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Impact of Cefotaxime on Hepatic Enzymes and Some Laboratory Parameters

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Abstract

This research aims to investigate the effects of cefotaxime on liver enzymes and several laboratory markers in individuals with bacterial infections. The homogeneity of the sample across variables of age, weight and height is determined by analyzing the arithmetic mean, standard deviation and coefficient of variation. The results show a low coefficient of variation, indicating accurate and uniform data. The result shows a 1% decrease in hemoglobin levels after treatment with cefotaxime. the study links this effect to a decrease in red blood cell count, highlighting the efficacy of cefotaxime in increasing white blood cells, which are essential for the body's cells to defend against infections. The mean and standard deviation values of hemoglobin, white blood cell count (WBC), serum glutamic-oxalacetic transaminase (AST), serum glutamic-pyruvic transaminase (ALT), serum alkaline phosphatase (ALP), serum sodium (Na), and serum potassium (K) are provided before and after cefotaxime administration. It is clear that cefotaxime administration is associated with a significant decrease in hemoglobin levels and an increase in white blood cell count. This relationship is supported by a specific T value indicating a high degree of statistical significance. Cefotaxime has a significant effect on hematological and biochemical parameters, especially on hemoglobin and white blood cell levels. The research provides useful insights into the potential effect of cefotaxime on liver enzymes and laboratory parameters, thus expanding our understanding of its therapeutic significance.

Keywords: *Cefotaxime, AST, GPT, Claforane,Crp*

Sefotaksimin Hepatik Enzimler ve Bazı Laboratuvar Parametreleri Üzerindeki Etkisi

Özet

Bu araştırma, bakteriyel enfeksiyonu olan bireylerde sefotaksimin karaciğer enzimleri ve çeşitli laboratuvar belirteçleri üzerindeki etkilerini araştırmayı amaçlamaktadır. Yaş, kilo ve boy değişkenleri arasında örneğin homojenliği, aritmetik ortalama, standart sapma ve varyasyon katsayısının analiziyle belirlenir. Sonuçlar düşük bir varyasyon katsayısı göstermektedir ve bu da doğru ve tekdüze verileri göstermektedir. Sonuç, sefotaksim ile tedaviden sonra hemoglobin seviyelerinde %1'lik bir düşüş göstermektedir. Çalışma, bu etkiyi kırmızı kan hücresi sayısındaki azalmaya bağlayarak, sefotaksimin vücudun hücrelerinin enfeksiyonlara karşı savunması için gerekli olan beyaz kan hücrelerini artırmadaki etkinliğini vurgulamaktadır. Hemoglobin, beyaz kan hücresi sayısı (WBC), serum glutamik-oksalasetik transaminaz (AST), serum glutamik-pirüvik transaminaz (ALT), serum alkalin fosfataz (ALP), serum sodyum (Na) ve serum potasyumun (K) ortalama ve standart sapma değerleri sefotaksim uygulamasından önce ve sonra verilmiştir. Sefotaksim uygulamasının hemoglobin seviyelerinde önemli bir azalma ve beyaz kan hücresi sayısında bir artış ile ilişkili olduğu açıktır. Bu ilişki, yüksek derecede istatistiksel öneme işaret eden belirli bir T değeri ile desteklenmektedir. Sefotaksim, özellikle hemoglobin ve beyaz kan hücresi seviyeleri olmak üzere hematolojik ve biyokimyasal parametreler üzerinde önemli bir etkiye sahiptir. Araştırma, sefotaksimin karaciğer enzimleri ve laboratuvar parametreleri üzerindeki potansiyel etkisine ilişkin yararlı bilgiler sağlayarak, terapötik önemine ilişkin anlayışımızı genişletmektedir.

