Expression of P fimbriae of uropathogenic Escherichia coli strains

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INTRODUCTION

Bacterial adherence is an important initial step in the pathogenesis of urinary tract infections (UTIs). In a number of cases, fimbriae have been shown to mediate this adherence. Fimbriae enable the bacteria to bind to specific receptor structures and thereby to colonize specific surfaces [1-5]. Fimbriae of uropathogenic Escherichia coli (UPEC) can be divided into three categories on the basis of their hemagglutinating activities: 1) Type 1 fimbriae that cause mannose-sensitive hemagglutination of guinea pig erythrocytes; 2) MR fimbriae that cause mannose-resistant hemagglutination (MRHA) of human erythrocytes. This group can be subdivided on the basis of receptor specificities into P, M, S and X fimbriae; 3) FIC fimbriae that cause no hemagglutination (HA) of any erythrocytes [6-10]. P fimbriae differ in serotype and the molecular weight of the fimbrial subunit [11, 12].

P fimbriae, which are subdivided into serologically distinct groups (F7-F13), recognize the α-D-Gal-(1→4)-β-D-Gal region of globosides [11, 13]. Vaccination with purified P fimbriae prevents experimental pyelonephritis in monkeys [14]. P fimbriae are known to occur in association with a limited number of E. coli serotypes [15-17]. The aim of this study was to investigate the prevalence of P fimbriae of E. coli causing human urinary tract infection.

MATERIALS AND METHODS

Bacteria: One hundred and ninety eight E. coli strains were isolated from the urine of patients with cystitis of the Social Security Bozyaka Hospital and 24 E. coli strains were isolated from the urine of children patients with pyelonephritis at the Ege University Hospital. A total of 222 E. coli strains were collected in two years. The E. coli isolates were identified by standard laboratory identification techniques and then tested for P fimbriae.

Detection of P fimbriated E. coli: The occurrence of P fimbriae on uropathogenic E. coli strains was determined by using a P-specific particle agglutination kit (Orion Diagnostica, Espoo, Finland) [18]. The E. coli strains to be tested were cultivated on Tryptic Soy Agar (TSA) overnight at 37 °C. One drop of phosphate buffer solution (PBS) from the dropper was dispensed on the test and control areas of the test card. A mixing stick was used to harvest 2 to 4 bacterial colonies from TSA, and they were suspended in the PBS droplets on the test and control areas. The bacterial suspension mixed with the reagents. The test card were tilted for two minutes and observed for the agglutination reaction. The result was positively interpreted, if agglutination was visible by the naked eye in the PF test reagent within two minutes, but not seen in the control reagent. A positive control card was also used.

Electron microscopy: Bacterial suspensions of positive P-specific particle agglutination were prepared for electron microscopy after being washed in sterile distilled water. One drop of the suspension was placed on a film-coated coppergrid, and excess fluid was removed with filter paper strips. The bacteria were negatively stained for 30 s with 2% (w / v) phosphotungstic acid (pH 7). Grids were kept at ambient temperature for one night and examined.
RESULTS

P fimbriae of a total of 222 uropathogenic \(E. coli\) strains were examined. Of the total, 31 (14%) were found with P fimbriae. Out of 198 \(E. coli\) strains, 29 (15%) were P fimbriated in patients with cystitis. Of 24 pyelonephritogenic \(E. coli\) strains, three (13%) had P fimbriae. Prevalence of P-fimbriae of \(E. coli\) strains were found to be quite similar in patients with cystitis and pyelonephritis. The fimbriated \(E. coli\) strain is shown in figure 1.

DISCUSSION

One of the various virulence factors of uropathogenic \(E. coli\) strains is adherence to uroepithelial cells [17, 19-21]. P fimbriae adhere to glycolipids on mucous membrane and urothelial cells [22, 23]. There is an important role of pyelonephritis associated pili (PAP) protein adhesins in the development of acute pyelonephritis in children [24]. Möllby et al [25], showed that out of 35 uropath-

ogenetic \(E. coli\) strains 34 (97%) were fimbriated in children with pyelonephritis, and of 26 \(E. coli\) strains five (19%) were fimbriated in patients with cystitis.

Väisänen-Rhen et al [26], reported that of 35 uropathogenic \(E. coli\) strains, 33 (94%) with P fimbriae occurred in children with clinical pyelonephritis and out of 26 \(E. coli\) strains, five (19%) occurred with cystitis. In another study, Väisänen-Rhen et al [16] found that the prevalence of P fimbriae of \(E. coli\) strains was 76% with pyelonephritis and 23% with cystitis.

Latham et al [27] reported that, out of 23 pyelonephritogenic \(E. coli\) strains, 13 (57%) were fimbriated, and of 116 \(E. coli\) strains isolated in patients with cystitis, 22 (19%) were fimbriated. Siegfried et al [28], suggested that P fimbriae production was significantly more frequent in pyelonephritogenic \(E. coli\) strains than in lower urinary tract infection \(E. coli\) strains in children. Lo Bue et al [29], showed that P fimbriated \(E. coli\) was the most prevalent microorganism in acute urinary tract infections (34%).

According to the findings of the above investigations, P fimbriated \(E. coli\) strains are more frequent in patients with clinical pyelonephritis than with cystitis.

In the present study, of 24 uropathogenic \(E. coli\) strains three (13%) P fimbriae-positive strains occurred in children with clinical pyelonephritis and of 198 \(E. coli\) strains 29 (15%) occurred with cystitis.

In this study, the prevalence of P fimbriae of uropathogenic \(E. coli\) strains in patients with cystitis is quite similar to the above findings. By contrast, in this study the prevalence of P fimbriae of pyelonephritogenic strains is lower than the findings reported in the literature.

The results of this study suggest that P fimbriae occur with a limited number of \(E. coli\) strains and indicate that many cases of pyelonephritis may be caused by non-P fimbriated \(E. coli\) strains.

Key words: P fimbriae, uropathogenic \(Escherichia coli\), urinary tract infection

SUMMARY

The occurrence of P fimbriae in a total of 222 uropathogenic \(Escherichia coli\) (UPEC) strains was investigated. Out of the total, 31 (14%) were P fimbriated. Of 24 pyelonephritogenic \(E. coli\) strains, three (13%) with P fimbriae occurred in children with clinical pyelonephritis, and of 198 \(E. coli\) strains 29 (15%) occurred in children with cystitis. Prevalence of P fimbriae of \(E. coli\) strains was found to be quite similar in patients with cystitis and pyelonephritis.
Nel presente studio è stata valutata l’incidenza di ceppi di Escherichia coli uropatogeni (UEPEC) dotati di fimbrie P. Complessivamente, dei 222 ceppi di Escherichia coli testati, sono risultati provvisti di fimbrie P 31 ceppi (14%). In particolare, sono risultati positivi per la determinazione delle fimbrie P il 13% (3/24) dei ceppi pielonefritogeni isolati in bambini affetti da pielonefrite e il 15% (29/198) dei ceppi isolati da bambini con cistite. La prevalenza dei ceppi di E. coli provvisti di fimbrie P è risultata simile sia nei pazienti con cistite sia in quelli con pielonefrite.

RIASSUNTO

REFERENCES