Phonocephalography

An objective diagnosis of tinnitus

By Sayed Tewfik (Cairo)

Auscultation in medical practice has undergone considerable progress since Laennec introduced his mono-aural stethoscope (Segal, 1965; Rogers, 1964). Objective tinnitus in the sense of audible sound heard by both the patient and the observer has been mentioned sporadically in case reports (Scott Brown *et al.*, 1965; Mackinnon, 1968; Arenburg and McCreary, 1971; Leventon *et al.*, 1968). Hearing the objective tinnitus is done by putting one's ear near to the patient, thus only sounds of very high intensity will be heard and otological examination is in the pre-Laennec era.

Phonocephalography is a new term introduced for the systematic auscultation, amplification and recording of sounds from both the surface of the head and its cavities such as the nose, external auditory meatus, and the nasopharynx.

Technique

Auscultation of the surface of the head was done by using the 'Littman stethoscope'. The nasopharynx was auscultated by using a modified stethoscopic end in the form of a polyethylene tube attached to a naso-pharyngoscope (Holmes' naso-endoscope).

Amplification and recording of the sound was done by the 'Helige Phonocardiographic apparatus'. The microphone was applied to the area to be tested. The sound was amplified, heard by the apparatus stethoscope and recorded by its recording system. The apparatus simultaneously recorded the patient's E.C.G. The recorded sound tracing was called 'Phonocephalogram' abbreviated 'P.C.G.'. Difficulties arose as regards the Helige phonocardiographic apparatus since its microphone was applied to the surface of the head which differs from that of the chest.

The amplified sound was fed back to the patient to see whether it was the sound subjectively heard by him or not. Later the effects of performing the acts of swallowing, opening the mouth, and compression of the carotid on the sound were noted.

Material and method

One hundred patients complaining of tinnitus were examined. Each patient underwent complete medical, neurological and otorhinolaryngo-

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logical examination. The otorhinolaryngological examination included the examination of the tympanic membrane under magnification, the naso-pharynx by the Holmes' naso-endoscope, and audiometry. Later phono-cephalography was performed.

Normal phonocephalography

Forty normal adults, each 20 years old, with no past history of any otological trouble, clinically healthy and with normal hearing levels were subjected to Phonocephalography. Apart from respiratory and muscular sounds of swallowing no particular pulsating, hissing or clicking sounds could be heard.

Results

Out of the 100 patients submitted to Phonocephalography, ten patients with audible tinnitus were picked out. The results are summarized in Table I. The objective tinnitus in these cases could be classified into two groups, pulsating and clicking tinnitus. The pulsating tinnitus had a fixed frequency, synchronous with the pulse, not affected by performing the acts of swallowing or opening the mouth but its character was changed by compression of the carotid. The clicking tinnitus had a variable frequency, asynchronous with the pulse, stopped on performing the acts of swallowing or opening the mouth and its character did not change by compression of the carotids.

TABLE I.

Case No.	Age	Sex	Tinnitus	Diagnosis	Other method of investigation
I	16	Female	Pulsating Hissing	Angiomatous malformation in region of basal ganglia	Angiography
II	45	Female	Pulsating Hissing	Glomus jugulare	Histopathology
III	39	Female	Pulsating	Hypertension	Trial with anti-hypertensive drugs, stopped both the tinnitus and the sound
IV	38	Male	Pulsating	Hypertension	
V	45	Male	Pulsating	Hypertension	
VI	60	Female	Pulsating	Hypertension	
VII	45	Male	Pulsating	Hypertension	
VIII	30	Male	Clicks	Clicking muscular tinnitus	Simultaneous visualization and auscultation of the nasopharynx
IX	41	Female	Clicks		
X	27	Male	Clicks		

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Selected case histories

Case No. I

Angiomatous malformation in region of the basal ganglia.

A.E., a 16-year-old female patient, complained of a hissing pulsating sound heard in her ears for two years.

Phonocephalography revealed a pulsating hissing sound heard especially over the mastoid region. The phonocephalogram showed a sound in the region of the T. and T.P. interval of the E.C.G. (Fig. 1).



FIG. 1.

