CHANGES IN SERUM ZINC LEVELS IN RELATION TO BLOOD PRESSURE DURING ANAESTHESIA

Garg H K¹, Agrawal P², Haleem S³

ABSTRACT

Fifty age and sex matched patients admitted for surgical operation, were divided into normotensive (control) and hypertensive (study) groups. Systolic and diastolic blood pressures were recorded preoperatively, 10 min after intubation, at max-increase of BP and 24 hours postoperatively. 5 ml. venous blood samples were drawn at these time periods, and serum zinc was also estimated. Control Gp (normotensive) subject recorded fall ($p < 0.001$) in serum Zn 10 min after intubation ($n = 18$) and max. Rise of BP ($n = 7$), Twelve subjects in study Gp recorded a rise in serum Zn at max. Increase of BP ($p < 0.01$). The pattern in normotensives points towards mobilization of zinc, while in hypertensives, homeostatic, defence mechanisms appear to resist mobilization of serum Zn till maximum rise in BP occurs, indicating hormonal and other influences on serum Zn levels during anaesthesia.

Key Words: Serum Zinc, Systolic BP, Diastolic BP, Anaesthesia

INTRODUCTION

Zinc is a trace metal which may have a close association with blood pressure. Serum zinc levels are likely to get disturbed in hypertension. The present study was designed to explore the possibility of a relationship between serum zinc levels and changing BP during G.A.

MATERIALS AND METHODS

Fifty patients of similar age and either sex were entered into the study. These patients, who were to be operated for various ailments, were divided into two groups of 25 subjects each. The control group (Group I) included normotensive subjects while the study group (Group II) included hypertensive

1. Associate Professor, Department of Pharmacology, Nepalgunj Medical College, Chisapani (Banke)
2. Senior Resident, Department of Anaesthesiology, J.N. Medical College, A.M.U., Aligarh (U.P.), India.
3. Lecturer, Department of Anaesthesiology, J.N. Medical College, A.M.U., Aligarh (U.P.), India.

Address for correspondence : Dr. H. K. Garg, Associate Professor, Department of Pharmacology
Nepalgunj Medical College, Chisapani (Banke) Nepal.
Ph. No.: 081-29119, Fax: 081-21152

subjects. Hypertensives were not operated till their BP came within normal range. Individuals with systemic or metabolic disorders or those receiving medications likely to affect serum zinc levels were excluded. Detailed history was taken and clinical examination and preoperative assessment was done in all cases. All patients were routinely investigated. Pulse rate and blood pressure were recorded in both upper limbs preoperatively, 10 minutes after intubation, at the maximum rise of BP and 24 hours after operation. BP was monitored every 10 min during operation, and the maximum increase of BP was thus detected. 5 ml. venous blood samples were drawn simultaneously for the purpose of correlating BP and serum zinc levels. Preanaesthetic medication was given using diazepam and pentazocine 15 mg, i.v, slowly. Induction was done with a sleep dose of thiopentone sodium I.V. slowly. Relaxation was done with succinylcholine, 1.5 mg/kg of body weight. The flow-in oxygen and nitrous

oxide were-maintained in a ratio of 40:60. Maintenance of anesthesia was achieved with vancuronium bromide and reversal was carried out using, neostigmine, 0.05mg/kg and inj. atropine, 0.02mg/kg body weight in all patients. Blood samples were kept at room temperature till serum separated, which was then stored at 4° C. Serum zinc was estimated by GBC 902 double beam, atomic absorption spectrophotometer. Statistical analysis of the data was done by Student's 't' test.

RESULTS

Mean systolic BP in the control group showed a rise ten minutes after intubation, ($p < 0.001$) No such change was seen in the study group. At maximum rise of BP systolic BP increased in normotensives ($p < 0.001$, Table I), but no change was seen in the study group (Table II). In the postoperative period, however a different pattern

Table I
Serum Zinc Levels in Normotensive Patients During Anaesthesia
(Data are mean $\pm$ s.e.m., n = 25)

Samples	Serun Zn (ug/100ml)	Pulse rate (per min)'	Systolic BP (mmHg)	Diastolic BP (mmHg)
Pre-operative	111.16 $\pm$ 4.39	91.84 $\pm$ 2.71	120.56 $\pm$ 1.97	80.16 $\pm$ 1.55
10 min after intubation	63.45 $\pm$ 4.49*	98.16 $\pm$ 2.31	139.96 $\pm$ 3.48*	93.20 $\pm$ 2.13
At max. Increase of B.P.	78.44 $\pm$ 5.25*	99.12 $\pm$ 2.72	150.88 $\pm$ 3.10*	101.44 $\pm$ 2.15
Post operative	61.68 $\pm$ 4.15*	85.44 $\pm$ 1.92	122.56 $\pm$ 3.12	84.40 $\pm$ 2.67

* $P < 0.001$, vs pre-operative

Table II
Serum Zinc Levels in Hypertensive Patients During Anaesthesia
(Data are mean $\pm$ s.e.m., n = 25)

Samples	Serun Zn (Ug /100ml)	Pulse rate (Per min)	Systolic BP (mmHg)	Diastolic BP (mmHg)
Pre-operative	135.16 $\pm$ 5.10	89.36 $\pm$ 2.66	154.32 $\pm$ 2.33	100.48 $\pm$ 1.06
10 min after intubation	112.46 $\pm$ 4.54**	98.56 $\pm$ 1.20**	147.36 $\pm$ 3.00	102.72 $\pm$ 1.37
At max. Increase of B.P.	139.30 $\pm$ 7.72	110.48 $\pm$ 2.57***	161.20 $\pm$ 2.54	112.64 $\pm$ 2.00***
Post-operative	117.00 $\pm$ 9.81	91.76 $\pm$ 2.27	141.76 $\pm$ 4.26*	95.52 $\pm$ 2.26

* $P < 0.02$, ** $p < 0.01$, *** $p < 0.001$, vs pre-operative

was observed. Systolic BP in the study group fell ($p < 0.02$), while no change was observed in the control group.

