Paparella: Volume III: Head and Neck

Section 2: Disorders of the Head and Neck

Part 6: The Thyroid Gland

Chapter 40: Malignant Diseases of the Thyroid Gland

Michael Friedman, Dean M. Toriumi

Many aspects of the epidemiologic and pathologic features, the diagnosis, and the management of malignant diseases of the thyroid gland are controversial and vary from institution to institution. All of these topics make the treatment of thyroid carcinoma a challenging and progressive aspect of head and neck surgery. This chapter discusses the epidemiologic and pathologic features of thyroid carcinoma to provide a better understanding of the natural history and prognostic indicators of this disease. Recent advances in the diagnosis of thyroid cancer are covered to assist the surgeon and the primary care physician. A specific treatment plan is introduced that will accommodate the treatment philosophy of most head and neck surgeons. Finally, the technical aspects of thyroid surgery are reviewed with emphasis on basic surgical principles. The purpose of this chapter is to provide an in-depth overview of the approach to thyroid carcinoma.

The Impact of Thyroid Disease

Between 4 and 7 per cent of the population has nodular thyroid disease. Approximately 3.5 to 4 per cent of all thyroid nodules contain malignant disease.

The incidental finding of thyroid carcinoma in autopsy series ranges from 4.5 to 28.4 per cent. Furthermore, the incidence of thyroid carcinoma has been increasing over the past decades.

The incidence of thyroid nodules in females is greater than that in males. The incidence of thyroid nodules was 6.4 per cent in females versus 1.5 per cent in males in a 15-year report on the incidence of thyroid malignancy. Conversely, the incidence of malignant thyroid nodules has been reported to be twice as high in males when compared with females.

Most thyroid carcinomas present in patients between the ages of 40 and 60 years. The incidence of thyroid nodules increases with age, especially in females, with a peak occurrence rate in middle-aged females. Thyroid carcinoma is the third-ranked malignancy in women between 15 and 34 years of age, with other malignancies becoming more prevalent in the older female population.

Pathologic Features

Thyroid tumors are classified by predominant histologic cell type (Table 1). Benign neoplasms include adenomatous nodules and adenomas. Well-differentiated malignant neoplasms include papillary, follicular, and Hürthle cell carcinomas. More aggressive variants include medullary carcinoma and anaplastic carcinoma. Lymphomas and metastatic tumors

also present in the thyroid gland.

Benign Neoplasms

The thyroid gland weighs about 30 gm and is surrounded by a smooth capsule. Normally the gland contains a number of colloid-filled follicles, which can increase in size and eventually become palpable nodules. A single palpable colloid-filled nodule is termed an *adenomatous nodule.* A multinodular goiter consists of several colloid-filled nodules and follicular epithelial cells multiplying at an accelerated rate. Other regions of the gland may replicate at a normal rate, resulting in even further involution and nodularity and eventual massive, asymmetric enlargement with vascular compression, necrosis, and fibrosis.

Table 1. Tumors of the Thyroid Gland

Benign	Malignant
Adenomatous nodule	Papillary
Multinodular goiter	Follicular
Adenoma	Hürthle cell
Follicular	Medullary
Colloid	Anaplastic
Embryonal	Lymphoma
Fetal	Metastatic.
Hürthle cell	

An adenoma is an encapsulated nodule composed of glandular epithelium. The cut surface of an adenoma is a lighter color than the surrounding thyroid tissue. A fibrous capsule surrounded by a rim of compressed thyroid parenchyma is seen on microscopy. Adenomas, composed of colloid-filled follicles separated by different amounts of fibrous stroma, can be further classified into the histologic variants of follicular, colloid, embryonal, fetal, or Hürthle cells. The cells in the follicular variant, which usually contain small nuclei, are columnar or flat. Colloid adenomas consist mostly of colloid-filled follicles and frequently undergo fibrosis, hemorrhage, and necrosis. Fetal adenomas are composed entirely of small follicles, and embryonal adenomas demonstrate cells arranged in solid cords.

Hürthle cell adenomas are proliferations of Hürthle cells that do not invade the thyroid capsule or blood vessels. These tumors often have nuclear hyperchromasia, granular cytoplasm, and variable cellular enlargement. Electron microscopic examination reveals abundant mitochondria. Some pathologists classify all Hürthle cell neoplasms as well-differentiated carcinomas. All Hürthle cell tumors should be examined closely to identify any capsular or vascular invasion, which would confirm malignancy.

Malignant Neoplasms

The incidence of malignancy in clinically detectable solitary thyroid nodules that have been excised ranges from 10 to 30 per cent. Eighty-five per cent of thyroid carcinomas are well differentiated.

Thyroid gland malignancies are heterogenic and exhibit significant variability in morphologic characteristics, behavior, and response to therapy. Papillary, follicular, Hürthle cell, and anaplastic carcinomas originate from follicular epithelium. Medullary carcinoma originates from the parafollicular cells, or C-cells. Malignant lymphomas originate from nonepithelial elements.

The tumor, node, metastasis (TNM) classification system is not applicable to thyroid cancer because it does not consider the cell type. The cell type of a thyroid malignancy is directly related to the clinical course, treatment, and prognosis.

Papillary Carcinoma

Papillary carcinoma accounts for 75 to 80 per cent of all thyroid malignancies, and 80 to 90 per cent of radiation-induced thyroid carcinomas. Papillary carcinoma is four times more common in females than in males, and it is the most common thyroid neoplasm in children. The peak incidence of the papillary variant is in the third and fourth decades of life. This neoplasm is composed of papillary fronds, but the majority of papillary carcinomas contain a follicular component. Interestingly, the biologic behavior of these mixed neoplasms is identical to that of pure papillary carcinomas and differs from follicular carcinomas.

Papillary carcinomas can be classified as occult (less than 1.5 cm), intrathyroidal, or extrathyroidal. On gross examination, the majority of papillary carcinomas are nonencapsulated tumors that readily invade lymphatics and replace normal thyroid tissue. These neoplasms often demonstrate central necrosis with fibrosis or hemorrhage. Larger tumors can undergo cystic degeneration and may resemble a benign thyroid cyst. Multicentricity occurs in up to 75 per cent of cases. Tumors associated with prior exposure to ionizing radiation are more likely to be multicentric.

