

Study of Autonomic Functions in Patients with Non-Specific Low Back Pain

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ABSTRACT

Aim and Objectives: To evaluate parasympathetic and sympathetic reactivity and assess any derangement in either or both of the limb of autonomic functions in patients of non specific chronic low back pain.

Introduction: Non specific chronic low back pain (nCLBP) is prevalent among adults and often leads to functional limitations, psychological symptoms, lower quality of life, and expenditure on health care. The focus of autonomic function and health has been cardiovascular diseases; musculoskeletal syndromes have been paid much less attention. However, there are many epidemiological and other studies suggesting that there is a connection between musculoskeletal disorders and psychological risk factors such as stress.

Material and Method: Male patients within the age group of 24-45 years(n= 40), who had a history suggesting chronic non specific low back pain were recruited from Orthopedics OPD and the control were the age and BMI matched healthy young adults within the same age bracket as that of study group. Autonomic function was assessed by using conventional autonomic function test. The data collected was evaluated using SPSS 17. Unpaired student “t” test was applied to compare the results P-value < 0.05 was taken as statistically significant. **Result:** The E: I ratio of control group was 1.85±0.14 and in study group it 1.30±0.17, the difference being statistically significant, Similar observation was made for other parasympathetic reactivity test like 30:15 ratio.

Conclusion: Our results and review of literature make us of the view that parasympathetic activity decreases in patients of non specific chronic low back pain.

Keywords: Non specific chronic low back pain, Parasympathetic reactivity test, Sympathetic reactivity test

INTRODUCTION

The human being is unique in having bipedal gait. This causes a vertical loading of the spine and consequently varieties of low back and neck problems.

Low back pain is mainly of two types, specific and non specific . Non-specific low back pain(nCLBP) is defined as pain, muscle tension or stiffness localized

below the costal margin and above the inferior gluteal fold of unknown etiology.

nCLBP is prevalent among adults and often leads to functional limitations, psychological symptoms, lower quality of life, and expenditure on health care¹. nCLBP is usually categorized in 3 subtypes: acute, sub-acute and chronic low back pain. This subdivision is based on the duration of the back pain. Acute low back pain is an episode of low back pain for less than 6 weeks, sub-acute low back pain between 6 and 12 weeks and chronic low back pain for 12 weeks or more ². According to Chandola et al. ³ there is a strong association between chronic stress and physiological health risks. It has been suggested

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that autonomic cardiovascular indices could be used in stress-related risk assessment in occupational health ⁴. The focus of autonomic function and health has been cardiovascular diseases; musculoskeletal syndromes have been paid much less attention. However, there are many epidemiological and other studies suggesting that there is a connection between musculoskeletal disorders and psychological risk factors such as stress, as shown by Brage et al. ⁵, Sudhaus et al. ⁶ and Waters et al. ⁷. It is also worth noting that interactions exist between pain sensitivity and cardiovascular control mechanisms.

Clinical observations of pain being spatially correlated to autonomic alterations and that blocking sympathetic efferent fibres could reduce muscle pain under certain circumstances suggest a causal role of the sympathetic nervous in the development and maintenance of localized and widespread musculoskeletal pain ^{8,9,10}. In contrast, in a recent experimental study of patients with fibromyalgia or NSP, a peripheral sympathetic blockade did not affect pain development during a stressful task ¹¹.

Considering above controversy, we planned to evaluate parasympathetic reactivity and sympathetic reactivity and assess any derangement in either or both of the limb of autonomic functions in patients of non specific chronic low back pain

MATERIAL AND METHOD

Male patients within the age group of 24-45 years (n=40), who had a history suggesting chronic non specific low back pain were recruited from Orthopedics OPD and the control were the age and BMI matched healthy young adult within the same age bracket as that of study group.

Inclusion criteria:

- Low back pain for more than 3 months
- Age between 24 and 45 years

Exclusion criteria:

- Straight leg test result below 35 degrees
- Ankylosing spondylitis, severe osteoporosis, severe osteoarthritis
- Paralysis; progressive neurological disease
- Spinal infection, previous spinal operation

- Vertebral fracture during the previous 6 months
- Neuro psychiatric disorders or
- On any medication known to alter autonomic function

Autonomic Assessment

Parasympathetic reactivity test were done using E: I ratio and 30:15 ratio. Sympathetic reactivity was assessed using Blood pressure response to sustained Handgrip.

