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RESEARCH ARTICLE

Study of heart rate variability in benign prostatic hyperplasia - A hospital-based study

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ABSTRACT

Background: Benign prostatic hyperplasia (BPH) is a major disease affecting middle-aged and elderly male. BPH is the result of unregulated proliferation of connective tissue, smooth muscle, and glandular epithelium within the prostatic zone resulting in lower urinary tract symptoms. The exact etiopathogenesis of BPH remains ambiguous, but there is increasing evidence that sympathetic overactivity appears to have an important role in the pathogenesis of BPH. Undoubtedly, the constellations of cellular, pathologic processes that give rise to symptoms of BPH are far complex than we currently realize. Only by unraveling these complexities, we will be able to successfully design alternative strategies to treat and prevent the adverse impact of BPH. **Aims and Objectives:** This study aims to evaluate the role of autonomic nervous system in the pathogenesis of BPH. **Materials and Methods:** After taking clearance from the ethical committee, a total of 42 male patients who were diagnosed clinically and ultrasonologically as cases of BPH were included in the study after applying appropriate inclusion and exclusion criteria. Patients were scored for the International Prostate Symptom Score (IPSS). The basal recording of electrocardiogram in lead II was done for 5 min. The Polyrite D was used for heart rate variability by frequency domain method. Pearson's correlation coefficient was calculated for low frequency (LF) versus IPSS and LF versus prostate size. **Results:** LF component was found significantly high in BPH patients. R value for LF versus IPSS was 0.9558 showing an increase in a sympathetic component with increase in IPSS which is statistically significant ($P < 0.001$). Patients with higher LF value had more lower urinary tract symptoms. R value for LF versus prostate size was 0.9421 which is also statistically significant ($P < 0.001$). This means if there is increase in the prostate size sympathetic activity also increased. **Conclusion:** This study was done with an aim to recommend methods of primordial prevention and our study shows greater sympathetic activity in BPH patients. Hence, we suggest yogic interventions such as meditation for primordial prevention.

KEY WORDS: Heart Rate Variability; Benign Prostatic Hyperplasia; International Prostate Symptom Score

INTRODUCTION

Benign prostatic hyperplasia (BPH) is a major disease affecting the elderly male in their 60s and 80s. BPH is the result of unregulated proliferation of the connective tissue, smooth muscle, and glandular epithelium within the prostatic zone resulting in lower urinary tract symptoms. The exact etiopathogenesis of BPH remains ambiguous, but there is increasing evidence that sympathetic overactivity appears to have an important role in the pathogenesis of BPH.[1,2] Sympathetic nervous system overactivity has been shown in patients with lower urinary tract symptoms suggestive of BPH.[3,4] There are many extraprostatic factors also which may lead to anatomical and physiological derangements which may ultimately lead to emergence of the symptoms of BPH.

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Undoubtedly, the constellations of cellular, pathologic processes that give rise to symptoms of BPH are far complex than we currently realize. Only by unraveling these complexities, we will be able to successfully design alternative strategies for primordial prevention to treat and prevent the adverse effects of BPH.

Heart rate variability (HRV), a non-invasive technique, represents an important marker for autonomic nervous system (ANS) evaluation. HRV is the amount of heart rate fluctuations around the mean heart rate. It is produced due to the continuous change in the sympathetic-parasympathetic balance that, in turn, causes the sinus rhythm to fluctuate around mean heart rate. HRV is being used widely to assess global sympathetic and parasympathetic activity.[5,6] We have taken this study to evaluate the ANS status using short-term HRV recordings in patients of BPH to reveal any etiologic association between sympathetic-parasympathetic dominance and prostate enlargement.

MATERIALS AND METHODS

This observational study was done in the Department of Physiology and Department of Surgery at Subharti Medical College, Meerut. After taking informed consent and clearance from the institutional ethical committee, a total of 42 male patients (50–65 years) were included in the study. After applying appropriate inclusion and exclusion criteria, only those patients were selected who presented with lower urinary tract symptoms and were diagnosed as cases of BPH clinically and transrectal ultrasonography with a prostate volume ≥ 40 g and with post-void urine of > 30 ml. Patients with other illnesses affecting ANS, prostate cancer, urinary tract infections, diabetes mellitus, hypertension, coronary artery disease, etc., were excluded from the study.

