CHAPTER 27

Clinical Evaluation of Olfactory and Gustatory Disorders

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There are four basic components in the clinical evaluation of the patient with a chemosensory disorder: the history, the physical examination, the psychophysical evaluation, and the medical imaging.

The history plays a very important role in the etiologic diagnosis. Often associated events with the onset of the chemosensory complaint give the most important clue as to the cause of the disorder. Although the principal strategy is to make an anatomic diagnosis and subsequently to make an etiologic diagnosis, the first step in the clinical evaluation, which is the history, often provides important etiologic information from the beginning. Indeed, the experienced interviewer always keeps in mind the mission of finding the cause and pursuing a line of inquiry that seeks causal information.

The physical examination also plays an important role in the etiologic diagnosis. Abnormalities seen in the nasal and oral cavities may provide key etiologic information and focus attention to a local factor in the nose or oral cavity to explain the development of the chemosensory disorder. The normal examination leaves the etiologic possibilities open. That there may be no current evidence of a pathologic process in the nose or oral cavity does not exclude the possibility of such a process in the past that could have resulted in the chemosensory disorder.

Taken together, the history and physical examination will provide the basis for the anatomic and etiologic diagnosis in the majority of patients. The role of imaging is in many ways an extension of the physical examination and may in the case of inflammatory processes in the nose and paranasal sinuses provide anatomic and etiologic diagnostic information that can be obtained in no other way.

The psychophysical evaluation is essential to corroborate the patient's complaints, determine the efficacy of treatment, and measure the degree of permanent impairment. The psychophysical evaluation has not been as contributory to either the determination of the site of the lesion or the cause of the chemosensory disorder as has been the case in the auditory system.

Medical imaging is essential to exclude the life-threatening causes of chemosensory disorders and, as mentioned, is of great value in identifying and quantifying inflammatory processes in the nose and paranasal sinuses (see Chap. 29 by Kimmelman on medical imaging).

Special studies employing rhinomanometry to evaluate the airway resistance and patency are an essential feature of the evaluation of a patient with an olfactory

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loss, as is well presented in Chap. 30 by Mozell et al. on nasal air flow and Chap. 31 by McCaffery on rhinomanometry. Likewise, electrogustometry is of great importance in the evaluation of the quadrants of the tongue in the patient with a gustatory loss, as is presented in Chap. 32 by Frank and Smith.

The evolving role of biopsy of the olfactory area offers the hope of major contributions to the process of anatomic and etiologic diagnosis, as presented in Chap. 44 by Strahan et al. Similar information can be anticipated from taste bud biopsy.

**HISTORY**

That which is not forgotten is the most valuable information to the diagnostician. Patients should be allowed to describe their chemosensory complaints without interruption. It is important to know if there were illness or injury that was temporally related to the onset of the symptoms. Related viral infections and head injury are of great importance, as discussed in Chap. 46 by Leopold et al. and 45 by Costanzo and Zasler, in establishing the etiologic diagnosis in a large number of patients.

In the case of olfactory losses, it is useful to inquire if the sense of smell is completely lost or only diminished and whether the loss is for all odors or for only a few. It is important to inquire about known strong trigeminal stimulants as well as relatively pure olfactory stimulants. One needs to know if the onset were sudden or gradual. Were there qualitative as well as quantitative changes in the symptoms as the disorder evolved? One needs to know if the loss is continuous or intermittent. Some patients report temporary recovery of the sense of smell under certain circumstances, such as exercise, changes in the relative humidity and temperature, and treatment with corticosteroids. Such a finding suggests interference with the transport of the odorant to the olfactory neuroepithelium as in allergic or infectious and noninfectious rhinitis, as described in Chap. 37 by Hendrix and 36 by Lekas, rather than a sensorineural lesion. It is important to inquire about the perversion of the sense of smell. In certain states of degeneration or recovery of olfactory function, there may be the perception of a foul odor in the presence of a normally pleasant odorant with environmental changes in temperature and relative humidity and in the absence of an odorant. The perception of a foul odor under the latter circumstance may occur in psychotic states and in forms of epilepsy. Although dysosmia is usually temporary, permanent cases do occur.