Morphologically, papillary thyroid carcinoma consists of columnar thyroidal epithelium set in papillary projections with well-formed fibrovascular cores. The nuclei are vesicular and have a ground-glass appearance. Homogenous material resembling colloid may surround the papillae, but the lobular architecture of Grave's disease is lacking. Localized calcium deposits arranged in concentric layers (psammoma bodies) are often seen on microscopic examination. The pathologist must inform the surgeon if there is evidence of extrathyroidal extension, vascular invasion, involvement of adjacent structures, or lymph node metastasis. These factors, as well as the cell type, can influence surgical treatment.

Regional lymph node metastasis can be quite high and has been reported in as many as 50 per cent of presenting cases. There is an even higher incidence of regional metastasis in papillary carcinoma in children.

Hematogenous dissemination is present in less than 1 per cent of patients at initial presentation, but subsequently develops in 4 to 20 per cent of them.

Papillary carcinoma of the thyroid gland usually has a long, protracted course but rarely causes death despite widespread disease. Mortality from papillary thyroid carcinoma has been reported in 1 to 10 per cent of cases and usually results from airway obstruction. In the Mayo Clinic series, the 10-year survival rates for occult and contained intra-thyroidal

lesions were 89.8 and 83.9 per cent, respectively.

Follicular Carcinoma

Follicular carcinoma which accounts for 5 to 10 per cent of all thyroid neoplasms, has a peak incidence in the fifth decade of life and a 3:1 female preponderance. Follicular neoplasms usually present as slowly enlarging nontender nodules. Tending to metastasize hematogenously to lung, bone, and brain, follicular carcinoma has a 10-year survival rate of 72 per cent. In lesions without marked invasiveness, the 10-year survival rate has been reported to be 86 per cent, whence when invasiveness was apparent, 10-year survival rate has been reported to be 44 per cent. Up to 75 per cent of patients who die of this tumor succumb to distant metastasis, and the others die of local invasion.

Grossly, follicular carcinoma are usually well encapsulated and grow in an expansile fashion. The tumor can undergo cystic degeneration, calcification, or hemorrhage. The microscopic appearance is that of microfollicular pattern, with the cells containing vesicular nuclei. The lumen of the acini are frequently devoid of colloid. The characteristic feature of follicular carcinoma is its tendency to invade the thyroid capsule and blood vessels. Multicentricity is much less common in follicular carcinoma than in papillary carcinoma. Well-differentiated, low-grade, encapsulated follicular carcinomas are difficult to distinguish from adenomas. Multiple sections may be required to define capsular or vascular invasion and thus establish the tumor as follicular carcinoma. High-grade follicular carcinomas are obviously invasive and have multiple mitotic figures with marked hypercellularity. The mortality rate is much higher with high-grade angioinvasive follicular neoplasms than with those that are minimally invasive.

Hürthle Cell Carcinoma

Hürthle cell neoplasms are more frequently invasive than comparable follicular tumors and are considered to be the most aggressive of the well-differentiated thyroid carcinomas. Hürthle cell (oxyphilic) carcinomas are morphologically distinct from other follicular tumors. Approximately 5 per cent of all thyroid carcinomas are of this variety. In many cases, there may be a papillary or follicular pattern with Hürthle cell or oxyphilic changes. Most pathologists make the distinction between benign and malignant forms of this tumor based on capsular or vascular invasion. In addition to a high incidence of bilateral thyroid lobe involvement, these tumors have long-term lethal potential for local invasion and distant metastasis. There is a high incidence of local recurrence and mortality if treatment is not aggressive.

Medullary Carcinoma

Medullary carcinoma accounts for up to 5 to 10 per cent of thyroid cancers. These neoplasms originate from calcitonin-producing parafollicular C-cells.

On gross examination, medullary tumors are gray to yellow, firm, and either well-circumscribed or invasive, with bilateral multicentric involvement. Medullary thyroid carcinomas are classified as sporadic or hereditary (familial). The latter accounts for 10 to 27 per cent of the cases.

Sporadic medullary carcinoma is usually unifocal and is not associated with endocrine tumors. This type typically occurs in middle-aged to elderly individuals and has no sex predilection.

The familial form is transmitted as an autosomal dominant trait, and therefore this neoplasm will develop in 50 per cent of the offspring. The tumor is associated with C-cell hyperplasia, which is the calcitonin-producing precursor lesion. Familial medullary carcinoma is associated with Sipple's syndrome or multiple endocrine neoplasia type II (MEN II). Further subdivision includes MEN IIA and MEN IIB as variant syndromes. MEN IIA is more common and consists of medullary carcinoma or C-cell hyperplasia, adrenal medullary hyperplasia or pheochromocytoma, and hyperparathyroidism. MEN IIB includes medullary carcinoma; pheochromocytoma; mucosal neuromas of the tongue, lips, or conjunctivae; ganglioneuromas of the intestines; characteristic facial appearance; and marfanoid habitus. Familial medullary thyroid carcinoma is frequently bilateral and multicentric. The median age of the patient at the time of tumor development is in the third decade of life with a female-to-male ratio of 1.5: 1.

Single nodules are more common in the sporadic form of medullary carcinoma. On microscopic examination one sees clusters of cells separated by regions of collagen and stromal amyloid. The cells are either round or polyhedral, are arranged in an organoid pattern, or are spindle-shaped, resembling immature fibroblasts. Variations include papillae (follicle) formations or giant cell proliferations. Amyloid in the stroma is peculiar to medullary carcinoma and is thus diagnostic. The stromal amyloid is found in the tumor and in metastatic lesions. Amyloid is present in 85 to 90 per cent of medullary thyroid carcinomas. If amyloid is not detected, medullary carcinoma can be diagnosed by electron microscopy or immunohistochemical studies.

Medullary carcinoma of the thyroid gland initially metastasizes to regional lymph nodes of the neck and superior mediastinum. Regional metastases occur in up to 50 per cent of patients, with 15 to 20 per cent having regional metastasis when the tumor is first recognized. The tumor may eventually metastasize to the lungs, liver, adrenal glands, bone (often osteoblastic), or other organ systems. The biologic activity of each tumor varies; some neoplasms recur locally and others present with early distant metastases. Patients often present with tracheal or esophageal invasion.

Sporadic medullary thyroid carcinoma has a poorer prognosis than does the hereditary form. The mortality rate of the sporadic form was about 50 per cent in the past but has been improving with earlier and more aggressive surgical intervention. Likewise, early screening for elevated calcitonin levels in patients at risk for the hereditary form has resulted in improved surgical rates. Because medullary carcinoma causes elevation of calcitonin levels, this determination can be used for detection of recurrence.

