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Vignette Thyroid Surgery: A Glimpse Into its History

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At present, physicians and surgeons treating thyroid disorders can rely on highly accurate and precise investigations, modern equipment, and state of the art operating theater to achieve optimum results; however, this was not the case at the beginning of the treatment of thyroid diseases centuries ago. We present a short history of the treatment and understanding of thyroid diseases in the past few decades. Also we present the contributions of the important surgeons who tried to perfect the treatment of thyroid diseases, including surgery, thus making modern day management easier.

Key words: Thyroid – History – Endocrine surgery

During the past several years many subspecialties of general surgery have evolved. Endocrine surgery as a specialty deals with the surgical treatment of thyroid, parathyroid, adrenal, and pancreatic endocrine diseases. Most of the glands that form part of the endocrine system were identified by the end of 19th century. They were later grouped as ductless glands or those that secrete substances internally. Epinephrine was the first such internal secretion to be identified in 1897.[1] In 1883 the observation by Theodor Kocher that thyroidectomy resulted in cachexia strumipriva was a pointer to the ductless nature of the thyroid gland.[1] The first endocrine dysfunctions recognized were Addison's disease and hypothyroidism, even before the hormones were discovered.[1] Hyperfunction of endocrine glands were suspected and diagnosed at a later stage (*i.e.*, in the 19th century). It was by the end of 19th century that endocrine surgery started developing and endocrine glands were being excised for glandular enlargement. It can be said that endocrine surgery began initially with castration for religious or social reasons.[1] Late 19th century saw tremendous development in endocrine surgery. Felix Mandl described hyperparathyroidism in 1925,[2] Roux Cesar and Charles Mayo, in 1926,

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Fig. 1 Photographs of Andreas Vesalius and B. Eustachius.

described pheochromocytoma, whereas William Mayo and Roscoe Graham described hyperinsulinism in 1929.[1] Results of thyroid surgery were further improved with the efforts of Thomas Dunhill from Australia, Charles Mayo and Henry Plummer (preoperative use of radioiodine for hyperthyroidism),[3] and Edwin Astwood (introduced antithyroid drugs).[4]

We now briefly look into the various aspects of the past history of thyroidology.

Goiter is very common in many parts of the world and was recognized long before the thyroid gland itself. Since prehistoric times, the visible outgrowths in the front of the neck have been objects of curiosity and study. Enlarged thyroids have been known to the Chinese in 2700 BC. Indian ayurvedic system had mentioned goiters as "Gala Ganda" in 1400 BC.[3] Hippocratic writings of the 4th century BC mention the term choiron, which probably signified goiter.[3]

Anatomy

Detailed anatomy of the thyroid gland was described by Andreas Vesalius (1514–1564; Fig. 1). Eustachius (1520–1547; Fig. 1) described the isthmus.[3] The term thyroid was given by Thomas Warton (Fig. 2).[4] James Berry described the ligamentum thyroideum. The parathyroid gland was identified by Sir Richard Owen in 1850 in the Great Indian Rhinoceros and in humans by Ivar Sandstrom in 1880.[2] *Bamberg Surgery,* published in the 12th century, contained the description of thyroid surgery in detail.[3] The earliest picture of a thyroid gland was drawn probably by Leonardo da Vinci in 1511.[5]

