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In vitro activity of tigecycline against local clinical isolates of some Enterobacteriaceae

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ABSTRACT

Infectious diseases that *Enterobacteriaceae* cause are spreading on a wide scale. Examples of these infections are gastrointestinal tract infections, meningitis, pneumonia, septicemia, urinary tract infections, and wound infections. Antibiotic resistance among *Enterobacteriaceae* is a critical problem that makes treatment difficult. Tigecycline is a broad spectrum antibiotic that is effective against multi-drug resistant organisms (MDR) and may be beneficial in the therapy of infections caused by *Enterobacteriaceae*.

This study aims to evaluate the *in vitro* activity of tigecycline against clinical isolates of *Enterobacteriaceae* species and detect the possible resistance mechanisms of them against β-lactams.

The sensitivity of different isolates to antibiotics was determined by standard disc diffusion method. Phenotypic detection of resistance mechanisms such as extended spectrum β-lactamase (ESBL), AmpC, ESBL& AmpC co-producers and metallo β-lactamase (MBL) β-lactamases enzymes producer isolates was investigated.

A total of eighty three *Enterobacteriaceae* clinical isolates were collected. The common bacteria isolated were *Escherichia coli* and *Klebsiella pneumoniae*. Multidrug resistance was found in 59.04% of tested isolates. The isolates were resistant to sulfamethoxazole-trimethoprim, ciprofloxacin, tetracycline and impenem. The highest resistance was found to sulfamethoxazole-trimethoprim followed by ciprofloxacin, tetracycline and imipenem. Phenotypic detection of resistance mechanisms revealed that 69.4% of clinical isolates were ESBL producers, 12.2% were AmpC producers, and 8.2% were ESBL and AmpC co-producers, while 10.2% were MBL producers. There was no resistance found to tigecycline among all *Enterobacteriaceae* isolates tested.

This study showed that tigecycline has potent *in vitro* activity against ESBL, AmpC, combined ESBL and AMPC and MBL β-lactamases producing *Enterobacteriaceae*.

Keywords :*Enterobacteriaceae*, tigecycline, antibiotic resistance.

INTRODUCTION

The *Enterobacteriaceae* includes numerous genera of Gram-negative bacteria. *E.coli, Salmonella, Shigella, Klebsiella, Enterobacter, Serratia, Yersinia, Proteus* are examples of the *Enterobacteriaceae* **(Mandell *et al.* 2009)**.

Enterobacteriaceae can be present in water, soil in addition to humans and animal intestinal tracts. They are etiological agents of many human diseases such as gastrointestinal tract infections, urinary tract infections, abscesses, meningitis, pneumonia, and septicemia as well as wound infections **(Mandell *et al.* 2009)**. Furthermore, they are frequent causes of healthcare-associated infections; *E.coli* is a common cause of UTIs, while *Klebsiella* spp. and *Enterobacter* spp. are commonly involved in pneumonia. Moreover, bloodstream infections, peritonitis, cholangitis,

and other intra-abdominal infections can be caused by *Enterobacteriaceae.* Also, *Salmonella* is responsible for gastroenteritis that may be complicated as invasive infection in some patients **(Paterson *et al.* 2006)**.

Enterobacteriaceae show multidrug resistance to antibiotics that constitutes a worldwide public health dilemma **(Partridge *et al.* 2015).** The factors that are responsible for the spread of antibiotic resistance include the misuse of antibiotics for prophylaxis and therapy of infections in both humans and animals, in addition to their use to promote growth in agriculture **(Caron *et al.* 2018).**

Antibiotic resistance of *Enterobacteriaceae*, especially β-lactams is enhanced by mobilization of genes encoding antibiotic inactivating enzymes. Other underlying mechanisms of antibiotic resistance include outer membrane impermeability and drug efflux, so antibiotic resistance to bacteria such as *E. coli* and *K. pneumoniae* has significantly increased **(Iredell *et al.* 2016).**

The production of extended-spectrum beta-lactamases (ESBLs) and carbapenemase-producing *Enterobacteriaceae* (CRE) are contributing to multidrug-resistance in *Enterobacteriaceae* **(Bassetti *et al.* 2016)**. The ability of genera of *Enterobacteriaceae* to produce beta-lactamases is commonly involved in their resistance to penicillins, cephalosporins, or aztreonam **(Thenmozhi *et al.* 2014)**.

