The Treatment of Ménière’s Disease with Ultrasonic Waves

A Preliminary Report

FRANZ ALTMANN, M.D., and JULES G. WALTNER, M.D., New York

In spite of considerable progress during the last 20 years, the results of the medical treatments of Ménière’s disease are still far from being satisfactory. Surgical destruction of the diseased labyrinth is, furthermore, feasible only in the limited number of cases in which in all probability only one labyrinth is affected and in which the hearing on the affected side has permanently fallen below the serviceable level. The numerous cases which do not respond to medical treatment and which, on the other hand, are not suitable for surgery present a very difficult therapeutic problem.

A new treatment aiming at selective destruction of the diseased vestibular portion of the labyrinth with ultrasonic waves with preservation of hearing would be ideally suited for these patients.

Although attempts at treatment of the ear with ultrasonic waves date back as far as 30 years, the apparatus used at that time by Mülvirt and Voss produced waves of such low intensity that they could not reach the inner ear at all. Later, machines capable of producing ultrasonic waves of higher frequency and of much higher intensity were used (Wiethe, Wyt, and Vyslonzil and others). The application was first purely empirical, without any theoretical or experimental basis.

Subsequently it was shown in animal experiments by Vyslonzil that ultrasound produces first a stimulation of the vestibular apparatus and that application of larger or repeated stimuli is followed by a complete loss of vestibular responses.

It was furthermore demonstrated that in man even ultrasounds of higher intensities when applied to the outer surface of the mastoid practically do not reach the inner ear, because they are almost completely absorbed by air and to a considerable extent by bone (Pfander, Frenzel and Pfander, Seidl and Krejci). Only in patients with sclerotic mastoids could a significant proportion of the ultrasound possibly reach the inner ear.

Animal experiments, together with histological studies, showed that if the ultrasound actually reaches the inner ear from the outside of the skull not only the vestibular but also the cochlear portion are damaged. Irradiation of the whole labyrinth with doses large enough to cause destructive changes in the endorgans did, under these circumstances, not present any appreciable advantages over the surgical destruction (Krejci, Portmann, Portmann and Barbe, Naumann).

Therefore, Krejci in other experiments, after operative exposure of the inner ear, tried to irradiate selectively the vestibular portion of the inner ear only. Using a narrow beam of ultrasonic waves, he succeeded in eliminating vestibular waves with preservation of cochlear function. Encouraged by these experimental results, Krejci then tried to destroy the vestibular...
portion of the labyrinth in a patient suffering from Ménière's disease. An antrotomy was performed, the semicircular canals skeletonized and irradiated with a beam with a diameter of 4 mm. by direct application of a specially constructed soundhead to the canals. Seven days after the irradiation a facial paralysis was noted. Eleven months after the operation the attacks of vertigo and the tinnitus had completely, and the facial paralysis almost completely, disappeared. The hearing on the treated side had decreased by 10 db. and the caloric vestibular responses were completely absent.

Arslan perfected Krejci's method by constructing, together with Federici, a thin and narrow sound-wave emitter which produces a narrow beam of sound waves with a frequency of 800,000 to 1,000,000 cps and of an intensity sufficient to produce a relatively rapid destruction of the vestibular portion of the inner ear on application to the bony wall of the lateral semicircular canal. Practically no sound waves seem to reach the medial wall of the petrous bone and the posterior cranial fossa. No ultrasound waves can escape from the side walls of the emitter, and thus facial paralysis or further hearing loss can be prevented.

Arslan proceeds in the following way: With the area under local anesthesia, an opening is made into the antrum by a short retroauricular incision and enough cells are removed to get a good exposure of the lateral semicircular canal without disturbing the incus. Very careful hemostasis is essential, since even a small quantity of blood around the tip of the ultrasound emitter would increase the field of irradiation. The tip of the emitter is applied to the convexity of the lateral semicircular canal (Fig. 1); the contact between the two should be as close as possible because intervening air would prevent the ultrasound waves from reaching the inner ear. The ultrasound should be applied in such a way that the facial nerve and the cochlea are not included in the field of irradiation (Fig. 2).

Nystagmus should be constantly observed by an assistant during application of the sound waves in order to determine the
of the ultrasound. Photograph by Dr. V. N. Epanchin.

The majority of Arslan's patients showed a marked improvement in hearing in the lower and middle tonal range. The tinnitus improved in the majority of cases; in many it was completely eliminated.

Experiments in dogs showed that the type of radiation used by Arslan selectively destroys the neurosensory epithelium of the cristae ampullares.

Arslan doubts that the initial "irritative" nystagmus is solely a hot-caloric nystagmus from the heat created by the ultrasound and feels that a direct mechanical vibratory effect of the ultrasound on the sensory neuroepithelium should also be considered a definite possibility. The therapeutic effect of the irradiation could be due either to the destruction of the neuroepithelium of the crista or to a relief from the endolymphatic hydrops by reducing the hypersecretion or facilitating the resorption of the endolymph. It is in his opinion very well possible that
both factors play a role in bringing about the favorable results.

The improvement in tinnitus could also be due to the improved endolymphatic circulation in the vestibular as well as the cochlear portion of the labyrinth.

Arslan reports, without giving detailed statistics, that the attacks of vertigo have disappeared in 95% of his patients, some of whom had been followed for as long as two and one-half years after the operation.

