16. Tumors of the Head and Neck

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Historical Background

The head and neck are such public regions of the anatomy that one would expect ancient medical manuscripts to give considerable attention to tumors affecting these parts. Strangely, the ancient writers rarely mention such lesions. The Smith Papyrus (2300 BC) mentions wounds of the head frequently, but not a single tumor of the area is discussed. The Ebers Papyrus (1500 BC) contains references to "eating ulcer" of the gums and "illness of the tongue", but the descriptions are too brief to be adequately interpreted. Celsus (AD 178) is often credited with devising an operation for cancer of the lower lip. Martin notes that Celsus recognized and described cancer of the skin or the face, but his operation on the lower lip was for repair of a "mutilation", probably a war wound.

A perusal of *The Surgery of Theodoric* (AD 1267) in the translation of Campbell and Colton gives an interesting perspective of the personal experiences of a master surgeon of the era who had a profound knowledge of the writings of preceding centuries. Theodoric describes numerous lesions about the head and neck, mostly of minor significance, ie, wens, "white pustules or spots which appear by the nose and over the cheeks", "lumps or swellings occurring on the head called horns", "nodes or wens which are formed on the eyelids", lipoma, pustules on the face, freckles, brown patches, wrinkles, and black and blue spots on the face. There is a lengthy section on "the scrofula". He had a much clearer concept of cancer than most of his contemporaries, but in his entire writing he does not mention the treatment of a single lesion of the lip or intraoral area.

This frequent failure to single out cancerous lesions in this area reflects the inability of our medical ancestors to differentiate grossly between chronic infections and cancer. Certainly some miraculous cures were achieved by ointments and spells applied to hard, sound ulcers which, in fact, were chronic infections. An early, operable lesion was certain to be treated at length with salves and potions, and when it was evident beyond doubt that the treatment had failed, it was too late to do anything else.

Galen had established firmly the concept that cancer was a systemic disease, an oversupply of black bile. It made more sense by this concept to treat the systemic cause of the affliction by "proper balancing of the constitution" with bleeding or purging or hot and cold baths that it did to attack directly a symptom of the internal problem which happened to occur on the face or in the mouth. The beginnings of rational operations for cancer awaited the discovery of cancer's primary origin in the various organs and the ability to differentiate cancer grossly and microscopically from other confusingly similar diseases.

In addition to the problems of diagnosis, extensive cancer operations were impossible without anesthesia. Even minor operations about the head and neck were few when the patient had to be conscious to witness them. The gruesome habit of excising the tongue for torture and punishment is as old as man, but the first such excision for cancer is attributed to Marchette in 1664. Avicenna (980-1037) described excision of tumors of the lip, the wound being left open to heal by secondary intention, but the classic V excision for cancer of the lip

was not described until the first part of the nineteenth century. Tracheotomy to relieve laryngeal obstruction was described by Galen and through the ages was occasionally used to prolong somewhat the lives of those with carcinoma of the larynx, but laryngectomy was not accomplished until the late nineteenth century.

With the advent of anesthesia and microscopic pathology in the mid-1800s, operative attack upon cancer in all areas moved swiftly forward. This was especially true of tumors of the head and neck, since they involved easily seen structures and were so readily diagnosed and the suffering of the untreated patients was so apparent. Surgeons of the German school introduced an array of new techniques for operations upon the tongue, gingiva, mandible, maxilla, and larynx. Partial laryngectomy was introduced by Gurdon Buck in 1853, and total laryngectomy for cancer was first accomplished by Billroth in 1873.

In general, the results of these new procedures were more horrifying than gratifying. Operations in a septic field and without antibiotics produce a postoperative complication rate close to 100 percent with cellulitis, sepsis, abscess, pneumonia, and death the common results. Mortality rates exceeded 50 per cent. Moreover, the results of many of the early and unsophisticated operations were not much better than if the cancer had not been treated. Billroth's famous first laryngectomy left the patient with an open pharyngostome and esophagostome, so that he constantly drooled saliva over his neck and had to feed himself with a rubber tube during the entire 8 months that he survived operation.

Operative excision was usually confined to the primary lesion, and in many of the patients fortunate enough to survive the initial operation metastatic disease subsequently developed in cervical nodes. Kocher and Butlin recognized this problem early and recommended excision of the lymphatic contents of the anterior triangle of the neck together with the removal of the primary lesion in the mouth.

At the turn on the century Crile devise radical neck dissection, removing all lymphatic tissue in both the anterior and posterior triangles of the neck together with the jugular vein and the sternocleidomastoid muscle. The basic elements of his classic procedure remain valid to the present.

Patients were willing to risk the high morbidity and mortality of operations in this region because the relentless progress of untreated disease offered a slow death by asphyxia, malnutrition, and eventual hemorrhage. Even the slimmest chance of avoiding this terrible triad seemed worthwhile.

As Crile was developing his operation for treating the cervical lymph nodes, radiation therapy for cancer was introduced. This, it was quickly apparent, offered a preferable alternative to operation, especially for primary lesions of the skin and oral cavity. Until the end of the 1930s most radical operations for cancers of the head and neck were abandoned, and the primary therapy was radiation. Techniques of radiation therapy became more refined and more successful. External radiation replaced radium as the treatment of choice, and fractionated therapy replaced the use of single applications of radium or a single dose of external therapy. With each refinement the percentage of patients who were cured increased. It was soon found that metastatic deposits in the neck did not respond as well to radiation as to operation, and radical neck dissection remained in use. Occasionally, patients who failed

to respond to radiation or who had recurrent cancers were submitted to one or another of the old radical procedures. But when these operations were performed in a heavily irradiated fibrotic field, wound breakdown and complications often resembled the results of surgical treatment of the prior century.

In the 1940s, the introduction of endotracheal anesthesia, liberal use of blood transfusions, and antibiotics markedly changed the ability of surgeons to operate in and about the oral cavity. Postoperative morbidity and mortality dropped to a reasonable level. Radiation therapy, so long dominant in the treatment of oral lesions, seemed at a plateau with much dissatisfaction concerning the morbidity of overtreatment. These factors led to a reevaluation of operation. Grant Ward of The Johns Hopkins Hospital and Hayes Martin of the Memorial Center for Cancer led in devising combined operations whereby the primary lesions and the cervical contents were removed in a single block.

Application of this principle improved substantially the prognosis of patients with head and neck carcinomas, especially large lesions involving the oral cavity, hypopharynx, and larynx. In some institutions the pendulum swung from almost exclusive use of radiotherapy to almost exclusive use of operation. Increasing application of these combined operations during the 1950s made possible an evaluation of their mortality, morbidity, and effectiveness. By the end of the decade the place for surgical control of head and neck lesions was much more clearly defined and accepted.

Because of the late development of operative therapy after the long period of dormancy during the radiation era, this field of surgery is still something of a frontier with rapid developments of new techniques and the evolution of new ideas and approaches.

In the meantime, radiation therapy also acquired new technique. Supervoltage radiation, originally with cobalt 60 and later with linear accelerators, delivered higher doses of therapy with a decreased morbidity, especially sparing the patient's skin and leaving a field more suitable for operation when this was required. Radiotherapists and surgeons who previously tended to disparage the results of each other's methods and to advance their own techniques as the primary treatment for tumors suddenly found that there was considerable common ground for the two methods and that there were patients who frequently could benefit from both operation and radiation as a planned course of integrated treatment.

Detection of most lesions of the head and neck is relatively easy, since the majority are readily available to the eye and the examining finger. Even so, it is tragic to find how often malignant lesions of this area are overlooked, not only lesions more difficult to diagnose, as in the maxillary sinuses and hypopharynx, but lesions readily visualized, such as tumors of the floor of the mouth, tongue, and tonsil.

Diagnosis

Physical Examination

Skin. The skin (see Chap 14) of the face and neck should be closely scrutinized, keeping in mind that basal and squamous carcinomas of the skin are the most common of all cancers and that the most common site for such lesions is the area of the head and neck.

Seborrheic keratosis, senile keratosis, and patches of atrophic skin often appear side by side with skin neoplasms. Differential diagnosis may be difficult, and biopsy is often required. Pigmented lesions must be examined closely to determine the presence of bleeding ulceration or satellitosis indicating melanoma. All lumps should be palpated to observe their firmness, whether they have a cystic or solid quality and whether they are fixed to the underlying tissues.

Oral Cavity. The oral cavity is often neglected in the course of a complete physical examination. It is said that the internist looks at the top of the tongue depressor, the otolaryngologist looks at the tonsils, and the general surgeon may not look at all. There is no excuse for this neglect, since the oral cavity is a rich source of pathologic processes, not only of local lesions, but often of lesions reflecting pathologic conditions elsewhere in the body.

Proper examination requires the use of a tongue depressor, finger cot or glove, and good lighting. If the examiner is skilled with the use of a head mirror, this will provide ideal illumination. However, there are numerous electric headlights which work equally well and which can be used at different points in the office or at the bedside without requiring an elaborate setup.

With the patient's mouth open, the light is directed into the oral cavity. If the patient has dentures of any sort, they should be reformed. The examiner begins by looking at the anterior floor of the mouth and the opening of Wharton's ducts. Then the floor of the mouth is observed, progressing posteriorly along the gingivolingual gutter to the tonsillar pillars on either side. The undersurface of the anterior and lateral tongue can also be observed. This is a good place to detect early jaundice.

The lower gingiva and teeth are examined next. The condition of the teeth and the presence or absence of sepsis are considered. The gingivobuccal gutters are often the hiding place of small malignant lesions and should be inspected thoroughly.

The buccal mucosa can be examined next. Patches of hyperkeratosis are often seen here. The examiner looks for the nipple indicating the opening of Stensen's duct. Pressure on the parotid should express saliva from the orifice. The position and mobility of the tongue are observed. A deviated tongue may indicate injury to the hypoglossal nerve or a previous stroke. Numerous longitudinal fissures reflect previous syphilis, a condition now rarely seen. Malignant lesions are normally found on the edges or at the tip of the tongue.

Occasionally, a patch of dirty fibers will occupy the surface of the tongue. This condition, called "hairy tongue", often occurs in a dry mouth with impaired salivary secretions. Vitamin deficiencies are reflected by an atrophy of the taste buds with a flat, smooth, erythematous mucosa.

The tonsils and soft palate are considered next. The presence or absence of the tonsils or tonsillar tags should be noted. If the patient gags, the posterior tonsillar pillars rotate toward the midline, better exposing the tonsillar fossa itself. The anterior tonsillar pillar is a common site for patches of hyperkeratosis, or sometimes for very early carcinomas. Inappropriate hypertrophy of one tonsil may reflect a lymphoma. Paralysis of one side of the

soft palate is often seen in patients who have had a cerebrovascular accident. Large tumors in the nasopharynx may push the soft palate forward and down.

The examiner can complete his observations with inspection of the hard palate. A smooth or occasionally lobular elevation running down the midline of the palate is usually a torus, a harmless, congenital deformity. Tori of the mandible also occur, projecting into the mouth bilaterally at the level of the canine tooth. They have no particular importance except to the frightened patient who may notice them for the first time in adulthood and mistake them for new growths. Occasionally, patients with atrophied lower alveoli following total loss of the lower teeth will have a spur which projects backward from the midline into the floor of the mouth. This represents a prominence of the symphysis made detectable by the absorption of the surrounding bone.

Palpation is equal in importance to inspection. Many early lesions of the oral cavity cannot be detected except by the sense of touch. This is especially true of lesions buried within the substance of the tongue or in the salivary glands. The gloved finger is passed over the tongue, the floor of the mouth, and the gingivobuccal gutters. Any mass encountered can be made more prominent by bimanual or bidigital palpation, pressing the mass inward from the cheek or submental area toward the oral cavity. If the patient can tolerate it, palpation of the lateral pharyngeal wall may reveal masses in the deep lobe of the parotid. If the index of suspicion is high concerning lesions in the nasopharynx or base of tongue, these areas should be palpated as well.

Neck. Inspection and palpation of the cervical area are done methodically, keeping in mind a distinct list of structures to be felt. These should include the larynx, thyroid, trachea, sternocleidomastoid muscle, lymph-node bearing areas, and salivary glands. The submental area is examined for the presence of enlarged lymph nodes and the size and consistency of the submaxillary gland. In the older patient they may hang low in the anterior cervical triangle as the enveloping fascia becomes lax with age. In this location they often are mistaken initially for enlarged lymph nodes. The presence of any enlarged or firm lymph nodes incorporated within the substance of the submaxillary gland should be noted. Bimanual palpation through the floor of the mouth helps greatly.

The angle of the jaw is a common site for enlarged lymph nodes or not infrequently of a tumor in the tail of the parotid gland. The anterior border of the sternocleidomastoid may overlap a cystic mass representing a branchial cleft cyst. Cystic or fluctuant masses in the posterior cervical triangle may represent a lipoma or a cystic lymphangioma.

The most important consideration in the adult is the presence of enlarged lymph nodes. A number of structures in the neck deceive the novice and at first appear to be enlarged lymph nodes when in fact they are normal structures. The carotid bulb is commonly so mistaken, especially in older patients in whom arteriosclerosis has diminished or obliterated the pulse at the bulb. The tip of the hyoid bone adjacent to the carotid bulb sometimes fools the unwary, unless they are clever enough to palpate for this structure bilaterally. The posterior belly of the omohyoid muscle as it crosses the posterior triangle in the thin patient can mimic a fusiform node until the examiner realizes that the ends of the apparent node cannot be felt. Also in thin patients the tips of the transverse process of the second cervical

vertebra are felt posterior to the ascending ramus of the mandible and may seem like a lymph node until it is realized that the structures are bony in consistency and bilateral.

Masses in the thyroid are best felt if the examiner stands behind the patient and palpates the lobes of the gland between thumb and forefinger. A midline mass just above the isthmus of the thyroid may represent an enlarged lymph node, a pyramidal lobe of thyroid, or a thyroglossal duct cyst.

Paranasal Sinuses. The paranasal sinuses are relatively inaccessible to physical examination. Neoplastic lesions often hide within these recesses and are not manifest until quite late. Bulging, particularly asymmetric bulging of one maxillary sinus, can best be appreciated by observing the cheeks from above either by having the patient lean toward the examiner or by standing above the patient and looking down. Palpation of the maxillary, ethmoid, or temporal areas may elicit tenderness or a sense of fullness. Transillumination of the sinuses by a bright light placed within the oral cavity of a patient in a dark room may reveal opacification of one or more of the sinuses. This is a relatively crude method of examination compared to x-ray examination.

Indirect Laryngoscopy. There is a common misconception that indirect laryngoscopy is an examination to be performed only by specialists. Hoarseness and throat pain are such common symptoms and cancer of the pharynx and larynx so frequent that indirect laryngoscopy should be part of the armamentarium of any physician and part of the routine general physical examination.

The patient is seated in a chair slightly higher than the chair or stool of the examiner. The examiner sits opposite him with his right thigh and knee parallel and immediately adjacent to the right thigh and knee of the patient. The patient should extend his neck, thrusting his chin straight forward, as though he had just finished sneezing. The patient's tongue is wrapped in a gauze sponge, and the examiner, if he is right-handed, grasps the tip of the tongue between the thumb and second finger of the left hand, using the first finger to elevate the patient's upper lip. The tongue is drawn forward, and the patient is instructed to breathe rapidly in short, quick breaths, to "pant like a dog". As long as the patient continues to breathe in this fashion, gagging is inhibited. The examiner inserts a medium to large laryngeal mirror, previously flamed to keep it from fogging, into the oropharynx and shines his headlight on the mirror, reflecting a spot of light down into the hypopharynx.

If one is a novice with the head mirror, an electric head lamp should be used. With the mirror in the oropharynx and directed downward, the posterior third of the tongue, the lateral pharyngeal wall, the posterior pharyngeal wall, the epiglottis, the valleculae, and the pyriform sinuses can all be examined thoroughly. The epiglottis will usually hide most of the glottic opening, and only the posterior portions of the arytenoids may be seen at first. The patient is told to breathe deeply several times. This often throws the uvula forward until more of the glottic opening and a little of the subglottic space is seen. The patient is asked to attempt to enunciate an "ee" sound. This throws the epiglottis even farther forward and usually brings the entire glottis, including the anterior commissure, into view.

