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Antibiotic sensitivity pattern of bacterial pathogens in the intensive care unit of Fatmawati Hospital, Indonesia

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ABSTRACT

Objective: To evaluate the sensitivity pattern of bacterial pathogens in the intensive care unit (ICU) of a tertiary care of Fatmawati Hospital Jakarta Indonesia. **Methods:** A cross sectional retrospective study of bacterial pathogen was carried out on a total of 722 patients that were admitted to the ICU of Fatmawati Hospital Jakarta Indonesia during January 2009 to March 2010. All bacteria were identified by standard microbiologic methods, and their antibiotic susceptibility testing was performed using disk diffusion method. **Results:** Specimens were collected from 385 patients who were given antimicrobial treatment, of which 249 (64.68%) were cultured positive and 136 (35.32%) were negative. The most predominant isolate was *Pseudomonas aeruginosa* (*P. aeruginosa*) (26.5%) followed by *Klebsiella pneumoniae* (*K. pneumoniae*) (15.3%) and *Staphylococcus epidermidis* (14.9%). *P. aeruginosa* isolates showed high rate of resistance to cephalexin (95.3%), cefotaxime (64.1%), and ceftriaxone (60.9%). Amikacin was the most effective (84.4%) antibiotic against *P. aeruginosa* followed by imipenem (81.2%), and meropenem (75.0%). *K. pneumoniae* showed resistance to cephalexin (86.5%), ceftriaxone (75.7%), ceftazidime (73.0%), cefpirome (73.0%) and cefotaxime (67.9%), respectively. **Conclusions:** Most bacteria isolated from ICU of Fatmawati Hospital Jakarta Indonesia were resistant to the third generation of cephalosporins, and quinolone antibiotics. Regular surveillance of antibiotic susceptibility patterns is very important for setting orders to guide the clinician in choosing empirical or directed therapy of infected patients.

1. Introduction

Antibiotic resistance is a major world-wide problem in the intensive care unit (ICU), including in Indonesia. It has been realized that the spread of drug resistant organisms in the ICU is related to the widespread use of antibiotics. The rate of antimicrobial resistance in the ICU is several folds higher than in the general hospital setting. Many surveillance efforts have drawn attention to this phenomenon[1-4].

ICU is one of potential sources of nosocomial infections even in countries where extensive infection control measures are routinely implemented. The international study of infection in ICU which was conducted in 2007, and involved with 1 265 ICUs from 75 countries, demonstrated that patients who had longer ICU stays had higher rates of infection, especially infections due to resistant *Staphylococci*, *Acinetobacter*, *Pseudomonas* species, and *Candida* species. Moreover, the ICU mortality of infected patients was more than twice that of non-infected patients[4]. Most ICU patients that acquired infections are associated with the use of invasive devices such as catheters and mechanical ventilators[5].

Globally, patients in the ICU have encountered an increasing emergence and spread of antibiotic-resistant pathogens. The worldwide incidence rate is 23.7 infections per 1 000 patient days. Rates of nosocomial infections range from 5% to 30% among ICU patients. Although ICUs generally comprise < 5% of all hospital beds, they account for 20% to 25% of all nosocomial infections. The increased risk of infection is associated with the severity of the patient's illness, length of exposure to invasive devices and procedures, increased patient contact with healthcare personnel and length of stay in the ICU[6].

In Indonesia, there have been few studies of antibiotic use, especially in ICU setting. Therefore, the objective of this study was to determine the antibiotic sensitivity pattern

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of bacteria isolated from patients in the ICU of Fatmawati Hospital, Jakarta, Indonesia.

2. Materials and methods

A cross-sectional study was carried out based on reports of bacteria isolates from the ICU of Fatmawati Hospital, from January 2009 to March 2010. The Fatmawati Hospital is a tertiary care and teaching hospital with 740 beds, which was located in Jakarta, Indonesia. During this period, 722 patients were admitted to the ICU, and 385 of them received antimicrobial treatment. All samples that were collected aseptically from the 385 patients were plated right after the collection. Identification of all causative microorganisms was performed by standard microbiologic methods. Susceptibility testing was performed using disk diffusion method. The results were interpreted according to the guidelines of the Clinical and Laboratory Standards Institute (CLSI)[7].