Inquiry into other nasal and paranasal symptoms such as nasal stuffiness or obstruction, clear or purulent rhinorrhea, sneezing, nasal dryness, foul odor from the nose, epistaxis, facial pain, and headache must be made. A history of allergy should be sought, as described in Chap. 34 by Baroody and Naclerio on allergic rhinitis. Operations on the nose and paranasal sinuses must be known, as discussed in Chaps. 33 by Loury and Kennedy, 39 by Weisman, and 38 by Kern and Mathog. Inquiry into the neurologic status is necessary, as indicated in Chap. 47 by Doty on Alzheimer's disease and other neurodegenerative disorders.

Many patients with a loss of olfactory sensitivity complain of a loss of the sense of taste as well as a loss of the sense of smell. Often, on psychophysical evaluation, such individuals have diminished olfactory sensitivity but normal gustatory sensitivity. Their complaint of a loss of taste sensitivity is probably more a loss of flavor perception that is largely an olfactory function. One can inquire whether they are able to taste the saltiness in potato chips and the sweetness in colas in trying to learn whether they have a true diminution of gustatory sensitivity. Once the patient recognizes the difference between flavor appreciation and sensitivity for sweet, salty, sour, and bitter stimuli, an important semantic bridge in communication about their chemosensory disorder is achieved.

In the investigation of the complaint of a loss of the sense of taste, it is useful to inquire if the sense of taste is completely lost or only diminished and whether the loss is for all tastants or only for one, two, or three. It is important to inquire about irritants to the oral cavity as well as tastants. One needs to know if the onset were sudden or gradual. Were there qualitative as well as quantitative changes in the symptoms as the disorder evolved? One needs to know if the loss is continuous or intermittent. Temporary recovery of the sense of taste may suggest interference with the transport of the tastant to the taste buds, as in xerostomia, and inflammatory processes in the oral cavity, as detailed in Chap. 40 by Catalanotto and Sweeney, rather than a sensorineural lesion. It is important to inquire about perversion of the sense of taste. Patients with gustatory disorders frequently report an odd or bad taste in the presence of a normally pleasant tastant or in the absence of a tastant.

Inquiry into other oral and dental symptoms must be made. Specifically dryness of the mouth, excessive salivation, burning of the tongue as described in Chap. 42 by Grushka and Sessle, soreness of the mouth, dental pain and periapical infection, periodontal disease, foul odor, and recent or needed dental procedures should receive inquiry.

Previous diagnostic procedures in the investigation of the disorder as well as previous attempts at therapy should be known. All other medical or surgical treatment must be known. Commonly one will find that the patient has been treated with zinc sulfate or vitamins.
The patient’s past family and social history including a thorough review of the systems (inquiry about symptoms relative to each system of the body) should be taken. The social history must include occupational exposures, substance abuse including alcohol and tobacco, and environmental accidents and exposures. The dietary history is of particular concern in the patient with a chemosensory disorder.

The historical evaluation of the patient’s general health may provide valuable clues. It is important to know the drugs that the patient is receiving or has received for other conditions, as is emphasized in Chap. 54 by Schiffman. Drugs that affect cell turnover such as antineoplastic chemotherapeutic agents cause losses of the senses of smell and taste. Radiation therapy to the head and neck can cause losses of both senses, as detailed in Chap. 48 by Smith and Beidler. Neurosurgical and otolaryngologic operations can also result in losses of both senses, as discussed in Chap. 39 by Weisman. The relationship of these senses to renal and hepatic disease is discussed in Chap. 51 by Deems et al., to diabetes in Chap. 53 by Settle, and to thyroid, parathyroid, and adrenal diseases in Chap. 52 by Mackay-Sim. The relationship of chemosensory disorders to depression is addressed in Chap. 55 by Settle and Amsterdam.

