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The effect of total thyroidectomy on bone tissue structure and its relationship to some physiological parameters

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Abstract:

Thyroid hormones indirectly influence the body's electrolyte balance by regulating metabolism and kidney function. Thyroid hormones influence the basal metabolic rate, which impacts energy expenditure and nutrient absorption, including electrolytes (physiological parameters). The thyroid gland also influences the kidneys, which play a crucial role in regulating fluid and electrolyte (salt) balance in the body. The thyroid gland secretes hormones that affect kidney function, which plays a key role in regulating fluid and electrolyte (salt) balance in the body. Disrupted kidney function resulting from an imbalance in thyroid hormones may lead to an imbalance in salts. Thyroid hormones play a role in regulating sodium and potassium levels in the body. The thyroid gland also affects calcium regulation in the body, through its influence on parathyroid hormone. In this study, 80 persons (60 patients and20 healthy control) male and female and aged (20-50) years who had undergone total thyroidectomy and were suffering from hyperthyroidism and hypothyroidism were divided into four groups. The fourth group was a healthy control group. Results were obtained showing a decrease in the physiological parameters of electrolytes: sodium, potassium, calcium, magnesium, and vitamin D, which led to the appearance of symptoms indicating weakness of bone tissue.

Key words:

(physiological ,parameters , thyroidectomy ,sodium ,potassium ,vitamin D.)

Introduction

The thyroid gland including two lobes lying on each side of the trachea produce hormones thyroid hormones can "target ,influence and alter the metabolism of approximately every cell in the body "so that the thyroid gland becomes one of the "largest and most sensitive" endocrine glands in the body[1]. is avital butterfly-shaped endocrine gland situated in the lower part of the neck. It is present in front and sides of the trachea, inferior to the larynx. It plays an essential role in the regulation of the basal metabolic rate (BMR), and stimulates somatic and psychic growth, besides having a vital role in calcium metabolism. It is a gland consisting of two lobes, the right and the left lobes joined together by an intermediate structure, the isthmus. Sometimes a third lobe called the pyramidal lobe projects from the isthmus. It has a fibrous/fibromuscular band, i.e., levator glandulae thyroideae running from the body of the hyoid to the isthmus[2]. Removing the thyroid gland and the parathyroid glands causes disturbances in the metabolism of electrolytes and vitamin D, as the thyroid gland has a major impact on almost all of the body's functions. Although vitamin D is essential for health and plays vital roles in electrolyte homeostasis, vitamin D deficiency is a relatively common nutrition disorder[3]. In general, vitamin D is recognized as vital molecule in the homeostasis of calcium and phosphate levels; vitamin D deficiency has been implicated in the diverse pathological conditions such as hypomagnesemia[4]. Electrolyte abnormalities, such as hypokalemia and hypomagnesemia, are often observed in the clinic. Indeed, magnesium exhibits critical roles in the normal homeostasis of potassium via suppression of the renal outer medullary potassium channel (ROMK)-mediated potassium secretion into therenal tubule[5]. We experienced a case of severe electrolyte disorders, including hypokalemia, hypomagnesemia, and hypocalcemia, associated with vitamin D deficiency. After surgical removal of the thyroid and parathyroid glands.

Hypocalcemia

Hypocalcemia is one of the most common electrolytic disorders whose diagnosis and management need careful evaluation by clinicians. It is defined as corrected serum total calcium levels <2.12 mmol/l (8.5 mg/dl). For clinical practice purposes, correction of serum calcium levels for serum albumin concentration is useful in many, but not all, cases, being less accurate in patients with perturbation of the acid-base balance or of the serum proteins concentration[6][7]. Patients with hypocalcemia may present with a variety of symptoms and signs, as the low serum calcium levels may potentially impact virtually any organ and system. New onset hypocalcemia may represent a life-threatening situation requiring immediate intervention, while the chronic reduction in serum calcium levels is sometimes asymptomatic or slightly symptomatic. In all cases, the identification, clinical

assessment and management of hypocalcemia are key points that need to be addressed simultaneously, as soon as possible. In particular, the evaluation of the causes of hypocalcemia is the main determinant in the diagnostic workup and to guide successful therapeutic interventions. Hypocalcemia is reported in both genetic and acquired disorders of several organs and systems. In particular, diseases that may alter the parathyroid glands, skeleton, gut, kidneys axis, all of which are responsible for the fine regulation of serum calcium levels, may cause hypocalcemia[9]. Low serum calcium levels are associated with low parathyroid hormone levels as a result of the removal of these glands, which are spread over the thyroid gland[10].