The spreading antimicrobial resistance among *Enterobacteriaceae* limits the use of traditional antimicrobial agents and necessitates the production of novel classes of antimicrobials **(Fair *et al.* 2014)**.

Tigecycline is a semi-synthetic derivative of minocycline and it was the first glycylcycline to be used clinically. Unlike other tetracyclines, tigecycline was found to produce very good results activity against many species of Gram-positive and Gram-negative bacteria, including multidrug-resistant ones **(Singh *et al.* 2017)**.

The Food and Drug Administration (FDA) approves the use of tigecycline as the best drug for the therapy of complicated infections of skin and soft tissue and intra-abdominal in addition to community-acquired infections affecting lower respiratory tract **(Song *et al.* 2018)**.

The study aimed to evaluate the *in vitro* activity of tigecycline antibiotic against local MDR clinical isolates of some *Enterobacteriaceae* species.

Material and methods

Media and chemicals

MacConkey agar, Mueller Hinton agar and broth, Triple sugar iron agar, Simmons citrate agar, Cystine lactose electrolyte deficient (CLED medium) and antibiotic discs were purchased from Oxoid, Hampshire, UK. Nutrient agar was obtained from Lab M limited, Lancoshine, UK. ESBL and AmpC D68C detection set discs were the products of MASTDISCS ID^{TM}. Urea broth medium and Motility medium were prepared and sterilized according to Atlas **(Atlas, 2004).** Other chemicals were of pharmaceutical grade.

Bacterial strains

One hundred and sixty specimens were collected from different sources such as urine, endotracheal tube, pus swab, sputum and wound swab. Sterile labeled containers were used for collection of specimens under complete aseptic precautions and the specimens were transported immediately to the microbiological laboratory for processing.

Isolation and identification of *Enterobacteriaceae*

Identification of *Enterobacteriaceae* was performed using standard microbiological techniques such as Gram staining, colony morphology, growth on MacConkey's agar media, motility, oxidase, citrate utilization,

urease, indole, and triple sugar iron tests **(Cheesbrough, 2006).**

Antimicrobial susceptibility testing

To test the susceptibility of different isolates to antibiotics, the disc diffusion method was used according to Clinical Laboratory Standards Institute guidelines **(CLSI, 2017)**. Each isolate was grown overnight, and the resulting suspensions were diluted with sterile saline to achieve a turbidity that matches 0.5 McFarland Standard. The prepared suspensions were used within 15 minutes. A sterile cotton swab was dipped into each inoculum and the excess liquid was removed by rotating the swab and pressed it firmly on the inner tube wall. The swab was streaked to spread the bacteria on the surface of the MHA plate. Antibiotics discs included amoxicillin-clavulanic acid (AMC, 30µg),ceftazidime (CAZ, 30µg) cefepime (FEP, 30µg), cefotaxime (CTX, 30µg), ceftriaxone (CRO, 30µg), cefoxitin (FOX, 30µg), minocycline (MIN, 30µg), ciprofloxacin (CIP, 5µg), gentamycin (CN, 10µg), imipenem (IPM, 10µg), tetracycline (TE, 30µg), and sulfamethoxazole-trimethoprim (SXT, 25µg), ampicillin-sulbactam (SAM, 20µg), amikacin (AK, 30µg), aztreonam (ATM, 30µg), tigecycline (TGC, 15µg). After incubation for 24 hours at 37ºC, the inhibition zone diameters were measured and the results were interpreted using CLSI guidelines **(CLSI, 2017)** for all antibiotics except for tigecycline for which **(EUCAST, 2016)** breakpoints were used for interpretation.