PHYSICAL EXAMINATION

A complete examination of the ears, upper respiratory tract, and head and neck in general is essential. Similarly, a neurologic evaluation that emphasizes the cranial nerves is mandatory.

Although there is difficulty in inspecting the olfactory neuroepithelium directly even with the smallest fiberoptic endoscopes, it is probable that with the use of current techniques, relatively little interfering with the transport of odorants to the olfactory neuroepithelium is missed. After the initial inspection, a topical vasoconstrictor should be applied for better visualization. The nasal mucous membrane should be evaluated for color, surface texture, swelling, inflammation, atrophy, epithelial metaplasia, exudate, erosion, and ulceration. Purulent rhinorrhea is a particularly important finding as is its site of origin. If it occurs generally throughout the nasal cavity, a rhinitis is suggested. If it emanates from the middle meatus, it suggests maxillary, anterior ethmoid or frontal sinusitis, while if it appears in the superior meatus, it suggests posterior ethmoid or sphenoid sinusitis. The importance of structural obstruction such as deviation of the nasal septum, polyps, and masses is self-evident. Paleness of the mucous membrane is usually due to edema in the lamina propria and suggests allergy. Epithelial metaplasia suggests the inhalation of environmental or industrial pollutants, as do swelling, inflammation, exudate, erosion, and ulceration. Unusual spaciousness, dryness, and crusting suggest atrophy of the lamina propria as occurs in atrophic rhinitis. Evidence of trauma should be sought. The presence of nasopharyngeal masses and exudate is important to detect.

Examination of the oral cavity is particularly rewarding in the patient with a taste disorder. The mucous membrane of the oral cavity may demonstrate dryness, inflammation, edema, atrophy, swelling, abnormal surface texture, leukoplakia, erythroplasia, exudate, erosion, and ulceration. The filiform papillae may be long and give the tongue a hairy appearance or may be unusually short, giving the tongue an unusually smooth appearance. The relative color and prominence of the fungiform papillae may give the tongue a more homogeneous appearance than normal or their contrast in infectious diseases may be so great as to give the tongue a strawberry appearance. With or without magnification, the structures housing the taste buds of the tongue—the fungiform papillae, the foliate papillae, and the circumvallate papillae—can be inspected. The application of irritants such as polycyclic aromatic hydrocarbons, the products of combustion of all organic compounds, cause leukoplakia, which may be epithelial metaplasia, hyperkeratosis, dysplasia, carcinoma in situ, and invasive carcinoma. Exudate, erosion, and ulceration may result from infection, caustic ingestions, and neoplastic or neoplastic processes. Candida infections produce white patches. Vincent augina due to a fusiform bacillus and a spirochete produces painful ulceration with surrounding erythema. Viral infections produce vesicles with surrounding erythema that may later appear as erosions or ulcers. All of these conditions and others are presented in detail in Chap. 40 by Catalanotto and Sweezy.

PSYCHOPHYSICAL EVALUATION

It is appropriate and necessary to perform an olfactory and gustatory evaluation on all patients who present with chemosensory complaints. This statement is true whether the complaint is anosmia, hyposmia, dysosmia, ageusia, hypogeusia, or dysgeusia. Serious errors in diagnosis occur if only one of the two senses are evaluated psychophysically.

Olfactory Evaluation

A number of procedures are available to the clinician for assessing a patient’s ability to smell. These include (a) psychophysiologic measures taken during or after odorant inhalation, such as blood pressure, heart rate, and electroencephalographic waveforms,
and (b) psychophysical sensory measures, such as detection thresholds and measures of suprathreshold odor acuity. Since a number of psychophysiological measures reflect autonomic nervous system activity resulting from stimulation of nonolfactory afferents (e.g., cranial nerve V) or, in some cases, direct absorption of the test stimulus into the bloodstream, they are rarely used clinically. Nevertheless, considerable progress has been made in both the development and understanding of some psychophysiological measures, such as odor-evoked potentials, and there is reason to believe that such techniques may be developed sufficiently in the not-too-distant future to be of clinical use (see Chap. 13 by Kobal and Hummel).