The selected patients were then scored for the International Prostate Symptom Score (IPSS). IPSS is an eight questions (7 symptom questions + 1 quality of life question), written screening tool used for screening, diagnosing, and suggesting management of symptoms of BPH. It was created by the American Urological Society, in 1992. The seven questions are scored from 1 to 5 for a total of maximum 35 points, whereas eight questions of quality of life are assigned a score from 1 to 6. All patients were divided into mild (0–7), moderate (8–19), and severe (> 20) groups. Analysis of HRV is an important method for assessing ANS. Recording of HRV was performed in the research laboratory in the department of physiology SMC between 9:30 am and 11:30 am after 2 h of light breakfast. The temperature of the recording room was kept between 25°C and 28°C and lights subdued. The subjects were asked to void urine before testing and made to sit comfortably for 20 min. The basal recording of electrocardiogram in lead II was done for 5 min. The Polyrite D was used for HRV by frequency domain method. The following components were recorded, namely high-frequency (HF) component (0.15–0.4 Hz), an indicator of vagal activity and low-frequency (LF) component (0.04–0.15Hz), a replicator of composite sympathovagal pathway, LF/HF ratio. Data were analyzed using GraphPad instant version. All values were expressed as Mean ± SD. Pearson's correlation coefficient was calculated for LF and IPSS and LF and prostate size.

RESULTS

Mean age of our study group was 59–65 years. In our study, patients with more lower urinary tract symptoms had higher LF value as shown by Table 1. As the IPSS increased, the LF component also increased linearly. The LF component was found to be 27.9 nu in mild group, 54.77 nu in moderate group, and 79.18 nu in severe group. Pearson's correlation showed an r value for LF and IPSS to be 0.9558 ($P < 0.001$)*** showing an increase in sympathetic component with increase in IPSS. A positive correlation was also exhibited by prostate size and LF component. The r value for LF and prostate size was 0.9421 which was also statistically significant ($P < 0.001$)***. This shows that as the prostate size increased so the sympathetic activity also increased linearly. Thus clearly showing that there is positive linear relationship between sympathetic overactivity and symptomatology of BPH.

DISCUSSION

The mean age group affected was 59.6 years. In our study, we found that as the IPSS scoring and the prostate volume increased so the LF component also increased. The Pearson's correlation was r= 0.9558 and r= 0.9421, respectively. Both were found to be highly significant ($P < 0.001$). Our study clearly showed sympathetic dominance and is in agreement with the following studies Sandfeldt and Hahn, McVary *et al.,* and Ulrich *et al*. Sandfeldt and Hahn demonstrated that man with a marked enlargement of prostate had higher arterial pressure, suggesting over dominance of sympathetic system.[7] McVary *et al.* also showed that there was a positive correlation in HRV, adrenaline plasma level, and prostate length and transition zone height.[3]

In our study, as the LF component increased linearly, so the prostate size increased as shown in Table 2. This clearly shows that sympathetic overactivity is involved in the pathogenesis of BPH. Regardless of the exact proportion of epithelial to stromal cells in the hyperplastic process, there is no question that prostatic smooth muscle represents a significant volume of the gland. Although the smooth muscle cells in prostate have not been extensively characterized, presumably, their contractile properties are similar to those seen in other smooth muscle organs. The spatial arrangement of smooth muscle cells in prostate is not optimal for force

Table 1: Comparison of LF and HF with IPSS score in power nu

IPSS Score	LF (nu) (mean±SD)	HF (nu) (mean±SD)	*P* value
Mild (*n*=4)	27.90±9.48	71.95±9.26	0.042*
Moderate (*n*=28)	54.77±7.66	45.17±7.60	0.007**
Severe (*n*=10)	79.18±2.75	20.78±2.56	<0.001***

All values are expressed as mean±SD. *Unpaired *t*-test was applied $P<0.05$, **$P<0.01$,***$P<0.001$, IPSS: International Prostate Symptom Score, LF: Low frequency, HF: High frequency

Table 2: Correlation of LF (nu) with HF, IPSS, and prostate volume of patients of BPH

Variables	r value	*P* value
HF	−1	<0.001***
IPSS	0.955	<0.001***
Prostate volume	0.942	< 0.001***

$P<0.05$ was considered significant. $P<0.05$, **$P<0.01$, ***$P<0.001$. BPH: Benign prostatic hyperplasia, IPSS: International Prostate Symptom Score, LF: Low frequency, HF: High frequency

generation; however, there is no question that both passive and active forces in the prostatic tissue play a major role in pathophysiology of BPH.[8] Urinary tract is mainly controlled through sympathetic and parasympathetic nervous system, stimulation of adrenergic nervous system clearly results in a dynamic increase in prostatic urethral resistance. Blockade of this stimulation clearly diminishes this response. Active smooth muscle tone in the human prostate is regulated by adrenergic nervous system.[9] Receptor-binding studies clearly demonstrated that α 1A subtype is the most abundant adrenoceptor subtype present in human prostate. Moreover, the α 1A receptor clearly mediates active tension in human prostatic smooth muscle.[10] It is still unclear whether other factors may regulate smooth muscle contraction. Endothelins and endothelin receptors have been reported in human prostate.[11] However, the physiologic role of this potent contractile agent on prostate smooth muscle function remains to be defined.

Limitations of Study

Small sample size and lack of any biochemical parameter like catecholamine levels were our limiting factor. We would recommend further studies with a bigger sample size.

CONCLUSION

We conclude that sympathetic dominance has an important role in pathophysiology of BPH.

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