BIOCHEMISTRY OF SPUTUM
ESTIMATION OF MAGNESIUM IN SPUTUM OF PATIENTS WITH BRONCHIAL ASTHMA

Thesis

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of the Master Degree in *General Medicine*

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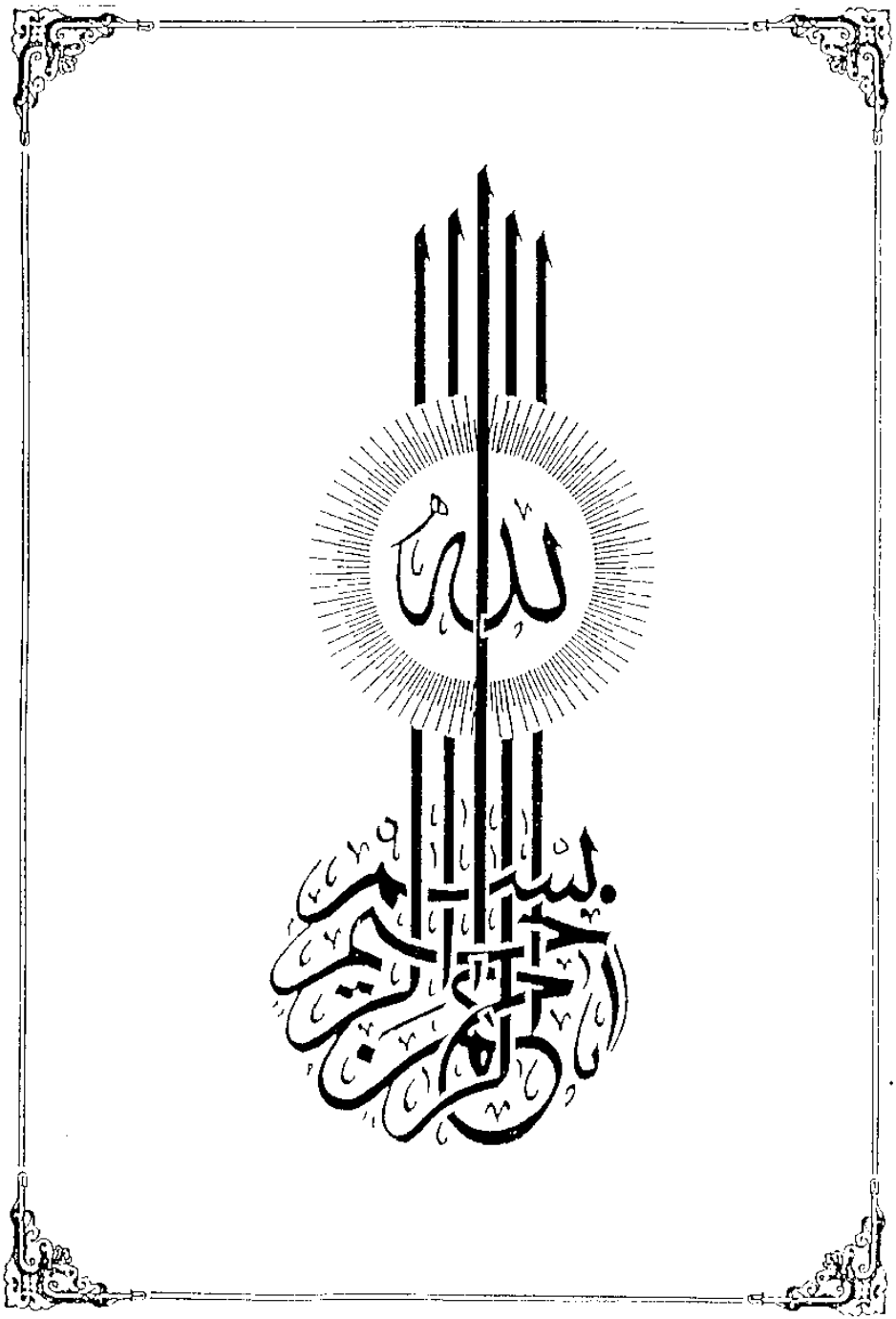

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* INTRODUCTION *

INTRODUCTION

The biochemistry of sputum is not well established. Some sporadic studies were done e.g *Volkov* (1980) who studied the contents of sputum for trace elements in 12 patients with bronchial asthma. The results showed absence of zinc and disturbance in the results of calcium.

