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Molecular and Bacteriologic Study of β-lactam Resistance *Proteus mirabilis* associated with Urinary Tract Infection in Holy Karbala province, Iraq

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Abstract

The study included isolating and diagnosing *Proteus mirabilis* from patients with urinary tract infections who were previously diagnosed by specialized physicians. In the period from (15 February to 15 May, 2017) , 325 urine samples were collected from Al Hussein Hospital in Karbala , Karbala Children's Hospital and health centers in the province , The number of samples that gave a positive result for laboratory culture was 227 samples formed ratio (69.84%) and the *Proteus spp* bacteria obtained were 31.61% of the total negative bacteria isolates . *Proteus mirabilis* isolates obtained from all isolates of *Proteus spp*. were 38 isolates formed ratio (88.37%). Also been tested the sensitivity of *P .mirabilis* toward 12 β-Lactam antibiotic to determine the most effective antibiotic toward these bacteria (Ampicillin , Piperacillin , Oxacillin , Cefazolin , Cephalothin , Cefoxitin , Ceftazidime , Ceftriaxone , Cefepime , Ertapenem , Imipenem and Aztreonam) were used . The isolates of *P. mirabilis* showed a clear sensitivity to the Erytapenem, Imipenem, and Aztreonam , the sensitivity ratio was 97.3% , 100% and 100% respectively. Polymerase Chain Reaction technique was performed for the detection of β-lactamases enzymes including the most two frequency families of these enzymes (TEM and SHV), The results of Polymerase Chain Reaction showed that 23 isolates formed ratio (60.53%) were harbouring *bla* $_{TEM}$ and 13 isolates formed ratio (34.21%) were harbouring *bla* $_{SHV}$, and this mean that 9 isolates formed ratio (23.68%) were harbouring *bla* $_{TEM}$ and *bla* $_{SHV}$ together

Keyword: *Proteus mirabilis*, *bla* $_{TEM}$, *bla* $_{SHV}$

INTRODUCTION

Urinary tract infection is a common and important disease that affects humans and different age groups and comes after respiratory tract infection in terms of importance. Therefore, this infection has received extensive studies by researchers in the scientific fields and no doubt medical because of the different clinical symptoms and the widespread prevalence in the whole world. The most important causes of urinary tract infection are different types of gram negative and positive microbes. *Proteus mirabilis*, a gram-negative bacteria belonging to the Enterobacteriaceae, is one of the most important bacterial species after *E. coli* caused this type of infection and subsequent serious complications such as a stones formation and pyelonephritis [1]. *Proteus mirabilis* has a number of virulence factors , which have made it one of the main causes of this infection , such as the swarming phenomenon in some solid media and produced a number of enzymes and toxins , such as Urease , Heamolysin and Protease in addition to the types of fimbriae that they possess which facilitate the process of colonization and adhesion in urinary epithelial cells, such as Mannose resistance / Proteus like fimbriae (MR/P)[2]. *Proteus mirabilis* has also been shown to be resistant to many β-lactam antibiotic such as penicillins , cephalosporins , carbapenems and monobactam for various reasons such as the production of β-lactamase enzymes which are important defense enzymes produced by bacterial strains to overcome the effect of β-lactam antibiotic and protect their cells from lysis by penicillins , cephalosporins and other antimicrobial agents and considered bla_{TEM} and bla_{SHV} are the most important genetic families encoded for β-lactamase enzymes. The TEM , a clinically significant enzyme belonging to Class A in beta-lactamase antibiotic which has the ability to lysis a wide range of β-Lactam antibiotic, for the first time in 1965 , *Escherichia coli* was isolated from a patient in Italy named Temoneira. Hence the name TEM , but was also diagnosed in other bacteria such as *K. pneumoniae* and *P.mirabilis* [3]. SHV (Sulfhydryl variant) is a broad spectrum of beta-lactamases (ESBLs), which was discovered in 1972. It is one of the most common enzymes in *K. pneumonia* and is responsible for the resistance of ampicillin, which is mediated by plasmid and chromosome and contains a avariable amino acids, as a result of genetic mutations. In 1980, SHV was detected in *P. mirabilis* bacteria, which showed remarkable resistance to penicillins , cephalosporins and monopactam [3]

Aim of study

Study the resistance of bacterial isolates toward some (β-lactam antibiotic) commonly used to treat urinary tract infections.

Investigate the presence of some β-lactam antibiotic resistance genes in these bacteria.