Phenotypic detection of resistance mechanisms

Phenotypic methods for detection of ESBL by the Modified double disk synergy test (MDDST)

A culture of each isolate was made on a 9 cm-diameter MHA plate, as recommended by CLSI[13]. Discs with amoxacillin-clavulanic acid (30µg) and with cefotaxime (30µg), ceftazidime (30µg), aztreonam (30ug) and cefepime (30µg) were put at 16 to 20 mm distant from each other. Moreover, a piperacillin-tazobactam disc (100/10µg) was placed at a distance of 22 to 25 mm from the cefepime disc. The plates were overnight incubated at 37°C and ESBL production was considered positive when the zone of inhibition of the combination discs in comparison to the ceftazidime disc alone increased by 5 mm **(Singh *et al.* 2014).** Also, ESBL production is considered if the zone of inhibition produced by cefepime or any of the extended-spectrum cephalosporin discs showed a clear-cut increase towards the piperacillin-tazobactam (PIT) or amoxicillin-clavulanic acid discs **(Shaikh *et al.* 2016).**

Phenotypic detection of AmpC using AmpC Disk Test

To screen for AmpC production among beta-lactam resistant isolates, the AmpC disc test was used. The standard strain *E.coli* ATCC 25922 was used for surface inoculation of MHA plate and a cefoxitin disc (30 µg) was placed on the plate. Then AmpC disc (blank filter paper) was moistened with 20 µl of sterile saline and inoculated with colonies of the test organism. The AmpC disc was placed touching the cefoxitin disc with the inoculated side facing downward. The plate was incubated at 35°C for 24 h and the presence of an indentation or flattening of cefoxitin inhibition zone indicated positive AmpC production **(Kaur *et al.* 2019).**

ESBL and AmpC Detection Discs set (MASTDISCS ID^{TM})

The co-production of ESBL and AmpC was investigated by using ESBL and AmpC Detection Discs set method **(Nourrisson *et al.* 2015).** The test is based on a combination disc method; Disk A contains cefpodoxime (10 µg) as a screening agent, disk B contains cefpodoxime (10 µg) and clavulanate as ESBL inhibitor, disk C contains cefpodoxime (10 µg) and cloxacillin as AmpC inhibitor, and disk D

contains cefpodoxime (10 µg) in combination with both clavulanate and cloxacillin as both ESBL and AmpC inhibitors.

Following the manufacturer's instructions, Mueller Hinton agar plates were surface inoculated by a sterile swab, each with a bacterial suspension of each isolate that is equivalent in density to a 0.5 McFarland standard. After placing of the disks on plates and incubation of the plates at 37 °C for 24 h, the results were interpreted by comparing A, B, C, and D inhibition zone diameters around the disks. If the differences (B–A) & (D–C) was ≥5 mm and the differences (D–B) & (C–A) was <5 mm, the organism was considered as a producer of ESBL alone, if (B–A) & (D–C) were <5 mm and (D–B) & (C–A) were ≥5 mm, the organism was a producer of AmpC alone, if (D–C) was ≥5 mm but (B–A) was <5 mm, the organism was considered to show ESBL and AmpC combined activity and if all zones were within 2 mm of each other, the organism was neither ESBL nor AmpC producer.

