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Bacterial pathogens and antibiotics susceptibility in children with gastroenteritis who attend Al-Batool teaching hospital in Diyala, Iraq

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Abstract

Background: Antibiotic-resistant infections are already widespread in all the world. Many public health organizations have described the rapid emergence of resistant bacteria as a “crisis” or “nightmare scenario” that could have catastrophic consequences. Thus, it was conducted this study due to the importance and seriousness of this situation.

Methods: it was collected 120 stool samples of patients with confirmed diagnosis of gastroenteritis who attend al-batool teaching hospital in Diyala. It was collected the data from the previous records of the public laboratories.

Results: *E. coli* was the most common bacteria in the isolate (63%) then *Klebsiella* (39%), *Enterbacter* (4%), *Pseudomonas* (3%) and *Staphylococcus* spp. (1%). There was high resistance for the common antibiotics such as ceftazidime and azithromycin.

Conclusion: It was shown there are increased rates of resistance bacteria among the Iraqi patients and need urgent intervention from the health authorities. The most resistant antibiotic was ceftazidime and the most sensitive was nitrofurantoin.

Keywords: Antibiotic susceptibility, Gastroenteritis, Enterobacteraceae.

Introduction

The majority of infectious diseases are bacterial in origin. With the discovery of laboratory methods to grow these microorganisms using an appropriate growth medium known as "culture," determining the sensitivity and resistance of specific pathogens to a wide range of antimicrobial agents becomes necessary so that healthcare providers can immediately institute proper treatment regimens to their patients (1).

As early as 1945, Sir Alexander Fleming raised the alarm regarding antibiotic overuse when he warned that the "public will demand [the drug and] … then will begin an era … of abuses." The overuse of antibiotics clearly drives the evolution of resistance. Epidemiological studies have demonstrated a direct relationship between antibiotic consumption and the emergence and dissemination of resistant bacteria strains. In bacteria, genes can be inherited from relatives or can be acquired from nonrelatives on mobile genetic elements such as plasmids. This horizontal gene transfer (HGT) can allow antibiotic resistance to be transferred among different species of bacteria. Resistance can also occur spontaneously through mutation. Antibiotics remove drug-sensitive competitors, leaving resistant bacteria behind to reproduce as a result of natural selection. Despite warnings regarding overuse, antibiotics are overprescribed worldwide (2-5).

Antibiotic-resistant infections are already widespread in the U.S. and across the globe. A 2011 national survey of infectious-disease specialists, conducted by the IDSA Emerging Infections Network, found that more than 60% of participants had seen a pan-resistant, untreatable bacterial infection within the prior year. Many public health organizations have described the rapid emergence of resistant bacteria as a "crisis" or "nightmare scenario" that could have "catastrophic consequences." The CDC declared in 2013 that the human race is now in the "post-

antibiotic era," and in 2014, the World Health Organization (WHO) warned that the antibiotic resistance crisis is becoming dire (6,7).

Antimicrobial susceptibility testing (AST) is a laboratory procedure performed by medical technologists (clinical laboratory scientists) to identify which antimicrobial regimen is specifically effective for individual patients. On a larger scale, it aids in the evaluation of treatment services provided by hospitals, clinics, and national programs for the control and prevention of infectious diseases. Recently, researchers have had to implement continuous surveillance activities for resistance patterns due to the mutations in bacterial DNA (8).

Acute diarrhea as a gastrointestinal related symptom may have some different causes such as infection. Infectious diarrhea leads to approximately three million deaths worldwide in children younger than 5 years per year. The rate of entropathogen isolation in acute diarrhea varied in different studies depending on the sampling methods and microbiological techniques. Some of them, the most common bacterial pathogen is diarrheagenic *E. coli* (9).

