



University of Nebraska Medical Center
DigitalCommons@UNMC

[MD Theses](#)

[Special Collections](#)

5-1-1941

Earache

Robert R. Shepard
University of Nebraska Medical Center

This manuscript is historical in nature and may not reflect current medical research and practice. Search [PubMed](#) for current research.

Follow this and additional works at: <https://digitalcommons.unmc.edu/mdtheses>

 Part of the [Medical Education Commons](#)

Recommended Citation

Shepard, Robert R., "Earache" (1941). *MD Theses*. 885.
<https://digitalcommons.unmc.edu/mdtheses/885>

This Thesis is brought to you for free and open access by the Special Collections at DigitalCommons@UNMC. It has been accepted for inclusion in MD Theses by an authorized administrator of DigitalCommons@UNMC. For more information, please contact digitalcommons@unmc.edu.

EARACHE

BY
ROBERT D. SHEPARD

Announcement: Senior Thesis presented to The College of Medicine,
University of Nebraska, Omaha, 1941.

FOREWORD

The impetus for the subject of this thesis was a lecture given by H. E. Kully (24). After hearing Dr. Kully, I realized how very little I knew about so frequent a symptom as earache. Also in my reading, it seems that this symptom, which appears to be extremely important, is treated rather lightly. For instance, a recently published "Symposium on Pain" discussed the many different forms of pain, but earache was not even mentioned.

Therefore, I took this opportunity to learn more about the many possible causes of earache.

481258

Earache is a broad term used to include pain in and about the ear. It is a symptom which everyone complains of sometime during his life and one which, if the cause is carefully and correctly analyzed, may save a life. This term, however, usually suggests a lesion in or about the ear and one is apt to forget that the pain may be due to any one of many extrinsic causes. In dealing with earache, therefore, it is always well to keep in mind that the symptom is deceptive and occasionally treacherous, because the severity of the pain may bear little or no relation to the gravity of the lesion which causes it. All ages are affected, hence it is essential to diagnose the cause and distinguish the urgent from the less serious type with, in many cases, little or no history from the patient.

Earache may be caused by organic lesions within the external auditory canal, middle ear, mastoid cells, and eustachian tube; or by remote lesions in other parts of the body that cause pain by the reflex route. Pain due to some affection of the ear itself is classified as Otodynia, while pain of a reflex nature is called Otagia. Otagia is further divided into referred or autonomic, reflex, transferred, herpetic, tabetic, and psychic forms.(12) In addition, there is a third group of patients with earache from less common causes. They belong to neither of the above groups, but are those with primary neuralgia of the various sensory nerves that supply the auricle, external auditory meatus, and tympanic membrane. (10)

Hubert (19) in a discussion of the mechanism of pain divides it into three types: (1) Somatic Pain--irritation of the special sensory nerve endings (sense organs) with stimulation of the afferent somatic neurons which carry impulses to the pain center in the Thalamus and thence to the Cerebrum. (2) Autonomic (visceral) or referred pain. In this condition one is not concerned especially with the viscera, but with structures visceral in origin, i.e. those arising from the branchial arches and pouches. (3) Psychic Pain--this may be regarded as an outward manifestation of a neurotic conflict having its origin in the cerebral cortex and being projected from here to the periphery.

When investigating a case of earache, the exact localization of the pain may be of assistance in determining its source, especially true in referred pain. Hence the explanation of the pathways of painful stimuli in and about the ear and auricle concerns itself with the anatomy of the sensory supply of the ear.

ANATOMY

The sensory supply for the auricle, external auditory meatus, middle ear, and tympanic membrane comes from a series of nerves consisting of the facial, trigeminal, glossopharyngeal, vagus, and cervical plexus.

Facial Nerve: (13) Clinically this nerve is usually regarded as being entirely a motor nerve. Histologically and embryologically, however, it has been proven to be a mixed nerve, its sensory

ganglion--the geniculate; its sensory root--Pars Intermedia (Nerve of Wrisberg). Fenton and Larsell (9) in their studies of human material, based upon experimental studies in comparative anatomy, concluded that both the chordi tympani and the great superficial petrosal nerves are composed of efferent sensory fibers whose cell bodies are located in the geniculate ganglion. Hunt (20, 21, 23), as the result of his study of primary isolated herpes zoster in the ear, formed the opinion that there are also afferent sensory fibers in the facial nerve. The sensory zone of these fibers consisting of the tympanic membrane, external auditory canal, concha, tragus, antitragus, antihelix, fossa of the antihelix, and the lobule of the ear. This area, however, is not entirely represented by the geniculate zone. He felt that allowance must be made for overlapping of the trigeminal in front and the cervical behind. In addition, Hunt found that the geniculate ganglion may in certain cases participate in the innervation of a strip of skin covering the postero-mesial surface of the auricle and adjacent mastoid; sharing with the vagus in the innervation of this region. His clinical evidence is somewhat substantiated by Fenton and Larsell (9) who found a small branch in the human fetus which passes to the skin of the posterior surface of the ear, after anastomosing with the auricular branch of the vagus. In addition, it supplies part of the external auditory meatus and tympanic membrane. Thus it is presumed that the facial fibers distributed thru the Rami Auricularis Vagi supply part of the external auditory meatus, tympanic membrane,

4

and the skin on the cranial side of the concha. A case presented by Clark and Taylor (3), to be discussed later, proved clinically that the Pars Intermedia is the sensory supply of the facial nerve.

Wilson (40), however, believes that there is insufficient evidence to prove that the geniculate ganglion nerves supply the tympanic membrane. Following a careful anatomical study of human material, he concludes that the chief supply of the membrane is by branches of the auriculo-temporal and vagus nerves, which enter from the external auditory meatus. These form a plexus in the fibrous tissue from which branches are distributed to a subepithelial and a submucous plexus. There are also nerves, fewer in number, which enter from the tympanic cavity.

Immediately before the facial nerve emerges from the stylo-mastoid foramen it generally receives a twig from the auricular branch of the vagus. After its exit from this foramen, the facial sends a branch to the glossopharyngeal nerve.

Trigeminal Nerve: (13, 35, 40) In addition to supplying sensation to the face, the trigeminal nerve also innervates the front of the upper portion of the auricle; principally the skin covering the front of the helix and tragus, the skin lining the external auditory meatus, and the tympanic membrane. The fibers pass to this region through the auriculo-temporal branch of the mandibular division of the trigeminal. The exact distribution of this nerve is not readily determined, since its distribution varies in different individuals and such extensive nerve overlap in this area.

