

Microbiology and Antibiotic Sensitivity Pattern of Diabetic Foot Ulcers Patients

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Abstract

One of complications in diabetes mellitus which occurs in the foot, due to a combination of peripheral vasculopathy, neuropathy and abnormal foot pressure, followed by immunopathy and infections is diabetic foot ulcer [1,2]. Those are a major medical, social, and economic problem and are the leading cause of hospitalization for patients with diabetes. Severe infections can lead to amputations and increasing the burden both to the patient and the hospital². This study aims to know the microbiology pattern and the antibiotic sensitivity pattern for diabetic diabetic foot ulcer in Sardjito General Hospital. The data were obtained from Clinical Pathology Laboratory Sardjito Hospital. Subject in this study were diabetic foot ulcer patients whom hospitalized and undergo surgical procedure between January 2013, until January 2015. Foot ulcers samples acquired from wound bed during surgery were analyzed microbiologically to provide information about the bacterial pattern and their antibiotic sensitivity. From 64 patient samples analyzed, 27 different kind of bacteria were obtained. *Acinetobacter baumannii* was the most frequent bacteria isolated from patient in this study (25%), followed by *Enterococcus faecalis* (8%) and *pseudomonas aeruginosa* (8%). The antibiotic sensitivity test was performed using 31 antibiotics, and the result was tabulated. Infection with multi drug resistant bacteria is common in diabetic foot ulcers and is associated with increased requirement for surgical treatment. This study proved that multidrug resistant bacteria also a complicating factor in Sardjito Hospital. There is a need for continuous surveillance of bacteria involved in diabetic foot infections to help determine the choice of suitable antibiotic selection.

Keywords: Diabetic foot ulcer; Bacterial pattern; Antibiotic sensitivity; *Acinetoobacter baumannii*.

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1. Introduction

Diabetes define as a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion and insulin action, or either one [3]. This condition is a chronic progressive condition that will lead to a long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels. The diabetic foot ulcers progression will be faster if this condition left untreated (uncontrolled glucose level) [4]. The diagnosis criteria for diabetes mellitus including (1) HbA1C \geq 6.5%, (2) Fasting plasma glucose \geq 126 mg/dl, (3) 2-h plasma glucose \geq 200 mg/dl during an OGTT, (4) In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose \geq 200 mg/dl [3].

Foot ulcer is one of diabetes complication [1,2,3,4]. This condition happens due to combination of peripheral neuropathy, peripheral vascular disease and impaired resistance, followed by infection [1,2]. Immunopathy also affect the patient's resistance to infection [1]. Recent studies showing that lifetime risk of developing a foot ulcer in diabetic patient may be as high as 15% [5]. Foot ulcer is a very devastating and major cause of disability in patient with diabetes mellitus. This untreated condition will lead to gangrene, and subsequent lower limb amputation. Approximately 38% of diabetes patient in United States undergo amputation due to diabetic foot infection [6].

In treating diabetic foot ulcer, antimicrobial therapy is crucial. Choosing the right antibiotic for the specific bacteria is the key, but usually the therapy initiate with empirical measure before the bacterial culture and antibiotic sensitivity is available. Therefore, to find the appropriate empirical antibiotic therapy, it has to be studied for each region considering there might be difference in bacterial pattern in each region [7]. This study will identify the most common bacteria that causes infection in diabetic foot ulcer patient in Sardjito General Hospital and the antibiotic appropriate to eradicate the bacteria.

2. Materials and Methods

This is an observational study with cross sectional design. The data were obtained from Clinical Pathology Laboratory Sardjito Hospital. Subject in this study were diabetic foot ulcer patients whom hospitalized and undergo surgical procedure between January 2013 until January 2015. Foot ulcers samples taken from the wound bed during surgery were analyzed microbiologically to provide information about the bacterial pattern and their antibiotic sensitivity.