MATERIALS AND METHODS

Collection of Samples: During the period from (15 February to 15 May, 2017) , a total of 325 urine samples from Al Hussein Hospital in Karbala , Karbala Children's Hospital and health centers in the province were collected from the patients into sterile plastic containers and were transported to the microbiology laboratory and they were processed immediately for detection of pathogenic Gram negative bacteria, it had been cultured on blood agar and macConkey agar to get pure colonies , subculture done on macConkey agar, incubated for overnight at 37C°

Bacterial isolation and identification

The samples were streaked on blood and MacConkey agar plates. The plates were incubated aerobically at 37° C for 24 h. The isolates were identified bacteriologically, biochemically according to [16]. In addition, the morphological features on culture media such as Swarming on blood agar, non lactose fermented growth on MacConkey agar were examined, then identification of bacteria was confirmed by using Vitek 2 identification system **[17]**

Antibiotic sensitivity test

Antibiotic sensitivity test was carried using Kirby Bauer method The following antibiotics were used Ampicillin , Piperacillin , Oxacillin , Cefazolin , Cephalothin , Cefoxitin , Ceftazidime , Ceftriaxone , Cefepime , Ertapenem , Imipenem and Aztreonam . the plates are incubated overnight at 37°C and the isolate was interpreted as susceptible, intermediate or resistant to particular antibiotics by comparison with standard inhibition zones according to Clinical Laboratories Standards Institute (CLSI).

DNA Extraction and Genes Amplification

Isolates were grown on macConkey agar (37 °C, over night). A single colony was inoculated to 5 ml of brain heart infusion broth and grown in a shaking incubator at 37 °C for 16–18 h. Genomic DNA was then extracted using the QIAGEN genomic DNA extraction kit (QIAGEN, USA) according to the manufacturer's recommendation.

PCR Amplification of bla_{TEM} gene and Qnr Genes

Amplification of bla_{TEM} and bla_{SHV} genes were performed in thermal cycler (MJ Reasearch USA) using primers illustrated shown in Table (1) were provided by (Bioneer Company, Korea). Briefly each reaction was carried out in 25µl reaction volume using 12.5µl of Accustart ™ Taq PCR Super Mix (VWR-USA), 1µlof primers, 2µl of DNA template, and 8.5µl of Nuclease free water (ddH2o). Thermocycling parameters were as follows: an initial denaturation of 95 °C for 5 min, 30 cycles of denaturation at 95 °C for 45 s, primer annealing 62 °C for 30 s, and extension at 72 °C for 45s. Finally one extension step at 72°C for 7 min. The amplicons were separated by 1.2% agarose gel electrophoresis at 70 V for 1 h. After electrophoresis, fragments were stained by ethidium bromide and visualized by using ultraviolet ligh

Table (1) show the primers used in PCR

Primer	Sequence		Produt size
TEM	F	5′-ATAAAATTCTTGAAGAAGACGAAA-3′	581 bp
	R	5′-GACAGTTACCAATGCTTAATC-3′	
SHV	F	5′-TCGTTATGCGTTATATTCGCC-3′	320 bp
	R	5′-GGTTAGCGTTGCCAGTGCT-3′	

RESULTS AND DISCUSSION

The number of samples that gave a positive result for laboratory culture was 227 samples formed ratio 69.84% , while the number of samples that gave a negative result of laboratory culture 98 samples formed ratio 30.84% , then the isolates were identified according to phenotypic and biochemical tests found that gram negative bacteria formed ratio 59.9% of total isolates, and the *Proteus spp* bacteria obtained were 31.61% of the total negative bacteria isolates. *Proteus mirabilis* isolates obtained from all isolates of *Proteus spp*. were 38 isolates formed ratio 88.37% . These isolates were initially identified by planting them on macConkey agar and the blood agar. This was followed by a number of morphological and biochemical tests. The isolates were then definitively identified using the diagnostic system (API 20E) andVitek 2 identification system [**17]**

Also been tested the sensitivity of *P .mirabilis* toward β-Lactam antibiotic to determine the most effective antibiotic toward these bacteria which illustrated in figure (1) , The results of the sensitivity test for *P.mirabilis* isolates were shown to 12 antibiotics. A different response to the antibiotic used. The percentage of resistance to Ampicillin and Piperacillin was 97.37% and this is close to what he reached [4]. *P. mirabilis* showed significant resistance to Oxacillin with a resistance ratio 94.8%, and showed a total resistance with ratio 100% to Cefazolin and Cephalothin, In addition , *P. mirabilis* isolates showed different resistance to Cefoxitin , Ceftazidime and Ceftriaxone (92.2%, 63.2% and 47.3%, respectively) and this is close to what he reached[5] also the sensitivity test for Cefepime for *P. mirabilis* isolates was obtained with a sensitivity ratio of 94.7%. The isolates of *P. mirabilis* showed a clear sensitivity to the Erytapenem , Imipenem and Aztreonam , the sensitivity ratio was 97.3%, 100% and 100% respectively. The results were confirmed using the Vetik compact system