As above mentioned, the auriculo-temporal communicates with the facial in the substance of the Parotid Gland.

Glossopharyngeal Nerve: (13, 36) This nerve contains both motor and sensory fibers, and it is the sensory branches that arise from the petrous ganglion that are to be considered. There are four main branches from this ganglion that are of especial significance. A small branch that anastomoses with the auricular branch of the vagus and continues with this nerve to the portion of the ear supplied will be discussed later. Another, and probably the most important offset of this ganglion, is the tympanic nerve (nerve of Jacobson). This branch passes to the tympanic cavity, where it breaks up to form, along with branches from the carotid plexus of the sympathetic on the external carotid artery, the tympanic plexus. This plexus supplies sensation to the mucous lining of the tympanum, mastoid cells, and the auditory tube. Other fibers become reunited to form, by their union with a small nerve from the geniculate ganglion, the lesser superficial petrosal nerve, which passes to the otic ganglion. The petrous ganglion also communicates with the superior cervical ganglion of the sympathetic and sometimes with the jugular ganglion of the vagus.

The main portion of the glossopharyngeal nerve is distributed to the tonsils, the mucous membrane, papillae, and follicular glands of the base of the tongue, and the muscles and mucous membrane of the pharynx, forming with branches from the vagus and sympathetics the pharyngeal plexus. Thus connecting this entire region with that of the ear.

Vagus Nerve: (13, 36, 40) This nerve emerges from the cranium through the jugular foramen, in which is formed the jugular ganglion and after emergence the ganglion nodosum is formed. The jugular ganglion gives off the auricular branch (Arnold's Nerve) which receives near its origin the filament from the petrous ganglion and usually communicates with the facial nerve by a branch arising from the latter in the Cranialis Facialis. It is distributed to the back of the auricle, inferior and posterior walls of the external auditory meatus and the concha. The ramus auricularis communicates superficially with the posterior auricular branch of the facial, while the jugular ganglion receives communications from the petrous ganglion, the superficial cervical ganglion, and the accessory nerve. The vagus has a very extensive supply, passing to the larynx, pharynx, esophagus, heart, bronchi, and abdomen, giving rise to pathways from very remote points to the ear.

Cervical Plexus:(13,36) The anterior rami of the first four cervical nerves are concerned in forming the cervical plexus. Each is joined, on its emergence from the intravertebral foramen, by a gray ramus communicans from the superior cervical ganglion of the sympathetic, and the plexus communicates with the vagus, accessory, hypoglossal and ansa hypoglossi nerves. The two branches which are concerned in the sensory supply of the auricle are the lesser occipital and great auricular.

The lesser occipital is an ascending branch which arises from the second and third cervicals. It divides into an auricular,

occipital and mastoid branches. The auricular branch supplies sensation to the upper half of the helix, the lateral occipital area, and the lower end of the mastoid. It communicates with the greater occipital, the greater auricular, and the posterior auricular branch of the facial. The mastoid branch passes to the mastoid area, and the third branch to the occipital region.

The greater auricular, arising from the second and third cervical nerves, likewise divides into three branches: mastoid, auricular, and facial. The mastoid branch supplies the skin of the scalp behind the ear and communicates with the lesser occipital of the cervical plexus and the posterior auricular branch of the facial. The auricular branch ascends to the ear and supplies the lower part of the auricle on both aspects, communicating with the lesser occipital of the cervical plexus and the posterior auricular of the facial. The facial division supplies the skin of the cheek over the inferior part of the masseter muscle and parotid gland, communicating with the branches of the facial.

In addition to the above nerve supply of the various portions of the ear, it is necessary to discuss in some detail several of the ganglia which are associated with these nerves, in order to establish the possible pathways by which pain may be referred or transferred to the ear.

Sphenopalatine ganglion: (13, 36, 9) This is the largest of the sympathetic ganglia associated with the branches of the trigeminal nerve. It is deeply placed in the pterygopalatine fossa, close to the sphenopalatine foramen. The ganglion's sensory root is de-

rived from two sphenopalatine branches of the maxillary nerve, and the motor root is probably derived from the Pars Intermedius through the great superficial petrosal nerve. It also receives a sympathetic root from the carotid plexus through the deep petrosal nerve.

The great superficial petrosal nerve is given off from the geniculate ganglion of the facial nerve, and the deep petrosal nerve arises from the carotid plexus. These two nerves join forming the vidian nerve (nerve of the pterygoid canal) which is joined by a small sphenoidal branch from the otic ganglion and ends in the sphenopalatine ganglion.

The branches of this ganglion are distributed to the periosteum of the orbit, the mucous membrane of the roof of the mouth, soft palate, tonsil, lining membrane of the nasal cavity, uvula, and the mucous membrane of the nasal part of the pharynx behind the auditory tube.

Otic Ganglion: (9, 13, 36) Situated immediately below the foramen ovale, the otic ganglion lies on the medial surface of the mandibular nerve. It is connected by two or three short filaments with the nerve to the pterygoideus internus, from which it may obtain a motor and possibly a sensory root. The sympathetic root consists of a filament from the plexus surrounding the middle meningeal artery. It communicates with the glossopharyngeal and facial nerves through the lesser superficial petrosal nerve. A slender filament ascends from the ganglion to the nerve of the pterygoid canal and another small branch connects it with the chorda tympani.

9

Its branches of distribution are to the tensor tympani and the tensor veli palatini.

Submaxillary Ganglion: (9, 13, 36) This ganglion is situated above the deep portion of the submaxillary gland on the hyoglossus nerve near the posterior border of the mylohyoideus. It receives filaments from the lingual, chorda tympani and the sympathetic plexus around the external maxillary artery. Its branches are distributed to the mucous membrane of the mouth and duct of the submaxillary gland, some being lost in the gland itself.

OTODYNIA

Local causes of earache are by far the more common, being in a ratio of 19 to 1 over extrinsic causes. To discover the intrinsic cause of earache, however, it is necessary to examine the auricle, external auditory meatus, tympanic membrane and surrounding parts of the ear, the mastoid process, and the scalp above and behind the ear. Because of this, I wish to follow the plan of Mollison (28) in which he divides the ear into its component parts and discusses the pathology of each separately.

