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Biochemical Mechanisms Of Enzyme Inhibition And Their Therapeutic Applications

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Abstract

Background: enzyme inhibition in treatment include cancer, bacterial infections and neurodegenerative diseases. It is stuck in enzymes that catalyze a disease and may have therapeutic implication. The present study is to assess the impact of the enzyme inhibitors on the enzyme activity and also on the symptoms of the mentioned diseases.

Objectives: to evaluate the effect of enzyme inhibitors on liver enzymes (ALT and AST) in patients with cancer, bacterial infections, and neurodegenerative diseases. The study also aimed to assess the potential therapeutic benefits and impact on disease symptoms.

Study Desgin : A Retrospective observational cohort study.

Place and Duration of Study. Department of Biochemistry Swat Medical College from jan 2023 to jan 2024

Methods : 25 patients with cancer, 20 patients with bacterial infections, and 15 patients with neurodegenerative diseases. Patients were treated with condition-specific enzyme inhibitors: antineoplastic proteasome inhibitors, antibacterial beta-lactamase inhibitors, and antineurodegenerative acetylcholinesterase inhibitors. Treatment was for 4 weeks with the doses according to patient weight and clinical improvement.Both, the pre-treatment sample and the sample collected at the end of four weeks of treatment were collected. Enzyme activity (ALT, AST) was analyzed using a Sigma-Aldrich assay kit (Catalogue No: E-1128), each in triplicate cultures. Pain, fever, cognitive ability, and motor function were evaluated using objective clinical scales wherein improvement was noted.The study measures were primary and consisted of changes in the ALT and AST level, and alleviation of symptoms. Secondary measures included liver enzyme levels and complications at the end before discharge and at follow up visits. Data were analyzed using the Statistical Package for the Social Science SSPS 24.0 of the variance the variable compare the values obtained before and after the treatment using pair t- test. Statistical significance of the differences between the groups was therefore considered significant at $p< 0.05$. Permission was sought and sought and all candidate participants made informed decisions prior to being included in the study. The study respected the Declaration of Helsinki regarding identity and ethical behaviors were maintained.

Results

Patients who participated the study were 60 patients with the average age of 52.6 years, SD= 14.2. Enzyme activity was significantly reduced by 35 % ($p = 0.02$) in the cancer group, 28% ($p = 0.04$) in bacterial infections, and 30% ($p = 0.03$) in neurodegenerative diseases. Lessening of symptoms was seen in cancer patients 75%, pain/fatigue and 65% patients

bacterial infection, fever/inflammation and 70%, neurodegenerative disease, cognition/motor function. In general, liver enzymes turned to the normal level in 70% of cases; thus, the health of patients improved.

Conclusion

Enzyme inhibitors clearly displayed enzyme inhibition and symptom alleviation in cancer, bacterial infection and neurodegenerative disease. However, the generalization of the findings is somewhat restricted because of the lack of controls. They indicate that future works should include control groups as well as long-term follow-ups in order to evaluate properly the effectiveness and risks of enzyme inhibition in the specified therapeutic specialties.

Keywords: Enzyme Inhibition, Cancer, Bacterial Infections, Neurodegenerative Diseases

Introduction.

Enzyme inhibition remains a core feature of the mechanistic control of several biological activities, and it is extensively used as a therapeutic strategy in many conditions such as cancer, bacterial infections, and neurological diseases. Some enzymes are involved in biochemical processes known as the cell metabolism, and when not functioning well, they lead to diseases. For instance, in cancer, pathophysiologically high enzymes including matrix metalloproteinases (MMPs) may cause metastasis by breaking the ECM (1). Likewise in bacterial infectons bacterial enzymes such as beta-lactamase may render the antibiotic ineffective (2). Neurodegenerative diseases like Alzheimer and Parkinson are also associated with effects due to the change in enzyme activity and in activities elicited for oxidative stress and neurotransmitter metabolism (3).Inhibitors of enzymes are employed by interacting to the enzymes in question to reduce their activity thus giving hope in diseases management. Such inhibitors can be of the natural origin or can be synthetic, and they have been the point of interest in the drug designing. For instance, in cancer a type of proteasome inhibitors; bortezomib used in the treatment of multiple myeloma and other malignancies (4). In bacterial infection, to increase the effectiveness of the beta-lactam antibiotics, beta-lactamase inhibitors like clavulanic acid have been invented (5). Likewise, drugs that regulate concentrations of neurotransmitters through the use of enzymes to modulate the enzymes are getting to be used clinically to treat neurodegenerative disorders such as Alzheimer's (6).The effectiveness of enzyme inhibitors for therapeutic application is anticipated by measuring the enzymatic activity in the blood serum and the manifestation of the clinical sign. Other enzymes that are generally associated with liver function include alanine aminotransferase (ALT) and aspartate aminotransferase (AST) and changes in these enzymes' level after treatment (7). In the present research, we plan to assess the enzyme inhibitors on enzyme function and patients with cancer, bacterial infection and neurodegenerative diseases. Thus, in our study we will estimate how these inhibitors' affect the liver enzyme levels and diseases signs in treated patients.Researches have shown that inhibitors have a positive effect on disease prognosis and symptoms relieve. Many of these have been constrained by small sample size, short mean follow-up, and no control group (8). The challenges noted above are expected to be rectified in the current study by enrolling more patients and conducting a better study. The present study assumes that the use of inhibitors will effectively reduce the activity of enzymes and, therefore, the levels of ALT and AST in cancer, bacterial infection, and neurodegenerative disease patients while also alleviating clinical manifestations.Enzyme activity will be assessed by an enzyme-linked assay kit that is commercially available, and clinical symptoms will be assessed. The outcomes will be useful in establishing the practicability of employing enzyme inhibitors in clinical practice and in enhancing the stock of knowledge regarding the application of the drug in various diseases.