Parasympathetic Reactivity Tests

E: I Ratio

E: I Ratio based on the phenomenon of respiratory arrhythmia, which is most pronounced at the respiration rate of 6 breaths per minute. The subject is asked to breathe at this rate (with 5 s of inhalation and 5 s of exhalation per breath). The expiratory-inspiratory ratio (E: I ratio), which is the ratio of the longest RR interval during expiration and the shortest RR interval during inspiration from 5 cycles was determined. The E: I ratio in young person should be higher than 1.2.

$$\text{E: I ratio} = \frac{\text{Longest R-R interval during expiration}}{\text{Shortest R-R interval during inspiration}}$$

30:15 Ratios

During the postural change from lying to standing a characteristic immediate rapid increase in heart rate occur which maximal at about the 15th beat after standing is followed by a relative overshoot bradycardia maximal at about the 30th beat. To perform this test the subject is asked to lie quietly on a couch and then to stand up unaided. The characteristic heart rate response can be expressed by the 30 : 15 ratio, which is the ratio of the longest R-R interval around the 30th beat after starting to stand up to the shortest R-R interval around the 15th beat. The 30:15 ratio should be at least 1.04. It was calculated by following formula:

$$30:15 \text{ ratio} = \frac{\text{R-R interval at beat 30 after assuming erect posture}}{\text{R-R interval at beat 15 after assuming erect posture}}$$

Sympathetic Reactivity Tests

Blood pressure response to sustained handgrip

A rise in diastolic blood pressure is determined during isometric pressing of a handgrip dynamometer at approximately one third of the maximum contraction strength for 3-5 min. Blood pressure measurements are taken at the other arm at 1 min interval. An increase in diastolic blood pressure is a result of heart rate acceleration without an increase of peripheral vascular resistance. The test result is presented as the difference between the highest diastolic pressure during the examination and the average diastolic pressure at rest. It should normally be higher than 15 mmHg.

Statistical Analysis:

The data collected was evaluated using SPSS 17. Unpaired student "t" test was applied to compare the results P-value < 0.05 was taken as statistically significant.

Table 1: Distribution of Age, Height, and Weight in Study group.

Parameter	Control	Study Group
Age(Years)	36.85±1.08	37.23±0.82
Height(cms)	159.40±5.74	160.50±4.80
Weight(kgs)	50.20±6.04	53.30±6.41

Table 2: Comparison of Heart Rate, Respiratory rate, SBP, DBP in Control group and Study group

Parameters	Control group	Study group	p-Value
Heart Rate	81.70±8.95	93.40±7.95	P<0.001
Respiratory Rate	16.00±1.34	18.20±0.83	P<0.001
Systolic Blood Pressure (SBP)	109.80±9.17	123.90±6.41	P<0.05
Diastolic Blood pressure (DBP)	72.60±7.29	76.30±5.00	P<0.001

All results are expressed as Mean ± standard deviation, p< 0.05 is significant

Table 3: Comparison of Autonomic Function Tests in Control group and study group

Parameters	Control Group	Study group	p-Value
E: I Ratio	1.85±0.14	1.30±0.17	<0.05
30:15 ratio	1.67±0.13	1.17±0.12	<0.05
Change in DBP due to Isometric Exercise(IE)	21.40±5.39	21.20±4.92	NS

All results are expressed as Mean ± standard deviation, p< 0.05 is significant

RESULT

Comparison of Autonomic Function Test in Control and Study Group

Parasympathetic Reactivity Tests

The E: I ratio of control group was 1.85±0.14 and in study group it 1.30±0.17, the difference being statistically significant Similar observation was made for other parasympathetic reactivity test like 30:15 ratio.

Sympathetic Reactivity Test

The study group showed a statistically non significant increase in the rise of SBP and DBP with isometric exercise when compared to control group.

DISCUSSION

Our study shows that parasympathetic activity did not change significantly but sympathetic activity showed statistically significant increase.

A systematic meta-analysis which followed the standard guidelines for systematic reviews and meta-analyses critically reviewed the literature on HRV in conditions associated with chronic pain¹². Fifty-one studies, out of 17,350 fulfilled the inclusion criteria. Across a wide range of conditions pooled results from the meta analysis reflected a consistent, moderate-large decrease in HF power of the HRV in chronic pain suggesting a decrease in parasympathetic activity. Our study is in alignment with the above meta analysis done by Tracy LM, et al.¹².

Specific yoga practices including yoga breathing and certain meditation techniques also influence the HRV with a shift towards greater parasympathetic activity^{13,14,15}. This study if read in between the line then it suggest a decrease in the parasympathetic activity in the patient complaining of non specific low back pain. Our study points in the same directions.

Another study reported that the measures of HRV i.e., SDNNi, RMSSD and mean RR interval which are strongly associated with vagal tone were significantly higher on the days of yoga intervention when compared to the placebo intervention and the control group and thereby supporting our result obliquely¹⁶.

CONCLUSION

Our results and review of literature make us of the view that parasympathetic activity decreases in patients of non specific chronic low back pain.

Conflict of Interest: None

Ethical Clearance: Taken

Source of Funding: Self

Acknowledgement: Nil

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