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CHRONIC INFLAMMATION: PATHOGENESIS, CAUSES, AND TREATMENT METHODS

Saidova Firuza Salomovna
Samarkand State Medical University Pathological
Assistant Professor of Physiology.
Samarkand, Uzbekistan.
Najmiddinov Humoyun Ulug'bek ugli
SamDTU treatment case No. 2
Student of group 204

Abstract: The research examines clinical along laboratory features of chronic inflammation through data collected from the Multidisciplinary Clinic of Samarkand State Medical University dating from 2022 to 2024. Multiple diseases develop from chronic inflammation yet medical experts still lack understanding about its diagnostic patterns and biomarker profiles when observed in natural clinical environments. The research examined 210 patients above 18 years who sought care for ongoing inflammatory disorders. Study results analyzed the biomarkers C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) and interleukin-6 (IL-6) together with tumor necrosis factor-alpha (TNF-α) and demographic characteristics and comorbidities and therapeutic outcomes. Medical staff excluded patients from the study who had acute infections and missing clinical documentation. The statistical evaluation was done using SPSS version 26.0. The research showed that patients displayed elevated inflammatory markers yet significant differences appeared when comparing between disease groups and patient ages. The most common causes of chronic inflammation stemmed from metabolic and autoimmune disorders yet these patients continued to experience unfavourable clinical results even when under medical treatment. The research results demonstrate the necessity of developing better approaches for identifying inflammatory markers at an earlier stage combined with patient-specific medical care. This study demonstrates why monitoring biomarkers routinely remains crucial for both diagnosis and management in tertiary medical care settings that face chronic inflammation as a key clinical issue. The research produces local insights about Uzbekistan which could serve as guidance for future medical strategies and health policy development.
Keywords: Inflammatory biomarkers, C-reactive protein (CRP), Interleukin-6 (IL-6), Tumor necrosis factor-alpha (TNF-α), Erythrocyte sedimentation rate (ESR), Metabolic syndrome, Autoimmune disorders, Systemic inflammation, Biomarker evaluation.

Introduction.

Chronic inflammation provides an extended faulty immune reaction that drives important disease pathways for multiple non-communicable conditions including cardiovascular conditions together with autoimmune conditions metabolic syndrome and specific malignant tumors. The protective nature of acute inflammation differs from chronic inflammation because it develops slowly while being difficult to detect so it causes cumulative damage to tissues and organ dysfunction. Research findings show that higher numbers of pro-inflammatory markers including C-reactive protein (CRP), interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) indicate worse clinical outcomes in multiple patient groups. Several parts of the world have experienced a developing trend of chronic inflammatory diseases which notably affects adults who have obesity and diabetes or autoimmune disorders. The Uzbek population lacks documented information regarding both the medical signs and laboratory findings of chronic inflammation which developed after global breakthroughs in biomarker research and immunology studies. The

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Multidisciplinary Clinic of Samarkand State Medical University between 2022 and 2024 requires an assessment to understand chronic inflammation prevalence and patterns for its patients. This research examines inflammatory markers in patients to better understand how disease categories and treatment results influence chronic inflammatory conditions within actual healthcare practice. The research results will serve as a foundation for better diagnostic practices and patient-specific treatments of chronic inflammatory diseases in this geographic area.

Literature Review

A prolonged low-grade immune response known as chronic inflammation serves as an essential factor for multiple chronic diseases to develop. The expert definition characterizes this process as a networked bodywide procedure that causes continual tissue destruction followed by organ decompensation [1]. Over the last few years medical science has understood that chronic inflammation functions as both a primary initiator and secondary outcome of cardiovascular, endocrine, autoimmune and oncological disorders. The frequency of non-transmissible diseases including obesity metabolic syndrome type 2 diabetes and cardiovascular disorders has markedly increased in Uzbekistan. These medical conditions share the underlying factor of ongoing low-grade inflammatory processes. Insulin resistance along with endothelial dysfunction occurs when proinflammatory cytokines are released from the adipose tissue of obese individuals according to international studies [2]. Medical research has thoroughly established how inflammation serves as an essential factor in cardiovascular disease development. Libby et al. suggest that inflammation takes part throughout all stages of atherosclerosis starting from damaged endothelium to immune cell penetration and finally leading to plaque rupture [3]. The cardiovascular system of Uzbekistan faces risks since ischemic heart disease together with stroke stand among the top causes of death.

The progression of Alzheimer's disease together with other neurodegenerative diseases brings about continuous neuroinflammation throughout the brain. According to Heneka et al., "persistent activation of microglia and astrocytes results in neuronal damage within Alzheimer's disease" [4] and this pathophysiology may increase significance in Uzbekistan because of expanding life expectancy. Different inflammatory diseases can be diagnosed and their outcomes predicted using biomarkers such as C-reactive protein (CRP), interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) [5]. Best results in autoimmune diseases have become possible through biologic treatments which target cytokines. Feldmann and Maini stated, "TNF-α blocking strategies transformed rheumatoid arthritis treatment" [6]. Uzbekistan requires early identification of chronic inflammation as a priority treatment for its growing non-communicable disease rates within its national healthcare plan.

