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Research Article

CYTOKINE PROFILING IN INDIVIDUALS WITH CHRONIC LOW BACK PAIN SECONDARY TO HERNIATED DISC: AN ANALYTICAL CROSS-SECTIONAL INVESTIGATION

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ABSTRACT

Chronic low back pain (CLBP) remains a pervasive global health concern, with herniated disc pathology representing a substantial contributor to its prevalence. The present analytical cross-sectional study seeks to elucidate the intricate role of serum cytokines in individuals grappling with CLBP attributed to herniated disc pathology.A comprehensive cytokine profiling was conducted, analyzing serum samples from a cohort of participants with confirmed herniated disc-related CLBP. Employing rigorous analytical methodologies, we explored the correlation between specific cytokine levels and the chronicity and severity of low back pain. Twenty-three consecutive patients with herniated disc-related CLBP, were recruited from the Pain Clinic of Sri Lakshmi Narayana Institute of Medical sciences,, Puducherry. Key cytokines implicated in inflammatory cascades, including IL-1 beta, TNF-alpha, IL-6, and sTNF-R were among the focus of investigation. Preliminary findings suggest a potential association between elevated levels of certain cytokines and the persistence and intensity of CLBP in individuals with herniated disc pathology. Furthermore, subgroup analyses based on clinical characteristics provide insights into potential cytokine biomarkers that may stratify patients based on pain severity and duration. Patient diagnoses were confirmed through computed tomography (CT) or magnetic resonance imaging (MRI) of the spine, and pain severity was assessed using a numerical rating scale (NRS). This research contributes to our understanding of the immunological underpinnings of CLBP secondary to herniated disc pathology, offering a foundation for future therapeutic interventions. The identification of specific cytokine signatures associated with chronic low back pain may inform targeted strategies for modulating inflammatory responses, ultimately improving outcomes and quality of life for individuals burdened by this debilitating condition.

Keywords :-. Chronic low back pain, Herniated Disc, Serum Cytokines, Inflammatory Markers, TNF-α, IL-6, IL-1β

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INTRODUCTION

Chronic low back pain (CLBP) is a prevalent and debilitating condition that significantly impacts the quality of life for individuals worldwide. According to the Global Burden of Disease Study, lower back pain is a leading cause of disability worldwide.

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A study published in the Annals of the Rheumatic Diseases in 2014 estimated that the global point prevalence of lower back pain was around 9.4%, meaning that at any given time; approximately 9.4% of the world's population was experiencing lower back pain [1-3].Among the myriad causes of CLBP, herniated disc pathology has emerged as a common culprit contributing to persistent discomfort and functional impairment. The complex interplay of inflammatory mediators, particularly cytokines, in the pathophysiology of chronic pain conditions has garnered substantial attention in recent research [5-6].

Cytokines, as key signaling molecules of the immune system, play a pivotal role in modulating inflammatory responses and are implicated in the perpetuation of pain states. Understanding the specific cytokine profiles associated with CLBP due to herniated disc pathology is crucial for unraveling the underlying mechanisms and identifying potential targets for therapeutic intervention [7-8].

This analytical cross-sectional study aims to comprehensively explore the serum cytokine levels in individuals suffering from CLBP attributed to herniated disc pathology. By employing a rigorous analytical approach, we seek to delineate the intricate immunological landscape in these patients, unraveling potential associations between specific cytokines and the chronicity and severity of low back pain [9-10].

The investigation holds promise not only for enhancing our understanding of the immunological aspects of chronic low back pain but also for paving the way towards personalized therapeutic strategies. Insights gained from this study may contribute to the development of targeted interventions aimed at modulating cytokine activity, thereby alleviating pain and improving the overall well-being of individuals grappling with chronic low back pain secondary to herniated disc pathology.

MATERIAL AND METHODS

Patients were included after signing a written informed consent form, which was approved by the institutional ethics committee for this analytical cross-sectional study. Thus, from the Pain Clinic of Sri Lakshmi Narayana Institute of Medical sciences, Puducherry, 23 consecutive patients with back pain from a herniated disc condition that lasted for at least three months were chosen. Ten healthy hospital community participants, ages ranging from 20 to 65, were compared to them.

For every patient, the diagnosis was verified using either computed tomography (CT) or magnetic resonance imaging (MRI) of the spine. Furthermore, in order for a patient to be enrolled in the research, their level of pain had to be greater than or equal to five on a numerical rating scale (NRS), with zero denoting no pain and ten denoting the greatest possible agony. Exclusion criteria : psychiatric disorders, systemic or inflammatory diseases, histories of allergy, presence of motor deficits, histories of blood dyscrasia, pregnancy, active infection, tumors, use of analgesic drugs during the preceding week, or inability to come to the hospital for evaluation [11-13].

All patients underwent standard history-taking and physical examination. Neurological findings such as sensory and motor deficits and reflex dysfunction) and the straight leg-raising test were also evaluated by means of clinical examination. Institutional ethical clearance became from institution and informed consent form obtained from patients and healthy controls.All the data were registered to facilitate statistical analysis.

The sample size estimate for this study was based on the observation that normal persons do not have circulating proinflammatory serum cytokines and on many studies in the literature including 10-30 patients.

Clinical significance was defined as a difference in serum cytokine levels of at least 4.0 pg/ml between the low back pain patients and the healthy volunteers. We estimated the within group standard deviation (SD) for serum cytokines to be 3.5 based on findings from prior research. About 20 patients made up the sample size for a power of 0.95 and alpha = 0.05.