The results showed after the samples were removed from the PCR and placed in the electrical relay device described in table 2 and the figure (2), (3) and (4) , 23 isolates of *P. Mirabilis* with ratio 60.53% carry bla_{TEM} with size 581 bp. and 15 isolates were non-carriers of this gene and thus agreed with the percentage obtained [6] which obtained 55% of the samples of these bacteria were carrying this gene, but different from what found in the researcher [7] which found that 76.7% of this bacteria carrying this gene

Table (2) shows the number and percentage of *P.mirabilis* carriers and non-carriers of the resistance genes blaTEM and blaSHV,

Type of gene	Status	number	ratio
bla_{TEM}	Not carrying the gene	15	39.47%
	carrying the gene	23	60.53%
bla_{SHV}	Not carrying the gene	25	65.79%
	carrying the gene	13	34.21%

Table (3) shows the presence of the bla_{TEM} gene in *P.mirabilis* and its effect on the antibiotic resistance mechanism under study. It showed that 23 isolates carrying this gene were resistant to both Ampicillin and Piperacillin by a percentage 60.5% for both of them while there were 14 isolates of these bacteria resistant to these two antibiotic but not carrying this gene with ratio 36.8% for both of them and only one isolation is sensitive to these two antibiotic not carrying this gene with ratio 2.6% and there are no sensitive isolates for these antibiotcs were shown to be carrying this gene. As shown in the table below the role of this gene in resistant Oxacillin antibiotic which showed that there were 23 isolates carrying this gene was resistant to Oxacillin with ratio 60.5% , while there were 13 isolates of these bacteria resistant to this antibiotic but not carrying this gene and with ratio 34.8% and only two isolates are sensitive to this antibiotic without carrying this gene with ratio 5.3%, and no sensitive isolation towards this antibiotic has been shown to be the carrier of this gene , which shows the primary role of this gene in the resistance of Penicillins group and shows that there may be other genes play that role in the resistance of these antibiotics or that there are other mechanics shown by these bacteria in the resistance of these antibiotics for isolates that showed resistance to those antibiotics without carrying these genes. This was explained by [8] in the role of this gene in the resistance of these antibiotics .

As the table shows that 23 isolates carrying this gene were resistant to both Cefazolin and Cephalothin with ratio 60.5% for both of them while there were 15 isolates of these bacteria resistant to these two antibiotic but not carrying this gene with ratio 39.5% for both of them and It is not indicated a presence of any sensitive isolates towards these antibiotic carrying or not carrying this gene.

The table also shows the role of this gene in Cefoxitin resistance which showed that there were 23 isolates carrying this gene was resistant to Cefoxitin with ratio 60.5% while there were 12 isolates of these bacteria resistant to this antibiotic but not carrying this gene with ratio 31.6% and only 3 isolates sensitive to this antibiotic without carrying the gene with ratio 7.9% and no sensitive isolation towards this antibiotic was reported carrying this gene. The table showed that 19 isolates carrying this gene were resistant to Ceftazidime with ratio 50% while there were 5 isolates of these bacteria resistant to this antibiotic but not carrying this gene and with ratio 13.2% and 10 isolates sensitive to this antibiotic without carrying this gene with ratio 26.3% and 4 isolates sensitive to this antibiotic be carriers of this gene with ratio 10.5%

The table also shows that the number of isolates resistant to Ceftriaxone carrier of this gene were 15 isolates with ratio 39.5% while the number of isolates resistant to this antibiotic was 3 with ratio 7.9% are not carriers of the gene , while the number of isolates sensitive to this antibiotic was 12 isolation and not carriers of the gene with ratio 31.6% while the number of isolates sensitive to this antibiotic was 8 isolates with ratio 21.1% and carrier this gene .The table also showed that 2 isolates carrying this gene were Cefepime resistance with ratio 5.3%, while not indicated any isolation from these bacteria resistance to this antibiotic not carrier to this gene , while 21 isolates sensitive to this antibiotic carrier of the gene with ratio 55.3%, as well as 15 isolates sensitive to this antibiotic without carrying this gene with ratio 39.5% and this is what [9] pointed out to the role of this gene in the resistance of these antibiotics.

The table also shows the relationship between the resistance of these bacteria to Carbapenemes group and bla_{TEM} gene , where we note the emergence of only one isolation carrying the gene with ratio 2.6% resistance to the Ertapenem, while no isolation indicated resistance to this antibiotic and did not carry the gene. The table also showed that 22 isolates sensitive to this antibiotic with ratio 57.9% were carriers of the gene while 15 isolates with ratio 39.5% were sensitive to this antibiotic not carrying the gene, while Imipenem antibiotic did not show any isolating carry or not carry of this gene to be resistant to this antibiotic in contrast , 23 isolates with ratio 60.5% were sensitive to this antibiotic carrying this gene while there were 15 isolates of these bacteria sensitive to this antibiotic, but not carrying this gene with ratio 39.5% It is clear from the above to the lack of the effect of this gene in the resistance of Carbapenem group and this is indicated by [10] in a statement that TEM enzymes do not have that role in the resistance of Carbapenem group.

