Atrial natriuretic peptide in chronic renal failure on maintenance hemodialysis: effect of heart failure

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ABSTRACT

Objective: To examine the plasma level of atrial natriuretic peptide (ANP) in patients with chronic renal failure (CRF) undergoing maintenance hemodialysis (HD) and to evaluate the effect of superimposed cardiac functional impairment on the plasma level of this hormone.

Design: A case-series study
Setting: A nephrology and dialysis unit of Ibn-Sina Teaching Hospital, Mosul, during the period from June 2003 to August 2004.

Participants: Forty patients with CRF undergoing maintenance HD, were divided into 2 groups depending on presence or absence of heart failure. Group I, includes 20 patients with CRF who did not have heart failure and group II, includes 20 patients with CRF who had heart failure. The study also includes 20 healthy volunteers as a control group.

Methods: Plasma ANP, serum creatinine, urea and body weights were measured in CRF patients before and after HD. The same parameters were also measured in the control group. The paired t-test was used to examine the difference in the mean of the studied parameters in patients with CRF before and after HD. The Unpaired t-test was used to assess the difference in the mean of the above-mentioned parameters between patients and control group. Pearson correlation coefficient was used to study the relation of the means of differences between pre and post dialyse values of the studied parameters within each patient group.

Results: The mean of plasma ANP level was significantly higher in group I (p<0.0001) and group II (p<0.0001) than that in the control group before and after HD. Furthermore, the plasma ANP in group II was significantly higher (p<0.0001) than that in group I. There was a significant decrease in the plasma ANP in group I (p<0.0001) and group II (p<0.0001) after HD. A significant positive correlation was found between the mean of decrease in plasma ANP level and body weight loss after HD in group I (r = 0.82, p<0.0001) and group II (r = 0.92, p<0.0001). A similar positive correlation was found between the mean of decrease in plasma ANP and the mean of decrease in serum creatinine in group II (r = 0.95, p<0.0001), and between the mean of decrease in plasma ANP and the mean of decrease in serum concentration of urea in group I (r = 0.48, p<0.05).

Conclusion: Periodic measurement of plasma ANP level in patients with CRF may be of great value in evaluating the actual fluid status in patients having CRF and in determination of frequency and duration of dialysis sessions. It also may be of value in predicting cardiac dysfunction in patients with CRF.

Key words: Atrial natriuretic peptide, chronic renal failure, haemodialysis.
PATIENTS AND METHODS

Forty patients with CRF (24 males and 16 females) who were attending the Dialysis Unit at Ibn-Sina teaching hospital for maintenance HD during the period from June 2003 to August 2004 were included in this study. The patients were divided into two groups according to the presence or absence of heart failure. Group I included 20 patients (13 males and 7 females) with CRF who did not have heart failure. Their age ranged from 26 to 73 years (49.6 ± 14.6). Group II includes 20 patients (11 males and 9 females) with CRF who have heart failure. Their age ranged from 28 to 73 years (46.9 ± 16.2) as a control group.

Ten ml of venous blood were obtained from a suitable forearm vein. Five ml of the sample was collected in heparinized tube and immediately placed in ice for the measurement of the ANP level. The other 5 ml was placed in a plain tube for the measurement of serum creatinine and urea level. Both tubes were centrifuged within 30 minutes, the plasma and serum were then separated and kept in capped plastic tubes.
RESULTS
The plasma levels of ANP, serum creatinine, serum urea and body weights of group I, group II and control group are shown in Table 1. The mean of plasma ANP was significantly higher in group I (p<0.0001) and group II (p<0.0001) than that in control group before and after HD. Furthermore, the plasma ANP in group II was significantly higher (p<0.0001) than that in group I. There was a significant decrease in the plasma level of ANP in group I (p<0.0001) and group II (p<0.0001) after HD. Figure 1. The mean of serum creatinine before HD was found to be significantly higher in group I (p<0.0001) and group II (p<0.0001) than that in control group. After HD the serum creatinine was significantly decreased in group I (p<0.0001) and group II (p<0.0001), but it was still significantly higher than that in control group (p<0.0001, p<0.0001 respectively). The mean of serum urea before HD was found to be significantly higher in group I (p<0.0001) and group II (p<0.0001) than that in control group. After HD the serum urea was significantly decreased in group I (p<0.0001) and group II (p<0.0001), but it was still significantly higher than that in control group (p<0.0001, p<0.0001 respectively). There was a significant reduction in the mean of body weight after HD in group I (p<0.0001) and group II (p<0.0001). There was a significant positive correlation between the Mean of reduction in plasma ANP level and the % mean of body weight loss in group I (r = 0.93, p< 0.0001) and group II (r = 0.94, p< 0.0001). A similar correlation was also observed between the mean of reduction in plasma ANP level and the mean of reduction in the serum creatinine in group II (r = 0.95, p<0.0001), and between the mean of reduction in plasma ANP and the mean of reduction in the serum urea in group II (r = 0.48, p<0.05).

