ROLE OF RADIOLOGY AND MEDICAL IMAGING IN ASSESSING PARATHYROID DISEASES.

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" THESIS "

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BY

DR. YOUHANA WADIE

M.B., B.CH.

SUPERVISED BY

PROF. DR. MOHAMED SAMI EL-BEBLAWI
PROFESSOR AND CHAIRMAN OF RADIOLOGY
DEPARTMENT OF RADIODIAGNOSIS
FACULTY OF MEDICINE
EIN SHAMS UNIVERSITY

16.0757
Y.W

25281

AND

ASSIST. PROF. DR. JANNETTE BOUSHRA HANNA
ASSIST. PROFESSOR OF RADIOLOGY
DEPARTMENT OF RADIODIAGNOSIS
FACULTY OF MEDICINE
EIN SHAMS UNIVERSITY

AND

DR. AHMED TALLAT
LECTURER OF RADIOLOGY
DEPARTMENT OF RADIODIAGNOSIS
FACULTY OF MEDICINE
EIN SHAMS UNIVERSITY

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INTRODUCTION AND AIM OF WORK

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The parathyroid glands largely contribute in the control of calcium and phosphorus metabolism, so they affect bone formation, resorption and remodelling. Also, they control calcium excretion through the urinary tract.

The diagnosis of parathyroid diseases depends, to a great extent, on the clinical and biochemical features. Radiography and other imaging modalities have recently shown that they can play a significant role in this field. Therefore, the aim of this study is to assess the role of different imaging modalities in the diagnosis of parathyroid disorders.

This thesis will handle the above subject as follows:

1. Introduction and aim of work.
2. Anatomy of the parathyroid glands.
3. Physiology of calcium metabolism.
4. Pathology.
5. Clinical features.
6. Radiological pictures.
7. Imaging modalities of parathyroid glands.
8. Illustrative cases.
9. Summary and conclusion.
10. Arabic summary.
11. References.

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ANATOMY

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The parathyroid glands are small paired endocrine glands. They are yellowish - brown, ovoid or lentiform bodies, which usually lie between the posterior borders of the thryoid gland and its capsule (Davies and Coupoand, 1969) (Fig. 1). Wang in (1976) stated that the average sized gland was 5 mm. in length, 3 mm. in width and 1 mm. in thickness, with an average weight of 35 - 50 mg. He mentioned that the paired superior glands derived from the fourth branchial cleft, were frequently found to lie in the crico - thyroid junction posteriorly, at the level of middle of posterior aspect of the throid lobes (Fig. 1), less frequently they lie behind the upper pole of thyroid, and rarely lie retropharyngeally or retro - oesphageally. Winzlberg et al., (1985) mentioned that the paired inferior glands derived from the third branchial cleft, are frequently located anterior ot in the lateral posterior surface of the lower pole of the thyroid gland (Fig.1). He mentioned that these inferior glands are more liable to be located in aberrant position. Doppman et al., (1985) stated that the most familiar embryonic aberration is continued migration of the inferior parathyois gland with the thymus into the anterior mediastinum. They can, however, arrest anywhere along their path of descent. They added that supernumerary glands develop along this same course of descent. Thus the number of parathyroid glands, although commonly four, may vary from less than four to twelve (Bernier et al., 1981).

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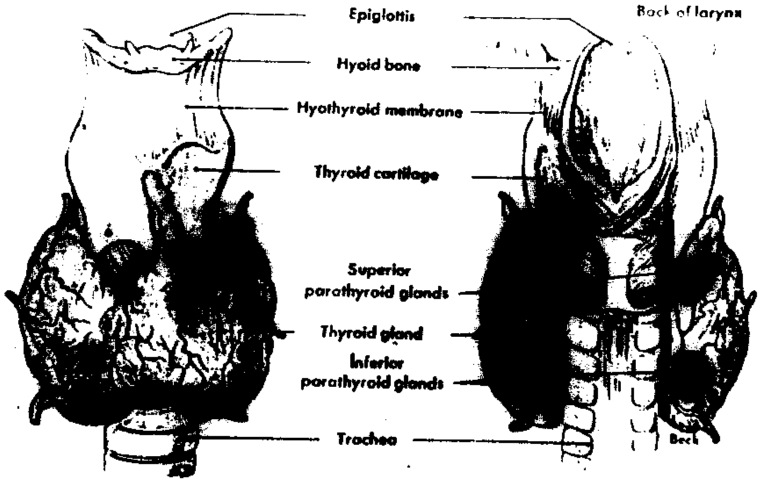

Fig.(1) Anatomical position and relations of the parathyroid glands. (Quoted from: Anthony & Thibodeu,1979).

(A) (B)

Fig. (2) Blood supply, (A) and venous drainage (B) of the parathyroid glands. (Quoted from: Brash, 1958).

