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RESEARCH ARTICLE

Antimicrobial Susceptibility Profiles and Prevalence of ESBLS among *Escherichia coli* Isolates Recovered from Clinical Specimens in Different Services

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Abstract

Objective: A retrospective analysis of the widely used antibiotics all susceptibility testing results from *Escherichia coli* cultured from clinical specimens private hospital from (January 2016 to November 2018) was performed.

Methods: The VITEK 2 Compact automated microbiology system is designed for automated rapid antimicrobial susceptibility testing and identification of clinically relevant bacteria. Minimum inhibitory concentration (MIC) results previously obtained in recent clinical isolates with well-defined in isolates with well-characterized resistance mechanisms with the microdilution method were re-interpreted for the susceptible, intermediate and resistant categories using the 2018 EUCAST breakpoints. Clinical samples are most commonly isolated from blood, sputum and urine samples.

Results: *Escherichia coli* isolates were highly resistant to ampicillin, cefuroxime and cefixime 79,16%, 60,41% and 58,33% respectively. Resistance rate of ceftriaxon was showed in 52,08%. When we compared to resistance of trimethoprim/sulfamethoxazole, *Escherichia coli* isolates showed 51,04% resistance rate. When it comes to the most sensitive antibiotics, sensitivity rate of fosfomycin, nitrofurantoin, ertapenem, imipenem, meropenem, gentamicin, and amikacin were 89,58%; 91,66%; 93,75%; 93,75%; 94,79%; 83,33%; 84,37% respectively.

Conclusion: Considering the antibiogram, fosfomycin, nitrofurantoin, ertapenem, imipenem, meropenem, gentamicin and amikacin should be preferred drugs for *E. coli* infection isolated from clinical samples.

Key words: *E. coli*, antibiotic sensitivity, clinical specimens

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Introduction

Escherichia coli (E. coli), a gram-negative bacteria normally residing in the intestinal tract, is among the most common pathogenic agents in humans and animals. It is classified into various pathotypes, causing in-testinal and extra-intestinal infections (Hammerum and Heuer, 2009). *E. coli* has shown an increasing in antimicrobial resistance to most antibiotics was isolated from human (Sherley et al., 2004). The β-lactam antibiotics including penicillins, cephalosporins, carbapenem

may act at several stages to prevent peptidoglycan synthesis (Jones et al., 2000). The incidence of infections caused by *Enterobacteriaceae* producing extended-spectrum beta lactamase (ESBL) has increased rapidly in the last 5 to10 years, mainly attributed to the successful distribution of CTX-M enzymes among *E. coli* causing urinary tract and bacteremic infections (Kang et al., 2012).

The aim of this study was to determine the characteristics and patterns of antibiotic resistance among isolates of *E. coli* recovered from clinical specimens in Giresun province.

Methods

Bacterial isolates

The ninety-six *E. coli* were isolated from clinical specimens from different services in private hospital. Bacterial isolates were identified and then commonly used for AST (Antimicrobial Susceptibility Testing) in clinical laboratories will therefore have to incorporate these criteria in their instruments to meet the needs of European microbiology laboratories according to standard methods described by (Cappuccino and Sherman, 2004). All isolates were obtained from patients at intensive care units. In total, ninety-six *E. coli* were isolated from various clinical samples and detected by the VITEK 2 (bioMérieux) at the microbiology laboratory of our hospital between from January in 2016 to December in 2018 (Ling et al., 2001). The data obtained were evaluated as numbers and percentages. Comments were made accordingly. It has taken the necessary permission from the outhorities.

Antibiogram profile of E. coli

Minimum Inhibitory Concentration (MIC) results previously obtained in recent clinical isolates with well-defined in isolates with well-characterized resistance mechanisms with microdilution method were re-interpreted using the 2018 EUCAST breakpoints. Fifteen different antibiotics were used. Antibiotics tested in AST-N327 (bioMérieux) card included ampicillin (AM), tazobactam/piperacillin (TPZ), cefuroxime (CXM), cefixime (CFM), ceftazidime (CAZ), ceftriaxone (CRO), ertapenem (ETP), imipenem (IMI), meropenem (MEM), amikacin (AK), gentamicin (GN), ciprofloxacin (CIP), fosfomycin (FOS), nitrofurantoin (F), trimethoprim-sulfamethoxazole (SXT).

Detection of ESBL

VITEK 2 system with the antimicrobial susceptibility extend card AST-N327 (bioMérieux) card was designed to perform both screening and confirmatory tests for phenotypic detection of ESBL on the same plate. The use of several antimicrobial agents increases the sensitivity of ESBL detection (Sorlózano et. al., 2005).

Multiple Antibiotic Resistance (MAR) index

MAR index values were tested for according to (Matyar et al., 2008).