In (1988), *Shimura et al* studied the pH, Na^+, Cl^-, and K^+ in sputum and saliva in 17 asthmatic patients and 8 normal persons respectively. The results were not confirmed and not satisfactory.

Volkov, (1988) reported 12 - 15 trace elements, including magnesium, in the sputum of patients with bronchial asthma.

AIM OF THE WORK

The aim of the work is to evaluate the level of magnesium in sputum of patients with bronchial asthma.

* REVIEW OF LITERATURE *

Magnesium Metabolism

Magnesium is quantitatively the second most abundant intracellular cation (second to potassium) in order of amount among the body's mineral constituents (*Whitby et al.*, 1980).

Magnesium is present as an intracelluar ion in all living tissues. It is essential for a wide spectrum of enzymatic reactions. (*Mac Intyre*, 1963).

Absorption and Excretion:

The factors concerned with control of Mg^{++} metabolism have not been defined. There is no factor known to influence its absorption but the recognition of specific magnesium malabsorption syndromes in man has led to suggestion that the ion is actively transported from the intestine. The daily intake is normally about 10 mmol (250 mg), and significant quantities are contained in gastric and biliary secretion; magnesium can be absorbed from both the small and large intestine (*Vernon and Volker*, 1978)

Walmsley, (1984) stated that the average daily intake of magnesium is about 10 - 15 mmol, and of this approximately 50% is absorbed mainly in the duodenum. The mechanism of absorption appears to be energy dependant.

Parathormone increases the absorption of magnesium from the intestine in the same way it increases the absorption of calcium, and calcitonin has the reverse effect. Parathyroidectomy lowers the absorption. Parathyroid extract (parathormone) given parenterally to dogs causes an increase in the urinary excretion of magnesium, and the plasma magnesium level may rise (*Best and Tailer*, 1969).

Harper et al., (1977) stated that the absorption of magnesium did not appear to be related to magnesium stores in the body. In the first 48 hours after administration of radioactive magnesium, about 10% of the amount absorbed was excreted in urine, thus, renal conservation of magnesium appears to be excellent.

The absorption of magnesium behaves, to a large extent, like calcium. Thus, a high fat, phosphate or alkali intakes appear to diminish its absorption from the

upper gut. A certain competition seems to exist between the two ions since a high magnesium intake apparently increases renal excretion of calcium (*Ghalioungui and Ghareeb*, 1963).

Vitamin D appears to be unnecessary for magnesium metabolism. This was reported by *Ghalioungui and Ghareeb* (1963), who stated that magnesium content of bones is not decreased in rickets and may actually be increase. Recently, *Jeppesen et al.*, (1980) reported that elevated concentration in the extracellular fluid presumably resulted from enhanced calcium and magnesium absorption associated with increased vitamin D activity.

Apart from losses of magnesium in the intestinal secretion, the main site of magnesium excretion from the body is via the kidney. Of the 100 - 150 mmol of Mg^{++} filtered by the glomeruli daily, approximately 3 - 5% is excreted in the urine, resulting in urinary magnesium loss of 2.5 - 5 mmol/day. The main site of magnesium reabsorption in the kidney is the ascending limb of the loop of Henle. At this site, magnesium reabsorption is closely related to calcium reabsorption. Factors which increase magnesium excretion through the kidneys in-

clude; extracellular fluid expansion, alcohol, diuretics, vitamin D, hypercalcaemia, calcitonin, thyroxin, glucose and diabetes mellitus. On the other hand, parathyroid hormone (P.T.H) decreases renal excretion of magnesium (*Walmsley and Gurine,* 1984).

Urinary excretion of magnesium is 80% greater in hyperthyroid patients and 30% less in hypothyroid cases due to the alteration in bone turnover of magnesium (*Walmsley and Gurine,* 1984).

