SURGICAL MANAGEMENT OF PRIMARY HYPERPARATHYROIDISM

ESSAY

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IN

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بسم الله الرحمن الرحيم

THIS WORK IS DIDECATED TO MY WIFE

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INTRODUCTION

The diagnosis of hyperparathyroidism and operations for its cure have increased dramatically during the last two decades. The development of routine sequential multiple analyzer (SMA) studies has enabled the routine measurement of serum calcium levels, and thus identify a greater number of patients.

A through knowledge of embryology, anatomy and pathology of the parathyroid glands is the basis of successful parathyroid surgery.

During the last years, various techniques were developed in a trial to localize the glands preoperatively including CT and NMR scanning, digital subtraction angiography and radionuclide imaging using Thallium- 201.

New aspects in parathyroid surgery are beginning to receive attention which are parathyroid cryopreservation and autotransplantation.

ANATOMY OF PARATHYROID GLANDS

Anatomy of the Parathyroid Glands.

A basic understanding of the embryologic development and normal anatomy of the parathyroid glands is essential in performing parathyroid surgery. The surgeon must be familiar with the appearances and different locations of normal and abnormal glands to decide the plan of the surgery.

Normal Development

The parathyroid glands develop as epithelial thickening of the dorsal endoderm of the third and fourth pharyngeal pouches. As a result of their subsequent migration,the derivatives of the third pouch, (parathyroid III) become the inferior parathyroid; while those of the fourth pouch (parathyroid IV) become the superior parathyroid. Both primordia descend from their level of origin, but parathyroid III is closely associated with the thymus gland derived from the ventral portion of the third pouch. This association usually ends in the eighth week, leaving the parathyroid gland near the level of the lower border of the thyroid gland (Skandalakis et al., 1983). On the other hand, the association of the parathyroid IV with the thyroid gland prevents it from descending (Last, 1984).

Gross Anatomy.

The gross anatomy of the parathyroid glands includes the following items:

Number:

Typically there are four parathyroid glands. In Alveryd's series, 1968, of 354 adults studied at an autopsy, 90.6 percent had four glands, 3.7 percent had five, 5.1 percent had three and 0.6 percent had two glands (Christopher, 1986). However, Gilmour, (1937) in his study of 527 autopsies, found that roughly 80 percent had four glands, 6 percent had five, and 13 percent had three. Two glands or six glands were present very rarely (Schwartz, 1984).

In the 109 cases of Noris (1947) and the 35 cases of Boyd (1950), in which parathyroids were identified by studying serial sections of embryos, at least four parathyroid glands were found in every specimen (Christopher, 1986).

Akerstrom in 1984 in an autopsy study of 503 cases found that 84 percent had four glands, 13 percent had super-numerary gland and in 3 percent only three glands were found. Nevertheless, many authors consider that at least four glands should be found, and that the presence of subnumerary glands reflects failure at identification of an existent gland, or glands, rather than failure of development of that gland, or glands (Akerstrom, 1984).

The cause of supernumerary glands is probably a result of division of the original primordia. Thus from five to eight - even in extreme cases as many as twelve - have been recorded (Romanes 1972).

Size:

Roughly speaking the gland is the size of a split pea (Du Plessis, 1984). In more exact terms it is about 3 to 6 mm. in length, from 2 to 4 mm. in width, and from 0.5 to 2 mm. in thickness. In some other cases: however, it may vary in size between extremes of 1 and 20 mm. in their long axis (Romanes, 1972).

Weight:

The average weight of a parathyroid is 35 to 40 mg. It varies some what with age and sex being heavier in the man and in persons between 20 and 30 years of age, and lighter in the woman and in those between 70 and 80 years (Wang, 1976). The total amount of parathyroid gland - tissue has been stated to show a mean variation from 0.09 to 0.13 g. (Wells, 1986).

Color:

In adults the parathyroids are usually red - brown to yellow, whereas in the new born they are grey and semitransparent (Wells, 1986).

Consistency:

The parathyroid gland is soft and pliable in consistency. As a consequence it is easily shaped and molded by the adjacent tissue.

Shape:

The gland shows a great variability in shape, it may be oval, spherical, such as a tear drop, or it may be flat and resembles a pan cake or a leaf. Occasionally a gland appears to be bean, sausage, or rod - shaped (Wang, 1976). A gland may also be bi - or multilobed (Akerstrom, 1984).