Mean diastolic BP ten minutes after intubation showed a significant rise ($p < 0.001$) in the study group, while no change was observed in the control group (Table II).

Definite and distinct patterns of rise and fall in serum zinc levels were observed. Nonhypertensive subjects were divided into two subgroups - I & II, according to changes in serum zinc levels.

- a) Subgroup I: - Eighteen normotensives showed a fall in serum zinc 10 min. after intubation, ($p < 0.001$) which increased ($p < 0.001$) at the time of peak rise of BP (Table III). No change was recorded in the postoperative period.
- b) Subgroup II: - Seven normotensives recorded a fall in serum Zn level at the time of peak rise of BP ($p < 0.01$). In the postoperative phase, the serum Zn level declined further ($p < 0.001$, Table III).

Table III
Fall in Serum Zinc Levels (ug/dl) in Normotensive Patients
(Data are mean $\pm$ s.e.m.)

Time of fall	Pre-operative	10 min after intubation	At max. Increase of B.P.	Post- operative
At 10 min. after intubation (n=10)	108.30 $\pm$ 6.92	55.72 $\pm$ 5.42***	68.93 $\pm$ 4.51***	69.23 $\pm$ 5.21***
In post-operative phase (n=7)	112.71 $\pm$ 7.64	84.28 $\pm$ 7.63*	65.85 $\pm$ 5.88**	52.42 $\pm$ 8.07***

* $P < 0.05$, ** $p < 0.01$, *** $p < 0.001$, vs pre-operative

On the basis of fluctuations in serum zinc levels, hypertensive subjects were divided into two subgroups:

- a) Subgroup I: - Twelve hypertensive subjects showed a rise in serum Zn level at maximum

rise of BP ($p < 0.01$). In the postoperative period, serum Zn fell (Table IV).

- b) Subgroup II:- Thirteen hypertensives did not show any significant change in serum Zn throughout the study period (Table IV).

Table IV
Rise in Serum Zinc (ug/dl) in Hypertensive Patients
(Data are mean $\pm$ s.e.m.)

Time of rise	Pre-operative	10 min after intubation	At max. Increase of B.P.	Post-operative
At max. After increase of B.P. (n=12)	137.00 $\pm$ 7.49	111.91 $\pm$ 14.62*	171.16 $\pm$ 4.20**	80.00 $\pm$ 4.99***
No rise (n=13)	134.00 $\pm$ 11.12	114.18 $\pm$ 9.22	114.25 $\pm$ 9.45	118.83 $\pm$ 13.11

* $P < 0.05$, ** $p < 0.01$, *** $p < 0.001$, vs pre-operative

DISCUSSION

The importance of normal serum zinc levels in the body cannot be overemphasized, as zinc has been found to be essential for growth and development, as well as for the general well being of an individual.² Zinc has been found to play an important role in the maintenance of blood pressure in rats.³ In the present study an attempt has been made to find out whether operative stress or general anaesthesia alter serum Zn levels. The serum zinc levels were significantly higher in hypertensive subjects as compared to normotensive subjects before anaesthesia.

The alteration in serum zinc levels during anaesthesia could be due to many factors. It could be due to the mobilization and redistribution of zinc. Redistribution of zinc was observed in hypertensives undergoing treatment with clopramide. Plasma, erythrocyte and W.B.C. levels of zinc registered an increase 8 weeks after initiation of therapy.⁴ Genetic predisposition to the effects of anaesthetic agents may be another reason of changes in zinc levels. Hypertension induced by deoxycorticosterone acetate was associated with higher serum zinc levels only in spontaneously hypertensive rats and not in normal rats.³ Yet another reason could be surgical stress. Surgical stress triggers the release of various mediators, possibly increasing hepatic zinc deposition, thus decreasing plasma and skin zinc levels.⁵ Studies on diverse tissue trauma such as following coronary bypass surgery, myocardial infarction^{7,8} and during fatigue⁹ have shown that there is a significant decrease in serum zinc levels.

In the present study, the changes observed in serum zinc levels were uniform and correlated with specific events, namely, stress of intubation, stress of increase in blood pressure or with postoperative stress. Patterns in normotensives and hypertensives

were also different. While a significant fall in zinc level at one time or the other was always observed in normotensives, serum zinc levels increased in hypertensive patients. Moreover, there are complex relations between zinc and arterial pressure, through the angiotensin converting enzyme (ACE) system and hormones like glucocorticoids and catecholamines used in the regulation of arterial pressure.⁹ Another factor, which may play a role in changes in serum zinc, is intraoperative hyperthermia.¹⁰

However, determination of zinc levels in hair and saliva also may help to give a clearer picture.^{11,12}

CONCLUSION

Serum zinc levels showed a fall in anaesthetized patient at the times of preoperative stress, due to intracellular mobilization. A rise in serum zinc was resisted by body homeostatic, defense mechanisms in hypertensive subjects, but serum zinc increased at the time of maximum rise in B.P., indicating ACE, and influences of other hormones. Serum zinc values are thus related to B.P. of anaesthetized subjects undergoing surgical stress.

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