Also Aztreonam , which belongs to the Monobactams group showed the same results observed in Imipenem, that did not show any isolating carry or not carry of this gene to be resistant to this antibiotic in contrast , 23 isolates with ratio 60.5% were sensitive to this antibiotic carrying this gene while there were 15 isolates of these bacteria sensitive to this antibiotic, but not carrying this gene with ratio 39.5% which showed that there was no role for resistance by this gene to Monobactams group.

The results showed that after the samples were removed from the PCR and placed in the electrical relay device described in table (2) and figure (5) , (6) and (7) , 13 isolates of *P. mirabilis* was carrying a bla_{SHV} with ratio 34.21% with size (320bp) and 15 isolates were non-carrying this gene, this is close to what [11] pointed out that the percentage of the gene obtained from *P.mirabilis* isolates is 35%, but it is totally contrary to what [12] concluded that this gene is not observed in isolates of this bacteria.

Table (4) shows that there are 13 isolates with ratio 34.2% carrying this gene and resistance to Ampicillin , while 24 isolates with ratio 63.2% not carrier of this gene and resistant to this antibiotic and only one isolated of these bacteria with ratio 2.6% sensitive to this antibiotic and not carry this gene and there is no isolation sensitive to this antibiotic be carrier of this gene. The table below shows that there are 12 isolates with ratio 31.6% carrying the gene and resistance to Piperacillin , while 25 isolates with ratio 65.8% were not carrying this gene and resistant to this antibiotic and only one isolated of these bacteria with ratio 2.6% sensitive to this antibiotic being gene-carrying , also it is not indicated a presence any sensitive isolation toward this antibiotic do not carry this gene. While Oxacillin showed that12 isolates with ratio 31.6% carry the gene and were resistant to this antibiotic and there were 24 isolates with ratio 63.2% not carry this gene and resistant to this antibiotic while there were only two isolates of these bacteria with ratio 2.6% to each of which are sensitive to this antibiotic, one of which is a carrier of the gene and the other is non-carrier. This was confirmed by [13] in the role of these genes and their responsibility in *P.mirabilis* bacteria in the resistance of Penicillin group.

Table (4) shows that there are 13 isolated with ratio 34.2% carry this gene and resistance to Cefazolin while 25 isolates with ratio 65.8% not carrying the gene and resistant to this antibiotic and no sensitive isolates of these bacteria have been indicated in relation to this carrier or non-carrier of the gene , Cephalothin also showed the same results as Cefazolin that are 13 isolated with ratio 34.2% carry this gene and resistance to Cephalothin while 25 isolates with ratio 65.8% not carrying the gene and resistant to this antibiotic and no sensitive isolates of these bacteria have been indicated in relation to this carrier or non-carrier of the gene ,