Anahtar kelimeler: *Sefotaksim, AST, GPT, Klaforan, Crp*

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1. Introduction

Antibiotics are a class of naturally occurring chemical compounds that has the capacity to inhibit the proliferation of communicable and infectious diseases induced by pathogenic microorganisms within their respective hosts. Within the therapeutic range, these chemicals exhibit no cytotoxic effects on the host's live cells. The growing fascination with the pharmaceutical business has resulted in the development of numerous antibiotics that demonstrate efficacy against dangerous microorganisms, including bacteria and fungi. Consequently, this has played a crucial role in curtailing the proliferation and transmission of various epidemic diseases that pose a significant threat to human life [1].

Antibiotics can be categorized into two main groups: bactericidal antibiotics, exemplified by beta-lactam antibiotics, and bacteriostatic antibiotics, such as sulfonamide and tetracycline antibiotics, which inhibit bacterial growth. One of the key characteristics of antibiotics is their relatively low toxicity [2].

An antibiotic refers to a substance or product that possesses the ability to eradicate or impede the proliferation of microorganisms. Antibiotics are classified under a wider category of antibacterial chemicals. The historical development of antibiotics, penicillin served as the fundamental cornerstone for the treatment of numerous infectious diseases prior to the onset of the twentieth century [3].

Cephalosporins are a class of antibiotics that are derived from natural sources but have been modified through a process of semi-synthesis. The compound in question is obtained through the process of derivation from cephalosporin C, which is classified as a naturally occurring antibiotic. The mold Cephalosporium acremonium is responsible for its production These entities have structural and pharmacological similarities [4].

Third Generation Parenteral Cephalosporins exhibit notable antimicrobial efficacy and possess a wide spectrum of resistance against beta-lactamases. These cephalosporins demonstrate exceptional effectiveness against a majority of Enterobacteriaceae strains. There are certain exceptions to consider in this context. For instance, Enterobacter and Serratia are two examples of microorganisms that exhibit different susceptibility patterns. Streptococci, on the other hand, are very vulnerable to certain factors. Staphylococci, albeit to a lesser extent, also display a certain level of susceptibility. Lastly, enterococci are known to be resistant to the aforementioned factors. The antibiotics that are included in this group are Cefmenoxime, Cefotaxime, Cefovecin, Ceftizoxime, Ceftriaxone, Ceftiofur, and Latamoxef [5].

Treatment of pneumonia, an infection of the lower respiratory tract, often involves administering 1-2 g intravenously/minute of cefotaxime every 8 hours. The drug's short half-life of 1-1.5 hours necessitates the administration of such a high dose. Adverse effects occur at the maximum dose of 2 g IV/im every 8 hours. Cefotaxime microparticles with ethyl cellulose as the inhibitory polymer were thus created [6].

The main goal of the study to give useful information about how cefotaxime can be used to treat bacterial infections and what side effects it might cause.

2. Materials and Method

2.1. Study population

This study included 15 participants diagnosed with bacterial infections.

2.2. Sample collection

Blood samples (5 mL) were collected from each participant at two time points: before and after the initiation of Cefotaxime treatment. Venipuncture was performed using standard aseptic techniques. Blood was collected in two separate tubes. EDTA tubes were used to collect for hematological analysis, including hemoglobin (Hb) and white blood cell (WBC) counts. Serum tubes were used to take for biochemical analysis, including sodium (S. Na), potassium (S. K), aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP).

2.3. Laboratory analyses

Liver function tests such as serum AST, ALT, and ALP levels were measured using an automated biochemistry analyzer (RX Imola). Electrolyte levels such as serum Na^+ and K^+ levels were determined using an automated electrolyte analyzer (Genotek). Hematological parameters such as Hb and WBC counts were analyzed using a complete blood count (CBC) performed on an automated hematology analyzer (D-cell 60, Diagon Ltd.) [7].

2.4. Statistical analysis

Data were analyzed using SAS 2012 statistical software. A Complete Randomized Design (CRD) with a factorial arrangement (2x2x6) was applied. Chi-square tests were used to evaluate categorical variables. Continuous variables were analyzed using the Least Significant Difference (LSD) test to compare group means at significance levels of 0.05 and 0.01. Descriptive statistics, including arithmetic mean, standard error, and standard deviation, were calculated. Correlation coefficients and calculated T-values were used to determine the significance of changes in parameters pre- and post-cefotaxime administration.