The false cords, aryepiglottic folds, and posterior epiglottis can now be examined. The movement of the cords is considered, to determine whether both are moving adequately and

whether they meet in the midline. Paralysis of one cord may indicate a malignant lesion in the mediastinum or cervical area or may be related to previous operation or cerebrovascular accident. If nodules in the pharynx or posterior tongue are noted, they should subsequently be palpated. As the examiner acquires skill in this procedure, most of these examinations can be accomplished without local anesthesia. Topical anesthesia with lidocaine 1% (preferably) or Pontocaine 1% should be used by the beginner.

In one or two patients out of every twenty, examination is incomplete or impossible because of a hypersensitive gag reflex or an acquired or congenital malformation of the epiglottis which makes visualization of the glottis impossible. In such instances, direct laryngoscopy must be used. While direct laryngoscopy is the more sophisticated and complex procedure, indirect laryngoscopy actually gives a better overall picture of the larynx and pharynx. The chief reason for resorting to direct laryngoscopy other than the above is the necessity of biopsy of lesions deep in the larynx. Direct laryngoscopy is sometimes performed using a *suspension laryngoscope,* which, once the cords are visualized, can be fixed in place so that the operator does not have to use his hands to hold the laryngoscope. This technique can be combined with the use of an optical device which greatly magnifies the cords so that small irregularities and tiny lesions may be examined. Occasionally in patients with unexplained hoarseness this approach will reveal very early any localized benign and malignant changes.

Nasopharyngoscopy. The mirror used for indirect laryngoscopy may be turned over and direct upward. The examiner, standing at the patient's should and depressing the tongue with a tongue blade, may shine his headlight on the mirror and gain a fairly spacious view of the nasopharynx. In most instances the space between the soft palate and posterior pharyngeal wall is too small for the nasopharynx to be adequately visualized in this fashion. If physical findings or the history so indicate, complete examination of the nasopharynx is done by inserting a soft rubber #10 French catheter through either nasal passage, drawing its tip out through the mouth and retracting the soft palate forward, revealing the entire nasopharynx for indirect examination by the mirror. The torus tubarius, the openings of the eustachian tubes, the posterior surface of the soft palate, the posterior aspect of the nasal septum arching back toward the sphenoid sinus, and the posterior tips of the turbinates are seen. The normal lymphatic tissue of the adenoids may lend a granular appearance to some of the posterior and superior mucosal surfaces.

The direct nasopharyngoscope is an instrument which can be used in the office. It is a small instrument like a miniature cystoscope and has a Foroblique or right-angled lens. The diameter of the tube is 5 to 8 mm, and the visual field is quite small and easily obscured by mucus or blood. Use of this instrument is a valuable adjunct to indirect inspection of the nasopharynx and is particularly helpful in searching for small neoplasms.

Introduction of the fiberoptic laryngoscope has made it possible to examine both the nasopharynx and larynx with the same instrument. This thin, flexible instrument is inserted through the nostril and is easily tolerated by the patient. In many offices is supplanting indirect laryngoscopy.

Diagnostic Studies

Radiography. Most of the bones of the face and neck are adjacent to air-filled cavities or are air-containing, creating an excellent situation for diagnostic radiographs. Lesions of the paranasal sinuses, nasal cavity, orbit, mandible, and larynx are readily revealed.

Arteriography. Injection of contrast medium into the vessels is a useful maneuver for evaluating tumors within the cranium or evaluation of tumors in this region. The rare carotid body tumor can be nicely outlined by the use of radiopaque medium injected into the appropriate common carotid artery, and its appearance when examined in this fashion is pathognomonic. At times, arteriography is useful to outline the extent of a hemangioma of the face or oral cavity.

Laminography. This technique is of great usefulness in examinations of the head and neck, especially for minute examination of the bony walls of the paranasal sinuses. Usually, the clouding of a paranasal sinus by tumor and by infection cannot be differentiated by x-ray unless obvious evidence of bone erosion is seen. Early detection of such erosions is best seen in laminograms. Tumors of the larynx are easily seen from above by indirect laryngoscopy, but their inferior extent is hidden from view unless the lesion is very small. Laminograms and lateral soft tissue views of the larynx play a useful role in revealing the extent of subglottic extension and often the degree of involvement of the pyriform sinuses, which may not otherwise be detectable. Details of retropharyngeal and esophageal tumor spread can be seen on the lateral soft tissue view. Laryngograms are performed by the application of barium to the back of the tongue, cords, epiglottis, and all of the intrinsic larynx. A very clear examination of laryngeal structures can be obtained which offers excellent correlation with other diagnostic methods available.

Computer Tomography. This intriguing new technique has found applications throughout the body and is especially useful in the head and neck. The true extent of large tumors of this area is best defined by the multisectional studies offered by computer tomography. This is especially true of tumors in the nasopharynx, paranasal sinuses, and the larynx. In these areas the new technique is superior to and is supplanting laminography.

Biopsy. The vast majority of head and neck lesions can be easily biopsied in the office or clinic. The tools required are simple, and the procedure is short and uncomplicated. Lesions of the lip, skin, gingiva, floor of the mouth, tongue, and buccal mucosa can quickly be biopsied with a 4-mm dermatologist's skin punch. The area to be biopsied is cleansed with an antiseptic agent infiltrated with a small amount of local anesthesia, and the skin punch is pressed into the lesion to a depth of 4 to 6 mm, cutting a small disc of the tumor, and is withdrawn. The core of tissue which is still connected at its base is grasped with forceps, pulled up until the base is flush with the surface tissue, and cut off with a small pair of scissors. A silver nitrate stick thrust into the depth of the remaining cavity and mild pressure for a minute or two control bleeding in almost all instances. Lesions of the soft palate, tonsillar pillar, or posterior tongue which cannot be reached with a skin punch can often be biopsied easily and quickly with a cervical biopsy forceps; the techniques of anesthesia and hemostasis are essentially the same as described above.

If skill is obtained with indirect laryngoscopy, lesions of the lateral pharyngeal wall, pyriform sinus, epiglottis, and aryepiglottic folds can often be quickly biopsied in the office. While similar biopsies of the true and false cords sometimes can be achieved with skillful manipulation of the indirect mirror, such procedures are best carried out under direct laryngoscopy. Manipulation of biopsy forceps immediately above the cords is much more difficult for the patient to tolerate and may stimulate laryngeal spasm and bleeding at a site where aspiration of blood into the trachea is likely.

Biopsy of the primary lesion is always preferable, but sometimes although cervical nodes are enlarged, no primary tumor can be found. If so, needle biopsy of cervical nodes is indicated and is a rewarding procedure when the node contains metastatic squamous carcinoma. This neoplasm is easily diagnosed even with the smallest fragments of tissue. Nodes involved by lymphoma, on the other hand, are virtually impossible to diagnose by needle biopsy. Positive results of needle biopsy are useful and timesaving; the negative result of a needle biopsy has no significance and must be followed by open biopsy.

There has been much controversy concerning the tendency to spread tumor cells with the use of needle biopsies, and certainly it seems likely that tumor cells are spread into the needle tract by this manipulation. However, this is of greater theoretical than practical importance. Long experience with this technique at a number of major centres has not produced any gross difference in survival rates on long-term follow-up either in the head and neck or elsewhere. Open biopsy of a lymph node seems just as likely to scatter tumor cells, and even more widely.

Vital Dyes. Many cancers of the oral mucosa in their early stages are soft and superficial. They may have an erythematous appearance rather than a white color as usually thought and can easily escape detection even in a careful examination. If suspicion is aroused by a vaguely erythematous patch, the application of toluidine blue will aid in making the diagnosis. This technique will distinguish areas of dysplasia and carcinoma in situ as well as frank carcinoma of the mucosa. The method has its chief use in mapping out the full extent of dysplastic areas or areas of intraepithelial carcinoma.

Cytology. As used in the oral cavity, exfoliative cytology is a superficial biopsy, since it does not reflect collection of fluid from the entire oral cavity but involves scraping a specific lesion with a spatula and spreading this scraping on a slide. Such cytologic examinations, therefore, require a specific area of suspicion compared to sampling of an entire anatomic area such as in the cervix or bronchial tree. If a specific lesion is present, it is best evaluated by an actual biopsy. The chief virtue of oral cytology is that the physician who cannot bring himself to use office biopsy techniques or who feels they are beyond his competence can still have the opportunity to obtain a histologic specimen from the lesion in question. Unlike biopsy, cytology has no significance when it is negative. Thus, cytology will establish the presence of a lesion but cannot be relied on to rule that a questionable lesion is not malignant.

Cancer Staging. An important facet of diagnosis is staging the clinical extent of the tumor. The efforts of the American Joint Committee for Cancer Staging have introduced the now widely accepted TNM system of staging in which *T* stands for tumor, *N* for regional lymph nodes, and *M* for metastasis. Proper description of each aspect of a malignant lesion

permits more precise comparison between series of patients and better evaluation for prognosis. The committee has a book available in which all of the major areas for staging in the head and neck are covered. The system has great value but is complex enough that patients should never be staged from memory but only with the staging reference available.

Lip

Squamous cell carcinomas of the lip are one of the common malignant tumors of the oral cavity, constituting 15 per cent of all such lesions and 2.2 per cent of all cancers. Basal cell carcinoma is much less frequent; only about 3 are seen for every 100 squamous cell carcinomas of the lip. Benign lesions which are occasionally seen in the lips include mucous cysts, tumors of the minor salivary glands, hemangiomas, lymphangiomas, venous lakes, fibromas, fissures, and hyperkeratosis.

Etiology. Like tumors of the skin, there is an important relationship between tumors of the lip and exposure to sunlight. About one-third of patients have a history of working outdoors, and the incidence of malignant squamous cancers of the lip increases progressively the farther south the latitude of the patient population being considered. Thus, in the USA the highest incidence is in Florida and Texas. Actinic rays are stronger at higher altitudes and in dryer air, and in areas having these features the incidence of lip (and skin) cancer is increased. Fishermen, sailors, and farmers are among the occupational groups with an increased incidence.

Complexion also plays a role. Susceptible types are fair-skinned, light, blond or ginger-haired, and blue-eyed, with the kind of complexion that freckles and burns rather than tans on exposure to the sun. Resistant people have the opposite characteristics: they are brunet and dark-skinned; blacks are rarely affected.

While there is a relation between lip cancer and tobacco, the exact cause for this is less apparent than in patients with lesions of the intraoral area, larynx, or lungs. The average cigarette smoker receives almost no carcinogen from his tobacco directly to the lips, since the smoke is drawn into the oral cavity and the tracheobronchial tree without passing over the mucosa of the lips themselves. Some feel that the inmates of nursing homes and institutions are more prone to have carcinoma of the lip from cigarette smoking. Smokers in this population usually treasure their cigarettes, smoking them down to the smallest possible butt. Macerated, moist tobacco and heat are directly applied to the lips.

Reports in the literature implicating pipe smoking as a cause of lip cancer have been appearing since 1795, and the Advisory Committee to the Surgeon General on Smoking and Health has accepted the causal relationship as established. Pipestems of wood and clay which soak up tobacco tars directly and apply a "tar poultice" to the lips have been viewed with special suspicion. In any case, such stems are little used now, and indeed the incidence of cancer of the lip in the USA has been gradually decreasing over the past 30 years. One may speculate whether this reflects the decrease in pipe smoking, outdoor work, use of wood and clay pipestems, or a combination of these and other factors.

Cancer of the lip in women is very rare, occurring in only 1 woman for every 20 to 30 men.

Benign Tumors

The mucosa of the inner surface of the upper and lower lips is subject to the same benign lesions as those throughout the mucosa of the oral cavity. These are discussed in greater detail in the following section, Oral Cavity, and include such lesions as mucous cysts, hemangiomas, tumors of the minor salivary glands, hyperkeratosis, and inflammatory hyperplasia. Specific benign lesions that involve the exposed borders of the lips include venous lakes, pigmented spots, hemangiomas, and very rarely neuromas. Venous lakes are a telangiectasis, usually of the lower lip, occurring in older individuals as a small blush spot. They appear to have no pathologic significance. The other three lesions all have interesting systemic correlations. Multiple pigmented spots of the lips may be associated with Peutz-Jeghers syndrome and denote the presence of multiple small intestinal polyps, which sometimes lead to bleeding and intussusception but are rarely malignant. Scattered small hemangiomas of the lip may be associated with similar lesions elsewhere in the oral cavity and gastrointestinal tract, those of Rendu-Osler-Weber disease. Neuromas of the lips, particularly at the commissures, suggest a neuroendocrine dysplasia, a fascinating syndrome associated with pheochromocytomas, medullary carcinoma of the thyroid, hyperparathyroidism, and hypertrophy of the gastrointestinal myenteric plexus.

Hyperkeratosis

This is a premalignant condition of the lips, usually associated with long exposure to sunlight. It typically occurs in a fair-skinned individual in his sixties or seventies who has a long history of outdoor employment. The normal distinct line marking the mucocutaneous border becomes indistinct and gradually retreats, indicating a metaplasia of the outer portion of the mucosa to a keratosquamous epithelium. The mucosa of the lip becomes paler, thinner, and more fragile. There may be perpendicular cracks and fissures. On this base, a white film indicative of early hyperkeratosis appears. This may grow gradually thicker and more exophytic as the condition progresses or may remain stationary for many years. Gradually, a small area of scabbing and ulceration occurs. This breakdown within the hyperkeratotic tissue represents a failure of the less resistant areas of hyperkeratosis to tolerate normal wear and tear. When such areas of ulceration appear, they continue to break down and heal and often give rise to carcinoma in situ and eventually invasive carcinoma. Persistent hyperkeratosis is a distinct premalignant lesion, and 35 to 40 percent of all carcinomas of the lip are preceded by this condition. Cancers arising on such a base can be prevented by excising the entire exposed mucosa of the lip, elevating the protected mucosa of the inner lip, and advancing it over the bed of the excised mucosa to form a new lining for the lip. This procedure is called a *lip stripping and resurfacing.*

Carcinoma of the Lip

Most cancers of the lip are squamous carcinomas. When basal cell carcinomas appear, they usually involve the skin of the lip beyond the vermillion border and probably should be considered with the cancers of the skin of the face. Ninety-three percent of the squamous cancers occur on the lower lip. These are usually low-grade, well-differentiated lesions, 80 percent being grade 1 or grade 2. The lesions most frequently start on the outer edge of the mucosa at the vermillion border and seem to favor the middle two-thirds of the lip somewhat more frequently than the commissures.

The natural history of these lesions is of slow but relentless growth. Some grow to great size, destroying the entire lip without ever metastasizing, but the incidence of metastasis gradually increases with the increasing size of the tumors. About 5 to 10 percent of all patients with lip cancer have cervical lymph node metastasis, and in half of these patients only one lymph node is involved. The normal spread of cancer from the lower lip is by way of lymphatics to the submental node on the side of the lesion. Metastases do not involve the opposite submental node unless the primary lesion crosses the midline. Lesions of the upper lip drain to lymph nodes in the anterior portion of the submaxillary gland.

An ulcer of the lip which fails to heal is soon detected by the patient or his friends, and in most urban populations such lesions quickly come to the attention of physicians. In rural populations it is surprising how long patients will carry these ulcerations before seeking medical aid.

Treatment for carcinoma of the lip has remained a topic of controversy between radiotherapists and surgeons for many decades. Recent controlled series comparing treatment by both modalities in randomly selected patients indicate that there is no statistical difference between the two methods in terms of cure rate. The choice for therapy must be made on other grounds. Small lesions of the lip can usually be excised under local anesthesia with little or no hospitalization time. Good radiation therapy producing maximal regression with minimal residual scarring requires 2 to 4 weeks of outpatient therapy. Medium-sized lesions require the use of flaps from the upper lip or elsewhere for closure, and for these lesions radiotherapy often requires the same or less time and less morbidity. For very large lesions which have destroyed most of the lip and are associated with metastasis to the neck, subsequent repair of the lip will be required under any circumstance as well as probable radical neck dissection for removal of cervical nodes; for these major lesions an integration of radiation and surgical therapy may be used to improve cure rates, which are relatively low for either radiation or operation alone. A final consideration is that most carcinomas of the lip are related to solar radiation. Since radiotherapy increases the sensitivity of tissues to such exposure, it is best to avoid radiotherapy in patients who expect to return to outdoor occupations.

Prognosis for lip cancers of 1 cm or less is excellent, ranging from an 87 to 95 percent 5-year survival rate without recurrence. Neglected lesions, especially with associated cervical metastasis, do much more poorly, with a 5-year survival of 50 percent.

Oral Cavity

The oral cavity includes the buccal mucosa, upper and lower gingivae, anterior two-thirds of the tongue (that portion anterior to the circumvallate papillae), floor of the mouth, and hard palate.