Patients and methods

Patients

The patients in the study were 44 men and 36 women who had undergone thyroidectomy, along with the healthy control group, and their ages ranged between 20-50 years. Samples were collected from participants at the Medical City Teaching Hospital in Baghdad, Iraq.

Methodology

In this study, 60 patients and 20 healthy individuals, aged 20-50 years, were taken and divided into four groups as follows:

Group I: consisted of 20 patients who underwent total thyroid and Para thyroidectomy and whose physiological parameters were examined on the second day after surgery.
Group II: included 20 patients who had their thyroid and parathyroid glands completely removed, and their physiological parameters were examined one week after surgery.
Group III: 20 patients who underwent total thyroid and Para thyroidectomy, and physiological parameters were examined one month after surgery.
Group IV: consisted of 20 healthy individuals who did not suffer from any disease and whose physiological parameters were examined as a control group for the study.

Inclusion criteria

1. Age: 20-50 years.
2. Patients who underwent surgical removal of the entire thyroid and parathyroid glands.

Exclusion criteria

1. Age over 50 years.
2. The thyroid and parathyroid glands have not been completely surgically removed.
3. Partial thyroid and parathyroid gland removal has been performed.

Sampling and preparation

The samples taken from patients who underwent thyroidectomy were blood samples that were placed in a gel tube and then centrifuged, separating the serum to examine the physiological parameters of the three cases with the healthy control group for the research. measured within 2 h of sampling and maintaining room temperature at 4 °C[8].

Measurement of the biochemical parameters

Serum potassium , sodium ,calcium ,magnesium ,vitamin D were measured using the Cobas 411 device completely automated analyzer was used to quantify for women and men with undergone thyroidectomy and a healthy control group aged from 20 to 50 years. urea using. These biomarkers' typical ranges were serum potassium for male and females is (3.6–5.5) mmol/l and serum calcium for male and female is(8.5-10.5) mg/dl and serum sodium for male and females is (128-160) mmol/l and serum magnesium for male and female is(1.6-2.6) mg/dl and vitamin D for male and female is(30-70) ng/ml .

Statistical illustration

Statistical analysis was used for all samples in this study using the statistical analysis package SPSS to a significance value of ($P < 0.05$) Duncan test was used to determine the significant differences We used one function in the study: one way ANOVA.

Result

The statistical results showed us that the first group showed us a clear decrease in the physiological parameters of electrolytes, while the second group had an increase in the physiological parameter of calcium and the rest were low, but the third group showed us its results of a continuous decrease in the physiological parameters of sodium, potassium, magnesium, calcium and vitamin D. These results were compared with the healthy control group.

Table 1:show descriptive statistics of variables

Variables	Mean	Standard deviation	Standard error	minimum	maximum
Ca(mg/dl)G1	4.000	1.2637	٠.2826	2.0	6.1
Mg(mg/dl)G1	1.070	٠.2364	٠.0529	٠.6	1.4
Na(mmol/l)G1	106.25	10.010	2.238	85	121
K(mmol/l)G1	2.695	٠.4501	٠.1006	2.0	3.2
vitD(ng/ml)G1	9.05	2.328	٠.521	6	15
Ca(mg/dl)G2	7.550	٠.5104	٠.1141	7.0	8.0
Mg(mg/dl)G2	1.040	٠.1875	٠.0419	0.8	1.5
Na(mmol/l)G2	108.85	10.022	2.241	90	130
K(mmol/l)G2	2.495	٠.5010	٠.1120	2.0	3.1
vitD(ng/ml)G2	9.75	2.173	٠.486	7	14
Ca(mg/dl)G3	5.550	٠.5104	٠.1141	5.0	6.0
Mg(mg/dl)G3	.885	٠.1531	٠.0342	0.7	1.2
Na(mmol/l)G3	94.40	6.707	1.500	80	110
K(mmol/l)G3	2.310	٠.5220	٠.1167	1.7	2.9
vitD(ng/ml)G3	8.35	1.663	٠.372	6	12
Ca(mg/dl)Gc	9.375	٠.4216	٠.0943	8.7	10.0
Mg(mg/dl)Gc	1.945	٠.1820	٠.0407	1.7	2.4
Na(mmol/l)Gc	143.45	7.273	1.626	130	154
K(mmol/l)Gc	4.150	٠.4261	٠.0953	2.8	4.7
vitD(ng/ml)Gc	46.15	7.618	1.703	33	66

