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TINNITUS AURIUM IN NORMALLY HEARING PERSONS

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As considered here, tinnitus aurium is a medical term describing sounds of physiological or pathological origin, which may or may not always be perceived in consciousness.

Kerrison enumerated five general groups of sounds: 1) obstructive, 2) circulatory-vascular alterations, 3) labyrinthine-cochlear sounds, 4) neurotic - instability of the auditory nerve, 5) cerebral sounds- involvement of the auditory centers.

Fowler has divided tinnitus into two categories: 1) vibratory, mechanical, exogenous- factual sounds within the body, and 2) non- vibratory, biochemical endogenous - total absence of sound without the body.

Vibratory tinnitus is real sound of a physical source such as muscle activity, or vascular alteration. Nonvibratory tinnitus is nonfactual sound: an illusion of sound caused by an irritation of the auditory neural elements. The points of origin may be anywhere from the tympanic promontory, along the pathways to the cortex inclusive.

Atkinson also has divided tinnitus into two categories; extrinsic and intrinsic, which appear to include the two types already mentioned. He considers intrinsic tinnitus as an auditory paresthesia, a paresthesia of the auditory nerve, of vascular origin and to be so treated.

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Wegel recorded: "Tinnitus is a pathologic symptom . . . I am under the impression that the presence of tinnitus.....generally indicates an active or progressive lesion and that the cessation of it.....is an indication that the degeneration or atrophy of tissue has been arrested." But then he continued, "people entirely without tinnitus are extremely rare, if such cases exist at all."

In 1941 Fowler wrote, "It has been found that the presence of tinnitus is always associated with more or less deafness." In 1944 he altered this view writing: "It may be, and often is, present in some form in persons who have no apparent aural or other disease."

Kopetzky stated that tinnitus is a symptom signifying disturbed sensation, a symptom of aural disease. He continued that tinnitus may appear before symptomatic deafness.

Lempert suggested on the basis of his observations associated with middle ear surgery that "tonus impulses originating in the sensory fibers of the trigeminus, the sympathetic, or glossopharyngeal may enter the tympanic plexus, but normally [are] not heard." In selected cases, he recommended tympanosympathectomy.

Fowler further described tinnitus, of which the patient is consciously aware, as "audible," and tinnitus not ordinarily impinging on the consciousness as "subaudible." He found tinnitus in 86% of 2000 patients. He indicated that subaudible tinnitus must be sought for by examination. He also determined that the loudness of tinnitus was within 5 dB to 10 dB above threshold. Tinnitus may be measured for frequency, loudness and quality. It may be a single frequency or multiple frequencies and difficulties may be encountered in its identification. The exact loudness may also be difficult to determine. Fowler described techniques for making such measurements.

Audible tinnitus at times appears to interfere with hearing. Patients often state that were it not for their head noises their hearing would be better, and that when the head noises are louder the deafness is more severe. It does not necessarily follow that the tinnitus is always responsible for this. Possibly with increased deafness the head noises are less easily masked and so appear louder subjectively. Fowler has described the busy line effect, whereby receptor cells and neural pathways already preoccupied by an intrinsic stimulus are not receptive to an external stimulus.

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Some conditions in which audible tinnitus have been observed are:

1) Otosclerosis.
2) Meniere's disease.
3) Lermoyez's Syndrome.
4) Pressure or neuritis of the auditory apparatus; brain tumor, eighth nerve tumor, aneurysm.
5) Otitis media; acute, chronic, suppurative, nonsuppurative.
6) Otitis interna; acute, chronic.
7) Deafness, conductive, perceptive, mixed.
8) Normal hearing with discrete frequency defect.
9) Nasopharyngeal Diseases: Eustachian salpingitis, sinusitis, pharyngitis, mucosal hypettrophy, hyperplasia, tumor, infection of lymphoid tissue.
10) Dental pathology: malocclusion, malfunction of temporomandibular joint, impaction, infection.
11) Myositis; cervical, pharyngeal, tympanic.
12) Intoxication-drug; quinine, alcohol, salicylates, caffeine, tobacco, antiluetic agents, streptomycin, thyroid gland extract.
13) Intoxication-systemic; gastrointestinal, foci of infection.
14) Allergy.
15) Cardiovascular pathology; blood dyscrasias, anemias, hypertension, hypotension, vascular anomalies, arteriosclerosis, cardiac diseases.
16) Metabolic dysfunction; thyroidism, water balance disturbances.
17) Trauma, acoustic, acute.
18) Trauma, acoustic, chronic.
19) Systemic fatigue.
20) Momentary tinnitus, spontaneous (idiopathic).
21) Impacted cerumen.
22) Cervical constriction.
23) Psychoses.
24) Otic herpes.
25) Bell's palsy.
26) Foreign body trauma to the ear.
27) Head injury, concussion, postconcussion syndrome.
28) Myringitis.
29) Hemorrhage, tympanum or myringa.