1. Pinna:

A common cause of earache, especially in youngsters, is trauma of the pinna. Injury to the ear as might occur in boxing or football produces a painful swelling on the lateral aspect of the auricle, resulting in a condition known as Hematoma Auris (31). A careful history and the local swelling should readily lead to a

diagnosis.

Erysipelas of the pinna (11, 29) is generally a part of a cutaneous infection of the scalp in the mastoid region or of the face in front of the ear. Again, the characteristics of this lesion are such that a definite diagnosis may easily be made.

Perichondritis of the pinna (19, 29, 31), while relatively rare, does occur and produces severe pain, depending upon the extent of the lesion. Such might arise from a scratch, spread of infection from a boil, or infection occurring in a hematoma. It is frequently due to infection of the cartilage following the cutting of a meatal flap during a radical mastoid. There is some pyrexia and considerable pain followed by swelling and redness of both aspects of the auricle. Involvement of the whole pinna usually assumes the characteristics of a cellulitis.

Frost-bite (18) causes a severe burning, itching type of pain localized in the pinna. In this condition a careful history will determine the cause. Other less common causes of earache due to involvement of the pinna are rodent ulcer, epithelioma, and gout. In the first two the appearance of the lesions is usually characteristic, while in the latter deposits of uric acid crystals in the lobe of the ear produce characteristic nodules called tophi.

2. External Auditory Meatus:

Foreign bodies (27, 38) in the canal are rather common in children. If a child, otherwise in good health, complains of a severe earache, a foreign body pushed into the meatus is probably the most likely cause. The foreign material usually causes a slight

laceration of the walls with resulting inflammation and pain.

A pea, small bean, or a grain of corn, or some other vegetable substance tends to swell under the influence of the warmth and moisture in the depth of the meatus producing an intense inflammation which might involve the tympanic membrane. In these cases, the only means of diagnosis is examination since the child will not give a definite history because of his fear of punishment. In adults who suffer from chronic discharge from the tympanum, it is not uncommon to have an inflammation and earache caused by a foul pledget of wool which the patient has forgotten to remove.

Impacted Cerumen: (27, 29, 38) It is not usual for wax to cause an earache, but will do so if it becomes hard and presses against the tympanic membrane. In such cases vertigo will be an outstanding symptom with earache secondary, except in very young children and infants. A plug of wax long retained in the meatus may start a dermatitis, producing an exudate which, on the inflamed surface, results in earache and, probably, some tenderness or pain behind the ear on the side of the head. These patients, many times, complain also of increased deafness and decreased autophony with, in some cases, discomfort and pain over the mastoid. In the presence of pain and giddiness, one must be careful not to mistake for impacted wax in the depths of the meatus, a brown colored, adherent accumulation which syringing fails to remove and difficulty is experienced in removing it with an aural hook or probe. Such conditions suggest a cholesteatomatous mass which is frequently associated with chronic suppuration in the tympanum or its adenexa (mastoid antrum and cells).

Furunculosis (19, 27, 28, 29, 38) is a rather common affection of the external meatal tube producing earache. This condition is usually caused by a staphylococcus infection of the hair follicle or sebaceous gland in the epidermic lining of the cartilaginous portion of the canal. The infection, in turn, causes an inflammation of the soft parts, which results in an irritation of nerve endings. Pain is the outstanding symptom and it is often more severe in the developing or presuppurative stage, owing to the restriction of the inflammatory edema. The pain is, usually, terrific by day and renders sleep impossible at night. The inflammatory process, in some cases, extends to the mastoid region with involvement of the mastoid branches of the great auricular and small occipital nerves. In such instances, the entire picture simulates that of an acute mastoiditis. In furunculosis, however, the auricle is very sensitive to touch and motion, and the pain is accentuated by any movement of the temporo-mandibular joint. Many times a boil is not at all easy to discover, and in these cases a small probe should be used, by which means a small area of tenderness may be discovered. If the boil is located in the anterior or inferior region of the canal, the tragus may be swollen and painful.

Diffuse inflammation of the meatus (31) causes acute pain within the ear accompanied by considerable pyrexia, some itching, and a watery discharge. Inflammation of this nature is usually predisposed to by seborrheic dermatitis or by irritation of the canal by chronic middle-ear discharge. Secondary infection gains

entry through fissuring of the skin or through trauma from scratching. On examination there is a generalized swelling of the meatus. The tympanic membrane is intact, but may be reddened, and is frequently partly or completely obscured by the swelling of the meatal walls.

Another pathological condition of the canal usually associated with a severe type of middle-ear infection is otitis externa hemorrhagica or hemorrhagic blebs of the canal (31), and is commonly seen during epidemic influenza. The patient complains of severe earache of a stabbing character, accompanied by tinnitus and deafness. Upon examination the meatus shows the presence of one or more hemorrhagic bullae in its inner osseous portion, usually on the roof or posterior wall, which may partially obscure the tympanic membrane.

Acute seborrheic dermatitis of the ear (31) is practically always secondary to seborrhea of the scalp. When it involves the auditory canal, the patient complains of pain in and around the ear, accompanied by itching, which may be very intense, and deafness, if the canal becomes blocked with debris. On examination one finds a swollen meatus with redness and scale formation and a little watery discharge.

Exostosis (29, 31), while not common, does occur in the bony meatus, and may be single or multiple. These are symptomless, except where there is an impaction of wax in the narrowed canal, or interference with drainage from a middle-ear infection. If, however, the growth becomes so extensive as to cause the lining of the walls to

contact, the resulting dermatitis would give rise to pain, although deafness would probably be a more outstanding symptom.

Carcinoma (31) of the meatus is also rare, but when it occurs it usually takes the form of a squamous epithelioma, producing a warty growth with a slight discharge and causing intermittent pain.

3. Tympanum and Membrane:

Acute otitis media (19, 27, 29, 38) is, by far, the most common cause of earache. Pain in this condition is practically always accompanied by those symptoms which are indicative of constitutional or general toxemia of a greater or less degree of severity. The onset is usually very sudden and the pain, which is the outstanding symptom, is steady, boring, or throbbing in character with occasional sharp twinges of greater intensity. Due to involvement of the auriculo-temporal nerve, pain may be felt in front of the ear, but it is of greatest intensity within the ear. Pain on pressure over the mastoid is practically always present during the first few days of otitis media and is not indicative, at this time, of mastoiditis or mastoidectomy. The chief difficulty in diagnosis occurs in infants who have not, as yet, learned to talk. In these cases, the subjective symptoms are of great importance. The infant, as a rule, is rather restless, fretting, crying, and occasionally screaming. They have a tendency to lie with the inflamed ear up. Not infrequently symptoms suggestive of meningitis will be outstanding. As the condition progresses towards suppuration, the pain becomes intensified and is often excruciating.