Olfaction can be measured psychophysically in many different ways (see Chap. 10 by Doty). The most common clinical tests examine the ability to identify and detect odors. Ideally, both unilateral and bilateral olfactory testing should be performed, even though (a) noticeable olfactory deficits usually require bilateral involvement and (b) clinically significant unilateral deficits are rarely observed. The need for unilateral testing largely stems from the rare situation in which a tumor or lesion impinges only on one olfactory bulb, tract, or associated projection region.

Odor identification tests that have found wide clinical usage require the patient to select, from a set of alternatives, a term that best describes his or her odor experience. Such tests are highly reliable and generally correlate well with the patient’s olfactory complaint. Forced-choice formats are used to minimize confounding of the threshold measure with response biases, and such tests range from simple yes-no tests (does this odor smell like a lemon?) to multiple-choice tests in which a large number of alternatives are presented (e.g., the confusion matrix) (see Chap. 10 by Doty). The most popular clinical smell identification test provides four response alternatives for each of 40 odorants located on microencapsulated strips. A patient’s score on this test is compared to that of normal subjects of equivalent age and gender using standardized norms. This allows for the determination of a quantitative percentile value.

Odor detection threshold tests that have received wide clinical usage are variants of the so-called method-of-limits procedure (Chap. 10 by Doty). In the method of limits, the concentration of a stimulus is increased (or decreased) incrementally until the stimulus is just barely perceived. Most commonly, log-step or half-log-step concentrations of an odorant are presented to a patient using “sniff” or squeeze bottles. For example, a patient may be asked to report, on a given trial, which of two successively presented stimuli smells stronger. One is a given concentration of an odorant dissolved in a liquid medium (e.g., light mineral oil) and the other the liquid medium alone. The presentation order of the two stimuli is randomized from trial to trial, and successively higher stimulus concentrations are presented until a reliable detection is made. Staircase procedures, in which odorant concentrations are increased or decreased as a function of the correctness of the subject’s responses, have gained in popularity in recent years and provide a reliable measure of threshold with a minimum number of trials (see Chap. 10 by Doty). Because threshold tests are time consuming, however, measures of a patient’s sensitivity to only one or two odorants are usually made.

Since a large number of chemicals are available for evaluation, a threshold test samples only a small segment of the potentially detectable stimuli. Therefore, the question arises as to whether the patient’s complaint reflects insensitivity to a stimulus domain other than the one being sampled. Fortunately, as discussed in Chap. 10 by Doty, clinical studies indicate that individuals who are insensitive to one compound usually evidence insensitivity to others, as inferred from the fact that relatively high correlations are present among threshold values obtained from different compounds within the same persons. Nevertheless, as indicated by Amoore in Chap. 41, instances of “smell blindness” occur in which only a small number of stimuli are involved. For this and other reasons, most clinics use odor identification tests in addition to threshold tests for assessing olfactory ability.

Other, less popular olfactory tests have also been applied in the clinic, including tests of (a) differential threshold (e.g., the amount an odorant needs to be increased in concentration before it is just noticeably different from another above-threshold odorant), (b) suprathreshold buildup in odor perception using either odor intensity rating scales or the technique of magnitude estimation, (c) adaptation, (d) ability to make fine distinctions among odors of varying quality, as measured by techniques such as multidimensional scaling, and (3) odor memory. These and other such tests are described in detail in Chap. 10 by Doty.

Gustatory Evaluation

Ideally, a psychophysical taste evaluation produces a picture of the taste world of the patient so that the evaluator can determine how the patient’s experience differs from normal. There are three important attributes of taste experience: quality, intensity, and location in the oral cavity. Chapter 11 by Miller and Bartoshuk on taste psychophysics is organized around these attributes and how to measure them.

The identification of quality is generally done simply by asking subjects to name the quantities perceived. It is important to realize, however, that many apparently simple taste stimuli actually produce more than one
taste quality. For example, salt is often described as partially sour and acids are often described as partially salty.

