

Etiology of Referred Otalgia

Zhraa Abd-Alkader Taboo*, Marwan F.Buraa**

ABSTRACT:

BACKGROUND:

Otalgia is defined as ear pain. It is one of the complaints which may occur at any age. The etiology of the pain may be in the ear, structures around the ear or other head and neck structures. This is caused by the complex nervous connections in the head and neck areas, the ear, the pharynx and the nose. Objective: since understanding the etiologies of referred otalgia can help in the assessment and treatment of the disease, this research was conducted to identify the etiologies of referred otalgia in patients visiting the ENT Clinic in Mosul, Iraq.

OBJECTIVE:

Since understanding the etiologies of referred otalgia can help in the assessment and treatment of the disease, this research was conducted to identify the etiologies of referred otalgia in patients visiting the ENT Clinic in Mosul, Iraq. We have reviewed the complex neuroanatomic basis of nonotogenic ear pain.

PATIENT AND METHODS:

A prospective study of 211 patients with ear pain. During a 12 month period from 2010 to 2011, two hundred and eleven patients with otalgia were studied, they were attendants of the outpatient clinic of ENT department in Al-Jumhuri Teaching Hospital. Patient age, gender, occupation, residence were recorded in a representative questionnaire form. All patients had a normal otologic examination and diagnosed with causes for referred otalgia were categorized according to distribution of cranial nerve, gender and age.

RESULTS:

The majority of causes of otalgia (64%) were due to referred pain, while only (35.5%) of causes were due to ear lesions. Significantly referred pain affected patients above the age of 15 years more than those below the age of 15 years. The most common cause for referred otalgia in females was Temporomandibular joint (TMJ) dysfunction (29.2%); while cervical spine lesion was commonest in males. The trigeminal nerve was the major cranial nerve causing referred pain in both genders (53.7%).

CONCLUSION:

Since the early 1900s, referred otalgia has been a well-documented phenomenon in the ear, nose, and throat (ENT) and neurosurgical literature. However, essentially any pathology residing within the sensory net of cranial nerves V, VII, IX, and X and upper cervical nerves C2 and C3 can potentially cause referred otalgia. A thorough understanding of the various sensorineural pathways that dually innervate the ear and other sites and ongoing dialogue with our clinical colleagues, will ensure that patients with referred otalgia will receive the best care in the head and neck.

KEY WORD: otalgia, neuroanatomy, trigeminal.

INTRODUCTION:

Ear pain (otalgia) can be divided into 2 main categories: primary and secondary. Primary ear pain is an entity whereby the origin of the pain arises from the ear itself. Common

disease processes resulting in primary otalgia include otomastoiditis, cholesteatoma, and foreign bodies lodged within the ear canal. In close to 50% of cases, however, the source of the pain does not reside within the ear but, rather, originates from sources distant from the ear so called "referred otalgia"^(1,2)

*Department of Anatomy-Embryology - Nineveh Medical College Nineveh Medical College/ University of Mosul.

**ENT Department. Al-Jumhuri Teaching Hospital. Mosul- Iraq.

Often, referred pain is caused by nerve compression or irritation. In this circumstance, the sensation of pain will generally be felt in the territory that the nerve serves (ie, somatic dermatome) even though the damage originates elsewhere (ie, visceral tissue)⁽³⁾. The ear is unique in that no other structure in the body of comparable size is supplied by so many sensory nerves from so many neural segments. The sensory innervation of the ear is supplied through a combination of four cranial nerves (CN V, VII, IX, and X) and two superior cervical plexus nerves (C2 and C3). Presumably this complex innervation serves as an evolutionary advantage as hearing is a necessary survival tool, and any pain perceived in that area causes a heightened sense of alarm. The differential diagnosis is specifically related to the sensory innervation of the ear, and therefore it is imperative that the otolaryngologist have a working knowledge of the complex neuroanatomic innervation of the external and middle ear.

Among all causes of referred otalgia, dental pathology, which transmits referred otalgia via a branch of the trigeminal nerve, is the most common source of nonotogenic pain.⁽⁴⁾ This was demonstrated by a previous study by the author (JPL), where the most common cause of referred otalgia with a normal-appearing ear was dental (74%)⁽⁵⁾. Furthermore, the cause of referred otalgia can also be referred pain from the mouth, teeth, larynx, or thyroid gland; neural, vascular, or lymphatic structures of neck; or the esophagus^(6,7). Elongation of the styloid process or ossification of the stylohyoid ligament may produce otalgia along with vague and facial pain. The incidence of this problem has been estimated to be as high as 28 per cent.⁸

Nerve Pathways and Etiologies in Referred Otalgia⁹⁻¹⁰⁻¹¹⁻¹².

