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INDEX

Sr. No.	Title	Author	Subject	Page No.
1	Antibacterial activity of Bauhinia tomentosa Linn	S. Jasmine Mary, Dr. A. John Merina	Chemistry	1-2
2	Impact of Personal Loan Offered by Banks and Non Banking Financial Companies in Coimbatore City	Dr. A. Vinayagamoorthy, M. Somasundaram, C. Sankar	Commerce	3-6
3	Sustainable Rural Development: A Case Study of Kalewadi Nirmal Gram, District Satara (Maharashtra)	Dr. Anandrao S. Patil	Commerce	7-10
4	Financial Performance Of Cadila Pharmaceuticals Ltd. & Cipla Pharmaceutical Ltd	Archana J. Bhoot	Commerce	11-12
5	The Role Of Advertisement In Buying Behaviour	Dr. K. Krishnakumar, K. Radha	Commerce	13-15
6	Business Performance Effectiveness with the Aid of Total Quality Management	Dr. Vipul Chalotra	Commerce	16-17
7	Women Entrepreneurial Success-Key Indicator Analysis	Dr. S. Valli Devasena, Priyadarshini	Commerce	18-19
8	Mentoring: A Tool For Lifelong Learning In Organizations	Dr. Sandeep Tandon, Mrs. Shelleka Gupta	Commerce	20-24
9	Energy-Efficient MAC Layer Protocols in Ad hoc Networks	Ajay Shah, Hitesh Gupta, Mukesh Baghel	Computer Science	25-28
10	"E-Governance Initiatives in Gujarat- A Case Study"	Prof. Priyank Gokani, Prof. Dr. H. N. Pandya	Computer Science	29-30
11	Impact of Carpet Weaving Activity on Rural Poor: (A case study on migrated weavers' households in West Bengal)	Chittaranjan Das, Dr. Swarup Kumar Jana	Economics	31-33
12	Role of Finance Commission in Fiscal Transfers in India	Prof. P. Dhiraviyam	Economics	34-37
13	Human Resource Practices in Banks Some Myths and Realities	Dr. K. Kaliyamoorthy, **Mrs. J. Shymala Devi	Economics	38-41
14	Employer-Employee Relationship In Co-Operation	Dr. Rohit N. Desai	Economics	42-43
15	Industrialization And Sustainable Development	Pallavi C. Vyas	Economics	44-46
16	Impact Of Teacher Absenteeism On The Quality Of Education At Government Elementary Schools	Dr. Praveena, K. B	Education	47-49
17	Relevance of Remote Sensing and GIS in Water Resources Engineering	Kaushikkumar R. Mayani, V. M. Patel	Engineering	50-51
18	Optimization of the Irrigation water Efficiency	Kiran R. Shah, PROF. A. I. Lalani	Engineering	52-54
19	Corporate Social Responsibility- An Analytical Case Study	Soheli Ghose	Finance	55-57
20	The story of colour	Kashyap Parikh	Fine Arts	58-59
21	Impact of Dietary Intake of Pregnant Women on Neonatal Outcome in North Chennai	Sudha S	Home Science	60-62
22	Some Initiatives of Rural Development through Rural Tourism and Mgnreg	Prof. D. Gunaseelan	Hotel Management	63-66
23	Innovative Methods in English Language Teaching	K. Rajkumar, Dr. P. Nagaraj	Literature	67-69

24	Leadership in Management	Dr.A.Jayakumar K.Kalaiselvi	Management	70-72
25	Leadership Styles in Organizations an Empirical Study	Dr.S.Saraswathi	Management	73-75
26	A Study of Job Stress Among Working Women in Government & Non Government Organization	Hetal M. Patoliya	Management	76-77
27	Achievement Evaluation Of Regional Rural Banks In India	Bind Kumar Tiwary	Management	78-81
28	Human Factors to Minimize the Human Error and Improving Patient Safety	Sanjay Saproo,Dr. Sanjeev Bansal,Dr. Amit Kumar Pandey	Management	82-86
29	Wealth Maximization in TATA Power Company Limited – An Empirical Study	R.Muruga Ganesh, Dr.A.Somu	Management	87-89
30	An Issues In Carbon Accounting Practices In India	Mr. Akhilesh N Shukla	Management	90-92
31	Motivation Of Employees In Public And Private Educational Institutions	T. Srinivasarao, Dr.S. Teki(Doms) ,Dr. M. Venkatasubba Reddy	Management	93-95
32	The Gap Analysis Of Hospitality Services: A Case Study	Dr. N. Ramanjaneyalu, Mr. Kiran Koppad	Management	96-100
33	Causes Of Stress And Affect Of Stress Indicators On Level Of Stress Among The Women Employees In It Sector	Sathyapriya.J,Dr.P.Amuth alakshmi, B.Aparna	Management	101-105
34	Social Marketing Effect on Knowledge and change in Attitude for prevention of STI/HIV/AIDS among Trucker's in Odisha	Mr. Prasanta Kumar Parida	Marketing	106-107
35	Rate Pressure Product In Type 2 Diabetic Cardiac Autonomic Neuropathy	Dr Rishu Segan	MEDICAL SCIENCE	108-109
36	Evaluation of rapid precurarisation technique using Rocuronium and Atracurium	Dr. Kalyani S. Konday, Dr. Daisy V. Jokhi	Medical Science	110-113
37	Prevalence Of Subclinical Thyroid Dysfunction In General Population: Focus On Tsh Co-Relation With Bmi	Dr. Kalyan Gaud, Ms. Shilpa Jaiswal	Medical Science	114-115
38	Static Sphere Of Dust Of Uniform Density Using Isotropic Line Element	Dr.M.A.Gaikwad	Science	116-117
39	Role of Political Parties in Urban Development	Dr. N.M. Sali	Social Science	118-119
40	Home range and habitat selection of Grey francolin (Francolinus francolinus) using radiotelemetry.	Sarita Rana	Zoology	120-122