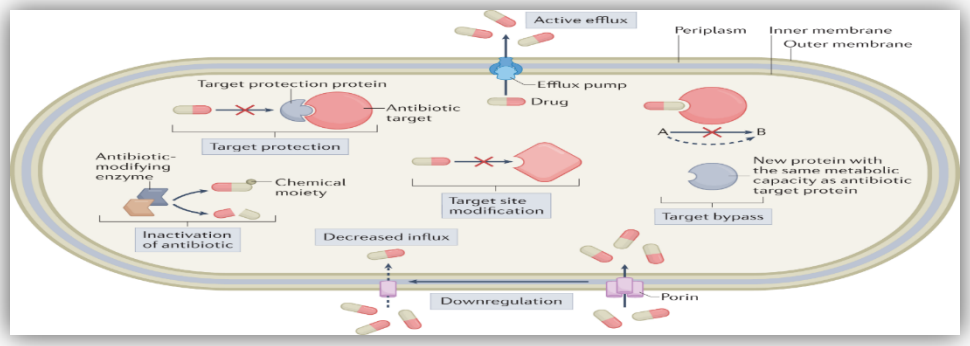

Figure 1. Mechanism of bacterial resistance for antibiotic action.

Figure 2. Antimicrobial susceptibility test.

Gastroenteritis due to enteric pathogens is generally a self-limiting disease for which antimicrobial treatment is not required. However, treatment should be considered for cases of severe or prolonged diarrhea, extraintestinal isolation of bacteria, or diarrhea in immunocompromised hosts, the elderly, and infants. Various resistance trends and current issues concerning antimicrobial susceptibility testing of enteric pathogens are studied in this article, including *E.coli, Klebsiella pneumoniae*, *staph* spp, *Enterobacter* and *Pseudomonas aerogenosa* (10).

Due to the overuse of antibiotics and change in epidemiology and antimicrobial resistance of bacterial agents, we conducted a study on the bacterial pathogens and antibiotic susceptibility among children with gastroenteritis.

Patients and Methods

This is observational study conducted in the Department of Pediatric in AI-Batool Teaching Hospital, Diyala Governorate, Iraq in the period from September 2022 to November 2022.

This study includes one hundred twenty stool samples (age ranged between 1 month to10 years) with confirmed diagnosis of gastroenteritis of males and a number of females that were admitted to the Neonatal care unit at the Al-Batoul Teaching Hospital for Gynecology and Pediatrics in Baqubah, Diyala Governorate.

It was collected the data from the public laboratories in the hospital after taking all the permissions required from the authorities and the administrators. The privacy and confidentiality of the patients was preserved.

Statistical analysis

Statistical package for social sciences (SPSS) version 17 was used to analysis the data that was collected. It was expressed the quantitative data by frequencies and percentages.

Results

It was collected 120 stool samples from the public laboratories in Al Batool hospital with confirmed bacterial gastroenteritis diagnosis. The male samples were 66 (55%) and the female were 54 (45%). The age groups are demonstrated in table1.Table 1. Distribution of patients according to their age and sex.

Age group	No.	Males	Females
Less than 1 month	11	4	7
1-3 months	8	5	3
4-6 months	9	4	5
7-12 months	11	6	5
1-5 years	9	3	6
5-10 years	10	5	5
More than 10 years	5	3	2
Total	120	66	54

It was showed that there are five main types of bacterial pathogens are caused gastroenteritis in children as shown in table 2.

Table 2. The types of the bacteria that cause gastroenteritis.

Bacteria	No.
Escherichia coli	63 (52.5%)
Klebsiella pneumoniae	39 (32.5%)
Enterobacter	4 (3.34%)
Pseudomonas aerogenosa	3 (2.5%)
Staphylococcus spp.	1 (0.83%)
No growth	10 (8.3%)
Total	120

It was used six different antibiotics for the susceptibility test in this study as shown in table 3.

Table 3. The antibiotics were used in the antibiotic susceptibility test.

Antibiotic	**Abbreviation**
Azithromycin	AZM
Levofloxacin	LE
Meropenem	MRP
Norfloxacin	NX
Ceftazidime	CAZ
Nitrofurantoin	NIT

It was demonstrated the results of *E. coli* susceptibility test in the table 4.

Table 4. *E. coli* antibiotic susceptibility test.