Auriculotemporal nerve (CN V). The auriculotemporal nerve derived from the mandibular division of the trigeminal nerve courses with the superficial temporal artery anteriorly to the external ear. The auriculotemporal nerve supplies sensory afferents to the tragus, anterior auricle, anterior wall of the external canal, and anterior portion of the lateral tympanic membrane. Due to the length and extensive distribution of the auriculotemporal nerve, it is the nerve that is

most commonly involved in referred otalgia. Temporomandibular joint (TMJ) disease and dental pathologies are associated with referred otalgia by way of the auriculotemporal nerve. Posterior auricular nerve (CN VII). The posterior auricular nerve, which is the first extracranial branch of the facial nerve, sends sensory afferents that provide innervation of the posterior wall of the external auditory canal, posterior lateral surface of the tympanic membrane, and posterior skin of the auricle. Otalgia referred from the facial nerve may also occur following an outbreak of herpes zoster (prior to vesicle eruption). Jacobson's nerve (CN IX). Jacobson's nerve, a derivative from the glossopharyngeal nerve, joins with the caroticotympanic branches from the sympathetic plexus to form the tympanic plexus. This plexus provides sensation to the middle ear, upper eustachian tube, and medial surface of the tympanic membrane. Referred otalgia transmitted by the glossopharyngeal nerve may be secondary to lesions and/or inflammatory processes of the nasopharynx, palatine tonsil, soft palate, or posterior one-third of the tongue. Arnold's nerve (CN X). Arnold's nerve, the auricular branch from the vagus, divides into a superior branch, which sends a small branch to the facial nerve sheath, and an inferior branch, which is joined by a small branch from the facial nerve. The inferior branch provides sensation to the inferior and posterior aspects of the external auditory canal, to the concavity of the concha, and finally to the lateral surface of the tympanic membrane. Thyroiditis, thyroid tumors, laryngeal carcinomas, and gastroesophageal reflux can present as referred otalgia secondary to irritation of the superior laryngeal nerve, a branch of the vagus nerve. Greater auricular and lesser occipital nerve (cervical plexus). The greater auricular and lesser occipital nerves, derivatives from C2 and C3 of the cervical plexus, course over the sternocleidomastoid muscle to innervate the posterior auricle and the skin overlying the mastoid bone and parotid gland. Pathology of the cervical spine that may present as referred otalgia includes cervical spine degenerative diseases (eg, osteoarthritis, cervical facet syndrome, spondylosis, disc herniation, and stenosis), whiplash injury, and cervical meningiomas. Several neuralgias have been

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implicated in causing otalgia. Most sources group neuralgia into primary and secondary categories, with primary causes being idiopathic and physiologic in disturbance and secondary neuralgia arising from a distinct anatomic abnormality, such as a compressive tumor or vessel. Trigeminal (V) neuralgia is the most common cranial neuralgia but has only been loosely linked to referred otalgia.

Geniculate (VII), glossopharyngeal (IX), vagal (X), sphenopalatine, and occipital neuralgias are much less common than trigeminal neuralgia, but all are widely documented as causing pain in the ear^(13,14,15,16).

In this prospective study, we have reviewed the complex neuroanatomic basis of nonotogenic ear pain, the prevalences of various etiological causes that have elicited this type of pain among our patient population.



PATIENT AND METHOD:

During a 12 month period from 2010 to 2011, two hundred and eleven patients with otalgia were studied, they were attendants of the outpatient clinic of ENT department in Al-Jumhuri Teaching Hospital, in Mosul city. The hospital is located in the right bank of Tigris river and it delivers services to many areas in Mosul city. Patient age, gender, occupation, residence were recorded in a representative questionnaire form.

A thorough history, regarding the nature of the pain, duration of pain, associated symptoms, exacerbating and relieving factors, any history of dental surgery or trauma, dental pain, also if there is history of neck pain, aural foreign body or foreign body ingestion, sore throat or symptoms related to nerves supplying the ear. Complete examination of the ear was done by inspection, palpation, then by auriscope or aural speculum. Siegle pneumatic speculum to show tympanic membrane mobility. Up to this most of the ear diseases can be diagnosed and other investigations will help us so: Pure tone audiometry and tuning fork also to confirm conductive deafness. Tympanometry to rule out the presence of fluid in the middle ear. radiology of postnasal space to rule out adenoid or other lesions, radiology of mastoid bone to confirm mastoiditis.