Results

The results of resistance pattern of *E. coli* isolates in our locality to antimicrobial agents showed that the ninety-six *E. coli* strains tested against fifteen antimicrobial agents in Table 1. *E. coli* isolates were highly resistant to AM, CXM and CFM 79,16%, 60,41% and 58,33% respectively. Resistance rate of CRO was showed in 52,08%. When we compared to resistance of SXT, *E. coli* isolates showed 48,95% resistance rate. When it comes to the most sensitive antibiotics, sensitivity rate of FOS, F, ETP, IMI, MEM, GN and AK were 89,58%; 91,66%; 93,75%; 93,75%; 94,79%; 83,33%; 84,37% respectively as is illustrated in Table 1. Table 2 shows the antimicrobial susceptibility of all *E. coli* isolated from urine, blood, and sputum. Of the total *E. coli* isolates, 50 (%52) isolates were ESBL producers and 46 (48%) isolates were non-ESBL producers in Table 2.

Discussion

In our study, when we compared to resistance of AM, *E. coli* isolates showed high antibiotic resistance with 79,16% AM. Some researchers have reported resistance rate AM from 88,4% to 16,5 % to *E. coli* in clinical samples (Tadesse et al., 2012; Niranjan and Malini., 2014). Our results were similar to Weissman et al. (2015) who also reported that AM resistance rate of *E. coli* 78%.

The result of resistance CXM rate, *E. coli* isolates showed high antibiotic resistance with 60,41% CXM. Previous researchers have reported resistance rate CXM from 100% to 60% to *E. coli* in clinical samples (Ugwu et al., 2017; Cheema et al., 2018).

In this study, resistance rate of CFM, *E. coli* isolates showed high antibiotic resistance with 58,33% CFM. Some researchers have reported resistance rate CFM from 94% to 40% to *E. coli* in clinical samples (Sah et al., 2016; Tasleem et al., 2018). Our results were like Cheema et al.,2018

who also reported that CFM resistance rate of *E. coli* 61%.

The resistance rate of CRO showed 52,08%. Many researchers were reported that resistance rate

Table 1. Antibiotic suspectibility pattern of ninety-six *E. coli* isolated from urine, sputum and blood samples

Antibiotics	Resistance	Intermediate	Sensitive
AM	76 (79,16%)	-	20(20,83%)
CXM	58(60,41%)	-	38(39,58%)
CFM	56(58,33%)	-	40(41,66%)
CRO	50(52,08%)	3(3,12%)	43(44,79%)
SXT	47(48,95%)	-	49(%51,04)
CAZ	43(44,79%)	8(8,33%)	45(46,87%)
CIP	40(41,66%)	2(2,08%)	54(56,25%)
TPZ	23(23,95%)	22(22,91%)	51(53,12%)
GN	14(14,58%)	2(2,08%)	80(83,33%)
FOS	10(10,41%)	-	86(89,58%)
F	8(8,33%)	-	88(91,66%)
ETP	6(6,25%)	-	90(93,75%)
IMI	2(2,08%)	4(4,16%)	90(93,75%)
MEM	2(2,08%)	3(3,12%)	91(94,79%)
AK	2(2,08%)	14(14,58%)	80(83,33%)

Abrevations; AM, Ampicillin, CXM, Cefuroxime; CFM, Cefixime, CRO, Ceftriaxon SXT; Trimethoprim sulfamethoxazole, CAZ; Ceftazidim, CIP; Ciprofloxacin, TPZ; Piperacilin-Tazobactam, GN; Gentamicin, FOS, Fosfomycin, F; Nitrofurantoin, ETP, Ertapenem; IMI; Imipenem; MEM; Meropenem, AK; Amikacin

Table 2: Distribution of ninety-six *E. coli* clinical samples, sexuality, source, MAR Index and ESBL Producers

Name of Clinic	Number of samples	Source of isolates	Sexuality F/M	ESBL Producers	MAR İndex
Infectious Diseases	49	Urine	35F/14M	30P/19N	0(7isl);0,07(4isl);0,13(2isl);0.2(3isl);0,27(5isl);0,53(3isl);0,33(4isl);0,6(3isl);0,8;0,47(8isl); 0,4(6isl); 0,67(3isl);0.87
Internal medicine	11	Urine	7F/4M	4P/7N	0; 0,2; 0,07(2isl); 0,13(2 isl); 0,47(3isl); 0,53(2isl);
Child Health and Diseases	12	Urine	4F/8M	3P/9N	0(2isl); 0,07(2isl);0,13(2isl); 0,2(2isl); 0,4(2isl); 0,53; 0,47
Urology	6	Urine	2F/4M	4P/2N	0,07(2isl);0,53(2isl); 0,47; 0,4
Chest Diseases	7	5 Sputum 1Urine 1Blood	3F/4M	6P/1N	0,47, 0,53(3isl); 0,33(2isl); 0,27
Anesthesia and Reanimation	2	Urine	2M	1P/1N	0,07;0,047
Physical Medicine and Rehabilitation	1	Urine	1F	1N	0,13
Gynocology	1	Urine	1F	1N	0
Cardiology	3	1Blood 2Urine	2F/1M	2N	0, 0,33;0,93
Norologia	1	Urine	1M	1N	0
Pediatric Surgery	1	Urine	1F	1N	0,13
Total	96	89 Urine, 5 Sputum, 2 Blood		50P (%52) 46N(%48)	63 (66%) ≥ 0.2 33 (34%) <0.2