Anaplastic Thyroid Carcinoma

Anaplastic (undifferentiated) carcinoma accounts for 10 per cent of all thyroid carcinomas. These tumors are most common in patients older than 50 years of age, and the incidence increases with succeeding decades. Women are affected more frequently than men, especially in endemic goiter areas. A pre-existing multinodular goiter is frequently the site

of origin. The anaplastic neoplasm may represent rare transformation of a well-differentiated thyroid carcinoma. Patients often describe the abrupt enlargement of a nodule that has been present for years. Anaplastic neoplasms invade all surrounding structures, including the trachea, esophagus, and so on.

Anaplastic thyroid carcinoma is unencapsulated and often extends outside the gland. The neoplasm has a fleshy, tan-white appearance, with areas of hemorrhage and necrosis. The cells vary histologically and are classified as spindle- or giant-cell variants. The spindle-cell variant resembles a fibrosarcoma or malignant fibrous histiocytoma. Microscopically, the giant-cell variant resembles a rhabdomyosarcoma. Mitoses are numerous in all variants, as are areas of invasion and necrosis. In some cases, there may be areas of papillary or follicular carcinoma.

Anaplastic carcinoma has a poor prognosis. Death usually results from airway obstruction or vascular invasion. Distant metastases usually involve lung and bone. There are a few reported long-term survivors, but the vast majority of patients die within several months of diagnosis.

Malignant Lymphoma

Lymphoma accounts for about 10 per cent of thyroid malignancies. The incidence is apparently increasing, especially in endemic goiter areas. This neoplasm is most common in patients older than 50 years of age and has a 3:1 female preponderance. Lymphomas may possibly arise from pre-existing Hashimoto's thyroiditis.

Lymphoma of the thyroid gland often presents as a rapidly enlarging mass in patients with a history of a multinodular goiter. Rapid tumor growth may result in tracheal or esophageal compression. On gross examination, thyroid lymphomas are large, yellow-tan, and scaly in appearance and frequently have areas of hemorrhage and necrosis. New techniques of electron microscopy and immunohistochemical studies have demonstrated that all varieties of lymphomas occur in the thyroid gland.

Ultrastructural and immunohistochemical studies are often crucial in distinguishing undifferentiated anaplastic thyroid carcinoma from lymphoma. Electron microscopy can identify desmosomal connections and basement membrane structures present in epithelial neoplasms but not in lymphoid proliferations. Immunoperoxidase stains for surface immunoglobulins can help identify lymphoid proliferations and their monoclonal characteristics.

The most common variants of thyroid lymphomas are the small-cell noncleaved type (poorly differentiated malignant lymphoma) and the large-cell noncleaved follicular cell type. Normal thyroid tissue is replaced by a diffuse pattern with some remaining atrophic follicles. Rarely one may find a nodular pattern or areas of thyroid tissue showing the changes of Hashimoto's thyroiditis.

The type and the stage of the lymphoma are critical factors in predicting prognosis. Small-cell, Hodgkin's, and immunoblastic lymphomas have a favorable prognosis if diagnosed at an early stage. Stage I disease, in which the primary lymphoma is restricted to the gland,

has a 5-year survival rate of 86 per cent. If the disease has metastasized to regional lymph nodes or has invaded the capsule, the 5-year survival rate drops to 38 per cent. Disseminated thyroid lymphoma carries a dismal prognosis, and long-term survivors are rare.

Metastatic Carcinoma

Carcinoma that is metastatic to the thyroid gland is present in 2 to 4 per cent of patients who die of a malignant disease. The most common neoplasms to metastasize to the thyroid gland are malignant melanoma, lung, kidney, breast, and colon cancers. Metastasis to the thyroid gland can occur by direct extension or by lymphatic or vascular deposits of tumor emboli.

Clinically, metastases to the thyroid gland can imitate primary thyroid carcinomas. The history of another primary tumor is often helpful, but the latent period between diagnosis of the distant primary tumor and appearance of the metastatic lesion in the thyroid gland may be great. Identifying metastatic lesions as such is important because surgical excision is usually of no benefit.

Prognostic Indicators

Multiple risk factors and prognostic indicators are considered in treating thyroid carcinoma. The cell type of thyroid carcinoma, as reviewed in the section on pathologic features, is the most predominant prognostic factor and also dictates the influence of other risk factors.

The second most important risk factor is the age of the patient at the time of diagnosis. Well-differentiated thyroid carcinoma has a greater tendency to invade nearby structures in patients older than 40 years of age. Mortality increases progressively until after age 60 years.

Other prognostic factors include sex of the patient, size of the primary lesion, and the presence or lack of extracapsular or vascular invasion and metastatic disease. Male patients have more aggressive tumors and a poorer prognosis than do female patients. The larger the tumor, the greater the chance of vascular invasion or metastatic spread. Tumors greater than 1.5 cm are more frequently associated with recurrence and subsequent mortality. Well-differentiated thyroid carcinomas with evidence of capsular and vascular invasion recur and metastasize more frequently, adversely affecting survival.

The effect of metastasis on prognosis varies among the different cell types. Regional metastasis in papillary carcinoma correlates with the incidence of local recurrence but has less of an influence on overall survival in patients less than 40 years of age. Patients older than 40 years of age have an increased mortality rate and higher incidence of recurrence with associated regional metastasis. With follicular carcinoma, the presence of regional lymph node metastasis has little significant influence on prognosis. Well-differentiated thyroid carcinoma that invades and paralyzes the recurrent laryngeal nerve requires a wider resection but does not affect prognosis if complete resection is accomplished.

Distant metastases are rare in papillary carcinoma, but follicular carcinoma has a tendency to metastasize to distant organs. The presence of distant metastasis in follicular

carcinoma is associated with a poor prognosis and increased mortality. Radiation exposure is associated with a higher incidence of multicentric disease with papillary carcinoma and requires a more extensive resection to assure eradication of disease. For this reason, a history of radiation exposure can be considered a risk factor.

The aggressive nature of medullary carcinoma, anaplastic carcinoma, malignant lymphoma, and metastatic lesions to the thyroid gland greatly outweighs the influence of other prognostic factors.

Diagnostic Evaluation of the Thyroid Nodule

The primary objective in evaluating a thyroid nodule is to help determine the likelihood of malignancy. Formerly, a routine diagnostic evaluation began with thyroid function studies and a radionuclide scan. Recently, refinement of diagnostic techniques and emphasis on cost containment have resulted in dramatic changes in diagnostic evaluation. Aside from the need for the physician to obtain information for the treatment decision, it is also important to provide information to the patient so that he or she can participate in the decision-making. The physician's attitude and personal philosophy will play a major role in the treatment decision as well. Finally, the patient's input in terms of anxiety and philosophy must be included in the overall picture.

