrobial susceptibility, multidrug-resistance (MDR)

Cite This Article: Budayanti, N.S., Suranadi, I.W., Tarini, M.A.,Violentina, G.A.D., Deva, I.D.G.S. 2019. Antimicrobial susceptibility patterns of *Acinetobacter baumanii isolates* from ICU and non-ICU wards. *Bali Journal of Anesthesiology* 3(1): 50-54. DOI:10.15562/bjoa.v3i1.147

[1]Department of Microbiology, Faculty of Medicine
[2]Department of Anesthesiology, Pain Management, and Intensive Care
[3]Udayana One Health Collaborating Centre
Faculty of Medicine, Udayana University, Sanglah General Hospital, Denpasar-Bali, Indonesia

*Correspondence to:
Nyoman Sri Budayanti, Faculty of Medicine, Udayana University, Jl. PB Sudirman, Denpasar 80232, Bali, Indonesia
nyomansribudayanti@gmail.com

INTRODUCTION

Infection still remains a problem in the health sector in developing countries. The mortality rate of infection cases, particularly hospital-acquired infection, is still high. A common agent of hospital-acquired infection is *Acinetobacter baumanii*. The fatality rate of Acinetobacter infection is increasing due to multidrug-resistant strain infection. Multidrug-resistant (MDR) strains emerged due to selective pressure antibiotic that mostly used in intensive care wards.[1]

There have been few reports on the tendency change of *A. baumanii* sensitivity to antibiotics in Indonesia.[2-4] The aim of this study is to describe the tendency of sensitivities and MDR patterns of *A. baumanii* in Sanglah hospital as tertiary referral hospital in Bali, Indonesia. This knowledge will help guide the selection of appropriate empirical treatment at a local level and to provide a benchmark for comparison at other sites in Indonesia and Asia. To the best of our knowledge, this study is the first to report on the antimicrobial susceptibility and MDR patterns of *A. baumanii* in a tertiary referral hospital in Indonesia.

MATERIAL AND METHODS

This study was conducted in Sanglah hospital, a tertiary referral hospital with 750 beds and a major healthcare hub for the eastern part of Indonesia. Data of *Acinetobacter baumanii* and its antimicrobial sensitivity test which routinely performed in Sanglah Hospital were gathered retrospectively from clinical specimens from patients in 2012 to 2014. The study has approved the Committee of Ethical Research of Udayana University/Sanglah General Hospital.

The *A. baumanii* was isolated from clinical specimens including blood, urine, sputum, cerebrospinal fluid (CSF) and other specimens (vitreous fluid, pleural fluid, synovial fluid, throat swab, feces). Specimens management for bacteriology culture based on the standard operating procedure of the Department of Microbiology of Sanglah Hospital based on Clinical Microbiology Procedure Handbook.[5]

Identification of microorganism and antimicrobial sensitivity tests were conducted using the microdilution method by Vitek-2 Compact system according to the Clinical And Laboratory Standard Institute (CLSI).[6] MDR was defined as resistance to 3 or more antibiotic classes as follow: quinolones

(ciprofloxacin or levofloxacin), extended-spectrum cephalosporins (cefotaxime, ceftazidime or cefepime), aminoglycosides (gentamycin or amikacin), and carbapenems (imipenem or meropenem).[7]

Data was collected and analyzed by Microsoft Excel 2017 software in a descriptive manner. Calculations were presented in descriptive tabulations.

RESULTS

During this study, as many as 1,143 isolates of *A. baumanii* were collected from various specimens. The number of total *A. baumanii* isolated from the year 2012 to 2013 was increasing from a total of 252 isolates to 378 isolates. In 2014, the isolates from non-ICU ward increased significantly by almost 60%, while isolates obtained from ICU slightly decreased to 111 isolates (Figure 1). Sanglah hospital has two ICU wards, for adult and neonates, and nine non-ICU wards.