Phenotypic detection of MβL activity by imipenem-Ethylene diamine tetra acetic acid combined disc test (IMP-EDTA CDT)

To detect the production of metallo-β-lactamases (MBLs), the imipenem-EDTA combined disc test (IMP-EDTA CDT) was used that is based on the augmentation of imipenem inhibition zone by EDTA (pH=8.0) **(Nagdeo *et al.* 2012).**

Each tested isolate was grown to a turbidity equivalent to 0.5 McFarland standard and surface inoculated on MHA plate, then two imipenem discs (10µg) were placed on the agar surface. Ten µL of sterile 0.5 M EDTA solution (pH =8) were added to one of disc pairs to have a final concentration of 750 µg. The inhibition zones of the imipenem and their counterpart EDTA-impregnated discs produced after incubation for 24h at 37°C were compared. If the difference in the zone diameter differed by ≥ 7 mm, MBLs production was considered positive **(Nagdeo *et al.* 2012).**

Results

Isolation, identification of *Enterobacteriaceae*

The identity of *Enterobacteriaceae* isolates was investigated biochemically as in table (1). Only 83 *Enterobacteriaceae* strains were recovered from the 160 samples (51.88%) as in table (2). The most common bacteria isolated were *E. coli* (56.63%), *K. pneumoniae* (38.55%), *Citrobacter* spp. (2.41%) and *Proteus mirabilis* (2.41%).

Urine specimens gave the highest frequency of *Enterobacteriaceae* (59.02%), followed by endotracheal tube (15.66%), wound swab (13.3%). Pus swab and sputum gave the lowest percentage of isolates; (7.22%) and (4.8%), respectively.

Antimicrobial susceptibility

High resistance was found with sulfamethoxazole/trimethoprim (69.88%), intermediate resistance was exhibited by minocycline (36.14%), while low resistance was reported with imipenem (10.84%). Tigecycline was effective against all tested isolates (table 3).

Phenotypic detection of resistance mechanisms

MDR isolates are the isolates that show resistance to at least three different antibiotic classes. MDR isolates (49 isolates) were selected for screening of resistance mechanisms such as ESBL, AmpC, MBL and ESBL & AmpC β-lactamase enzyme co-producers as shown in table 4.

By screening of ESBL production by Modified Double Disc Test (MDDST), thirty four resistant isolates were ESBL producers (figure1). The IMP-EDTA-CDT was performed for the nine imipenem resistant isolates and the results revealed that five of these isolates were MβL producer (figure 2). Six isolates were AmpC β-lactamase producers (figure 3). On the other hand, four isolates were AmpC and ESBL co-producers (figure 4).

Table 1: Biochemical characteristics of clinical Enterobacteriaceae isolates

Biochemical reactions		***E.coli* isolates**	***K.pneumonia* isolates**	***Citrobacter* isolates**	***P.mirabilis* isolates**
Oxidase test		_	_	_	_
Citrate utilization test		_	+	+	+
Indole test		+	_	_	_
Urease test		_	+	_	+
Motility		Motile	Non Motile	Motile	Motile Swarming
Growth on Triple sugar iron agar	**Slant**	Acidic (yellow)			Alkaline (red)
	Butt	Acidic (yellow)			Acidic (yellow)
	H_2S	_	_	+	+
Morphology on Macconkey agar		Pink olonies (Lactose Fermenter)	Mucoid pink colonies (Lactose Fermenter)	Pink colonies (Lactose Fermenter)	Colourless colonies (Non-Lactose Fermenter)

Table 2: Distribution of different species of *Enterobacteriaceae* among collected specimens:

Specimen	**Micro – organisms**				**Total**
	E.coli	***K.pneumoniae***	***Citro.* spp**	***P.mirabilis***	
Endotracheal tube	7 (53.8 %)	6 (46.2%)	0	0	13 (15.66%)
Pus swab	2 (33.3 %)	3(50%)	1(16.7%)	0	6 (7.22%)
Urine	31(63.3%)	16 (32.7%)	0	2 (4.1%)	49 (59.02%)
Sputum	2 (50%)	2 (50%)	0	0	4 (4.8)
Wound swab	5(45.5%)	5 (45.5%)	1 (9.1%)	0	11(13.3%)
Total	47(56.6%)	32 (38.6%)	2 (2.4%)	2 (2.4%)	83 (100%)
$\chi 2 = 12.44$, P = 0.41					