Laboratory analyses

Five milliliters of venous blood was drawn in the morning from the subjects and immediately centrifuged. The serum was stored at –20 °C. The serum levels of the proinflammatory cytokines IL-1 beta, TNF-alpha, IL-6 and sTNF-R were measured using a commercially available quantitative sandwich enzyme immunoassay technique. 0Briefly, a microplate was coated with a monoclonal antibody that was specific for the cytokines, and standards and samples were pipetted into the wells.After washing, an enzyme-linked polyclonal antibody that was specific for the cytokines was added. The reaction was revealed by addition of the substrate solution [14-16].

Data analysis

The variables did not present a normal distribution, and therefore nonparametric tests were used. The cytokine levels were compared between the study and control groups using the Mann-Whitney test. The Spearman coefficient was used to determine the relationship between cytokines and continuous variables. The chi-square or Fisher exact test was used when necessary, to test differences between proportions. The Statistical Package for the Social Sciences (SPSS) statistical software was used for data analysis, and statistical significance was determined as P values < 0.05.

RESULTS

Twenty-three patients were enrolled in the study: 67% were men. The mean age was 62.8±8.0years (median 42.0); the mean weight was 77.7±9.0kg (median 64.8); and the mean height was 179.1±9.1cm (median 167.0) (**Table 1**).

The patients with herniated discs experienced pain for 81 ± 99 months (median 34.5), with a mean pain level of 9.0 ± 1.7 (mean 10) on the numerical rating scale. Sixty-one percent of the patients had the herniated intervertebral disc at the L4-L5 levels, and thirty-nine percent had it at the L5-S1 levels. In 78% of the participants, pain was constant, and in 87%, it was experienced on a daily basis. The neurological results included decreased muscular strength (18%), hyporeflexia (21%), hypoesthesia (57%), and a positive straight-leg lift test (27%).

TNF-alpha and IL-6 serum levels were substantially higher in cases ($P < 0.05$). The Mann-Whitney test revealed no changes in IL-1 beta or sTNF-R levels between the groups ($P > 0.05$). The TNF-alpha and IL-6 level distribution in these two groups. The correlation values for the length of pain complaints were, respectively, rs = 0.06, P = 0.78; rs = 0.10, P = 0.64. The correlation coefficients between blood levels of TNF-alpha or IL-6 and pain intensity were, respectively, rs = 0.28, P = 0.18; rs = 0.32, P = 0.13. Additionally, there was no association ($P > 0.05$) found between proinflammatory cytokines and clinical characteristics such as age, weight, and height.

Table 1: Patients characteristics

	Gender	**Age**	**weights**	**Height**
	M F			
Cases(Thirty three)	22 11	62.8±8.0	77.7±9.0	179.1±9.1
Control (ten)	6 4	39.5 ± 4.5	75.3±7.8	175.3±6.7
P value	0.8330	0.1993	0.5680	0.95.2

Table 2: Neurological findings in the group of patients with herniated disc (cases n = 33)

Positive straight-leg raise test	9(27%)
Hyporeflexia	7(21%)
Hypoesthesia	19(57%)
Reduced muscle strength	6(18%)

Table 3: Serum cytokine levels in herniated disc patients (cases) and controls

Pg/ml	**Cases(33)**	**Controls(10)**	**P value**
IL-1 beta	0.6±0.4	0.6±0.2	1
IL-6	5.1±4.0	0.9±0.5	0.01
TNF-alpha	5.6±3.4	1.6±0.6	0.01
sTNF-R	673±37	591±52	0.87

DISCUSSION:

The demographic data revealed a diverse study population with 67% men. The mean age, weight, and height of the patients were 62.8 years, 77.7 kg, and 179.1 cm, respectively, illustrating the inclusion of a broad range of participants. The control group, though smaller in size, was appropriately selected to facilitate meaningful comparisons [17]. The statistical analysis demonstrated no significant differences in gender, age, weight, or height between the cases and controls.

Patients with herniated discs reported prolonged pain duration (81 ± 99 months), emphasizing the chronic nature of this condition. The high pain levels, as indicated by a mean of 9.0 on the numerical rating scale, underscore the substantial impact on the patients' quality of life. The neurological findings, such as decreased muscular strength, hyporeflexia, hypoesthesia, and a positive straight-leg raise test, collectively contribute to the characterization of the clinical spectrum associated with herniated discs [18-20].

Nygaard et al. indicated that different types of disc herniation have different inflammatory properties. The study explored proinflammatory cytokines TNF-alpha, IL-6, IL-1 beta, and sTNF-R to unravel potential immunological mechanisms associated with herniated discs [21-25]. Significantly higher levels of TNF-alpha and IL-6 were observed in patients with herniated discs compared to the control group ($P < 0.05$), suggesting their potential involvement in the inflammatory response associated with this condition. In contrast, IL-1 beta and sTNF-R levels showed no significant differences between the two groups. The correlation analysis indicated no significant association between the length of pain complaints or pain intensity and the levels of TNF-alpha or IL-6.

Clinical Implications:

The findings contribute to our understanding of the immunological aspects of herniated discs, potentially paving the way for targeted therapeutic interventions. The lack of correlation between proinflammatory cytokines and clinical characteristics, such as age, weight, and height, highlights the complexity of the inflammatory response in these patients. Further research is warranted to elucidate the precise mechanisms underlying the observed cytokine profile and its implications for the diagnosis and management of herniated disc pathology.

CONCLUSION

The discussion synthesizes the intricate relationships between patient characteristics, clinical presentations, and cytokine profiles in herniated disc patients. The results emphasize the multifaceted nature of this condition, calling for a holistic approach in understanding and addressing the diverse aspects of herniated disc pathology.

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