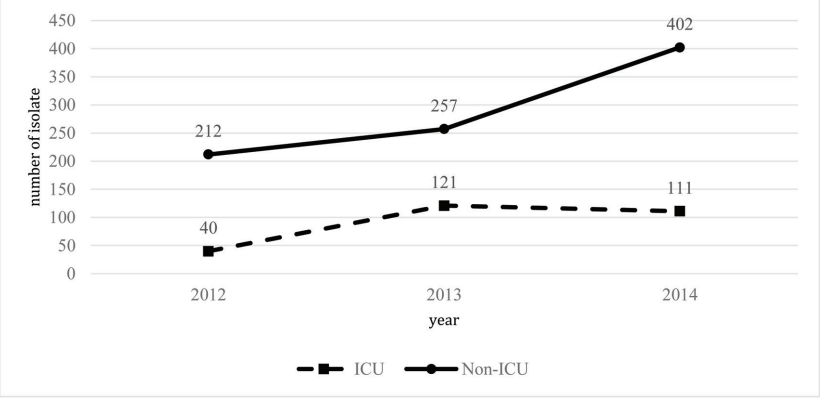

Figure 1 Total number *A.baumanii* isolates from ICU and non-ICU wards in 2012-2014

Most of *A. baumanii* isolates obtained from ICU were collected from sputum during 2012-2014 (7.9%, 11.1%, and 7.0%, respectively). In 2012, isolates of *A.baumanii* from Non-ICU wards were mostly obtained from urine specimens (62%), while in 2013 and 2014 the isolates were mostly obtained from both sputum and urine (Table 1).

The antimicrobial susceptibility of A. baumanii showed a different pattern between ICU and non-ICU isolates. The susceptibility of a. baumanii isolates, from ICU and non-ICU wards to quinolones (ciprofloxacin and levofloxacin), carbapenems (imipenem and meropenem), and 3rd generation cephalosporins (cefotaxime and ceftazidime) were decreasing from 2012 to 2014. The susceptibility of isolates from ICU to cefepime, the fourth generation of cephalosporin, were 9%, 12%, and 8% in 2012, 2013, and 2014, respectively. Meanwhile, the susceptibility of isolates from non-ICU were 29%, 35%, 33% in 2012, 2013, and 2014, respectively. We observed high sensitivity of ICU isolates to amikacin in 2012 but it was decreasing to 24% and 23% in 2013 and 2014, respectively, while the sensitivity of non-ICU isolates to amikacin remained high throughout the years with an increase in 2014 to 63%.

The susceptibility pattern of *A. baumanii* to cotrimoxazole was increasing from 12% in 2012 to 32% in 2014 in isolates from ICU wards, and from 22% in 2012 to 46% in 2014 in isolates from non-ICU wards (Table 2). The *A. baumanii* isolates, from both ICU and non-ICU wards, showed reduced susceptibility to other combination of antibiotics such as ampicillin-sulbactam, cefoperazone-sulbactam, and piperacillin-sulbactam. The susceptibility test to colistin was conducted in 2014. We found that all isolates remained sensitive to colistin (Table 2).

Table 1 **Sources and number of *Acinetobacter baumanii* isolates at ICU and non-ICU wards in 2012-2014**