In chronic otitis media or chronic suppurative otorrhea (27, 38) pain is rare and earache should be regarded as significant because it means that septic inflammatory products are being retained, under tension, in the middle-ear or in its adenexa. Attacks of acute inflammation may recur in cases of chronic supuration causing an exacerbation of the latter with some earache. Although rarely severe, and never as bad as the pain of acute otitis media, the pain is usually felt in the tympanum, but it may spread to the mastoid, this being tender to pressure.

Eustachian tube (19, 27, 29, 31): Inflammatory involvement of the eustachian tube precedes, as a rule, that of the middle-ear. The pain is localized in the region behind the angle of the jaw, in front of the anterior border of the sternocleidomastoid, and below the lobule of the ear. It is often preceded by pain lower down in the region of the tonsil. The milder and fugitive forms of earache in children almost invariably imply a mild infection of the eustachian tube and middle-ear. Examination of the nasopharynx will frequently reveal that there is an abnormal degree of hypertrophy of the adenoids. Enlarged tonsils and adenoids may obstruct the orifice of the eustachian tube, bringing about a negative pressure in the middle-ear. Retraction of the tympanic membrane, which results from this condition, causes considerable pain. While this condition is practically confined to infants and children and appears mostly at night, it is becoming more of a problem in adults, due to our present day aviation. Due to the sudden changes in

altitude a positive or negative pressure is produced within the middle-ear. This condition depends entirely upon the functioning of the eustachian tube, and in cases in which the tube does not function properly or rapidly enough, severe earache becomes quite a problem (1).

Some rarer causes of earache (29) due to middle-ear involvement may be the result of: (1) Erosion of the attic roof or outer wall. Ulceration of the bone in this situation is usually accompanied by neuralgic pains above the ear, radiating to the vertex. The pain is possibly aggravated by a periostitic patch of the inner end of the meatal roof, which has been infected by extension from the attic erosion. Cases with large, open perforations of the tympanum or attic with a dry and completely healed lining, often complain of earache. This is especially true in cold weather or exposure to wind. (2) Non-suppurative diseases of the middle-ear such as: middle-ear catarrh and otosclerosis. In these conditions gradually increasing deafness is the dominant symptom, while earache is a minor one. In both the pain is periodical and of a fleeting, dart-like nature. (3) Earache may be a symptom of inflammatory lesions of the labyrinth or graver intracranial complication of middle-ear infection. Generally speaking, however, such pain is in the nature of a headache rather than an earache.

4. Mastoid

Acute mastoiditis (19, 29) is secondary to inflammatory infection of the middle-ear--which, anatomically, implies the

Eustachian tube, middle-ear, otitis, and mastoid antrum. With primary infection of the middle-ear, pain may be felt in the mastoid synchronously with that of the tympanic cavity. With the onset of middle-ear suppuration, however, the mastoid pain usually subsides, to develop later if suppuration activity in the antrum or air cells should ensue. In this condition there is, in most instances, periostitis and acute bone congestion with severe pain over the mastoid. The pain is at first deep seated and boring, due to the involvement of the mastoid branch of the tympanic nerve. The pain soon becomes more superficial and diffuse over the head and neck as the mastoid branches of the great auricular and small occipital nerves become irritated. Tenderness to pressure over the bony process is present only during the manifestations of pain. A diagnosis of mastoiditis is sometimes made in erysipelas of the external meatus, since the cutaneous involvement is many times accompanied by pain first noticed over the mastoid with a burning pain in the ear and high fever. Severe mastoid pain may also be present without middle-ear infection in cases of malignancy. Pressure over the bone in this condition produces an egg-shell cracking sound, which is considered as being pathognomonic.

OTALGIA

After a careful examination of the ear and no local cause can be found to explain an earache, the examiner must turn to those regions

from which pain might be referred or transferred. I, therefore, am following the plan of presentation used by Goldsmith (11), in which the causes of otalgia are discussed by considering these regions and their lesions separately.

1. In and about the auricle and canal (11, 29): Pain in and about the ear is frequently found in cellulitis of the scalp and usually occurs previous to the characteristic swelling of erysipelas. Inflammation of the small gland situated on the posterior part of the mastoid process gives pain which may be referred to either the auricle or within the ear. Pre-auricular lesions not uncommonly give rise to pain in the ear, and a styne on the eye-lid is a frequent cause of inflammation of the pre-auricular gland. The close association of the tempero-mandibular joint makes aural pain frequent in derangements of this joint, either of traumatic or arthritic origin. In tempero-mandibular arthritis pressure over the joint, or the opening or closing of the mouth will elicit pain within the ear. Such pain may also be produced by irregular chewing bites. Acute inflammation of the parotid gland, either as mumps or as postoperative parotitis, causes pain in the ear that may be both referred and radiating.

2. Jaws and teeth (11, 27, 28, 29): Earache is one of the commonest, and at times the only, indications of maleruption of the last molar, especially, but not exclusively, the mandibular one. The maxillary molar is occasionally at fault and is often overlooked.

The tender, carious tooth with pain in the ear is common, but the tooth may not always be tender. In such cases only careful dental and xray examination will decide the tooth at fault. In the absence of caries, the third molar, if unerupted, must be suspected, and, again, xray is the only definite means of diagnosis. Pain in the teeth, jaws, and ears, however, may be an early sign of tic douloureux, and one must be careful that good teeth are not sacrificed uselessly. Alveolar inflammation associated with dental caries or ^e cysts of the alveolar margin may be the cause of earache. Teeth around which the band of false teeth plays should be especially examined, since here the band wears the enamel, exposing the dentine which is readily irritated by changes in the temperature. Earache is commonly complained of during the meal in such cases, especially with very hot or cold food. Osteomyelitis, acute or chronic, bony tumors of the jaw, retained roots of teeth, and adamantinomatous teeth can readily cause otalgia. In the lower jaw the presence of bony cysts, however, may be confusing, being so situated that xray misses them. Goldsmith (11) cited a case in which pain was localized in front of the external auditory canal. This was found to be due to a cyst, undetected by xray, which encroached upon the mandibular nerve in its canal. He thinks that finger palpation of the teeth, palate, and alveolar margins is very helpful in locating suspicious areas otherwise undetected.