In 4 of the 88 cases the vestibular portion of the labyrinth had not been completely destroyed and the attacks of vertigo had not completely ceased within one year after irradiation. Ultrasound was, therefore, applied a second time, and thereafter all the vertigo stopped.

In none of the cases of Ménière's disease had it been necessary for Arslan to apply ultrasound to both ears, in spite of the frequent involvement of both labyrinths in this disease.

The results reported by Arslan seemed very impressive, and after a visit to Arslan's department in Padua, Italy, by one of us (J. G. W.) it was decided to try this method of treatment in the E. N. T. Department of Presbyterian Hospital.

Although only six cases have so far been treated by us, we nevertheless feel that a presentation of our preliminary results might be of interest.

Report of Cases

Case 1.—A 57-year-old man. Attacks for four years, with perceptive hearing loss in left ear, averaging 60 db. for the conversational range.

June 3, 1957. Application of ultrasound to the left labyrinth.

Seven months after application. No more vertigo for five months; ringing has completely disappeared, the hearing is unchanged from the best it was between attacks.

Case 2.—A 67-year-old man. Attacks for about one year, with perceptive hearing loss in the right ear, averaging 80 db., and ringing.

June 3, 1957. Application of ultrasound to the right labyrinth.

Eight months after application. Attacks of vertigo much improved; unsteadiness between attacks persists; hearing unchanged; ringing persists. Caloric vestibular responses slightly hypoactive on the side operated on.

Case 3.—A 30-year-old woman. Attacks for one and one-half years, increasing in severity, with perceptive hearing loss in the right ear, averaging 40 db. and marked ringing.

Sept. 17, 1957. Application of ultrasound to the right labyrinth.

Five months after application. No more vertigo for more than three months, hearing loss now averaging 20 db.; ringing has almost completely disappeared. No vestibular responses on the side operated on.

Case 4.—A 72-year-old man. Attacks of vertigo for many years with bilateral perceptive hearing loss averaging 70 db. on the right and 80 db. on the left side, ringing in both ears, more marked on the left.

Sept. 26, 1957. Application of ultrasound to the left labyrinth (Fig. 3).

Five months after application. No more vertigo since the operation, hearing unchanged, ringing in left ear has almost completely disappeared. No vestibular responses on the side operated on.

Case 5.—A 51-year-old man. Attacks for six months with ringing in left ear; mixed hearing loss, left side, averaging 50 db. Patient states that simple mastoidectomy was done many years ago; drum shows dry posterosuperior marginal perforation.

Dec. 10, 1957. Exploratory modified radical mastoidectomy; no pathology found. Application of ultrasound to the left labyrinth.

Two and one-half months after application. Attacks persist, ringing continues, hearing unchanged. Prompt vestibular responses after insufflation of cold air into the external auditory meatus.

Case 6.—A 48-year-old woman. Attacks for six years with ringing in left ear and perceptive hearing loss, averaging 80 db.

Dec. 18, 1957. Application of ultrasound to the left labyrinth.

Two months after application. Attacks of diminishing intensity until one month ago, ringing markedly improved, hearing unchanged; vestibular responses absent.

Comment

A review of these six cases shows that the hearing remained practically unchanged in five of them and improved in one. We do, however, not believe that this improvement exceeds the fluctuations frequently noted in cochlear hydrops and we are wondering if this is not also the case in the
patients observed in Arslan. Of greater
significance seems to us the fact that in none
of our patients did the hearing get notice-
ably worse.

The beneficial effect of the radiation on
the ringing was quite striking, and in this
respect the irradiation seems superior to all
other forms of conservative or surgical treat-
ment.

Whether the vertiginous attacks have been
completely eliminated or not can be decided
only after a much longer period of observa-
tion. In two of the cases (2 and 5) the
amount of ultrasound applied to the laby-
rinth had evidently been insufficient to de-
stroy the vestibular portion. This explains
the persistence of vertigo together with the
persistence of the vestibular responses.
In order to get a complete destruction of
the vestibular end-organs, one should not
be content with the appearance of the
"paralytic" nystagmus in one particular posi-
tion of the applicator: the direction of the
beam of ultrasonic waves should then be
changed, and one might in a different posi-
tion again get "irritative" nystagmus. The
application should not be terminated until
one gets "paralytic" nystagmus in all posi-
tions.

The two just-mentioned cases will, there-
fore, require a second treatment with ultra-
sound. Increasing experience with this type
of treatment will undoubtedly greatly re-
duce the number of such cases.

But even now we feel that the results
of the treatment of Ménière's disease with
ultrasound are so encouraging that it is not
improbable that this method will not only
replace the present surgical methods but that
it will also be used in many cases in which
at present medical treatment seems the only
possibility.

Summary and Conclusions

The principle of the treatment of Ménière's disease with ultrasonic waves is
discussed and the Arslan technique de-
scribed.

Altmann—Waltner

The preliminary results in six cases
treated with this method are quite promis-
ing. In four of them the attacks of vertigo
were eliminated. The failure of the treat-
ment in two cases is evidently due to an
insufficient amount of ultrasound applied
to the labyrinth. Increasing experience with
the technique will undoubtedly greatly re-
duce the number of such cases.

10 E. 85th St.

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