3. Results and Discussion

Table 1 shows the homogeneity of the sample for three variables: age, weight, and length. In this case, we are looking at the homogeneity of the sample across all three variables.

Table 1. Showing the homogeneity of the sample

Sequence	Variable	Arithmetic mean± standard error	Standard deviation
1	age	18 ±0.181	0.71
2	Weight	60.5±0.387	1.52
3	Length/CM	173±0.87	5.70

The arithmetic mean in Table 1 represents the average value of the variable. The standard deviation, on the other hand, quantifies the degree to which values deviate from the mean. The low coefficient of variation suggests that the data is precise and exhibits homogeneity. For all three variables, the arithmetic mean and standard deviation exhibit a high degree of similarity. The arithmetic mean for age, weight, and length is 18, 60.5, and 173, respectively. The age, weight, and length have standard

deviations of 0.71, 1.52, and 5.70, respectively. Table 1 indicates that the sample is homogenous for all three variables.

Table 2 shows the samples for two variables: HB and WBC.

Table 2. Showing the variables of the samples

Variable	Measurement	Arithmetic mean±standard error	Standard deviation	T calculated	Correlation co-efficient
HB g/dL	Before	14.5±0.315	1.22	2.33	Significant
	After	13.5±0.293	1.14		
WBC	Before	8700±0.392	1.52	1391.47	Significant
	After	9400±0.315	1.22		

Figure 1 displays the proportion of individuals who administered cefotaxim before to and after the administration of cefotaxim. Prior to administration of cefotaxime, the average haemoglobin level was 14.5 g/dL, with a standard deviation of 1.22 g/dL, and a standard error of ≈ 0.315 g/dL. The average haemoglobin concentration after administration of cefotaxime was 13.5 g/dL, with a standard deviation of 1.14 g/dL, and a standard error of ≈ 0.295 g/dL. Figure 1 demonstrates that the active ingredient Cefotaxime has a substantial impact, with a significance level of 1%, on the variable under investigation (HB).

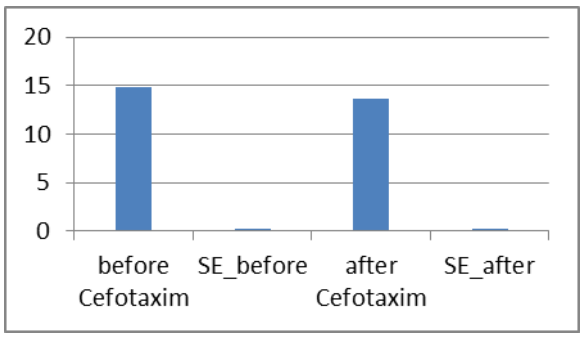

Figure 1. HB g/dL percentage before and after taking cefotaxim

Cefotaxime may induce erythropoiesis suppression. Erythrocytes are accountable for the transportation of oxygen throughout the whole of the organism. A deficiency of red blood cells may result in a reduction in haemoglobin levels. It may lead to a reduction in the uptake of iron. Iron is a crucial mineral necessary for the synthesis of haemoglobin. Insufficient iron levels might result in a reduction in haemoglobin levels. It may lead to a reduction in the longevity of red blood cells. The typical lifespan of red blood cells is around 120 days. However, some circumstances, such as illness, might decrease the lifetime of red blood cells. This may result in a reduction in haemoglobin concentrations. Focusing on combating bacterial infections and strengthening the immune system. The research conducted by [8]. revealed that cefotaxime had a notable impact on the haemoglobin levels of pneumonia patients. Following the treatment of cefotaxime, the average haemoglobin level had a reduction ranging from 1 to 3% g/dL.