Rate Pressure Product In Type 2 Diabetic Cardiac Autonomic Neuropathy

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ABSTRACT

Cardiac autonomic neuropathy is linked to unexplained sudden and silent death in type 2 diabetics. Altered cardiovascular haemodynamics or blood flow may be substantially involved in adverse cardiovascular mortality. Case control study was done on age matched (40-60 years) type 2 diabetics (n=100) with and without cardiac autonomic neuropathy divided into two groups of 50 each. Rate pressure product, non invasive indicator of myocardial blood flow, was calculated and results analysed using one way ANOVA (SPSS software). A significantly heightened rate pressure product was observed in cardiac autonomic neuropathy patients compared to non neuropathy counterparts ($p < 0.1$). Resting rate pressure product was found to be highest (> 12) in neuropathy patients.

Our findings suggest that type 2 diabetic cardiac autonomic neuropathy significantly increases resting rate pressure product. This reflects heightened resting myocardial blood flow. It leaves little capacity of the body to increase blood flow further especially at times of need contributing to exaggerated ischemic episodes.

Keywords : Diabetic cardiac autonomic neuropathy, Myocardial blood flow, Rate pressure product

Introduction:-

Autonomic Nervous System plays an important role in regulation of myocardial function, heart rate & myocardial blood flow. Chronic imbalance of autonomic nervous system is prevalent & potent risk factor for adverse cardiovascular events including mortality.¹ Within ten years of developing overt symptoms of autonomic neuropathy, 30-50% of the patients are dead, many from sudden cardio respiratory arrest – the cause of which is unknown.² The exact mechanisms remain unclear. An insight into the state of myocardial blood flow in diabetic cardiac autonomic neuropathy patients can help clear doubts surrounding this mystery. Rate Pressure Product or the Double product is the product of heart rate and systolic blood pressure. It is a major determinant of cardiac oxygen consumption and hence a predictor of myocardial blood flow.³ We aimed to assess the status of myocardial blood flow in diabetic cardiac autonomic neuropathy patients using a non invasive parameter - Rate Pressure Product.

Material and Methods:-

Study was carried out on 100 subjects taken from a tertiary health care hospital in Northern India. This study was approved by the Institutional Review Board of our hospital in accordance with Helsinki Declaration of 1964. Informed written consent was taken from each subject before commencing the test. Fasting / Random blood sugar test was performed using glucometer. Blood pressure was recorded using sphygmomanometer and heart rate calculated from lead II from ECG recording (cardiofax, Medicaid Systems). The subjects were divided into two groups of 50 each. Group A: 50 subjects of either sex between age group of 40-60 years having type 2 diabetes with cardiac autonomic neuropathy. These patients were having a postural fall in BP > 30 mm Hg and impaired hand grip.⁴ Group B: 50 subjects of either sex between age group of 40-60 years having type 2 diabetes without cardiac autonomic neuropathy. These patients did not show a postural fall in BP. Detailed history was taken from all the subjects and recorded on a special proforma. Exclusion Criteria: Subjects were examined to rule out Ischaemic Heart Disease, Congestive heart failure and Cardiac arrhythmias.

Rate Pressure Product Calculation

It is a product of systolic blood pressure and heart rate.⁵

RPP = Systolic Pressure in mm Hg x Heart Rate in beats/min x 10⁻²

The value obtained is expressed as mm Hg. beats per min. 10⁻² Values were expressed as mean + Standard Deviation and statistical analysis done using one way ANOVA with SPSS software. Probability value of $P < 0.1$ was taken as level of significance.