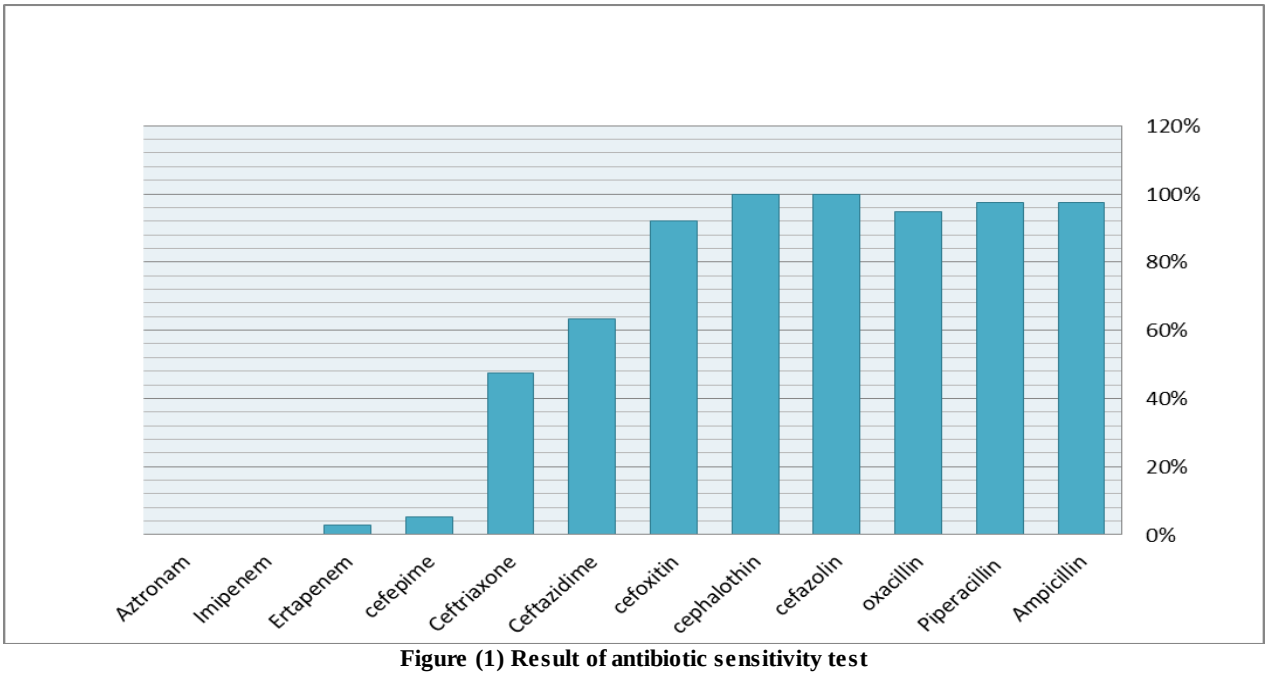

Figure (1) Result of antibiotic sensitivity test

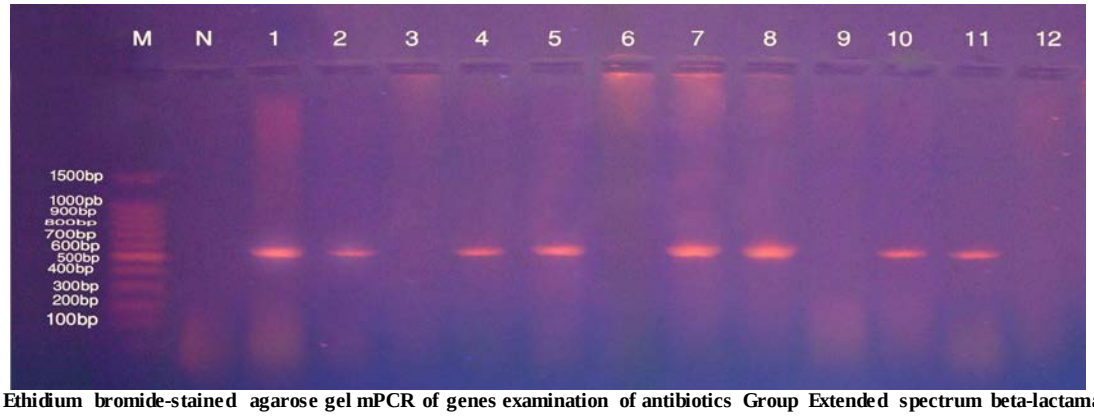

Figure (2) Ethidium bromide-stained agarose gel mPCR of genes examination of antibiotics Group Extended spectrum beta-lactamase bla_{TEM} gene in isolates of *P. mirabilis*. Where an DNA molecular size marker M: Marker ladder 15000-100bp, 8 isolates were positive for the gene beta-lactamase (*blaTEM*) gene length of 581bp. The electrophoresis performed at 70 volt for 1 hr.

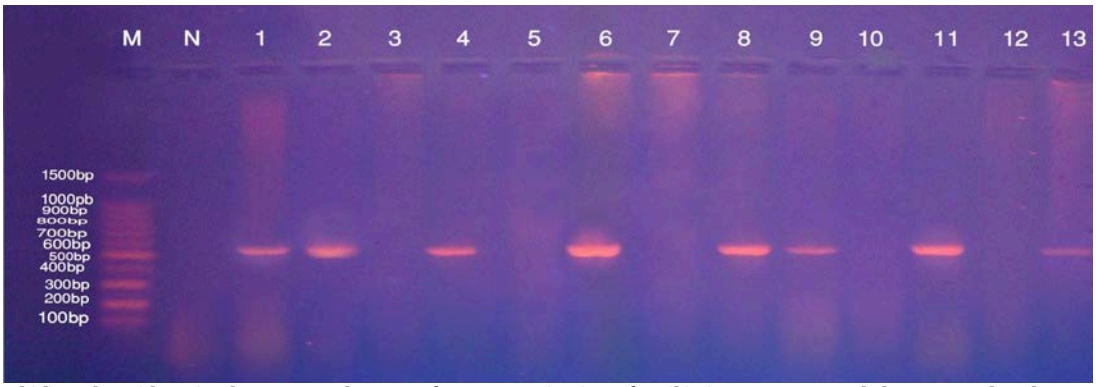

Figure (3) Ethidium bromide-stained agarose gel mPCR of genes examination of antibiotics Group Extended spectrum beta-lactamase bla_{TEM} gene in isolates of *P. mirabilis*. Where an DNA molecular size marker M: Marker ladder 15000-100bp, 8 isolates were positive for the gene beta-lactamase *blaTEM* gene length of 581bp. The electrophoresis performed at 70 volt for 1 hr.