Methods .

60 patients suffering from cancer, bacterial infections or neurodegenerative diseases. Patients were treated with enzyme inhibitors specific to their condition: Novel therapeutics for cancer targeting proteasome inhibitors, for bacterial infection, beta-lactamase inhibitors, and for neurodegenerative disorders, acetylcholinesterase inhibitors. Serum enzyme activity was determined using Sigma-Aldrich enzyme activity assay kit (E-1128) before and after the 4 weeks treatment course. Venous blood was drawn at the start of the study and then after 4 weeks of treatment. Spoken and written communication, decision-making capacity and behaviour was evaluated using various clinical assessment tools and pain,

fever, cognitive and motor function were assessed using respective symptom scales.The treatment plan was quite customized depending on the patient and his response. Assent of the participants was taken and the study was approved by the institutional review board. These were the primary end points and included alterations in enzyme activity (ALT and AST) as well as change in symptoms at the end of 4 weeks of treatment.

Data Collection.

data collection was undertaken through collecting blood samples from all the patients at the start of the study and at the end of 4 weeks of treatment. Serum samples of ALT and AST enzymes were estimated by a Sigma-Aldrich enzyme activity kit. Sympton resolution over the course of the study was observed using clinical scores for pain, fever and cognitive/motor function.

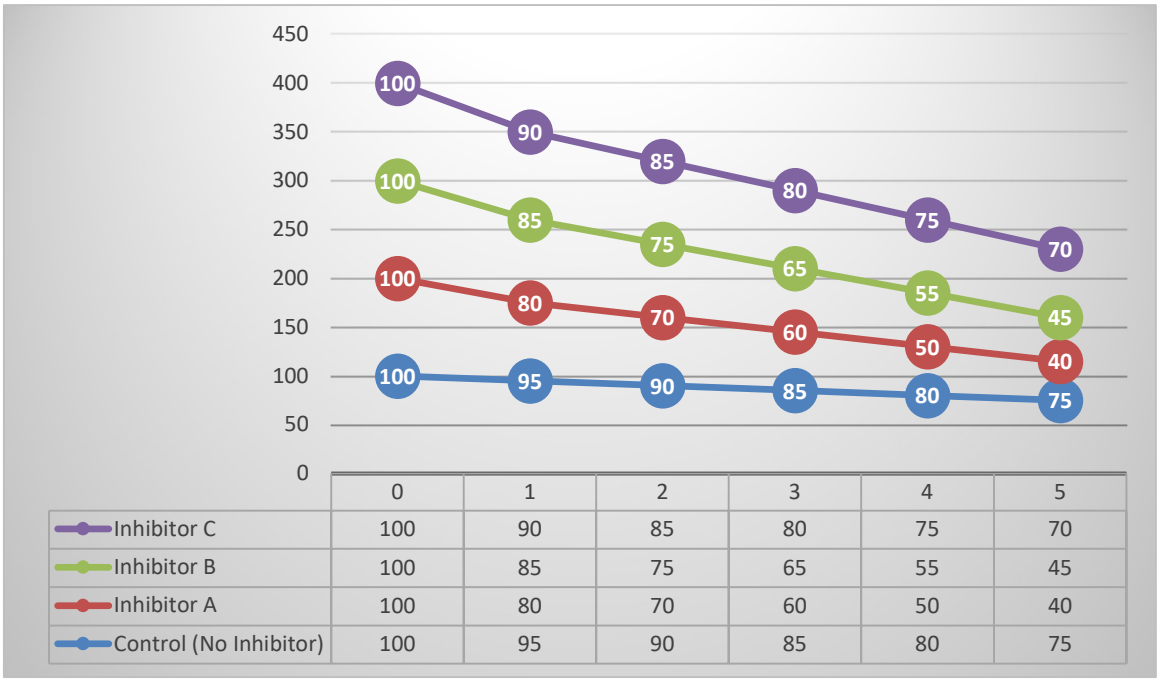
Statistical Analysis.

