

ORIGINAL ARTICLE

Comparative Study of Carbapenemase Inhibitor and NG-Test CARBA5 for the Detection of Carbapenemase of *Enterobacteriaceae*

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SUMMARY

Background: This study aimed to evaluate the application of carbapenemase inhibitor and NG-test CARBA5 in the detection of carbapenemase genotype for *Enterobacteriaceae*.

Methods: We collected non-repetitive CRE (carbapenem-resistant Enterobacterales) isolated from patients at the Affiliated Cancer Hospital of Zhengzhou University in 2022. The carbapenemase type and gene type were detected by carbapenemase inhibitor test and NG-test CARBA5 assay, respectively.

Results: Sensitivity and specificity of the carbapenemase inhibitor test detecting five common carbapenemases were 100.00% and 98.36%, respectively. Sensitivity and specificity of NG-test CARBA5 were 95.90% and 99.18%, respectively.

Conclusions: The carbapenemase inhibitor test and NG-test CARBA5 showed high sensitivity and specificity in detecting carbapenemase of *Enterobacteriaceae*.

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Supplementary Data

Table S1. Resistance rate of CRE to antibiotics.

Antibiotics	<i>Klebsiella pneumoniae</i> (62)		<i>Escherichia coli</i> (30)		<i>Escherichia cloacae</i> (12)		<i>Klebsiella oxytoca</i> (8)		<i>Citrobacter</i> (8)		<i>Serratia marcescens</i> (4)	
	n	Percentage	n	Percentage	n	Percentage	n	Percentage	n	Percentage	n	Percentage
Amikacin	5	8.06%	4	13.33%	6	50.00%	5	62.50%	4	50.00%	0	0.00%
Polymyxin B	1	1.61%	1	3.33%	0	0.00%	0	0.00%	0	0.00%	4	100.00%
Meropenem	58	93.55%	27	90.00%	12	100.00%	7	87.50%	8	100.00%	4	100.00%
Imipenem	62	100.00%	30	100.00%	12	100.00%	8	100.00%	8	100.00%	4	100.00%
Piperacillin/ Tazobactam	62	100.00%	30	100.00%	10	83.33%	7	87.50%	8	100.00%	4	100.00%
Cefoperazone/ Sulbactam	61	98.39%	30	100.00%	10	83.33%	7	87.50%	8	100.00%	4	100.00%
Chloramphenicol	15	24.19%	6	20.00%	4	33.33%	8	100.00%	7	87.50%	3	75.00%
Ceftazidime	61	98.39%	30	100.00%	12	100.00%	8	100.00%	8	100.00%	4	100.00%
Amoxicillin/ Clavulanate	62	100.00%	30	100.00%	12	100.00%	8	100.00%	8	100.00%	4	100.00%
Aztreonam	55	88.71%	10	33.33%	9	75.00%	6	75.00%	4	50.00%	3	75.00%
Cefepime	61	98.39%	30	100.00%	12	100.00%	8	100.00%	8	100.00%	4	100.00%
Levofloxacin	45	72.58%	20	66.67%	7	58.33%	5	62.50%	6	75.00%	3	75.00%
Ciprofloxacin	48	77.42%	19	63.33%	8	66.67%	5	62.50%	5	62.50%	3	75.00%
Ceftriaxone	62	100.00%	30	100.00%	10	83.33%	8	100.00%	8	100.00%	4	100.00%
Sulfamethoxazole- Trimethoprim	55	88.71%	26	86.67%	10	83.33%	7	87.50%	6	75.00%	3	75.00%
Cefotaxime	62	100.00%	30	100.00%	10	83.33%	8	100.00%	8	100.00%	4	100.00%
Cefuroxime	62	100.00%	30	100.00%	10	83.33%	8	100.00%	8	100.00%	4	100.00%
Tetracycline	60	96.77%	22	73.33%	9	75.00%	8	100.00%	4	50.00%	3	75.00%
Ampicillin/ Sulbactam	62	100.00%	30	100.00%	10	83.33%	8	100.00%	8	100.00%	4	100.00%
Cefazolin	62	100.00%	30	100.00%	10	83.33%	8	100.00%	8	100.00%	4	100.00%
Tigecycline	13	20.97%	7	23.33%	2	16.67%	1	12.50%	1	12.50%	0	0.00%
Ceftazidime/ Avibactam	20	32.26%	23	76.67%	4	33.33%	2	25.00%	1	12.50%	0	0.00%

There are in total 124 unduplicated CRE strains, including 62 *Klebsiella pneumoniae* strains (50%), 30 *Escherichia coli* strains (24.1%), 12 *Escherichia cloacae* strains (9.7%), 8 *Klebsiella oxytoca* strains (6.5%), 8 *Citrobacter* strains (6.5%), and 4 *Serratia marcescens* strains (3.2%). CRE strains have a high resistance rate to common antibiotics. The CRE strains exhibit a resistance rate of 100% to imipenem and 94% to meropenem.



Figure S1. Partial results of NG-test CARBA5 detection.

C quality control, K *bla*_{KPC}, O *bla*_{OXA}, V *bla*_{VIM}, I *bla*_{IMP}, N *bla*_{NDM}.

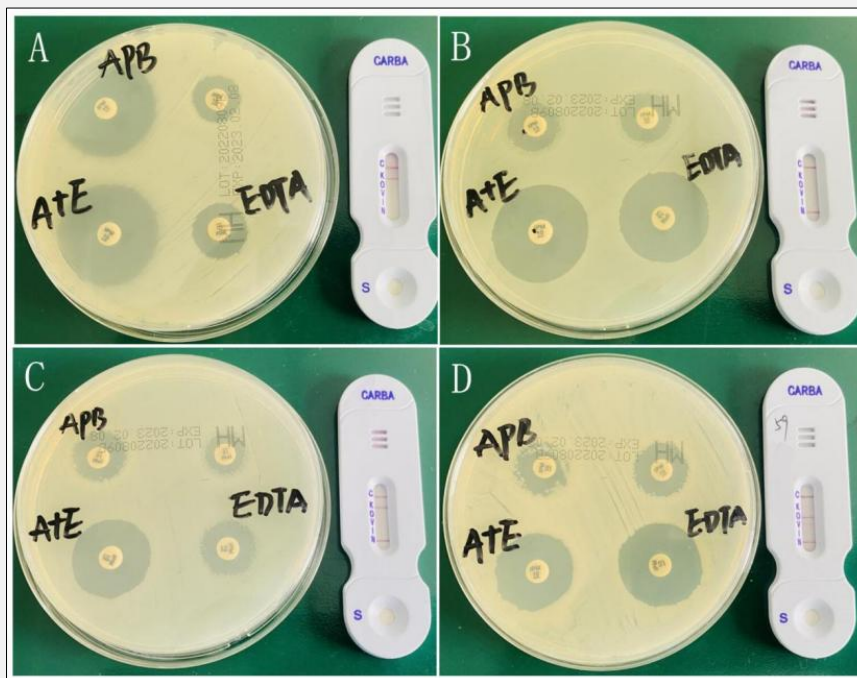


Figure S2. Partial comparison results of carbapenemase inhibitor detection.

A) Only producing *bla*_{KPC} class-A carbapenemase, B) only producing *bla*_{NDM} class-B carbapenemase, C) producing *bla*_{KPC} and *bla*_{NDM}, and D) producing *bla*_{OXA} and *bla*_{NDM}. APB (3-aminophenylboronic acid) can inhibit the activity of class-A carbapenemase, EDTA (ethylene diamine tetraacetic acid) can inhibit the activity of class-B carbapenemase.