MAR, Multiple Antibiotic Resistance Index, isl; ısolates, +; ESBL Producing-; Non-ESBL Producing F; Female, M; Male

of CRO varied from 41.6% to 91.8% (Park et al.,2012; Ayatollahi et al.,2013). Our results were higher than Ayatollahi et al. (2013) who also reported that CRO resistance rate of *E. coli* 41,6%.

In our study, when we compared to resistance of SXT, *E. coli* isolates showed high antibiotic resistance with 48,95% SXT. In the previous researchers have reported resistance rate SXT from 34% to 16,1% to *E. coli* in clinical samples (Karlowsky et al., 2002; Guneysel et al., 2009).

When it comes to the most sensitive antibiotics, sensitivity rate of FOS, F, ETP, IMI, MEM, GN and AK were 89,58%; 91,66%; 93,75%; 93,75%; 94,79%; 83,33%; 84,37% respectively. Some researchers have reported sensitive rate FOS from 100% to 86% to *E. coli* in clinical samples (Ayub et al., 2016; Lawhale and Naikwade., 2017; Wagle et al., 2018).

Our results were similar to Ouizdi et al. (2018) who also reported that FOS sensitivity rate of *E. coli* 92%. Some researchers have reported sensitive rate F from 100% to 86% to *E. coli* in clinical samples (Lawhale and Naikwade, 2017; Ouizdi et al., 2018). Our results were similar to Ouizdi et al. (2018) who also reported that F sensitivity rate of *E. coli* 92%. Naber et al., (2010) repoprted that a positive urine culture was found in 74.6%, and *E. coli* was most frequent (76.7%) with the highest rate of susceptibility to fosfomycin (98.1%). Similar findings of high susceptibility to nitrofurantoin and fosfomycin shown by Gupta et al. (2013), Fajfr et al. (2017) which is supportive to this study (Gupta et al., 2013; Dash et al., 2013; Fajfr et al., 2017).

The sensitivity rate of TPZ was 53,12%. In previous researchers have reported sensitive rate TPZ from 57.9 % to 9.2% to *E. coli* in clinical samples (Ghafur et al.,2012; Rugini et al.,2015). Our results were similar to Ghafur et al.,2012 who also reported that TPZ resistance rate of *E. coli* 57.9%.

The susceptibility rate of ertapenem from 97.6% to 100% in different countries like Turkey, Estonia, Latvia, Lithuania, Portugal, Romania, Switzerland. and UK (Hawser et al., 2012). Many researchers have reported sensitivity rate ETP from 100% to 14,8% to *E. coli* in clinical samples (Malhotra et al., 2016; Devrim et al., 2018).

Unlike our study, no resistance to IMI was observed by Al-salamy (2012), Malhotra et al. (2016). Some researchers have reported that MEM sensitivity rate to *E. coli* in clinical samples (Mulla et al.,2011; Fernando et al.,2017).

Many researchers reported ESBL activity in *E. coli* strains, Albayrak and Kaya (2009), Eryilmaz et al. (2010) and Mumcuoglu et al. (2004) 19%, 20% and 6% respectively. Guducuoglu et al. (2007) reported the samples according to the origin as policlinics or clinics and showed the ESBL activity as 18% and 47% respectively in *E. coli* strains.

In the present study, 63 (64%) of the isolates showed Multiple Antibiotic Resistance three to fourteen antibiotics. All of the isolates showed resistance to at least one antibiotic. Malhotra et al. (2016) reported that out of 41 MDR isolates, maximum numbers of MDR strains were from urine (43.9%) followed by pus (41.5%), blood (8.3%), fluid (5.6%) and sputum (2.8%) samples (Malhotra et al., 2016). Niranjan & Malini also observed that majority of *E. coli* isolates (76.5%) from urine samples were multidrug resistant like ours.

Conclusion

In this study, it has been shown that *E. coli* in different clinical specimens have experienced high resistance to AM, CXM, CFM and CRO. Some antibiotics show low resistance such as IMI, MEM and AK. An effective national and state level antibiotic policy should be framed for preserving the effectiveness of antibiotics and prevent the emergence of resistance.

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