The most common diagnostic options include thyroid blood work, radiologic studies, and various types of needle biopsy or aspiration. Fine needle aspiration, a superior diagnostic technique, can easily provide accurate cytologic information with virtually no morbidity. Besides being the first step in evaluating nodular thyroid disease, fine needle aspiration can be the determining factor in selecting further tests and can be used in combination with thyroid imaging.

The two primary methods of needle biopsy are core needle biopsy and fine needle aspiration. Results with core needle biopsy are excellent. Adequate tissue for diagnosis is obtained in 90 per cent of patients. Vim-Silverman and Tru-Cut needles are used for obtaining a core of thyroid tissue for biopsy. Biopsy is guided by palpation and is significantly more traumatic than fine needle aspiration. Accordingly, core needle biopsy has a higher complication rate than does fine needle aspiration. There have been reports of seeding the needle tract with malignant cells, resulting in a localized skin implant. Core needle biopsy, which is technically more difficult and results in greater morbidity than does fine needle aspiration, provides comparable results. For these reasons, fine needle aspiration is preferred. Core needle biopsy is reserved for instances in which fine needle aspiration is not diagnostic of tumors in patients who are not candidates for surgery because of obvious unresectable disease or generally poor health.

Fine needle aspiration is performed from a palpable nodule and is sent to an experienced cytopathologist, who can classify specimens as malignant, suspicious, benign, or diagnostically inadequate as well as cystic or solid. Fine needle aspiration can accurately diagnose papillary, medullary, metastatic, and anaplastic carcinomas as well as malignant lymphomas. Follicular and Hürthle cell carcinomas are diagnosed based on capsular or vascular invasion, but this cannot be demonstrated by fine needle aspiration. Most pathologists will not attempt to distinguish among an adenomatous nodule, follicular adenoma, and

follicular carcinoma. The majority of thyroid nodules with follicular cytologic patterns are actually adenomatous nodules or follicular adenomas.

Several large series on fine needle aspiration of the thyroid gland report the confirmed rate of malignancy to be 64 to 100 per cent (greater than 90 per cent in most series) in nodules diagnosed as such preoperatively. Of the nodules reported as suspicious on fine needle aspiration, about 20 per cent were found to be malignant. Among the nodules found to be benign on fine needle aspiration, about 7 per cent were falsely negative. Ashcraft and Van Herle reported a comprehensive review on needle biopsy and compared the accuracy of fine needle aspiration and core needle biopsy. They concluded that neither biopsy technique was clearly superior, but fine needle aspiration had a lower yield of insufficient specimens and was essentially free of complications. A recent review of fine needle aspiration of thyroid nodules reported a false-negative rate of 0.3 to 10 per cent and a false-positive rate of 0 to 2.5 per cent. The experience of most centers is closer to a false-negative rate of 10 per cent. In practical application, a malignant specimen on fine needle aspiration is a strong indication for surgery. In contrast, a negative result on fine needle aspiration cannot definitely rule out a malignancy. In the case of nondiagnostic or benign results on fine needle aspiration, other tests and further clinical evaluation become even more important. When fine needle aspiration is unavailable, clinical examination and diagnostic imaging become first-line diagnostic tools.

Preliminary Evaluation

The evaluation of a thyroid mass begins with a thorough history and physical examination. The head and neck examination must include indirect laryngoscopy to evaluate vocal cord mobility. Blood tests to evaluate thyroid function can be limited to a thyroxine (T_4) level unless abnormal thyroid function is suspected, in which case a full thyroid battery [(triiodothyronine (T_3), T_4, T_3 resin-uptake test, and thyroid-stimulating hormone (TSH)] is obtained.

Steps in Making the Diagnosis

Thyroid neoplasia usually presents as either a discrete nodule or nodules or a diffusely enlarged gland, although the former is more likely to be malignant.

Solitary Nodule

Fine needle aspiration is the initial test performed to evaluate a discrete thyroid nodule. If fine needle aspiration reveals the mass to be solid but benign, a technetium 99m pertechnetate (Tc 99m) thyroid scan is obtained to help define the functional status of the nodule. The patient can be informed that a "cold" nodule has a 10 per cent chance of being malignant in spite of the negative results on fine needle aspiration. A patient with a cold nodule with a benign result on fine needle aspiration should be placed on a 3-month course of levothyroxine (T_4) suppression and examined very month. The size of the nodule can be evaluated clinically or by ultrasound if the nodule cannot be easily palpated. If the nodule remains the same size or enlarges, surgery is indicated.

A thyroid nodule that is benign on fine needle aspiration and "hot" on Tc 99m scan should be re-evaluated every 3 months. If the nodule grows larger, one must consider the

possibility of an "autonomous" hot nodule, which is a tumor that is not regulated by TSH and has the potential to secrete excessive thyroid hormone, resulting in a hyperthyroid state. In this case, a radionuclide scan using radioactive iodine (I-131, I-125, or I-123) should be performed to document the true functional status of the nodule. If the patient becomes clinically hyperthyroid, surgery is considered.

A nodule that is cystic on fine needle aspiration should be aspirated and then re-evaluated every month for 3 months. If the cyst re-forms, an ultrasound is obtained and an ultrasound-guided needle biopsy is performed if the cyst has a solid component. Cystic thyroid nodules are rarely purely cystic, and ultrasound can locate any solid component. If the lesion is purely cystic, repeated aspiration can be performed. Any cyst with a solid component (mixed nodule) should undergo a Tc 99m scan, and cold lesions should be suppressed. Hot mixed nodules are re-evaluated every 3 months. Surgical excision is considered if a cystic nodule re-forms after two successive aspirations, or if a cold mixed nodule enlarges on thyroid suppression.

Diffusely Enlarged Thyroid

Diffuse thyroid enlargement usually represent a benign goiter but may hide malignant disease. The initial diagnostic test is a Tc 99m thyroid scan. Ultrasound-guided fine needle aspiration is performed if there is any solid or irregular region that corresponds with a cold region on thyroid scan and is difficult to palpate. If the fine needle aspiration results are benign, the patient is placed on T_4 suppression for 3 months to shrink the gland and make the cold nonfunctioning area easier to evaluate. If after 3 months, the mass is the same size or larger, surgery should be considered.

