AURAL REFLEXES.

By MACLEOD YEARSLEY, F.R.C.S. Eng.,

Assistant Surgeon to the Royal Ear Hospital, Surgeon-in-charge of the Department for Diseases of the Throat, Nose, and Ear, the Farringdon General Dispensary, etc.

OF the numerous reflex phenomena which occur throughout the body those arising in the ear are not the least in interest. They range from the trifling "ear cough" to the more alarming "cardiac reflex," and to the otologist form as familiar a part of his day's work as the passage of a Eustachian catheter. I propose, in this short paper, to relate a few cases of aural reflexes which have recently come under my notice in the ordinary out-patient clinic.

Before proceeding further, however, it will be well to shortly review the nervous connections of the external and middle ear, which are responsible for the production of these interesting phenomena. The external meatus derives its nerve supply from the auriculo-temporal branch of the third division of the fifth nerve, and from the auricular branch of the vagus. The latter (Arnold's nerve) arises from the ganglion of the root of the pneumogastric, and, receiving a connecting filament from the petrous ganglion of the glosso-pharyngeal, passes through a narrow canal in the substance of the temporal bone, crossing in its way the Fallopian aqueduct, and being connected with the facial nerve by ascending and descending branches of communication. Emerging from the bone in the interval between the mastoid process and the external auditory meatus, Arnold's nerve ends by supplying the integument on the posterior aspect of the ear, sending a twig to join the posterior auricular branch of the facial. It is important, in considering aural reflexes, to remember that Arnold's nerve supplies the skin of the osseous meatus, and that which covers the lower part of the membrana tympani (Sappey).

The auriculo-temporal nerve supplies the skin lining the meatus by two filaments, and also gives two to the integument over the upper and fore part of the pinna; the latter gain the interior of the meatus by passing between the osseous and cartilaginous portions of the canal. The two former twigs supply the upper and greater part of the membrane. Beside these, the auriculo-temporal has the following distribution:—(1) One or two strong branches of communication to the temporo-facial nerve; (2) filaments which enter the posterior aspect of the temporo-maxillary joint; (3) twigs to the paortid gland; and (4) terminal filaments to the scalp.

The middle ear is rich in nerves, for, besides those which supply the parts of the tympanum itself, there are several which merely serve to connect nerves of different origin. The lining membrane is supplied from the tympanic plexus, which is formed of (1) Jacobson's branch of the glosso-pharyngeal; (2) the small deep petrosal (connecting Jacobson's

https://doi.org/10.1017/S1755146300166296 Published online by Cambridge University Press

nerve with the carotid plexus); (3) a branch which joins the great superficial petrosal; and (4) the small superficial petrosal, passing to the otic ganglion. In the plexus are numerous ganglion cells. Jacobson's (tympanic) nerve arises from the petrous ganglion of the glosso-pharyngeal and goes to join the otic ganglion; besides the connections mentioned it is also joined by a branch from the geniculate ganglion of the facial. Whilst in the tympanum it supplies (1) the mucous membrane of the tympanum; (2) the lining membrane of the mastoid cells; and (3) the mucous membrane of the Eustachian tube. The passage of the chorda tympani and facial nerve through the tympanum must not be overlooked.

From the above short review it is seen that the external and middle portions of the ear are supplied by a nerve of very wide distribution—the vagus; and from a nerve of special sense—the glosso-pharyngeal; and its nerve channels are multiplied by connections with the facial, the sympathetic, and that great sensory nerve, the fifth. That irritation of the terminal twigs by this nerve supply should call forth reflexes of corresponding amplitude is not to be wondered at.

The reflex phenomena for which the ear can be called to account are ear cough, cardiac, taste, and gastric reflexes, epileptiform convulsions, hiccough, and the reflex effects of ear disease on the oculo-motor apparatus. Of two of these reflexes, namely, hiccough and epileptiform convulsions, I have no personal knowledge, but I have frequently seen instances of the others. One case of persistent hiccough due to retraction of the membrana tympani, and relieved at once by Politzerization, has been recorded anonymously.[1] Epileptiform convulsions may be reflexly produced by both aural and intranasal disease. Instances of the latter have been published by Barclay Barron[2] and the late Sir Benjamin Richardson,[3] and the former by Walker Downie,[4] Griffiths,[5] Wilde,[6] and others. The mechanism of this reflex is probably an exaggeration of the reflex laryngeal irritation which gives rise to "ear cough." Marshall Hall considered the immediate cause of epilepsy to be spasm of the glottis, *plus* reflex spasm of the cervical muscles, resulting in venous engorgement and coma. Kussmaul and Tenner showed that spasm of the glottis alone is capable of causing both coma and convulsions. The irritation carried by Arnold's and Jacobson's nerves to the floor of the fourth ventricle gives rise to a reflex irritation of the laryngeal nerves, which causes, not the contraction of the expiratory muscles producing ear cough, but spasm of the muscles of the larynx, and consequent laryngismus. The inheritance of any special neurotic tendency—a family history of epilepsy, for instance—might act as a predisposing cause.

