ADVANTAGES OF THORACIC ELECTRICAL BIOIMPEDANCE USED FOR HYPERTENSION CONTROL IN METABOLIC SYNDROME PATIENTS

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ABSTRACT

Our research was aimed at determining whether a hemodynamic guided treatment could contribute to a better hypertension control in patients suffering from metabolic syndrome, by choosing the best specific therapy for each patient depending on his/her hemodynamic profile. We monitored the evolution of both the patient's blood pressure and hemodynamic profile under anti-hypertension treatment, which we assessed using thoracic electrical bioimpedance (TEB). TEB examination, which is a both simple and noninvasive method, provides in just a few minutes precious information on the patient's cardiac output and hemodynamic anomalies: vasoactivity, blood volume, inotropy and chronotropy. **Material and methods** The study was conducted on a group of 30 subjects, who were transport workers, suffering from metabolic syndrome and uncontrolled hypertension, and who declared treatment compliance. We monitored the evolution of both the patient's blood pressure and hemodynamic profile under anti-hypertension treatment, which we assessed using TEB. For each patient, we recorded the percentage deviation of the hemodynamic parameters, whereas treatment modulation was done depending on the hemodynamic profile of each patient. **Results** According to our study results, hemodynamically guided anti-hypertension therapy improves the hypertension control rate. In our study, normal blood pressure was achieved, accompanied by normal dynamic status, which obviously led to better quality of life. **Conclusions** Our research supports the assumption according to which hypertension is associated with hemodynamic modulator disorders and it should therefore be treated as a hemodynamic origin condition and not as a mere rise in the blood pressure values.

Key words: thoracic electrical bioimpedance, metabolic syndrome, hypertension

INTRODUCTION

The metabolic syndrome is considered a public health problem, given its association with a high cardiovascular risk, as well as its high prevalence in the adult population (2).

Hypertension is currently considered the most important risk factor for cardiovascular conditions, as the relation between hypertension and the risk of cardiovascular events has been continuous, constant and independent of other risk factors. Hypertension is a common component of the MS and also a factor that is highly susceptible to change (3, 5). Paradoxically, despite the impressive therapeutic options that are currently available, recent studies conducted worldwide show that the "rule of halves" continue to apply (meaning that only half of the people suffering from hypertension are aware of this diagnosis, and only half of them

get treatment, and less than a quarter of the people receiving treatment attain the therapeutic targets) (1, 6).

Current hypertension approaches disregard the fact that hypertension patients may have different hemodynamic statuses, since their blood flow is not usually measured (4).

According to a new approach, in most cases HT has hemodynamic origin and it should be treated as such. The hemodynamic HT treatment involves tackling hemodynamic modulators the deviations of which are identified by the HOTMAN system, which relies on the thoracic electrical bioimpedance method. According to literature data, hypertension therapy guided according to hemodynamic parameters determined by thoracic electrical bioimpedance increases the blood pressure control rate. Assessing the plasma volume without hemodynamic methods is often difficult (1, 5).

The TEB method identifies the hemodynamic disorders (causes) associated with hypertension (effect) and enables the doctor to choose the best anti-hypertension therapy for each patient, allowing blood pressure and perfusion to reach normal levels (7).

MATERIAL AND METHODS

The study included 30 patients suffering from metabolic syndrome and uncontrolled hypertension, who declared treatment compliance.

Hypertension was considered uncontrolled when the blood pressure was 140/90 mmHg or above, in patients that did not suffer from diabetes mellitus, and 130/80 mmHg or above, in patients suffering from DM. The patients were monitored for 6 months, during which 4 sets of hemodynamic measurements were performed, namely on their inclusion in the study and after 1, 3 and 6 months, respectively.

Vasoactivity, blood volume, inotropy and chronotropy were determined. The values were generated automatically by a HOTMAN system after having entered each patient's data (demographic and anthropometric data, blood pressure, temperature, haemoglobin values).