3. Nose and sinuses (2, 9, 11, 19, 26, 27, 29, 33, 36, 39):

The nose is a very infrequent seat of otalgia, but earache due to

to pressure of a highly deflected septum against the middle turbinate has been recorded (11). Inflammatory lesions of the paranasal sinuses do not often cause otalgia, in spite of the fact that the sensory nerve supply of these two areas is so closely related. In both sphenoiditis and posterior ethmoiditis the pain is referred to the mastoid region, and sometimes is felt in the depth of the ear. According to Sluder (33), the pain passes to the lower jaw and teeth extending beneath the zygoma to the ear to take the form of earache. He also states that the pain is emphasized at the mastoid, but is nearly always severest at a point about two inches posterior to the mastoid. This tender point is quite constant in nasal ganglion headaches.

The work of Fenton and Larsell (9) concerning the sphenopalatine ganglion was the result of their interest in an otalgic girl whose mastoid had twice been open fruitlessly by an ill-advised colleague. Her otalgia disappeared completely after wide opening of a sphenoidal empyema, invisible to xray.

In all cases of otalgia due to sphenoiditis, mastoid tenderness is so marked that acute mastoiditis is the usual diagnosis. The pain and suffering, however, are clinically out of proportion to any possible cause in the mastoid region. The symptoms continue over a period of years without any gross pathology. There is no relief from mastoidectomy or cocainization of the nasal ganglia, while opening of the sphenoid and ethmoid sinuses results in marked amelioration of the mastoid symptoms. In those cases which have a

definite history of otorrhea and pyrexia, a diagnosis is extremely difficult to make, especially in those instances where there are no signs of nasal pathology. The only means of diagnosis is xray and in case this fails to show any pathology an exploratory should be done.

Suppuration within the antrum very seldom causes pain in the ear, but may do so. Watson-Williams (38) reported a case in which the pain was of a throbbing character, being worse at night. The mastoid was slightly tender, the temperature high, but the ear and nose showed no pathological findings. The diagnosis was made by an exploratory of the antrum--with complete recovery.

Sepsis in the cells of the ethmoid region may cause changes around the eustachian tube which results in earache. Carcinoma in this region has also been known to cause referred pain to the ear.

4. Mouth and tongue (11, 12, 19, 27, 28, 29): Lesions within the mouth and on the tongue are another rather common cause of otalgia. In making an examination of the mouth in such cases, it is essential to have good illumination and thorough exposure. Lesions of the mouth cause pain that is usually located within the ear and external auditory meatus, with the greatest intensity just in front of the ear. Ulceration of the hard palate, carcinoma of the cheek, infiltrating or ulcerating areas of the floor of the mouth at the junction with the under surface of the tongue, and involvement of the gums, as in Vincent's or pyorrhea, are conditions within the mouth that give rise to referred pain within the ear.

Ulcerations or erosions of the tongue may cause intense, constant, or intermittent pain in the ear which is always aggravated by mastication of food. Infiltrating leucoplakia, probably early carcinoma, carcinomatous and non-malignant warts, and neoplasms of the tongue might also give rise to painful sensation in or about the ear.

Inflammation and edema of the soft palate, accompanying peritonsillitis, or as the result of acute inflammation following removal of the tonsils, tuberculous ulceration, or epithelioma may produce an otalgia of a rather severe character.

Enlargement of the submaxillary gland, owing to either inflammation or to blocking of the duct by a stone, causes referred pain to the ear that is of an indefinite character. Diagnosis is aided by the intake of a small amount of food, since this will increase or bring on the pain. A stone in Wharton's Duct usually causes a hardness that may be felt along the line of the duct.

5. Pharynx (11, 19, 28, 29, 37): Pathological conditions of the fauces and tonsils are rather common sources of referred pain in the ears. Acute tonsillitis is often accompanied by a discomfortable sensation in the ears, while quincy, on the other hand, causes severe pain. Encysted abscesses, malignancy, tuberculosis, or specific ulceration in this area are other, not infrequent, causes of otalgia. Recurring tonsil inflammation or small abscesses on the tonsils, although appearing insignificant, may be productive of a very worrying type of earache. Also one must not forget to warn a patient

of the possibility of an earache following tonsilectomy. This ache is present during the first few days or does not appear until the fourth or fifth postoperative day, and is made worse by swallowing.

Painful ulceration, carcinoma, tuberculosis, or specific disease of the epiglottis readily causes referred pain to the ear. Growths deep within the pharynx and acute inflammation of the deep lateral pharyngeal wall will cause an intense earache.

Pain from a lesion in this region might also be referred to the mastoid as well as with in the ear. Such a condition is illustrated by Tilley's (37) case in which pain in the right ear and mastoid region was due to an accumulation of septic products in the corresponding tonsil.

6. Nasopharynx (11, 29, 37): Growths in the neighborhood of the eustachian tube, either carcinoma, sarcoma, or fibroma, are other likely causes of otalgia. It should be remembered that in young persons (under 25), the nasopharynx is the most frequent site of carcinoma.

Another important observation to be made in this area with reference to otalgia is that connected with Rosenmueller's Fossa. Early Carcinoma here is a common cause of earache referred through the palatine branches of the sphenopalatine ganglion. Later, when the disease reaches the sphenomaxillary fossa, the second division of the fifth nerve is involved directly and the ear pain is increased with upper jaw pain added. It is hard to examine this area but nothing justifies failure to see the entire vault under good

illumination.

Nasopharyngeal fibromas, with or without extension into the posterior sinuses, and ulcerations, malignant or specific located on the posterior wall of the nasopharynx or about the tubal orifice readily cause ear pain. Acute lymphoid inflammation, including tubal tonsils, may produce pain without tympanic changes. Tubal strictures must also be included, but this may be tympanic pain due to excessive indrawing of an extraordinary sensitive membrane. In adults, earache is sometimes caused by infection with chronic abscess formation in the masses of adenoid tissue.

8. Laryngopharynx (11, 19, 28, 29): The lateral part of the pharynx passes down externally to the larynx into a recess called the pyriform fossa or sinus, and this area is a very favorite seat for carcinoma. When present, even in the early stages, in the bottom of the recess, the lateral wall, or creeping behind and external to the arytenoid ear pain is common. Otalgia in this case, however, is of rather bad significance since it denotes an infiltrating lesion involving the external branch of the superior laryngeal nerve. Abermetny (quoted by Goldsmith)(11) states, "A lump in the neck with pain in the ear means cancer of the throat."