3. Results and Discussion

There are 64 patients undergo surgery procedure for diabetic ulcers between January 2013 until January 2015. Polymicrobial infection found in 21 patients (32,8%), 38 patients (59,36%) has monomicrobial infection, and 5 patient (7,8%) has negative result (no growth) in microbial study. Sekhar and his colleagues in his study found from 108 specimens of the diabetic foot lesions, culture showed polymicrobial growth in 44.4% (48/108), monomicrobial growth in 44.4% (48/108), and no growth in 11.1% (12/108) [10]. While Lipsky and his colleagues in his study found higher incidence of polymicrobial infection compared to monomicrobial infection [11]. Result from this study is get along with study conducted by Singh and his colleagues in 2012, in which

monomicrobial infections cases (43.5%) were more than polymicrobial infections (35.5%) [12].

Table 1: Bacterial pattern in infection of diabetic foot ulcer in Sardjito General Hospital

No	Bacteria	Patient infected
1	<i>Acinetobacter baumannii</i>	23
2	<i>Burkholderia cepacia</i>	2
3	<i>Candida albicans</i>	1
4	<i>Citrobacter freundii</i>	2
5	<i>Coagulase negative staphylococcus</i>	2
6	<i>Entamoeba coli</i>	2
7	<i>Enterobacter aerogenes</i>	1
8	<i>Enterobacter cloacae</i>	3
9	<i>Enterococcus faecalis</i>	7
10	<i>Eschericia coli</i>	4
11	<i>Klebsiella oxytosa</i>	1
12	<i>Klebsiella pneumonia</i>	8
13	<i>Kocuria kristinae</i>	2
14	<i>Morganella morganii</i>	1
15	<i>Proteus mirabillis</i>	4
16	<i>Proteus vulgaris</i>	2
17	<i>Providentia stuartii</i>	2
18	<i>Pseudomonas aeruginosa</i>	9
19	<i>Pseudomonas maltophilia</i>	1
20	<i>Pseudomonas putida</i>	1
21	<i>Staphylococcus aureus</i>	3
22	<i>Staphylococcus epidermidis</i>	2
23	<i>Staphylococcus haemolyticus</i>	1
24	<i>Staphylococcus hom hominis</i>	1
25	<i>Staphylococcus saprohiticus</i>	1
26	<i>Streptococcus faecalis</i>	2
27	<i>Streptococcus viridans</i>	3
28	Negatif result	5

In this study, 27 different kind of bacteria were obtained from the samples (Table 1). *Acinetobacter baumannii* was the most frequent bacteria isolated from patient in this study (25,3%), followed by *Pseudomonas aeruginosa* (9,9%), *Klebsiella pneumonie* (8,8%) and *Enterococcus faecalis* (7,7%). The antibiotic sensitivity test was performed using 31 antibiotics, and the result was tabulated for the 4 most common causing bacteria

(Table 2).

Table 2: Antibiotic sensitivity for the 4 most common bacteria in diabetic foot ulcer in Sardjito General Hospital

No	Bacteria	Most Sensitive Antibiotic					
1	Acinetobacter baumannii	Tigecycline (100%)	Tetracycline (82%)	Amikacin (73%)	Meropenem (71%)	Cefotaxime (67%)	Cefuroxime (67%)
2	Pseudomonas Aeruginosa	Gentamicin (100%)	Levofloxacin (100%)	Amikacin (100%)	Meropenem (100%)	Cefotaxime (100%)	Ciprofloxacin (86%)
3	Klebsiella pneumoniae	Cefmetazole (100%)	Tetracycline (100%)	Amikacin (100%)	Meropenem (100%)	Tigecycline (75%)	Cefepime (75%)
4	Enterococcus faecalis	Co-Amoxiclav (100%)	Tigecycline (100%)	Linezolid (100%)	Ampicillin-Sulbactam (100%)	Piperacilin (100%)	Vancomycin (100%)

A study in 530 patients with diabetic foot infection conducted by Mathangi T, it was shown that *Staphylococcus aureus* (21,6%) is the most common bacteria isolated, followed by *Pseudomonas aeruginosa* (15,1%) and *Escherichia coli* (14%) [2]. Jabbar and his colleagues in his study in Southern India shows that *Staphylococcus aureus* (21.8%), *Enterococcus faecalis* (4.6%), *Pseudomonas aeruginosa* (18.2%), *Escherichia coli* (13.6%), *Proteus spp* (9.1%), and *Acinetobacter baumannii* (7.3%), *Klebsiella pneumoniae* (6.4%) found from 110 samples of 75 patients [13]. Cardoso and his colleagues found *Pseudomonas*, *Proteus*, and *Morganella* as the most common bacteria found in diabetic foot ulcer, with acinetobacter and klebsiella are the predictive factor for amputation in diabetic foot ulcer [14].