Table 3: Antibiotic susceptibility of tested *Enterobacteriaceae* isolates

Antibiotics	**Number (%) of resistant isolates**				**Total**
	***E-coli* n=47**	***K.pneumonia*n=32**	***Citro.*n=2**	***P.mirabilis*n=2**	
Amoxicillin/Clavulanic	7(63.6)	4(36.4)	0	0	11
Ampicillin/Sulbactam	14 (43.75)	15(46.88)	2(6.25)	1(3.12)	32
Cefotaxime	23(53.49)	16 (37.21)	2(4.65)	2(4.65)	43
Cefotriaxone	23(54.76)	17(40.48)	1(2.38)	1(2.38)	42
Ceftazidime	24(54.54)	17(38.64)	2(4.55)	1(2.27)	44
Cefepime	21(55.3)	16(42.1)	1(2.6)	0	38
Cefoxitin	9(56.25)	6(37.5)	1(6.25)	0	16
Imipenem	4(44.4)	5(55.6)	0	0	9
Tetracycline	28(54.9)	19(37.3)	2(3.9)	2(3.9)	51
Minocycline	17(56.67)	12(40)	1(3.33)	0	30
Tigecycline	0	0	0	0	0
Amikacin	13(54.2)	11(45.8)	0	0	24
Gentamicin	15(57.7)	11(42.3)	0	0	26
Ciprofloxacin	30(57.7)	18(34.6)	2(3.85)	2(3.85)	52
Sulfamethoxazole/ Trimethoprim	39(67.24)	15(25.86)	2(3.45)	2(3.45)	58
Aztreonam	25(56.82)	18(40.91)	1(2.27)	0	44

Table 4: Resistance mechanisms detected among different species of isolated *Enterobacteriacaeae*

		ESBL only	AMPC only	ESBL / AMPC Co-producer	MBL	Total
E-coli	No.	19	4	2	2	27
	%	38.8	8.2	4.1	4.1	55.1
Klebsiella pneumonia	No.	15	2	1	3	21
	%	30.6	4.1	2	6.1	42.9
***Citrobacter* spp**	No.	0	0	1	0	1
	%	0	0	2	0	2
Proteus mirabilis	No.	0	0	0	0	0
	%	0	0	0	0	100
Total	No.	34	6	4	5	49
	%	69.4	12.2	8.2	10.2	100
$\chi^2 = 12.405$, P = 0.054						

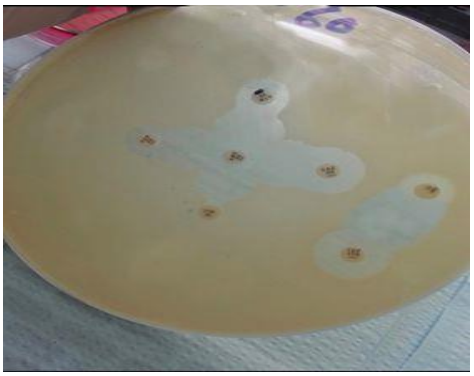

Figure 1: Detection of ESBL by modified double disk synergy test (MDDST), showing a clear-cut increase towards the piperacillin-tazobactam (PIT) disc or amoxacillin-clavulinic acid disc that considered ESBL producer.

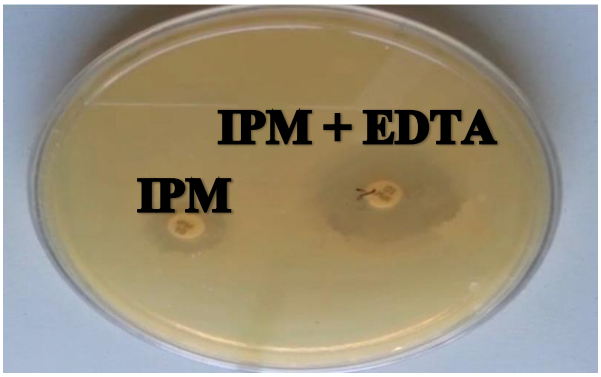

Figure 2: Detection of MBL by IMP-EDTA-CDT method, positive result when the increase in zone of inhibition of imipenem disc in presence of EDTA is ≥ 7 mm than imipenem disc alone.

