Urinary Tract Infections Caused by β-lactamase Producing Clinical Bacteria in Oncology Center, Mansoura University, Egypt

Mohamed Ismail Abou-Dobara¹, Ahmed Kassem El-Sayed¹, Hosam Zaghloul² and Yahia Anwar*¹

¹Botany and Microbiology Department, Faculty of Science, Damietta University, Egypt.
²Clinical Pathology Department, Faculty of Medicine, Mansoura University, Egypt.

Received: 26 April 2023 /Accepted: 24 June 2023

* Corresponding author’s E-mail: yahiabdreldeen@yahoo.com

Abstract

β-lactamases exhibited by uropathogenic bacteria represent a major issue in the treatment of urinary tract infections. The resistance of β-lactamases is a world-wide medical issue. Recently, the evaluating of bacterial β-lactamases production, and identification of their drug obstruction, should be a constant cycle. The present study was performed to deduce the antibiotic resistance and the β-lactamases gene type of isolates from Oncology Center Hospital (Mansoura University). The results came out that E. coli and K. pneumoniae were the most associated strains (42.0%, and 35.0%, respectively). Antimicrobial sensitivity test displayed that K. pneumoniae was resistance to Ciprofloxacin and Levofloxacin, Cefotriaxon and Trimethoprim-sulpham by 37.8%, 39.1%, 39.3%, and 33.8%, respectively. E. coli was resistant to Ciprofloxacin and Levofloxacin, Cefotriaxon and Trimethoprim-sulpham by 41.8%, 41.8%, 45.4%, and 46.7%, respectively. The detection of blaTEM gene using Polymerase Chain Reaction showed that it was introduce by 70% in K. pneumoniae and 30% in E. coli of isolates. It could be concluded that β-lactamases production among uropathogenic bacteria is present at a high rate among urinary tract Egyptian cases in Oncology Center Hospital, Mansoura University.

Keywords: Beta-lactamase, urinary tract infections, Escherichia coli, Klebsiella pneumoniae, TEM gene.

Introduction

Infection of urinary tract is indicating to the infection any where in the urinary tract. Infections of urinary tract are run about by a wide compass of microbes, including Gram-positive and Gram-negative bacteria, as well fungi. Urinary tract disorders regularly reach ladies, children and older cases that are generally healthy. Confounded infection of tract of urine is generally associated with catheters, urinary tract irregularities, immunosuppression or resistance to antibiotics. The widely feted causative specialists for urinary tract trouble are Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, Staphylococcus saprophyticus, Enterococcus faecalis, Streptococcus, Staphylococcus aureus...
and Candida spp., Enterococcus spp. (Ana et al 2015). In the event that infection of urinary tract is not treated prematurely and adequately, it might affect into insistent sickness and damage of kidney (Adjei and Opoku, 2004).

Patients with cancer are a special with the characteristics of immune deficiency, and multiple complications (Van et al 2018). The incidence rate of beta lactamase urinary tract infection in cancer patients is high continues (Sime and Biazin 2020).

Bacterial beta lactamases had to be a precaution against the mortal force of cephalosporins and monobactams on cell wall combination. The beta lactamase product is the most predominant design explicable for protection from beta lactams. All beta- lactams have a relative component of action; they discourage the production of cell wall (Essack, 2001). The initiative of beta lactams on sensitive bacteria can be noticed as a two-stages process, in the main stage, the antibiotics tie to native receptors, truly distinguished as grade related penicillin-binding protein. These proteins act focal jobs in the cell cycle associated, morphogenetic blend of cell partition peptidoglycan. In actuation of penicillin-confining protein by set antibiotic has a prompt, biochemically distinguishable impact on their capacity. The later stage incorporates the physiological consequences for the sensitive cell started by this constitutive receptor ligand connection (Donald and Tipper 1985).

Generally, Escherichia coli and Klebsiella pneumoniae are kinds of Gram-negative Enterobacteriaceae with the high frequency causing beta lactamase urinary tract infection (Vachvanichsanong et al 2020), Sanders and Sander (1992), showed up that Enterobacteriaceae beta- lactamases introduced as the most usually in uropathogens, as Klebsiella and E. coli. Other enterobacteria also produce beta-lactamases to a low category (Goussard and Courvlin 1999, Bush and Jacoby 2010). Multifarious spitz of beta- lactamases was assembled into class (A, B, C and D) (Bush et al 1995). Beta-lactamases class A which are arrested in vitro by sulbactam, tazobactam, and clavulanic acid while those having a grade with class B, class C and class D aren’t slammed (Patricia 2001). A large part of beta lactamases are extrapolated from TEM gene and SHV gene mutations. Beta-lactamases creatures basically spread, and turned into a considerable reason for infections associated with high death rates, particularly in effective diseases like septicemia (Bjorn et al 2005).