The laryngopharynx passes posteriorly behind the arytenoid and larynx to the upper edge of the cricoid forming a potential space. According to Goldsmith(11), this area should also be examined, especially in cases of earache associated with even slight dysphagia. He claims that it is surprising how frequently extensive carcino-

matous involvements are found.

Glandular enlargement and tumors of the neck, such as goiter, cause pain behind the ear due to involvement of the great auricular and small occipital nerves.

8. Larynx (11, 25, 27, 29): Referred pain to the ear is common in ulcerative lesions in the larynx. Otagia is usually late in tuberculosis, or in malignancy when the disease has passed beyond the confines of the cords, or becomes the type spoken of as extrinsic. Tuberculosis of the larynx or an ulcer on the posterior wall will often give pain referred only to the ear and not to the throat. In advanced carcinoma of the larynx the pain may be in one or both ears and is quite often of such intensity that it interferes with sleep.

Posterior cricoid carcinoma, a condition arising in the upper end of the esophagus, may be responsible for referred pain to the ear at an early stage in its growth. It is decidedly more common in females and earache in the absence of any inflammation of the ear or deafness should, in females over fifty years of age, attract attention to any throat symptoms present and to examination for post-cricoid carcinoma.

9. Cervical spines and glands in the neck (11): Otagia from this region is referred to the ear through the great and small occipital and great auricular nerves. Caries of the spine, cord tumors, lesions of the articular surfaces, Pott's Disease, and deeply descending retropharyngeal abscesses, if not below the second or third cervical roots, have to be considered. Extensive surgical

procedures high up in the neck may be followed by pain in the ear due to the nerves being caught in the cicatrix. The pain induced is usually localized in the auricle since its greater portion is supplied by the above mentioned nerves.

Angel Jones reports in The British Medical Journal of January, 1933 (quoted by Goldsmith)(11) a case of hyperesthesia of the lobe of the ear and paresis of the lower lip on the same side following radium needles and subsequent surgery for a retrocricoid carcinoma. Goldsmith(11) also had a case of carcinoma of one half the epiglottis with no earache until months after the epiglottis was removed and radium needles were put into the neck for the associated adenitis.

10. Intracranial and rare cases(11, 17, 22, 27, 37, 39):

E. Watson-Williams(39) cited a case in which an earache was found to be the symptom of an aneurysm of the Circle of Willis. Such a case was also reported by Tilley(37). Angel Jones (quoted by Tilley) (37) records a case whose mastoid was opened because of pain, and the cause was found to be due to an aneurysm of the basilar artery. Goldsmith(11) had a case of otalgia resulting from an aneurysm found on the right vertebral artery.

Hunt(22) presented a case in which the patient had sharp lancinating pain like the prick of a needle in the depths of the ear. This pain was very sharp and was frequently accompanied by sudden, reflex jerks of the head. The cause was diagnosed as tabetic otalgia in which there was a degeneration of the Nerve Of Wrisberg.

Another rare condition was reported by Tilley(37) in which the

patient was complaining of pain in the right ear accompanied by discomfort in the right half of the soft palate. Examination disclosed an ulcerating gumma on the pharyngeal orifice of the eustachian tube. This symptom disappeared completely with antisyphilitic treatment.

A boy, age ten, complained of a bad earache of a few hours duration following a chill. On examination, the ear was normal and there was no tenderness. A general examination revealed a consolidation of the left lower lobe of the lung, and a diagnosis of pneumonia was made. This case was reported by Watson-Williams(39).

In considering the causes of otalgia, one must not neglect the condition known as Bell's Palsy. While this condition usually has rather definite characteristic symptoms, the initial symptom, many times, is simply an earache, the pain being posterior and somewhat below the ear. It also follows an attack of palsy in many instances.

11. Herpetic Otagia(7, 8, 19, 20, 21, 23, 32): Herpetic otalgia may be caused by an inflammatory process in any of the six sensory ganglia that supply the ear with sensation; gasserian of the fifth, second and third cervicals, jugular of the vagus, petrous of the ninth, and the geniculate of the seventh.

Most cases of herpetic otalgia are ushered in by mild prodromal symptoms such as; a feeling of malaise followed by a slight temperature and a feeling of general discomfort or aching. Or they may be more severe with a feeling of general illness and severe

headache, succeeded, sometimes, by a violent chill with nausea and vomiting (depending upon the ganglion affected). There may, however, be no marked initial symptoms, the disease arising suddenly with or without a chill and violent pain being the first symptom.

Herpes auricularis may be caused by inflammation and changes in the geniculate ganglion. The first symptom, in most cases, is a severe pain in the ear, lancinating, throbbing, or deep aching in type. The pain may result in a high degree of intensity, radiating to adjacent areas and prostrating the patient by its violence. On the third to fifth day the typical patches of herpetic vesicles make their appearance. Hunt(20, 21, 23) reports a case with an onset of headache, vomiting, and a slow irregular pulse. On the fourth day the acuteness of the pain subsided and settled in the mastoid region. On the fifth day herpetic vesicles made their appearance on the anti-tragus and the lobule of the ear, which suggested geniculate ganglion involvement. On the sixth day vesicles appeared on the mesial surface of the lobule and pinna. The frequent vomiting and the slow irregular pulse in this case strongly suggested a vagus disturbance and parts of the area of distribution of the eruption corresponds to the cutaneous filaments of this nerve. Herpes zoster of the auricle may be followed by severe neuralgic pains in the ear and mastoid region, depending upon the changes in the geniculate ganglion.

If the upper cervical ganglia are chiefly affected, the first sensory symptom may be a sense of burning discomfort over the neck and occiput, which later develops into pain of the type as above

described. The pain usually gives way after the appearance of the eruption, but may persist as a postherpetic pain for many months, and may take the form of violent otalgia or mastoidalgia. These sensory symptoms may be more annoying at night, causing loss of sleep. If the ganglion of the eighth nerve should be involved, deafness, vertigo, nystagmus, and loss of equilibrium will be added to the general symptoms. Involvement of the ninth and tenth nerves produce vesicles in the pharynx and larynx, in addition to the external lesions. In those cases with eruption on the tympanic membrane, if pain and tenderness over the mastoid are present, together with pain in the ear and fever, otitis media is frequently suspected and the true condition may be overlooked (7).