Table 2: below show frequency and percentage of gender

Gender	Frequency	Percentage %
Male	44	55.0
Female	36	45.0
Total	80	100%

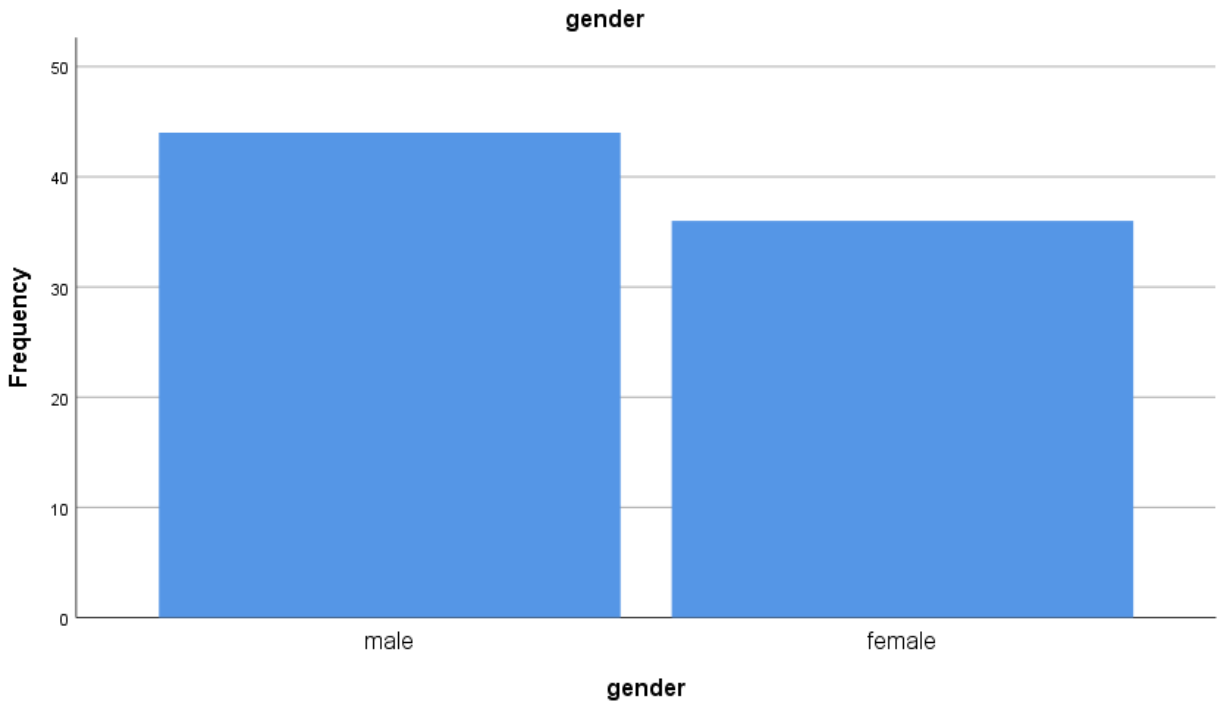

Figure 1:show frequency of gender

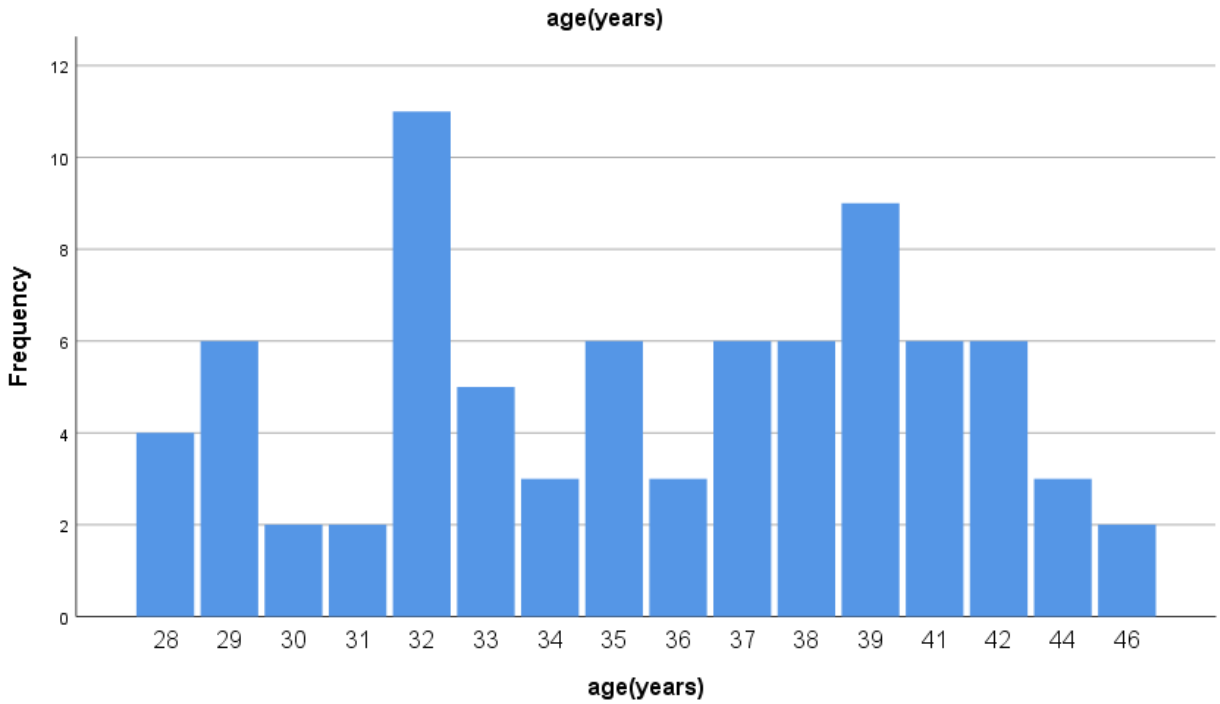

Figure 2: above figure show frequency of age .

Table 3: below show compare between mean of subgroups

ANOVA				
Variables		df	f	Sig.(p-value)
vitD(ng/ml)Gc	vitD(ng/ml)G1	19	1.627	0.341
	vitD(ng/ml)G2		1.329	0.428
	vitD(ng/ml)G3		1.290	0.442
Ca(mg/dl)Gc	Ca(mg/dl)G1	19	1.739	0.236
	Ca(mg/dl)G2		0.572	0.812
	Ca(mg/dl)G3		0.572	0.812
Mg(mg/dl)Gc	Mg(mg/dl)G1	19	0.950	0.506
	Mg(mg/dl)G2		0.561	0.774
	Mg(mg/dl)G3		0.919	0.525
Na(mmol/l)Gc	Na(mmol/l)G1	19	0.225	0.972
	Na(mmol/l)G2		0.149	0.993
	Na(mmol/l)G3		0.106	0.998
K(mmol/l)Gc	K(mmol/l)G1	19	2.472	0.104
	K(mmol/l)G2		5.253	0.013
	K(mmol/l)G3		6.246	0.008

Note :
p-value <0.05 non-significant
p-value > 0.05 significant

Discussion

The statistical results showed that the first group showed a decrease in the physiological parameters of sodium, potassium, calcium, magnesium, and vitamin D after the thyroid gland was removed along with the parathyroid glands[11][12]. We noticed a severe decrease in the physiological parameter of calcium, which leads to a disturbance in its metabolism, which is controlled by the parathyroid glands and the regulation of its level in the body, in addition to a disturbance in the balance of other physiological parameters. Its low level is a result of the loss of the thyroid gland, which affects the metabolism of electrolytes and regulates their levels in the human body. As for the second group, the statistical results showed that the loss of thyroxine hormone after a week from the body and the body's compensation with intravenous calcium solutions for it[13][14], we noticed an increase in calcium after a week of thyroid surgery compared to other physiological parameters that showed a decrease, which makes patients suffer from muscle and body pain to a great extent. The effect of thyroxine hormone and parathyroid hormone is very important[15].