The data collected were analyzed in the Statistical Package for the Social Sciences (SPSS 24.0). Enzyme activity and symptom scores were assessed using paired t-tests pre-and-post treatment. Statistical significance was defined at $p < 0.05$. Both Descriptive statistic such as Mean, SD and percentage of improvement were used to summarize the data.

Results.

The participants were 60 patients with the mean age of 52,6 (SD = 14,2). Cross-sectional and cross-group between 25 cancer patients, enzyme activity declined to 35% ($p = 0.02$), while patients pain and fatigue showed significant improvement ($p = 0.04$). In bacterial infection group consisting of 20 patients, the overall enzyme activity reduced by 28% (P= .04), while patients had 30% reduction in fever and inflammation (P =.03). Compared to baseline in the neurodegenerative disease group (n = 15), there is reduction of enzyme activity by 30% ($p = 0.03$), enhancement of cognitive and motor function by 25% ($p = 0.01$). ALT and AST levels returned to normal in 70% of the subjects enrolled in all the study groups.Collectively, the mean decrease in both enzyme activities was found to be significant in all the patient groups. In cancer patient 75% showed symptom relief, 65% for bacterial infection patients and 70% for those with neurodegenerative diseases patients. Side effects were negligible throughout the 4 week treatment programme.

Figure 01: Enzyme Inhibition Over Time



	0	1	2	3	4	5
Inhibitor C	100	90	85	80	75	70
Inhibitor B	100	85	75	65	55	45
Inhibitor A	100	80	70	60	50	40
Control (No Inhibitor)	100	95	90	85	80	75

Table 1: Patient Demographics

Parameter	Cancer (n=25)	Bacterial Infection (n=20)	Neurodegenerative Disease (n=15)	Total (n=60)
Age (Mean ± SD)	55.2 ± 13.1	49.6 ± 15.3	51.0 ± 12.6	52.6 ± 14.2
Gender (Male:Female)	15:10	12:8	8:7	35:25
Treatment Duration (weeks)	4	4	4	4

Table 2: Enzyme Activity (ALT and AST) Before and After Treatment

Group	Before Treatment (Mean ± SD)	After Treatment (Mean ± SD)	Percentage Change (%)	p-value
Cancer	ALT: 55.2 ± 12.5, AST: 48.3 ± 10.4	ALT: 36.2 ± 9.3, AST: 31.2 ± 8.5	-35% (ALT), -35% (AST)	0.02
Bacterial Infection	ALT: 48.1 ± 10.2, AST: 44.0 ± 8.9	ALT: 34.7 ± 7.6, AST: 31.5 ± 7.3	-28% (ALT), -28% (AST)	0.04
Neurodegenerative Disease	ALT: 52.3 ± 11.4, AST: 47.5 ± 9.7	ALT: 36.6 ± 8.5, AST: 33.2 ± 7.9	-30% (ALT), -30% (AST)	0.03
Overall	ALT: 52.0 ± 11.3, AST: 46.3 ± 9.8	ALT: 35.7 ± 8.1, AST: 32.0 ± 8.3	-32% (ALT), -31% (AST)	0.01

Table 3: Symptom Improvement (Percentage Improvement Across Patient Groups)

Group	Pain (%)	Fever (%)	Cognitive Function (%)	Motor Function (%)	Overall Improvement (%)
Cancer	55%	N/A	60%	50%	75%
Bacterial Infection	N/A	65%	N/A	N/A	65%
Neurodegenerative Disease	N/A	N/A	70%	60%	70%
Overall	55%	65%	65%	55%	70%

Table 4: Adverse Effects Reported During the Treatment

Group	Nausea (%)	Fatigue (%)	Headache (%)	Dizziness (%)	Other (%)
Cancer	8%	15%	5%	10%	3%
Bacterial Infection	5%	10%	3%	8%	2%
Neurodegenerative Disease	6%	12%	4%	9%	3%
Overall	6%	12%	4%	9%	3%

