Middle-East Journal of Scientific Research 20 (9): 1041-1045, 2014
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2014.20.09.82312

Susceptibility of Gram Negative Bacteria to Three Frequently Used Antibiotics from Specimens Sent to the Laboratory of Shahidbeheshti Hospital

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Abstract: Gram-negative bacteria (GNB) are important pathogens due to high morbidity and mortality the cause. As the use of different antibiotics increase in the treatment of gram-negative infections we evaluated the pattern of infection and bacterial susceptibility of GNB in Shahidbeheshti Hospital. In our 205 samples 64.4% were *E. coli*, 15.1% *Klebsiella*, 9.7% *Pseudomonas*, 4.9% *Enterobacter*, 3.4% Citrobacter, 1% Proteus and 1% *Acintobacter* and 0.5% *Brucella*. There were 21.4% resistance rate for ciprofloxacin 14.6% for nitrofurantoin. The resistance rate of ceftriaxone was 49.7%. High rates of GNB resistance is an exaggerating threat, especially when we look at low rates of previous years studies.

Key words: Antimicrobial · Bacteria · Resistance · Ciprofloxacin · Ceftriaxone

INTRODUCTION

Gram-negative bacteria (GNB) are the dominant killers among bacterial pathogens in the intensive care unit and are important pathogens when it comes to treatment. Antibiotic resistance has become a threat in hospital settings [1]. The global problem of antimicrobial resistance is particularly important in developing countries, where the infectious disease rate is high and cost constraints prevent the widespread application of newer, more expensive agents. It is one of the biggest challenges facing global public health [2-6].

Although antimicrobial drugs have saved many lives and eased the suffering of many millions; bad governance in developing countries has tremendously limited the benefits of these drugs in controlling infectious diseases. The development of resistance in pathogens has worsened the situation limited the antimicrobial agents choices [6-11]. Although antimicrobial resistance is a challenging issue of the medicine, nowadays, the increasing trend of antimicrobial resistance is most worrisome for GNB because there has been little successful development of new antibiotic agents targeting this class of pathogens [12]. Furthermore, we are now in the presence of GNB that have "extreme drug resistance," indicating complete resistance of strains to first-line antibiotics used for the treatment of GNB infections plus second-line drugs [13].

As the use of different antibiotics increase in the treatment of Gram-negative infections and also there is a lack of access to accurate information on regional sensitivity pattern of these antibiotics and although previous announcements of high bacterial resistance in our hospital settings [2, 5, 8, 10] we decided to evaluate pattern of infection and bacterial susceptibility of Gram-negative bacteria in patients with positive culture of GNB in Shahidbeheshti Hospital in 2010-2011.

MATERIALS AND METHODS

This study was approved by Kashan University of Medical Sciences Ethical Committee and names of the patients remained unrevealed In this retrospective study, by referring to the Shahidbeheshti Hospital laboratory, cultures of Gram-negative bacteria isolated from different samples of patients admitted to the hospital from1st Jun 2010 to 1st December 2011, were identified [14]. Final diagnosis and susceptibility of every case to

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ciprofloxacin, ceftriaxone and nitrofurantoin have been added to checklists and all data were analyzed with SPSS software version 11.5. Antimicrobial susceptibility was evaluated by the Kirby-Bauer disk diffusion method in guide lines of Clinical and Laboratory Standards Institute [14].

RESULTS

Data of 205 samples that had been entered to checklists were evaluated. 97 (47.3%) were from male patients and 108 (52.7%) were from female ones.

The susceptibility patterns among samples of patients with GNB are shown in figure 1; and figure 2 shows different bacterial types.

Different bacterial resistance pattern are illustrated in table 1 and figure 3.

DISCUSSION

By discovery of antimicrobials in 1940s, human gained the power of defeating infection. However, the remarkable healing power of antibiotics invites widespread and often inappropriate use.