A diffusely enlarged gland containing a prominent nodule that is hot on Tc 99m scan is treated as a solitary hot nodule without regard to the enlarged gland.

Diagnostic Imaging

Conventional Radiographs

Of conventional radiographs, only a recent chest roentgenogram to rule out lung metastasis or tracheal deviation need be obtained. Soft tissue neck roentgenograms can help identify tracheal calcifications or compromise but should not be routine because these nonspecific findings will not likely alter treatment. Complaints of dysphagia or a foreign body sensation can be evaluated with a barium swallow to rule out esophageal compression or invasion.

Radionuclide Scans

If fine needle aspiration is unavailable or diagnostically inadequate, radionuclide scan remains the initial diagnostic tool to evaluate a thyroid nodule. Thyroid scans are also used to evaluate the functional status of nodules that are benign on fine needle aspiration. Cold nodules are radiolucent on thyroid scan, whereas hot nodules are radiopaque.

Thyroid scanning after fine needle aspiration helps to identify false-negative results by further evaluating the functional status of the lesion. Furthermore, the thyroid scan provides information about the odds of malignancy and helps determine the frequency of follow-up visits. Patients with a cold nodule on thyroid scan can be told that there is a 10 per cent chance of malignancy, and further management can be discussed. This information on the odds of malignancy is a form of informed consent. Patients with cold nodules should be seen every month, whereas those with hot nodules should be seen every 3 months.

Three major radiopharmaceutical agents are currently available for radionuclide scanning: (1) Tc 99m, (2) radioactive iodine (I-131, I-125, I-123), and (3) thallium 201 (TI 201) chloride. All of these agents have advantages and disadvantages.

Intravenous Tc 99m is the preferred agent for screening because it has the lowest radiation exposure, the greatest sensitivity, and the shortest test time, and is readily available at relatively low cost. Tc 99m is trapped by the thyroid gland but is not organified. A non-functioning lesion will not trap any of the agent and is cold. A nodule that is hot on Tc 99m scan proves only that the agent is being trapped and does not prove that the nodule is functional. A functioning nodule can be confirmed only by radioiodine scan.

Radioactive iodine (I-131, I-125, I-123) is the only agent that is both trapped and organified by the thyroid gland, thus permitting detailed functional evaluation of the thyroid gland and any masses within. Furthermore, the quality of the image produced by radioiodine scan is superior to that of Tc 99m. I-123 is the most favorable of the more than 20 isotopes of radioiodine because of its short half-life (13.2 hours), good photon energy for high-quality images, and lack of particulate emissions. A large tracer dose can be given at an acceptable radiation level that is much lower than that of I-125 and I-131. However, I-123 is very expensive and has a short shelf-life, rendering it practical only to large institutions that perform several scans on a daily basis.

Discordant nodules, which are hot on Tc 99m scan but cold on radioiodine scan, theoretically trap iodine but do not organify it. Most of these nodules are benign colloid or follicular adenomas but are considered suspicious for carcinoma. Therefore, nodules that are hot on Tc 99m scan and increase in size should be evaluated with radioiodine scan to verify the functional status. Some institutions routinely perform I-123 scans if a hot nodule is found on Tc 99m scan.

Indeterminate nodules can be palpated but cannot be visualized on thyroid scan. They have a significance similar to that of cold nodules and should be treated as such. These nodules represent nonfunctioning areas that are hidden by the normally functioning portions of the gland.

TI 201 is a relatively new agent for thyroid imaging that is incorporated into well-perfused cellular lesions. TI 201 is sensitive for cancer in nodules that are cold on Tc 99m scan, especially on delayed films. The disadvantage of TI 201 is that carcinomas are indistinguishable from adenomas and thyroiditis. TI 201 is useful for (1) detection of lymph node involvement, substernal extension, and residual, recurrent, or metastatic disease and (2) detection of functioning nodules amid suppressed normal thyroid tissue. The extent of tumor and the presence of metastatic nodes can be identified with this agent. TI 201 should be

studied in large institutions under controlled conditions but should not be used for routine evaluation.

Dimercaptosuccinic acid scintigraphy has been shown to be specific for medullary thyroid carcinomas, with no sign of uptake in other thyroid carcinomas. This new scintigraphic agent for medullary thyroid carcinoma can help determine the extent of the primary lesion and can locate metastases.

Ultrasonography

The primary purpose of thyroid ultrasonography is to help predict the potential for malignancy in a mass by determining if it is cystic, solid, or mixed. Also, ultrasound may be used to monitor lesion size during T_4 suppression in selected cases in which the nodule is not easily palpated because of a large gland or neck or because of intrathoracic extension. There is no need to discontinue suppression if ultrasound is used, as opposed to radionuclide scanning, which requires the termination of T_4 suppression 6 weeks prior to the procedure to obtain a high-quality study. Other applications include guiding fine needle aspiration, screening patients who have had prior neck irradiation, and detecting recurrent disease.

The two types of ultrasound are gray scale B-mode and high-resolution real-time ultrasound. Gray scale B-mode ultrasound is available in most hospitals and can detect lesions as small as 5 mm. Smaller, nonpalpable lesions are difficult to detect, as indicated by the reported false-negative rate of 32 per cent. High-resolution real-time ultrasound can detect occult nodules as small as 2 to 6 mm and purely cystic lesions with an accuracy of 95 to 100 per cent.

Cystic lesions identified by gray scale B-mode sonography have a relatively high incidence of cancer at 7 per cent, indicating that many nodules that appear to be purely cystic on gray scale B-mode sonography actually have a solid component. Indeed, a great majority of lesions that appear purely cystic on gray scale B-mode ultrasound really have a solid component that is more likely to harbor cancer. The incidence of carcinoma in solid cold nodules ranges from 15 to 25 per cent, which is much higher than in purely cystic lesions. Furthermore, the incidence of malignancy in cysts with a solid component (mixed or complex) is significantly higher than that in purely cystic lesions. Therefore, mixed cystic-solid lesions should undergo ultrasound-guided fine needle aspiration to obtain an aspirate from the solid component of the lesion. Ultrasound can identify the presence of multiple nodules in a gland. The incidence of carcinoma arising in a gland containing multiple nodules is 1 to 6 per cent (excluding patients who have had prior irradiation).

