Endocrinology of the Heart

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Table of Contents

ANP in Healthy Volunteers

ANP and Cardiac Diseases

ANP and the Kidney

ANP and Pregnancy

ANP and Ca-Antagonists

The Heart in Acromegaly

Renal and Hormonal Reactions During Water Imnmersion in Healthy Pregnant Women and Patients with EPH-Gestosis

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Introduction

Head-out water immersion (WI) increases central venous and atrial volume by shifting blood from peripheral vessels to the intrathoracic venous bed. Because of stimulation of central low pressure and volume receptoprs there is an influence in hemodynamic and renal regulations. Thus thermoneutral WI results in a progressive diuresis, natriuresis and kaliuresis; concerning hormonal reactions WI leads to a decrease of antidiuretic hormone (ADH), renin and aldosterone in the blood (for Rev. see [4]). Furthermore it could be demonstrated in a previous study, that WI stimulates atrial natriuretic factor (ANF) in man [5] and thus seems to be a useful mean to study the physiological role of ANF in acute volume regulation.

In pregnancy there are changes in the control of extracellular water and electrolyte homeostasis and therefore it may be of interest to look at the responses of healthy pregnant women and patients with EPH-gestosis in a standardized water bath, regarding renal functions, plasma volume, renin, aldosterone and especially the atrial natriuretic factor.

Methods

Experiments were done with 27 women (group I [n = 13]: no pathological symptoms; group II [n = 14]: EPH-gestosis) after obtaining their informed consent. At the time of the studies the women were pregnant between the 28th and the 38th week. Furthermore a group (n = 9) of healthy non-pregnant women were investigated concerning ANF. The subjects were on an ordinary diet; alcohol, tobacco, tea and coffee were forbidden at the day of the experiment. The procedure consisted of a 40 min control period, followed by a 40 min bath (35 °C) and a 40 min recovery period. Blood samples drawn from a brachial vein by means of a butterfly needle were analysed for ANF (radio-immuno-assay with XAD-extracted plasma [1]), plasma renin activity (PRA) and aldosterone (commercial kits). Urine samples were collected after every period for determinations of urine output, sodium and potassium (flame photometry), creatinine (Jaffe reaction) and osmolality (freezing point depression). Changes of the hematocrit allowed the calculation of changes in the plasma volume. If necessary patients received medication. Data are given as means and standard errors of the mean.

Results

As can be seen in Fig. 1, WI significantly increased ANF plasma levels in all three groups. After 40 minutes there was an increase of about 50–70%. In the recovery period the hormone decreased with tendency to baseline levels. Neither basal nor stimulated values showed statistical differences between the groups. Only three pregnant women didn't respond.

WI was followed by a significant decrease in PRA and aldosterone. The drop in plasma levels was similar in the groups. No relationship between these hormonal changes and ANF could be found.

There were distinct effects of WI concerning renal excretion. Urinary flow rate was enhanced to 3 or 4 times of controls. Mean values of sodium and potassium excretion were increased, too. The gestosis-group showed lower basal values for sodium and significantly higher excretion rates after WI compared to the healthy pregnant women. Correspondingly there was an increase in fractionated excretions. In all groups WI resulted in increased osmotic and free water clearance. Creatinine clearance reached significantly higher values only in the gestosis group. During WI rises of plasma volume of about 8 or 9% could be demonstrated.

Discussion

A striking change in hemodynamics occurs in women during pregnancy and some 900 mmol sodium progressively accumulates and total body water increases by 6 to 8 liters, distributed amongst the fetus, the placenta and enlarged maternal blood and interstitial fluid volumes. Abnormalities of sodium and water balance are thought to be connected with diseases such as pre-eclampsia. On the other side pregnancies complicated by pre-eclampsia are associated with a reduction of plasma volume and central venous pressure. Furthermore the renin-aldosterone axis is involved in circulatory regulation and water and electrolyte balance.

Some authors demonstrated an elevation of plasma ANF levels during normal pregnancy and much higher levels in patients suffering from EPH-gestosis [2, 7, 8, 10]. Higher ANF levels in normal pregnancy were thought to be a consequence of the increased blood volume. Other results suggest that plasma ANF levels are normal in women during uncomplicated pregnancy [6, 3]. In our studies the basal values didn't show any significant differences between the groups.

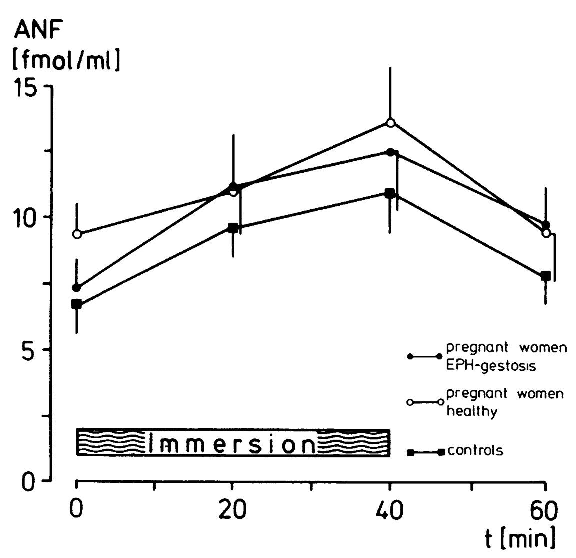

Fig. 1. Behaviour of plasma ANF during and after thermoneutral water immersion in healthy pregnant women, patients with EPH-gestosis and non-pregnant controls

There is the question if the trigger mechanisms of ANF secretion are less sensitive to central blood volume changes in pregnancy and uncomplicated pregnancy. Results from investigations with the WI model published Doniec-Ulman et al. [3] are consistent with this hypothesis. They documented a less stimulation rate for ANF in healthy pregnant women and women with moderate EPH-gestosis as compared to non-pregnant controls. Contrary to this we found comparable values of stimulated ANF during WI in all groups. We didn't observe any changes in the slope of the ANF-increases. That might not indicate a desensitisation of ANF secretion. Also an intact ANF-system seems to be necessary to normalize the water and electrolyte balance in the postnatal period [9]. However, statements about the WI-induced maximum concentrations of ANF cannot be given by our studies. Renin and aldosterone showed the decrease which is known in immersion physiology.

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