The beta-lactamases enzymes exhibited by bacteria are gradually causing urinary tract infections both in hospitalized and others cases. This is making treatment of urinary tract problems troubling and advancing more prominent application of expensive extensive range antibiotics, for instance, carbapenems.

Identification of beta-lactamases involving standard antimicrobial helplessness approaches and deferral in the recognition and announcating of beta-lactamases promotion by Gram-negative bacilli are related with delayed clinic stay, increase bleakness, mortality and medical care price tickets (Mehran and Rahbr 2008). The aim of our research was to estimate the antibiotic resistance of beta-lactamases pathogenic bacteria in Mansoura University Oncology Center.

Material and Methods

This study imparted in the laboratories of Microbiology of the Mansoura Center of Oncology, Egypt from the first of October, 2019 to end of September, 2020. Collection of urine samples were done by the medical center nurses then transferred to the microbiology laboratory, then reprocessed for urine culture, were streaked on of MacConkey agar medium at 37 °C were also incubated for 24 h. With the appearance of bacterial growth including all bacterial isolates with a clinically significant growth were included in study. The strains were identified using the Vitek 2 system at Mansoura University Oncology Center. Samples tested for antibiotic resistance using the method of disk diffusion, for 24 h, the disks were placed on the plates at 37 °C. After incubation, the inhibition zone diameter was measured by (mm) and the testing susceptibility results were observed according to CLSI (2011).

Detecting of beta-lactamase producers using polymerase chain reaction (PCR) based detection (Koneman et al 1997, Hefernan et al 2007). Extraction of DNA was performed according to guidelines of the kit of Qiagen isolation DNA kit (Germany). The targeted genes were amplified using Taq polymerase master mix (ready to use PCR reagent) using specific primers for antibiotic blaTEM. DNA was amplified with the thermal cycler Robocycler (Stratagene) using the cycling parameters and the conditions of amplification (Table 1).
DNA fragments were visualized by the agarose gel electrophoresis. DNA band of 800 bp were interpreted as positive specimen for presence of TEM gene.

Table 1: PCR primer used for detecting blaTEM gene

<table>
<thead>
<tr>
<th>Nucleotide sequence (5’-3’)</th>
<th>Target gene</th>
<th>Ta (°C)</th>
<th>Product size</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>F: CATTTCGGT GTCGCCCT TATTCC</td>
<td>blaTEM</td>
<td>58</td>
<td>800 bp</td>
<td>Luo et al 2011</td>
</tr>
<tr>
<td>R: CGTTCATC CATAGTTG CCTGAC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Results**

The total numbers of samples include one hundred and fifty during the study period. 96 bacterial isolates were obtained from urine samples. Gram-negative bacilli were the most common. There were 42.0% E. coli, 35.0% and K. Pneumoniae, others isolates mentioned in Table 2.

**Klebsiella pneumoniae** was resistant to Cefpodoxime, levofloxacin Ceftoprazon-sulbactam, Cefazidime and Ciprofloxacin by 46.1%, 39.1%, 44.4%, 38.4%, and 37.8, respectively. E. coli was resistant to Piperacillin-tazobactam, Gentamycin, and Ceftazidime, Ciprofloxacin, and Levofoxacin by 57.1%, 58.8%, 46.1%, 41.8%, and 41.8, respectively. K. pneumoniae was sensitive for cefoxitin by 50%, E. coli was sensitive to cepoprazon-sulbactam, levofloxacin and ciprofloxacin, also with 50% (Table 3).

