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Research Article

Comparative Analysis of Antimicrobial Activity of Three Cephalosporins on Clinical Isolates

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ABSTRACT

Objective: To compare in-vitro antimicrobial activity of commonly used cephalosporins against some Gram-positive and Gram-negative microorganisms.

Material and methods: Clinical isolates were obtained from Madonna University Teaching Hospital, Elele, Rivers State, Nigeria, and were tested for antibiotic susceptibility using disc diffusion standard procedure.

Result: Ceftriaxone gave the highest zone of inhibition value against *Proteus specie* (29.70 mm) and E. coli (25.50 mm), as compared to cefuroxime (15.60 mm and 12.00 mm), and Ceftadizime (21.00 mm and 14. 50 mm) respectively. There were however, differences in the zones of inhibition values of the three Cephalosporins with *Staphylococcus aureus* and *Klebsiella pneumoniae.*

Conclusions: From the result obtained, ceftiaxone was the most effective antibiotic in inhibiting the growth of the four clinical isolates especially *E. coli* and *Proteus specie,* and hence could be used for treatment of resistant organisms where ceftadizime and cefuroxime have failed.

Key-words: Cephalosporins, clinical isolates, in-vitro susceptibility, antimicrobial activity.

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INTRODUCTION

Due to the complexities involved in the diagnosis and treatment of microbial infections, many patients may receive inadequate antibiotic treatment or indeed a lack of treatment altogether.[1] Many cephalosporins with broad antibacterial spectra have been in clinical use for the treatment of a wide range of bacteria infections. In the past, cefotiam, cefoxitin and cefuroxime have been semi synthesized, but they are still ineffective against some strains of *Enterobacter spp.*[2] Ceftiaxone, discovered in the late 70s, has been reported to have a broad antimicrobial spectrum as well as a potent inhibitor of beta lactamase and stable in the presence of this enzyme.[3] Recently, there has been a steady increase in clinical infections caused by Gram-negative bacteria resistant to beta lactam antibiotics.[4] More agents were discovered and have been in use in the fight against infection however, the problems of affordability and availability in Nigeria today, have limited the clinical utility of most of these newer drugs. The few that could be afforded were utilized without adherence to the ethics of antibiotic regimen thereby posing threats of resistance in the fight against infections. This study was undertaken with the aim of reporting the comparative in-vitro antimicrobial activity of the commonly used cephalosporins against selected skin, urinary tract, respiratory tract and gastrointestinal tract disease-causing organisms such as *E. coli, Staph, aureus, Kleb. Pneumonia* and *Proteus specie.*

MATERIALS AND METHODS

Collection of test organisms

The test organisms were authenticated clinical isolates obtained from the Department of Medical Microbiology, Madonna University Teaching Hospital (MUTH), Rivers State, Nigeria. These included a Gram-positive (*Staph. aureus*) and three Gram-negative *E. coli, Kleb. Pneumonia and Proteus spp)* organisms. The organisms were identified according to standard methods reported [5.6]

Antibiotics

Single antibiotic discs for the following cephalosporins: ceftraxone (CRO, 30μg), cefuroxime (CXM, 30μg) and ceftadizime (CAZ, 30μg) and ceftadizime (CAZ, μg) obtained commercially were used.

Antimicrobial susceptibility testing:

Disc diffusion method was used to determine the antimicrobial activity.[7] Plates containing nutrient agar were inoculated with 10^7cfu, which was evenly spread on the entire surface of each of the plates. The turbidity of the inocula was adjusted using 0.5 McFarland turbidity standard. Using an ethanol-dipped and flamed forceps, the discs containing the various concentrations were aseptically placed individually over the seeded agar plates and incubated at 27^{o}C for 24-48 h. The tests were performed in triplicate and the mean diameter of zones of inhibition produced by the micro-organisms were observed and measured.

RESULTS

The result showed the mean and range zones of inhibition of the three cephalosporins on the four test micro-organisms. Of the four microorganisms *Proteus spp*. (29.5 mm) is highly sensitive to ceftriaxone, followed by *E.coli* (25.5 mm), *S. aureus* (23.5 mm), while *Kleb. pneumonia* was least sensitive (that is resistant) with 15.2 mm. The pattern of sensitively of the micro-organisms to cefuroxime indicated that *Staph. aureus* (21.5 mm) is highly sensitive, followed by *Proteus spp.* (15.5 mm), *E. coli* (12.0 mm) and *Kleb. pneumonia* (9.5 mm) the most resistant. To the antibiotic ceftadizime, *Proteus spp* (21.0 mm) was highly sensitive with *E. coli* (14.5 mm) and *Kleb. Pneumonia* (15. 0 mm) (Table 1 and Fig. 1).

