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Original Article

Examining the Consumption Pattern of Three Expensive Antibiotics (Meropenem, Ciprofloxacin, and Cefepime) Before and During the COVID-19 Pandemic in Shahid Beheshti Hospital, Hamadan-Iran

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Abstract

Background: Antibiotic resistance is a global challenge, and information on antibiotic usage is required to combat this issue. The aim of this study was to investigate the consumption pattern of three expensive antibiotics (meropenem, ciprofloxacin, and cefepime) in Shahid Beheshti Hospital, Hamadan.

Methods: All patients who were admitted to Shahid Beheshti Hospital in Hamadan, Iran, in the first 6 months of 2019 as the period before the COVID-19 epidemic and the first 6 months of 2021 as the period during the epidemic and after hospitalization, entered this retrospective cross-sectional study. They received meropenem, ciprofloxacin, and cefepime for treatment and underwent examination. The obtained data were analyzed using SPSS software.

Results: Overall, 213 (35.2%), 270 (34.2%), and 187 (30.6%) patients received meropenem, cefepime, and ciprofloxacin, respectively. In 2.5% of cases, the selected antibiotic was appropriate considering the type of identified microorganism, while in 10.9% and 86.6% of cases, it was wrong or not tested, respectively. The sites of infection for the patients were bacteremia (n=2, 0.3%), coronary artery catheter (n=3, 0.5%), kidney and bladder (n=14, 2.3%), and skin and soft tissue (n=1, 0.2%).

Conclusion: Based on the results, for most cases receiving three expensive antibiotics (meropenem, ciprofloxacin, and cefepime) in Shahid Beheshti Hospital in Hamadan before and during the COVID-19 epidemic, it is impossible to judge if the prescription has been rational or not.

Keywords: Antibiotic, Drug utilization evaluation, Meropenem, Ciprofloxacin, Cefepime, Iran

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Introduction

An antibiotic is generally a product or substance that is produced by or taken from a microorganism and kills other microorganisms or prevents their growth (1-3). Different types of antibiotics vary in terms of chemical, physical, and pharmacological properties, antimicrobial spectrum, and mechanism of action (4,5).

Broad-spectrum antibiotics are those that are active against different types of microorganisms. For example, tetracycline is effective against many Gram-positive bacteria, chlamydia, mycoplasma, and rickettsia. Antibiotics with a limited range are those that are active against only one microbe or a limited range of microbes, such as vancomycin, which is mostly used against Gram-positive cocci, such as staphylococci and enterococci (6-7).

The World Health Organization has recently warned against antibiotic resistance worldwide and declared the practice of prescribing and overusing antibiotics among the most serious threats to global public health. After this warning, many countries began to educate and improve the understanding of the medical community and people in this field with advertisements and media training on various television channels (8,9).

Statistics show that in Tehran, the capital city of Iran, 40%–50% of outpatient prescriptions include antibiotics, while according to the World Health Organization, the standard of antibiotics in prescriptions should be less than 20%. Therefore, it seems that we are facing the problem of irrational prescribing of antibiotics (10-12).

The indiscriminate prescription of new and expensive antibiotics not only imposes costs on the patient and the country's healthcare system but also causes the emergence

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of antibiotic resistance at the community level, which in turn creates many problems in the treatment of infectious and contagious diseases in the future (13-16).

There is a dearth of information on hospital antibiotic usage, particularly in countries without well-established antimicrobial stewardship programs (15-17). In addition, data reveal that nations with a high frequency of COVID-19 infection have a substantial rank in the occurrence of multi-drug-resistant infections, indicating that this pandemic is happening under critical circumstances of microbial resistance (18). To reduce the harmful effects of overuse, antibiotics should be used responsibly (19). Information about the antibiotics used by hospitalized patients assists in the development of programs to regulate antibiotic usage (17). Considering the explained issues, the present research was conducted to study the consumption of the injectable form of three antibiotics, namely, meropenem, ciprofloxacin, and cefepime, in Shahid Beheshti Hospital in Hamadan.

Materials and Methods

Shahid Beheshti Hospital in Hamadan served as the subject of this retrospective and cross-sectional research. Study time was the first six months of 2019 (the period before the epidemic) and the first six months of 2021 (the period during the epidemic).