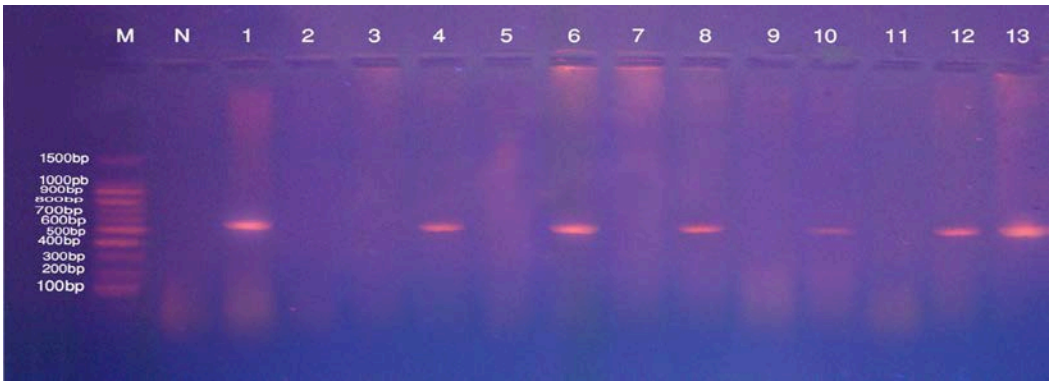

Figure (4) Ethidium bromide-stained agarose gel mPCR of genes examination of antibiotics Group Extended spectrum beta-lactamase bla_{TEM} gene in isolates of *P. mirabilis*. Where an DNA molecular size marker M: Marker ladder 15000-100bp, 7 isolates were positive for the gene beta-lactamase (*blaTEM*) gene length of 581bp. The electrophoresis performed at 70 volt for 1 hr.

The table showed that there were 12 isolates with ratio 31.6% carry the gene and Cefoxitin resistance while there were 23 isolates with ratio 60.5% resistance to this antibiotic and non-carrying this gene and only two isolates were identified with ratio 5.3% were sensitive to this antibiotic and were not carrying the gene compared to only one isolated with ratio 2.6% carry this gene and sensitive to this antibiotic contrary to what was observed in Ceftazidime, it was observed that there were 7 isolates with ratio 18.7% carrying this gene and resistance to Ceftazidime. while 17 isolates with ratio 44.7% were not carry this gene and resistant to this antibiotic while 6 isolates with ratio 15.8% were carry the gene and sensitive to this antibiotic as opposed to 8 isolates with ratio 21.1% not cary the gene and sensitive to Ceftazidime, and 9 isolates were recorded with ratio 23.7% gene-carrying and Ceftriaxone resistance and the same number and ratio is also resistant to this antibiotic but does not carry the gene while 16 isolates with ratio 42.1% were sensitive to this antibiotic and did not carry the gene compared to 4 isolates with ratio 10.5% sensitive to Ceftriaxone and are carriers of the gene .

Table (3) shows the presence of the bla_{TEM} gene in P.mirabilis bacteria and its effect on the antibiotic resistance mechanism under study

Gene found	Resist	Resistant precentage	Sensitive	Sensitive precentage
Ampicillin				
Not	14	36.8%	1	2.6%
harbouring	23	60.5%	0	0.0%
Piperacillin				
Not	14	36.8%	1	2.6%
harbouring	23	60.5%	0	0.0%
Oxacillin				
Not	13	34.2%	2	5.3%
harbouring	23	60.5%	0	0.0%
Cefazolin				
Not	15	39.5%		
harbouring	23	60.5%		
Cephalothin				
Not	15	39.5%		
harbouring	23	60.5%		
Cefoxitin				
Not	12	31.6%	3	7.9%
harbouring	23	60.5%	0	0.0%
Ceftazidime				
Not	5	13.2%	10	26.3%
harbouring	19	50.0%	4	10.5%
Ceftriaxone				
Not	3	7.9%	12	31.6%
harbouring	15	39.5%	8	21.1%
Cefepime				
Not	0	0.0%	15	39.5%
harbouring	2	5.3%	21	55.3%
Ertapenem				
Not	0	0.0%	15	39.5%
harbouring	1	2.6%	22	57.9%
Imipenem				
Not			15	39.5%
harbouring			23	60.5%
Aztreonam				
Not			15	39.5%
harbouring			23	60.5%