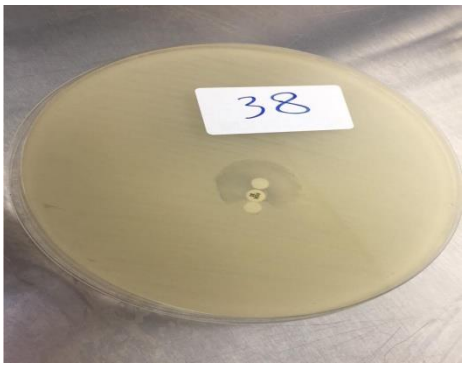

Figure 3: Detection of AmpC by AmpC disc test, positive isolates showed an indentation or flattening of cefoxitin inhibition zone.

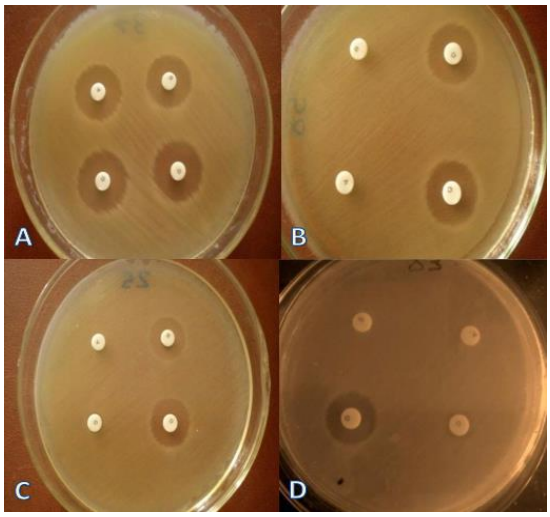

Figure 4: Phenotypic detection by ESBL and AmpC detection set.

A) Sensitive non ESBL non AmpC strain, B) AmpC positive strain, C) ESBL positive strain, D) Combined ESBL and AmpC.

Discussion

The *Enterobacteriaceae* family is a heterogeneous group of naturally found Gram-negative bacteria in the intestinal tracts of humans and animals. They are frequently encountered among the nosocomial pathogens with the urinary tract infections (UTIs) as the most common, while infections of the bloodstream and lower respiratory tract are the most dangerous as life threatening **(Ramos-Vivas *et al.* 2019).**

The Excessive drug prescription and inappropriate use of antibiotics represent the most important threats that affect public health worldwide, resulting in the emergence of multidrug resistance. It is thus vital to understand the antimicrobial resistance mechanisms of these bacteria in order to develop new therapeutic tools to combat the public health problems related to infections such as the development of new antibiotics **(Santajit and Indrawattana 2016).**

The present study showed that *Enterobacteriaceae* especially *Escherichia coli and Klebsiella* species were the most common organisms isolated. These results agreed with **Shakya *et al.* (2017)**, who found that the predominant pathogens isolated from patients infected with UTIs were *E.coli* and *Klebsiella pneumoniae*.

In our study *Proteus* spp. and *Citrobacter* species showed a much lower prevalence; they represented 2.41% of isolated bacteria each. These results were lower than those reported by **Chen *et al*. (2012)** (8.9% for *Proteus* spp.) and **Yesuf *et al*. (2016)** (8% for *Citrobacter* species).

On regarding the type of isolated bacteria as correlated to the type of the sample collected, the present study showed that *E.coli* was isolated mainly from urine followed by endotracheal tub, sputum, wound swab, and finally pus swab. Our results were somewhat different than those reported by **Taj *et al.* (2018)** who found that urine was the most common source for bacteria, but it was followed by pus, endotracheal tube, sputum and finally swab samples.

