Perspective

Prognostic Value of Heart Rate in Cardiovascular Disease

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Background

Those animals that live longer tend to have slower heart rates (HR). Several plausible theories suggest that this may not be a chance association but that the slower heart rate may have a causal relationship to longer life. Accordingly, a large number of cohort studies in the past years have tried to establish whether HR measurement may portend significant prognostic implications in apparently healthy subjects or even in cardiac patients.

Heart rate in apparently healthy subjects

Several studies have shown that increasing HR is predictive of clinical events in asymptomatic subjects[1-5]. When followed from 4 to 17 years, associations between HR and risk of ischemic heart disease and of cardiac and noncardiac death were confirmed[1-4]. Even age-adjusted total mortality increased for increasing values of HR[5] Jouven et al[6] have recently reported data showing that resting HR > 75 bpm was associated with a significant increase in all-cause mortality and, even more, with the occurrence of sudden death from acute myocardial infarction (MI).

Heart rate in subjects with Coronary Artery Disease (CAD)

Many earlier evidences confirmed that increased resting HR in patients with acute MI is an important predictor of fatal events[7-11]. Increased HR seems to maintain a significant predictive value even in the modern era of primary percutaneous coronary intervention (PCI) in acute MI patients[12,13]. This predictive value extends at long-term follow-up and is independent of most clinical parameters.

Besides acute MI, a predictive prognostic value of HR has also been reported in patients with stable CAD in which all-cause and cardiovascular mortality was demonstrated to increase with increasing HR[14].

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Heart rate in Chronic Heart Failure (CHF)

The association between HR and clinical outcome has been confirmed in patients with CHF. In ambulatory patients with advanced CHF, resting HR was the best predictor of an adverse outcome[15]. In the CIBIS-II study, which assessed the effect of bisoprolol therapy in CHF, multivariate analysis showed that HR at enrolment was a significant predictor of death, independently of several variables and of beta blocking treatment[16].The association between increased HR and worse outcome in CHF was also confirmed in a substudy of the MERIT-HF study[17].

Relation between heart rate reduction and prognosis

Although the use of beta-blockade has been associated with improved prognosis in patients with acute MI and those with CHF, the relationship between its effect on HR and an improved clinical outcome has rarely been investigated.

In acute MI patients, the observation that beta blocking agents with a limited effect on HR, such as those with intrinsic sympathomimetic activity, were not found to have significant effects on survival, in contrast with those with pure beta-blocking effect, suggests that HR reduction might be of importance in determining efficacy of beta-blocking agents.

A direct evidence of this relation was found in the CIBIS-II trial, in which the higher tertile of HR change, was associated with a lower mortality[18].

Pathophysiologic mechanisms

HR mainly reflects the sympathovagal balance, the association between autonomic imbalance and arrhythmic risk can explain the relationship between increased HR and sudden death in patients with depressed left ventricular function. Recently, sympathovagal imbalance has been associated with increased indexes of inflammation[19], which predisposes to vascular atherosclerosis and coronary plaque complications[20], thus also explaining the reported relationship between increased HR and development of atherosclerosis in experimental studies.

In CAD patients, increased HR can cause an increase of cardiac work, which increases myocardial oxygen consumption, and a reduction of the diastolic time, which decreases coronary blood flow, both favoring the development of myocardial ischemia. An increased HR also facilitates arrhythmias in ischemic areas by favoring reentry mechanisms. Furthermore, Heidland and Strauer found that an HR > 80 bpm was an independent predictor of plaque disruption[21].

Conclusion

In summary, studies have shown that a high resting heart rate is a strong predictor of total and cardiovascular mortality in healthy populations as well as in patients with cardiovascular diseases. Patients with higher heart rates are prone to more cardiovascular complications, independently of major risk factors when compared with those with lower resting heart rates. Resting heart rate is a simple measurement with important prognostic implications and is a possible major target in the pharmacological interventions of cardiovascular diseases.