Result:- See Table 1 and Figure 1 before references.

As highlighted in table 1, statistical analysis using one way ANOVA, demonstrated that type 2 diabetics with cardiac autonomic neuropathy had a significantly higher resting rate pressure product than type 2 diabetics without cardiac autonomic neuropathy ($P < 0.1$). Fig. 1 shows that the mean resting rate pressure product was highest in type 2 diabetics with cardiac autonomic neuropathy (> 12).

Discussion:-

In our study, the resting RPP was found to be significantly higher in type 2 diabetic cardiac autonomic neuropathy patients ($P < 0.1$). Previous studies have shown that diabetes has an independent association with heightened rate pressure product.⁶ But our study confirmed the association of double product with diabetic cardiac autonomic neuropathy also. This may be because of relatively increased sympathetic tone present in diabetics with cardiac autonomic neuropathy. Since parasympathetic fibres are affected earlier there is a relative increase in sympathetic tone. Sympathetic fibres get damaged at least five years after parasympathetic fibres causing postural hypotension.⁷ Heightened double product at rest suggests that these patients have higher myocardial oxygen consumption at rest. Some investigators have observed that angina pectoris occurs at a constant value of Rate Pressure Product and that the degree of ST segment depression is correlated with Rate Pressure Product. Thus the risk of cardiovascular problems increases with greater levels of Rate Pressure Product.⁸ Another observation in this study was that the resting rate pressure product was highest in diabetics with cardiac autonomic neuropathy as shown by figure 1. The mean normative value of Rate Pressure Product as calculated by manufacturers of RPP unit, Pepper MG & Crowley BE is < 12 (where heart rate is between 60-120 beats per minute and systolic blood pressure between 100-140 mm Hg).

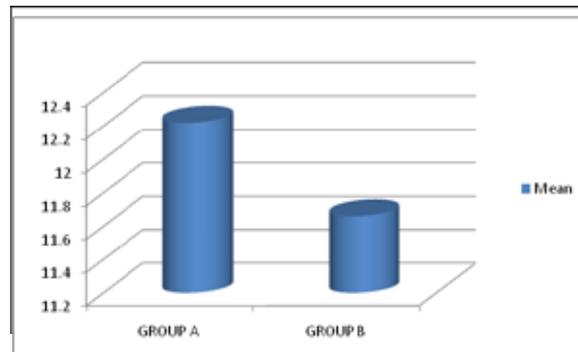
and $RPP = HR \times SYSP/1000$.⁹ It was found to be >12 in cardiac autonomic neuropathy group. The group without cardiac autonomic neuropathy had the values within this normative range but other group fell out of it. Justin R concluded in his study that subjects with coronary artery disease with blood glucose levels $> 110\text{mg/dL}$ have significantly higher rate pressure product at rest. Since already rate pressure product at rest is high so there is little capacity of the body to increase it further and improve myocardial perfusion.¹⁰ This renders diabetic autonomic neuropathy patients vulnerable to various cardiac risks like left ventricular dysfunction, cardiac arrhythmias, silent myocardial infarction, cardiac arrest and sudden death on exposure to current life stress episodes. We conclude that rate pressure product is significantly higher in type 2 diabetic cardiac autonomic neuropathy. We have found that type 2 diabetics who have cardiac autonomic neuropathy have resting rate pressure product values > 12 . It is out of the mean normative range suggesting a higher, almost fixed myocardial oxygen demand, resulting in little capacity of body to improve it further, potentially contributing to sudden adverse cardiovascular events.

Table 1:- Rate Pressure Product in type 2 diabetics with and without cardiac autonomic neuropathy

Groups	Age(Mean \pm SD)	RPP(Mean \pm SD)	F - ratio	P - value
Group A (with neuropathy)	53.65 \pm 8.00	12.22 \pm 1.82	2.788	0.098*
Group B (without neuropathy)	52.05 \pm 5.70	11.66 \pm 1.67		

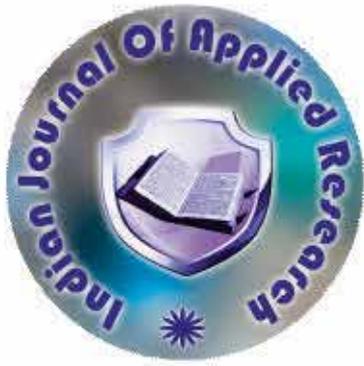
*P<0.1 significant

Fig. 1:- Resting Rate Pressure Product in type 2 diabetics with and without cardiac autonomic neuropathy



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