They are important for regulating the level of electrolytes in the body. The loss of these two hormones will lead to a disturbance and a decrease in electrolyte levels, which may cause weakness in bone tissue and its structure. The statistical results regarding the third group without taking any compensatory supplements for a full month after the complete thyroid surgery showed a continuous decrease in physiological parameters and their imbalance, as side effects began to appear on the patients such as muscle and bone pain due to a severe deficiency in the physiological parameters calcium and magnesium, which participate in the contraction and relaxation of skeletal muscles and interfere with the formation of bone tissue. In addition to other physiological parameters, the decrease of which may be a cause of weak bone marrow and insufficient production of blood cells, we noticed that patients began to suffer from anemia and low blood pressure a month after surgery due to potassium and sodium disturbance. The statistics were studied by comparing the statistical results of the groups with the control group of healthy research[16].

Conclusion

We conclude from this study that removal of the thyroid and parathyroid glands has a significant impact on bone tissue through the continuous decrease in physiological parameters, calcium, which is clearly decreased compared to other parameters. After a period of time, patients suffer from anemia and low blood pressure. If the decrease continues without treatment, it may lead to weakness in the bone tissue and osteoarthritis.

Recommendations

It is important to adhere to taking supplements rich in electrolytes and vitamin D to prevent continued deficiencies resulting from thyroid and parathyroid removal. This is necessary to compensate for the deficiency in the patient's body, restore electrolyte balance, and gradually return to a healthy state. The patient's condition should be monitored monthly to prevent bone weakness and joint osteoarthritis.

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