Table 1: Susceptibility of different GNB to the 3 tested antibiotics

	Ciprofloxacin			Ceftriaxone			Nitrofurantoin			
Antibiotic	S	I	R	S	I	R	S	I	R	Sum
E. coli	95	8	29	52	14	66	28	91	13	132
Klebsiella	18	6	7	13	6	12	14	10	7	31
Pseudomonas	11	4	5	6	4	10	12	5	3	20
Enterobacter	5	3	2	1	2	7	5	3	2	10
Citrobacter	5	2	0	1	2	4	1	4	2	7
Proteus	2	0	0	0	1	1	0	1	1	2
Acintobacter	1	0	1	1	0	1	0	1	1	2
Brucella	0	1	0	0	0	1	0	0	1	1
Total	137	24	44	74	29	102	60	115	30	205

Table 2: Comparison of antibiotic resistance (in percentages) in years 2007, 2008, 2009, 2010 of Khalili *et al*. [18] study and present study (7: 2007, 8: 2008, 9: 2009 and 10: 2010) in Khalili *et al*. [18] study, P: Present study (Jun 2010 till December 2011)

	Ciprofloxacin					Nitrofurantoin					Ceftriaxone				
Bacterial type	7	8	9	10	P	7	8	9	10	P	7	8	9	10	P
Asintobacter	8	8	13	4	50	5	3	0	2	50	15	13	10	9	50
E. coli	44	51	49	18	21.9	2	11	11	1	4.8	51	50	55	17	50
Entrobacter	8	7	8	2	20	1	8	3	0	20	9	12	8	5	70
Klebsiella	20	7	20	7	22.5	1	3	3	2	22.5	16	6	13	4	38.7
Proteus	5	3	7	0	0	2	0	1	1	50	5	0	2	0	50
Pseudomonas	2	9	14	3	25	1	8	3	5	15	7	13	19	8	50

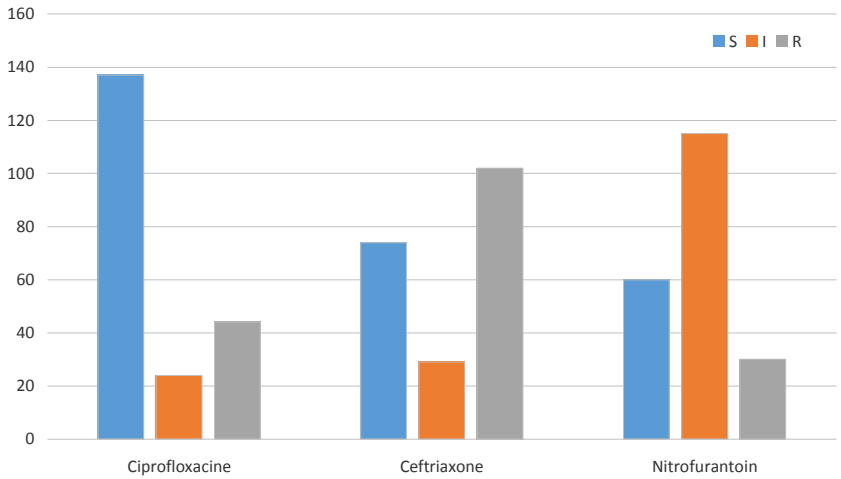

Fig. 1: Susceptibility pattern of ciprofloxacin, ceftriaxone and nitrofurantoin among patients with GNB