3. Results

During January 2009 to March 2010, 249 (64.68%) of the 385 specimens, were culture positive and 136 (35.32%) specimens showed no growth. The most common locations for infection were respiratory tract (78.7%), urinary tract (7.6%), surgical site (7.5%), blood (3.8%), and peritoneal fluid (2.4%). *Pseudomonas aeruginosa* (*P. aeruginosa*) was the most frequently isolated bacteria (26.5%), followed by *Klebsiella pneumoniae* (*K. pneumoniae*) (15.3%), *Staphylococcus epidermidis* (*S. epidermidis*) (14.9%), *Enterobacter aerogenes* (*E. aerogenes*) (13.3%), *Klebsiella ozaenae* (*K. ozaenae*) (8.4%), *Escherichia coli* (*E. coli*) (5.2%), *Serratia liquifaciens* (*S. liquifaciens*), respectively, as shown in Table 1. In this study almost bacteria isolated from ICU of Fatmawati Hospital Jakarta Indonesia were resistant to cephalexin (75%–95%) as shown in Table 2.

Table 1
The frequency of microorganisms isolated from patients admitted in ICU of Fatmawati Hospital [*n* (%)].

No	Microorganism	Frequency
1	*P. aeruginosa*	66 (26.5)
2	*K. pneumoniae*	38 (15.3)
3	*S. epidermidis*	37 (14.9)
4	*E. aerogenes*	32 (13.3)
5	*K. ozaenae*	21 (8.4)
6	*E. coli*	13 (5.2)
7	*S. liquifaciens*	10 (4.0)
8	*Staphylococcus aureus*	8 (3.2)
9	*Klebsiella* spp.	5 (2.0)
10	*Serratia marcessens*	4 (1.6)
11	*Pseudomonas fluorescens*	3 (1.2)
12	*Enterobacter cloacae*	2 (0.8)
13	*Enterobacter* spp.	2 (0.8)
14	*Streptococcus* group A	1 (0.4)
15	*Pseudomonas putida*	1 (0.4)
16	*Acinetobacter baumannii*	1 (0.4)
17	*Klebsiella terrigena*	1 (0.4)
18	*Proteous mirabilis*	1 (0.4)
19	*Raoutella ornithinolytica*	1 (0.4)
20	*Burkholderia cepacia*	1 (0.4)
	Total	249 (100.0)

Table 2
Antibiotic resistance pattern of predominant microorganisms isolated from patients admitted in ICU of Fatmawati Hospital (%).

Antibiotic	*P. aeruginosa* (*n*=66)	*K. pneumoniae* (*n*=38)	*S. epidermidis* (*n*=37)	*E. aerogenes* (*n*=32)	*K. ozaenae* (*n*=21)	*E. coli* (*n*=13)	*S. liquifaciens* (*n*=10)
Cephalexin	95.3	86.5	75.0	83.9	95.2	76.9	90.0
Ceftazidime	42.2	73.0	72.2	58.1	85.7	38.5	30.0
Ceftriaxone	60.9	75.7	64.9	61.3	85.7	46.2	70.0
Cefotaxime	64.1	67.9	67.9	67.7	100.0	46.2	50.0
Cefepime	35.9	56.8	54.1	38.7	61.9	38.5	30.0
Cefpirome	59.4	73.0	56.8	67.7	81.9	38.5	50.0
Imipenem	18.8	5.4	18.9	3.2	9.5	0.0	20.0
Meropenem	25.0	5.4	32.4	3.2	9.5	7.7	10.0
Amikasin	15.6	10.8	0.0	3.2	9.5	15.4	20.0
Gentamicin	39.1	59.5	0.0	61.3	76.2	38.5	40.0
Ciprofloxacin	56.3	64.9	63.9	51.6	85.7	46.2	60.0
Ofloxacin	53.1	62.2	58.3	48.4	76.2	46.2	70.0
Moxifloxacin	50.0	62.2	38.9	45.2	76.2	30.8	60.0
Levofloxacin	42.2	62.2	50.0	41.9	6.2	53.8	60.0
Fosfomycin	28.1	2.7	29.7	12.9	23.8	7.7	0.0

4. Discussion

This result revealed that *P. aeruginosa*, *Klebsiella* spp., and *E. coli* were still predominant isolates as previously investigated in ICU of Fatmawati Hospital Jakarta, Indonesia[8]. Another study showed the most frequent bacteria isolated in Dr. Kariadi Hospital, Semarang Indonesia were *P. aeruginosa* (50.9%), *E. aerogenes* (37.5%) and *E. coli* (8.7%). *P. aeruginosa* demonstrated multidrug resistance to several antibiotics[9].