The present study shows that among *Enterobacteriaceae*, the highest rate of resistance was found against sulfamethoxazole-trimethoprim (69.88%) followed by ciprofloxacin (62.65%). These results were different from other reports. Thus, Yekani et al. (2018) found a higher resistance rate of *Enterobacteriaceae* isolates to sulfamethoxazole-trimethoprim (96.8%), while a lower one (44.1%) was found by **Wu *et al*. (2016).**

Our study showed that the resistance rates for the cephalosporins cefotaxime, ceftazidime and ceftriaxone ranged between 50.6% and 53.02%. These results were in accordance with the study of **Adhikari *et al*. (2018)** who found resistance percentages between 51% and 54% to the same cephalosporins. On the other hand, the lowest rate resistance was to imipenem. **Alipourfard and Nili (2010)** reported complete sensitivity to imipenem in their study.

The difference in the rate of isolated bacteria among different studies may be attributed to the difference in location, types of studied specimens, predisposing factors and number of studied cases **(Eshetie *et al*. 2015).**

Then the rate of MDR isolates was detected among the tested bacteria. About 59% of the isolates were MDR. **Odonkor and Addo (2018)** found that MDR *E. coli* isolates represent 49.48% of the tested isolates. MDR isolates were used for the screening of the production of ESBL, AmpC, ESBL& AmpC co-producers and MBL enzymes.

This study revealed that the frequency of ESBL producers constituted 69.4% of the tested isolates; a result similar to that reported by **Shrestha *et al*. (2016)** who found that 64.9% of isolates obtained from community acquired urinary tract infection were able to

produce ESBL. Our study revealed that 38.8% of *E. coli*, and 30.6% of *Klebsiella* spp. were ESBL producers, while none of the isolated *Proteus* strains were ESBL producers. A Nigerian study of **Horsefall *et al*. (2017)** revealed more or less similar results, while **Quan *et al*. (2017)** found different results (ESBL producers were 55.5% among *E.coli* isolates and 16.5% among *K. pneumoniae* isolates).

AmpC producing isolates in our study represented 12.2% of tested isolates; a result that lower than that reported by **Shinu *et al*. (2014)** (21.76%) in India, but comparable to another study **Ibadin *et al*. (2017)** that found a rate of 15.2% for AmpC production. The co-production of ESBL and AmpC was reported in 8.2% of isolates in this study. However, **Shayan and Bokaeian (2015)** found lower prevalence of combined ESBL and AmpC production (5%).

Considering the production of MBL, 10.2% of imipenem resistant isolates were MBL producers. **Fazeli *et al*. (2015)** study in Isfahan showed a rate of 10.2% of MBL producers among carbapenem resistant *K. pneumonia*, while **Ghotaslou *et al*. (2018)** reported only a rate of 4.9% for carbapenemase production. Moreover, an Indian study **Mwinga *et al*. (2018)** mentioned a higher prevalence of MBL (18.46%). This difference observed may be explained by the variation in the number of isolates studied and the difference in the methods used for detection in each study.

As a result of the high rate of MDR and resistance to beta-lactams in our study, we tested the activity of different members of tetracyclines to screen for the most effective one against tested isolates. The susceptibility to tetracycline, minocycline was 38.55% and 63.86%. However, tigecycline was effective against all tested isolates that could produce ESBL and/or AmpC and carbapenemases. **Devarajan *et al*. (2018)** previously reported susceptibilities of 98.13% and 66.39% to tigecycline and minocycline, respectively against Gram-negative isolates. Moreover, previous work emphasizes our results. Thus, **(Mariappan *et al*. 2011**, **Mustafa 2017**, **Sattar *et al*. 2016**, **Gandham and Amatullah 2015 and Vega and Dowzicky 2017)** reported very high or complete sensitivity of ESBL producing isolates to tigecycline. Many other reports support our results. **Shetty *et al*. (2016)** revealed that tigecycline is highly active against MDR nosocomial *Enterobacteriaceae*. Also, Tigecycline showed potent activity against wide range of carbapenem-resistant Gram-negative clinical isolates **Singh *et al*. (2017)**. Furthermore, **(Oliveira *et al*. 2018, Pfaller *et al*. 2017 and Rajni et al. 2018**) found very low or no resistance to tigecycline among carbapenem resistant *Enterobacteriaceae* (CRE).