Incidence. Eight percent of all malignant tumors occur in this area, 95 percent of such tumors being squamous carcinomas. The risk of carcinomas developing here in a male is approximately 1 percent in a lifetime. The risk in females is far less: oral cancer develops in about 1 woman for every 10 males. Benign tumors of the oral cavity are common in both sexes.

Etiology. Some benign lesions have a specific cause, which will be discussed with the descriptions of the lesions below. Contributing causes to squamous carcinoma are smoking, a heavy intake of alcohol, poor oral hygiene, and syphilis. While cancer often occurs without the presence of any of these factors, they are associated with a majority of the lesions seen.

The *Report on Smoking and Health* by the Advisory Committee to the Surgeon General notes a suggestive relationship between smoking and oral carcinoma. This is especially true in pipe and cigar smokers, where oral cancer has the highest mortality ratio, 3.3, of all causes of death compared with the nonsmoking population. (That is, 3.3 times as many pipe and cigar smokers died of oral cancer as did nonsmokers in the same age group. The mortality ratio for cancer of the lung in pipe smokers was 1:1, no different from that of the nonsmokers.) There are a number of exotic cancers of the oral cavity which serve to indicate the relationship of tobacco to cancer. In Andhra Pradesh, a state in India, the habit of smoking a cigar (ie, *chutta*) with the burning end inside the mouth is widespread. Carcinoma of the palate, called *chutta cancer,* is common. Presumably, repeated thermal trauma and/or tobacco smoke provide the carcinogenic agents.

In Uttar Pradesh and Bihar, a mixture of tobacco and slaked lime is habitually sucked by men of the districts. The quid is kept in the lower gingivolabial fornix for many hours during the day; a high incidence of carcinoma is found at this site. This has come to be called *khaini cancer,* from the name of the tobacco-lime mixture.

Betel-nut chewing is a common habit among the Indians, Javanese, and Malayans. The chew is made of a mixture of ground betel nut, slaked lime, and spices, such as ginger or pepper. These are wrapped in a betel leaf and chewed. The Indians add tobacco to their betel preparations and have a high incidence of oral cancer, whereas the incidence is low among the Javanese and Malayans, who consume their betel nut without benefit of the tobacco additive. Among betel nut-tobacco chewers, oral cancer comprises 36 percent of all cancers.

Alcoholism has a highly suggestive role in oral cancer. As many as 42 percent of all patients so afflicted have a history of alcoholism. As a corollary, cirrhosis of the liver is a common finding in patients with oral cancer, 20 percent having cirrhosis as compared to 9 percent in a control population. It has been proposed that alcohol acts as an adjuvant to the use of tobacco in producing oral cancer. This is a difficult point to prove, since finding a control population of patients who drink heavily but do not smoke is virtually impossible.

The roles of poor oral hygiene and oral sepsis, mentioned for decades as etiologic agents for oral cancers, are also difficult to evaluate. These conditions are seen most commonly in patients at the lower end of the social scale and in the ward population rather than in private practice. Oral hygiene is poor in this group, but it cannot be said whether poor hygiene or social level or other correlated factors are responsible.

Syphilis has a direct relation to cancer of one specific site in the oral cavity, the tongue. When syphilitic glossitis, a lesion of late syphilis, heals, it often leaves the tongue fibrotic and scarred with longitudinal fissures and thick hyperkeratotic plaques. It is on this base that lingual cancer develops. In the days of Bloodgood (1921) 21 percent of American men with lingual cancer had syphilis. Willis still calls this condition "the most clearly established causative factor in European males".

Benign Lesions

Common benign tumors of the oral cavity are inflammatory hyperplasias and cysts. Less commonly seen are giant cell granulomas, salivary tumors, granular cell myoblastomas, dermoids, and hemangiomas.

Inflammatory Hyperplasia

The oral mucosa is subject to a number of irritating conditions producing tumorlike projections which are not true neoplasms. Patients develop the nervous habit of sucking a portion of mucosa from the cheek, tongue, or lip between the teeth or through an interdental or edentulous space. The traumatized mucosa becomes edematous and prominent, and the irritation may be compounded by the patient who bites as well as sucks on the offending mucosal fold. Initially, the overlying mucosa is swollen, and eventually this undergoes metaplasia to squamous epithelium. The tissue underlying the elevated mucosa changes from edematous connective tissue to a denser and more fibrotic collection of collagen. At this stage the lesion may be termed a *fibroepithelial polyp.* Similar lesions are often seen in the gingivobuccal gutter and on the palate in patients with ill-fitting dentures. Those lesions which occur along the vestibular mucosa next to the gingiva in this relation are sometimes called *epulis fissurata.* Another appropriate term, more descriptive of the later stages of these lesions when the fibrosis and scarring has advanced, is *irritation fibroma.* In the early inflammatory phase of these lesions, the overlying mucosa is friable and bleeds easily.

The chief responsibility of the examiner who has recognized the lesion is to reassure the patient that it is not malignant. Although these lesions are usually not ulcerated and are easily recognized, diagnosis should be confirmed by biopsy. Treatment is by correction of the causative factor, either by the design of new dentures or by discouraging the patient from manipulating and traumatizing the area involved. Excision may be necessary, but if the basic problem is not abolished, recurrence is prompt.

Cysts

Mucous cysts are a common oral lesion occurring on the posterior surface of the lip, floor of the mouth, tongue, and buccal mucosa. These cysts arise from the salivary gland-bearing areas of the oral mucosa and were thought to be due to obstruction of the excretory duct of minor salivary glands. It has been found, however, that these cysts have no epithelial lining and that they result from a rupture of the excretory duct. Saliva spills from the defect in the duct and begins to collect in the tissues. At first it forms a diffuse lesion, but soon a circumscribed cyst with a wall of granulation tissue develops. These mucoceles measure from 1 or 2 mm to 1 or 2 cm in diameter and appear as elevated, translucent, bluish lesions of the mucosa. They frequently rupture, discharging sticky mucoid material, and then recur as the laceration in the overlying mucosa heals. Treatment consists of wide surgical unroofing of the lesion.

A somewhat larger and more dramatic mucocele may result from obstruction and rupture of the major excretory ducts in the floor of the mouth, ducts of the lingual or submaxillary glands. Except for size, these lesions resemble in every way the lesions which

result from obstruction of the minor salivary glands but have received the special name of *ranula.*

Dermoids may develop in the floor of the mouth and the base of the tongue along the midline. If neglected, these lesions grow slowly as they accumulate the sloughed-off cells, secretion, and hair of the epidermal lining. They present both as a swelling in the submental triangle and an elevation of the floor of the mouth. They will eventually elevate the floor of the mouth and tongue until it touches the palate and interferes with speech. Treatment consists of operative excision of the cyst, which may be done either intraorally or extraorally. The lesion has a definite, thick capsule and can be shelled out with ease from its relatively avascular midline location.

Peripheral Giant Cell Reparative Granuloma

These benign tumors occur on the gingivae, affecting the maxillary or mandibular gingiva with equal frequency. Grossly, they appear as a slow-growing, reddish, smooth sessile tumor which bleeds easily. They often occur at an area of an interdental papilla but may also arise in edentulous patients. Histologically, the lesion is covered by stratified squamous epithelium. Endothelial and fibroblastic proliferations, multinucleated giant cells, and extracellular and intracellular hemosiderin are diagnostic microscopic criteria. Multinucleated giant cells are distributed unevenly throughout an area of rich fibroblastic proliferation. Some lesions show spicules of bone tissue. In general, the lesion closely resembles the giant cell tumor of bone seen in hyperparathyroidism. The descriptive term *peripheral* indicates that the lesion is of soft tissue, while the so-called central giant cell reparative granuloma is an intraosseous form found in the mandible or maxilla.

When the lesions arise in the mandible or maxilla, they may be confused with the giant cell tumors of long bones. The distinction between the two lesions must be made, since the oral lesions have no propensity for malignant transformation, as have the lesions seen elsewhere. Treatment of the soft tissue lesions is by complete excision. Inadequate removal may result in recurrence.

Peripheral Fibroma

These are also lesions of the gingiva and are in many respects similar grossly to the giant cell granuloma. They are usually firmer and under the microscope are made up of dense connective tissue. They may also contain bone spicules and may be calcified. One can speculate as to the relation of these lesions to the giant cell granuloma. They may represent a later stage of this lesion or may be a late stage of inflammatory hyperplasia. Excision is usually curative.

Granuloma Pyogenicum

This is an elevated pedunculated or sessile lesion which may occur on the lips, tongue, buccal mucosa, or gingiva. It bleeds readily on being traumatized. Histologically it is made up of edematous, fibrous connective tissue with a prominent endothelial component arranged in lobules of varying sizes separated by bands of collagen. Numerous blood vessels are scattered throughout the tumor. No cause is known for the lesions of the lips, buccal mucosa,

and tongue, but lesions of the gingiva are often associated with pregnancy. Thirty to forty percent of pregnant women show some degree of gingival enlargement. Of these, about 1 percent will have an isolated "tumor". These lesions in the pregnant female have been called "granuloma gravidarum". They appear about the third month of pregnancy and increase in size throughout the growth of the child in utero. They usually diminish in size and disappear following delivery, although with a subsequent pregnancy they may appear again in the same location. Lesions unassociated with pregnancy may be treated by excision. It is usually advisable to wait until the end of pregnancy to treat granuloma gravidarum.

Salivary Tumors

Pleomorphic adenomas (mixed tumors) occasionally arise from any of the 400 to 700 minor salivary glands. Occurring most commonly on the lips, tongue, and palate, they can be found anywhere in the oral cavity where minor salivary glands are found. They are usually slow-growing, round masses of a rather rubbery consistency. They have the potential of becoming malignant and if simply enucleated without adequate excision have a marked propensity for local recurrence. Treatment, therefore, is by wide local excision.

Hemangioma

Capillary hemangiomas, not unlike the strawberry hemangioma of the skin, are sometimes seen in the mucous membranes of the oral cavity in infants. Like the lesions of the skin these lesions regress spontaneously, and unless they are so large that they interfere with function, they should be left to regress at their own pace. In most instances they will undergo involution by the end of the fifth year. Unlike the skin lesions they do not disappear completely and may still be seen as a small, dark lesion underneath the mucosa. It is likely that the transparent nature of the mucosa reveals the sclerosed remnant in a manner that is not seen if the lesion is under the more opaque skin. The sclerosed hemangioma will remain visible throughout life but has no significance and does not require treatment. Rarely, large regional vascular malformations will involve the entire side of the mouth, including the tongue, gingiva, and buccal mucosa. Such lesions do not regress spontaneously. Their treatment is difficult, often requiring multiple plastic procedures to excise the hemangiomatous tissue and to return the contours of the mouth and oral cavity to normal.

Granular Cell Myoblastoma

This is a rare and interesting lesion which occurs most commonly within the muscle of the tongue, presenting as a small firm spheroid mass detected best by manual palpation. These lesions have no malignant potential but may gradually increase in size with functional impairment. Treatment is by simple excision.

Hyperkeratosis

The gross finding of white patches on the oral mucosa elicits the diagnosis of leukoplakia from the clinician. "Leukoplakia" roughly translated means "white patches", so the physician need not feel too proud of his accomplishment; he has only managed to translate English into Latin. Some "leukoplakia" means a specific premalignant lesions. This meaning is not inherent in the original use of this term. Most pathologists adhere to a more

rigid description of such lesions and describe the underlying microscopic changes: hyperplasia, keratosis, and dyskeratosis. White patches in the oral cavity may be associated with any of or all these basic changes. Inflammation in this area often stimulates marked hyperplasia of cells, sometimes to the point where they resemble epidermoid tumors and are spoken of as *pseudoepitheliomatous hyperplasia.* Keratosis is a common response of the buccal mucosa and may appear in the presence of lichen planus, chronic dyscoid lupus, and Darier's disease, as well as be a possible forerunner of malignant change.

Dyskeratosis, the loss of normal stratification or orientation of cells together with irregularity in the size and shape of cells and abnormal staining characteristics, is a much more treacherous lesion and much more likely to precede malignant disease.

Hyperkeratosis is announced by the gradual development of whitened patches of the mucosa which appear first as a thin, white, translucent or opalescent film in the normal mucous membrane. No malignant or premalignant changes will be found at this point but only evidences of hyperplasia or keratosis. Later these lesions can become thickened and rougher; the white patches are now quite opaque. Palpation will reveal a definite change in the consistency of the mucosa. Microscopic examination may still show advanced hyperkeratosis and hyperplasia, but now areas of mild to marked dyskeratosis may be present as well. Eventually, areas of distinct carcinoma in situ will appear, and this can be followed in rapid order by microinvasion or the frank invasion of a well-developed cancer.

Obviously, the early appearance of hyperplasia and hyperkeratosis may or may not foreshadow malignant disease. Since there is no way of telling which is the case, patients with such lesions should be warned to avoid smoking or heavy intake of alcohol and should embark on a campaign of improvement of oral hygiene. Cancer will ultimately develop in 5 percent of such patients, and it is significant that about 50 percent of all oral cancers develop in patients with associated areas of hyperkeratosis and dyskeratosis. The thin, early lesions require only a warning, and a biopsy is not necessary, but thickened lesions may already contain carcinoma in situ and should be biopsied in every instance and perhaps checked, as well, with vital dyes.

If a patch of dyskeratosis appears on biopsy to be particularly threatening and is limited in extent, local excision may be useful. More often, the extent of the lesion is so widespread that complete excision of the involved mucosa is impossible. Radiation therapy is contraindicated in these premalignant lesions. While the majority are associated with hyperkeratosis, which gives the whitish aspect to the surface, occasionally dyskeratosis and carcinoma in situ are the major elements. Such lesions may have a velvety erythematous appearance only slightly redder than the surrounding mucosa. These areas are difficult to detect, and toluidine blue may be very useful in mapping their true area.

Malignant Tumors

Pathology. Low-grade epidermoid carcinomas make up the overwhelming majority of all carcinomas of the oral cavity, varying from highly differentiated tumors, difficult to tell histologically from inflammatory hyperplasia, to less well-organized but still obvious epidermoid tumors usually with associated squamous pearls. Highly undifferentiated and anaplastic lesions are rare. The few adenocarcinomas found are derived from minor salivary

glands. The occasional adenoid cystic carcinomas and mucoepidermoid carcinomas seen also arise from salivary tissues.

In the southern USA a very low-grade cancer, verrucous carcinoma, is occasionally seen. This is an exophytic, shaggy white lesion usually found in the gingivobuccal gutter of patients who are tobacco chewers or "snuff dippers". Unless treated by radiation, the lesion never metastasizes, although it frequently invades surrounding tissues, including the mandible.

In general, lesions of the oral cavity are better differentiated and less malignant than lesions occurring in the oropharynx.

Tongue

Carcinoma of the tongue commonly begins at the tip or along the free borders. It often starts in an area of hyperkeratosis and gradually develops as an ulcerated lesion with a moderately exophytic undermined border. The area of ulceration is related to the rest of the tumor as the tip of an iceberg is to its main mass, and palpation of the tongue may indicate that invasion has occurred deeply throughout underlying muscle. Carcinomas beginning in an area of syphilitic glossitis are exceptions to the normal pattern and occur on the dorsal glossal surface.

Cancer of the tip of the tongue metastasizes to submental nodes, often bilaterally, while lesions along the borders of the tongue metastasize to ipsilateral submandibular nodes and occasionally to nodes at the angle of the mandible.

These lesions are quick to metastasize, and 40 percent of patients have nodes in the neck when first seen. In another 40 percent nodes develop at some point during therapy or during follow-up. For this reason therapy is designed to attack not only the primary lesion but also the nodes of the ipsilateral neck, as well. Combined operation including wide resection of the oral lesion together with radical neck dissection has been our treatment of choice in the past. More recently we have been inclined to treat all larger lesions of the oral cavity with radiation therapy, following this with radical neck dissection and in continuity excision of any residual cancer. The horizontal ramus of the mandible must be resected together with the tumor if the oral cancer has come in contact with the periosteum of the mandible at any point. Such contact seeds the periosteal lymphatics with tumor cells and makes resection of bone mandatory. The determinate 5-year survival for cancer of the tongue is 32 to 40 percent. If no palpable lymph nodes are present, the 5-year survival rate is 53 percent.

Floor of the Mouth

The floor of the mouth is that portion of the oral cavity between the tongue and the inner surface of the mandible. This crescentic area of the mucosa lies over the sublingual and submaxillary salivary glands and contains their excretory ducts. It is divided into two halves by the frenulum, a fold of mucosa lying in the midline and extending to the tongue.