A very high rate of resistance (>72%) was observed among

S. epidermidis and *Klebsiella* spp isolates to ceftazidime, whereas *E. coli, S. epidermidis, E. aerogenes, P. aeruginosa, Klebsiella* spp. and *Serratia* spp., resistant to ceftriaxone. *P. aeruginosa* isolates showed high rate of resistance to cephalexin (95.3%), cefotaxime (64.1%), and ceftriaxone (60.9%). Amikacin was the most effective (84.4%) antibiotic against *P. aeruginosa* followed by imipenem (81.2%), and meropenem (75.0%).

We found that *K. pneumoniae* was also multidrug resistant bacteria to the third generation cephalosporins, and quinolone antibiotics. *K. pneumoniae* showed high rate of resistance to cephalexin (86.5%), ceftriaxone (75.7%), ceftazidime (73.0%), cefpirome (73.0%) and cefotaxime (67.9%). Similar observations to our study demonstrated that 96%-100% *K. pneumoniae* and *P. aeruginosa* isolated from ICU patients were resistant to ceftazidime[10,11]. *K. pneumoniae* isolates were also resistant to ciprofloxacin (64.9%), ofloxacin (62.2%), moxifloxacin (62.2%), and levofloxacin (62.2%). This finding is related most probably due to the extensive usage of third generation cephalosporins and quinolone antibiotics at the ICU of Fatmawati Hospital. Another interesting result of this study is fosfomycin showed good sensitivity against all bacteria isolated from ICU admitted patients, most probably because this antibiotic is not commonly used in our setting. The sensitivity of fosfomycin was better than imipenem and meropenem.

Antibiotic use contributes to the emergence of antimicrobial resistance in gram positive as well as gram negative bacteria[2,12,13]. In developing countries, antibiotics are prescribed for 44%-97% of patients in hospital, often inappropriately[14,15]. In Indonesia, a high proportion (84%) of patients in hospital received an antibiotic but 32% of prescription is an inappropriate indication[3].

In Asian countries including Indonesia, the most frequent pathogen isolated from infections in the ICU are *P. aeruginosa, Klebsiella* spp., *E. coli, Enterococcus*, and *Staphylococcus aureus*. For example, in 12 ICUs in seven Indian cities, overall 87.5% of all *Staphylococcus aureus* health care associated infections were caused by methicillin-resistant strains, 71.4% of *Enterobacteriaceae* were resistant to ceftriaxone and 26.1% to piperacillin-tazobactam; 28.6% of the *P. aeruginosa* strains were resistant to ciprofloxacin, 64.9% to ceftazidime and 42.0% to imipenem[16]. In Thailand the predominance causative pathogens in ICU, were the imipenem resistant *P. aeruginosa*, ceftazidime-resistant *Acinetobacter baumannii*, third-generation-cephalosporin-resistant *K. pneumoniae*, and quinolone-resistant *E. coli*[17]. Another study performed at ICU of a tertiary care center in Saudi Arabia showed that the most frequent pathogens are *Acinetobacter baumannii, P. aeruginosa, E. coli, K. pnemoniae*[18]. Recently, similar studies were conducted in hospitals and several ICUs in Asian countries including Philippine[19], India[11,20-23], Iran[24,25], China[26], Malaysia[27], Singapore[28], and Nepal[29], demonstrated that the most frequent microorganism derived from ICU samples were *P. aeruginosa, Klebsiella* spp. and *Staphylococcus aureus*.

In Canada, the Canadian National Intensive Care Unit study conducted during 2005-2006, showed that *P. aeruginosa, Staphylococcus aureus, Haemophilus influenzae, Enterococcus* spp., *Staphylococcus pneumoniae*, and *K. pneumoniae* are the most common isolates recovered from clinical specimens in Canadian ICUs. Moreover, *P. aeruginosa* is the most frequent multi drug-resistant phenotype, which is resistance to three or more of the antibiotics including cefepime, piperacillin-tazobactam, meropenem, amikacin or gentamicin, and ciprofloxacin[30].

In Indonesia, beside *P. aeruginosa*, another multi drug resistant *E. coli* was also found as pathogen of nosocomial infection[31], furthermore these *E. coli* isolates were high rates of resistance to ampicillin, ciprofloxacin, chloramphenicol, and trimethoprim-sulphamethoxazole[32].

The prescribing of antibiotics in the ICU is usually empiric. Therefore, the ongoing surveillance of antibiotic susceptibility patterns of predominant bacteria is a fundamental effort to monitor changes in susceptibility patterns and to guide the clinician in choosing empirical or directed therapy appropriately, especially in ICU setting. Appropriate antibiotic utilization in ICU is crucial not only in ensuring an optimal outcome, but also in preventing the emergence of multi drug resistance bacteria.

Conflict of interest statement

We declare that we have no conflict of interest.

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