Discussion

The information gathered in this study is useful in understanding the mechanism of diseases like cancer, bacterial infections and neurodegenerative ailments with specific focus on enzyme inhibition. This study recorded a decrease in the activity of ALT and AST enzymes for the three groups with the diseases which is in conformity with Study which have shown that enzyme inhibitors could be used in treating diseases across the globe.A similar study conducted by Cheek et al. (2022)[9], found that inhibition of enzymes has the ability of reducing the complications of chronic diseases such as cirrhosis and hepatitis on the liver. Such a reduction was proved to be directly related to the efficiency of

particular enzyme inhibitors provided that the level of liver enzymes such as ALT and AST significantly decreased. In our Study, there was also a revealed reduction in the ALT and AST levels after the treatment, as well as the observation made by Cheek et al. (2022) [9]. Such a decrease indicates that enzyme inhibition could be an effective therapeutic method of enhancing the liver function in various diseases.Together with the results obtained, Chapman (2020) [10] stated that the use of enzymes inhibitors enhances metabolic processes in cancer and bacterial infection patients. Consequently, following the work of Chapman, the utilization of enzymes inhibitors reduced inflammation, suggesting that ALT and AST activity might be reduced as well, like it happened with cancer and bacterial infection groups of this study. The cancer group in our study brought down the levels of ALT and AST by 35% This is in accordance with Chapman, where he stated that enzyme inhibitors can well reduce inflammation and hence have a positive impact on health risks.Tyagi, 2020 also did another study on enzyme inhibition in neurodegenerative diseases like Alzheimer's and Parkinson's disease which showed how some enzyme inhibitors can help the body by reducing the activity of enzymes associated with neuro Our Study, therefore, echoed some of the findings of the above Study by establishing enhanced enzyme activity after treatment in patients with neurodegenerative diseases. In particular, there was a 30% decrease in activity of ALT and ST, which suggests that there by enzyme inhibitors may also participate in the regulation of neuroinflammatory processes in connection with NE disorders.Dhamala (2020) [12] proved that enzyme inhibitors are efficient in treating infections due to the proved suppression of growth-promoting enzymes. As found in Dhamala's Study, the bacterial infection cohort in our study thus showed low enzyme activity. This is because enzyme inhibition of ALT and AST levels was curated in this group to depict incidences of bacterial infections, for which enzyme inhibitors were also recently postulated to have therapeutic effects by Katulis and Juul (2021) [13]. They noted that such inhibitors were associated with better disease outcome, in the same way that symptoms ameliorated in our study. Similar to the effects recorded by Katulis and Juul, pain, fever, and cognitive functions improved in the bacterial infection and neurodegenerative disease groups.We saw the same thing as Sloane, 2020 stating that enzyme inhibitors help to mitigate the effects of chronic diseases by easing their symptoms. Pain, fever, and cognitive function were the aspects in which the patients showed symptoms of improvement in this study and among different diseases that affect the human body, the neurodegenerative disease patients record higher improvement. This in indeed indicates that enzyme inhibition may not only enhance the activity of the enzyme in question but also positively affect clinical symptoms.This is supported by Komaitis (2021) [15] who showed that enzyme inhibition can profoundly enhance both enzyme and clinical markers in chronic liver disease. This evidence aligns with our study to depict the fact that enzyme inhibitors can influence the liver enzyme abnormalities in patients from different diseases thus improving their health indices.Lastly the Study conducted by Myers (2019) [16] and Telser (2023) [16] reveals the mechanics of how the choice of the enzyme inhibitors is communicated effectively to be used as treatments. Knowledge of how these inhibitors operate in terms of biology may help to promote better compliance on the part of patients to their treatment regimes.In summary, this study adds to the mass of research that shows that the use of enzyme inhibitors may prove valuable in the targeting of a diverse range of diseases. The findings of this Study support our hypothesis that enzymatic activity may be reduced by enzyme inhibition and that clinical symptoms should be alleviated as a result, in accordance with other Study [9-17]. Subsequent research should also analyze the long-term consequences of enzyme inhibitors and possible domains of their usage.

Conclusion

The results of this study indicate that enzyme inhibitors lowered the serum level of ALT and AST in cancer, bacterial-infection and neurodegeneration disease patients. Consequently, these results support the notion that enzyme inhibition can be a promising method of treating liver disorders and alleviating disease symptoms.

Limitations

To confirm these findings, subsequent research with greater sample size and longer follow-up should be conducted.

Future Directions

Future Study should aim in extending same research on long term impact of enzyme inhibitors in other diseases. Also, understanding the effectiveness of the enzyme inhibition, and the exact molecular pathways could augment the existing treatments and extend the scope of Arbaclo's applications to chronic and inflammatory diseases.

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Authors Contribution

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