If all above are negative we proceed to

examine other parts of the body starting from the (mouth, tongue, tonsils, pharyngeal walls, teeth for missing or malocclusions, opening of parotid gland), then proceed to the nose with anterior and posterior rhinoscopy. clinical and radiological examination of paranasal sinuses and cervical spine. However larynx examine either by mirror or by flexible laryngoscopy. assessment of neck lymph node, parotid gland, goiter enlargement. TMJ check for crepitus, pterygoid spasm. Panoramic radiographs were used when required. CT scan, MRI these are only done when there are associated symptoms suggestive of malignant diseases.

STATISTICAL METHOD:

Statistical analyses of data were carried out and data were expressed as number and percentage. The Z-test of proportions for comparison between various groups was obtained for assessing the level of significance. The statistical results were considered significant at P-value equal or less than 0.05.

RESULT:

In the ENT department of Al-Jumhuri teaching hospital, 211 patients with otalgia from 2010 to 2011 were studied. The referred pain was the correct diagnosis in 136 cases (64.5%), while ear lesions were only found in 75 cases (35.5%) and this is shown in figure 1.

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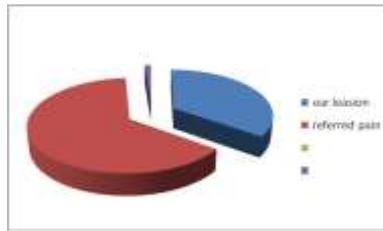


Fig1: types of otalgia.

The distributions of causes for ear pain with their respective sensory innervations are shown in Table 1. All cranial and cervical ear sensory nerves are represented within our patient population, The trigeminal nerve was the major cranial nerve causing referred pain in both gender (53.7).

Table1: Cranial nerve distribution.

cranial nerve	male		female		Total	
	No.	%	No.	%	No.	%
Trigeminal nerve	20	42.6	53	59.6	73	53.7
Cervical plexus	17	36.1	16	18	33	24.3
Glossopharyngeal nerve	7	14.8	18	20.2	25	18.3
Vagus nerve	2	4.3	1	1.1	3	2.2
Fascial nerve	1	2.1	1	1.1	2	3.2
total	47	34.6	89	65.4	136	100

Concerning to Referred pain ,age and gender,for 47 males, the ages was from 4-65yr with a mean age of 42yr, while for 89 females, the ages ranged from 4-63yr with a mean age of 38yr. table2 show that cervical lesions were

the major cause in males(36.1)"p-value significant",while TMJ dysfunction was the major cause in females (29.2%)"p-value not significant. In both gender dental proplems were the major cause(26.5%).

Table 2: Gender distribution of referred pain.

Diagnosis	male		female		Female : Male Ratio	Total		*P value
	No.	%	No.	%		No.	%	
Dental proplem	11	23.4	25	28.1	2.3:1	36	26.5	N.S**
TMJ dysfunction	8	17.1	26	29.2	3.2:1	34	25	N.S
Cervical spine lesion	17	36.1	16	18	0.9:1	33	24.3	<0.05
Post tonsillectomy	4	8.5	7	7.9	1.7:1	11	8.1	N.S
Tonsillitis	2	4.3	7	7.9	3.5:1	9	6.6	N.S
Pharyngitis	1	2.1	3	3.4	3:1	4	2.9	N.S
Sinusitis	1	2.1	2	2.2	2:1	3	2.2	N.S
Quinsy	1	2.1	2	2.2	2:1	3	2.2	N.S
Ca larynx	2	4.3	-	-	0:2	2	1.5	N.S
Ca thyroid	-	-	1	1.1	1:0	1	0.7	N.S
total	47	34.6	89	65.4	1.9:1	136	100	

*z test was used between males and females

**no sigificant

Regarding age, in patient below 15yr,post-tonsillectomy pain was the major cause(42.9)"p-value significant",while in

patient above 15yr, TMJ dysfunction was the major cause(27.9%)"p-value significant" other causes are seen in table 3.

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Table 3: Age distribution of referred pain.