Methodology

This research was structured as a retrospective observational analysis and was executed at the Multidisciplinary Clinic of Samarkand State Medical University for a three-year duration from January 2022 to December 2024. The study sought to assess the prevalence, biomarker profiles, and clinical correlations of chronic inflammation in patients treated at a tertiary healthcare facility in Uzbekistan. The choice to do the study in this area was predicated on the escalating national prevalence of non-communicable diseases, including cardiovascular problems, type 2 diabetes, and autoimmune ailments, all of which are associated with chronic low-grade inflammation.

Medical records of 210 adult patients, aged 18 and older, were obtained from the clinic's computerised health database. Participants in the study had verified diagnoses or clinical characteristics indicative of chronic inflammatory conditions. The exclusion criteria encompassed patients with acute illnesses, those undergoing active cancer therapy, or individuals

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with inadequate laboratory results. The retrieved data encompassed demographic features, comorbidities, and laboratory investigation results, including C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), interleukin-6 (IL-6), and tumour necrosis factor-alpha (TNF-α). Data regarding drugs, encompassing anti-inflammatory and immunosuppressive therapies, was also gathered.

Quantitative data were analysed utilising SPSS software version 26.0. Descriptive statistics, including means, standard deviations, and frequencies, were employed to summarise patient characteristics and biomarker levels. Comparative studies, including chi-square tests, ANOVA, and t-tests, were performed to evaluate differences in inflammatory markers among diagnostic groups and age categories. A significance level of $p < 0.05$ was deemed statistically significant. Ethical approval was secured from the Research Ethics Committee of Samarkand State Medical University. All data were anonymised before analysis, and patient information confidentiality was rigorously upheld. This methodology facilitated an evidence-based evaluation of chronic inflammation within a real-world Uzbek clinical cohort and yielded insights pertinent to regional healthcare strategy.

Results and Discussion

This study examined the clinical and analytical profiles of 210 patients treated at the Multidisciplinary Clinic of Samarkand State Medical University from 2022 to 2024. Patients were classified into four diagnostic categories: cardiovascular, metabolic, autoimmune, and mixed diseases. The objective was to assess the levels of chronic inflammatory biomarkers and their correlations with illness type.

Table 1. Mean levels of inflammatory biomarkers across diagnostic groups (n = 210)

Diagnostic Group	Number of Patients	Mean CRP (mg/L)	Mean ESR (mm/hr)	Mean IL-6 (pg/mL)	Mean TNF-α (pg/mL)
Cardiovascular	60	7.8	25	12.5	18.3
Metabolic	55	6.2	30	10.1	16.7
Autoimmune	50	9.4	40	15.8	21.2
Mixed	45	8.1	33	13.6	19.5

Note: CRP – C-reactive protein, ESR – erythrocyte sedimentation rate, IL-6 – interleukin-6, TNF-α – tumor necrosis factor-alpha.

The results indicate a uniform increase in all assessed biomarkers among the patient group, validating the pervasive occurrence of chronic inflammation. The autoimmune cohort demonstrated elevated levels of CRP, ESR, IL-6, and TNF-α, signifying active immunological inflammation. This indicates the hyperactivation of immunological pathways typically seen in disorders like rheumatoid arthritis and systemic lupus erythematosus.

In the metabolic cohort, individuals with type 2 diabetes and obesity exhibited moderate yet sustained increases in CRP and IL-6 levels, indicative of low-grade, chronic inflammation or "metaflammation." These findings underscore the function of adipose tissue as a persistent source of inflammatory cytokines, potentially contributing to insulin resistance and endothelial dysfunction.

The cardiovascular cohort exhibited notable inflammatory activity, specifically characterised by increased CRP and TNF-α levels, corroborating the recognised association of inflammation with atherosclerosis and ischaemic heart disease. Chronic endothelium damage induced by inflammatory mediators is a fundamental factor in the advancement of vascular problems. Patients in the mixed group with concurrent comorbidities exhibited biomarker levels that were intermediate but significantly higher. This indicates that concurrent disease processes may

collaboratively enhance systemic inflammation. Such circumstances may necessitate more sophisticated, multidisciplinary management strategies.

Statistical analysis validated that the disparities in biomarker levels between the four groups were substantial ($p < 0.05$), signifying a robust correlation between disease type and the extent of chronic inflammation. These findings offer significant insights into the impact of chronic inflammation in a practical therapeutic context in Uzbekistan. They emphasise the necessity of integrating routine biomarker screening into diagnostic methods, particularly in tertiary healthcare facilities. Monitoring biomarkers such as CRP, ESR, IL-6, and TNF-α may assist clinicians in stratifying patients according to inflammatory risk, tailoring treatment regimens, and potentially enhancing long-term outcomes in chronic disease management.

Conclusion

This study highlights the widespread influence of chronic inflammation across multiple illness categories, including cardiovascular, metabolic, autoimmune, and mixed disorders, in the patient population at Samarkand State Medical University's Multidisciplinary Clinic. The persistent increase of inflammatory biomarkers including CRP, ESR, IL-6, and TNF-α among these populations underscores the systemic character of chronic inflammation and its essential role in disease pathogenesis. Given Uzbekistan's increasing prevalence of non-communicable diseases, these findings support the incorporation of inflammatory biomarker evaluations into standard clinical practice. This integration could improve early identification, enable risk assessment, and guide personalised treatment methods to reduce the effects of chronic inflammation on patient outcomes. Future research must prioritise longitudinal investigations to clarify causal links between chronic inflammation and disease development, including interventional trials to evaluate the effectiveness of specific anti-inflammatory therapies in these patient groups.

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