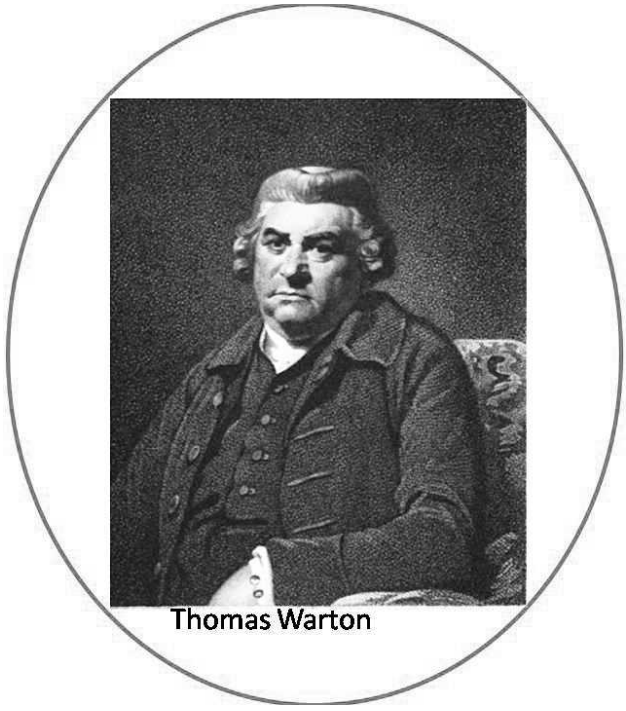

Fig. 2 Photograph of Thomas Warton.

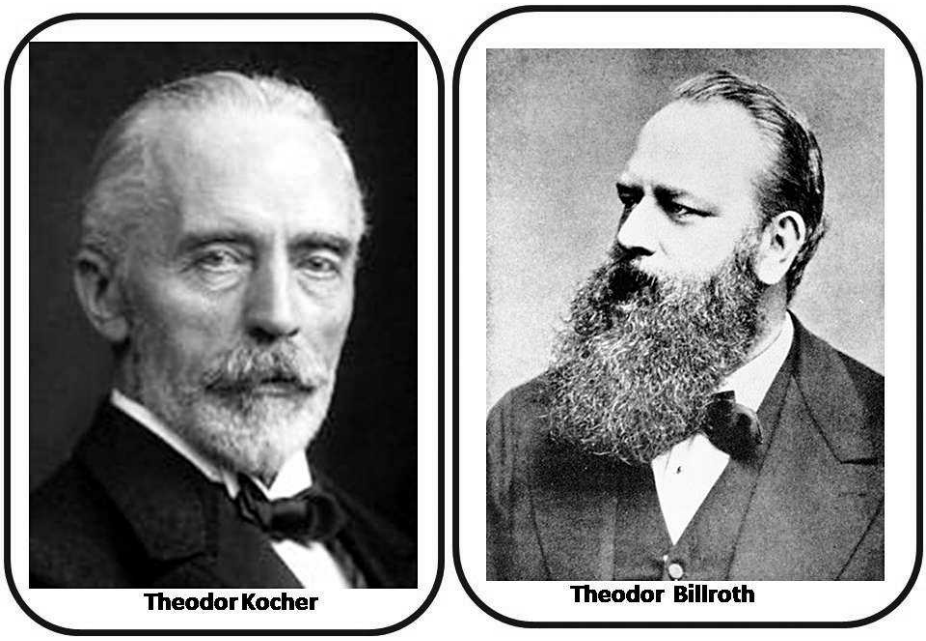

Fig. 3 Photographs of Theodor Kocher and Theodor Billroth.

Aetiopathogenesis

During the Hippocratic period many failed to differentiate between thyroid and the cervical glands. During the Roman period (156–576 BC), Gaius Plinius Secundus believed that goiter was caused by drinking dirty water.[6] Gallen (130–200 AD) believed that secretions from the thyroid lubricated the larynx.[3] C. B. Morgagni (1682–1771) said that the neck has two glands from which moisture is generated and that it flows out by the vessels.[3] In 550 AD Aetios regarded exophthalmos as a type of aneurysm. Paul of Aegina described goiter as bronchocele. Albucasis (1013–1106) operated on a patient who had "elephantiasis" of throat, which actually was a thyroid swelling. In 1271 Marco Polo described a province in Turkestan where the people were affected with swelling in the neck and he thought that it was due to the water they consumed.[3] Thyroid was considered as a structure that held the trachea away from the sternum. Paracelsus (1453–1541) attributed goiter to mineral impurities in drinking water, probably iron sulfide. An hereditary factor was also proposed by him. Theodor Billroth (Fig. 3) said that goiters are a local expression of general infection.[3] Theodor Kocher (Fig. 3) believed that iodine is present in the thyroid gland; however, Fugen Bauman (1846–1896) was the first to demonstrate it. By the 1940s iodine deficiency was accepted as a cause of endemic goiter. Soon goitrogens were also described.[3]

