

Microorganism Prevalence and Antibiotic Sensitivity for Imipenem and Meropenem in Patients with Diabetic Foot Ulcers in Thi Qar, Iraq

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Abstract

OBJECTIVE: The aim of the study is to identify the types of gram-negative bacteria that cause diabetic foot infections in Iraqi patients.

METHODS A cross-sectional study has been conducted on surgical operations on the bottom of the foot at Al-Imam Al-Hussein hospital in Thi-qar province, which is one of the southern provinces in Iraq, for the period from March 1st to December 31st, 2020.

RESULT: Among gram-negative bacteria, *Enterobacter* spp. and *E. coli* were, respectively, the most frequently isolated organisms. The antibiotic meropenem was found to be effective against microorganisms. Imepenem, however, was highly resistant to antibiotics.

CONCLUSION: Understanding the bacteriology of diabetic foot infection, as well as its isolation and identification, aids in the selection of antibiotics and the planning of proper diabetic foot infection management.

Keywords: diabetic foot, infection, Gram negative bacteria.

1. INTRODUCTION

A diabetic foot is a major consequence of diabetes that can have a significant impact on a patient's quality of life (Kiadaliri et al., 2013).

According to a World Health Organization (WHO) report, diabetes mellitus (DM) is on the rise, particularly in developing countries. As a result, recognizing the bacteria implicated in such infections is critical for choosing the best antibiotic treatment (Haddadi et al., 2014).

Diabetic foot ulcers (DFU) are associated with a high rate of morbidity and mortality in diabetic patients (Chiwanga and Njelekela 2015).

Diabetes complications such as diabetic retinopathy, diabetic nephropathy, and diabetic neuropathy are clearly more common in patients with uncontrolled diabetes. Furthermore, amputations are frequently required if DFUs are not treated promptly.

Gram-negative bacteria that are multidrug resistant are a major public health concern. Despite concerted efforts to contain their spread, the global number of multidrug-resistant gram-negative bacteria continues to rise. Most beta-lactamases hydrolyze carbapenems, the most broad-spectrum beta-lactam antibiotics active against gram-negative bacteria, rather slowly. Because of their broad-spectrum nature, they can be used in a variety of situations (Ting et al., 2018).

Carbapenem is a β -lactam antibiotic that causes lytic cell death by inhibiting transpeptidases (penicillin-binding proteins) and preventing the production of peptidoglycans (Kohanski et al., 2010).

Gram-negative infections are treated with beta-lactam medicines. Of all the beta-lactam antibiotics, carbapenems have the broadest spectrum of inhibitory activity against Gram-positive and Gram-negative bacteria (Podschun and Ullmann 1998).

Carbapenems such imipenem, meropenem, ertapenem, doripenem, panipenem, biopenem, reopenem, and faropenem are currently used in clinical practice (Nicolau, 2008).

Carbapenem resistance can develop in Enterobacteriaceae through a variety of mechanisms, including (i) selective loss of external membrane permeability (such as the loss of the OprD porin in *P. aeruginosa*) and (ii) selective loss of internal membrane permeability (such as the loss of the OprB porin in *P. aeruginosa*) (Tamma and Simner 2018). (ii) Impermeability in combination with a wide range of broad-spectrum β -lactamases (extended-spectrum-lactamase and/or cephalosporinase) (Armand et al., 2003).

Carbapenem-hydrolyzing enzymes are carbapenemases. Because carbapenemase genes (e.g., blaKPC, blaVIM, blaOXA-23, blaOXA-48, blaIMP, and blaNDM) are carried by transmissible genetic elements with high dissemination potential, this final technique is of particular concern (Cuzon et al., 2010).

Carbapenem-resistant Enterobacteriaceae are also typically resistant to aminoglycosides, fluoroquinolones, and co-trimoxazole (Souli et al., 2008).

2. Material and methods

2.1 Study Design and Setting

A cross-sectional study was carried out in Surgical operations on the bottom of the foot at Al-Imam Al-Hussein hospital in Thi-qar province, one of Iraq's southern provinces, from the 1st of March to the end of December 2020.

2.2 Sampling

One hundred swabs were taken from diabetic feet, sugar feet, or diabetic feet (in English : Diabetic Foot).

2.3 Cultural Media

Swabs were incubated on cultural media such as Blood agar, MacConkey agar, and Nutrient agar for (24-48) hours at 37°C, following the manufacturer's recommendations.

2.4 Isolation and Identification

bacterial growth purification In accordance with the connected references, colonies create pure isolates of bacteria, which are subsequently investigated culturally, morphologically, microscopically, and biochemically (Retty et al., 2007; Hasan et al., 2017) The following kits were used for isolate identification:

Gram-negative bacilli identification using the API 20E kit (BioMeriux).

2.5 Antimicrobial Sensitivity Tests

Susceptibility to the examined isolates was evaluated using Muller-Hinton agar with the following antibiotic discs: imipenem and meropenem, as described by Nester et al. (2004), and the findings were reported using CLSI (2007).

3. Results and Discussion

Bacterial growth was found in 48 cultures (48%) out of 100 swabs and samples obtained after surgical operations on the bottom of the foot (Table 1).

Table 1: The Genus and numbers of bacteria isolated from patients

Genus of bacteria	Numbers
<i>Enterobacter</i> spp.	18
<i>E. coli</i>	15
<i>Pseudomonas</i> spp.	12
<i>Acinetobacter</i> spp.	3

Enterobacter spp. is the most common disruptive genus, with 18 isolates (37.5%), *E. coli* with 15 isolates (31.25%), *Pseudomonas* spp. with 12 isolates (25%), and *Acinetobacter* spp. with 3 isolates (3.5%). (6.25 percent).