Table 2: Bacterial isolates distribution among studied cases

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>E. coli</th>
<th>K. pneumoniae</th>
<th>Enterococci</th>
<th>Pseudomonas</th>
<th>Proteus mirabilis</th>
<th>Citrobacter</th>
<th>Breundimona</th>
<th>Raoultella</th>
<th>Kluyvera cryocrescens</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R%</td>
<td>1%</td>
<td>S%</td>
<td>R%</td>
<td>1%</td>
<td>S%</td>
<td>R%</td>
<td>1%</td>
<td>S%</td>
</tr>
<tr>
<td>Amoxillin-clavulanic</td>
<td>41.6</td>
<td>25.1</td>
<td>33.3</td>
<td>16.6</td>
<td>30.1</td>
<td>33.3</td>
<td>0.142</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>39.1</td>
<td>60.9</td>
<td>0</td>
<td>41.8</td>
<td>8.2</td>
<td>50</td>
<td>&lt;0.001*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azetronam</td>
<td>16.6</td>
<td>83.4</td>
<td>0</td>
<td>83.3</td>
<td>16.7</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azithromycin</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>33.3</td>
<td>66.7</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amikacin</td>
<td>77.3</td>
<td>4.2</td>
<td>18.5</td>
<td>45.4</td>
<td>18.9</td>
<td>35.7</td>
<td>0.254</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azlocilin</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefazidime</td>
<td>38.4</td>
<td>61.6</td>
<td>0</td>
<td>46.1</td>
<td>53.9</td>
<td>0</td>
<td>&lt;0.001*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>46.1</td>
<td>28.9</td>
<td>25</td>
<td>35.8</td>
<td>64.2</td>
<td>0</td>
<td>&lt;0.001*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>37.8</td>
<td>62.2</td>
<td>0</td>
<td>41.8</td>
<td>8.2</td>
<td>50</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefoprazon</td>
<td>44.4</td>
<td>55.6</td>
<td>0</td>
<td>37</td>
<td>13</td>
<td>50</td>
<td>0.039*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>39.3</td>
<td>50.7</td>
<td>10</td>
<td>45.4</td>
<td>54.6</td>
<td>0</td>
<td>0.982</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>39.3</td>
<td>40.8</td>
<td>22.2</td>
<td>40.7</td>
<td>3.8</td>
<td>55.5</td>
<td>0.983</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefexime</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefexime</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefexime</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefexime</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefexime</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R(Resistance), S(Sensitive), I(Intermediate).
Urinary Tract Infections Caused by β-lactamase Producing. Scientific Journal for Damietta Faculty of Science 13(1) 2023, 128-134

Cancer Institute of Egypt (Hossam and Amany 2009) and 14.2% in Al-Azhar University (Khalid et al. 2010). According to Mekonnen et al. (2023), presence of bacterial infection in urinary tract was 24.1%, and most of the bacterial isolates 68.75% were gram-negative bacteria, the E. coli 28.75% and K. pneumoniae 12.50%.

Comparably typical studies appeared changing rate from 20% to 40% in Greece (Bratu et al. 2005; Giakoupi et al. 2009), and approached consequent of 83% was showed in America (Marquez et al. 2013). The pervasiveness of carbapenem resistance K. pneumoniae was 33.3% (Dalia and Doaa 2017). Our results showed that TEM gene is spread among Enterobacteriaceae by 20% in clinical isolates. Worldwide spread of β-lactamases exhibiting strains gives an extraordinary importance to the exploration of these strains in original area and emergency gatherings for reassessment of the immediate treatment prescriptions. In Egypt, mutitudinous examinations have delved the pervasiveness of beta lactamases among Enterobacteriaceae dissociated from medical clinics and local domain gained urinary tract infections (Fam et al. 2011; Abdel-Moaty et al. 2016; Hasuna et al. 2020). Additionally, our commonness of β-lactamases showing isolates is veritably advanced than that revealed in a several other Egyptian surveys; namely, 17% by Fam et al (2011) and 38.8% by Shash et al (2019). The pervasiveness of β-lactamases differences as indicated by species, geological zones, kinds in infection control programs, various exemplifications of empiric antibiotic rules and, unexpectedly, after some time. El-Nagdy (2016) found that 139 out of 200 E. coli isolates from urinary tract infected patients were multidrug resistant E. coli and he also recorded that 129 out of 200 of E. coli are positive for extended spectrum beta lactamase. According to Wang et al., (2023), E. coli presented the absolute percent 82.50% for production the beta lactamase enzyme, so it served as the most contributed to the overall trend in the prevalence of beta lactamase enzyme urinary tract infection in that study, and also K. pneumoniae with 16.82%, presented the subsidiary effect on the all prevalence of beta lactamase enzyme urinary tract infection. Besides, specific pressure ran about by the misemployment of antibiotics in certain nationalities prompts the rising of β-lactamases production. Since the beginning of the new
thousand periods, E. coli has turned into the most regularly restricted β-lactamase exhibiting bacteria worldwide with CTX-M being the most frequently disentangled types (Hong et al 2018) as 43.9% of E. coli and 56.1% of K. pneumoniae produced β-lactamase. The genes from SHV and TEM types among the β-lactamase producing isolates were 14.4% and 20.6%, respectively. Proportions of positive β-lactamase isolates from out-cases to hospitalized patients were 24% to 33% (Fatemeh et al 2012).