Conclusion

High rate of antibiotic among *Enterobacteriaceae* was reported. Beta-lactamases; ESBLs, AmpC and MBL contributed to such resistance. Tigecycline may be an alternate to beta-lactams against MDR *Enterobacteriaceae*.

Conflict of interest

The authors declare that they have no conflict of interest.

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فعالية مضاد تايجيسيكلين في المختبر ضد عزلات إكلينيكية محلية من عائلة إنتروبكترياسي

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البكتيريا المعوية (الانتيروباكترياسي) تعتبر سببا هاما لكثير من أنواع العدوى المنـتـشرةعلى نطاق واسع مثـل التهابات الجهاز الهضمي والتهاب السحايا والالتهاب الرئوي وتسمم الدم والتهابات المسالك البولية والتهابات الجروح. و تشـكل مقاومة المضادات الحيوية بين عائلة البكتريا المعوية مشكلة حرجة فى علاج هذه الأمـراض. مضاد تايجيسيكلين هو مضـاد واسـع المـجال فعـال ضد البكتيريا عديدة المقاومة و قد يكون مفيدًا في علاج العدوى التي تسببها عائلة البكتريا المعـوية.

تهدف هذه الدراسة الى تقدير فعالية مضاد تايجيسيكلين في المختبر ضد عزلات إكلينيكية محلية من عائلة إنتروبكترياسي وتحديد الية المقاومة المحتملة لهذه العزلات للمضادات الحيوية المحتوية على البيتا لاكتام .

تم إجراء اختبار الحساسية للمضادات الحيوية لهذه العزلات بواسطة طريقة انتشار الأقراص. كما تم الكشف عن آليات المقاومة باستخدام اختبارات مظهرية مثل البحث عن افراز انزيمات البيتالاكتاميز واسعة المدى،و انزيم الأمبـيسي ونسبة تواجدهما معا وايضا انزيم الميتالوبيتالاكتاميز.

تم جمع عزل ثلاثة وثمانون (٨٣) عزلة من عائلة البكتريا المعـوية. أكثر الكائنات الحية الدقيقة المعزولة شيوعا بين العزلات ايشيريشيا كولاي و الكليبسيلا. بلغت نسبة البكتيريا عديدة المقاومة (٥٩,٠٤٪) من العـزلات المـختـبـرة. وفيما يتعلق بحساسية العزلات التي تم جمعها للمضادات الحيوية المستخدمة في المعالجة التجريبية كانت أعلى مقاومة ل ترايميثوبريم سلفاميثاكزازول ثم يليه سيبـروفلوكساسين, تيتراسايكـلين و اميـبـيـنم. كانت نسبة إنتاج الـبكتريا المعوية المفرزة لأنزيمات البيتالاكتاميز واسعة المدى بين البكتيريا المعوية (٦٩,٤٪)، ونسبة الأمبـيسي (١٢,٢٪) بينما تواجدا معا بنسبة (٨,٢٪), بينما نسبة تواجد الميتالوبيتالاكتاميز (١٠,٢٪). لا يوجد اي مقاومة من العزلات ضد مضاد تايجيسيكلين.

هـذه الدراسة اوضحت النشاط القوى والفـعـال لمضاد تايجيسيكلين ضد عزلات عائلة البكتريا المعـوية (الانتيروباكترياسي) المنتجة لانزيـمـات البيتالاكتاميز واسعة المدى،و انزيم الأمبـيسي و انزيمي البيتالاكتامييز واسع المدى والامبيسي المفرزين مـعا وايضا انزيمات الميتالوبيتالاكتاميز.