Aldosterone increases urinary excretion of magnesium. Also, increase in potassium excretion is associated with magnesium diuresis. (*Walmsley and Gurine,* 1984).

Distribution

The human body contains about 20 gm of magnesium of which the greater part is found in muscles and bone. The normal plasma concentration ranges between 1.8 - 2.4 mg/dl of which some is protein bound (*Best and Tailer,* 1969).

Ghalioungui and Ghareeb, (1963) stated that magnesium is present in red cells and plasma. About 80% of magnesium is present in the serum and the rest is bound to plasma proteins. They also stated that there is a reciprocal relationship between calcium and magnesium in the serum. Also, *Kroll and Elin*, (1985) suggested that 25% of the total serum magnesium is bound to albumin and 8% to globulin.

Magnesium is predominantly located inside body cells, in blood for instance, plasma level is 1.5 - 2 mEq/L, compared with 5 mEq/L in red cell. Muscles contain about 15 mEq/L, mainly concentrated within the mitochondria (*Keele and Neil*, 1974).

Walmsley and Gurine, (1984) reported that magnesium is taken up into the cells by an energy dependant mechanism. Calcium transport mechanism, which involves magnesium, is thought to be involved in this process. Intracellular magnesium levels are at the order of 20 mmol/L (plasma levels are at the order of 0.7 - 0.95 mmol /L)

Magnesium is present with calcium in bone salts and tends to move in and out of bone with calcium (*Zilfa*, 1984).

Bone provides a reserve of magnesium for use when there is a shortage in the body (*Keele and Neil*, 1974).

Walmsley, (1984) classified total body magnesium into three main compartments; free (55%), protein bound (33%) and complexed (12%) as phosphate and citrate. He also stated that the intracellular distribution of magnesium is not homogeneous, being mainly present in microsomes, with lesser amounts in mitochondria.

About 15% of total body magnesium is exchangeable. Exchangeable magnesium increases in hyperthyroidism and in Paget's disease of bone. It is decreased in hypofunction of the thyroid gland. (*Tag Eldin*, 1974).

Plasma magnesium levels, as measured by atomic absorption spectroscopy, are at the order of 0.7 - 0.95 mmol/L in fasting young adults (*Walmsley and Gurine*, 1984).

Plasma magnesium is kept in a narrow range. Neither lactation nor length of lactation significantly affected plasma concentration or erythrocyte magnesium concentration. Dietary magnesium intake was not significantly correlated with the level of magnesium in either the plasma or erythrocyte (*Moser et al.*, 1983).

Sex related differences between plasma and protein bound plasma magnesium were not significant (*Speich et al.*, 1981).

Action

Magnesium ions (Mg^{+2}) serve as activators of many important enzymes involved in intermediary metabolism. They inhibit, however, adenosine triphosphate (ATP). They are similar to calcium ions (Ca^{+2}) in their effect in neuromuscular excitability (*Ghalioungui and Ghareeb*, 1963). Indirectly they affect all anabolic and catabolic reactions involving carbohydrate, fat, and protein metabolism. In addition, magnesium is an essential co-factor for some peptidases, ribonucleases and glycolytic and co-carboxylation reaction (*Tag Eldin*, 1974).

Magnesium is an important prosthetic or activator

ion, participating in the function of many enzymes involved in phosphate transfer reaction, including those requiring ATP or other nucleotide triphosphate as co - enzymes (*Krupp and Chatton*, 1981).

The action of magnesium upon the nervous system was studied by *Richaradson and Vilalt* (1963) who reported that magnesium is both central and peripheral nervous system depressant. The peripheral effect is due to decreased liberation of acetylcholine at neuromuscular junction and sympathetic ganglia. They also started that this effect may be antagonized by an excess, or accentuated by a diminution of calcium.

Krupp and Chatton, (1981) also studied the physiological effect of magnesium on the nervous system. They found that elevated magnesium concentration in the interstitial fluid produce sedation and central & peripheral nervous system depression and that low concentration enhance irritability, disorientation and convulsion.

Keele and Neil, (1974) reported that magnesium and calcium ions are mutually antagonistic. For example, the