High-resolution real-time ultrasound has enabled the radiologist to detect cystic thyroid lesions as small as 1 mm and solid lesions as small as 3 mm. Despite improved sensitivity and higher resolution, there is no reliable sonographic criteria for thyroid malignancy. The combination of physical examination and fine needle aspiration can provide most of the information provided by ultrasound. Therefore, ultrasound should be used only in specific clinical situations. If ultrasound is used, high-resolution real-time ultrasound is the preferred mode.

Computed Tomography and Magnetic Resonance Imaging

Computed tomography (CT) and magnetic resonance imaging (MRI) have similar uses for evaluating thyroid disease, and neither should be used routinely. CT and MRI can demonstrate changes in the normal anatomy of the thyroid gland and surrounding structures. The high iodine content gives the gland increased intensity against other structures on CT scan. MRI images the thyroid gland with a signal intensity distinct from surrounding structures in both T1- and T2-weighted images. Distortion of the normal fatty compartments or tissue planes by tumor can be demonstrated by both CT and MRI. CT and MRI are effective for (1) demonstrating the extent and invasiveness of large thyroid malignancies, (2) evaluation of substernal or retrosternal extension of tumors or large goiters, and (3) detection and localization of metastatic disease or local recurrence.

CT and MRI each have specific advantages in thyroid imaging. CT scanning is less expensive, more accessible, and more familiar to most radiologists. However, MRI provides superior soft tissue and vascular imaging without contrast media or radiation exposure. The contrast between muscle and tumor is much more intense on MRI when compared with CT. Streak shoulder artifacts are not a problem with MRI as they are with CT.

Of particular importance in the examination of the neck and mediastinum is the ability of MRI to provide coronal and sagittal sections to identify mediastinal extension. MRI can provide more information about thyroid disease with better quality images and is therefore preferred. CT scanning or MRI can be used as a baseline postoperative study to document the extent of disease or the amount of thyroid tissue remaining after surgery.

Postoperative Evaluation

After surgery, certain patients require further diagnostic tests to evaluate residual, recurrent, or metastatic disease. Postoperative I-131 scans are recommended for patients with invasive follicular carcinoma or papillary carcinomas greater than 1.5 cm.

Postoperative preparation for total body I-131 is crucial because high levels of TSH are needed for adequate visualization of residual primary carcinoma and its metastases. Subtotal, or preferably total, thyroidectomy must be performed to assure an accurate metastatic study, because TSH levels will not be adequate if considerable thyroid tissue (enough to take up 5 per cent of the tracer dose) remains. For 6 weeks before the scan, all thyroid medications are withheld, and 1 week prior to the scan, the patient may be placed on a low-iodine diet to help improve visualization.

The usual dose of radioactive iodine is 2 to 3 microC of oral sodium iodine I-131 given 24 to 72 hours before scanning. The study can be repeated whenever there is suspicion of metastasis or recurrence.

Radionuclide scanning with Tc 99m medronate detects bone metastasis at an early stage. Gallium citrate (Ga 67) can be used for systemic staging of thyroid lymphoma. CT and MRI should be used as a baseline study after thyroidectomy for extensive tumors that invade surrounding structures. A baseline study should be obtained 4 weeks after surgery when surgical edema has resolved. Follow-up CT or MRI can detect recurrent disease and can aid

in planning management.

Surgical Management

The primary objective in thyroid cancer surgery is to eradicate all of the neoplastic tissue. Any residual focus of well-differentiated thyroid carcinoma has the potential to recur or degenerate into anaplastic carcinoma. When tumor is left behind for any reason, regrowth is inevitable, although it may take several years. Recurrences in the elderly tend to occur early and be more aggressive. Therefore, some surgeons perform total thyroidectomy for well-differentiated carcinoma. Nevertheless, complications associated with total thyroidectomy can be life-threatening in themselves. There is at least a 2 per cent risk of permanent unilateral recurrent nerve paralysis and a 0.25 per cent risk of bilateral paralysis. The complications of hypoparathyroidism and hypocalcemia, which may be life-threatening, occur with an incidence ranging from 1.6 to 29 per cent (less than 5 per cent in most series). Survival statistics must be weighed against such complications.

No study has shown any increased local control with total thyroidectomy when compared with lobectomy for localized, noninvasive well-differentiated papillary thyroid carcinoma. This fact, combined with the morbidity of total thyroidectomy, results in the recommendation of total thyroidectomy in selected situations only.

Well-Differentiated Thyroid Carcinoma

Basic surgical options for well-differentiated thyroid carcinoma include lobectomy and isthmusectomy or total thyroidectomy. Lobectomy with isthmusectomy is sufficient in most cases of well-differentiated papillary carcinoma with a clinically normal contralateral lobe (especially in patients younger than 40 years of age). Central node picking along the ipsilateral tracheoesophageal groove is performed to evaluate the nodal status.

Total thyroidectomy removes the primary carcinoma along with the remainder of the gland, which could harbor multicentric disease. Removing the entire gland permits detection of residual or metastatic disease without requiring ablative I-131 therapy. Total thyroidectomy is indicated for the treatment of well-differentiated thyroid carcinoma in the following situations: (1) follicular carcinoma (high-grade, angioinvasive); (2) papillary carcinoma in a patient with a history of irradiation to the head and neck, because of the high incidence of multicentric disease; (3) multicentric disease within a single lobe; (4) bilateral disease; (5) lesions measuring greater than 1.5 cm; (6) regional or distant metastasis; and (7) Hürthle cell carcinoma.

There are some instances in which the indications for total thyroidectomy are not absolute, and the risk of complications of total thyroidectomy may outweigh the benefits. Factors that must be considered include the experience and philosophy of the surgeon, health and life expectancy of the patient, and feasibility of close follow-up. Finally, information from permanent section that was not available intraoperatively may alter treatment decisions. *Relative indications* for total thyroidectomy for well-differentiated thyroid carcinoma include the following: (1) occult follicular carcinoma without capsular invasion limited to a single lobe (low-grade, well-differentiated); (2) papillary carcinoma less than 1.5 cm but with capsular and vascular invasion; (3) microscopic nodal disease in the ipsilateral medial

compartment; (4) patients older than 40 years of age; and (5) occult low-grade Hürthle cell carcinoma.

Total thyroidectomy is performed if intraoperative frozen section reveals any of the absolute or relative indications. Other factors such as age, sex, and overall health of the patient, plus the degree of cellular differentiation, must be considered when determining the extent of resection.

