The Association of Virulence Determinants of Uropathogenic Escherichia coli With Antibiotic Resistance

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Background: The emergence of antimicrobial resistant strains of Escherichia coli has raised considerable interest in understanding the diversity and epidemiology of E. coli infections in humans. Virulence factors of E. coli determine the specific infections caused by this microorganism.

Objectives: This study aimed to determine the prevalence of eight E. coli virulence factors and their association with antimicrobial resistance in bacteria isolated from patients with urinary tract infections (UTI).

Patients and Methods: One thousand patients with UTI were enrolled in this cross-sectional study. Antimicrobial susceptibility was examined by disc diffusion method according to CLSI guidelines. After DNA extraction, the materials were probed by PCR for eight virulence factors genes, namely fimH, hly, iucC, ibeA, sfa/foc, neuC, papC, and afa genes.

Results: The frequency of virulence factors papC, afa, sfa/foc, fimH, hly, neuC, ibeA, and iucC were 53.3%, 51.7%, 53.3%, 56.7%, 23.3%, 31.7%, 20%, and 73.3%, respectively. In addition, there was a high degree resistance to cotrimoxazole and nalidixic acid while a high degree of susceptibility to nitrofurantoin was detected. There was a statistically significant association between fimH gene and resistance to ciprofloxacin (P = 0.006), nalidixic acid (P = 0.025), and cotrimoxazole (P = 0.02). Such associations were found between ibeA gene and amikacin (P = 0.02) and cotrimoxazole (P = 0.02) as well as between afa gene and gentamycin (P = 0.05).

Conclusions: The results showed that E. coli isolated from patients with UTI had eight virulence factors with high frequencies. Moreover, these results alleged a direct connection between virulence factors and antimicrobial resistance in E. coli.

Keywords: Escherichia coli; Virulence Factor; Drug Resistance

1. Background

The incidence of urinary tract infection (UTI) is estimated to be about 150-250 million cases worldwide. It also accounts for approximately 35% of all hospital acquired infections (1, 2). Escherichia coli is one of the most common agents causing extra intestinal infections. These infections are an important cause of morbidity, mortality, and increased healthcare costs. In addition, there are common leading causes of UTI, pneumonia, meningitis, osteomyelitis, sepsis, and intra-abdominal as well as diverse soft tissue infections.

E. coli strains causing UTI are termed uropathogenic E. coli (UPEC). UPEC isolates are a genetically heterogeneous group that possess several virulence factors (VFs) necessary for persistence and colonisation of the bacteria in the urinary tract, overcome host defenses, and extra intestinal disease (3-5). These VFs include fimbral adhesins (P, type 1, S, and FIC fimbriae), afimbrial adhesin, toxins (hemolysin and cytotoxic necrotizing factor), siderophores (aerobactin system), and capsular polysaccharide (group II capsules) (5-7).

Non-complicated infections constitute the majority of UTIs. Patients recognized with acute non-complicated cystitis are treated as outpatients. The microbiological features of this infection are greatly predictable even in healthy subjects. Therefore, physicians have been informed that empirical antibiotic treatment without culture is convenient in such cases. The empirical therapy has been so widely used that only a few UTIs are routinely cultured (1). Worldwide data shows that there is an increasing resistance to conventional drugs among UTI pathogens. Resistance has emerged even to the newer and more potent antimicrobial agents. Antimicrobial re-