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Blood Pressure and Heart Rate-Related Ratios as Predictors of Cardiovascular Diseases: A Comprehensive Review

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ABSTRACT

Blood pressure (BP) and heart rate (HR) are vital parameters widely utilized in assessing cardiovascular health. Beyond these standalone measures, derived indices such as pulse pressure (PP), mean arterial pressure (MAP), and heart rate variability (HRV) offer significant insight into cardiovascular disease (CVD) risk. This comprehensive review examines the role of BP and HR-related ratios—such as systolic-to-diastolic BP ratio, HR-to-BP ratio, and HRV—in predicting the onset and progression of CVDs. The review highlights recent research findings, clinical implications, and future prospects for utilizing these parameters in preventive cardiology.

1. Introduction

Cardiovascular diseases (CVDs) remain the leading cause of morbidity and mortality worldwide, with hypertension and abnormal heart rate parameters being key contribut(1). While systolic blood pressure (SBP), diastolic blood pressure (DBP), and resting heart rate (RHR) are primary indicators, their derived ratios and variability measures offer improved predictive accuracy for CVD risk.

Ratios such as SBP/DBP and PP provide insight into arterial stiffness and vascular resistance, while HRV reflects autonomic nervous system regulation. These parameters are increasingly recognized for their prognostic value in conditions like coronary artery disease (CAD), heart failure, and stroke(1).

2. Blood Pressure-Related Ratios

2.1. Pulse Pressure (PP)

PP, calculated as the difference between SBP and DBP, reflects arterial stiffness and vascular compliance. Elevated PP is strongly associated with the risk of atherosclerosis, CAD, and heart failure(2,3).

- **Clinical Evidence:**
  Studies have shown that PP >60 mmHg is a predictor of increased cardiovascular mortality, particularly in older adults(4).

2.2. Systolic-to-Diastolic Blood Pressure Ratio (SBP/DBP)

The SBP/DBP ratio highlights the balance between systolic pressure-driven perfusion and diastolic pressure-driven coronary artery filling.

- **Clinical Evidence:**
  A higher SBP/DBP ratio has been associated with increased left ventricular hypertrophy and stroke risk, particularly in hypertensive populations.

2.3. Mean Arterial Pressure (MAP)

MAP, calculated as (SBP+2×DBP)/3(\text{SBP} + 2 \times \text{DBP}) / 3(SBP+2×DBP)/3, is a key determinant of end-organ perfusion.(4)

- **Clinical Evidence:**
  Low MAP (<60 mmHg) is associated with hypoperfusion and increased CVD events in patients with sepsis or heart failure(5,6).

3. Heart Rate-Related Ratios

3.1. Resting Heart Rate (RHR) and HR-to-BP Ratios

RHR is a simple yet powerful predictor of cardiovascular risk. The HR-to-BP ratio (HR/SBP or HR/DBP) integrates autonomic regulation with vascular tone.

- **Clinical Evidence:**
  Elevated RHR (>80 bpm) and higher HR/BP ratios are linked to increased mortality in patients with hypertension and heart failure(7).

3.2. Heart Rate Variability (HRV)

HRV measures fluctuations in the intervals between heartbeats and reflects autonomic nervous system (ANS) function.

- **Clinical Evidence:**
  Reduced HRV is a robust predictor of sudden cardiac death, myocardial infarction, and arrhythmias, particularly in post-myocardial infarction patients.(8)

4. Combination of BP and HR Parameters in Risk Prediction

Combining BP and HR measures improves the predictive accuracy for CVD risk. For example:

- **BP and HR Synchrony:**
  Elevated PP combined with a high RHR indicates heightened sympathetic activity, which is associated with increased CVD mortality(8).

- **HRV and MAP:**
  Reduced HRV coupled with low MAP identifies high-risk patients with heart failure(9).

5. Implications in Clinical Practice

5.1. Screening and Early Detection

BP and HR-related ratios can aid in identifying high-risk individuals, enabling early lifestyle or pharmacological interventions.

5.2. Personalized Treatment Strategies

- **Hypertension:** Tailoring antihypertensive therapy based on PP or SBP/DBP ratio.
- **Heart Failure:** Adjusting beta-blocker dosage based on HRV and HR/BP ratios.

5.3. Monitoring Therapeutic Efficacy

HRV changes can reflect the success of interventions like lifestyle modification or beta-blocker therapy(10).

6. Challenges and Future Directions

6.1. Challenges

- **Measurement Variability:** BP and HR readings are influenced by factors like stress, posture, and circadian rhythms.
- **Limited Awareness:** Many clinicians rely solely on SBP/DBP without considering derived indices.

6.2. Future Directions

- **Wearable Technology:** Development of devices for continuous monitoring of BP and HR parameters.
- **Artificial Intelligence (AI):** Using AI to analyze BP and HR data for personalized risk assessment.
- **Large-Scale Studies:** Conducting population-based research to validate the utility of BP and HR ratios in diverse demographics.

7. Conclusion

BP and HR-related ratios provide invaluable insight into cardiovascular health beyond standalone measurements. Parameters like PP, SBP/DBP ratio, and HRV enhance risk prediction for CVDs and guide personalized treatment strategies. Incorporating these indices into routine practice can significantly improve outcomes, particularly in high-risk populations. Future advancements in technology and AI hold promise for optimizing the use of these parameters in preventive cardiology.

References

1.Benjamin EJ, Muntner P, Alonso A, Bittencourt MS, Callaway CW, Carson AP, et al. Heart Disease and Stroke Statistics-2019 Update: A Report From the American Heart Association. Circulation. 2019;139(10).

2.Laurent S, Boutouyrie P, Asmar R, Gautier I, Laloux B, Guize L, et al. Aortic stiffness is an independent predictor of all-cause and cardiovascular mortality in hypertensive patients. Hypertension. 2001;37(5).

3.S L, P B, R A, I G, B L, L G, et al. Aortic stiffness is an independent predictor of all-cause and cardiovascular mortality in hypertensive patients. Hypertension. 2001;37.

4.,Kim HL. Arterial stiffness and hypertension. Vol. 29, Clinical Hypertension. 2023.

5.Magder S. The meaning of blood pressure Luigi Forni. Vol. 22, Critical Care. 2018.

6.Vishram-Nielsen JKK, Kristensen AMD, Pareek M, Laurent S, Nilsson PM, Linneberg A, et al. Predictive Importance of Blood Pressure Characteristics with Increasing Age in Healthy Men and Women: The MORGAM Project. Hypertension. 2021;77(4).

7.Ben-Dov IZ, Kark JD, Ben-Ishay D, Mekler J, Ben-Arie L, Bursztyn M. Blunted heart rate dip during sleep and all-cause mortality. Arch Intern Med. 2007;167(19).

8.Seravalle G, Grassi G. Heart rate as cardiovascular risk factor. Vol. 132, Postgraduate Medicine. 2020.

9.Tamaki S, Yamada T, Okuyama Y, Morita T, Sanada S, Tsukamoto Y, et al. Cardiac Iodine-123

10.Metaiodobenzylguanidine Imaging Predicts Sudden Cardiac Death Independently of Left Ventricular Ejection Fraction in Patients With Chronic Heart Failure and Left Ventricular Systolic Dysfunction. Results From a Comparative Study With Signal-Averaged Electrocardiogram, Heart Rate Variability, and QT Dispersion. J Am Coll Cardiol. 2009;53(5).

11.John Camm et. al. Task Force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology. Eur Heart J. 1996;17