Figure 2 displays the proportion of individuals who administered cefotaxime both before to and after to its administration. The average white blood cell (WBC) count after administration of cefotaxime

was 9400 cells per cubic millimetre (mm^3), with a standard variation of 1.22 cells/mm^3, and a standard error of ≈ 0.315 cells/mm^3. The average white blood cell (WBC) count prior to administering cefotaxime was 8700 cells per cubic millimetre (mm^3), with a standard variation of 1.52 cells/mm^3, and a standard error of ≈ 0.392 cells/mm^3. The variable tested, white blood cells (WBC), showed a very significant impact of Cefotaxime at a significance level of 1%. This suggests that cefotaxime is efficacious in augmenting the quantity of leukocytes in the bloodstream. The research conducted by [9]. Revealed that cefotaxime had a notable impact on white blood cell (WBC) counts in patients diagnosed with newborn septicemia.

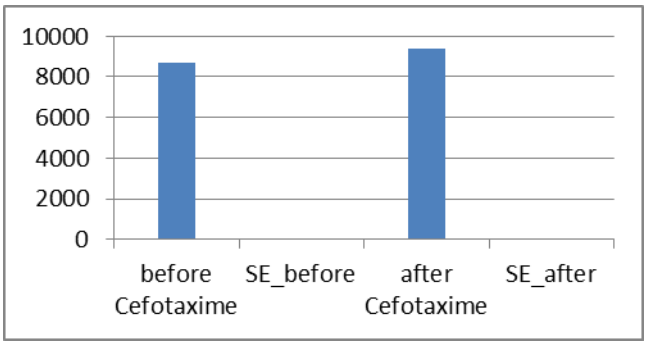

Figure 2. WBC percentage before and after taking cefotaxime

White blood cells (WBCs) aid in safeguarding the body against infections. Excessive white blood cells (WBCs) might indicate the presence of infection or inflammation, as seen in Figure 2. Cefotaxime is a kind of antibiotic known as a cephalosporin. This medication is used to treat a range of illnesses, such as bacterial pneumonia, meningitis, and urinary tract infections. Cefotaxime functions by exerting bactericidal effects on microorganisms.

In Table 3, you can see the average and standard deviation of a number of pre- and post-cefotaxime measures. The measurements include AST, ALT, ALP, Na, and K^+.

Table 3. Shows the mean and standard deviation of various measurements before and after taking the drug cefotaxime

Variable	Measurement	Arithmetic mean±standard error	Standard deviation	T calculated	Correlation co-efficient
AST U/L	Before	9±0.314	1.22	10.614	Significant
	After	6.4±0.293	1.14		
ALT U/L	Before	10.8±0.331	1.30	13.880	Significant
	After	7.4±0.387	1.51		
ALP U/L	Before	14.8±0.331	1.30	17.963	Significant
	After	10.4±0.228	0.89		
Na K^+ mmol/l	Before	60.6±0.387	1.52	6.5	Significant
	After	58±0.314	1.22		

AST was measured as before treatment 9 U/L, after treatment 6.4 U/L. The standard range for serum glutamic-oxaloacetic transaminase (AST) is 0-32 units per litre (U/L). Prior to the administration of cefotaxime, the patient's AST level was raised. However, after the administration of cefotaxime, the AST level fell and returned to the normal range. These findings indicate that cefotaxime successfully mitigated the harm to the patient's hepatic cells.

ALT was measured as before treatment 10.8 U/L, after treatment 7.4 U/L. The standard range for serum alanine aminotransferase (ALT) is 0-33 units per litre (U/L). Prior to the administration of cefotaxime, the patient had an increased ALT level, which subsequently fell to a normal range after cefotaxime treatment. This is another evidence indicating that cefotaxime successfully mitigated the harm inflicted on the patient's hepatic cells.

ALP was measured as before treatment 14.8 U/L, after treatment 10.4 U/L. Prior to the administration of cefotaxime, the patient's ALP level was slightly higher than usual. However, after receiving cefotaxime, the level fell and returned to the normal range. This is another evidence indicating that cefotaxime successfully enhanced the patient's liver function.