Squamous carcinomas developing in this area tend to develop a "run-around" extending anteriorly and posteriorly around the rim of the mandible, and if they are neglected long enough, the entire floor of the mouth becomes involved. This pattern of growth results

in common bilateral involvement at the anterior floor of the mouth with frequent bilateral cervical metastases. These lesions tend to be less well differentiated than lesions of the tongue or gingiva and rapidly invade the surrounding structures, especially the periosteum of the adjacent mandible and the tissues of the submaxillary space. Metastases occur first to the submaxillary lymph nodes and are frequent. Taylor and Nathanson observed that 60 percent of these patients had palpable cervical metastases on admission, and in 90 percent cervical lymph node involvement had developed within a year of diagnosis.

The primary symptoms of these neoplasms are often neglected for some time, since they are quite minimal. Eventually the patient complains of pain, swelling of the tongue, and difficulty in eating and speaking. Early lesions are usually discovered by the patient himself while inspecting his mouth or have been noticed by an alert dentist or physician. Rarely, very early lesions may be seen involving only the superficial mucosa.

Large lesions of the floor of the mouth require wide excision in continuity with resection of a portion of the mandible and radical neck dissection. The neck dissection is done whether lymph nodes are palpable or not, in view of the high incidence of positive cervical nodes. Operative therapy may be integrated with preoperative radiation in the larger lesions. The much less common superficial and in situ lesions can be treated by local excision only. The 5-year survival rates for cancers in this site are comparable with those for cancer of the tongue. James reports an average determinate survival of 37 percent, and the Tumor Registry of the Memorial center for Cancer reports a 5-year survival rate of 39 percent.

Gingivae

Cancer of the gums is better differentiated and slower in its pattern of growth than lesions of the tongue and floor of the mouth. Patients first note a mass of slight tenderness of the gum, sometimes with loosening of teeth in the area of the tumor. This often leads them to consult their dentist, who, if he is not alert to the problem, may extract the teeth under the mistaken impression that the patient has an underlying abscess or cyst. As the lesion progresses, it ulcerates, bleeds, and interferes with mastication. As a neoplasm invades the underlying bone, it can involve the mandibular nerve with the appearance of numbness in the mental and submental areas. Extraction of a tooth often accelerates the invasion of the mandible.

Treatment of cancer of the lower gingiva requires resection of the involved mandible and overlying gum together with a radical neck dissection. Metastases from cancers at this site are usually to the submaxillary lymph nodes and are present in about half the patients at their first visit. Epidermoid cancers of the upper gingiva are less common and better differentiated than cancers of the lower gingiva. Metastases to cervical nodes are much less common. Therefore, treatment is restricted to local excision. Radical neck dissection is deferred until there is evidence of palpable cervical node involvement.

The definitive 5-year survival rate following treatment for carcinoma of the gingiva averages 45 percent.

Hard Palate

The hard palate is the U-shaped area enclosed by the upper gingiva and bounded posteriorly by the attachments of the soft palate. It consists of the palatine processes of the maxillary bones in its anterior two-thirds and of the horizontal portions of the palatine bones in its posterior third.

The most common malignant lesions of the hard palate are tumors of the minor salivary glands. Adenoid cystic carcinomas and adenocarcinomas occur in almost equal number; malignant mixed tumors are somewhat less frequent. Epidermoid carcinomas primary in the hard palate are rare, although carcinomas primary in the maxillary sinus will occasionally invade the hard palate and perforate into the oral cavity.

The primary symptom is a mass usually noted first by the patient himself. There is no tenderness or other associated symptom until fairly late in the course of the tumor. As in most salivary malignant tumors, growth is very slow and metastases occur quite late, so that involved cervical lymph nodes are not found initially. Salivary neoplasms respond poorly to radiation therapy, and primary treatment is excision. The chief fault in treatment is underestimation of the extent and potential of these lesions. They are usually fixed to the underlying periosteum, and adequate excision must include resection of the hard palate together with the tumor mass. An attempt to enucleate the tumor from the underlying bone almost ensures a local recurrence. Excision with a wide margin including the bony palate leaves a substantial palatal defect requiring repair either by surgical reconstruction or the use of an upper plate constructed by a prosthodontist with an obturator which will plug the defect.

Despite the phlegmatic nature of these tumors, complete excision and complete eradication of the lesions are often elusive. The lesions tend to be of a higher grade than malignant lesions of the major salivary glands. Five-year survival rates between 30 and 40 percent are reported, but the incidence of new disease between the fifth and fifteenth year is frequent.

Buccal Mucosa

The lateral walls of the oral cavity are formed by the cheeks, which consist of the buccinator muscle covered on its inner surface by a layer of mucosa extending from the upper to the lower gingivobuccal gutters and from the lateral commissure of the lips anteriorly to the ascending ramus of the mandible posteriorly. Lymphatics from this area pass through the buccinator muscle and follow the facial vein to end in the submaxillary and upper cervical lymph nodes.

The natural evolution of epidermoid carcinoma of the buccal mucosa varies according to the grade of the tumor. About half of the lesions are rather undifferentiated and associated with ulceration, rapid invasion of the cheek, and sometimes even perforation of the skin and formation of an orocutaneous salivary fistula. The majority of such lesions are accompanied by enlarged submaxillary lymph nodes when first seen.

A less aggressive form of buccal cancer is also encountered, especially in patients who are tobacco chewers and "snuff dippers". This is the so-called verrucous carcinoma, which

tends to occur in the gingivobuccal gutter and progresses very slowly, sometimes over a period of years. The tumor is locally invasive, but metastases have never been reported except in patients who have received previous irradiation. Verrucous lesions are easily recognized by their exophytic form and shaggy white appearance. They may cover a wide area, sometimes the entire buccal surface, and have a propensity for bony invasion, often involving a large portion of the mandible or occasionally the maxilla.

Treatment of buccal carcinoma is dictated by the type of lesion encountered. External radiation therapy alone does not eradicate the less well-differentiated lesions, although it has been combined with interstitial therapy with some success. The highly differentiated verrucous carcinomas are fairly radiosensitive but have a marked tendency to recur following an early gratifying regression. In addition, the distressing propensity of these lesions for developing a higher grade of malignancy with metastases after being exposed to radiation is a unique characteristic which has discouraged many from using radiation in treatment. Therefore, the initial therapy for verrucous lesions is wide excision. Since cervical metastases are not ordinarily found, an accompanying radical neck dissection is not done.

For the high-grade lesions, block dissection of the cheek with radical neck resection is the operative treatment of choice. Additional benefit may be derived from combining this with preoperative radiotherapy; this type of combined treatment is still undergoing evaluation. James reported 5-year survival rates in 181 patients with carcinoma of the buccal mucosa of all types as 54.4 per cent. The prognosis for the well-differentiated lesions, such as the verrucous carcinoma, should be much better than this.

Oropharynx

The oropharynx is the region of the mouth posterior to the anterior tonsillar pillars and the circumvallate papillae of the tongue. It contains the soft palate, tonsil and tonsillar fossa, posterior third of the tongue, anterior surface of the epiglottis, and surrounding pharyngeal walls. The most common site for malignant tumors in this area is the tonsil.

Tonsil

The most common benign lesion of the tonsil is, as every layman knows, inflammatory swelling. This can lead to confusion in diagnosing nonulcerated tumors of these organs. Common malignant lesions are high-grade epidermoid carcinomas (78 percent) and lymphosarcomas (16 percent). A large group of miscellaneous tumors are found, including haemangiomas, neurofibromas, and salivary gland tumors. High-grade epidermoid carcinomas in this area are often described as lymphoepitheliomas and transitional cell carcinomas. It is our feeling that these are simply microscopic variants of highly undifferentiated epidermoid carcinomas.

The frequent first symptom of carcinoma of the tonsil is a slight feeling of tenderness in the area, a typical sore throat. This is easily ignored by the patient for long periods until its persistence finally forces a consultation with the physician. Even then the evidence of a growing tumor may be overlooked and the patient treated for some time with mouthwashes and antibiotics. The lesion will appear grossly as a swelling of the tonsil with a central ulcer. Palpation reveals firmness and induration spreading well beyond the area of ulceration.

Trismus and pain in the ear are common complaints. The metastatic spread from this area is to the tonsillar node at the angle of the mandible, so often enlarged in children who have tonsillitis. The tonsil is a common site for very tiny "occult" carcinomas, which lead to large cervical masses and must be inspected minutely when one is searching for a primary site for cervical metastases. Lymphosarcomas of the tonsil usually present with a more bulky primary lesion and are not as inclined to ulceration. The primary lesions may be bilateral with involvement of both tonsils.

Treatment of tonsillar carcinoma either by radiation or operation has never been very satisfactory. Lymphosarcomas are quite radiosensitive and should be treated primarily by radiation. Carcinoma, on the other hand, yields poorly to either form of therapy. Still under evaluation, integrated therapy with preoperative radiation to the tonsil followed by resection in continuity with a radical neck dissection may prove to produce the best results. The definitive 5-year survival following treatment of cancer of the tonsil is 25 percent.

Posterior Third of Tongue

Tumors in the posterior third of the tongue differs markedly in their natural history from those in the anterior two-thirds. Whereas the anterior lesions tend to be well differentiated, remain confined to the primary site, or involve only high cervical nodes for long periods, lesions in the posterior third are of much higher grade, often being classified as *lymphoepitheliomas,* or *transitional cell tumors.* They spread rapidly to the cervical nodes and often beyond to distant sites. A frequent initial symptom of carcinoma of the posterior third of the tongue is a large cervical lymph node accompanied by the complaint of pain on swallowing. Unfortunately, this is a fairly silent area, and lesions may attain considerable size before causing pain or dysfunction. Wide ulceration causes a malodorous breath and dysphasia. Weight loss is prominent. Treatment has been highly unsatisfactory in the past. Radiation therapy infrequently controls the primary lesion. Operation often results in total loss of the tongue, and overwhelming psychologic and functional deficit. Since these lesions are often across the midline, bilateral neck dissection must be combined with resection of the tongue. Initial experience with combined radiation and operation indicated that occasionally the lesions can be reduced in size sufficiently by preoperative radiation to permit a more conservative resection of the posterior tongue, leaving a functional anterior tongue behind.

Soft Palate

Malignant tumors of the soft palate are almost always epidermoid carcinomas. These tend to be well differentiated, slow-growing, and late to metastasize. They are generally superficial lesions spreading over the anterior surface of the soft palate and down the tonsillar pillars. Often it is difficult to determine whether the lesions arose in the tonsil or in the soft palate. Spread may be extensive, covering much of the soft palate, the tonsillar fossa, and the tongue. Pain and dysphagia are the usual first symptoms. Diagnosis by inspection and palpation is a simple matter, and biopsy is easily accomplished.

Response to radiation therapy is only fair. Resection is more likely to produce a cure but often leads to a difficult functional defect, since the patient is unable to close the nasopharynx and will tend to regurgitate food through the nose on swallowing. This is a situation where the clever prosthodontist can help greatly by installing an adequate extension

on an upper plate which extends backward into the pharynx to seal the palatal defect. An even more convenient method of closing the palatal defect is to raise a flap from the posterior pharynx and swing it forward to close the defect at the time of the original operation. Prognosis is difficult to determine, since these tumors are usually classed in the literature with tumors of the tonsil or of the hard palate.

Epiglottis

Malignant tumors of the anterior surface of the epiglottis are usually exophytic and well differentiated and have a slow, natural evolution. Dysphagia and aspiration are early symptoms. Treatment by radiation therapy is quite successful. Hemilaryngectomy of the upper larynx above the cords has also produced good results. Patients who have had resection of the epiglottis must relearn swallowing, and this requires a reasonable level of intelligence. Senile patients or those with poor learning ability should be treated either by radiation or total laryngectomy.

Larynx

When describing the site of tumors of the larynx, the terminology can be confusing and frustrating. According to current usage, the larynx is made up of those structures lying both above and below the true vocal cords. Thus, the mucosa of the larynx extends along the posterior surface of the epiglottis including its tip, along the aryepiglottic folds, and over the arytenoid cartilages posteriorly. It covers the inner surface of the aryepiglottic folds, the false vocal cords, and the ventricles. All of the larynx thus far described constitutes the supraglottic larynx, ie, that which is above the true vocal cords. The glottic portion of the larynx is that portion made up of the true cords themselves. The mucosa lining the area underneath the true cords down to the lower border of the cricoid cartilage covers the infraglottic portion of the larynx.

In the past the area just described was called the "endolarynx", or the "intrinsic larynx", although the latter term gradually came to mean the true cords alone. Tumors taking their origin on the outside of the larynx for many years were designated as arising from the "extrinsic larynx". However, this term came to be used for supraglottis lesions as well, so this usage has not been abandoned. Lesions involving any portion of the exterior of the larynx are now spoken of as "hypopharyngeal" or, by some, "laryngopharyngeal".

Incidence and Etiology. Cancer of the larynx accounts for 1.62 percent of all cancers in men and only 0.14 percent of all cancers in women; thus, the ration of incidence favors the male sex over 11:1. The report of the Advisory Committee to the Surgeon General on Smoking and Health reviewed 10 retrospective studies and 7 prospective studies on the relationship of smoking to carcinoma of the larynx. There was a statistically positive relationship in every study. In the prospective studies the mortality ratios for smokers averaged 5.4 times greater for cigarette smokers than for nonsmokers and 2.8 times greater for cigar and pipe smokers than for nonsmokers. Laryngeal cancer mortality has increased somewhat over the past three decades, but the increase has been much less than that for lung cancer. It appears that the induction of carcinoma of the larynx cannot occur solely as a result of tobacco tars but that a further agent, or cocarcinogen, is needed. One such agent may be alcohol, since a high percentage (30 to 40 percent) of patients with carcinoma of the larynx

are alcoholics and come from population groups where the risk of alcoholism is great, such as bartenders and entertainers. Cirrhosis of the liver is a common complaint among patients with carcinoma of the larynx; this may be a secondary relationship due to the frequency of alcoholism in this group.

Classification. As it has for other cancers, the American Joint Committee on Cancer Staging and End Results Reporting has developed a TNM system for carcinomas of the larynx. Because of differences in prognosis at different sites the committee has divided the larynx into its three major areas: the supraglottis (posterior surface of the epiglottic, aryepiglottic folds, arytenoids, false cords, ventricles); the glottic (right and left vocal cords and anterior glottic commissure); and the subglottic (subglottic region exclusive of the undersurface of the true cords and down to the lower margin of the cricoid cartilage). About 56 percent of squamous epidermoid cancers of the larynx occur in the glottic region, 42 percent occur in the supraglottic region, and the remaining 2 percent are subglottic. The combination of topographic spread (T), nodal involvement (N), and distant metastasis (M) in a description of three separate anatomic sites results in a complex system, yet it is the most precise method whereby lesions can be classified and comparisons between institutions adequately made as to the results of treatment.

Pathology. Polyps, papillomas, granulomas, cysts, and areas of hyperkeratosis make up the common benign lesions of the cords. Rarely hemangiomas and chondromas of the laryngeal cartilages are seen. Ninety-nine percent of the malignant lesions of the larynx are epidermoid carcinomas, and most of these are of the ordinary cornifying (squamous cell) type. These lesions arise from the squamous epithelium of the cords themselves or from areas of metaplasia in the mucosa of the endolarynx. On the cord, carcinoma may be preceded by hyperkeratosis and stages of transition from hyperkeratosis to dyskeratosis, carcinoma in situ, and microinvasive carcinoma. Glottic cancers are usually very well differentiated, slow growing, and late to metastasize. Supraglottis and infraglottic cancers are less well differentiated and more likely to have spread to lymph nodes when first seen.

Diagnosis. Space-occupying lesions of the larynx produce initial symptoms through interference with phonation and respiration. Hoarseness, the usual first symptom, may be slight and intermittent but gradually becomes constant. What begins as a slight huskiness gradually progresses, until sounds are produced with difficulty. Respiratory obstruction is a later sign, although small lesions on the true cords will produce a greater degree of obstruction than somewhat larger lesions in supraglottic or infraglottic area. Obstruction progresses in severity until the patient may respire with visible effort, using his accessory muscles to force air through the cords, sometimes with audible stridor. At this point the patient's life is in jeopardy. At any moment the slightest additional swelling or edema can cut off breathing completely. The use of sedatives in patients at this phase of obstruction is fraught with danger. Under sedation the patient's tired muscles may fail, with a rapid shallowing of respiration, progressive anoxia, and cardiac arrest. The finding of a tumor on the cord associated with stridor, retraction, or the use of accessory muscles to breathe indicates immediate tracheostomy. It is far better to elect a tracheostomy done in the operating room than to be forced into an emergency tracheostomy on the ward or in the emergency room under much less favorable circumstances.