The measurement of a patient’s ability to perceive intensity appropriately was initially done by measuring the threshold. Threshold measurement is still a useful laboratory tool but has limited usefulness in the clinic because thresholds are often dissociated from suprathreshold perceived intensity. As methods for the direct measurement of suprathreshold intensity were developed, they took their place in the clinic as important tools. One of the most interesting new methods is called magnitude matching. It provides the closest approximation that we have to assessing absolute perceived intensity of taste across individuals. It should be noted that additional types of measures are under investigation and hold promise for revealing new insights about chemosensory dysfunction. For example, Weiffenbach, in Chap. 19 on aging, discusses the use of measures of consistency of the suprathreshold responses that show age effects.

The measurement of taste function on localized areas in the oral cavity has been an important clinical tool since the nineteenth century. The types of measurement include all of those discussed so far: quality identification, thresholds, and suprathreshold scaling. Localized taste testing has been done in a variety of ways. In the nineteenth century, investigations often tested various areas determined by anatomic landmarks (e.g., the uvula, soft palate, tip of the tongue). More recently the localized testing has been oriented toward testing areas of known innervation (e.g., fungiform papillae, foliate papillae, circumvallate papillae). There has been a considerable amount of confusion over the anatomy of taste receptors. For this reason, Chap. 11 by Miller and Bartoshuk contains a detailed review of this anatomy.

In addition to perceived intensity, the pleasantness or unpleasantness of stimuli can be measured. Essentially, the same psychophysical tools are used. The patient is simply asked to describe the hedonic attributes rather than the sensory ones. Stimuli are selected for a psychophysical evaluation of taste based on safety, convenience, and purity of sensation. A typical series is NaCl, sucrose, citric acid, and quinine. Unfortunately, even these simple stimuli do not stimulate only taste sensations. NaCl, citric acid, and quinine all produce tactile sensations in some subjects. The complications that this introduces for threshold studies are noted in Chap. 11 by Miller and Bartoshuk on taste psychophysics. In addition to the conventional chemicals used to elicit taste, the electrogustometer can be used to test taste.

The advantages and limitations of such devices are described in Chap. 32 by Frank and Smith.

The evaluation of dysgeusia requires more than a standard taste evaluation. Topical anesthesia can provide useful diagnostic clues about the origin of the dysgeusia (see Chap. 11 by Miller and Bartoshuk on taste psychophysics).

MEDICAL IMAGING

Computed tomography of the head provides essential information in evaluating the patient with an olfactory disorder and to a much lesser extent with a gustatory disorder. As detailed in Chap. 29 by Kimelman, computed tomography provides detailed structural information about the nasal cavities, particularly in the superior portions of the nasal cavities, the cribriform plates, and the anterior cranial fossa. It provides definitive information on the presence or absence of sinusitis. It is a valuable adjunct in ruling in or out neoplasms of the nose, paranasal sinuses, and cranial cavity. Particularly with the use of enhancement with intravenous iodinated compounds, computed tomography is an effective means of excluding intracranial neoplasms, such as meningiomas of the anterior cranial fossa, that may affect the olfactory system, as presented in Chap. 43 by Esiri. Unexpected trauma to the cribriform plate and the base of the skull may be found in this manner. Magnetic resonance imaging is particularly helpful in evaluating the contents of the cranial cavity. In the initial evaluation, computed tomography takes precedence because of the bony detail it provides.

BIOPSY OF THE OLFACTORY NEUROEPITHELIUM AND TASTE BUDS

The techniques of biopsy of the olfactory neuroepithelium, as described in Chap. 44 by Strahan et al., and the taste buds are well defined and safe. The results in the histopathology of the olfactory neuroepithelium must be interpreted in the light of the known widespread degeneration of the olfactory neuroepithelium and the intercalation of respiratory epithelium in the olfactory region with age. This area of study in the olfactory and gustatory systems holds great promise for important new information.

In conclusion, information from the clinical evaluation along with known causes of chemosensory disorders prepares the clinician for carrying out the next step, the differential diagnosis.