On occasion, the final pathologic report conflicts with the intraoperative frozen section diagnosis, requiring further treatment. A final pathologic report disclosing any of the absolute indications for total thyroidectomy necessitates reoperation for completion thyroidectomy. The patient should be reoperated upon within 1 week, when inflammation is still minimal, or after 4 to 6 weeks. If the final pathologic report discloses a relative indication for total thyroidectomy, the patient is observed closely, and thyroid suppression therapy is begun. If the patient has two or more relative indications for total thyroidectomy, completion thyroidectomy should be performed.

The status of the regional lymph nodes is very important in well-differentiated thyroid carcinoma. The central cervical nodes (central compartment) are located along the recurrent laryngeal nerve as it passes into the superior mediastinum. The ipsilateral central nodes in the tracheoesophageal groove are usually the first to develop metastatic disease. The ipsilateral central cervical compartment nodes are always removed along with the ipsilateral thyroid lobe. If lateral cervical nodes are enlarged, or if biopsy results are positive, an ipsilateral modified radical neck dissection is performed, sparing the sternocleidomastoid muscle, cranial nerve XI, internal jugular vein, and submandibular gland when these structures are not invaded.

Medullary Thyroid Carcinoma

Medullary carcinoma of the thyroid gland is an aggressive disease that is treated with total thyroidectomy. The sporadic form of the disease is usually bilateral. It is often difficult to rule out the hereditary form, and therefore total thyroidectomy is the suggested surgical treatment. The extent of lymph node dissection differs for the sporadic and hereditary types.

In some cases, the lesion is detected in the stage of C-cell hyperplasia before there is clinical evidence of a tumor. In this case, Block performs a total thyroidectomy and then samples the midjugular lymph nodes, performing cervical lymph node dissections if frozen section results of the sampled nodes are positive.

For clinically evident sporadic or hereditary medullary thyroid carcinoma, bilateral modified or radical neck dissections are recommended. Bilateral radical neck dissections are recommended for extracapsular nodal invasion. Mediastinal dissection is performed to remove all involved lymph nodes. Patients should have serum calcitonin levels checked periodically, because the degree of elevation of calcitonin levels is correlated with the extent of residual disease. In medullary carcinoma, serum calcitonin levels frequently remain elevated despite total thyroidectomy and bilateral neck dissections.

Enlarged parathyroid glands discovered during surgery in patients with familial medullary carcinoma (MEN II) should be removed. In the rare case of hyperparathyroidism, a subtotal parathyroidectomy can be performed. In either case, preservation of normal parathyroid tissue is crucial.

Anaplastic Thyroid Carcinoma

In most cases, anaplastic (undifferentiated) thyroid carcinoma is diagnosed when the tumor is already unresectable. In most cases, the only surgery indicated is for tissue diagnosis or tracheotomy if needed. Tumor debulking has no therapeutic benefit, and fatal complications are frequent. Response to the nonsurgical treatment modalities of radiation and chemotherapy is poor. Rarely, an anaplastic carcinoma is detected in an early stage. Aggressive surgical therapy consisting of total thyroidectomy and bilateral neck dissection may be the patient's only chance for cure. The rare anaplastic carcinoma discovered within a well-differentiated thyroid carcinoma should be treated with total thyroidectomy and bilateral radical neck dissections.

Malignant Lymphoma of the Thyroid Gland

The treatment of malignant lymphomas of the thyroid gland consists of surgery and external beam radiation therapy. The extent of surgical resection depends on the extent of the disease. Disease confined to one lobe is adequately treated with lobectomy. Disease involving both lobes is treated with total or near-total thyroidectomy. In cases of extensive soft tissue infiltration, external radiation is preferred treatment to avoid lethal complications associated with wide-field radical operations.

Carcinoma Metastatic to the Thyroid Gland

In most cases, the only purpose of surgery in patients with carcinoma metastatic to the thyroid gland is for biopsy or diagnostic lobectomy. These patients have grave prognoses and futile thyroid surgery can often be prevented by fine needle aspiration. Identification of a thyroid nodule ar a metastatic lesion is very important because thyroid surgery rarely affects survival. On rare occasions, thyroid lobectomy is warranted if the primary cancer is under good control and there is no evidence of other metastatic disease.

Thyroidectomy Technique

Thyroidectomy technique has remained fairly standard over the years. Several minor modifications have been introduced in an effort to develop an ideal approach that minimizes trauma to the recurrent laryngeal nerve and the parathyroid glands. The basic technique of thyroid lobectomy can be extended to perform a total or near-total thyroidectomy.

Elevation of a Skin Flap

A gently curved (collar) incision is made in a natural skin crease about 3 cm above the sternal notch and is extended to the midportion of the clavicle on each side. It is important to identify and mark the crease with the patient's head flexed. The flaps are raised in a subplatysmal plane with the superior flap extending up to the thyroid notch and the

inferior flap to the clavicle.

Exposure of the Thyroid Gland

First, the sternohyoid muscles are separated in the midline and retracted laterally. The sternothyroid muscles do not meet in the midline and can be easily retracted. The gland is exposed to the superior pole and is then carefully palpated. The normal lobe is always evaluated first to look for previously undetected abnormalities.

Thyroid Dissection

The inferior thyroid vein, which forms a venous plexus anterior to the trachea, is carefully dissected. Small tributaries are coagulated with bipolar cautery; larger ones are ligated. If found, the thyroidea ima artery (lowest thyroid artery) is also ligated. The inferior thyroid artery is identified medially in the area between the trachea and the carotid artery. The middle thyroid vein should be identified and ligated. Veins, arteries, and nerves should be carefully dissected while a bloodless field is maintained by using only bipolar cautery (no Bovie) and saline irrigation.

The inferior thyroid artery can be followed medially behind the thyroid gland at which point it crosses the recurrent laryngeal nerve. It is important to note that there is no consistent pattern and the nerve can pass anteriorly or posteriorly to the inferior thyroid artery. After the nerve is identified, it is followed cranially until it reaches the lower border of the cricoid cartilage. If the right recurrent laryngeal nerve cannot be located, one must consider the possibility of a non-recurrent laryngeal nerve, and meticulous lateral dissection must be performed to identify it. Another approach to the recurrent laryngeal nerve is via the thoracic inlet as described by Lore and co-workers.