		2012 n(%)		2013 n(%)		2014 n(%)	
No	**Specimen**	**ICU**	**Non-ICU**	**ICU**	**Non-ICU**	**ICU**	**Non-ICU**
1	Blood	3 (1.2)	11 (4.4)	21 (2.9)	12 (3.2)	9 (1.8)	14 (2.7)
2	Pleural fluid	0 (0.0)	2 (0.8)	1 (0.3)	2 (0.6)	0 (0.0)	1 (0.2)
3	Sputum	20 (7.9)	33 (13.1)	42 (11.1)	59 (15.6)	36 (7.0)	102 (19.9)
4	Pus	1 (0.4)	18 (7.1)	1 (0.3)	25 (6.6)	2 (0.4)	58 (11.3)
5	Wound swab	0 (0.0)	5 (2.0)	1 (0.3)	31 (8.2)	1 (0.2)	68 (13.3)
6	LCS	1 (1.4)	10 (4.0)	0 (0.0)	8 (2.1)	1 (0.2)	2 (0.4)
7	Throat swab	0 (0.0)	1 (0.4)	1 (0.3)	4 (1.2)	1 (0.2)	1 (0.2)
8	Tissue	0 (0.0)	23 (9.1)	1 (0.3)	20 (5.3)	2 (0.4)	17 (3.3)
9	Urine	6 (2.4)	62 (24.6)	7 (1.8)	59 (15.6)	5 (1.09)	99 (19.3)
10	Others	9 (3.6)	20 (8.0)	51 (13.5)	32 (8.5)	44 (8.6)	23 (4.5)
	Sub total	40 (16)	212 (84)	121 (32)	257 (68)	111 (22)	402 (78)
	Total	252 (100)		378 (100)		513 (100)	

Table 2 **The result of the antimicrobial susceptibility test of *Acinetobacter baumanii* in 2012 -2014 in the percentage of susceptible isolates**

No	Antibiotic	ICU			Non-ICU		
		2012 (%)	2013 (%)	2014 (%)	2012 (%)	2013 (%)	2014 (%)
1	Ciprofloxacin	13	12	6	23	30	27
2	Levofloxacin	15	12	6	30	33	31
3	Cefotaxime	0	1	1	4	4	4
4	Ceftazidime	8	6	4	19	16	11
5	Cefepime	9	12	8	29	35	33
6	Aztreonam	5	2	2	7	6	4
7	Imipenem	38	21	15	62	51	53
8	Meropenem	23	10	11	71	30	32
9	Gentamycin	15	15	16	36	35	43
10	Amikacin	50	24	23	55	52	63
11	Ampicillin-Sullbactam	30	18	13	45	35	49
12	Cefoperazone – Sulbactam	45	17	19	52	48	54
13	Piperazilin -Sulbactam	26	12	7	34	30	28
14	Co-trimoxazole	12	25	32	22	31	46
15	Colistin	-	-	100	-	-	100

Table 3 **Multidrug-resistant patterns of *A. baumanii* in 2012-2014**

No	Quinolones	Cephalosporins Gen 3/4	Aztreonam	Aminoglycosides	Beta-lactams	Cotrimoxazole	Carbapenem	2012 n (%)		2013 n (%)		2014 n (%)	
								ICU	Non-ICU	ICU	Non-ICU	ICU	Non-ICU
Carbapenem-resistant *A. baumanii* (CRAB)													
1	+	+	+	+	+	+	+	16 (40)	37 (17.4)	34 (28.1)	44 (17.1)	41 (37)	99 (24.6)
2	+	+	+	+	+	-	+	5 (12.5)	15 (7.1)	52 (43)	61 (23.7)	35 (31.5)	26 (6.5)
3	+	+	+	+	-	+	+	1 (2.5)	7 (3.)	1 (0.8)	3 (1.2)	2 (1.8)	7 (1.7)
4	-	+	+	+	+	+	+	0 (0.0)	2 (1)	1 (0.8)	2 (0.8)	0 (0.0)	2 (0.5)
5	-	+	+	+	+	+	+	0 (0.0)	1 (0.5)	2 (1.6)	0 (0.0)	1 (0.9)	0 (0.0)
Carbapenem-sensitive *A. baumanii* (CSAB)													
1	+	+	+	+	+	-	-	3 (7.5)	13 (6.1)	7 (5.8)	18 (7)	3 (2.7)	21 (5.2)
2	+	+	+	+	-	+	-	4 (10)	28 (13.2)	0 (0.0)	7 (2.7)	1 (0.9)	9 (2.2)
3	+	+	+	+	-	-	-	5 (12.5)	7 (3.3)	0 (0.0)	6 (2.3)	1 (0.9)	10 (2.5)
4	+	+	+	+	+	+	-	1 (2.5)	31 (14.6)	0 (0.0)	0 (0.0)	3 (2.7)	1 (0.02)
5	-	+	+	+	-	+	-	0 (0.0)	2 (0.9)	0 (0.0)	1 (0.0)	0 (0.0)	0 (0.0)
				Total MDR isolates				35 (87.5)	143 (67.4)	97 (80.1)	142 (55.2)	87 (78.4)	175 (43.5)
				Total isolates				40 (100)	212 (100)	121 (100)	257 (100)	111 (100)	402 (100)

