RESEARCH ARTICLE

MICROBIOLOGICAL PROFILE AND *ESCHERICHIA COLI* RESISTANCE PATTERNS IN DIABETIC FOOT INFECTIONS AND URINARY TRACT INFECTIONS OF LEBANESE PATIENTS

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ABSTRACT

The aim of this study was to characterize the bacterial profile of Diabetic foot Infections (DFI) and Urinary Tract infections (UTIs) and to assess the antibiotic sensitivity of the causative pathogens. Specimens were obtained from 254 Lebanese patients (109 with DFI and 145 with UTI).Bacterial identification and antibiotic susceptibility of *E. coli* isolates from those patients were assessed using the Vitek machine. *Staphylococcus coagulase. Negative* (33.03%) and *E.coli* (27.52%) were the most common isolates identified in DFIs. On the other hand, *E. coli* (73.10%) and *Klebsiella* (11.03%) were the two most frequent pathogens detected in UTIs. *E. coli* isolates from DFIs and UTIs showed comparable antibiotic sensitivity profiles with being significantly sensitive to ertapenem, meropenem, imipenem or amikacin, only moderately susceptible to fluoroquinolones (ciprofloxacin and levofloxacin) and weakly sensitive to ceftazidime, cefepime and bactrim. The etiology of DFIs and UTIs as well as their susceptibility patterns are essential for the Public health in Lebanon where antibiotics misuse is serious.

INTRODUCTION

Diabetic foot infection (DFI) and Urinary tract infection (UTI), primarily caused by microbial agents, are two major worldwide health problems. DFI represents one of the most serious complications of diabetic patients. Foot Ulceration as well as distinct immunological disorders are considered as the predisposing factors associated with DFI (Lipsky *et al*., 2016). DFIs can be classified as mild, moderate, or severe where the most mild infections are usually non-microbial and are associated with aerobic Gram-positive Cocci including *Staphylococcus aureus* and *Streptococcus sp* (Frykberg, 2003). On the other hand, severe infections are usually polymicrobial containing

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aerobic Gram-positive Cocci, gram-negative bacilli (including *Pseudomonas spp*, *Escherichia coli*, *Klebsiella spp*, and *Proteus spp*) as well as anaerobic bacteria (Frykberg, 2003). Antibiotic therapy is mainly applied to manage DFIs where patients can be exposed to different antibiotic regimens depending on the severity of the infection and the medical status of the patient (Frykberg, 2003; Frykberg, 2002; Frykberg, 2000). UTIs can occur in all ages and are more frequent in women than men, mainly due to the anatomic variance. UTIs can be classified according to their level of severity as well as presence/absence of risk factors.Depending on the severity level, UTIs can be classified as cystitis, pyelonephritis, and urosepsis (Bartoletti *et al*., 2016). Moreover, UTIs can be referred to as uncomplicated and complicated UTIs where the latter are defined as conditions with abnormal anatomy and/or function of the urinary tract, accompanied withdisorders that are able to impair with host's physiologic defense mechanisms, and/or unsuccessful previous medical therapy (Bartoletti *et al*., 2016).

In uncomplicated UTIs, *E. coli* (70–95% of cases) and *Staphylococcus saprophyticus* (5–10%) are the major causative bacteria. However, *Proteus mirabilis* and *Klebsiella* spp are also detected occasionally. In complicated UTIs, the microbiological spectrum is more broad with *E coli* being the most frequent pathogen in addition to other gram-negative bacteria, including*Citrobacter* spp, *Enterobacter* spp, *Pseudomonas aeruginosa*, and distinct gram-positive bacteria such as *Enterococcus* spp and *Staphylococcus* spp(5,6). Different antibiotic regimens are also recommended for the treatment of UTIs (Bartoletti *et al.*, 2016). However, bacterial resistance to antibiotics remains a major challenge for obtaining a total eradication of the infection. Nowadays, the ability of *E. coli* to cause UTIs is increasing, while the abilityto clear these infections due to multidrug antibiotic resistance (MDR) to first line antibiotics including cotrimoxazole, ampicillin and nitrofuranton is uncertain (Bartoletti *et al.*, 2016). The increase in resistance to fluoroquinolones such as ciprofloxacin and levofloxacin represent another major concern (Hooton, 2003). In this study we screened the types of bacteria present in samples derived from Lebanese patients with either DFI or UTI. We further assessed the sensitivity of *E. coli* isolates, derived from these samples, to antibiotics.

MATERIALS AND METHODS

A retrospective, open-label, controlled study was performed at Raee hospital between January 2017 and April 2018analyzing 254 patients (adults >18 years old) presented with either Diabetic foot infection (DFI) or Urinary tract infection (UTI). Main exclusion criteria were pregnancy and lactation.Materials used for microbiological evaluation for pathogen in DFIcorresponded to curettage of the base of the ulcer after debridement, needle aspiration of the abscess material, or aspiration of material through the infected skin and deep tissues. UTI microbiological evaluation was done by obtaining a clean-catch midstream specimen or a suprapubic aspirate being collected in a sterile wide-mouth leak-proof container to hold about 50 ml specimen. The type of bacteria and the in vitro antimicrobial susceptibility of the *E.coli*isolated was determined by the Vitek machine method (Pincus, 2007).