Case No. I: Phonocephalogram of the mastoid region.
(*a*) Electrocardiogram (E.C.G.). (*b*) Phonocephalogram (P.C.G.).

Carotid angiography demonstrated an angiomatous malformation in the region of the left basal ganglia, the supplying vessels were widened, the choroidal and strial arteries draining in to the deep veins (Fig. 2).

Case No. II

Intra-tympanic glomus jugulare tumour.

F.G., a 45-year-old female, complained of a pulsating hissing sound heard in her right ear for five years. The tinnitus was accompanied by a decrease in hearing power.

Clinical otological examination revealed an intra-tympanic red tumour.

Phonocephalography revealed a pulsating sound which could be heard only after amplification with the phonocardiographic stethoscope. When the sound was amplified and fed back to the patient, she stated that the sound was similar to her tinnitus. The phonocephalogram showed a sound synchronous with the cardiac cycle (Fig. 3) which disappeared on compression of the right carotid.

Explorative tympanotomy was performed and the tumour was removed. The histological diagnosis was that of a glomus jugulare tumour.

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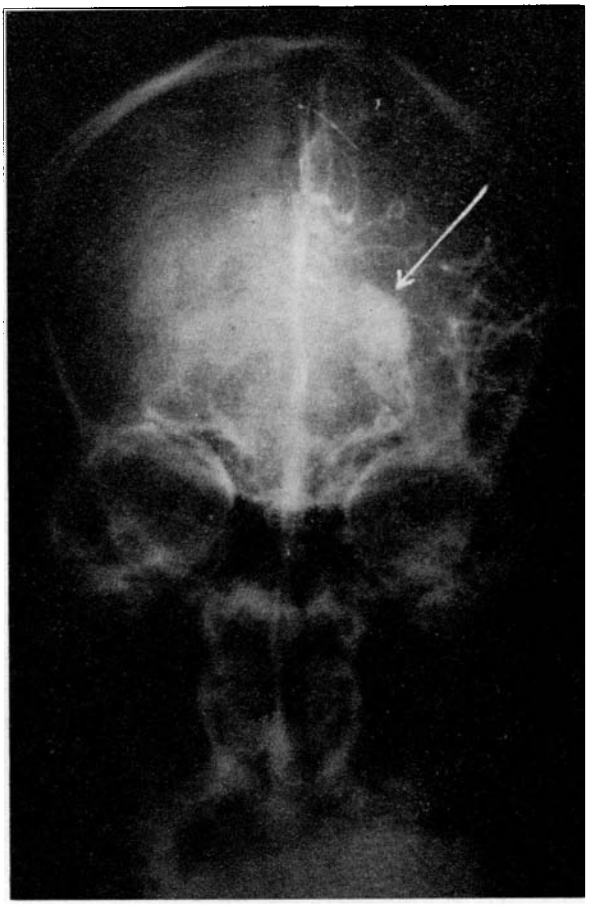


Fig. 2.

Case No. I: Left carotid angiography, postero-anterior view. Angiomatous malformation in region of the basal ganglia (arrow).

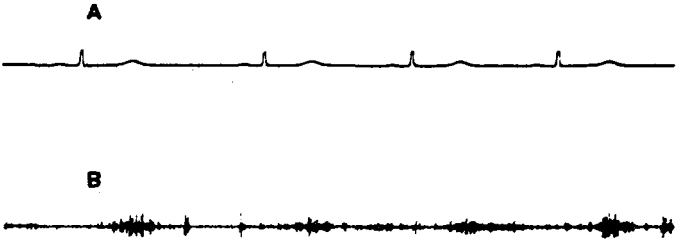


Fig. 3.

Case No. II: Phonocephalogram of the right mastoid region. (*a*) Electrocardiogram (E.C.G.). (*b*) Phonocephalogram (P.C.G.).

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Comment

In this case the sound needed amplification to be audible.

Case No. V

An example of the hypertensive cases.

H.S., a 45-year-old male patient, referred from the medical department with hypertension. He was complaining of tinnitus. His blood pressure was 220/120.