Treatment modulation was done depending on the hemodynamic profile of each patient. The interpretation of the results provided by TEB relied on normal percentage deviations: ±36% for vasoactivity and ±25% for blood volume and inotropy. The data were computer processed using the SPSS program.

RESULTS

Blood pressure (BP) was initially uncontrolled in all the patients, and after a month the percentage of patients with uncontrolled blood pressure dropped to about 45% and then to 20% after 6 months (χ^2=73.51; GL=3; p<0,001) (Fig. 1).

The cases under survey exhibited significant hypervolemia only at the beginning of the study (53.3%), as later monitoring only revealed some cases of mild hypervolemia ranging from 64% after one month to 44% after 6 months (χ^2=33.17; GL=4; p=0.000003) (Fig. 2).

One should note that if initially 98% of the patients associated uncontrolled BP with altered blood volume, after one month 60% of the patients with altered blood volume experienced high BP, the relative risk in these patients being about 2 times higher (RR=1.98). After 3 months, about 40% of the patients associated uncontrolled BP with altered blood volume values, in whom the relative risk was over 2 times higher (RR=2.38). At the end of the study, uncontrolled BP was associated with altered blood volume levels in about 30% of the patients, who still had a risk of about 1.71 times higher, yet the frequency distribution does not reveal statistically significant differences (p=0.261) able to support this risk ratio (Fig. 3).

In the cases we studied, we found

significant vasoconstriction only at the beginning of the study (33.3%). The following monitoring processed revealed only cases of mild vasoconstriction ranging from 58% after one month to 36% after 6 months (χ^2=15.41; GL=4; p=0.001) (Fig. 4).

At first, 73% of the patients associated uncontrolled BP with altered vasoactivity, and after one month, 54% of the patients with altered vasoactivity suffered from uncontrolled blood pressure, the relative risk in these patients being 1.46 times higher, yet the frequency distribution does not reveal statistically significant differences (p=0.238) able to support this risk ratio. After 3 months, we noticed a relation between uncontrolled blood pressure and altered vasoactivity in less than 20% of the patients, in whom the relative risk was 1.43 times higher, yet the frequency distribution does not reveal statistically significant differences (p=0.548) able to support this risk ratio. At the end of the study, uncontrolled BP was associated with altered vasoactivity in about 50% of these patients, who experienced a relative risk 2.4 times higher in the case of such an association (Fig. 5).

95% of the patients initially associated blood volume with altered vasoactivity, whereas after only one month 69% of the patients with altered vasoactivity suffered from mild blood volume changes, the relative risk in these patients being 1.24 times higher, yet the frequency distribution does not reveal statistically significant differences (p=0.639) able to support this risk ratio. After 3 months, we noticed an association of hypervolemia with altered vasoactivity in over 60% of the patients, with a relative risk 1.64 times higher, yet the frequency distribution does not reveal statistically significant differences (p=0.280) able to support this risk ratio. At the end of the study, hypervolemia was associated with altered vasoactivity in 69% of the patients, and we detected a relative risk 2.75 times higher in the case of such an association (Fig. 6).

We noticed that the hyperdynamic status dropped from 20% to 7% in all the moments where it was analysed. The hypodynamic status also decreased from an initial percentage of 29% to 7% after 6 months of monitoring. The frequency distribution had statistically significant differences (χ^2=17.13; GL=4; p=0.0007) (Fig. 7).

At first, all the patients associated uncontrolled blood pressure with altered hemodynamic status, which was also revealed at the evaluations conducted after one and even 3 months, despite the lower number of people with uncontrolled blood pressure, yet we were unable to identify any relative risk of this association. At the end of the study, uncontrolled blood pressure was associated with altered hemodynamic status in few over 60% of the patients, the relative risk being 8.44 times higher in the case of this association (Table I).