In 1768, Hillier Parry in his "Enlargement of thyroid gland in connection with enlargement or palpitation of heart" described exophthalmic goiter.[7] Exophthalmic goiter was considered to be due to excessive sympathetic activity and sympathectomy was later proposed as a treatment modality.[1] Robert James Graves and Carl Adolf von Basedow described the association of goiter with exophthalmos and hyperthyroid symptoms.[8] In 1896 Bernhard Riedel reported Riedel disease, wherein he described the case of hard fibrous thyroid mimicking malignancy.[5] In 1902 de Quervain described nonbacterial inflammation of the thyroid. In 1912 Hakaru Hashimoto described the first 4 cases of struma lymphomatosa, which was later given his name.[1] In 1956 Deborah Doniach and her colleagues found that the sera of these patients contained thyroid autoantibodies. This lead to the autoimmune theory in thyroiditis.[9]

Earliest Pathologic Classification of Goiters

Dupuytren described three types of goiters (*i.e.*, cystic, scirrvus, and hyperplastic).[3] James Berry described eight types of goiters at the beginning of the 20th century. These are parenchymatous, Wolfer fetal adenoma, cystic adenoma, fibrous, malignant

and exophthalmic, mixed, and inflammatory.[3] Crile, in 1910, described three types of goiters (*i.e.*, hypertrophy, hyperplasia, and involution).[3]

Treatment of Goiter: The Past

Mobile neck tumors were considered as curable and those that were immobile and solid as incurable by the Chinese physician Tshui Chin-thi in 85 AD.[6] Treatment of goiters with marine products, such as sponges and seaweed, was common during the 14th century.[3] In the 5th century AD the Chinese alchemist Ko-Hung recommended an alcoholic extract of seaweed for goiter. Treatment with ointments was suggested by L. Heister (1683–1758) from Germany.[1] In 1811 Bernard Courtois described iodine treatment for goiters. JCA Lugol and William Prout also advocated use of iodine. Theodore Billroth also advocated iodine treatment for early goiters and believed that it was useless for established cases. Rest, ice packs, and sedatives were used for toxic goiters.[1] Digitalis and quinidine were used for cardiac complications. Injection of boiling water[10]; alcohol carbolic acid and glycerine were constantly tried.[1] Irradiation of thyroid with external beam radiotherapy was used in Boston in 1902. Radiotherapy was considered safer than thyroidectomy and many investigators advocated external beam radiotherapy as a first-line treatment for hyperthyroid cases.[1]

Thyroid Surgery in the Past

Earliest description of thyroid surgery is provided by Paul of Aegina in the 7th century.[6] The first reliable description of a successful thyroidectomy has been attributed to Albucasis. It used opium sedation and a bag was placed around the neck to collect the lost blood. Roger Frugardii, in 1170, performed a thyroidectomy using setons, hot irons, and caustic powders. These were classified as "noncutting operations" for thyroid. Various techniques were used by the surgeons for goiters obstructing the airways. In 1840 Robert Liston of London divided the sternocleidomastoid to reduce the pressure caused by the goiter, which resulted in dyspnea.[11] Similarly, Samuel Cusak of Dublin suggested division of cervical fascia for relief of dyspnea. William Blizard, in 1811, first described ligation of the thyroid arteries to reduce the size of the goiter. This was followed by similar attempts by Astley Cooper and Henry Coates with "successful" outcome.[12] Enucleation of thyroid nodules and ligation of the base of pedunculated nodules were widely performed with mixed results.[13] Exothyropexy was described by Mathieu Jaboulay in 1892.[1] Cervical sympathectomy was performed by some with the belief that thyroid secretion was controlled by the sympathetic chain.[1] In 1896 Jaboulay was the first person to try sympathectomy for exophthalmic goiter. Crile treated select patients with hyperthyroid by unilateral adrenalectomy and claimed success.[1]