Ear cough is the simplest form of reflex, and, probably, the commonest. It is readily induced in many cases by the simple introduction of a speculum. Fox, of Scarborough, found that he could excite it in one in five cases out of one hundred and eight examined by him. It is a reflex of importance to the general practitioner, since it may be excited by cerumen or foreign bodies, especially in cases where the accumulations

[1] *Hospital Gazette*, Aug. 23, 1890.
[2] *Brit. Med. Journ.*, Mar. 14, 1890.
[3] *Æsclepiad*, 1887, p. 48.
[4] *Lancet*, June 16, 1888.
[5] *Lancet*, Vol. I., 1872.
[6] *Practical Observations on Aural Surgery*, 1853, p. 326.

https://doi.org/10.1017/S1755146300166296 Published online by Cambridge University Press

of wax are hard, dry, and movable. Such a cause for the cough is not infrequently overlooked, as in the following example :—

E. W., aged sixty, paperhanger, complained of headache and troublesome "dry" cough, the paroxysms of which brought on pain in the left ear. He was treated in the physician's outpatient department of a general hospital for over a month, with various cough mixtures, etc. At the expiration of that time he began to notice slight deafness, and came of his own accord to the ear department. Both ears contained plugs of hard, dry cerumen, which was removed by syringing, with the result that the cough disappeared in one day.

Dr. Percy Jakins[7] has reported one case which, to those not conversant with these reflexes, would sound like a fairy-tale.

The mechanism of ear cough was worked out by Fox, as early as 1869. Originally believed to be the result of stimulation applied to the auricular branch of the vagus being conducted to the laryngeal branches of the same nerve, Fox concluded that "the connection between the nerves concerned took place in the nervous centres," the nerves involved being the two branches of the auriculo-temporal and Jacobson's nerve. By these channels the stimulus is carried to the centres in the floor of the fourth ventricle, where, it will be remembered, the roots of the vagus and glosso-pharyngeal nerves are in close connection. The stimulation being mistaken for laryngeal irritation (of comparatively frequent occurrence), cough is the result.

The cardiac reflex varies from mere faintness to syncopal attacks, calculated to alarm both patient and friends. Every otologist knows how patients will occasionally become faint whilst the ear is being syringed, or even examined. The following example shows it in its more severe aspect :—

H. D., aged six, was brought to me in 1891, suffering with discharge from both ears, of thick, yellow, highly offensive pus. His father was unable to give any definite history as to duration, cause, etc., beyond saying that the discharge had lasted "some time," and had never been treated. The left ear was gently syringed with no untoward result ; but whilst a similar proceeding was being carried out on the right side, the boy suddenly complained of feeling very faint, and dropped unconscious from the chair. Ordinary remedies revived him in less than three minutes, but it was judged best to keep him lying down for half an hour, before sending him home. This unfortunate occurrence seriously alarmed his father, and prevented further treatment at my or any other surgeon's hands, with the result that he succumbed eighteen months later to cerebral abscess.

Similar examples are not lacking in any clinic devoted to diseases of the ear. Middlemass Hunt[8] described a case in which profound coma lasted more than half an hour.

Closely allied to the cardiac is the gastric reflex, several instances of which have been recorded by Hilton, Toynbee, Politzer, Wilde,[9] Kynaston,[10] and others. The following are good examples :—

[7] *The Practitioner*, June, 1887.
[8] *Lancet*, Oct. 10, 1887.
[9] *Loc. cit.*, p. 188.
[10] *Lancet*, June 30, 1888.

https://doi.org/10.1017/S1755146300166296 Published online by Cambridge University Press

E. W., aged twenty-three, the subject of chronic suppuration in the left middle ear. On removing a large polypus she complained of great nausea, and could with difficulty refrain from vomiting. She was similarly affected a month later.

M. A. J., aged fifty-four, the subject of keratosis obturans, was treated with instillations of glycerine and salicylic acid. On removing the epithelial masses she complained of nausea, followed almost immediately by violent retching, which culminated in vomiting.