The ideal approach to the treatment of audible tinnitus would seem to be a therapeutic assault on the related etiological factors. At present there is no sure way to accomplish this. Frequently the etiological agent no longer exists, however the tinnitus persists. Some of the contemporary measures are:

Medical:

1) Medication; bromides, barbiturates, other sedatives, potassium Iodide, vitamins, benzyl cinnamate, antiallergic drugs, histamine therapy, intravenous procaine.
2) Local therapy to disease processes.
3) Elimination of drugs and intoxicants.
4) Elimination of foci of infection.
5) Correction of faulty gastrointestinal function.
6) Correction of metabolic diseases
7) Control of diseases of the vascular system and blood forming organs.
8) Dietary control of fluids, salt , and water balance.
9) Dental rehabilitation.
10) Intratympanic medication.
11) Therapy directed to correct nose and throat pathology, including roentgen and radium therapy.
12) Politzerization, inflation, message.
13) Removal of cerumen.
14) Psychotherapy.
15) Hearing aid.
16) Electrical therapies, i.e., ultra violet, quartz lamps, galvanism.

Surgical:

1) Otologic
   ossiculectomy
   mastoidectomy
   tympano-sympathectomy
   fenestration of the labyrinth
   obliteration of the saccus endolymphaticus.
2) Rhinologic.
3) Spinal tap.
4) Cranial surgery for tumor, vascular anomalies section of eight cranial nerve.
5) Splanchnectomy and similar technics for alleviation of hypertension.

TABLE I.

REPORT OF SOUND EXPERIENCED BY 80 NORMALLY HEARING SUBJECTS, IN A SOUND-PROOF ROOM AND INCIDENCE OF TINNITUS IN 100 PATIENTS WITH DEAFNESS.

	NUMBER OF HARD OF HEARING PATIENTS	PER CENT OF HARD OF HEARING PATIENTS	NUMBER OF NORMAL SUBJECTS	PER CENT OF NORMAL SUBJECTS
Sound heard (tinnitus)	73	73	75	93.75
No Sound (no tinnitus)	27	27	5	6.25
	100	100	80	100

Fowler has emphasized the value of explaining to the patient the nature of his tinnitus: that it is a symptom and not a disease, and that despite its annoying and distressing presence, it does not imply a threat to him. An understanding of the symptom and a recognition of its relative significance in some instances may reconcile the sufferer to his burden.

From the foregoing it appears that both audible and subaudible tinnitus have been described as a symptom associated with impaired hearing, or with systemic diseases, and yet they have been observed in the presence of these same factors, in persons considered healthy. The implication has been made that tinnitus may be an early symptom preceding impaired hearing.

It has been noted that healthy persons with normal hearing have reported tinnitus when the ambient noise level is low. The opportunity presented itself to us to determine the incidence and character of subaudible tinnitus by exposing normally hearing persons to an environment in which the ambient noise level was considerably less than in ordinary living conditions.

Two separate groups of persons were studied: normally hearing, healthy, adults who experienced tinnitus rarely or not at all, and hard of hearing adults, veterans of military service.

A sound-proof chamber was used. The ambient noise level was probably between 15 dB and 18 dB (re: 0.0002 dynes per cm^2). Exact measurements could not be made due to the limitations of the sound level meters at hand.

In a previous study we investigated the influence of tinnitus of the doughnut type of receiver worn over both ears. Normlly hearing persons were placed in the sound proof chamber and the tinnitus experienced with and without receivers was compared. They were unable to determine any difference and we concluded that the ambient noise of this chamber was not an intruding factor.

Eighty adults, apparently normally hearing males and females, from 18 to 60 years of age were included. The selection was predicated on a denial of past or present aural disease. They reported no deafness or tinnitus, and considered themselves in good health. They were representative of a sedentary population, including physicians, dentists, teachers, students, administrators, clerks and housewives.

Upon entering the sound-proof room the subjects are instructed to make notes of sounds which might be detected. No suggestion was given that the source of sound might be within the subject himself. The time of observation was usually limited to five minutes or less. Written details of their observations were obtained.

One hundred hard-of-hearing patients, consecutively admitted to the Clinic, composed a control group. Their histories, otorhinological examinations and pure-tone audiograms were obtained. A diagnosis of deafness, its type, and the presence or absence of tinnitus and its description were recorded. See Table I.

A total of 39 different sounds were described by both groups. Of these, 27 sounds were named in the impaired group, and 23 sounds were n~med in the normal group. The sounds described as "buzz," "hum" and "ring" were enumerated most frequently in both groups, comprising at least 50% of the responses of each group. Eleven sounds recorded 's were identified in both groups.

