Effects of Exercise on Atrial Natriuretic Factor Release Mechanisms and Implications for Fluid Homeostasis

Beau J. Freund, Charles E. Wade, and John R. Claybaugh

Department of Clinical Investigation, Tripler Army Medical Center, Honolulu, Hawaii, USA, and the Division of Combat Casualty Care, Letterman Army Institute of Research, San Francisco, California, USA

Summary

Atrial natriuretic factor is reported to be elevated during and immediately following exercise and is thought to play a role in fluid homeostasis and cardiovascular regulation. The predominant stimuli for atrial natriuretic factor release during exercise appear to be increases in atrial pressures or atrial distension, both of which are reported to increase with exercise. The intensity and perhaps duration of exercise also influence the magnitude of the atrial natriuretic factor response. It is not clear if the rise in plasma atrial natriuretic factor during exercise plays any role in altering renal function since high intensity exercise is typically associated with an antidiuresis. However, elevations in plasma atrial natriuretic factor may in part be responsible for the increase in urine flow reported when exercise is performed at low or moderate intensities. Atrial natriuretic factor also has vascular...
Atrial natriuretic factor or peptide (ANF) is believed to play a role in fluid homeostasis. Since its identification by de Bold et al. (1981) this hormone has generated much enthusiastic study. The complete amino acid sequence for the primary circulating form in humans has been determined and the peptide has been synthetically replicated (Kangawa & Matsuo 1984). The development of sensitive radioimmunoassays for the measurement of atrial natriuretic factor and the commercial availability of the synthetic hormone have allowed researchers to study the responses to atrial natriuretic factor infusion and determine those factors or stimuli responsible for release of atrial natriuretic factor into the circulation. The storage site, stimuli for secretion, and principal sites of action have been studied in some detail. However, much remains to be learned about this hormone and its potential effects on fluid homeostasis.

The primary stimuli responsible for the release of atrial natriuretic factor will be discussed in some detail later. In brief, however, atrial distension or pressure increases appear to be primary candidates (Goetz 1988). Disease conditions or experimental perturbations that induce atrial distension or increase atrial pressure elevate plasma levels of atrial natriuretic factor. These include various clinical disorders: cardiac disease or dysfunction (Dietz et al. 1986b; Fyhrquist et al. 1987; Nicklas et al. 1986; Tikkanen et al. 1987), chronic renal failure (Anderson et al. 1986b; Morris et al. 1987; Ogawa et al. 1987), primary aldosteronism (Tunny et al. 1986), the syndrome of inappropriate secretion of antidiuretic hormone (Cogan et al. 1986; Doncker et al. 1985) and normal ageing (Emmick & Cohen 1986; Ohashi et al. 1987; Tijima et al. 1988). Experimental perturbations that have been found to induce an elevation in plasma atrial natriuretic factor levels include blood volume expansion (Sagnella et al. 1986; Walker et al. 1987; Zimmerman et al. 1987), head-down tilt (Anderson et al. 1986a; Hodsman et al. 1986; Ogawa et al. 1987; Toshiro et al. 1986), movement from a standing to a supine posture (Fyhrquist et al. 1987; Hodsman et al. 1986; Toshiro et al. 1986), head-out body-water immersion (Anderson et al. 1986a; Gerbes et al. 1986; Fyhrquist et al. 1987), and, most recently, dynamic exercise (e.g. Freund et al. 1987a).

The response of atrial natriuretic factor to exercise has been studied in healthy and diseased subjects and these reports indicate that atrial natriuretic factor release is stimulated during exercise. It is the purpose of this paper to review those factors thought to be responsible for the atrial natriuretic factor elevation during or immediately following exercise, the potential role of atrial natriuretic factor in exercise-related fluid homeostasis and the alteration of the atrial natriuretic factor response to exercise in cardiovascular disease.

1. Response of Atrial Natriuretic Factor to Exercise

1.1 Effects of Exercise Intensity

Numerous studies during 1986 and 1987 reported an increase in plasma levels of atrial natriuretic factor during or immediately following exercise in healthy subjects (Espiner et al. 1986; Freund et al. 1987a; Hodsman et al. 1986; Keller