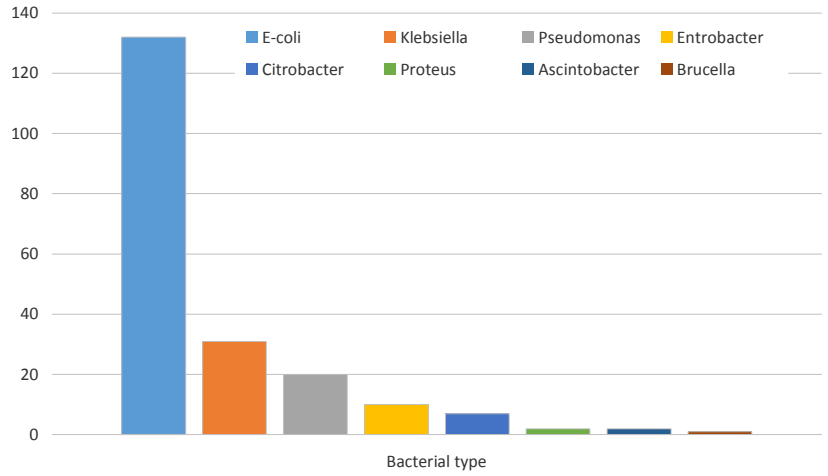

Fig. 2: Distribution of bacterial types among patients with GNB sample

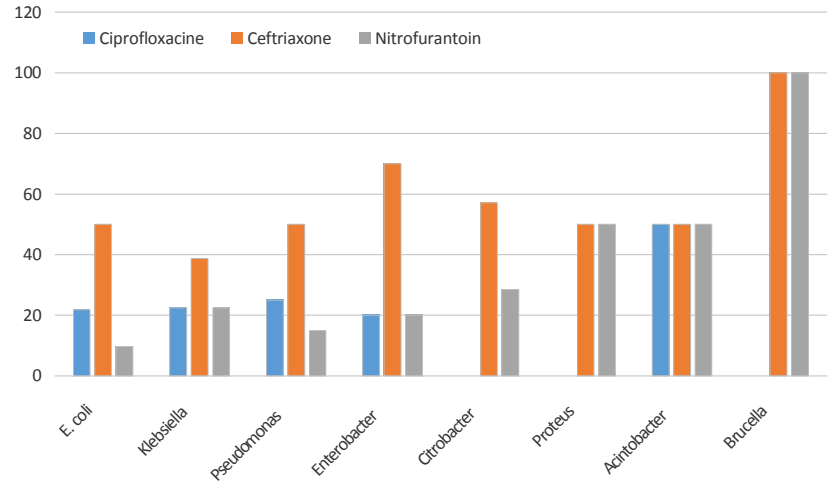

Fig. 3: Resistance rate of GNB to different antibiotics

This misuse and overuse of antibiotics leads to antibiotic resistance among bacteria and consequent treatment complications and increased healthcare costs. In this study we determined the susceptibility pattern of GNB to 3 commonly used antibiotics that are ciprofloxacin, ceftriaxone and nitrofurantoin. These antibiotics are chose because they are frequently administered in Shahidbeheshty Hospital but in our practice we encountered various reports of failure in treatment with these antibiotics. In our 205 samples 64.4% were *E. coli*, 15.1% *Klebsiella*, 9.7% *Pseudomonas*, 4.9% *Enterobacter*, 3.4% *Citrobacter*, 1% Proteus and 1% *Acintobacter* and 0.5% *Brucella*. There were 21.4% resistance rate for ciprofloxacin and 30 isolates (14.6%) were resistant to nitrofurantoin. In a study by Sureshkumar *et al*. [15] that conducted on 734 GNB samples, there were 27.9% *E. coli*, 25.7% *Klebsiella*, 36.7% *Pseudomonas*, 6.1% *Proteus* and 3.6% *Acintobacter*. The resistance rate to ciprofloxacin was 32% which is twice our result and may be attributed to the prevalent use of ciprofloxacin in that study compared to ours. But the results of nitrofurantoin resistance conveys that there may be similarities in the use of this antibiotic in the two studies, because the resistance rate of the antibiotic is 18% in that study.

In our study resistance rate of *E. coli* to ceftriaxone and ciprofloxacin was 50% and 21.9%. In a study by Hsu *et al*. [16] resistance rate of *E. coli* to ceftriaxone and ciprofloxacin were announced 20% and 38.7%. Regarding *Klebsiella* resistance to ceftriaxone and ciprofloxacin our results are 38.7% versus 22.5 and Hsu's study that are 32.3% and 30.1%. This shows the different antibiotic use

in two studies. But these results show that although most of these results are less than 50% but *E. coli* as the most prevalent GNB type in our study reaches 50% resistance rate to ceftriaxone that should ring the alarm for using this antibiotic.

In 2001 Mazzulli *et al*. [17] announced the resistance rate of GNB to ciprofloxacin and nitrofurantoin 0% and 4.6%, while the results in the present study are 21.4% and 14.6% respectively and shows that there is an increasing rate in antibiotic resistance through these 13 years. We have put our results in series with Khalili *et al*. [18] results concerning resistance of each GNB in 2007, 2008, 2009 and 2010 as table 2 shows. It appeared that the trend of increasing in antibiotic resistance is much more than we expected in these years.

Antibiotic resistance has become a new challenge in clinical medicine. High rates of GNB resistance is a threat, especially when we look at low rates of previous years in other studies. New policies can prevent this uncontrollable burst in bacterial antibiotic resistance. These policies should perform by all countries especially those high in bacterial resistance like Iran.

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