Table 2: Distribution of bacteria according to the age groups.

Genus of bacteria	Age (years)			Total
	40-50	51-60	61-70	
<i>Enterobacter spp.</i>	6	3	9	18
<i>E. coli</i>	6	6	3	15
<i>Pseudomonas spp.</i>	0	3	9	12
<i>Acinetobacter spp.</i>	3	0	0	3
Total	15	12	21	48

We included the diabetic foot culture findings from a total of 100 samples in this investigation, with 15 isolates (31.25 %) from patients aged 40-50 years, 12 isolates (25 %) from patients aged 51-60 years, and 21 isolates from patients aged 61-70 years (43.75 %).

Table 3: Antibiotics resistance for gram negative bacteria against Carbapenems group

No.	Name of Bacteria	MEM (10 µg)			IPE (10 µg)		
		S	I	R	S	I	R
1	<i>Enterobacter spp.</i>	15	3		13	5	
2	<i>Acinetobacter spp.</i>	3			3		
3	<i>E. coli</i>	15			6	5	4
4	<i>Pseudomonas spp.</i>	10	1	1		6	6
Total		43 (89.5%)	4 (8.3%)	1 (2.08%)	22 (45.5%)	11 (22.9%)	15 (31.25%)

Results of the antimicrobial susceptibility test showed a high level of resistance toward against Imipenem (45.5%). On the other hand, low resistance (2.08%) against Meropenem (Table 3).

DISCUSSION:

The most significant complication of diabetes is foot ulceration, which affects diabetic patients whose ulcers are not limited to a specific location of the underlying subcutaneous tissue. If diabetes is not well controlled or self-care is inadequate, diabetic foot ulcers can develop (Vickers 2017).

To establish the best treatment for DFUs and avoid amputation, the germs that cause them must be identified (Lipsky et al., 2016).

The results of DFU cultures revealed that 48% of the samples were gram negative.

The findings of this study are similar to those of (Qadir et al., 2020) and colleagues in Iraq, who discovered that gram-negative bacteria, especially *E.coli* and *Acinetobacter spp.*, were the most common. These findings are congruent with the findings of Al-Iraqi Hemedawi's investigations (shaya et al., 2006).

This finding is in line with that of Xie et al., who discovered a greater incidence of gram-negative bacteria isolated from DFUs in a Chinese (study 54.1 %).

The most common gram-negative bacteria responsible for DFUs, according to the current investigation, were *Enterobacter spp.* and *E. coli*.

Differences in microbe cultures between studies could be explained by the diversity of risk factors for developing foot ulcers among diabetics.

We isolated bacteria from 48 patients out of 100, while no bacteria were isolated from 52 patients. This could be due to the administration of antibiotics before to collecting the swab or the use of local antiseptic during wound dressing. antibiotics and

local antiseptics could reduce the amount of bacterial identified (Mims et al., 1995).

The diabetic foot culture findings from a total of 100 samples were included in this investigation, with 15 isolates (31.25 %) from patients aged 40-50 years, 12 isolates (25 %) from patients aged 51-60 years, and 21 isolates from patients aged 61-70 years (43.75 %).

This finding matched the findings of a retrospective group study conducted among the Saudi population, as published by (Al-Rubeaan et al., 2015). They discovered that diabetic foot ulcers are more common in people who are 45 years old or older. This is supported by the majority of investigations (Wu et al., 2018; Gadepalli et al., 2007).

Despite the fact that prior research revealed that DF patients were mostly male, (Magiorakos et al., 2012; Ahmed et al., 2020).

It's possible that the fact that over 93 % of patients were over 40 years old is due to the fact that various factors, such as professional activities and lifestyle, that would cause the feet to tolerate more pressure have changed over time, and the consequences are more commonly seen in middle-aged and older people (Anvarinejad et al., 2015).

In the current investigation, microorganisms were shown to be more sensitive to meropenem (about 43 %), but resistant to imipenem (approximately 15 %) (31.25 %). These findings echo those of a recent Iraqi study, which discovered that microbes isolated from DFUs were extremely susceptible to meropenem and vancomycin (Qadir et al., 2020).

The higher rate of multidrug resistant bacteria observed in the DFUs could be explained by patients taking antibiotics prior to surgical debridement) Sivanmaliappan and Sevanan 2011).

Antibiotic resistance can also be explained by many antibiotic courses, which is common among DFU patients due to their frequent hospitalization (Lipsky et al., 2007).

indicate that microbial infection patterns in diabetic foot infections are inconsistent; thus, repeated evaluation of microbial characteristics and antibiotic sensitivity is required for the selection of appropriate antibiotics (Singh et al., 2009).

The antibiotic meropenem caused the highest rate of sensitivity in the current study.

4. Conclusions

Gram-negative bacteria, such as *Enterobacter* spp. and *E. coli*, are the most common cause of DFUs. Meropenem was also an effective antibiotic against the microorganisms that cause DFUs.

In this prospective study we found that male diabetic patient is more prone to have diabetic foot infection patients with age of 61-70 years More research should be conducted on aerobic and anaerobic bacteria, as well as research into the value of various methods of bacteria isolation, such as swab from the wound, aspirate from the lesion, or tissue biopsy, in detecting pathological bacteria in diabetic foot lesions, which will aid in the selection of antibiotics and proper therapy.

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