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The parathyroid glands receive a very rich blood supply from the inferior thyroid arteries or the anastomotic arteries between the superior and inferior thyroid arteries. (Fig.2 A), (Selkurt, 1947). The venous drainage of each parathyroid gland occurs via the veins of thyroid plexus into the adjacent superior, middle and inferior thyroid veins as shown in (Fig.2 B), (Dunlop et al., 1980). The lymph vessels of the parathyroid glands are numerous and associated with those of thymus and thyroid glands. Their nerve supply is derived from the sympathetic and they are not secretory in function (Davies and Coupland, 1969).

Microscopically, each gland has a thin connective tissue capsule and septa dividing it into lobules. Two types of epithelial cells are present, the chief cells, which are the source of the hormone, while the oxyphile cells, which appear in the 6th year of age, has unknown function (Selkurt, 1947).

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PHYSIOLOGY

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Parathyroid hormone effectively contributes to mineral metabolism. Its main target organs are the bones,in which calcium and phosphate are stored, and the kidneys from which they are excreted. It also acts on the small intestine, but its effect is considered to be indirect, (Bernier et al., 1981).

Calcium - ions are vital to many functions as bone rigidity, cell membrane permeability, muscle contractility and finally in many steps of blood clotting. Phosphate - ions are also vital to cellular metabolism, e.g. as a component of nucleotides, cell membrane and buffering systems (Weinreb, 1984).

Calcium metabolism is regulated by the integrated actions of parathormone, cholecalceferol and calcitonin. The serum level of calcium is maintained despite flactuations in bone storage, dietary intake and excretion (Fig. 3).

PARATHORMONE:

It is the only secretory product of the chief cells of the parathyroid glands. The principal function of the hormone is the regulation of calcium - ion concentration in the body fluids. Also, it acts as a tropic hormone, regulating the kidney oxidation of 25 - hydroxy - vitamin D3 to 1.25 - hydroxy vitamin D3, which

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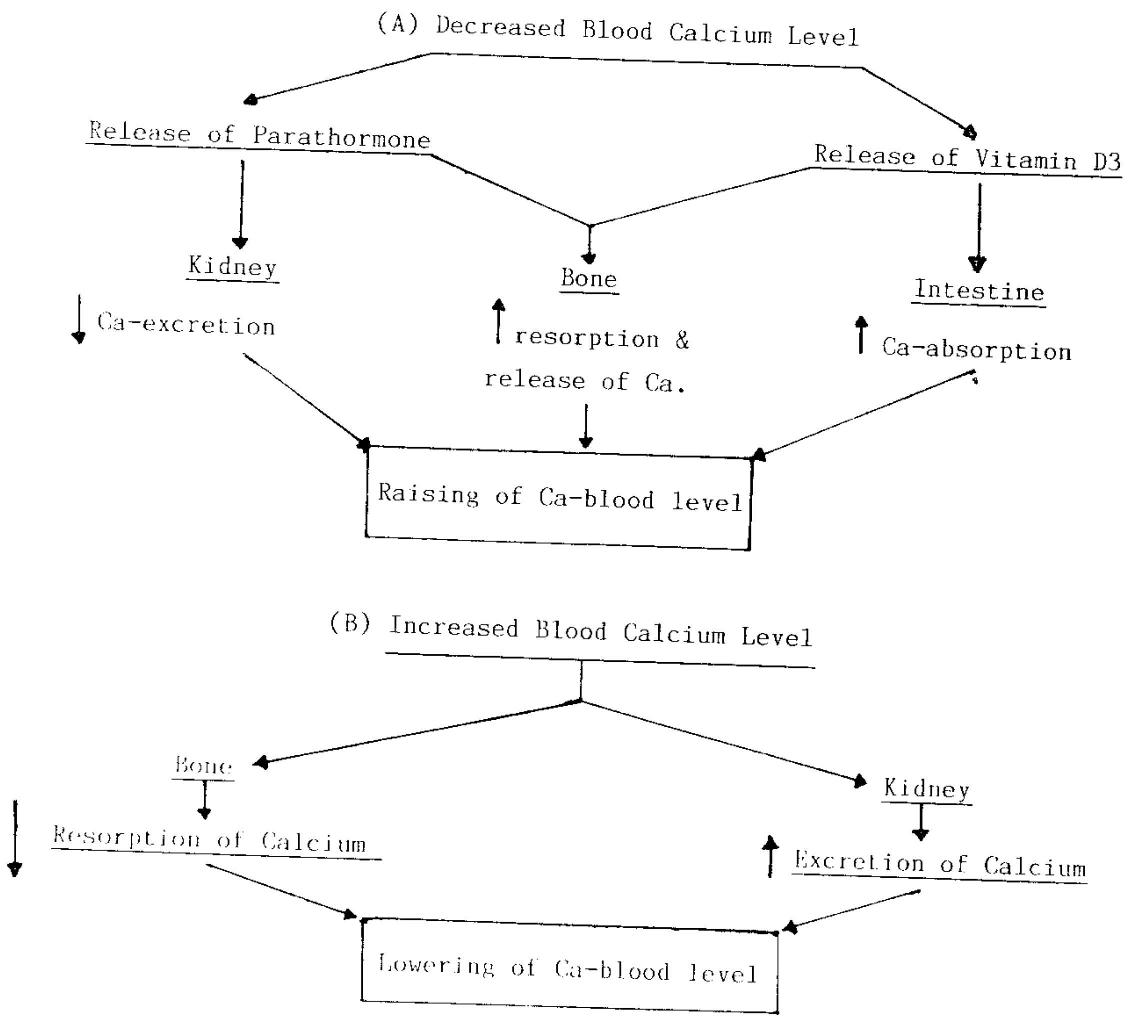

Fig. (3) Regulation of Serum Calcium Level

(Quoted from: Weinreb, 1984).