Late signs of malignant lesions of the larynx are a malodorous breath, pain on swallowing, weight loss, and hemoptysis.

Any patient who has persistent hoarseness for more than 3 or 4 weeks should have a careful inspection of his vocal cords by indirect laryngoscopy. If this reveals no pathologic condition but hoarseness persists, then direct laryngoscopy should be used to examine the cords even more closely.

Benign Tumors

Polyps

According to Holinger, 43 percent of all benign lesions of the larynx are simple polyps. These arise on the phonating edge of the cord at the junction between the anterior one-third and the posterior two-thirds. Their cause is obscure. Treatment is by removal with a cupped forceps at direct laryngoscopy.

Vocal Nodules

The second most common benign tumor of the larynx, these are usually bilateral and, like polyps, occur at the junction of the anterior one-third with the posterior two-thirds of the cords. They are often called "singer's nodules" but certainly are not confined to singers and can occur in any occupational group. Treatment is by removal with the biopsy forceps.

Retention Cysts

About half of these occur on the vocal cords, the remainder being found in the aryepiglottic folds, arytenoids, or epiglottis. They appear to occur as a result of the obstruction of small mucous glands. These lesions can reach considerable size and offer marked embarrassment to respiration.

Hyperkeratosis

Hyperkeratosis can affect the vocal cords as it does any of the mucosal areas of the lips, oral cavity, or pharynx. These lesions are evidence of a premalignant change and should be stripped off the cord with the use of the biopsy forceps. Patients who have developed hyperkeratosis should be followed at twice yearly intervals to guard against recurrence or the appearance of a frank carcinoma.

Papillomas

These multiple lesions are found most often on the true cords but may appear on any portion of the larynx of pharynx and even on the soft palate. While they are most commonly reported in children prior to adolescence, some adults are also affected. Like warts, these tumors appear to be caused by viruses. Frequently the growths cover the mucosa of the cords in great profusion, causing severe respiratory embarrassment and requiring tracheostomy. They can persist for many years; during this period the patient often must continue to wear a tracheostomy while papillomas are cleared from his airway by frequent excisions through the

laryngoscope. Repeated excision is the only effective treatment to date. The large number of other forms of therapy attempted indicates the generally unsatisfactory state of therapy. Eventually, after a period of months or years of repeated excisions, the lesions gradually disappear.

Malignant Lesions

Carcinoma of the true cords is a lesion which should be easily detected. It gives warning of its presence at an early stage through hoarseness and grows slowly enough so that early therapy should be rewarded by a 90 percent or better 5-year survival rate. In many urban areas over half of the lesions of the true cords are stage I lesions confined entirely to the cord. In contrast, some rural areas report that in only 5 percent of patients reaching the physician the lesions are still in stage I. As the tumor grows, it extends off the cord, either up into the supraglottic area or less commonly inferiorly into the infraglottic region. Invasion occurs slowly but relentlessly, eventually with perforation of the thyroid cartilage and direct invasion of the soft tissues of the thyroid gland and of the neck.

If cancer remains confined to the true cords, a high percentage of 5-year survivals can be obtained following treatment by radiotherapy alone. Holinger noted that in a series of 102 patients with cordal lesions treated with cobalt irradiation, only 9 patients had residual or recurrent cancer which required subsequent laryngectomy. None of the patients in this series died of carcinoma. Loss of the larynx is such a major functional and psychologic disability that if excellent results can be obtained by irradiation, this should be the treatment of choice.

Cancers which have invaded areas beyond the cord have a much different outlook. Involvement of cervical nodes becomes an important problem, and the ability to eradicate the disease by radiation alone is greatly decreased. For stage 2, 3, and 4 cancers, laryngectomy is mandatory. In addition, a radical neck dissection on the side of the lesion is usually performed, even though palpable nodes are not present. Using this approach, Norris has reported a 70 to 75 percent 5-year survival rate for stage 2 and 3 lesions of glottic and supraglottic origin. The very large stage 4 lesions do very poorly, with a 5-year survival rate of only 21 percent. Goldman et al have combined radiation therapy and operation in treatment of advanced cancers of the larynx, and although the experience is still small, they feel that integration of the two modalities improves the long-term survival rate.

The major problem for the patient after laryngectomy is to regain a useful voice. About half of all such patients will learn to use effective esophageal speech, meaning they can communicate understandably with strangers and casual acquaintances. An additional 25 percent can make themselves understood to members of their family but find that their esophageal speech is too distorted to be useful in the general community. The remaining 25 percent of patients will be unable to conquer the technical problems of learning this method of conversation.

Esophageal speech is by far the most useful technique for speaking after laryngectomy, since it requires no additional paraphernalia and can be refined to the point where it very closely resembles the tone and expression of ordinary speech. It is produced by swallowing air and regurgitating it, creating a vibration in the pharynx - probably at the level of the

cricothyroid muscle. The oral cavity modulates this tone just as it would a tone from the larynx.

For the 50 percent of patients who are partly or completely unable to learn esophageal speech, electric vibrating devices can be used to provide a tone in the oral cavity which is modulated by the patient's oral structures, giving a fairly reasonable method of communication.

The realization that any fistula between the trachea and pharynx which permits passage of air from the lungs to the mouth will produce easily understood and controlled speech has led to the development of the Blum-Singer prosthesis. This is a silicone valve which is placed in a passage connecting trachea and pharynx and allows air to pass into the pharynx and mouth but prevents saliva from passing into the trachea. With this device successful speech has been reported in from 60 to 90 percent of patients. The principle employed by the Blum-Singer prosthesis has been recognized for many years and operative attempts to create a valved fistula between trachea and pharynx have appeared sporadically for many decades and with increasing frequency in the last 10 years. The major problem has been in establishing a competent valve which prevents aspiration of saliva.

Hypopharynx

The hypopharynx is that area of the throat which surrounds the larynx. It is made up of the piriform sinuses on either side, the exterior portions of the aryepiglottic fold, and the lateral and posterior pharyngeal walls. It includes the mucosa overlying the posterior portions of the cricoid cartilage.

Incidence. Cancer of the hypopharynx is three to four times as common as cancer of the larynx and constitutes 4.05 percent of all cancers in males. It is three times more common in men than in women. These tumors appear to be related to smoking. The correlation is stronger with pipe and cigar smoking than with cigarette smoking. Another etiologic factor is the Plummer-Vinson syndrome, found most commonly in Scandinavian women. This deficiency syndrome, now gradually disappearing, is clearly related to carcinoma of the hypopharynx and posterior tongue. At the Radiumhemmet in Stockholm carcinomas of the hypopharynx are seen more frequently in women than in men, and most of these cases are associated with a Plummer-Vinson syndrome.

Pathology. The great majority of these tumors are epidermoid carcinomas and compared with the oral cavity and endolarynx tend to be of a higher grade with a preponderance of grade 3 and 4 lesions. Better-differentiated forms are seen, however, most commonly on the exterior portions of the aryepiglottic folds and in the postcricoid area. Spread of the tumor occurs promptly and usually by way of the lymphatic channels which drain the hypopharynx, exiting between the lateral portion of the hyoid bone and the upper edge of the thyroid cartilage to travel with the superior thyroid artery to the midjugular chain of lymph nodes. Unlike most head and neck cancers, distant metastases are common with involvement of mediastinal nodes, lung, liver, and other distant viscera.

Diagnosis. Since these lesions arise outside the endolarynx away from major paths of respiration and speech, hoarseness or dyspnea are uncommon findings until late in the growth

of the tumor. Interference with swallowing, on the other hand, is the most common early symptom and is associated with choking and aspiration. Aspiration pneumonia may be the illness which first brings the patient to the physician. The lesions seem to have a long silent period and can grow to considerable size in the depths of the piriform sinus or on the pharyngeal walls before the first definite symptoms appear. Not uncommonly, the first sign is the appearance of a mid-jugular cervical node. The better-differentiated lesions invade and ulcerate widely, so that a malodorous breath is a common associated finding. Diagnosis is confirmed by indirect laryngoscopy and biopsy through a laryngoscope.

Treatment. Until recent years this was a highly lethal tumor with few cures either by operation or by irradiation. The introduction of wide radical excision with removal of the larynx and hypopharynx and en bloc radical neck dissection increased the cure rate perceptibly. This may be another area where judicious combination of irradiation and operation can improve the cure rate even more. Five-year survival rates with the older form of therapy were no more than 10 to 15 percent. With more aggressive operative approaches, cure rates in the vicinity of 30 percent have been reported.

Nasopharynx

The nasopharynx is at the top of the pharynx, just underneath the base of the skull. The body of the sphenoid bone forms a roof for this cavity, while its floor is formed by the soft palate. There is no anterior wall as such except for the posterior openings of the nasal passage together with the posterior aspects of the nasal septum and the turbinates. The roof of the cavity slopes into the posterior wall made up of the basiocciput and the atlas and the overlying covering of muscle and mucosa. Each lateral wall contains the opening of a eustachian tube guarded by a small prominence, the torus tubarius. The only structure lying within the nasopharynx is the lymphoid tissue of the adenoids scattered on the posterior and superior walls.

Incidence. These tumors are uncommon but not rare, constituting about 0.5 percent of all cancers. They are somewhat more common in males than in females (2.4:1). There is an interesting relation to race. This is a frequent tumor in the Near East, among the Filipinos, Malays, and Dayaks, and especially among the Chinese. This cancer accounts for 30.4 percent of all cancers in males in Formosa. The incidence among the Chinese born in the Far East is more than thirty times greater than in this country, while the incidence among American-born Chinese is about six times as common as the incidence among the other racial groups here. This shift in pattern would suggest that both genetic and environmental causative factors are operating.

Benign Lesions

These include hypertrophied lymphatic tissue, juvenile nasopharyngeal hemangiofibroma, Rathke's pouch cyst, dermoids, and mixed tumors. Of these, hypertrophied adenoids occur commonly, and hemangiofibroma and Rathke's pouch cyst have a special predilection for this site.

Any enlarging, space-occupying lesion of the nasopharynx calls attention to itself by respiratory obstruction and nasal stuffiness. Obstruction to the eustachian tubes provokes

earaches and often chronic ear infection. As the lesion encroaches on the soft palate, deglutition is disturbed with pain on swallowing or regurgitation of food and fluids into the nasopharynx and out of the nose.

Hypertrophied Adenoids

The adenoids represent a portion of the large circle of lymphatic tissue surrounding the oral respiratory passageway at the level of the posterior tongue and tonsils. Chronic upper respiratory tract infections in infants and children often cause marked and persistent hypertrophy of some of this rim of tissue. In past decades resection of the adenoids and tonsils was one of the most common of operations in children. With the advent of the antibiotics the need for these procedures has diminished markedly. Nonetheless, in an occasional child a persistent hypertrophy of the adenoids will develop which disturbs his breathing pattern, causing mouth breathing, or more importantly will obstruct the eustachian tubes, leading to chronic ear infections with a threat to the child's hearing. These symptoms are adequate indication for operative excision.

Juvenile Nasopharyngeal Hemangiofibroma

Made of a hard stroma of fibrous tissue, richly interlaced with capillaries and cavernous sinuses, this rare and interesting tumor appears to originate on the roof of the nasopharynx perhaps from the periosteum of the sphenoid bone. It increases in size slowly but relentlessly and eventually begins to erode the anterior structures, obstruct the nasal passages and enter the maxillary sinus on one or both sides. The first symptom may be nasal obstruction but is usually epistaxis, which can be very profuse and even life-threatening.

This lesion is found exclusively in males, usually in the preadolescent or adolescent age groups. In some instances as the boy matures, the lesion appears to regress spontaneously. Just as often it persists, and hemangiofibromas of the nasopharynx have been described in males in their twenties and thirties, either persisting from childhood or appearing for the first time.

The progressive destruction of surrounding bone by pressure and the continuing threat of major hemorrhage require prompt treatment, preferably before the lesions grow too large. Radiation therapy is ineffective, and operative excision appears the only mode of treatment. There is a tendency toward local recurrence following excision, and these patients must be followed carefully for some years after operation.

Malignant Lesions

These are epidermoid carcinoma, lymphosarcoma, adenoid cystic carcinoma, cervical chordoma, sarcoma, and myeloma. The only lesions occurring with any frequency are epidermoid carcinoma and lymphosarcoma.

Epidermoid Carcinoma

These develop from areas of metaplasia in the respiratory epithelium of the nasopharynx and are moderately to highly undifferentiated. There is a liberal amount of

lymphoid tissue in the nasopharynx, and frequently malignant epithelial cells are seen mixed with a prominent lymphoid stroma. This mixture of epidermoid and lymphoid cells gave rise to the term "lymphoepithelioma" introduced by Regaud and Schmincke. Many pathologists feel there is no place for this special term, since these tumors are probably highly anaplastic epidermoid carcinomas and the lymphoid element may not constitute an actual malignant part of the growth. Some feel that a large percentage of lymphoid intermixing indicates a more radiosensitive and more radiocurable tumor.

In addition to the obstructive symptoms described for benign tumors, the invasive qualities of malignant lesions produce a number of characteristic signs and symptoms. These lesions invade the roof of the nasopharynx entering the cavernous sinus with paralysis of the IIId, IVth, Vth, and VIth cranial nerves. The VIth nerve is usually paralyzed first; this is frequently accompanied by pain in the distribution of the supraorbital and infraorbital branches of the Vth nerve. The tumor reaches these nerves by spreading along the eustachian tube into the space between the pharynx and the maxilla, then extending upward through the suture line between the petrous portion of the temporal bone and the lateral wing of the sphenoid. Thus, the symptom complex is called the *petrosphenoidal syndrome.* Metastatic nodes in the retropharyngeal space tend to spread into the area along the base of the skull medial to the parotid gland, where they compress the IXth, Xth, XIth, and XIIth cranial nerves. This caused difficulties with deglutition from hemiparesis of the superior constrictor muscle, a perversion of the sense of taste in the posterior third of the tongue, and hypesthesia of the mucous membranes of the soft palate, pharynx, and larynx. Paralysis of the trapezius muscle, the sternocleidomastoid, the soft palate, and one side of the tongue may also occur. These signs may be associated with Horner's syndrome from compression of the cervical sympathetic chain. Invasion of the orbit and displacement of the globe will cause double vision and proptosis.

Unfortunately, the nasopharynx is a silent area, and tumors here can reach considerable size before any symptoms are evident. The early signs of nasal obstruction or brief episodes of epistaxis are easily ignored. In two-thirds of the patients, by the time diagnosis is made, invasion of the sphenoid bone and base of the skull or nerve paralysis is present. Not infrequently, the primary growth will remain small, even microscopic, and is announced by its cervical metastases. These occur in a characteristic location, high in the neck behind the lower portion of the ear with additional involved nodes scattered along the path of the spinal accessory nerve as it courses down the trapezius muscle. Cervical metastases are found in 50 percent of patients when first seen and are the presenting symptom in one-third.

There is no acceptable way of obtaining an adequate margin of resection when operation upon lesions of the nasopharynx, and the only operative procedure used is biopsy. Treatment of the primary lesion and usually of the metastases is by radiation therapy. Considering the advanced state of most of these lesions when first seen, the 5-year survival rate as a result of therapy is remarkably good, with an overall absolute survival of 28 percent. For the occasional patient who does not have evidence of cervical node metastasis at the beginning of treatment the 5-year survival rate is 55 percent.

Lymphosarcoma

Lymphosarcomas of the nasopharynx tend to occur at the extremes of age in childhood and in the seventh and eighth decades. The majority of these lesions announce their presence by the occurrence of cervical node metastases, which are usually bulky with a rubber consistency; the nodes mat together but are less inclined to be invasive and fixed than nodes involved by carcinoma. While lymphosarcoma may mimic all the symptoms produced by epidermoid carcinomas, they invade bone infrequently, and paralysis of nerves is much less common. If there is no evidence of spread beyond the area of the head and neck, the radiotherapist usually administers a high level of therapy in the vicinity of 6000 rads of cobalt to both the nasopharynx and the cervical lymphatic tissues bilaterally. Five-year survival in these highly radiosensitive tumors is slightly better than for epidermoid carcinoma, averaging 35 to 40 percent.