+ : resistant, - : sensitivity

In addition, we observed two kinds of MDR pattern on *A. baumanii* based on its sensitivity to carbapenem, carbapenem-resistant *A. baumanii* (CRAB) and carbapenem-sensitive *A. baumanii* (CSAB). All isolates of CRAB and CSAB were resistant to 3rd/4th generation cephalosporins, aztreonam, and aminoglycosides. Meanwhile, a few of CRAB and CSAB isolates were susceptible to cotrimoxazole, beta-lactams, and quinolones. About 87.5%, 80.1% and 78.4% isolates from ICU wards were identified as MDR *A. baumanii* in 2012, 2013 and 2014 respectively (Table 3).

Published by DiscoverSys | *Bali Journal of Anesthesiology* 2019; 3(1): 50-54 | doi: 10.15562/bjoa.v3i1.147

DISCUSSION

MDR *A. baumanii* is one of the most pathogens that can cause serious hospital infection and has a high mortality rate. Most isolates were collected from non-ICU specimens. This result was similar to previous studies.[2,3] In this study, sputum was the most specimen which *A. baumanii* isolated from both ICU and non-ICU wards. *A. baumanii* isolated from sputum is a significant cause of hospital-acquired pneumonia (HAP) or ventilator-acquired pneumonia (VAP).[2,3,8]

Urine specimens from non-ICU wards in 2013 and 2014 showed an increasing number of *A. baumanii* isolates. It shows that *A. baumanii* can be one of the causes of nosocomial urinary tract infection since Sanglah Hospital is a tertiary referral hospital where some patients were on a long-term catheter. Decreasing susceptibilities of *A. baumanii* isolates to many classes of antibiotics like quinolones, cephalosporins, and carbapenems were possibly due to overuse antibiotics either as empirical or definitive therapy. Furthermore, most of the referred patients have used those kinds of antibiotic prior to hospital admission.

The low susceptibility of *A. baumanii isolates* from ICU to Amikacin during 2014 (23%) will make intensivist difficult to use that regiment since it is used as empirical therapy. Another study showed higher susceptibility of *A. baumanii* to amikacin from 65-73.5%.[2,3] Dent[9] reported that 58% of isolates from ICU were susceptible to amikacin in which has a similar percentage of susceptibility with non-ICU isolates (55-63%). Meropenem was one of the most frequently used carbapenems with similarly reduced susceptibility during 2012-2014. The lowest number of isolates that susceptibility to meropenem was occurred in 2013 and became constant on the next following years. This result was different with surveillance conducted by Cucunawangsih showed a decrease of susceptibility to meropenem in 2014 followed by an increase in 2015.[2,3] The availability and adherence to antibiotic guidelines in the hospital will affect the susceptibilities of bacteria to certain antibiotics.

The susceptibility to Co-trimoxazole in ICU and non-ICU isolates was low about 12-32% and 22-46%, respectively. Those numbers showed the tendency of increased susceptibility for three years of surveillance. The other study reported a moderate susceptibility to Co-trimoxazole, between 57.9-73.2%, from ICU isolate. This significant difference is due to different type of hospital.[3] Increasing sensitivity caused by limited used of cotrimoxazole in referral hospital is because Cotrimoxazole is only available in oral preparation in Indonesia. Colistin has shown 100% of sensitivity but this regiment is unavailable in Indonesia yet.