For many years there was no development in the field of thyroid surgery when the Catholic Church started to control legislation. Surgical work was removed from libraries and medical faculty did not teach surgery. In 1791 Pierre Joseph Desault performed a partial thyroidectomy.[14] Dupuytren, William Blizard, and Henry Earle performed thyroid surgeries in 1808, 1811, and 1823, respectively. Series of cases were operated on by Heusser (35 patients between 1842 and 1859) and Victor von Bruns (28 patients between 1851 and 1876; 6 deaths). Before 1850 the mortality rate from thyroid surgery was 40%. It was due to hemorrhage, asphyxia, hospital gangrene, and air embolism.[15] Robert Liston and Samuel Gross were of the opinion that thyroid gland surgery was too risky to be undertaken (1846 and 1848, respectively). Gross stated that "no sensible surgeon would ever engage in it."[16,17] The French Academy of Medicine banned thyroid surgery in 1850.[6]

Three important events in the middle of the 19th century improved the outcome of thyroid surgery. These were introduction of anesthesia, use of hemostatic forceps, and infection prophylaxis.[6] In 1842 Crawford W. Long from Georgia used sulfuric ether. W. T. G. Morton demonstrated its use at the Massachusetts General Hospital in 1846. Successful thyroidectomy under anaesthesia was performed by Nikolai Pirigoff in St. Petersburg in 1849.[16] Spencer Wells and Jules Pear in 1874 introduced the first hemostatic forceps for controlling bleeding.[18] Infection prophylaxis led to better surgical outcomes. Joseph Lister used carbolic acid in 1867. Cap and gown was introduced by Gustav Neuber in 1883 and, in 1886, Ernst von Bergmann introduced steam sterilization.[19–21] Mortality from thyroid surgery in Theodor Billroth's series fell from 44.4% to 8.3% during the period from 1877 to 1881. Theodor Kocher, who became professor of surgery in Berne at the age of 31 years in 1872, had a mortality rate of 2.4% in his 101 cases of thyroidectomies. Mortality rate fell further to 1% by 1895.[6] He used an oblique incision along the anterior border of sternocleido-

matoid muscle or a vertical midline approach. He introduced the extra capsular dissection. He won the Nobel Prize in 1909. Of the 5000 thyroid surgeries performed in his lifetime Theodor Kocher had a mortality rate of 0.5%.[21]

Theodor Billroth, performed surgery very quickly and worked with less regard to tissues and less concern for hemorrhage, had a specific problem related to hypoparathyroidism. He had high incidence of tetany.[6] Halsted opined that this was in contrast to Theodor Kocher's surgical style, as the latter did not have tetany. Gley, in 1891, suggested the etiology of tetany could be due to the removal of parathyroids or interference with its blood supply. Billroth's pupils, Anton Wolfer and Jan Mikuliez Radecki, focused their attention on post-thyroidectomy tetany. Halsted and Evans, in 1907, advocated that the inferior thyroid artery should not be ligated at the trunk.

Billroth's pupil, Jan Mikuliez Radecki, was also interested in the recurrent laryngeal nerve. The danger to the recurrent laryngeal nerve was recognized since antiquity. Karl von Klein described a young man who became speechless after goiter excision. His voice returned but was changed from the normal.[1] Felix Semon, in 1881, observed that the first sign of partial nerve injury was abductor paralysis of the cord and it was called Semon's law.[22] Billroth, Kocher, and other investigators avoided the nerve injury and proposed that the inferior thyroid artery should be isolated and ligated laterally to avoid nerve injury. Kocher also used to leave behind the posterior portion of the internal thyroid capsule to avoid the nerve injury.[23] Many nerve injuries were going unnoticed until the laryngoscopy was started. The Spanish singer Manuel Garcia is credited with it since he discovered it in 1851 due to his extreme enthusiasm to see inside his throat while singing.[6] Billroth, Kocher, and Joll tried to avoid the nerve at surgery; however, August Bier (1911) preferred to deliberately expose the nerve.[24] Frank Lahey, in 1938, advocated that exposure of the nerve routinely resulted in an injury rate of only 0.3%.[25]