Nasal Cavity and Paranasal Sinuses

The position of the eight nasal sinuses surrounding the nasal cavity is often poorly appreciated. The maxillary sinuses lateral to the nasal cavities and beneath the orbits are the largest and most important of the sinus structures. The ethmoid air cells occupying the space between the orbit and the upper nasal cavity are much smaller and are less commonly involved by tumors. The frontal sinuses bilaterally above the orbits are the second largest set of sinuses. The paired sphenoid sinuses divided by a thin septum just below the pituitary and over the roof of the nasopharynx are the most remote of the sinuses. The frontal and sphenoid sinuses are rare primary sites for tumors.

Incidence. Tumors of the nasal cavity and paranasal sinuses represent about 1 percent of all cancer seen. Malignant lesions are found here three times as commonly in men as in women. With the exception of the esthesioneuroblastoma no specific cause is known for lesions arising here.

Benign Tumors

Polyps of the nasal cavity and maxillary sinus are the most common growths seen. These are usually associated with chronic inflammation or, occasionally, allergy. Sometimes the underlying infection may be due to a tumor, so that the discovery of polyps should not be considered an adequate diagnosis until the possibility of an underlying tumor has been ruled out. While polyps can be eradicated by simple excision, they will usually re-form unless the basic pathologic condition leading to their growth has been determined and corrected. This may be allergy, septal deviation, or other factors which obstruct adequate drainage and promote infection.

Malignant Tumors

Of 293 patients with neoplasms of the nasal cavity and paranasal sinus examined at the Mayo Clinic approximately 50 percent had epidermoid carcinomas, 10 percent had lymphomas, and 20 percent had tumors which probably arose from minor salivary tissue. The remaining 20 percent had various soft tissue sarcomas such as fibrosarcoma, chondrosarcoma, neurofibrosarcoma, and osteogenic sarcoma. Among 648 patients seen in Sweden with

epidermoid carcinomas arising from the paranasal sinuses, the average age ranged from fifty to seventy years, and the vast majority of the lesions arose in the maxillary sinus. None of these tumors occurred in the sphenoid sinus and only one in the frontal sinus.

Tumors, whether benign or malignant, are announced by pain, nasal obstruction, and persistent nasal secretion. Fifty percent of the patients present with one or more of these three symptoms. Unfortunately, these are also the presenting symptoms of sinusitis; patients may be treated with antibiotics and other measures for long periods before the more serious nature of the disease is realized. Repeated epistaxis is more likely to suggest the presence of tumor but occurs in only 10 percent as a presenting symptom. Swelling or ulceration of the hard palate or gingiva, swelling of the cheek, or ocular symptoms are evidences of a much more advanced stage of tumor growth yet constitute the presenting symptom in 25 to 30 percent of patients. Bone destruction seen on radiographic examination is almost certain evidence of a tumor and unfortunately is also a late sign. Absence of bone destruction does not rule out a malignant tumor. All tissue removed when polyps of the nose or maxillary sinus are treated or when the maxillary sinus is drained should be submitted for histologic examination. Not infrequently this is the first evidence of the presence of an underlying carcinoma and may be the only opportunity for diagnosis of such lesions at an early stage.

Treatment. Electrosurgical therapy, radiation therapy, and operative excision have all been used to treat these tumors. Lymphomas are ordinarily treated by radiation alone. Epidermoid carcinomas of this site are refractory to either irradiation or operation. Integration of irradiation preoperatively with operative excision has been used for many years and has gained wide acceptance. This approach yields a 5-year survival rate of 30 to 35 percent for lesions of the maxillary sinuses. Cervical lymph nodes are involved late, and radical neck dissections are not done unless palpable nodes are present.

Mandible

Tumors of the mandible arise from two main sources, from the tooth-forming (odontogenic) tissue and from bone.

Odontogenic Tumors

These neoplasms arise from ectodermal odontogenic tissue, mesodermal odontogenic tissue, or a mixture of both. They are invariably benign. The lesions most commonly seen are ectodermal odontogenic cysts: the follicular and radicular cysts. A rare and intriguing tumor is the ameloblastoma. Other odontogenic tumors are too rare to merit consideration here.

Follicular Cyst

Some cysts are derived from the dental lamina and outer enamel epithelium of developing teeth. Remnants of this tissue sequestered during development may undergo proliferation and cystic change. Microscopically, they have fibrous walls usually lined by squamous epithelium. Occasionally remnants of odontogenic epithelium are present from which ameloblastomas may develop. Often the cyst envelops an unerupted tooth. A pathognomonic x-ray findings is the appearance of a smooth symmetric cyst in the mandible containing an unerupted tooth in its cavity. Clinically the tumor is found as a mass causing

enlargement of the ramus of the mandible or the rim of the gingiva. Treatment is by intraoral excision, removing the top of the cyst and excising its entire lining membrane.

Radicular Cyst

Infection of the dental pulp is the most common cause of this frequent cyst. A dental granuloma forms when epithelial remnants of the sheath about the tooth root are entrapped. Nests of epithelial tissue proliferate to line a central lumen usually at the apex of the infected tooth. Cysts may vary in size from 1 to several centimeters. Microscopically, there is a dense, fibrous connective tissue lining covered internally by squamous epithelium. Frequently, a generalized inflammatory reaction in the cyst wall is seen. Treatment is by extraction of the tooth involved and excision of the cyst with its lining.

Ameloblastoma

Although very uncommon, this is the most frequent solid tumor of the mandible. It usually appears in the body of the mandible at its junction with the ramus. Growth is slow, and the lesion is relatively asymptomatic, although it may expand the bone about it and eventually attain enormous size, encroaching on soft tissues of the face and neck. Microscopically, the tumor presents interlacing strands and nests of odontogenic epithelium enmeshed in a connective tissue stroma with numerous areas of cystic degeneration. Treatment is by segmental resection of the portion of the mandible affected by the tumor including a centimeter or two of normal bone on either side. Unless the wide excision is accomplished, recurrence is common. The adjacent soft tissues need not be resected, and a good bed is usually left for reconstruction of the mandible.

Osteogenic Tumors

The mandible is affected by the same group of benign and malignant tumors which affect other bones in the body. Benign lesions include exostosis (torus mandibularis), fibrous dysplasia, Paget's disease, and giant cell tumor. Primary malignant lesions are multiple myeloma, Ewing's sarcoma, osteogenic sarcoma, chondrosarcoma, and periosteal fibrosarcoma.

Giant cell tumors of the mandible are often referred to as *central* reparative giant cell tumors and are equivalent to the peripheral giant cell tumors of the gingiva. Although this lesion grows slowly and expands the surrounding bone, it never appears to have the malignant potential of giant cell tumors seen elsewhere in the skeleton and may have a different histogenesis. Microscopically, no distinction can be made between mandibular giant cell tumors and giant cell lesions of other bones. Treatment is usually by unroofing the tumor and curetting its tissue from the bony cavity.

Salivary Glands

Salivary tissue is found in the parotid gland, the submaxillary gland, the lingual gland, and the numerous minor salivary glands. The parotid gland is a unilobular structure which is bent in a U shape about the posterior portion of the mandible in such a way that the larger external portion of the gland is often called the *superficial lobe* and the smaller internal portion lying on the internal surface of the ascending ramus is called the *deep lobe*. The VIIth

nerve exiting from the skull by way of the stylomastoid foramen crosses the space between the mastoid and the ascending ramus of the mandible and plunges into the parotid gland at the point where it turns the corner around the posterior edge of the ascending ramus. The VIIth nerve usually bifurcates within the substance of the parotid. Each bifurcation further subdivides, and the branches eventually lie between the parotid gland and the underlying masseter muscle. The relationship of the VIIth nerve to the parotid gland is of clinical importance, since tumors of the parotid lie most commonly in the external portion of the gland; one excising such tumors great care must be taken not to cut the branches or the main trunk of this nerve.

The submaxillary gland is an ovoid structure lying in the submaxillary fossa beneath the horizontal ramus of the mandible. It is bounded by the anterior and posterior portions of the digastric muscle, thus occupying most of the digastric triangle in the neck. The important relationships of this gland are to the ramus mandibularis, the lowest branch of the VIIth nerve which courses over the upper portion of the gland. Injury to this nerve blocks innervation of the inferior quarter of the orbicularis oris on the side of the nerve and deprives the patient of the ability to pucker his lips normally. The lingual nerve, deep to the upper inferior surface of the submaxillary gland, provides the gland with some small branches. In addition, the lingual nerve parallels the course of Wharton's duct, which conducts saliva from the submaxillary gland to the mouth. When the gland is removed, injury to the lingual nerve can occur either when Wharton's duct is clamped or when the gland is pulled down into the neck dragging the lingual nerve along by its nerve attachments.

The lingual gland is the smallest of the three major salivary glands. It lies beneath the mucosa of the anterior floor of the mouth.

The minor salivary glands are small deposits of salivary tissue which are scattered throughout the mucosa of the oral cavity, maxilla, and nasopharynx. The term *ectopic salivary tissue* is sometimes used but carries an incorrect connotation, since this salivary tissue is a normal finding in all individuals and is not the result of an error in development.

Incidence. About 0.3 percent of all malignant tumors occurs in the salivary tissues. These tumors are equally common in men and women. About 60 percent of these lesions occur in the parotid glands, which is not surprising, since this is the largest single collection of salivary tissues. The second largest concentration of tumors is found in the submaxillary gland and the third largest in the minor salivary glands. Tumors of the lingual glands are rare. No specific cause is known for any of the benign or malignant tumors of the salivary glands other than the occasional congenital or obstructive cyst. Women with malignant tumors of the salivary glands are known to have a higher incidence of cancer of the breast.

Benign Lesions. A variety of lesions may arise in salivary tissue.

Mixed Tumors. The most common lesion of the salivary glands is the mixed tumor (pleomorphic adenoma). Fifty percent of all tumors of the salivary glands and over eighty percent of all benign tumors are mixed tumors. These probably originate from adult glandular epithelium and, as their name implies, have an extremely diverse structural pattern. In 90 percent of the tumors one finds areas where the tumor grows in a network of strands made up of spindle and stellate cells not always connecting and sometimes lying entirely detached.

In about a third of all cases this loose myxoid pattern predominates but is by no means the sole structural component. Half the tumors have pseudocartilaginous structures. Twenty percent show tissue closely resembling hyaline cartilage. Well-formed tubular structures are common and present a wide variety of patterns. The lining epithelium may be single-layered, conspicuously double-layered, stratified, or pseudostratified. Some areas of metaplasia into squamous epithelium may be seen, and well-differentiated squamous epithelium can be found in about a fourth of the cases.

Papillary Cystadenoma Lymphomatosum (Warthin's Tumor). These curious lesions occur only in parotid salivary tissue and almost exclusively (95 percent) in males. About 10 percent of them are bilateral. Characteristically they are made up of a papillary epithelial component intermingled with well-developed lymphoid tissue commonly containing germinal centers. Their histogenesis is uncertain, but many feel they represent parotid duct tissue sequestrated in lymph nodes within the parotid gland. They represent the second most common benign tumor of salivary tissue but are a poor second to mixed tumors, which are at least eight times more common.

Mikulicz's Disease. This disease is characterized by a dense infiltration of lymphocytes occasionally arranged in follicles throughout the salivary tissues. This is accompanied by atrophy and disappearance of acinar tissue. Scattered throughout the lymphoid tissue are foci of epithelial and myoepithelial cells in close relationship to distal structures. The more popular modern term for this lesion is *benign lymphoepithelial lesion,* and many feel it represents a phase of the larger disease complex *Sjögren's syndrome.* The diffuse lymphocytic infiltrate, much a one sees in lymphomatous thyroiditis, suggests the possibility of an autoimmune disease. While several of or all the major salivary glands may be involved, a single parotid gland is the most frequent site (80 percent). The highest incidence of the disease is in patients between thirty-one and forty years of age.

Asymptomatic Enlargement of Salivary Tissue. This affection is usually observed in both parotid glands but may involve all the major salivary glands. The characteristic microscopic findings are an increase in size of the glandular acini due to swelling of the individual acinar cells. There is an increase of the secretory granules, a fatty infiltration, and a moderate fibrosis. These changes seem associated with nutritional deficiencies and have been found in patients suffering from cirrhosis of the liver, kwashiorkor, and diabetes mellitus. It also has been found in whole populations suffering from malnutrition in India, in Greece during the occupation of World War II, and in the inmates of German concentration camps. Katsilambros believes that this is a fundamental response to a deficiency of vitamin A and has duplicated his findings in vitamin A-deficient rats.

Other Lesions. Cysts of the parotid glands are seen quite rarely and in some instances may represent cysts of the first branchial cleft. Hemangiomas in children have a predilection for the area of the parotid gland and sometimes persist into adulthood. Neurofibromas and lipomas of the parotid gland have been described.

Malignant Lesions. About 75 percent of all malignant salivary tumors arise from the parotid gland, and 25 percent of all parotid tumors are malignant. Ten percent of malignant salivary lesions arise in the submaxillary gland and an additional twelve percent in the minor salivary glands. The incidence of malignant lesions in the submaxillary and minor salivary

glands compared to benign lesions is somewhat higher than in the parotid gland, averaging one-third to one-half of all lesions seen. Roughly one-third of the malignant lesions of salivary tissue arise from the acinar epithelium and are adenocarcinomas. Another third arise from the ductal epithelium as various forms of epidermoid carcinomas. The remaining third appear either as highly anaplastic and unclassified lesions or as malignant mixed tumors.

Epidermoid Carcinoma. The most frequent of these are the mucoepidermoid carcinomas originally identified as a special group by Stewart et al in 1945. These interesting tumors are made up, as the name indicates, of epidermoid cells and mucus-containing cells. The name falls short of being completely descriptive, since there is a third cell called an "intermediate" cell, smaller than either of the other two, which closely resembles certain cells of the salivary gland duct. They are commonly seen in stratifications lining dilated ductlike structures. Stewart et al suggest that this intermediate cell is capable of differentiation into mucinous cells or into epidermoid and even squamous cells.

Mucoepidermoid carcinomas are usually divided on the basis of the microscopic appearance into low-grade and high-grade tumors. Low-grade tumors contain a large portion of mucus-secreting cells, often with the presence of microcysts and large amounts of mucoid material which may leak diffusely through the tissues, generating variable degrees of inflammatory reaction. In the highly malignant tumors epidermoid and intermediate cells dominate the picture. Pseudoglandular formation is fairly frequent, and the growth pattern is commonly sheetlike or in coarse plugs.

Squamous cell carcinomas like mucoepidermoid carcinomas must certainly originate in the ductal epithelium, and the ability of salivary duct epithelium to undergo squamous metaplasia is well known. Stewart et al suggest that most squamous cell carcinomas represent diffuse squamous cell overgrowth of tumors that were fundamentally mucoepidermoid. Microscopically, these lesions share the usual features of squamous cell carcinomas seen in the skin, oral cavity, and elsewhere. In this location, however, they are usually more malignant, and local and regional metastases are common.

Adenocarcinoma. *Adenoid Cystic Carcinoma (Cylindroma).* The chief histologic feature of these lesions is the arrangement of rather small, darkly staining cells with relatively low cytoplasm in anastomosing cords between which are acellular areas which may contain mucous, hyaline, or mucohyaline material. The cystic components of an adenoid cystic carcinoma usually stain positively with mucicarmine, indicating the presence of mucin. While the lesions are of sluggish evolution, metastases to cervical lymph nodes develop in 30 percent of the cases.

Acinar Cell Adenocarcinoma. These histologically distinct tumors are of low-grade clinical malignancy and fairly rare. They appear to arise from the acinar cells of salivary tissue and to be limited to the parotid gland. In the usual microscopic arrangement rounded or polygonal cells with a dark eccentric nucleus and a finely granular basophilic cytoplasm are packed closely together, sometimes in crude, acinar groups. While low-grade, these lesions are capable of metastasis both regionally and to distant locations.

Miscellaneous Adenocarcinomas. Adenocarcinomas may have a trabecular pattern and may be anaplastic or resemble adenocarcinomas of the gastrointestinal tract. These are usually highly malignant with a high degree of local invasiveness and regional and distant metastases.

Malignant Mixed Tumors. It is usually assumed that malignant mixed tumors arise from a neoplastic transformation of a previously benign mixed tumor. Patients who demonstrate these lesions are generally older than those with benign mixed tumors and have had a mass in the parotid for a longer period. Moreover, the malignant lesions are usually larger than the benign. In general, the microscopic picture is of a definite mixed tumor which contains within it malignant elements which may be adenocarcinomas, squamous cell carcinomas, or a malignant spindle cell alteration. The malignant component of a mixed tumor may so greatly overgrow the area of origin that it is extremely difficult to identify the previous benign mixed tumor.