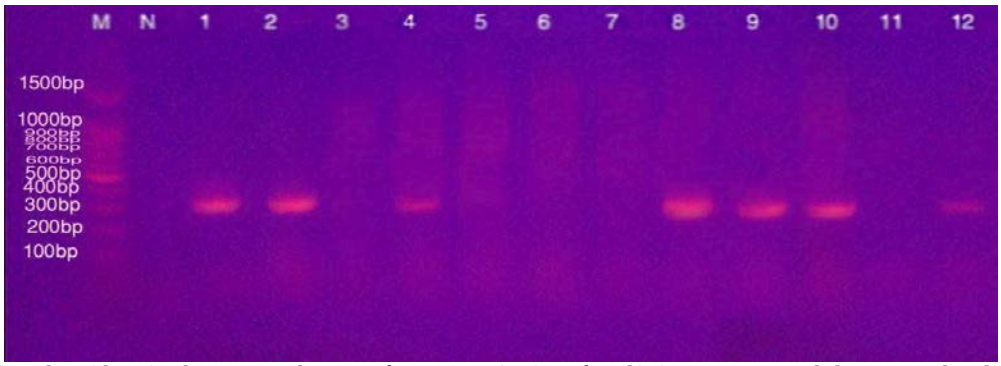

Figure (5) Ethidium bromide-stained agarose gel mPCR of genes examination of antibiotics Group Extended spectrum beta-lactamase $blaS_{HV}$ gene in isolates of *P. mirabilis*. Where an DNA molecular size marker M: Marker ladder 15000-100bp, 7 isolates were positive for the gene beta-lactamase (bla_{SHV}) gene length of 320bp. The electrophoresis performed at 70 volt for 1 hr.

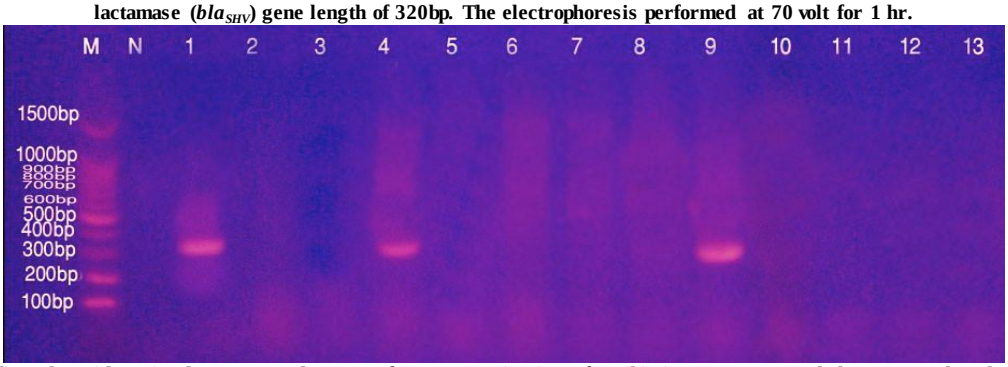

Figure (6) Ethidium bromide-stained agarose gel mPCR of genes examination of antibiotics Group Extended spectrum beta-lactamase $blaS_{HV}$ gene in isolates of *P. mirabilis*. Where an DNA molecular size marker M: Marker ladder 15000-100bp, 3 isolates were positive for the gene beta-lactamase (bla_{SHV}) gene length of 320bp. The electrophoresis performed at 70 volt for 1 hr.

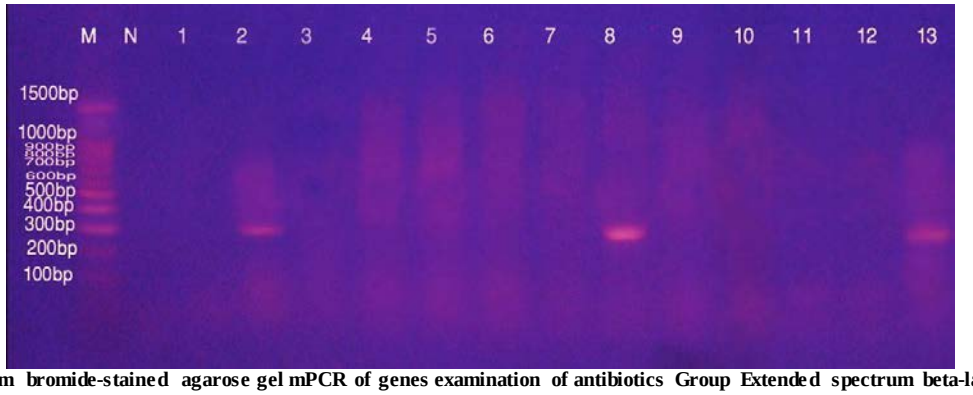

Figure (7) Ethidium bromide-stained agarose gel mPCR of genes examination of antibiotics Group Extended spectrum beta-lactamase $blaS_{HV}$ gene in isolates of *P. mirabilis*. Where an DNA molecular size marker M: Marker ladder 15000-100bp, 3 isolates were positive for the gene beta-lactamase (bla_{SHV}) gene length of 320bp. The electrophoresis performed at 70 volt for 1 hr.