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is the most active form of vitamins D3 (Bernier et al., 1981). The secretion of parathormone is continuous, and is influenced by the calcium - ion level in blood as shown in Fig. (3), where increased calcium level decreases the hormone and vice versa (Walter and Israel, 1974).
Radioimmunoassay of parathormone in blood has a pathognomonic significance in the diagnosis of parathyroid diseases (Bernier et al., 1981).

The parathyroid hormone promotes bone resorption by osteoclasts, and osteolysis by osteocytes. It also inhibits the action of osteoblasts, but it can stimulate them to form new bone later on. However, the overall picture of the hormone is bone resorption (Gillard, 1961).

Figure (4) shows the effect of parathormone on the nephron It increases the resorption of calcium and magnesium in the ascending loop of Henle and in the distal tubules. This results in increase of calcium - ion level in blood, and this, together with calcium released from mobilised bone will cause hyper - calcemia resulting in increased glomerular load of calcium and consequently hypercalcuria. Parathormone may cause slight decrease in proximal tubular resorption of isotonic fluid

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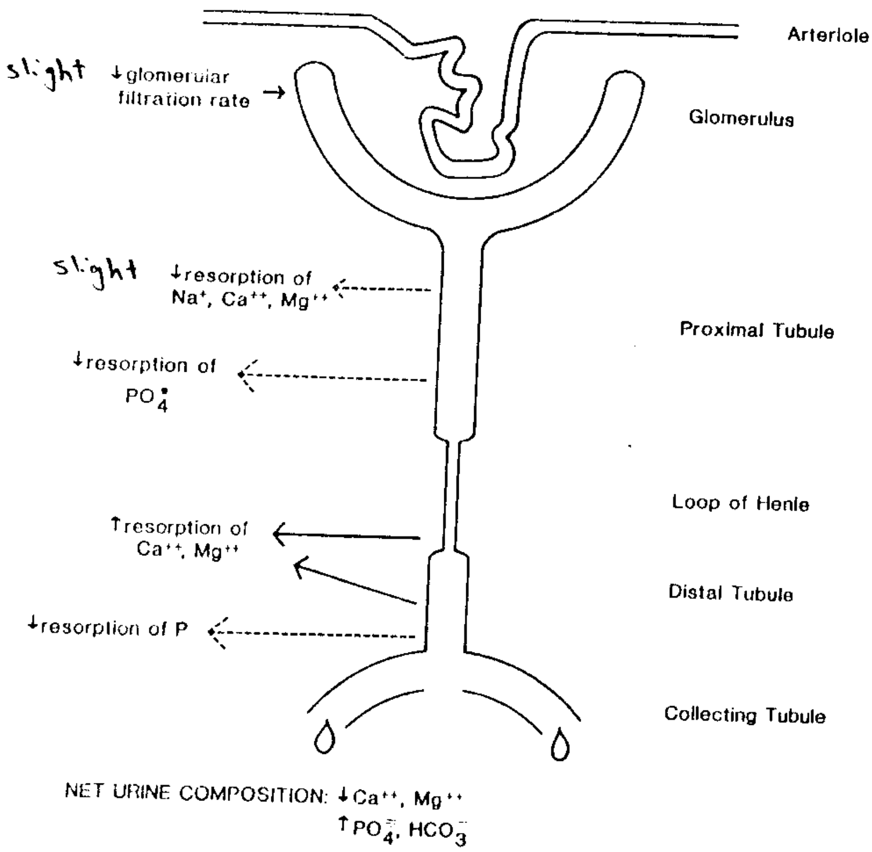

Fig.(4) Effect of parathormone on Renal tubules.
(Quoted from: Kaplan & Pesco,1984).

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containing calcium, sodium and magnesium. On the other hand, it causes decreased phosphate reabsorption in the proximal tubules and possibly in the distal tubules resulting in hypo phosphatemia. It also causes a slight decrease in the glomerular filtration rate (Kaplan & Pesco, 1984).

Parathormone tends to increase the absorption of calcium from the intestine and augment the activity of vitamin D. (Rasmussen, 1961).

VITAMIN D3 (25 - cholecalciferol):

It is produced in the skin by the ultraviolet radiation of 1 - delydrocholesterol. The main action of vitamin D3, is to aid calcium absorption from the gut. It also can exhibit a parathormone - like action when given in pharmachological doses. Therefore, it is utilised in treatment of hypoparathyroidism (Walter & Israel, 1974). A deficiency of vitamin D results in impaired absorption of calcium from the intestine leading to rickets in childhood and osteomalacia in adults (Wills, 1974).

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