Fluoroquinolone resistance via qnrA integron cassette in ESBL producing Escherichia coli clinical isolates from Thailand

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**Background:** Although qnrA, encoding quinolone resistance protein, confers low-level resistance to fluoroquinolone, its role in quinolone resistance when associated with other resistant mechanisms remains unknown.

**Methods:** One hundred extended-spectrum beta-lactamase (ESBL) producing *Escherichia coli* were collected from Siriraj Hospital (Bangkok, Thailand) and tested for qnrA by PCR. All qnrA positive isolates were investigated for gyrA mutations and a presence of class 1 integron by DNA sequencing and PCR. The locations of qnrA and intI1 genes were analyzed by Southern blot hybridization. Phenotypic characteristics were studied by antimicrobial susceptibility test and time kill method.

**Results:** qnrA genes were found in 8% of ESBL-positive *E. coli* (8/100), confirmed to be qnrA1 by DNA sequencing. All qnrA1 positive isolates also harbored intI1 gene. Double mutations (S83L and D87N) in gyrA were found in 50% (4/8) of qnrA1 positive isolates. Specific qnrA1 and intI1 probes showed both qnrA1 and intI1 genes could be found on the chromosome and/or plasmids. Some isolates possessed two integron elements. The MIC (ciprofloxacin) against the isolate harboring both qnrA1 and gyrA mutations with double mutations was 2-fold higher than that against the isolate with only gyrA, and was much higher than that against the isolate harboring only qnrA1 (MICs of 64 μg/ml, 32 μg/ml, and 0.12 μg/ml, respectively). According to the time kill study, 0.5 μg/ml of ciprofloxacin showed bactericidal activity after six hours of incubation against the isolate harboring only qnrA1. The bacteriostatic activity against the isolate harboring only gyrA with double mutations could be observed when the concentrations of ciprofloxacin were ≤256 μg/ml. The regrowth of the isolate carried both genes in 64-128 μg/ml at 24 hours of incubation were observed. Only 512 μg/ml of ciprofloxacin showed bactericidal activity after four hours of incubation against the isolate harboring both qnrA1 and gyrA with double mutations.

**Conclusion:** qnrA could integrate into the chromosome by class 1 integrons. Presence of fluoroquinolone resistance elements on both plasmid and chromosome indicated high selection pressure in *E. coli* and, may be, in other Gram-negative bacteria as well. The qnrA gene conferred higher-level ciprofloxacin resistance on double mutations in gyrA (S83L and D87N) background.

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