Table (4) shows the presence of the bla_{SHV} gene in *P.mirabilis* and its effect on the antibiotic resistance mechanism under study

Gene found	Resist	Resistant precentage	Sensitive	Sensitive precentage
Ampicillin				
Not	24	63.2%	1	2.6%
harbouring	13	34.2%	0	0.0%
Piperacillin				
Not	25	65.8%	0	0
harbouring	12	31.6%	1	2.6%
Oxacillin				
Not	24	63.2%	1	2.6%
harbouring	12	31.6%	1	2.6%
Cefazolin				
Not	25	65.8%		
harbouring	13	34.2%		
Cephalothin				
Not	25	65.8%		
harbouring	13	34.2%		
Cefoxitin				
Not	23	60.5%	2	5.3%
harbouring	12	31.6%	1	2.6%
Ceftazidime				
Not	17	44.7%	8	21.1%
harbouring	7	18.4%	6	15.8%
Ceftriaxone				
Not	9	23.7%	16	42.1%
harbouring	9	23.7%	4	10.5%
Cefepime				
Not	0	0.0%	25	65.8%
harbouring	2	5.3%	11	28.9%
Ertapenem				
Not	0	0.0%	25	65.8%
harbouring	1	2.6%	12	31.6%
Imipenem				
Not			25	65.8%
harbouring			13	34.2%
Aztreonam				
Not			25	65.8%
harbouring			13	34.2%

Also not marked any isolation resistant to Cefepime do not carry the gene as compard with 2 isolates with ratio 5.3% carry the gene and resistant to Cefepime while 25 isolates with ratio 65.8% not carry the gene and sensitive to the antibiotic and 11 isolates with ratio 28.9% were found to be sensitive to the antibiotic and carry the gene

The results show that there is a correlation between the presence of this gene and the resistance of Cephalosporins to the first and second generation. This is what [14] pointed out to the role of this gene in the resistance of Cephalosporins , contrary to what [12] indicated, there is resistance to Cephalosporins in the isolates of these bacteria without diagnosis of any bla_{SHV} gene in these isolates indicates that there is no association between this gene and the resistance of these antibiotics.

The table also shows the relationship between the resistance of these bacteria to Carbapenemes group and bla_{SHV} gene . We note that 25 isolates with ratio 65.8% are sensitive to Ertapenem antibiotic and not carry the gene compared to 12 isolated with ratio 31.6% sensitive to this antibiotic and carrier of this gene also marked only one isolation with ratio 2.6% resistance to this antibiotic and carrier of this gene compared with the absence of any isolate resistance to this antibiotic not carrier of the bla_{SHV} gene .While there was no indication of any resistance to the Imipenem carrier or non-carrier this gene, in contrast 13 isolates with ratio 34.2% were sensitive to Imipenem carrying the gene

and 25 isolates with ratio 65.8% are sensitive to this antibiotic and are not carrying the gene. This results show the absence of the role of this gene in the resistance of Carbapenem group and this is close to what [12] pointed, where the gene was not obtained from isolates of these bacteria, despite the resistance shown by these isolates of these antibiotics

As shown in the table below, the relationship between resistance of these bacteria to Monobactam group and bla_{SHV} gene where 25 isolates were identified with ratio 65.8% sensitive to Aztreonam do not carry the gene compared to 13 isolates with ratio 34.2% are sensitive to this antibiotic and are carriers of this gene while none of the isolates showed resistance to Aztreonam carrying or not carrying a bla_{SHV} gene which shows that the isolates are not affected by the presence of this gene in the resistance of Monobactams group and this is close to what [15] pointed out that there is no role for this gene in the resistance of these antibiotics

CONCLUSIONS

The results of the present study showed the primary role of *Proteus mirabili*s bacteria as one of the main causes of urinary tract infections.

Proteus mirabilis isolates showed an enhanced sensitivity to fourth-generation Cephalosporins such as Cefepime, and Monobactam group such as Aztreonam, also Carbapenems group such as Ertapenem and Imipenem

The large spread of genes for resistance to beta lactam antibiotic such as bla_{TEM} and bla_{SHV} in these bacteria where the gene TEM is the most common .

RECOMMENDATIONS

The use of antibiotics Cefepime , Aztreonam , Ertapenem and Imipenem in the treatment of urinary tract infection caused by bacteria Proteus mirabilis

Further studies on bacteria using a modern technique such as Real time PCR in the detection of the expression of genes that resistance betalactam antibiotic

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