Table 1: The mean ± SD of plasma ANP, serum creatinine and urea and body weight in group I, group II and control group.

| Parameters | Group I | | Group II | | Control group |
|------------|--------|------------------------|--------|----------------|
|            | Before | After | Before | After | |
| Plasma ANP | 177 ± 21.8 | 89.5 ± 5.5 | 209.1 ± 28.1 | 105.8 ± 26.8 | 36.1 ± 7.9 |
| µg/L | P<0.0001 | P<0.0001 | |
| Serum creatinine | 700.6 ± 56.9 | 625.1 ± 57.1 | 850.4 ± 81.4 | 647.7 ± 64.9 | 687.7 ± 71.1 |
| µmol/L | P<0.0001 | P<0.0001 | |
| Serum urea | 38.6 ± 2.6 | 25.1 ± 2.4 | 37.8 ± 4.3 | 18.4 ± 3.5 | 33.3 ± 0.57 |
| mmol/L | P<0.0001 | P<0.0001 | |
| Body weight | 69.5 ± 8.9 | 66.9 ± 1.1 | 69.8 ± 7.2 | 65.9 ± 10.2 |
| kg | P<0.0001 | P<0.0001 | |

A: significantly higher in group II from respective values in group I (p<0.0001)
B: significantly higher in group II from respective values in control group (p<0.0001)
C: significantly higher in group II from respective values in control group (p<0.0001)


DISCUSSION

It is well known that plasma level of ANP is elevated by several folds in patients with CRF when compared to values obtained in normal subjects[19]. The primary stimulus for the release of the ANP is increased stress of the atrial myocyte as a consequence of increased circulating blood volume and increased intra-atrial pressure[10]. Patients with CRF tend to retain water and salts between dialysis sessions; this accumulation should provide a potent stimulus to the release of this hormone. The present study showed that the mean of plasma ANP in group I (p<0.0001) and group II (p<0.0001) were significantly higher than that in control group. Moreover, the results also showed a significantly higher level of plasma ANP in group II (p<0.0001) in comparison with that of group I. In fact, this finding appears to be logical since patients with CRF who had heart failure tend to have an extra water and salt retention in comparison with patients with CRF who did not have such complication. Accordingly, they had an additional increment in atrial pressure and more stimulus to release ANP by atrial myocyte[10].

After HD the plasma ANP was significantly reduced in group I (p<0.0001) and group II (p<0.0001), but the level remained above the normal range. The reduction in plasma ANP level observed after dialysis is probably due to volume depletion with subsequent decrease in plasma volume and atrial pressure[10]. The present study revealed a significant loss in body weights after dialysis in group I (p<0.0001) and group II (p<0.0001) in comparison to the pre-dialysis values. Furthermore, the study showed a significant positive correlation between the mean reduction in body weights and mean decrease in plasma ANP levels in group I (r = 0.83, p< 0.0001) and group II (r = 0.54, p< 0.0001). A second factor that may contribute to the reduction in plasma ANP is the clearance of the hormone during the process of HD. Indeed many investigators have reported the presence of considerable amount of ANP in the dialysate filtrate, and they also observed a significant positive correlation between plasma level of the ANP and the ANP content of the filtered solution[14].

In conclusion the present study revealed a significant increase in the plasma ANP level in patients with CRF in comparison to normal subjects. The study also showed that plasma ANP level tends to be significantly higher in patients with CRF who had heart failure in comparison to those patients who did not have such complication. Therefore, periodic measurement of plasma ANP level in patients with CRF may be of great value in evaluating the actual fluid status in these patients and in determination of frequency and duration of dialysis sessions. It also may be of value in predicting cardiac dysfunction in patients with CRF.

REFERENCES