Antibiotic	**Sensitive**	**Resistant**
Azithromycin	22 (34.8%)	41 (65.2%)
Levofloxacin	38 (60.2%)	25 (39.8%)
Meropenem	59 (93.5%)	4 (6.5%)
Norfloxacin	34 (53.3%)	29 (46.7%)
Ceftazidime	3 (4.7%)	60 (95.3%)
Nitrofurantoin	54 (86%)	10 (14%)

Furthermore, the antibiotic susceptibility test of *Klebsiella pneumoniae* was showed in table 5.

Table 5. *Klebsiella pneumoniae* susceptibility test

Antibiotic	Sensitive	Resistant
Azithromycin	14 (36%)	25 (64%)
Levofloxacin	21 (54%)	18 (46%)
Meropenem	38 (97%)	1 (3%)
Norfloxacin	20 (51%)	19 (49%)
Ceftazidime	3 (8%)	36 (92%)
Nitrofurantoin	24 (62%)	15 (38%)

The susceptibility test for *Enterobacter* was showed in table 6 and for *Pseudomonas aeruginosa* in table 7.

Table 6. *Enterobacter* susceptibility test.

Antibiotic	Sensitive	Resistant
Azithromycin	1 (25%)	3 (75%)
Levofloxacin	2 (50%)	2 (50%)
Meropenem	3 (75%)	1 (25%)
Norfloxacin	2 (50%)	2 (50%)
Ceftazidime		4 (100%)
Nitrofurantoin	3 (75%)	1 (25%)

Table 7. *Pseudomonas aerogenosa* susceptibility test.

Antibiotic	**Sensitive**	**Resistant**
Azithromycin	1 (33%)	2 (67%)
Levofloxacin	2 (67%)	1 (33%)
Meropenem	2 (67%)	1 (33%)
Norfloxacin		3 (100%)
Ceftazidime		3 (100%)
Nitrofurantoin	1 (33%)	2 (67%)

Staphylococcus spp. susceptibility test was resistant for all the included antibiotic in this study.

Discussion

In this study, it was found bacteria from more than a 90% of stool samples of children with acute gastroenteritis (110 samples). Our findings are in agreement with the results of other studies from the developing countries (11).

This may be related to the environmental and personal hygiene factors in our region. In this study, the frequency of bacterial diarrhea in older age group was significantly higher than the others that differs from the results of the other studies .This may be due to the kind of nutrition and high rate of breast milk feeding in infancy in our region (10,12).

E coli was the most common cause of bacterial diarrhea similar to many other previous studies (12, 13). In other studies, *E.coli* was also the most common cause of bacterial dysentery in our study, but *Mota et al.* (14) in Uruguayan children showed that the Shigella was the most frequently isolated pathogen in children with bloody diarrhea.

Overall, our results showed high resistance to first-line antibiotics such as ampicillin, ceftazidime, azithromycin which is consistent with old and recent reports around the globe (15). These first line antibiotics are widely empirically used in developing countries to treat diarrhea because of their low cost and availability.

The current findings showed that almost all the bacteria isolates were susceptible to meropenem, nitrofurantoin, levofloxacin. This might be attributed to the low prescription and consumption of these antibiotics in Iraq's health care facilities, reflecting the compliance with the antibiotic guidelines and stewardship program. Cumulatively, our findings indicate that ampicillin and ceftazidime are

redundant as first line empirical antibiotics for the treatment of diarrhea in acute cases and alternatives should be considered.

The main limitation of our study was the dependance on the previous records which could be relatively unreliable source.

Conclusion and recommendation

There high increase in the rates of resistance of the typical antibiotics and the authorities should prescribe law against the chaotic prescription of antibiotics in Iraq. the most resistant antibiotic was ceftazidime and the most sensitive was nitrofurantoin. We recommend the following:

- It is important to perform general stool exam to diagnose the causative pathogen.
- It is important to perform antibiotic sensitivity test before giving any antibiotic.
- We recommend against the usage of ceftazidime because of high resistance.

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