The target population included patients admitted to Shahid Beheshti Hospital in Hamadan, and injectable forms of meropenem, ciprofloxacin, or cefepime were prescribed for them. Sampling was performed in such a way that at least 100 cases were included in the study for each period before and after Corona for each antibiotic. According to the census, the total number of patients for one antibiotic was less than 100 in each of the two mentioned periods.

The required data were extracted from the patient's files. The investigated parameters included demographic information (age and gender), underlying disease, white blood cell count, conduction of microbial culture, antibiotic sensitivity, drug dose, duration of treatment, presence or absence of fever, specialty of the prescribing physician, and indication of prescription.

Data were analyzed by using SPSS. 16 software. Quantitative and qualitative variables were reported as means and standard deviations, as well as frequencies and percentages, respectively.

Results

In total, 605 files were studied, 297 of whom were selected among patients admitted during the first six months of 2018 (the period before the epidemic of COVID-19), and 308 patients were selected from the cases belonged to the first six months of 2014 (as the period during the epidemic).

Three antibiotics, namely, meropenem, cefepime, and ciprofloxacin, were prescribed for 213 (35.2%), 270 (34.2%), and 187 (30.6%) patients, respectively. The microorganism was correct in 2.5% of patients, while it was wrong in 10.9% of the cases, and 86.6% of the cases were not tested.

The site of infection was not recorded for most patients. More details are provided in Table 1.

The prescribing physician's specialty major was infectious diseases in 31.6% of cases (Table 2).

No significant relationship was observed between microorganisms and the prescribed antibiotic in the 2 studied periods ($P > 0.05$, Table 3).

However, a significant relationship was found between doctors' specialty and prescribed antibiotics in the 2 studied time periods ($P < 0.05$, Table 4).

Discussion

The present research addressed the pattern of use of three expensive antibiotics (meropenem, ciprofloxacin, and cefepime) before and during the COVID-19 epidemic in Shahid Beheshti Hospital in Hamadan. According to a review of the literature and the best of our knowledge, no previous research has so far studied this topic.

Based on the results of the study, it seems that in

Table 1. The Frequency of Site of Infection for the Patients

Site of Infection	Frequency	Percent
No	585	96.7
Bacteremia	2	0.3
Coronary artery catheter	3	0.5
Kidney and bladder	14	2.3
Skin and soft tissue	1	0.2

Table 2. The Frequency of Specialist Doctor for Patients

Specialist Doctor	Frequency	Percent
No	9	1.5
Infectious	191	31.6
Others	405	66.9

Table 3. Relationship Between Microorganism and Patients' Prescription Drugs in the Two Studied Time Periods

Time Period	Prescription Drug	Microorganism			*P* Value
		No Test (%)	Correct (%)	Wrong (%)	
2019	Meropenem	98 (81.7)	3 (2.5)	19 (15.8)	0.095
	Cefepime	88 (89.7)	4 (4.1)	6 (6.1)	
	Ciprofloxacin	75 (94.9)	1 (1.3)	3 (3.8)	
2021	Meropenem	79 (87.9)	4 (2.7)	10 (9.4)	0.12
	Cefepime	96 (88.1)	3 (2.8)	10 (9.2)	
	Ciprofloxacin	88 (83)	0 (0)	18 (17)	

Table 4. Relationship Between Doctors' Specialty and Prescribed Antibiotic in the Two Studied Time Periods

Time Period	Prescription Drug	Specialist Doctor			*P* value
		No (%)	Infectious (%)	Others (%)	
2019	Meropenem	3 (2.5)	29 (24.2)	88 (73.3)	<0.001
	Cefepime	0 (0)	59 (60.2)	39 (39.8)	
	Ciprofloxacin	1 (1.3)	12 (15.2)	66 (83.5)	
2021	Meropenem	3 (1.4)	57 (26.8)	153 (71.8)	<0.001
	Cefepime	1 (0.5)	97 (46.9)	109 (52.7)	
	Ciprofloxacin	5 (2.7)	37 (19.4)	143 (77.3)	

