Poster 1407

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Risk Factors for Infection or Colonization with CTX-M Extended-Spectrum β-Lactamase (ESBL)-Positive Escherichia coli

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ABSTRACT

Background: Infections with extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae are associated with increased morbidity, mortality, and healthcare costs. In the past decade, there has been a significant increase in the prevalence of Enterobacteriaceae that produce CTX-M-type ESBLs. The objective of this study was to evaluate risk factors for infection or colonization with CTX-M-positive *Escherichia coli*.

Methods: A case-control study was conducted within a university health system from January 2007 to December 2008. All patients with clinical cultures with *E. coli* demonstrating resistance to extended-spectrum cephalosporins were included. The presence of the $bla_{\text{CTX-M}}$ gene was detected by polymerase chain reaction. Case patients were designated as those with cultures positive for CTX-M-positive *E. coli*, and control patients as those with non-CTX-M-producing *E. coli*. Multivariable logistic regression analyses were performed to evaluate risk factors for CTX-M-positive isolates.

Results: A total of 146 unique patients with clinical cultures with *E. coli* resistant to extended-spectrum cephalosporins were identified during the two year study period. Of these, 83 (56.8%) patients had cultures with CTX-M-positive *E. coli*. The majority of isolates (62.6%) belonged to CTX-M group I. On multivariable analyses, there was a significant association between infection or colonization with CTX-M-type beta-lactamase-positive *E. coli* and receipt of piperacillin-tazobactam in the 30 days prior to the culture date (odds ratio [OR], 7.36; 95% confidence interval [CI], 1.61-33.8; P=0.01) and a urinary culture source (OR, 0.36; 95% CI, 0.17-0.77; P=0.008). Resistance to fluoroquinolones was significantly higher in isolates from cases as opposed to controls (90.4% and 50.8%, respectively; P<0.001).

Conclusions: Non-urinary sources of clinical cultures and recent use of piperacillin-tazobactam conferred an increased risk of colonization or infection with CTX-M-positive *E. coli* as opposed to other ESBL types. Future studies will need to focus on outcomes associated with infections due to CTX-M-positive *E. coli*, as well as infection control strategies to limit the spread of these increasingly common organisms.

BACKGROUND

- Infections due to extended-spectrum β-lactamase producing Enterobacteriaceae are associated with increased morbidity, mortality, and healthcare costs.
- In the past decade, there has been a significant increase in the prevalence of *Escherichia coli* that produce CTX-M-type β-lactamases.
- The epidemiology of CTX-M-type β-lactamase producing *E. coli* may differ from non-CTX-M-type.
- However, risk factors for CTX-M-type β-lactamase positive *E. coli*, especially in the United States, remain unclear.

OBJECTIVE

- To evaluate risk factors for infection or colonization with CTX-M-positive *Escherichia coli*.

METHODS

- Study design: Case-control study at the Hospital of the University of Pennsylvania (HUP) and Penn Presbyterian Medical Center (PPMC).
- Inclusion criteria: All adult inpatients and outpatients with clinical cultures with *E. coli* demonstrating resistance to extended-spectrum cephalosporins from January 1, 2007 to December 31, 2008.
- The presence of the $bla_{\text{CTX-M}}$ gene was detected by polymerase chain reaction.
  - Cases: Patients with CTX-M positive *E. coli*.
  - Controls: Patients with non-CTX-M-producing *E. coli*.
- Data collection: Demographics, comorbidities, prior hospitalization, inpatient vs outpatient, antimicrobial receipt, intravascular devices.
- Statistical analyses: A multivariable logistic regression model was developed to evaluate risk factors for CTX-M positive isolates.

SUBJECT CHARACTERISTICS

Variable	CTX-M (n=83)	Without CTX-M (n=63)	OR (95% CI)	*P* value
Age, mean years (SD)	64.8 (15.3)	61.1 (19.6)	N/A	0.32
Female sex	45 (54.2)	40 (63.5)	0.68 (0.35-1.33)	0.26
Non-white race	38 (45.8)	27 (42.9)	1.13 (0.58-2.18)	0.72
Inpatient status	67 (80.7)	41 (65.1)	2.25 (1.06-4.77)	0.03
Receipt of a first-generation cephalosporin ≤30 days prior to sampling	7 (15.9)	13 (28.9)	0.47 (0.14-1.45)	0.20
Nosocomial onset	35 (42.2)	20 (31.8)	1.57 (0.79-3.11)	0.20
Bacteremia	22 (26.5)	7 (11.1)	2.89 (1.14-7.27)	0.02
Urinary source	40 (48.2)	48 (76.1)	0.29 (0.13-0.60)	0.001
Charlson comorbidity score, mean (SD)	2.5 (2.4)	1.7 (2.3)	N/A	0.01
Indwelling device	36 (43.4)	19 (30.2)	1.77 (0.89-3.54)	0.10

RESULTS

- 146 patients with cultures positive for *E. coli* resistant to extended-spectrum cephalosporins were identified.
- Of these, 83 (56.8%) had CTX-M positive isolates.
- Culture source: 88 (60.3%) urine, 29 (19.9%) blood, 18 (12.3%) wound, and 11 (7.5%) respiratory.
- CTX-M positive isolates were more likely to be resistant to fluoroquinolones (P<0.001) and tobramycin (P=0.004).
- On MV analyses, there was a significant association between infection or colonization with CTX-M positive *E. coli* and receipt of piperacillin-tazobactam in the 30 days prior to the culture date (OR, 7.36; 95% confidence interval [CI], 1.61-33.8; P=0.01) and a urinary culture source (OR, 0.36; 95% CI, 0.17-0.77; P=0.008).

MULTIVARIABLE MODEL OF RISK FACTORS FOR CTX-M POSITIVITY

Variable	OR (95% CI)	*P* Value
Urinary source	0.36 (0.17-0.77)	0.008
Charlson comorbidity score	1.11 (0.95-1.30)	0.20
Receipt of an extended-spectrum penicillin ≤30 days prior to the culture date[a]	7.36 (1.61-33.8)	0.01

OR, odds ratio; CI, confidence interval.

[a]Piperacillin-tazobactam.

CONCLUSIONS

- Non-urinary sources of clinical cultures and recent use of piperacillin-tazobactam conferred an increased risk of colonization or infection with CTX-M-positive *E. coli* as opposed to other ESBL types.
- CTX-M-type β–lactamases may play an important role in the nosocomial setting (i.e., bacteremia).
- Future studies will need to focus on outcomes associated with infections due to CTX-M-positive *E. coli*.

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