Acinetobacter baumannii is a Gram-negative bacillus that is aerobic, pleomorphic, non-motile, and also an opportunistic human pathogen. In human body, *A. Baumannii* infection can implicate wide range of anatomical region, causing pneumonia, bloodstream infection, wound infection, and meningitis. Recent years, there is a dramatic increase in the incidence of multidrug-resistant (MDR) strains of this bacteria [12].

Infection is a common and serious complication of diabetic foot wounds. Infection will cause further ischemia, necrosis, progressive gangrene, and then will increase the need of amputation in diabetic foot ulcer patient. Foot ulcer in diabetic patient initiate from a local trauma and/or pressure (often in association with lack of sensation because of neuropathy). With the combination of microvascular disease, this condition may result in various diabetic foot infections that run the spectrum from simple, superficial cellulitis to acute and chronic osteomyelitis and deep-skin and soft-tissue infections [1].

Multi-drug resistant pathogens in diabetic foot ulcer increasing risk of peripheral artery disease which could lead to amputation [8]. The increasing of multi-drug resistant (MDR) pathogens in diabetic foot ulcers is a challenge faced by the physician or the surgeon in treating diabetic ulcers without resorting to amputation. To prevent this MDR pathogens from getting increased, usage of antibiotics have to be appropriate.

The most potent antibiotic in this study to inhibit *Acinetobacter baumannii* culture is Tigecycline with 100% sensitivity. While Gentamycin, Levofloxacin, Amikacin, Meropenem, and Cefotaxime proved success to inhibit the *Pseudomonas aeruginosa* isolate.

Acinetobacter baumannii is a multi drug resistant bacteria with only few antibiotics active against it. Beta-lactam antibiotic is the first line choice in treatment of *Acinetobacter baumannii* infections. But in recent years due to resistance of the bacteria, carbapenem become the second line choice [16]. In this study, cefotaxime and cefuroxime (beta-lactam group antibiotics) each has 67% effectiveness against *Acinetobacter baumannii*, while meropenem (carbapenem group) has 71 % effectiveness. Effectiveness of tigecycline against *Acinetobacter baumannii* also described in Pachon-Ibanez study in 2004, which 92% of the *A. baumannii* strains were tigecycline susceptible [17]. Meta analysis by Wentao Ni and his colleagues Against the use of tigecycline because it is associated with higher in-hospital mortality, lower microbial eradication rate and longer hospital stay [18].

Also showed in the result of this study, amikacin, cefmetazole, meropenem, and tetracycline are potent antibiotic to inhibit *Klebsiella pneumonia* cultures. amoxicillin/clavulanic acid, linezolid, piperacillin, ampicillin/sulbactam, tigecycline, piperacillin/tazobactam, and vancomycin, can 100% inhibit *Enterococcus faecalis* cultures

4. Conclusion and Recommendations

Acinetobacter baumannii is the most common type of microorganisms isolated from this study, followed by *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, and *Enterococcus faecalis*. The most potent antibiotic in this study to eradicate *Acinetobacter baumannii* culture is Tigecycline with 100% sensitivity. Aside of that, Gentamycin, Levofloxacin, Amikacin, Meropenem, and Cefotaxime proved success to eradicate the *Pseudomonas aeruginosa* and *Enterococcus faecalis* isolate which is the second most common type of microorganisms isolated from this study. There is a need for continuous surveillance of bacteria involved in diabetic foot infections to help determine the choice of suitable antibiotic selection. Study for pathogen and antimicrobial sensitivity for diabetic foot ulcer should performed in each medical facilities, because of different pathogens and sensitivity of antibiotic in each locations. More study also need to determine the most potent antibiotic against each pathogen. The bacterial study and antimicrobial sensitivity study in diabetic foot ulcer is very important for more rational use of antibiotics.

5. Limitation

This study is only performed in diabetic foot ulcer patient which undergo surgery procedure. Although it was to get better samples for bacterial study, but we can not involve samples from diabetic foot ulcer patients which

treat conservatively.

Conflict of Interest

The authors declare no conflict of interests

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