Bajpi et al (2017) concluded the pervasiveness of β-lactamase TEM, SHV, and CTX- M genes among the individualities from Enterobactriaceae as 78.2% E. coli and Klebsiella isolates were recognized out of the 80% individualities. Additionally, the frequency of TEM gene was 55.1% in E. coli and 58% for Klebsiella. Jena et al (2017) have delved the predominance of SHV TEM and CTX genes of β-lactamase producing E. coli isolated from urinary tract infection. The predominant TEM gene was 93.43% followed by CTX was 82.21 %, and SHV was 4.3%. In another research, Bali et al (2010) showed that among the beta lactamase producing E. coli (71.93 %) was TEM gene.

Conclusion

Our research had offered an overview of the common urinary bacteria introduced in Oncology Hospital Mansoura and appeared a specific diverseness. The spectrum of antibiotic conditioning showed that some antibiotics apply the effectiveness on urinary tract infections. Mansoura Hospital of Oncology as well as in other developing nationalities, many propensities were at point of distinguished as conditioning which advancing the resistance development of bacterial strain to antibiotics as a self- medication, TEM gene is far reaching among clinical isolates. Wide spread of beta lactamase producing strains gives an extraordinary importance to disposition of these strain in local area and medical clinics for assessment of the instant therapy prescriptions.

Acknowledgements

The authors are thankful to Mansoura Oncology Center Hospital, Mansoura University for providing the necessary laboratory facilities.

References


Clsi. Clinical and Laboratory Standards Institute
Urinary Tract Infections Caused by β-lactamase Producing \dots Scientific Journal for Damietta Faculty of Science 13(1) 2023. 128-134


Patricia A. 2001. Extended-spectrum β-lactamases in the 21st century: characterization, epidemiology, and detection of this important
Urinary Tract Infections Caused by β-lactamase Producing… Scientific Journal for Damietta Faculty of Science 13(1) 2023. 128-134


الملخص العربي

عنوان البحث: التهابات المسالك البولية التي تسببها البكتيريا السريرية المنتجة للبيتا لاكتاماز في مركز الأورام ، جامعة المنصورة ، مصر

محمد إسماعيل أبو دبارة 1، أحمد قاسم السيد 1، حسام زغلول 2، يحي أنور الدسوقى 1*
1قسم النبات والميكروبيولوجي، كلية العلوم، جامعة دمياط، مصر
2قسم الباثولوجيا الإكلينيكية، كلية الطب، جامعة المنصورة، مصر

تعد التهابات المسالك البولية أحد الأسباب الرئيسية لوصف الأدوية واستهلاك المضادات الحيوية من أجل استخدام أفضل علاج البكتيريا المسببة. لذلك فإن المراقبة المنتظمة في كل دولة مطلوبة. هدفت هذه الدراسة إلى التحقق من التنوع البكتيري الموجود ومعدلات مقاومة مضادات الميكروبات للبكتيريا المسببة للأمراض البولية بمستشفى المنصورة للأورام (مصر-مدينة المنصورة) في الفترة من 1 أكتوبر 2019 إلى 30 سبتمبر 2020. تمت تحليل النتائج لعينات البول بجرم و بعد التحليل لعينات البول في مستشفى مركز الأورام المتخصص وفقاً للبروتوكول الروتيني، تم تحليل النتائج. وجدنا أن معظم البكتيريا كانت إشريشيا كولاي و كلبسيلا بنيومنيا، حيث كانت إشريشيا كولاي 42.0٪ و كلبسيلا بنيومنيا 35.0٪. أظهرت الاختبارات المقاومة للمضادات الحيوية أن كلبسيلا بنيومنيا كانت أكثر مقاومةً للسيبروفلوكساسين بنسبة 39.3٪، بينما كانت مقاومة إشريشيا كولاي لمضادات خميرة كوكسية و أفوكوبكساسين بنسبة 41.8٪. يبدو أن نوع بكتيريا السريرية للأمراض البولية التي تم الحصول عليها مميزة، حيث توجد بعض البكتيريا المسببة للأمراض البولية التي تم الحصول عليها مقاومة لمضادات حيوية مختلفة. هذا يشير إلى أن تطبيق أسلوبية متعددة مقاومة مع ظهور بكتيريا متعددة المقاومة، فإن تحديد الأسباب الخاصة بالمنطقة أمر بالغ الأهمية لتكييف العلاج بالمضادات الحيوية. وجدنا أيضًا أن مصطلح التهابات المسالك البولية يشمل البكتيريا كولاي و كلاسيلا بيديوما هو جين ال .TEM gene.