Phonocephalography revealed a pulsating sound heard over the carotid and mastoid regions synchronous with the pulse. When the sound was amplified and fed back to the patient, he stated that the sound was like his tinnitus. The phonocephalogram showed a sound in the region of the T. wave of the E.C.G. (diamond-shaped) (Fig. 4).

The patient received anti-hypertensive measures. The blood pressure dropped to 140/95. The tinnitus subsided and no sound could then be detected.

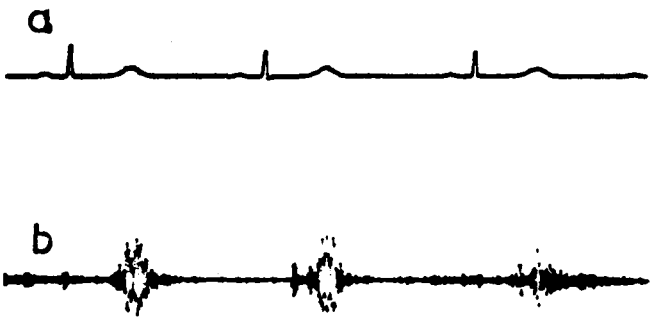


FIG. 4.
Case No. V: Phonocephalogram of right mastoid region.
(*a*) Electrocardiogram (E.C.G.). (*b*) Phonocephalogram (P.C.G.).

Comment

When the patient received anti-hypertensive measures both the tinnitus and the sound subsided. This demonstrated that both the sound which was objectively heard and recorded and the tinnitus were the same.

Case No. X

An example of clicking tinnitus due to palatal myoclonus.

M.A., a 27-year-old male patient, complained of a clicking sound heard in his ears which occurred after he had attended an air raid within which an explosion had occurred near to him.

Systematic otorhinolaryngological examination revealed fine palatal twitches together with movements of the eustachian cushions.

Phonocephalography revealed clicking sounds in both mastoid regions, with irregular speed and asynchronous with the cardiac cycle (Fig. 5). The sounds were not affected by compression of the carotid but stopped on performing the acts of swallowing or opening the mouth.

Nasopharyngeal phonocephalography using the nasopharyngeal stethoscopic end attached to Holmes' naso-endoscope showed that the clicks were

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synchronous with the movements of the eustachian tube cushions. The stoppage of the clicks by performing the acts of swallowing or opening the mouth was due to stoppage of the movements of the eustachian tubal cushions.

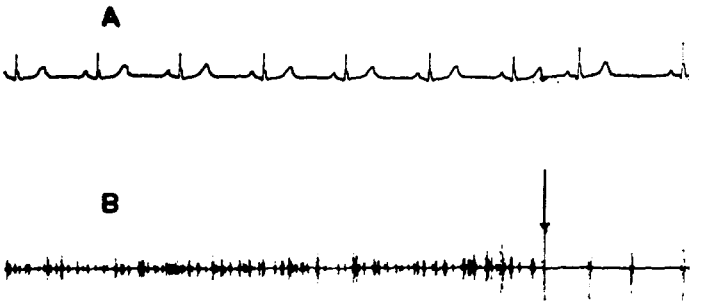


FIG. 5.

Case No. V: Phonocephalogram of the right mastoid region.
(*a*) Electrocardiogram (E.C.G.). (*b*) Phonocephalogram (P.C.G.). Effect of opening the mouth widely (arrow).

Comment

This case represented an example of the clicking tinnitus due to palatal myoclonus. Simultaneous auscultation of the nasopharynx by the nasopharyngeal stethoscopic end and visualization of the eustachian tube cushions by the nasopharyngoscope proved the clicks to be synchronous with the movements of the eustachian cushions. The disappearance of the clicks by performing the acts of swallowing or opening the mouth widely was due to the stoppage of the movements of the eustachian cushions.

Summary

Phonocephalography is a new term introduced for the systematic auscultation and amplification of sounds from both the surface and the cavities of the head and neck. 100 patients complaining of tinnitus were examined by this technique; 10 cases with objective tinnitus were detected among them. The objective tinnitus was either of the pulsating vascular type or the clicking muscular type. Phonocephalography proved helpful in localizing, recording and aiding in the diagnosis of the lesion. The phonocephalographic data were confirmed by other methods of investigation.

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