Table 1: Mean (range) diameter (mm) of zone of inhibition of the three cephalosporins on the test of micro-organisms.

Micro-organism	mean (range) zone of inhibition (mm)		
	Ceftriaxone (CRO, 30 μg)	Cefuroxime (CXM, 30 μg)	Ceftadizime (CAZ, 30 μg)
E. coli	25.5(24-27)	12.0(8-16)	14.5(14-15)
S. aureus	23.5 (22-25)	21.5(20-23)	18(17-19)
*K. pneumonia*e	15.0(10-20)	9.5(9-10)	15(14-16)
Proteus spp.	29.5(29-30)	15.5(15-16)	21(20-22)

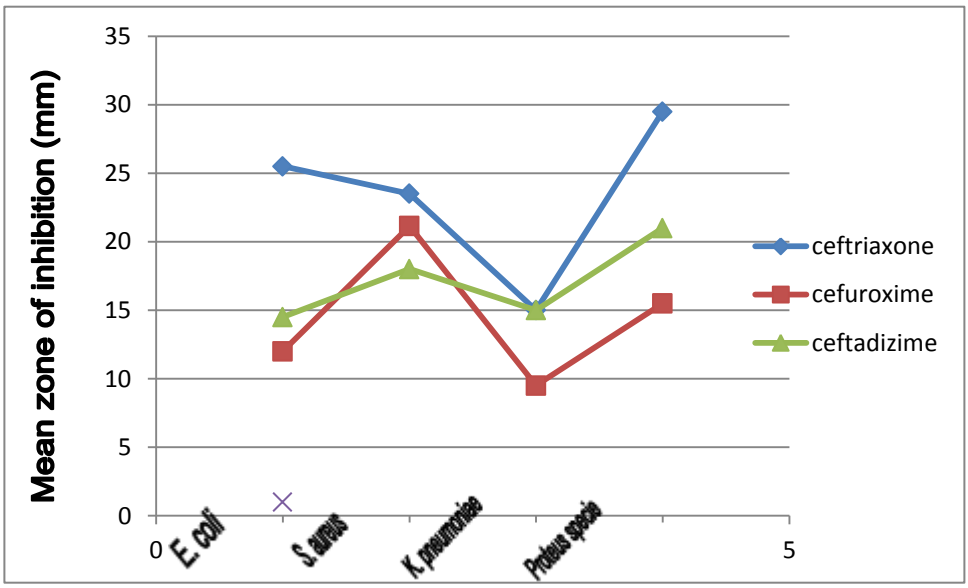

Figure 1: Mean zone of inhibition of the three cephalosporins on the four test micro-organisms

DISCUSSION

Ceftriaxone demonstrated exceptional in-vitro antimicrobial activity compared with other cephalosporins in this study. The mean ratio of ceftriaxone and ceftadizime were similar on *Kleb. Pneumonia.* Therefore, it may be because they are stable to beta lactamase produced by the micro-organisms.[8] All the cephalosporins showed antimicrobial activity against *Staph. aureus. Staph aureus* belongs to Gram-positive bacteria and various studies have shown that Gram-positive micro-organisms are more sensitive compared with Gram-negative micro-organisms [9,10] because the cell envelop of Gram-negative bacteria contains lipopolysaccharides which makes them less sensitive in comparison with Gram-positive microorganisms and this frustrated the penetration of the antimicrobial agents, hence the poor antimicrobial activity.[11] And the mean ratio of the ceftriaxone as compared with cefuroxime and ceftadixime against *E. coli* and *proteus spp* were significantly different. This is due in part, to their ability to stabilize in the presence of beta lactamases produced by these micro-organisms. [8]

CONCLUSION

This investigation demonstrated that ceftriaxone was comparatively the most effective in inhibiting the growth of the selected clinical isolates especially *Escherichia coli* and *Proteus specie* and is favoured in event where ceftadizime and cefuroxime have failed.

CONFLICT OF INTEREST

The authors have not declared any conflict of interest

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