Diagnosis	Below 15 yr		15yr and above										P *value		
			15-30yr		31-45yr		46-60yr		>60yr		Total			Total	
	no	%	No.	%	No.	%	No.	%	No.	%	No.	%		No.	%
Dental proplem	3	21.4	11	31.4	12	25	9	29.1	1	12.5	33	27.1	36	26.5	** N.S
TMJ dysfunction	-	-	13	37.1	18	37.5	3	9.7	-	-	34	27.9	34	25	<0.0001
Cervical spine lesion	-	-	-	-	11	22.9	16	51.6	6	75	33	27.1	33	24.3	<0.0001
Post tonsillectomy	6	42.9	3	8.6	2	4.1	-	-	-	-	5	4.1	11	8.1	<0.01
Tonsillitis	4	28.9	4	11.4	1	2.1	-	-	-	-	5	4.1	9	6.6	<0.05
Pharyngitis	-	-	2	5.7	1	2.1	1	3.2	-	-	4	3.3	4	2.9	<0.05
Sinusitis	-	-	1	2.9	2	4.1	-	-	-	-	3	2.4	3	2.2	N.S
Quinsy	1	7.1	1	2.9	1	2.1	-	-	-	-	2	1.6	3	2.2	N.S
Ca larynx	-	-	-	-	-	-	1	3.2	1	12.5	2	1.6	2	1.5	N.S
Ca thyroid	-	-	-	-	-	-	1	3.2	-	-	1	0.8	1	0.7	N.S
total	14	10.3	35	25.7	48	35.3	31	22.8	8	5.9	122	89.7	136	100	

*z test between below 15yr and above 15yr was used

*not significant

DISCUSSION:

Despite published awareness regarding the many potential causes of referred otalgia, diagnosis often eludes the most experienced physician.¹ This may be due, in part, to the complex neuroanatomic innervation of the ear, head, and neck, and therefore the inherent limitless sources for referred ear pain.

The incidence of ear lesion in our study was (35.5%) while that of referred pain was (64.5%), this finding coincides with that of Siamak in which 65% of causes due to referred pain in comparison with Falace's study in which 89.8% of samples reported referred pain^(17,18).

We documented many causes of referred otalgia representing all five nerve pathways, with women reporting otalgia more frequently than men by 1.9:1. These causes ranged from the benign etiology of whiplash (cervical spine nerves) to the more serious tumor. The two most common nerve pathways for secondary otalgia were the trigeminal nerve (53,7%) and the superior cervical plexus nerves (24,3%). Due to the length and extensive distribution of the trigeminal nerve, it is not surprising that this nerve is most commonly involved in referred otalgia.^{4,10}

Nonotogenic otalgia is listed as a chief complaint by 29.2% of females patients with TMJ disorders (table 2). TMJ disorders have

a2–9 times higher prevalence in women than in men and occur in both sexes between 40 and 70 years of age.¹⁹ It is unclear whether this is a true reflex referred ear pain secondary to direct impingement of the auriculotemporal nerve, related to masseteric muscle spasm, or secondary to a direct ligamentous connection between the TMJ and middle ear, but all of these theories may potentially explain TMJ pathology resulting in otalgia.¹⁰ Cervical spine lesion were the most important causes of referred pain in adult male (36.1). The mechanism of how cervical spine disease is referred to the ear is controversial. One possible mechanism is via an interconnection between the cervical afferents with the spinal tract of the trigeminal nerve, which is thought to descend as far down as C4. Sensory information from the upper cervical roots is subsequently relayed to the trigeminal dermatomes (namely CNV3), which in turn can be referred to the ear. This type of nonotogenic ear pain, especially involving disorders of the tempo-mandibular joint, is well documented throughout oral surgery, otolaryngology, and pain journals.^(10,20,21, 22,23)

Dental caries have the capacity to produce constant boring ear pain, whereas laryngeal cancer may result in a much less intense earache. Within the subset of processes

affecting V3, dental diseases account for most pathology causing referred otalgia.^{2,10,24}This was parallel to our study which indicated that dental problems form the major cause (26.5) in both genders followed by TMJ dysfunction (25%) then cervical spine lesions (24.3%).

In general the referred pain was more common in females(65.4) than in males (34.6),but the proportion did not differ significantly, these findings were agreed with others studies^(2,10,25).According to James⁴ research the elderly will begin to emerge as a major etiologic source for referred otalgia, same as our result, the patient above 15 yr (89.7) were affected more than patient below15yr(10.3) .

CONCLUSION:

Since the early 1900s, referred otalgia has been a well-documented phenomenon in the ear, nose, and throat (ENT) and neurosurgical literature. However, Essentially any pathology residing within the sensory net of cranial nerves V, VII, IX, and X and upper cervical nerves C2 and C3 can potentially cause referred otalgia. A thorough understanding of the various sensorineural pathways that dually innervate the ear and other sites and ongoing dialogue with our clinical colleagues, will ensure that patients with referred otalgia will receive the best care in the head and neck, alongside a constant.referred pain to ear was much more common than the pain due to ear lesions.

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