TABLE II
DIFFERENT SOUNDS DESCRIBED BY BOTH GROUPS.

		NUMBER OF PATIENTS WITH IMPAIRED HEARING	NUMBER OF NORMAL SUBJECTS
1	Bell	3	0
2	Buzz	12	13
3	Drone	1	0
4	Hiss	3	3
5	Hum	10	16
6	Ring	32	11
7	Steam	4	0
8	Roar	5	2
9	Whistle	9	3
10	Click	3	0
11	Tap	1	1
12	Falling water	3	4
13	Heart beat	2	0
14	Truck	1	0
15	Rushing	1	0
16	Airplane	2	1
17	Singing	1	0
18	Insects, crickets	2	6
19	Fog horn	2	0
20	Musical Sounds	1	0
21	Machinery	1	0
22	Rumble	1	0
23	Hollow sound	1	0
24	Squeal	1	0
25	Echo	1	0
26	Surf	0	1
27	Pressure	0	2
28	Vibration	0	1
29	Squeak	0	3
30	Throbing	0	1
31	Rustling leaves	0	1
32	Stuffiness	0	1
33	Tunnels	0	2
34	Pulse	0	7
35	Rubbing Cloth	0	1
36	Watch tick	0	2
37	Thumping pulsation	0	4
38	Zooming-whizzing	1	2
39	Sea shell	2	0

TABLE III.

NUMBER OF SOUNDS REPORTED BY EACH 75 NORMAL SUBJECTS WITH SUBAUDIBLE TINNITUS AND BY EACH OF 75 HARD OF HEARING PATIENTS WITH AUDIBLE TINNITUS.

	NUMBER OF PATIENTS	PER CENT OF PATIENTS	NUMBER OF NORMAL SUBJECTS	PER CENT OF NORMAL SUBJECTS
1 sound	48	64	54	72
2 sounds	20	27	15	20
3 sounds	6	8	3	4
4 sounds	1	1	2	2
5 sounds	0	0	1	0.75

The number of different sounds described by the normally hearing group and by the patients with deafness, in terms of percentage, are in general agreement. While a majority in both groups reported hearing only one sound, a substantial number of persons in each group distinguished two or more sounds.

TABLE IV.
DIAGNOSIS OF DEAFNESS AND INCIDENCE OF TINNITUS IN 100 PATIENTS.

DIAGNOSIS	NUMBER OF PATIENTS	TINNITUS PER CENT OF 100 PATIENTS
Conductive deafness without otosclerosis		
Tinnitus constant	3	
Tinnitus inconstant	10	13
No tinnitus	7	
Total	20	
Otosclerosis (1 case mixed deafness, 7 cases conductive deafness)		
Tinnitus constant	4	
Tinnitus inconstant	4	8
No tinnitus	0	
Total	8	

DIAGNOSIS	NUMBER OF PATIENTS	TINNITUS PER CENT OF 100 PATIENTS
Perceptive deafness		
Tinnitus constant	21	
Tinnitus inconstant	18	39
No tinnitus	16	
Total	55	
Mixed deafness		
Tinnitus constant	2	7
Tinnitus inconstant	5	
No tinnitus	1	
Total	8	
Mixed deafness of one ear, perceptive deafness of other		
Tinnitus constant	3	
Tinnitus inconstant	1	4
No tinnitus	1	
Total	5	
Diagnosis not available		
Tinnitus constant	2	
Tinnitus inconstant	0	2
No tinnitus	2	
Total	4	

Of this group, 73% of the patients experienced tinnitus, 27% did not. All the eight patients in this series with deafness due to otosclerosis had tinnitus. Of a larger group of otosclerotics in our Clinic, 83 patients, 85% have tinnitus and 15% are free of it.

COMMENT

> Seventy-three per cent of 100 unselected patients with deafness described tinnitus as a symptom. Twenty-seven per cent experienced no tinnitus.82

Audible tinnitus was experienced by 94% of the 80 apparently normally hearing adults when placed in a testing situation having an ambient noise level no greater than 18 decibels, re: 0.0002 dynes per cm^2. It appears that tinnitus is present constantly but is masked by the ambient noise which floods our environment. This ambient noise level for ordinary quiet living conditions usually exceeds 35 dB, and apparently is of sufficient intensity to mask physiological tinnitus, which remains subaudible.

It would appear, then, that tinnitus will not be eliminated by any treatment but at best can only become subaudible. This, of course, would be welcomed both by the patient and the physician.

CONCLUSION

The kinds of head noises described by patients with impaired hearing as a symptom associated with their deafness and those sounds described by normally hearing healthy adults, elicited while in a sound-proof room, appear to be similar.

These head noises seem to occur in about the same order of frequency.

Tinnitus, which is subaudible, may be a physiological phenomenon in an intact auditory apparatus.

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