RESULTS

A total of 254 samples (145 issued from the urine of UTI patients and 109 derived from the Pus of DFI patients) were screened for the contained pathogens and antibiotic sensitivity.
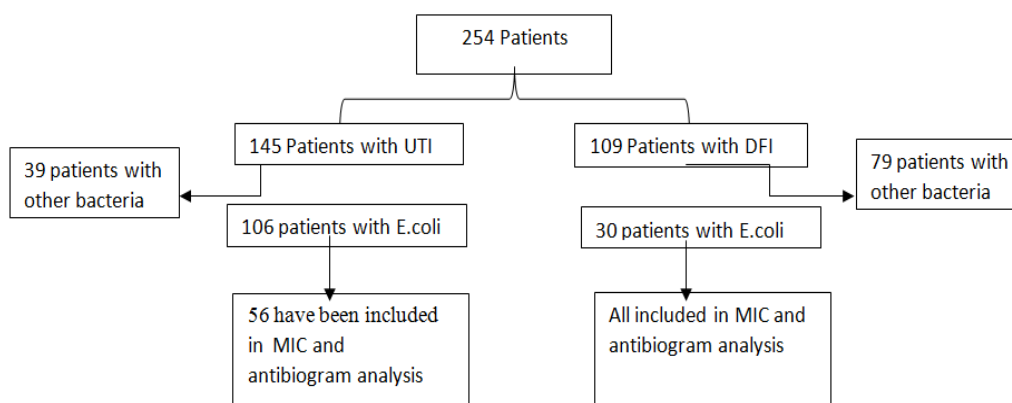

Figure 1. Flow chart of the laboratory process during this study

Table 1. Percentage of bacteria identified in the Pus of UTI patients

Bacteria	No	(%)
Escherichia coli	106	73.10%
Klebsiella	16	11.03%
Proteus Mirabilis	8	5.52%
Staphylococcus coag. Negative	7	4.83%
Pseudomonas spp	4	2.76%
Streptococcus	3	2.10%
Pseudomonas A.	1	0.70%
Total	145	100%

Table 2: Percentage of bacteria identified in the urine of DFI patients

Bacteria	No	(%)
Staphylococcus coag. Negative	36	33.03%
Escherichia coli	30	27.52%
Proteus Mirabilis	15	13.76%
Pseudomonas spp	11	10.10%
AcinetobacterBaumannii	6	5.50%
Klebsiella	8	7.34%
Pseudomonas Aerogenosa	2	1.83%
SerratiaFiceria	1	0.92%
Total	109	100%

The various pathogens detected in the cultures are shown in Tables 1 and 2. E. coli (73.10%) and Klebsiella (11.03%) were the two most frequent uropathogens (Table 1). However, Staphylococcus coag. Negative (33.03%), followed by E.coli (27.52%) were the two most common organisms identified in the Pus derived from DFI patients (Table 2). In a second step, *E. coli* isolates, derived from 56 samples issued from the urine of UTI patients as well as from all the PUS samples issued from the DFI patients, were screened for antibiotic sensitivity using Antibiogram and MIC assays. The Antibiogram results revealed that the antibiotic efficacy in both UTI and DFI samples was not significantly different (Table 3). Carbapenems (Ertapenem, Meropenem and Imipenem) followed by amikacin were the most effective antibiotics for *E. coli* eradication in both infections, while ceftazidime, cefepime and bactrim were the least effective antibiotics to eradicate *E. coli*. On the other hand, the incidence of resistance to fluoroquinolones (especially ciprofloxacin and levofloxacin) was around 50% of the cases. The MIC results (Table 4) were in accordance with the Antibiogram data.

DISCUSSION

As the prevalence of diabetes and resistance to antibiotics are rapidly increasing worldwide, diabetic foot infection (DFI), which is caused by resistant strains, is considered as a great medical concern.In the last decades, the extended-spectrum β-lactamases (ESBLs), enzymes capable of hydrolyzing an extended-spectrum of cephalosporins and monobactams thus underlying therapeutic failures, was highlighted as key mechanisms of resistance in gram-negative bacilli such *E. coli*(9).*E. coli*, commonly found in the intestine flora, is well described, worldwide, to be the most frequent pathogen in UTI infections (Bartoletti *et al.*, 2016; Kucheria *et al.*, 2006; De Francesco *et al.*, 2007; Drekonja *et al.*, 2008). Previously, it was shown that *E. coli*, *Klebsiella* and *Proteus* are the most frequent uropathogens among Lebanese patients presenting UTIs (Daoud *et al.*, 2005; Daoud *et al.*, 2009).

This observation in agreement with our present study showing that *E. coli* followedby *Klebsiella* and *Proteus* are the most common isolates from UTIs. Of great concern, an increased resistance of the *E. coli* isolates, derived from Lebanese patients showing UTIs, to antibiotics was detected since year 2000 till year 2012 (Daoud *et al.*, 2005; Daoud *et al.*, 2009). In contrast to UTIs that have been well studied among Lebanese population, only little information if any, is available about the bacterial types and sensitivity in DFIs among Lebanese patients. In this study, we describe for the first time different pathogens identified in DFIs. Remarkably, we noticed that *E. coli*represents the second most frequent isolates after staphylococcus coagulase negative. Given the significant prevalence of *E. coli* isolates in DFIs we assessed their sensitivity to different antibiotics. *E. coli* was highly sensitive to Ertapenem, Meropenem, Imipenem and amikacin but significantly resistant to ceftazidime, cefepime and Bactrim. A moderate resistance to fluoroquinolones (ciprofloxacin and levofloxacin) was observed. Remarkably, *E. coli* isolates from DFIs showed a similar pattern of sensitivity to those isolated from UTIs. These outcomes are highly important to better design the antibiotic regimens that are most useful for E. coli eradication in DFIs.

Conclusion

In conclusion, we show in this study that *E. coli* is among the most common bacterial species present not only in UTIS but also in DFIs. Moreover, *E. coli*showed significant resistance to different antibiotics.

Acknowledgment

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