References

1. Dyer AR, Persky V, Stamler J, Paul O, Shekelle RB, Berkson DM, et al. Heart rate as a prognostic factor for coronary heart disease and mortality: findings in three Chicago epidemiologic studies. Am J Epidemiol 1980; 112: 736-49.
2. Gillum RF, Makuc DM, Feldman JJ. Pulse rate, coronary heart disease, and death: the NHANES I Epidemiologic Follow-up Study. Am Heart J 1991; 121: 172-7.
3. Wilhelmsen L, Berglund G, Elmfeldt D, Tibblin G, Wedel H, Pennert K, et al. The multifactor primary prevention trial in Goteborg, Sweden. Eur Heart J 1986; 7: 279-88.
4. Benetos A, Rudnichi A, Thomas F, Safar M, Guize L. Influence of heart rate on mortality in a French population: role of age, gender, and blood pressure. Hypertension 1999; 33: 44-52.
5. Seccareccia F, Pannozzo F, Dima F, Minoprio A, Menditto A, Lo NC, et al. Heart rate as a predictor of mortality: the MATISS project. Am J Public Health 2001; 91: 1258-63.
6. Jouven X, Empana JP, Schwartz PJ, Desnos M, Courbon D, Ducimetiere P. Heart-rate profile during exercise as a predictor of sudden death. N Engl J Med 2005; 352: 1951-8.
7. Hillis LD, Forman S, Braunwald E. Risk stratification before thrombolytic therapy in patients with acute myocardial infarction. The Thrombolysis in Myocardial Infarction (TIMI) Phase II Co-Investigators. J Am Coll Cardiol 1990; 16: 313-5.
8. Hjalmarson A, Gilpin EA, Kjekshus J, Schieman G, Nicod P, Henning H, et al. Influence of heart rate on mortality after acute myocardial infarction. Am J Cardiol 1990; 65: 547-53.
9. Disegni E, Goldbourt U, Reicher-Reiss H, Kaplinsky E, Zion M, Boyko V, et al. The predictive value of admission heart rate on mortality in patients with acute myocardial infarction. SPRINT Study Group. Secondary Prevention Reinfarction Israeli Nifedipine Trial. J Clin Epidemiol 1995; 48: 1197-205.
10. Zuanetti G, Mantini L, Hernandez-Bernal F, Barlera S, di Gregorio D, Latini R, et al. Relevance of heart rate as a prognostic factor in patients with acute myocardial infarction: insights from the GISSI-2 study. Eur Heart J 1998; 19(Suppl F): F19-26.
11. Lee KL, Woodlief LH, Topol EJ, Weaver WD, Betriu A, Col J, et al. Predictors of 30-day mortality in the era of reperfusion for acute myocardial infarction. Results from an international trial of 41,021 patients. GUSTO-I Investigators. Circulation 1995; 91: 1659-68.
12. Steffenino G, Santoro GM, Maras P, Mauri F, Ardissino D, Violini R, et al. In-hospital and one-year outcomes of patients with high-risk acute myocardial infarction treated with thrombolysis or primary coronary angioplasty. Ital Heart J 2004; 5: 136-45.
13. Mauss O, Klingenheben T, Ptaszynski P, Hohnloser SH. Bedside risk stratification after acute myocardial infarction: prospective evaluation of the use of heart rate and left ventricular function. J Electrocardiol 2005; 38: 106-12.
14. Diaz A, Bourassa MG, Guertin MC, Tardif JC. Long-term prognostic value of resting heart rate in patients with suspected or proven coronary artery disease. Eur Heart J 2005; 26: 967-74.
15. Aaronson KD, Schwartz JS, Chen TM, Wong KL, Goin JE, Mancini DM. Development and prospective validation of a clinical index to predict survival in ambulatory patients referred for cardiac transplant evaluation. Circulation 1997; 95: 2660-7.
16. CIBIS-II Investigators and Committees. The Cardiac Insufficiency Bisoprolol Study II (CIBIS-II): a randomised trial. Lancet 1999; 353: 9-13.
17. MERIT-HF Study Group. Effect of metoprolol CR/XL in chronic heart failure: Metoprolol CR/XL Randomised Intervention Trial in Congestive Heart