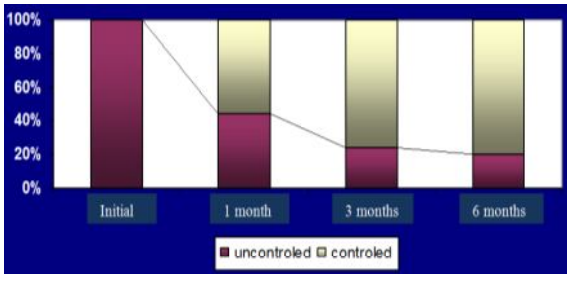

Fig. 1. Patient distribution depending on blood pressure

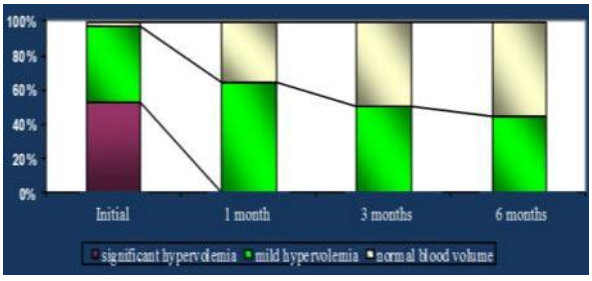

Fig. 2. Patient distribution depending on blood volume

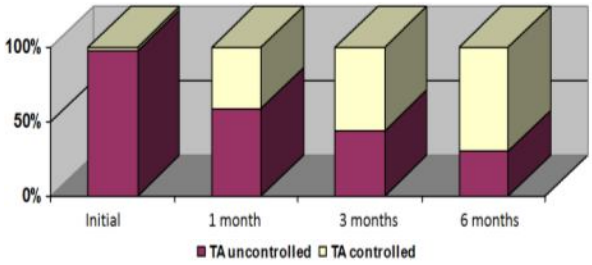

Fig. 3. Distribution of cases of altered blood volume depending on blood pressure

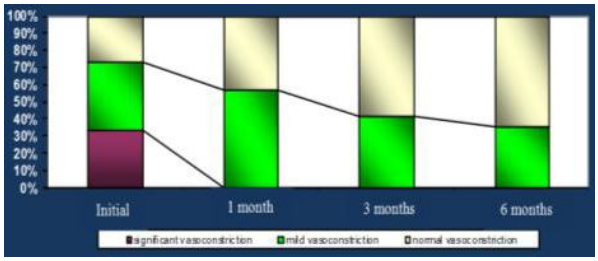

Fig. 4. Patient distribution depending on vasoactivity

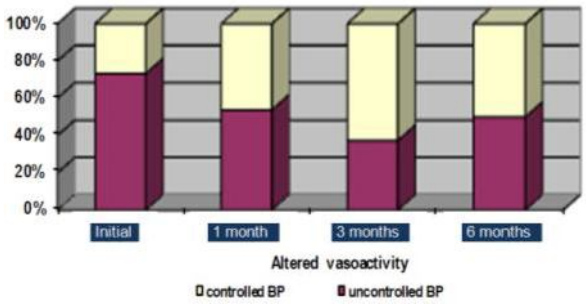

Fig. 5. Distribution of cases of altered vasoactivity depending on blood pressure