NEURALGIA

Idiopathic (19): This condition is attributed to neuralgia of the third division of the fifth nerve or of the great auricular and occipital nerves, depending upon the position of the pain. Hunt (23) believes that there is an idiopathic primary otalgia of the sensory portion of the seventh nerve. The pain is very severe, lancinating, paroxysmal, and neuralgic in character, being localized within the ear, on the anterior wall of the external auditory meatus, and just in front of the ear.

Glaser (10) reported a study of twelve cases all complaining of some form of earache, which was found to be caused by neuralgia of one of the six sensory ganglia connected with the ear. He divided

primary neuralgia of the auricle, external auditory meatus, and tympanic membrane into two types: (1) acute, lancinating attacks of pain of short duration, with or without sympathetic phenomena, and caused by neuralgia of the glossopharyngeal and facial nerves; (2) insidious, lengthy attacks of pain, simulating migraine, and located in the sensory areas of the cervical, vagus, and possibly the facial nerves. Because of the extensive overlapping of the sensory supply, novocaine injection is the only means to be used in differentiating neuralgia of the cervical plexus, trigeminal, facial, glossopharyngeal, and vagus nerves. In some cases, however, differentiation is made still more difficult because of a past history of ear pathology.

In glossopharyngeal neuralgia (15, 28) the pain commonly begins in the pharynx, tonsil, or at the base of the tongue. It then radiates to the inner portion of the ear; to the lobule, meatus, and concha; or immediately anterior, or posterior to the pinna. In a few cases reported, however, the pain originated within the ear and in the lobule of the pinna. Regardless of the origin of the pain, it is invariably caused by swallowing, chewing, etc, and it is always excruciating, sharp, and lancinating. The pinna may be sensitive to touch and paroxysms of pain may be induced from this location. The individual attacks last only a few seconds and usually occur in a series, lasting from a few days to a few weeks. The pain is thought to reach the ear through Jacobson's nerve, but since the glossopharyngeal has no sensory distribution in the pain areas about

the ear, it is assumed that pain is also referred through the trigeminal and vagal branches in this region.

Trigeminal neuralgia (18, 19, 25) seldom attacks the ear alone, earache being only a small part of the pain. Cases, however, are reported in which the auriculo-temporal nerve was principally attacked, with severe attacks of pain localized in the outer anterior portion of the canal. At times this pain is also referred to the posterior area associated with the great auricular nerve. Jugular thrombosis has been reported to be accompanied, in some instances, by trigeminal neuralgia with referred earache.

Hall (14) reports a case of severe attacks of earache in which the pain was confined to the outer shell of the ear, especially the lower portion, and involving, to a less extent, the lobe of the ear. These attacks of pain were diagnosed as being due to neuralgia of the greater auricular nerve. The distribution of pain, as a rule, is behind the ear over the back of the head and neck. Tender spots may be felt between the mastoid and spine, above the parietal eminence, and between the sternocleidomastoid and trapezius muscles. This condition may arise from riding or sitting in a draft, especially in hot weather (29).

Neuralgia involving the sensory division of the seventh nerve appears to be rather rare, but occasionally does occur (3, 17, 34). The pain is very severe and, most often, occurs in spasms, but at times there may be a steady pain localized in the depths of the ear, on the anterior wall of the external auditory meatus, with paroxysms of stabbing pain in front of the ear and in part of the pinna.

Harris (16) states that geniculate or otic neuralgia produces paroxysms of pain with a sudden onset and a marked intensity, simulating chronic trigeminal neuralgia. The distribution begins in the throat or posterior palatal region and spreads into the ear, in front of the ear onto the cheek, and down the side of the neck.

Aural neuralgia of dental origin has been reported (30). The patient complains of a severe and rather constant earache, but not suggesting the throbbing, continuous, intensifying pain of an acute otitis media. The pain may be intermittent, and may be elicited by hot or cold liquids or foods. X-ray examination is sometimes necessary in order to make a positive diagnosis.

Neuralgia of the nasal ganglia (25, 34) will give rise to the symptom of earache, although probably not as commonly as the above mentioned. In these cases the pain is very severe and at times the severity makes examination difficult. The sphenopalatine ganglion is the common seat of this condition. At times, neuralgia of this ganglion causes pain over the mastoid and simulates acute mastoiditis. The fact that these patients have a normal temperature is of great diagnostic value.

As in pain of other regions, earache may be of a psychic basis and might be regarded as an outward manifestation of a neurotic conflict, the pain having its origin in the cerebral cortex and from here projected to the periphery (19). Persistent pain over the mastoid, either with or without digital pressure, is frequently quite disturbing. Because of this, mastoid operations have been

performed as many as three and four times on neurotic women, who have had, at some time, tympanic suppuration. Goldsmith (11) cites one case in which the patient had been operated four times, with immediate relief. A relapse would occur, however, when economic conditions made it better for her to be in a hospital at the public's expense. She had learned the symptoms of acute mastoiditis and used them. Her last attack was cured with only a skin incision, under anesthesia.

Watson-Williams (39) had a patient with severe left earache, intense tenderness to the lightest touch on the mastoid, giddiness, and falling, but no nystagmus or nausea. Xray showed a normal mastoid and a diagnosis of hysterical neurosis was made. When the patient learned that no operation was necessary, he lost all pain.

SUMMARY

The commonest causes of earache are pathological conditions of the ear itself.

In an investigation of pain in the ear, when one has satisfied himself that no local, irritating process is present, a thorough systemic examination should be made. Good illumination and exposure are extremely important when making an extensive examination of the mouth, nasopharynx, pharynx, larynx.

A definite knowledge of the sensory and sympathetic nerve supply of the ear is the only hope in making a diagnosis of referred earache, because pain is not easy to locate as to source.

Neuralgia of the sensory ganglia associated with the sensory supply to the ear will give rise to severe earache. The only definite means of differentiation is by cocainization of the various ganglia, since their sensory areas have such an extensive overlapping.

If an organic cause for an earache is ruled out entirely, the examiner must not neglect the possibility of a neurotic conflict. One must be certain of the source of pain, before extensive surgery is performed.