The inferior parathyroid gland is located near the terminal branch of the inferior thyroid artery along the posterior aspect of the thyroid gland. The superior parathyroid gland is usually near the upper terminal branch of the inferior thyroid artery at the border of the middle and upper thirds of the lobe. The glands should be left next to their fat-connective tissue attachments. After the recurrent laryngeal nerve and parathyroid glands have been identified, the inferior thyroid artery can be ligated as close to the gland as possible. The superior parathyroid glands are not infrequently intracapsular and invariably lose their blood supply after dissection of the gland. Intracapsular parathyroid are carefully removed and reimplanted into the ipsilateral sternocleidomastoid muscle after histological confirmation by frozen section regardless of the viability of the other parathyroid glands. If a gland is reimplanted, the site is tagged with a nonabsorbable suture.

The lower pole of the thyroid gland and the isthmus are carefully freed upward to provide good exposure of the trachea. Lymph node tissue in the tracheoesophageal groove is carefully mobilized and removed en bloc with the lobe. The recurrent nerve is visualized and protected as it enters the larynx between the arch of the cricoid cartilage and the inferior cornu of the thyroid cartilage. The suspensory ligament is divided while protecting the recurrent nerve.

A decision must be made concerning the point at which to divide the thyroid tissue. The division is usually made across a plane that includes the isthmus and medial margin of the contralateral lobe. Running horizontal mattress sutures are placed over the cut edge of the thyroid gland. While applying downward traction on the superior pole of the thyroid gland, the superior thyroid vessels are identified. Next, the external laryngeal nerve is identified. It lies adjacent to the inferior constrictor muscle and is usually not enclosed by the thyroid sheath. The external laryngeal nerve can be functionally identified by using a nerve stimulator set at 0.5 mA while watching the ipsilateral cricothyroid muscle contract. The cricothyroid muscle elongates the vocal cord and is crucial to fine speech coordination. Once the external laryngeal nerve is identified, the superior thyroid vessels are doubly ligated. The lobe is now free and can be inspected further.

Hemostasis is obtained and a Penrose drain is placed in the wound. The incision is closed by approximating the layers anatomically. The incision is closed by approximating the layers anatomically, followed by a running subcuticular skin closure.

Total Thyroidectomy

Total thyroidectomy technique follows the dissection as previously described except that the entire gland is removed from one tracheoesophageal groove to the other. Each parathyroid gland is identified and should be reimplanted into the sternocleidomastoid muscle if its blood supply has been interrupted.

Near-Total and Subtotal Thyroidectomy

Surgeons who are uncomfortable with total thyroidectomy can decrease patient's risk of hypoparathyroidism and recurrent laryngeal nerve injury by performing procedures developed to minimize dissection in the contralateral tracheoesophageal groove. Near-total thyroidectomy minimizes dissection by leaving a few grams of thyroid tissue along the posterior aspect of the contralateral lobe. Subtotal thyroidectomy leaves no more than 25 per cent of one lobe (approximately 3 gm). Near-total and subtotal thyroidectomy are not recommended for the treatment of thyroid carcinoma. In situations of relative indications for total thyroidectomy, the surgeon may decide to perform a near-total or subtotal thyroidectomy in light of the other factors described later.

Medical Treatment of Thyroid Carcinoma

Thyroid Replacement

Patients who have undergone total thyroidectomy must receive thyroid hormone replacement. Synthetic T_4 (levothyroxine) is preferred because of its uniform and predictable metabolic effects, long duration of action, and excellent T_4 concentration. The dosage of levothyroxine, starting at 150 to 200 microg (0.15 to 0.2 mg) daily, can be adjusted by monitoring clinical tolerance as well as TSH levels. The dosage can be increased by 25-microg increments at 2- to 3-week intervals depending on patient response. In patients who are elderly or who have cardiac disease, the starting dosage can be as little as 25 microg daily, increasing by 25-microg increments every 3 to 4 weeks.

Thyroid Suppression

Patients with thyroid cancer are given exogenous thyroid hormone (T_4) not only to prevent the complication of hypothyroidism but also to prevent the release of thyrotropin, which may be a significant growth factor for differentiated thyroid carcinoma. The more differentiated the thyroid tumor the greater the chance it is thyrotropin-sensitive. Some well-differentiated tumors actually secrete enough thyroid hormone to cause hyperthyroidism. Thyroid hormone replacement can prevent thyrotropin stimulation of well-differentiated thyroid carcinoma and its metastases.

The dosage of levothyroxine is 100 to 200 microg/day, depending on the age and health of the patient. The dose should be as high as tolerated by the patient without producing a clinically evident hyperthyroid state (usually 200 microg/day). In older patients, the dosage should be started at 100 microg and increased to 200 microg/day by 25 microg increments over 2- to 3-week intervals, and the patient should be observed for toxic side effects. The serum TSH radioimmunoassay, as well as clinical examination, can determine if the treatment dose is greater than therapeutic levels.

Thyroid Ablation

The two applications for radioactive iodine in thyroid cancer are (1) treatment of the thyroid cancer itself and (2) the ablation of remaining thyroid tissue after thyroidectomy to permit subsequent treatment of metastatic cancer. The most precise indication for radioactive iodine therapy is for the treatment of functioning metastases that are in less accessible places such as bone and lung.

After near-total or subtotal thyroidectomy, radioiodine can be used to ablate any remaining thyroid tissue. An I-131 scan can then be performed to detect any functioning metastases. The overall effort of I-131 treatment on survival has yet to be documented with a well-controlled study. The use of I-131 in papillary carcinoma is questionable because pure papillary cancers do not take up radioiodine. A large retrospective study by Mazzaferri and Young suggested that radioiodine treatment was associated with a decreased number of recurrences in papillary thyroid carcinoma.

Although relatively safe, radioiodine therapy has been associated with sialoadenitis and rare reports of bone marrow damage, leukemia, bladder cancer, and impaired spermatogenesis. The effects of radioiodine on progeny are undetermined, but currently there is no evidence of decreased fertility or damage to the offspring. Radioactive iodine should be used in carefully selected cases. Patients with the poorest prognosis should be the first to be treated with radioactive iodine.

Conclusion

The methods of diagnosing and treating thyroid carcinoma are controversial and constantly changing. Advances in radionuclide scanning, ultrasound, CT, and MRI have permitted the surgeon to obtain more information about the likelihood of malignancy of a thyroid nodule. Fine needle aspiration has permitted the surgeon to make preoperative cytologic diagnosis. All of these diagnostic techniques allow the surgeon to better inform the

patient on the options for treatment and long-term prognosis. This information permits the patient to play a more active part in the decision on mode of treatment and the extent of resection in view of the possible complications. Active patient to physician communication is crucial to providing good health care.