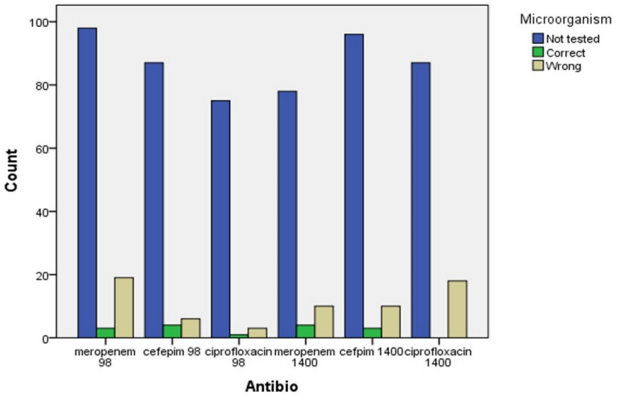

Figure 1. Conformity of the Prescribed Antibiotic With the Identified Microorganism in the Two Studied Time Periods

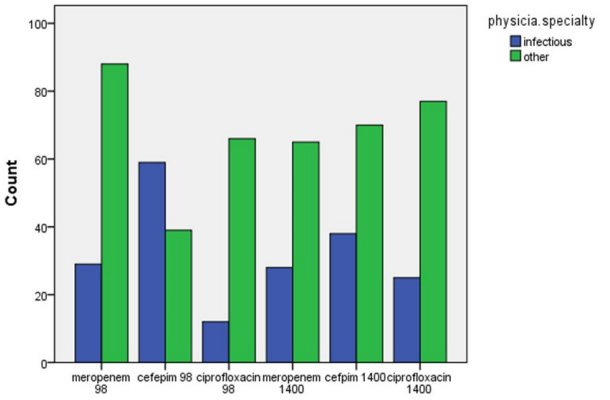

Figure 2. Frequency of Prescription Drugs Based on Specialist Doctors in the Two Studied Time Periods

Shahid Beheshti Hospital in Hamadan, three expensive antibiotics (meropenem, ciprofloxacin, and cefepime) were widely used without any record of antibiogram test, probably implying that antibiogram test has not been performed in this regard. Several prior investigations reported that meropenem, ciprofloxacin, and cefepime had been utilized in large quantities (20-25). For instance, Molla et al found that 133 patients (68.91%) had received numerous antibiotics. Patients with serious illnesses often get more antibiotics. Ceftriaxone (53.8%), meropenem (40.9%), moxifloxacin (29.5%), and doxycycline (25.4%) were the four antibiotics administered among the patients undergoing the examination; the researchers concluded that patients with severe illness and those who had abnormal *C-reactive protein* and d-dimer values had a greater incidence of numerous antibiotic prescriptions. However, there were no data about the effectiveness of antibiotic administration (17).

In accordance with the findings of the current study, Beović et al, investigating antibiotic prescription in patients with COVID-19, reported that the most significant justification for initiating antibiotics was clinical symptoms (22).

According to Wang et al, findings, which are in line with those of the current investigation, the majority of the patients had received antibiotic treatment experimentally, and only 2.7% of cases (n = 37) had serious co-infections. The results of this paper demonstrated that while paying attention to inflammatory variables may be beneficial for the experimental administration of these medications, experimental antibiotic therapy may not be required for all individuals (24).

In accordance with the findings of the current investigation, Goncalves Mendes Neto et al revealed that the administration of antibiotics to patients was documented in 67% of cases, and no evident bacterial infection cause was noted in 72% of them (25).

Conclusion

Based on the results of the study, for most cases receiving three expensive antibiotics (meropenem, ciprofloxacin, and cefepime) in Shahid Beheshti Hospital in Hamadan before and during the COVID-19 epidemic, it was impossible to judge if the prescription has been rational or not. Therefore, improvements in antibiotic stewardship seem to be necessary.

Authors' Contribution

F. D. contributed to data gathering and paper drafting. In addition, M. R. conducted data analysis and finalized the manuscript. Further, M. E. performed idea generation, study design, and manuscript finalization.

Conceptualization:
Data curation:
Formal analysis:
Funding acquisition:
Investigation:
Methodology:
Project administration:
Resources:
Software:
Supervision:
Validation:
Visualization:
Writing–original draft:

Writing–review & editing:

Competing Interests
The authors declare that they have no conflict of interests.

Ethical Approval
The patients and doctors were assured of data confidentiality. The findings of the study will be made available to the relevant regulatory organizations upon request. The proposal for this research was reviewed and approved by the Ethics Committee of Hamadan University of Medical Sciences (ID No. IR.UMSHA.REC.1400.626).

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