Location:

The parathyroid glands are arranged in pairs - closely applied to the thyroid gland, but outside its capsule (Rains and Ritchie, 1981). The upper pair are fairly constant in position and found on posterolateral border of the thyroid above the level at which the inferior thyroid artery crosses the recurrent laryngeal nerve. Less commonly it is found above or intra-thyroidal, occasionally it is found retropharyngeal or retroesophageal. The inferior parathyroid sharing the same branchial complex as that of the thymus, may be found any where from the angle of the jaw to the pericardium (Wang, 1976). However the gland is mostly situated below the inferior artery near the lower pole of the thyroid gland. The next commonest site is within one cm. of the lower pole of the thyroid gland. Abberant inferior parathyroids may descend along the inferior thyroid veins in front of the trachea and may even track into the superior mediastinum in company with thymic tissue. Less commonly, the inferior gland may lie behind and outside the fascial sheath of the thyroid and be found behind the oesophagus or even in the posterior mediastinum. On rare occasions the glands are buried completely within thyroid tissue (Ellis, 1978). Two important land marks are of help in identification of the glands. The first is the passage of the anastomotic artery connecting the superior to the inferior thyroid artery along the posterior border of the lobe close to the glands. The second is the recurrent laryngeal nerve having the superior parathyroid dorsal and the inferior ventral to it (Warwic, 1973).

Vessels and Nerves.

Blood supply: a special small parathyroid artery comes from the inferior thyroid artery. The upper parathyroid artery comes from the inferior artery or more commonly from an anastomotic branch joining the superior and inferior thyroid arteries (Du Plessis, 1984). However, with ligation of major thyroid arteries for total thyroidectomy, an adequate supply of blood to the parathyroid glands is provided by anastomosis of thyroid vessels with the bronchial, inferior laryngeal, or tracheoesophageal arteries (Skandalakis, 1983). The parathyroid artery forms a single leash of blood vessels which can be clearly seen running in the subcapsular plane (Rains and Ritchie, 1981).

Venous drainage accompanies that of the thyroid especially via the inferior thyroid veins.

Their lymphatics are numerous and are associated with those of thyroid and thymus glands. The draining lymph nodes are the pretracheal, the deep cervical, and mediastinal lymph nodes.

Nerve Supply: the glands are supplied by sympathetic vasomotor fibers either directly from the superior or middle cervical ganglia, or indirectly through a plexus in the fascia on the posterior surface of the lobes of the thyroid gland (Warwic, 1973).

Structural Anatomy:

Each parathyroid gland is contained in a thin connective tissue capsule, from which septa pass into the gland but do not subdivide it into distinct lobules (Warwic, 1973).

The stroma consists of a rich sinusoidal capillary network with islands of secretory cells interspersed with fat cells (Rains and Ritchie, 1981). Another common pattern is diffuse, with cells forming large sheets intercepted by a small amount of stromal fat scattered here and there. A lobular pattern is a less common one, where parenchymal cells form angular masses, with a small amount of fat or loose fibrous stroma separating them. Different patterns are some times present in the same gland. In some cases small oxyphilic or clear cell nodules are seen. A micro-follicular pattern or microcysts 0.1 - 0.5 mm. in size can be also present.

The distribution of fat within the gland is very uneven from part to part within the same gland. This uneven distribution also does not correlate with the size of the gland or the percentage of fat content. Fat content varies between 0 percent - 75 percent with a mean of 29 percent. This percentage does not correlate with glandular weight and does not show an increasing trend with age (Ghandur et al., 1986).

The parenchyma of the parathyroid glands consists of 2 types of cells: the chief or principal cells and the oxyphil cells. In hyperplasia, however, a third cell type, the water-clear cell, is also seen.

Ultra Structural Anatomy:-

The chief cells are the most numerous, they are polygonal, with a vesicular nucleus and a pale-staining, slightly acidophilic cytoplasm. Electron microscopy shows irregularly shaped granules 200-400 nm. in diameter in their cytoplasm, but are more numerous at the vascular pole of the cell. They are believed to be secretory granules containing parathyroid hormone. A prominent Golgi apparatus is situated adjacent to the nucleus. Granular endoplasmic reticulum and free ribosomes are found. Small ovoid or spherical mitochondria and lipofuscin pigment bodies are also evident. Masses of glycogen granules occur and are especially large in resting or inactive chief cells.

The oxyphil cells begin to appear at about age 7 and increase in number with age. They are too polygonal in shape, but they are larger than chief cells and their cytoplasm contains many acidophilic granules. The electron microscopy reveals that these granules are mitochondria with abundant cristae.