There are several patterns of MDR *A. baumanii* recovered from this study, which are categorized into CRAB and CSAB. The most likely pattern in CRAB group was resistance to all antibiotic classes used in this study. Meanwhile, in the CSAB group, the isolates were mostly still susceptible to beta-lactams and cotrimoxazole.

The surveillance of antimicrobial susceptibility pattern will help to determine empirical treatment in infection cases. The cutoff point of antimicrobial sensitivity can be used as a guidance empirical therapy is 80-90%. Our surveillance showed that the susceptibility of *A. baumanii* to most common antibiotics was decreasing to the point where no antibiotics were appropriate as an empirical therapy against *A. baumanii* infection due to low sensitivity to all antibiotics relative to the empirical therapy threshold.

CONCLUSION

Three years surveillance showed that the susceptibility of *A. baumanii* to most common antibiotics was decreasing. MDR *A. baumanii* was found to be resistant to all classes of common antibiotics mostly from ICU ward isolates.

ACKNOWLEDGMENT

The authors report no conflict of interests. Moreover, they wish to acknowledge the support of Sanglah Hospital and the trainees of the Department of Clinical Microbiology during the entire study

REFERENCES

1. Lin MF, Lan CY. Antimicrobial resistance in Acinetobacter baumannii: From bench to bedside. *World J Clin Cases*. 2014; 2(12): 787-814. DOI: 10.12998/wjcc.v2.i12.787.
2. Karuniawati A, Saharman YR, Lestari DC. Detection of carbapenemase encoding genes Acinetobacter baumanii isolated from patients at intensive care unit Cipto Mangunkusumo Hospital in 2011. *Acta Med Indones*. 2013; 45(2): 101–6. Available at: www.inaactamedica.org/archives/2013/23770789.pdf
3. Cucunawangsih, Wiwing V, Lugito NPH. Antimicrobial susceptibility of multidrug-resistant Acinetobacter baumanii in a teaching hospital: A two-year observation. *Open J Med Microbiol*. 2015; 5: 85–9. DOI: 10.4236/ojmm.2015.52010
4. Cucunawangsih, Wiwing V, Lumbuun N, *et al*. Increased number of metallo- or OXA carbapenemase producing Acinetobacter baumanii isolated from Tangerang, Indonesia. *Arch Clin Microbiol*. 2016; 7(3): 1–5. DOI: 10.4172/1989-8436.100045
5. Garcia LS (ed). Clinical microbiology procedures handbook, 3rd Edition [Internet]. American Society for Microbiology Press; 2010.

6. CLSI. Performance standards for antimicrobial susceptibility testing. 27th ed. CLSI supplement M100. Wayne, PA: Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing. 27th ed. CLSI supplement M100. Wayne, PA: Clinical and Laboratory Standards Institute 2017. p:282.
7. Koo SH, Kwon KC, Cho HH, *et al*. Genetic basis of multidrug-resistant Acinetobacter baumannii clinical isolates from three university hospitals in Chungcheong Province, Korea. *Korean J Lab Med*. 2010; 30(5): 498–506. DOI: 10.3343/kjlm.2010.30.5.498.
8. Tsakiridou E, Makris D, Daniil Z, *et al*. Acinetobacter baumannii infection in prior ICU bed occupants is an independent risk factor for subsequent cases of ventilator-associated pneumonia. *Biomed Res Int*. 2014; 2014(Article ID 193516). DOI: 10.1155/2014/193516
9. Dent LL, Marshall DR, Pratap S, *et al*. Multidrug-resistant Acinetobacter baumannii: A descriptive study in a city hospital. *BMC Infect Dis*. 2010; 10:196. DOI: 10.1186/1471-2334-10-196.