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Rhythm Disturbances in the Aerospace Medicine

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ABSTRACT

A number of rhythm disorders such as sinus arrhythmia, premature ventricular contractions, premature atrial contractions and sinus bradycardia and heart rate alterations may be seen under +Gz. The shift in autonomic balance may lead to alterations in cardiac rhythm and heart rate. The significance of these rhythm disturbances is not yet fully understood. In this manuscript the rhythm disturbances in the aerospace medicine were reviewed.

Key Words: Aerospace medicine; rhythm disturbances; gravity

Havacılık ve Uzay Tıbbında Ritim Bozuklukları

ÖZET

Sinüzal aritmi, ventriküler erken vurular, atriyal erken vurular ve sinüs bradikardisi gibi birçok ritim bozukluğu ve kalp hızı değişiklikleri +Gz altında görülebilir. Otonomik balanstaki kayma kardiyak ritim ve kalp hızında değişikliklere yol açabilir. Bu ritim bozukluklarının önemi tam olarak anlaşılamamıştır. Bu yazıda, hava ve uzay tıbbında gözlemlenebilen ritim bozuklukları gözden geçirilmiştir.

Anahtar Kelimeler: Havacılık ve uzay tıbbı; ritim bozuklukları; yer çekimi

INTRODUCTION

The Rhythm Disturbances on the Aerospace Medicine

Humans are adapted to live the accelerative force of gravity[1]. Acceleration is described in units of the force called Gs (m/s^2 or N/kg). There are linear, radial and angular acceleration. These accelerations induce G-forces on the body which may be described as Gx, Gy, and Gz. Gx is described as force acting on the body from chest to back. +Gx is force that pushes the pilot back into the seat as the aircraft accelerates. -Gx is described as force from back to chest. This force pushes the pilot forward into the shoulder strap. Gy is a lateral force that acts from shoulder to shoulder. Gz is a gravitational force that is applied to the vertical axis of the body. If it is experienced from head to foot, it is termed +Gz. -Gz travels from foot to head[1].

A number of rhythm disorders and heart rate alterations may be seen under +Gz[1-6]. The shift in autonomic balance may lead to alterations in cardiac rhythm and heart rate[4-6]. Generally, heart rate response is dependent on +Gz and blood lactate level[6,7]. During spaceflight, heart rate decreases early in microgravity that is more or less a synonym of weightlessness and zero-G and then gradually returns to normal[8]. After return to normal gravity heart rate increases and remains elevated for around two weeks. Spectral analysis of heart rate variability, is the physiological phenomenon of variation in the time interval between heartbeats, showed no significant changes during spaceflight, but after return to earth the ratio of low to high frequency components of the short-term heart rate variability increased, suggesting decreased parasympathetic tone[8].

In healthy people, the rhythm disturbances such as sinoatrial and atrioventricular dissociation and ventricular tachycardia under +Gz are probably benign[1]. A 3-year history of acceleration-related dysrhythmias observed in 544 different individuals exposed to 9.831 +Gz runs on the United States Air Force School of Aerospace Medicine centrifuge[9]. These dysrhythmias were sinus arrhythmia (rating varying >25 bpm), premature ventricular contractions, premature atrial contractions, sinus bradycardia (rate <60 bpm), ectopic atrial rhythm, premature junctional contractions, bigeminy/trigeminy premature ventricular contractions, multiform premature ventricular contractions, atrioventricular dissociation and paired premature ventricular contractions, respectively. There are several pathophysiological mechanisms under the rhythm disorders in the space such as underlying heart disease, potassium deficiency, catecholamines and autonomic nervous system[10].

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Rotman and Triebwassershowed that in a study of 230.000 air force personnel, 394 individuals had complete right bundle branch block. The majority of individuals with right bundle branch block had no underlying cardiac disease and, as a result, had an excellent prognosis[11]. Manningstudied a selected group of fit aircrew with complete right bundle branch block[12]. This study covered a period of 18 years during which a consecutive study of 139.651 men from 1960 to 1978 was carried out. Complete right bundle branch block occurred in 103 cases. This study demonstrated that right bundle branch block, both incomplete and complete, in itself does not confer a poor prognosis, particularly when found in young men applying for aircrew training. Taniguchi et alalso evaluated the prognostic and clinical significance of newly acquired complete right bundle branch block in Japan Airlines pilots[13]. This study group included 36 pilots with acquired complete right bundle branch block, identified from a group of over 2.700 Japan Airlines pilots. During the observation period (10.9±5.7 years), no cardiovascular events were noted.

In conclusion, the significance of these rhythm disturbances is not yet fully understood. In view of the large amount of important data that has already accumulated, additional studies in this field should be of high priority.

CONFLICT of INTEREST

The author reported no conflict of interest related to this article.

REFERENCES

1. www.faa.gov/pilots/training/airman_education/aerospace_physiology/index.cfm
2. Lees PJ. Cardiology in space. Hellenic J Cardiol 2005;46:320-3.
3. Leguay G, Seigneuric A. Cardiac arrhythmias in space. Role of vagotonia. Acta Astronaut 1981;8:795-801.
4. Baevsky RM, Bennett BS, Bungo MW, Charles JB, Goldberger AL, Nikulina GA. Adaptive responses of the cardiovascular system to prolonged spaceflight conditions: assessment with Holter monitoring. J Cardiovasc Diagn Proced 1977;14:53-7.
5. Rossum AC, Wood ML, Bishop SL, Deblock H, Charles JB. Evaluation of cardiac rhythm disturbances during extravehicular activity. Am J Cardiol 1997;79:1153-5.
6. Gundel A, Drescher J, Spatenko YA, Polyakov VV. Heart period and heart period variability during sleep on the MIR space station. J Sleep Res 1999;8:37-43.
7. Burton RR, Whinnery JE, Forster EM. Anaerobic energetics of the simulated aerial combat maneuver (SACM). Aviat Space Environ Med 1987;58:761-7.
8. Migeotte PF, Prisk GK, Paiva M. Microgravity alters respiratory sinus arrhythmia and short-term heart rate variability in humans. Am J Physiol Heart Circ Physiol 2003;284:H1995-2006.
9. Leverett S, Whinnery J. Biodynamics: Sustained Acceleration pp 202-249 in R DeHart Fundamentals of Aerospace Medicine, Lea and Febiger, New York, 1985.
10. Leguay G, Seigneuric A. Cardiac arrhythmias in space. Role of vagotonia. Acta Astronaut 1981;8:795-801.
11. Rotman M, Triebwasser JH. A clinical and follow-up study of right and left bundle branch block. Circulation 1975;51:477-84.
12. Manning GW. An historical review of the electrocardiogram of right bundle branch block in the Royal Canadian Air Force. Can J Cardiol 1987;3:375-7.
13. Taniguchi M, Nakano H, Kuwahara K, Masuda I, Okawa Y, Miyazaki H, et al. Prognostic and clinical significance of newly acquired complete right bundle branch block in Japan Airline pilots. Intern Med 2003;42:21-4.