BIBLIOGRAPHY

1. Armstrong, Harry G.; Heim, J. W. Medical Problems of High Altitude Flying. The Jour. of Lab. & Clin. Med. 26: 263-271, 1940.
2. Casselberry, W. E. Attenuated Types of Suppurative Sphenoiditis in relation to So-Called Post-Nasal Catarrh, to Headache with Mental Daze, and to Asthma. Trans. of the Amer. Laryngological Ass. 92: 105, 1911.
3. Clark, Pierce; Taylor, Alfred S. True Tic Douloureux of the Sensory Filaments of the Facial Nerve. Jour. of the Amer. Med. Ass. 53: 2144-2146, 1909.
4. Clerf, Louis H. Control Through the Nasal Ganglion; Earache of Laryngeal Origin. Jour. of the Amer. Med. 82: 630, 1924.
5. Colledge, Lionel Referred Pain. Proc. of the Royal Soc. of Med. 25: 56-59, 1932.
6. Costen, James B. Neuralgias and Ear Symptoms Involved in General Diagnosis Due to Mandibular Joint Pathology. Jour. of the Kansas Med. Soc. 36: 315-321, 1935.
7. Dennis, Frank L. Herpes Zoster Oticus. A case with Involvement of the Fifth, Seventh, Eighth, and Ninth Cranial Nerves, and with Complete Vestibular Examination. Laryngoscope. 35: 665-674, 1925.
8. Emerson, Francis P. Report of Two Cases of Herpes Zoster Oticus with Special Reference to their Etiology. Laryngoscope. 34: 137-139, 1924.
9. Fenton, Ralph A.; Larsell, O. The Embryology and Neurohistology of the Sphenopalatine Ganglion Connections; A Contribution to the Study of Otalgia. Trans. of the Amer. Otol. Soc. 18: 183-209, 1928.
10. Glaser, Mark Albert Acute Primary Auricular Neuralgia as a Cause of Earache. Western Jour. of Surg., Ob., & Gyn. 46: 355-369, 1938.

11. Goldsmith, Perry C. Referred Pain in the Ear. Trans. of the Amer. Otol. Soc. 24: 201-223, 1936.
12. Grant, Sir Jones Dundas Discussion on Earache. Trans. of the Med. Soc. London. 52:161, 1929.
13. Gray, Henry Anatomy of the Human Body. Philadelphia. Lea and Febiger. 1936.
14. Hall, George W. Auricular Neuralgia. Trans. of the Amer. Neur. Ass. 58: 261-264, 1932.
15. Hansel, French K. Glossopharyngeal Neuralgia: A Report of Five Cases. Ann. Otol. Rhin. Laryng. 37: 440-450, 1928.
16. Harris, Wilfred Some Experiences with Alcohol Injection in Trigeminal and Other Neuralgias. Jour. of the Amer. Med. Ass. 63: 1725-1731, 1914.
17. Harris, Wilfred Neuritis and Neuralgia. New York, Oxford University Press. Humphrey Milford. 1926.
18. Howard, C. Norman Otagia: Some Practical Points in Differential Diagnosis. Jour. of the Ind. State Med. Ass. 18: 378-380, 1925.
19. Hubert, L. The Study of the Mechanism of Pain as Seen in Otological Cases. Laryngoscope. 33: 596--608, 1923.
20. Hunt, J. Ramsay Herpetic Inflammations of the Genuiculate Ganglion; A New Syndrome and its Complications. Jour. of Nerv. and Men. Dis. 34: 73-95, 1907.
21. Hunt, J. Ramsay A Further Contribution to the Herpetic Inflammations of the Genuiculate Ganglion. Amer. Jour. of Med. Sciences. 136: 226-241, 1908.
22. Hunt, J. Ramsay The Sensory System of the Facial Nerve and its Symptomatology. Jour. of Nerv. and Men. Dis. 36: 321-349, 1909.
23. Hunt, J. Ramsay The Sensory Field of the Facial Nerve; A Further Contribution to the Symptomatology of the Genuiculate Ganglion. Brain. 38: 418-444, 1915.
24. Kully, H. E. Earache. Lecture Midwest Medical Society October 29, 1940.

25. Lillie, Harold I. Otaglia and Mastoidalgia; Not Indications for Operation on the Mastoid Process. Jour. of the Amer. Med. Ass. 79: 431-434, 1922.
26. Lyman, H. W. Simulated Mastoiditis Relieved by Sphenoidectomy. Laryngoscope. 34: 948-955, 1924.
27. McCrea, Moreland; Tilley, Herbert M. Discussion on Earache. Trans. of the Med. Soc. London. 52: 148-164, 1920.
28. Mollison, W. M. Earache. The Practitioner. 141: 577-585, 1938.
29. O'Malley, John F. Earache and its Treatment. The Practitioner. 133: 234-250, 1934.
30. Richards, George L. Aural Neuralgia of Dental Origin with Report of Cases. Trans. of the Amer. Laryng. Rhin. Otol. Soc. 1905.
31. Scarff, Gordon Affections of the External Ear. The Practitioner. 141: 586-593, 1938.
32. Sears, W. Hardin Herpes Zoster Oticus. Trans. of the Amer. Acad. of Ophth. & Otolaryng. 406-431, 1926.
33. Sluder, Greenfield The Syndrome of Sphenopalatine Ganglion Neurosis. Trans. of the Amer. Laryng. Ass. 234-247, 1910.
34. Sluder, Greenfield Nasal Neurology, Headaches, and Eye Disorders. St. Louis. The C. V. Mosby Co. 1927.
35. Starr, M. Allen A Case of Neuralgia Limited to the Sensory Filaments of the Seventh Nerve. Jour. of Nerv. & Men. Dis. 35: 583, 1908.
36. Taylor Charles B. A Study of The Nervous System with a View to Understanding Otic Pain. Jour. of the Iowa State Med. Soc. 15: 537-539, 1925.
37. Tilley, Herbert Earache of Reflex or Referred Nature. Proc. of the Roy. Soc. of Med. 22: 67-73, 1929.
38. Tremble, G. Edward The Common Causes of Earache. Jour. of the Canadian Med. Ass. 24: 808-813, 1931.
39. Watson-Williams, E. Pain Referred to the Ear. British Med. Jour. 1: 92-94, 1933.

40. Wilson, J. Gordon The Nerves and Nerve Endings in The Membrana Tympani of Man. Amer. Jour. of Anat. 11: 101-112, 1910-11.
41. Wolfe, Russel F. Otodynia Diagnosis and Treatment. The West Virginia Med. Jour. 29: 340-345, 1933.