Vogan[11] has recorded a case in which the cardiac and gastric reflexes were combined. It is not surprising that they should so occur when one considers the distribution of the pneumo-gastric. The following is a very complete and interesting example of such a combination :—

J. W., aged twenty-five, had been deaf, with discharge and occasional pain, for twenty years. Both ears were affected, and the disease originated in an attack of scarlet fever at the age of five. The discharge was very fœtid. He had been a long time under treatment at the Homœopathic Hospital, and was getting steadily worse. In both ears the membranæ were destroyed, the stapes only remaining. The left ear was examined with a probe under a five per cent. solution of eucain hydrochloride, which rendered it quite anæsthetic. On touching a small granulation in the left inferior posterior quadrant the patient dropped from the chair in a syncopal attack. His face became pallid, the lips blue, the eyes turned upwards, and the pulse small and irregular. He recovered quickly, breaking into a profuse cold sweat. He afterwards stated that as the probe touched the ear he felt as if "whirled round upon a wheel," heard a "noise like machinery," and felt very sick. Once during the following week he had a similar attack whilst the ear was being syringed, during which he vomited. After a month's treatment, local and general, he was so far improved as to allow the ears to be probed under eucain without suffering any inconvenience.

The intimate connection between the nuclei of the vagus and glosso-pharyngeal nerves in the floor of the fourth ventricle will easily account for the following case of "taste reflex" :—

J. C., aged thirty-two, suffered with chronic suppurative right middle ear disease, with granulation polypi. Whenever the free discharge of pus was interfered with by a polypus blocking its outlet a bitter taste at the back of his mouth was complained of. Removal of the polypus and the establishment of freer drainage caused the disappearance of the symptom. No pus was ever seen to issue from the Eustachian tube with the posterior rhinoscope.

I have been unable to find any other recorded cases of taste reflex.

The reflex effects of ear disease upon the oculo-motor apparatus was recently the subject of a paper by Urbantschitsch.[12] He pointed out that the influence of the ear upon the oculo-motor apparatus most commonly manifests itself in nystagmus—more rarely in spasm or paralysis of the eye muscles and affection of the internal musculature.

Nystagmus, which is more frequently oscillatory than rotatory, may be caused by affections of the outer, middle, or inner ear, or of the

[11] *Lancet*, July 7, 1888. [12] *Wien. Med. Woch.*, Jan. 2, 1896.

https://doi.org/10.1017/S1755146300166296 Published online by Cambridge University Press

auditory nerve itself. In one case a slight inflammation of the cavum tympani caused oscillation, a more violent inflammation rotation. A powerful movement of the eye away from the affected ear usually favours the nystagmus, but may in some cases weaken or inhibit it. Nystagmus is often evoked by very slight interference with the ear, such as syringing, particularly with cold water ; this shows that the reflex action depends not solely upon pressure, but also on thermic influences. It may also result from the removal of a polypus, or a plug of secretion.

Högyes obtained very marked nystagmus by draining the perilymph space, and inflating it with air. Nystagmus may also result from acoustic influences, such as a special sound or tone, being in such cases usually slight. The occurrence of nystagmus in ear affections is, according to Urbantschitsch's further remarks, usually of reflex origin, although occasionally it may be induced by morbid conditions of the occipital lobes, or by thrombosis of the lateral sinus.

A much more rare reflex disturbance of the oculo-motor apparatus in ear disease is strabismus. Urbantschitsch records two cases. In one, a boy of six years, a convergent squint was directly attributable to otitis media, its degree varying as the intensity of the inflammation. A cure of the otitis greatly improved the squint, although it did not cause it to disappear. The second case was that of a woman in whom the divergent strabismus of the eye of the affected side resulted from slight inflammation, associated with an aural polypus. The removal of the growth caused a sudden increase of the squint, which persisted, although the ear rapidly became well. Luc described a third case.

Moos has recorded a case of paralysis of the superior oblique muscle as the result of otitis media, and one of myosis of the corresponding eye in a case of purulent otitis. Gellé speaks of sudden dilatation of the pupil occurring at the moment of removal of an aural polypus. Slight pupil dilatation is not uncommon with changes in the intratympanic pressure, and is particularly associated with condensation or rarefaction of the air in the external ears of patients with perforations of the membrana tympani.

The perusal of Urbantschitsch's remarks led me to pay some attention to the eye whilst examining or syringing the ear. On one occasion I observed a transient strabismus on the affected side to occur in a man, aged twenty-seven, whilst the right ear (affected with chronic suppurative middle ear disease) was being syringed. The squint occurred once again on a subsequent occasion.

Dilatation of the pupil I have noticed on four occasions, during the condensation or rarefaction of the air in the meatus with a Siegle's pneumatic speculum. Of these four cases, two had perforations, and in two the tympanic membranes were intact. In three cases the dilatation of the pupil occurred in both eyes ; in one (in which there was a large inferior posterior perforation), in the eye of the affected side only. No doubt, if one could pay more attention to the eye whilst examining the ear, instances of this dilatation of the pupil would be multiplied, and, possibly, further cases of transient strabismus might be recorded.

https://doi.org/10.1017/S1755146300166296 Published online by Cambridge University Press