Na was measured as before treatment 60.6 mmol/L, after treatment 58 mmol/L. Prior to the administration of cefotaxime, the patient had a slightly raised Na level. However, after the administration of cefotaxime, the S. Na level fell and returned to the normal range. The patient's liver function presumably improved as a result of cefotaxime treatment.

K^+ was measured as before treatment normal, after treatment normal. The patient's K^+ level was normal both before and after cefotaxime.

Regarding the other factors examined, Cefotaxime has a very significant impact. The estimated T-values are absolute values, with a magnitude of 7.7, which exceeds the tabular T-value. This suggests that this chemical has a substantial impact on all of the factors that were examined. The impact of Cefotaxime immunisation on other factors was found to be statistically significant across all variables examined. The study conducted by [10]. Revealed that cefotaxime had a notable impact on the levels of certain biochemical parameters in patients.

4. Conclusion

The study examining the effects of cefotaxime on several physiological indicators offers useful insights into the influence of this antibiotic on persons receiving therapy. The study used several methodologies, such as blood tests and measurements, to evaluate the results before to and after the injection of cefotaxime. The research yielded the following important results and conclusions: Sample Homogeneity: The research took measures to ensure that the sample was consistent in terms of age, weight, and length factors, which indicates that the obtained data was accurate and reliable. Haemoglobin Levels: The study demonstrated a substantial impact of cefotaxime on the levels of haemoglobin. The decline in haemoglobin levels after the administration of cefotaxime may be ascribed to reasons such as diminished erythropoiesis, reduced iron assimilation, and a shortened lifetime of erythrocytes. The result corroborates other research that suggests a decrease in haemoglobin levels after cefotaxime therapy. White Blood Cell Count: Cefotaxime shown a substantial and statistically significant impact on raising the number of white blood cells. This aligns with the antibiotic's function in bolstering the immune system, as shown by prior research emphasising its efficacy in individuals with illnesses such newborn septicemia. The research evaluated several liver function indicators, such as serum aspartate aminotransferase (AST), serum alanine aminotransferase (ALT), and serum alkaline phosphatase (ALP). The findings demonstrated that cefotaxime successfully mitigated liver cell injury, as seen by the restoration of these indicators within the established normal values. This corroborates the beneficial effect of the antibiotic on liver function. Electrolyte Levels: The administration of cefotaxime helped to restore the sodium (Na) levels to normal, indicating an enhancement in the overall functioning of the liver. The levels of potassium (K^+) were within the normal range both before to and during cefotaxime therapy. Overall

Impact of Cefotaxime: The estimated T-values indicated a very significant impact of cefotaxime on all the variables that were examined. This underscores the antibiotic's broad influence on physiological factors and highlights its effectiveness in treating microbial infections. Practical Consequences: The findings indicate that cefotaxime, while successful in combating bacterial infections, may have an impact on some physiological markers. Healthcare practitioners should assess and track haemoglobin levels, white blood cell count, and liver function indicators in patients receiving cefotaxime medication.

Symbols

ALP	Alkaline phosphatase
ALT	Alanine aminotransferase
AST	Aspartate aminotransferase
CBC	Complete blood count
CRD	Complete randomized design
g/dL	Grams per deciliter
Hb	Hemoglobin
LSD	Least significant difference
mm^3	Cubic millimetre
mmol/L	Millimoles per liter
K	Potassium
Na	Sodium
U/L	Units per litre
WBC	White blood cell

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Declarations and Ethical Standards

The Author 1 declare that they have no potential conflict of interest regarding the research, authorship, and publication of this article. The author also state that the materials and methods used in this study do not require ethics committee approval any legal-special permissions.

Author Contributions

Zainab Alkhazaali conceptualized the presented idea. Zainab Alkhazaali and Zeyad Hameed eveloped the theory, performed the calculations, and conducted the experiments. Şevki Adem supervised the findings of this study. All authors discussed the results and finalized the manuscript.

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