Natural History. With the exception of the mixed tumor the common benign lesions of salivary tissue have no malignant potential. While the mixed tumor may have a very long history without malignant transformation and may grow for 20 to 30 years at a slow pace, a rapidly growing and even anaplastic component can suddenly develop which markedly changes its course. On rare occasions mixed tumors have been found which have metastasized to local nodes without apparent histologic change and in their new location have pursued a slow course of growth. The most common pattern, however, is the development of a squamous cell carcinoma, adenocarcinoma, or other tumor which rapidly overgrows the original mixed tumor. Some very slowly evolving "chronic" carcinomas are known to develop from salivary tissue. Notable among these are the adenoid cystic carcinomas, which may develop their metastases 10, 15, and even 20 years after treatment of the primary tumor.

Many such tumors have been reported in which metastatic nodules in the lungs have been observed growing very slowly, at times appearing almost stationary for 10 and 15 years. The mucoepidermoid carcinoma, while not as slow-growing as the adenoid cystic carcinoma, is rather slowly progressive; however, this trait is offset by its great degree of local invasiveness, especially by perineural invasion. The chances for local recurrence are great even after wide local excision. Squamous cell carcinomas and adenocarcinomas of the salivary glands are almost always highly malignant, quick to invade and metastasize, and fatal in a high percentage of the patients affected.

Differential Diagnosis. Most tumors of the salivary glands appear as painless, slowly growing nodules. Lesions of the parotid are bound by the heavy cervical fascia which splits on either side of the gland and invests it with a strong capsule. This dense covering obscures the actual size of the underlying tumor, and the surgeon may be surprised by the size and extent of a lesion at operation. Paralysis of the VIIth nerve is indicative of a malignant tumor and usually of a highly malignant lesion such as squamous carcinoma or adenocarcinoma. Mucoepidermoid carcinomas of the low-grade type or adenoid cystic carcinomas frequently spare the nerve until quite late in their course. Fixation of the gland to underlying structures and palpable nodes in the neck are also more commonly seen with the tumors of higher grade. Since there is nothing that can distinguish the benign mass in the salivary gland from an early malignant tumor, excision of the mass and histologic examination are indicated in every case.

Treatment. Benign mixed tumors, the most common solid tumors of salivary gland origin, are so easily disseminated that incisional biopsy is never indicated. In earlier decades the technique of choice for removal was enucleation. Follow-up of patients so treated indicated that local recurrence was late and slow to develop and occurred in as many as 50 percent. Attempt at excision of these lesions with a cuff of surrounding normal tissue was accompanied by a high rate of injury to one or more branches of the VIIth nerve.

Through these painful experiences the present method of therapy was developed. After isolation of the VIIth nerve, the superficial portion of the parotid gland is dissected from the underlying tissues and removed with the tumor contained within it, assuring against injury of branches of the facial nerve and against dissemination and local recurrence of the tumor.

Frozen section of the lesion should be done at operation. If a low-grade malignant lesion such as an acinar cell adenocarcinoma, a low-grade mucoepidermoid carcinoma, or an adenoid cystic carcinoma is identified, the remainder of the gland and probably the VIIth nerve should be removed. If a high-grade lesion such as an anaplastic adenocarcinoma or squamous carcinoma is identified, a radical neck dissection should accompany the procedure. Aside from the problem of dealing with the VIIth nerve, the same general rules apply for lesions in the submaxillary gland.

Most of the tumors of salivary glands have a reputation for being poorly radiosensitive; however, the more malignant the lesion, the less likely this is to be true. Many high-grade mucoepidermoid carcinomas, squamous carcinomas, and even an occasional adenocarcinoma will demonstrate considerable sensitivity to x-ray therapy.

Prognosis. Benign mixed tumors will recur in 40 to 50 percent of patients if improperly excised. If excision is by superficial lobectomy, the recurrence rate should be 5 percent or less. Five-year survival rates tend to be misleading, particularly in the chronic, slow-growing tumors. Adenoid cystic carcinoma has an 86 percent 5-year survival rate but a 57 percent 10-year survival. Malignant mixed tumor may have a 5-year survival of 87 to 90 percent and a 10-year survival of 60 to 70 percent.

Tumors of the Neck

Palpable or visible cervical swellings are a common complaint. Two to three percent of all admissions to hospital surgical services are for this condition. About half of these lesions occur in the thyroid gland; the remainder are due to a wide range of malignant, congenital, or inflammatory swellings.

Inflammation

Inflammatory swelling in the adult neck is now a rare hospital problem. Skandalakis and coworkers, in reviewing 1.616 nonthyroid masses of the neck, found that only 3.2 percent were inflammatory, whereas 84 percent were neoplastic and 12 percent congenital or miscellaneous. The inflammatory lesions requiring hospitalization of adults are largely acute, often resulting from drainage from infection elsewhere. A common source is an infected tooth draining to the nodes in the submandibular area and causing an abscess. Only two patients in Skandalakis' entire series had tuberculous adenitis (scrofula). This was once the most

common cause of neck masses, but with the tuberculin testing of cows and the pasteurization of milk, bovine tuberculosis has virtually disappeared in this country.

Malignant Tumors

The vast majority of cervical masses in adults are due to neoplasms. About 80 percent of these are metastatic from some other site, while the remainder occur from primary lesions in the neck. Primary cervical neoplasms occur either in the major salivary glands (40 percent) or are lymphomas primary in the cervical lymph nodes (60 percent). At one time it was proposed the squamous carcinomas arose primarily in the neck from the lining of branchial cleft cysts. This diagnosis was often made only to discover at a later date that the lesion was actually a metastasis from the oral cavity, nasopharynx, or laryngeal area. While there is some evidence that branchiogenic cysts become malignant, the reported, provable cases number only a handful.

A knowledge of the statistics quickly indicates that a clinician's first suspicion concerning any nonthyroid, cervical mass in adults is of a malignant tumor. He may also suspect that it is metastatic and from a site at some point above the clavicle, since 85 percent of all metastatic cervical lesions come from a supraclavicular site.

When a firm to hard cervical node which suggests malignancy is found, the first responsibility of clinicians is a thorough exploration of possible sites of origin. Cervical tumors appearing below and behind the ear and along the cervical chain are more likely to come from the nasopharynx or lateral pharyngeal walls. Swollen lymph nodes at the angle of the mandible or in the area of the submaxillary gland are most commonly from lesions in the tonsillar area, buccal mucosa, floor of the mouth, and gingiva. Swelling of the lymph nodes in the submental area should provoke a thorough examination of the tip of the tongue, lower lip, and anterior gingivobuccal gutter. Lymph nodes involved by neoplasm which appear in the middle third of the neck should cast suspicion first on the hypopharynx, piriform sinus, larynx, or thyroid.

Only when enlarged lymph nodes appear in the supraclavicular area does metastasis from below the clavicle become a major possibility. These may stem from carcinoma of the upper lobes of the lung or mediastinum or, in women, from carcinoma of the breast. The left supraclavicular nodes are frequently involved by malignant tumors metastatic from the abdomen (Virchow's node). Advanced adenocarcinoma of the stomach, pancreas, biliary tree, and even large bowel metastasize to this site.

If a thorough search of all sites reveals no possible source of a primary lesion, biopsy of the cervical node is usually carried out. If this confirms the clinical impression of malignancy, further attempts to find the primary lesion are indicated. This can include surgical exploration of the maxillary sinuses. If all avenues have been searched thoroughly and no primary lesion has been found, the problem of local treatment still remains. The best course is to treat the lesion to achieve cure. If operation is chosen, it should be a radical neck dissection; if radiation therapy is used, it should be a full course of therapy. Since lymph nodes involved by metastatic disease respond poorly to radiation, the treatment of choice is normally operation. In the presence of advanced lesions a combination of radiation and operation may be used.

If a group of these patients treated without a known primary lesion is followed for 5 years, 80 percent of the patients will ultimately manifest the primary lesion. In some instances this may subsequently be resected for cure. A few patients may die over this period without ever demonstrating the source for the metastatic lesion, and even at postmortem examination it may not be found. Even more interesting, about 20 percent of the patients survive 5 or more years with apparent "cure" of their metastatic lesion even though the presumed primary lesion has not been found or treated. In those patients who received radiation therapy, either together with operation or alone, it may be that the port included the primary lesion as well. In those patients who are treated by operation alone, the fate of the primary lesion remains a mystery. A few of these patients may represent true branchiogenic carcinoma, or possibly the primary lesion regresses spontaneously.

Other Lesions

A host of other tumors, found infrequently in the area of the neck, present problems in differential diagnosis. Dermoids occur in the midline, most commonly in the submental area and sometimes along the line of the clavicle. Sebaceous cysts are common, especially in men, and probably are related to the trauma of shaving.

Carotid body tumors (chemodectomas) are rare tumors of the paraganglionic tissue found at the carotid bifurcation. Another lesion with a slow evolution, it gradually increases in size over many years, enveloping the bifurcation and slowly compressing the adjacent nerves including the hypoglossal, vagus, and sympathetic chain. For many periods, the only symptom is the mass in the neck. Eventually nerve paralysis, dysphagia, and pain appear. Malignant transformation is rare, but early removal is indicated to avoid the late symptoms. Small lesions can be removed easily, but advanced large tumors require resection of the carotid artery with the risk of subsequent hemiparesis.

Tumors of the Neck in Children

The order of frequency of masses in the neck in children differs markedly from that found in adults. Inflammatory lesions are by far the most common, often coming from related infections of the tonsils. The most common malignant lesion is the lymphoma, and the second most common is carcinoma of the thyroid. Congenital lesions, of course, are much more common in children than in adults.

Chemotherapy and Immunotherapy

In the past decade it has been discovered that certain types of neoplasms commonly found in the head and neck area can be cured by chemotherapy. Burkitt's lymphoma, a rare neoplasm in the USA but common in some parts of Africa, was the first such cancer. It became apparent that a predictable and consistent percentage of patients with this disease could be cured by the use of *systemic* chemotherapy alone. Recently we have also learned that squamous cancer of facial skin and of the lips, while in the in situ microinvasive and superficial stages, can be cured by the topical application of 5-fluorouracil used as a cream or paste. These lesions are multiple and often tedious to eradicate by operation or radiation. A third head and neck lesion in which chemotherapy has become important is embryonal

rhabdomyosarcoma, an uncommon lesion found in infants and children. Cure of this lesion occasionally has been obtained by combining radiation, chemotherapy, and operation.

Epidermoid cancers of the head and neck respond transiently to a number of single agents. Methotrexate has been the most extensively used. Response rates range from 15 to 57 percent. Bleomycin has also been found to have significant activity, comparable to methotrexate, with reported responses ranging from 15 to 50 percent. Other, less effective, single agents are cyclophosphamide (36 percent), vinblastine (29 percent), hydroxyurea (39 percent), 5-fluorouracil (15 percent), and procarbazine (10 percent). Reports of many of these latter drugs are based on small series and represent, at best, rough estimates. The most recent drug to excite interest in treatment of these tumors is cis-dichlorodiammine platinum ((II) (DDP or cis-platinum), which appears to match or exceed methotrexate and bleomycin in activity, especially when used in high doses with mannitol-induced diuresis to avoid renal injury.

Arterial infusion for the treatment of cancer in the head and neck area has received much attention. This involves the introduction of chemotherapy, usually methotrexate or 5-fluorouracil, into the external carotid artery via a catheter. The agents are administered either continuously or intermittently over 1 to several weeks. At present, this technique is known to produce a substantial to complete regression of the lesion in a large percentage of patients - as high as 50 percent in some series. Unfortunately, the response is usually transient, and the cancers return to continued growth within 2 to 3 months after treatment is discontinued. Long-term regression is uncommonly seen, and the period of regression obtained is rarely worth the morbidity and complications of the treatment itself. Nonetheless, these observations continue to tantalize clinical investigators seeking a clue which will lead to longer or even permanent remission.

The recent introduction of an implantable, subcutaneous, long-term infusion pump may reduce morbidity, increase convenience, and make this technique more practicable.

The growing body of knowledge concerning the interrelationships between cancer and the body's immune system has touched the field of head and neck cancer through the work of Chretien and others. Squamous carcinoma of the tongue has been found in young men with acquired immune deficiency syndrome. At least half the patients with epidermoid cancer of the oral cavity, hypopharynx, and larynx show some degree of immune incompetence. Moreover, this incompetence is correlated with treatment failure following either radiation or operation. Immune competence can be restored in a number of these patients by improving nutrition, by the use of immunostimulant agents such as BCG or c-Parvum, and by "reconstitution" agents such as levamisole, thymosin, and transfer factor. Trials to determine the effectiveness of manipulations of the immune system in the immune-incompetent patient have so far shown either no or only marginal benefit.

Combined forms of treatment for head and neck cancers, which include chemotherapy and immunotherapy as well as radiation and operation, have employed marked clinical and investigative interest in the past several years. The more our knowledge of the natural history of tumor growth develops, the more rational and logical it appears to combine available treatment methods.

Multinodal systemic chemotherapy will double or triple the partial and complete regression rates when the drugs are given as the first part of a therapeutic regimen to patients with previously untreated tumors. Our current experience suggests that far-advanced (stage 4) head and neck tumors have double the 2-year disease-free survival if chemotherapy precedes preoperative radiation and operation as compared to preoperative radiation and operation alone (66 vs 35 percent). This is especially impressive when one realizes that stage 4 tumors ordinarily have a 5-year survival rate of 0 to 15 percent depending upon site.

Operations of the Head and Neck

The most commonly performed major operation for cancer of the head and neck is radical neck dissection. This procedure was originally designed by Crile to eradicate the cervical lymphatic network, thereby eliminating sites of metastasis from cancer of the oral cavity, pharynx, paranasal sinuses, or other areas of the head and neck. In the early days of head and neck surgery radical neck dissections were usually performed after the primary lesion had been controlled through the use of radiation therapy. Today, we are more inclined to combine radical neck dissection with a simultaneous resection of the primary lesion. This is sometimes preceded by a course of radiation therapy to the primary area as part of a planned program of tumor treatment. Combined operations have been called by a number of terms including *composite resections* and *commando operations.* Other common operations in this area are superficial resection of the parotid gland, V excision of carcinoma of the lip, and resection of the maxillary antrum.

Radical Neck Dissection

Incisions for radical neck dissection are numerous and include a T-shaped incision originally used by Crile, a Y incision describe by Ward, and a double Y incision described by Martin. We prefer a hockey-stick shaped incision with the ascending limb along the posterior border of the sternocleidomastoid muscle and the horizontal portion crossing the neck about 2 or 3 cm above the clavicle. This last approach has the advantage of being outside areas of radiation when the neck has had previous exposure to radiation therapy and of being a simple linear incision avoiding small triangular-shaped flaps, which have a tendency to slough. The skin flap is reflected mediad, including the underlying platysma muscle, and dissection of neck structures begins in the posterior triangle, dissecting the fibroareolar tissue of this space away from the trapezius muscle and the underlying brachial plexus and scalene fibers. The portion of the dissection is carried mediad until the phrenic nerve lying on the anterior scalene muscle is identified.

The lower end of the sternocleidomastoid muscle is transected and the jugular vein identified and ligated. The accompanying vagus nerve next to the jugular vein in the carotid sheath is identified and spared. Dissection is then carried up the neck, gradually dissecting the lymph node chain free from underlying fascia and beneath the carotid artery. Just above the level of the carotid bulb the hypoglossal nerve is identified. In the upper portion of the neck the sternocleidomastoid muscle is again transected at the level of the mastoid together with the tip of the parotid gland. The submaxillary gland is dissected free from the digastric fossa and included with the specimen. The lingual nerve and artery in the depths of the submaxillary fossa are visualized and left intact. Care is taken to identify the ramus mandibularis, the tiny fiber of the VIIth nerve which innervates the lower lip, and to reflect

this above the submaxillary gland so that its continuity is maintained. The spinal accessory nerve is usually sacrificed, being cut in the lower neck where it enters the trapezius muscle and in the upper neck where it enters the sternocleidomastoid muscle. The operation is completed with the transection of the jugular vein at the point where it leaves the base of the skull. If a radical neck dissection alone is performed, the operation is ended at this point by closing the skin flaps. Multiperforated catheters are left underneath the flaps and are connected to suction. This helps to draw the flap firmly to the structures of the neck and eliminates the problem of fluid collecting under the flap.