The importance of superior laryngeal nerve function was realized after the injury to the nerve during the surgery on the famous singer Amelita Galli-Curci. Arnold Kegel and G. Raphael Dunleavy performed the surgery with resultant injury to the external branch of superior laryngeal nerve.[1]

Kocher also observed that after total thyroidectomy the patients developed certain changes and became fat, sluggish, and cold. When he reviewed his patients who had undergone thyroid surgery he made some important observations. Twenty-eight of the 30 patients who underwent partial thyroid excision were doing fine. However, all of his patients who had undergone total thyroidectomy had become hypothyroid. This he called "cachexia strumi priva." He presented this at the Congress of German surgeons in Berlin in 1883.[26] William Ord named this disorder as myxedema in 1877.[27] Kocher advised to perform only lobectomies and he himself vowed not to do complete removal of the thyroid. Kocher believed that the hypothyroid symptoms were due to injury to the trachea and a result of chronic asphyxia. Victor Horsely and Semon believed that these symptoms were due to stoppage of the thyroid gland function.[28] In 1891, George Murray demonstrated that injected thyroid extracts were useful in treating the problem encountered by Kocher.[29] Murray injected subcutaneously extract of sheep's thyroid in glycerin with good results. Fox demonstrated that extract can also be given orally.[30] He administered half of a sheep's thyroid, lightly fried and taken with jelly, once a week. An active compound containing 65% iodine was crystallized in 1914 by Edward Kendall, which was the important landmark in the treatment of hypothyroidism.[31]

Postoperative tetany was first described by Wolfer in 1879 in one of Billroth's patients.[32] This was attributed to hyperemia of the brain.

Surgery in toxic goiters developed later. Ludwig Rehn, in 1884, reported that 3 patients, in whom goiter was removed for compressive symptoms, had relief of toxic symptoms after the surgery. Many techniques were adopted by different surgeons during surgery for toxic goiter. Hartley suggested partial removal of the second lobe in toxic cases. Similarly, initial ligation of thyroid arteries was advocated by Theodor Kocher and Mayo.[17,33] Dunhill suggested unilateral lobectomy initially and second lobectomy if there is recurrence of hyperthyroidism. Kocher and Dunhill used local anesthesia for toxic goiters; however, Crile preferred general anesthesia.[34] Introduction of iodine resulted in a decrease in operative mortality to 1% in 600 thyrotoxic patients.[35] Introduction of radioactive iodine (Means, Evans, Hertz; 1942)[6] and thiouracil (Edwin Bennet Astwood; 1943)[6] further improved the treatment of hyperthyroid patients. In 1965, propranolol was introduced for patients with toxic goiters. Soderstorm introduced the fine needle aspiration cytology (FNAC) in 1952, which resulted in improvement in diagnosis of thyroid nodules.[20]

Thomas Dunhill described sternotomy for better access of intrathoracic goiters.[36] In the 1930s bilateral subtotal resection was the accepted procedure for toxic goiters. Preoperative preparation usually was with iodine alone in mild toxicity and with antithyroid drugs in severe toxicity.

Advances in radiology, like ultrasound, computerized tomography, endoscopic thyroidectomy, neuromonitoring, and robotic surgery, have taken thyroid surgery to further heights.

To conclude, the understanding of the thyroid anatomy, physiology, and pathology has seen tremendous changes through the centuries. The investigation modalities have improved, treatment options have changed with excellent surgical outcomes due to the availability of antithyroid medications, thyroxine, and advancements in anesthesia.

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