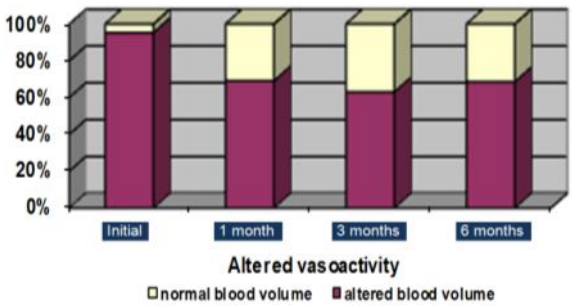

Fig. 6. Distribution of altered vasoactivity cases depending on blood volume

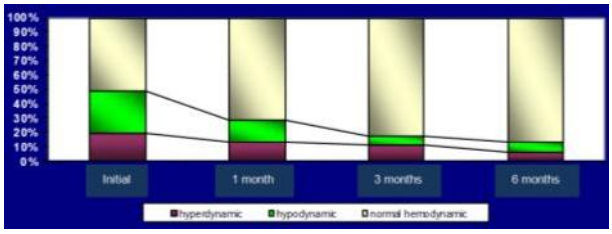

Fig. 7. Patient distribution depending on hemodynamic status

Parameter	Estimated value	95% CI	
		min	max
6 months			
Opportunity ratio (OR)	14.40	1.60	11.70
Risk ratio (RR)	8.44	1.82	39.16
Chi-square (χ^2)	6.82		
Significance level	**p=0.009**		

Table I. Estimation of risk parameters in blood pressure-hemodynamic status association

Initially, 98% of the patients associated blood volume with altered hemodynamic status, and after one month 92% of the patients with altered hemodynamic status experienced mild blood volume changes, the relative risk in these patients being 6.62 times higher.

After 3 months, we noted an association between hemodynamic status and altered blood volume in over 60% of the patients, with a relative risk 6.7 times higher. At the end of the study, altered hemodynamic status was associated with altered blood volume in 69% of the patients, with a relative risk 6.25 times higher in the case of this association (Fig. 8).

Initially, 73% of the patients associated altered vasoactivity with altered hemodynamic status, and after one month 50% of the patients with altered hemodynamic status experienced mild vasoactivity changes, the relative risk in these patients being 6.62 times higher. After 3 months, an association between hemodynamic status and altered vasoactivity was reported in fewer than 40% of the patients, with a relative risk 6.7 times higher. At the end of the study, altered hemodynamic status was associated with altered vasoactivity in 50% of the patients, with a relative risk 6.25 times higher in the case of this association (Fig. 9).

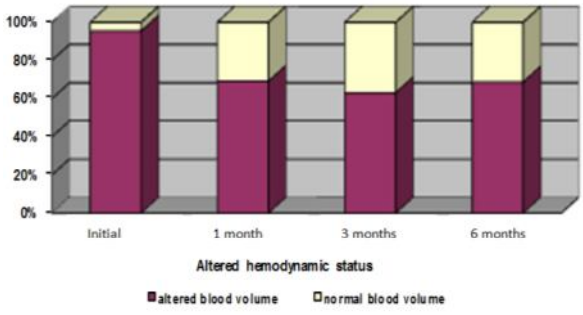

Fig. 8. Distribution of cases of altered hemodynamic status depending on blood volume

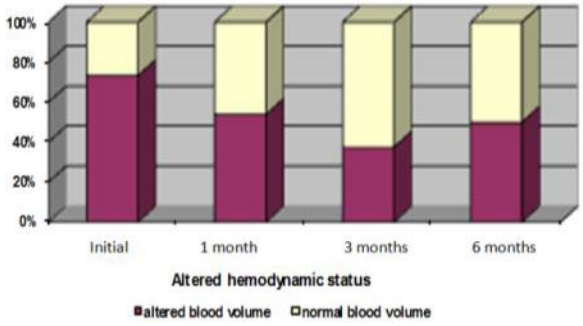

Fig. 9. Distribution of cases of altered hemodynamic status depending on vasoactivity

CONCLUSIONS

Hypertension is associated with hemodynamic modulator disorders and it should therefore be treated as a hemodynamic origin condition and not as a mere rise in the blood pressure values. Thoracic electrical bioimpedance is a simple, rapid and noninvasive method, which is useful for practitioners when examining hypertension patients and which identifies hemodynamic deviations associated with hypertension. A hemodynamic approach of hypertension patients enables the doctor to choose the best specific therapy for each patient.

According to our study results, hemodynamically guided anti-hypertension therapy improves the hypertension control rate. In our study, normal blood pressure was achieved, accompanied by normal dynamic status, i.e. normal tissue perfusion, which obviously led to better quality of life.

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