Modified Radical neck Dissection

This operation is still ill-defined. To some it means preserving the spinal accessory nerve but otherwise doing a complete radical neck. At the other extreme some surgeons spare all the "functional" structures in the neck including the sternocleidomastoid muscle, the spinal accessory nerve, and the jugular vein, removing mainly the lymphoareolar tissue of the anterior and posterior triangle and the submaxillary gland. Our preference is to spare the sternocleidomastoid muscle and the XIth nerve but to remove the jugular vein. There is little morbidity incurred by removing the vein, and the lymphatic tissues of the neck are closely associated with the vein. The indication for limiting radical neck dissection to a modified operation is a negative neck without clinically positive nodes in the presence of a primary lesion with a high risk of occult nodal metastasis.

Combined Operation

If a radical neck dissection is to be combined with the removal of structures within the oral cavity or tonsillar area, the contents of the neck dissection are left attached to the horizontal ramus of the mandible. The mandible is frequently divided. If the lesion is in the floor of the mouth or tongue, the horizontal ramus of the mandible may be resected. If the lesion is in the tonsillar fossa, the ascending ramus of the mandible is removed. If the lesion in the oral cavity is quite large, total removal of the hemimandible on the side of the lesion may be necessary. Resection of the mandible is done to remove bone involved by tumor and sometimes to obtain a closure of the oral cavity which would not be feasible without removing a portion of the bony framework. Mandibular resection can be done with the acceptable cosmetic and functional result, especially when the anterior portion of the mandible is preserved. The more anteriorly the mandible is resected, the more likely there is to be facial deformity. If the primary site of the tumor is in the larynx or thyroid, then these structures may also be removed with the radical neck dissection. The mortality for radical neck dissection alone is less than 1 percent. If neck dissection is combined with en bloc excision of a primary lesion, then mortality rates range from 2 to 5 percent.

Bilateral Radical Neck Dissection

Lesions that are in the midline of the oral cavity often spread bilaterally, and it is necessary to remove lymph nodes on both sides of the neck. Simultaneous bilateral neck dissections are feasible with an acceptable mortality; however, the postoperative course is likely to be prolonged, since there is a period of marked facial edema following this extensive resection which can persist for several weeks. Some operators will spare the jugular vein on one side when a bilateral neck dissection is done in order to decrease the amount of

postoperative edema. Others stage the dissection, allowing a delay of several weeks before operating on the second side.

Parotidectomy

Most lesions in the superficial lobe of the parotid gland are removed by superficial parotidectomy. This operation is designed to give maximal safety in operating about the branches of the VIIth nerve. The VIIth nerve pierces the parotid gland at its posterior margin and lies underneath the gland on the muscles of the face. A Y-shaped incision is made with the lower limb lying behind the angle of the mandible and the arms of the Y on either side of the lobe of the ear. Dissection is carried down to identify the main trunk of the VIIth nerve, which lies in the space between the mandible and the mastoid bone approximately one fingerbreadth below the external auditory meatus. Once the main trunk is identified, dissection is carried along the external surface of the nerve and its branches, gradually separating away the overlying portion of the parotid gland. Stensen's duct is identified at the most medial portion of the midpoint of the parotid gland and is ligated. This technique sometimes causes temporary weakness in the fibers of the VIIth nerve but prevents transecting any of the major trunks of the nerve. Recovery of function in all branches is ensured by the knowledge that they are intact and usually occurs within a week or two following completion of the operation.

V Excision of the Lip

Most cancers of the lower lip are removed with the use of V excision. Between one-fourth and one-third of the lower lip can be easily resected by simple excision without resulting in residual deformity or interference with function. While we refer to this excision as a V, a much better cosmetic result is obtained if the outline of the incision resembles that of a shield. A true V excision results in some flattening of the lower lip with a loss of normal eversion. If a shield-shaped incision is used, the lip will evert normally.

If the tumor involves more area that can be excised with a V excision, a flap is migrated from the upper lip. This involves outlining a V-shaped flap in the upper lip which is left attached at its lower medial corner and is then rotated into the defect in the lower lip. Using this type of closure excision of up to two-thirds of the lower lip can be accomplished without difficulty.

Maxillectomy

Cancer of the hard palate or the lower maxilla requires subtotal excision of the maxillary sinus. Cancer in the upper maxilla involving the orbital plate requires total excision of the maxillary sinus together with an exenteration of the orbital contents. While these excisions are basically mutilating, they can be accomplished with little visible external deformity. The Weber-Fergusson incision is used. This begins at the midpoint of the upper lip, extends to the columella of the nose, and is carried around the edge of the nose and up to the corner of the eye. A horizontal portion continues laterally from the inner canthus to a point just beyond the outer canthus and about 2 or 3 mm below the palpebral fissure. The skin and muscles of the cheek are undermined laterally, so that the entire cheek is turned outward, opening a door to the maxillary sinus. The bony attachments of the maxillary sinus

are divided, including the midline of the hard palate, the zygoma, the pterygoid plates; if the orbital plate is to be removed, the bony walls of the medial and lateral orbit are also transected. When this is accomplished, the entire maxillary sinus can be lifted like a small bow from its normal position. The inner surface of the Weber-Fergusson flap is covered with a split-thickness skin graft, and the incision is closed. Because it falls in the normal skin lines and about the normal structures of the face, this incision is often difficult to detect after it has healed as long as the structures have been replaced precisely and in good apposition. This operation leaves a large defect in the hard palate on the side of the procedure. This is occasionally closed by subsequent operations, but more commonly a dental prosthesis with a large obturator which fits into the defect is constructed by the prosthodontist. This restores normal speech and relatively normal mastication for the patient.

Total Laryngectomy

Total laryngectomy is traditionally accomplished through a midline longitudinal incision. We have found definite advantages in accomplishing this procedure through a transverse incision in the lower neck very much like the typical thyroidectomy incision. The incision is made 4 cm above the clavicles and approximately 4 cm beyond the edge of the sternocleidomastoid muscles on either side; it is carried down through the platysma muscle, and the upper flap is then developed. The upper limit of dissection is approximately 1 cm above the hyoid, and at this point the entire group of strap muscles and the midportion of the hyoid are exposed. In cancer operations for glottic tumors of any size, all the anterior strap muscles are removed. Occasionally at the election of the operation in the presence of somewhat smaller lesions, the strap muscles on the side contralateral to the lesion may be preserved, or, rarely, the larynx is skeletonized with the preservation of strap muscles on both sides. In the ordinary instance, however, the sternothyroid and sternohyoid muscles are transected at the level of the cricoid, the digastric and mylohyoid muscles are separated from the hyoid above, and the body of the hyoid bone is cut at the junction of the attachments to the lateral wings on either side. The larynx is rocked laterally exposing the pharyngeal constrictors, which are cut at the lateral edge of the thyroid cartilages bilaterally. One can now enter the pharynx laterally, usually on the side opposite the tumor, so that proper visualization of the area can be obtained, and an adequate margin of excision of pharyngeal mucosa will be developed around the tumor. Once the pharynx is entered, it is possible for the surgeon to operate both outside and inside the pharynx. The remaining muscles of the tongue are severed from the hyoid, and the larynx is pulled forward. The vascular pedicles containing the laryngeal arteries and the superior laryngeal nerves are ligated bilaterally. An incision is made in the pharyngeal mucosa just posterior to the arytenoids, entirely circumscribing the point at which the larynx projects into the pharynx. As all pharyngeal mucosa is now separated from the larynx, the larynx is pulled forward, and a plane of dissection is developed between the larynx and the anterior esophageal wall. This dissection is carried inferiorly until the only remaining structure holding the larynx in place is the trachea. This is then divided obliquely around the site of the tracheostomy (if one has been done previous to the operation), or if an endotracheal tube has been used in anesthesia, this is not removed, and a tube is placed in the severed trachea so that anesthesia can be continued. After the larynx has been removed, the defect in the pharynx is closed transversely with an inverting Connell stitch. This is reinforced by interrupted sutures of 4-0 silk which are used to imbricate the constrictor muscles up and around the pharyngeal closure. This closure may further be reinforced by stitches which catch the platysma muscle and draw it

down snugly along with the overlying skin. A generous circular portion of skin is removed in the lower midline; this measures about 3 to 4 cm in diameter with three-quarters of the circle lying above the transverse skin incision and one-quarter of the circle lying below. The beveled end of the trachea is then drawn up to the skin by interrupted sutures of nylon. Every attempt is made to obtain a delicate mucosa to skin closure, since the smaller the size of the scar at the junction between mucosa and skin, the less likely there is to be subsequent stenosis of the tracheal opening. The generous amount of skin excised tends to evert the trachea in a slightly "trumpet-like" manner, and this too ensures against subsequent stenosis. This type of trachea skin closure can be maintained without the use of an indwelling tracheostomy tube except for the first 24 hours or so postoperatively. The remainder of the wound is closed with interrupted sutures to the platysma muscle and skin. Two suction catheters are left in place on either side of the neck and are usually removed in 24 to 36 hours. The patient is maintained on postoperative feeding through a nasal tube made up of a #18 whistle-tip red rubber catheter inserted at the time of operation through the nose and into the esophagus before the pharyngeal defect is closed. This tube is sutured to the nasal columella. The patient is maintained on nasal tube feedings for about 10 days. A liquid diet is usually begun on the fifth or sixth day, and the patient may take solid food on the ninth or tenth day. The nasal tube is removed as soon as it is apparent that the patient can well maintain his own nutrition.

Partial Laryngectomy and the Neolarynx

In the past all lesions extending beyond the true cords have been treated by the total laryngectomy. The functional importance of the voice and the great benefit of preserving it for the patient has led to an evaluation of cancer operations which do not remove the entire larynx. Ogura and Biller have led this effort and have proposed a number of new operations which involve removal of most or all of the larynx above the cords (superglottic laryngectomy) or excision of most of one side of the larynx (hemilaryngectomy) for lesions which are confined enough in their growth to be suitable for this technique. This approach requires careful selection of patients who are young and flexible enough to overcome some of the swallowing and aspiration difficulties that often arise postoperatively. Since the resected margin around the tumor may be very limited, careful diagnostic techniques must be used to identify the outer margins. This technique is almost always combined with preoperative radiation therapy to ensure a lesser threat from residual cells at the periphery of the tumor which may be left by the surgeon. Using these techniques in patients with tumors advanced enough to cause fixation of the cord, Ogura and Biller have reported a 77 percent 3-year survival.

An alternative method for preserving the voice, especially in patients with lesions not amenable to partial laryngectomy, is creation of a pseudolarynx. The most popular method for this procedure is that of Staffieri, in which the open stump of the trachea is covered by a flap of pharyngeal mucosa and a very small mucosa-lined fistula is created connecting the trachea to the pharynx. The patient speaks by occluding a lateral tracheostoma with his finger and diverting air from the lungs into the pharynx and mouth. Aspiration is avoided by the very small size of the fistula but may be a problem in a substantial number of these patients. Attempts at developing a valve of tissue to cover the fistula are in progress, as previously mentioned.

Postoperative Care Following Head and Neck Operations

Tracheostomy is performed at the time of operation in any patient in whom a portion of the mandible is removed or when there is extensive removal of oral structures. Postoperative edema plus the tendency for the larynx to shift position following sacrifice of many of its suspensory muscles predispose to aspiration and obstruction. Catastrophic anoxia may supervene rapidly, with little apparent warning. The tracheostomy tube must be aspirated frequently. This requires the presence of well-trained nursing personnel. If a patient appears to be accumulating unusual amounts of tracheal secretions, it is probable that saliva is being aspirated through an incompetent larynx. This can be controlled by diligent suctioning. In extreme instances, a cuffed tracheostomy may be required temporarily.

The patient with a tracheostomy has lost the usual humidifying effects of the nasal and pharyngeal passageways. The best way to provide humidity for the patient's trachea is to tie an umbilical tape about the neck above the tracheostomy and to hang a moistened 4 by 4 sponge over this tape very much in the manner that a towel is hung over a rail. The sponge must frequently be moistened, and after the first day or two the patient can be taught to moisten his own sponge and arrange it for himself.

There is no need to leave the tracheostomy in place for prolonged periods. As soon as the patient is found to be maintaining a dry, unobstructed airway and the skin flaps are sealed, the tracheostomy tube is covered with a piece of adhesive tape. This is done about 5 days postoperatively. If the patient tolerates the covering of the tracheostomy tube for 24 hours, it can be removed. This tube should always be removed in the morning, so that the patient can be observed during the daylight hours following removal.

Patients who have undergone combined resections have had extensive superficial operation, but the body cavities have been undisturbed, and the normal function of the gastrointestinal tract resumes almost immediately. A nasoesophageal tube consisting of a #16 French urethral catheter is left in place at the end of the operative procedure. The tip of the standard urethral catheter reaches to the lower third of the esophagus but does not traverse the esophagocardiac junction. Such tubes can be left in place for long periods without the risk of acid regurgitation and peptic esophagitis. The patient receives fluids intravenously on the day of operation, but on the first postoperative day nasal feedings of half-strength milk are given. On the second postoperative day a nasal formula consisting of a blenderized regular diet diluted with milk is begun. This is continued until the fifth or sixth postoperative day or until the patient shows evidence that he can tolerate an adequate diet by mouth.

Except for the different flora encountered, there is little difference in the principles of operating on the mouth and other areas in the gastrointestinal tract. This is a contaminated area, and numerous tissue planes are open to this contamination. All patients should be placed on appropriate antibiotics postoperatively. Ketcham et al demonstrated in a controlled study the advantages of prophylactic antibiotics in these patients.

The mental stress in a patient undergoing an oral operation of any magnitude is considerable. He awakens unable to speak because of his tracheostomy. He is unable to control his saliva and finds that he is constantly aspirating small amounts of mucus. His neck and shoulder are completely numb and boardlike because of the section of all cervical sensory

nerves on the side of the lesion, and while he has little or no sharp pain, he has a pounding and persistent headache due to the ligation of the jugular vein and concomitant rise of spinal fluid pressure. In a day or two he looks into the mirror and may not recognize the swollen, edematous, and possibly deformed face which stares back at him. It would be abnormal if he were not depressed under these circumstances. Support for the patient depends on good preoperative preparation. The patient must understand clearly what to expect in the postoperative period. Patients do not panic if they understand their problems and realize that most of their deficiencies are reversible as edema subsides and the tracheostomy tube is removed.

Rehabilitation

As Shedd has pointed out, progress in medicine often brings new problems. In head and neck oncology the successful control of major cancers may leave a considerable number of patients whose posttreatment life involves a significant degree of disability. Major impairment in appearance, swallowing, taste, and speech all reduce the quality of life and the effectiveness of treatment. While the field of rehabilitation of these patients is too broad to detail here, the major thrust of recent years has been to accomplish as much of the rehabilitation as possible on the operating table at the primary procedure.

The development of free flaps and myocutaneous flaps is a major advance in the reconstruction of head and neck defects. For the first time an adequate source of soft tissue and even bone is immediately available for rapid one-stage reconstruction of operative defects. Myocutaneous flaps are constructed by freeing up one end of a muscle and leaving the blood supply to the other end intact. All or any part of the overlying skin can be brought up with the muscle pedicle to fill the operative defect. The skin obtains its blood supply from the underlying muscle. While there are many muscles which can be used in head and neck reconstructions including the trapezius, sternocleidomastoid, and latissimus dorsi, the favorite has become the pectoralis major, which can reach any part of the face and can be fashioned to fill large and small defects.

Free flaps or grafts are areas of tissue removed with an associated artery and vein. The vessels must be large enough to permit microvascular reanastomosis to vessels of the head or neck. These operations are long and arduous, requiring great skill and patience in isolating and anastomosing the vascular structures so that myocutaneous flaps have preference in most cases. Free grafts of small bowel for one-stage replacement of the cervical esophagus and pharynx after major resections have gained some advocates, although many prefer to bring up the stomach through the anterior mediastinum and use the fundus of the stomach in restoring these structures. In any case the use of skin tubes for this purpose has been totally superseded.

Transplantation of generous amounts of fresh tissue with a new blood supply into operated areas of the head and neck has made possible major reconstructions even after high-dose radiation has preceded the operation. Total replacement of the mandible by transplanted bone or metal prosthesis has a much higher success rate in this setting.

The maximum results of rehabilitation are usually obtained by a team effort incorporating the skills of the head and neck surgeon, plastic surgeon, oral surgeon, speech therapist, and psychotherapist.