Failure (MERIT-HF). Lancet 1999; 353: 2001-7.
18. Funck-Brentano C, Lancar R, Hansen S, Hohnloser SH, Vanoli E. Predictors of medical events and of their competitive interactions in the Cardiac Insufficiency Bisoprolol Study 2 (CIBIS-2). Am Heart J 2001; 142: 989-97.
19. Tracey KJ. The inflammatory reflex. Nature 2002; 420: 853-9.
20. Libby P, Ridker PM, Maseri A. Inflammation and atherosclerosis. Circulation 2002; 105: 1135-43.
21. Heidland UE, Strauer BE. Left ventricular muscle mass and elevated heart rate are associated with coronary plaque disruption. Circulation 2001; 104: 1477-82.

ความสำคัญของอัตราเต้นหัวใจต่อการพยากรณ์โรคทางระบบหัวใจและหลอดเลือด

อภิชาต สุคนธสรรพ์

ลองสังเกตดูว่าสัตว์ที่หัวใจเต้นช้าจะมีอายุยืนกว่าสัตว์ที่หัวใจเต้นเร็ว ปัจจุบันข้อสังเกตดังกล่าวไม่ได้เป็นเพียงทฤษฎีอีกต่อไปแล้ว ข้อมูลจากการศึกษามากมายในปัจจุบันแสดงว่าอัตราเต้นหัวใจเป็นสิ่งบอกการ พยากรณ์โรคในบุคคล ไม่ว่าผู้นั้นจะเคยมีโรคหัวใจอยู่แล้วหรือไม่ก็ตาม ข้อมูลจากบุคคลสุขภาพปกติ บุคคลที่เป็นโรคหลอดเลือดหัวใจโคโรนารี่อยู่แล้ว หรือ บุคคลที่มีภาวะโรคหัวใจล้มเหลวเรื้อรังล้วนแสดงว่ายิ่งหัวใจเต้นเร็วยิ่งเพิ่มปัญหาแทรกซ้อนและเพิ่มการเสียชีวิตในระยะยาว ปัจจุบันได้นำยากลุ่ม beta blocker มาใช้รักษาโรคหัวใจอย่างแพร่หลาย ทั้งโรคหลอดเลือดหัวใจโคโรนารี่และโรคหัวใจล้มเหลวเรื้อรัง ประสิทธิภาพของยากลุ่มดังกล่าว ส่วนหนึ่งขึ้นอยู่กับว่ายาจะลดอัตราเต้นของหัวใจได้มากหรือน้อย

ภาวะหัวใจเต้นเร็วน่าจะส่งผลเสียต่อหัวใจหลายด้าน โดยอัตราเต้นที่เร็วนี้อาจสะท้อนถึงภาวะขาดสมดุลของระบบ sympathovagal ซึ่งนำไปสู่การเพิ่มภาวะหัวใจเต้นผิดจังหวะอย่างรุนแรง นอกจากนี้หัวใจเต้นเร็วยังนำไปสู่สภาพที่กล้ามเนื้อหัวใจต้องใช้ออกซิเจนเพิ่มขึ้น ได้รับโลหิตไปหล่อเลี้ยงน้อยลง และในทางทฤษฎียังน่าจะเป็นสาเหตุหนึ่งของภาวะหลอดเลือดแข็ง ตลอดจนการปริแยกของ plaque ที่ผนังหลอดเลือด

การจับชีพจรเพื่อนับจังหวะเต้นของหัวใจ เป็นการตรวจที่ง่ายแต่ให้ประโยชน์สูงและน่าจะมีบทบาทในการวางแผนและติดตามการรักษาผู้ป่วยโรคหัวใจตลอดจนการพัฒนาชนิดและคุณภาพของยาใหม่ ๆ ต่อไปในอนาคต