DIVER'S EAR

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WITH the increasing popularity of shallow water diving, traumatic injuries to the ear from pressure effects are likely to become increasingly common, making their recognition and a knowledge of their prognosis of importance. With this in mind, a series of 71 men attending a course of training in shallow water diving was studied, and the effects of various types of injury noted.

The army diving school at Marchwood provided an excellent opportunity for studying a large series of men who were starting diving for the first time, and who presented with various ear complaints during the course. Courses were held fortnightly, with an average of six men attending each course. On the first day each man was subjected to pressure in a compression chamber equivalent to a 60 foot depth of water (i.e. an extra 30 lbs. per sq. in., or approx. three atmospheres absolute). Here of course he was not wearing a mask or helmet. If during this test he was able to "clear" his ears adequately, he was allowed to continue with the rest of the course, which consisted of daily diving practice in Southampton water. Here he used standard shallow water diving equipment consisting of a rubber suit and head piece (a C-type hood), to which was attached a breathing tube, clamped at the neck. The mask over the face was fastened by a rubber strap passing round the ears and back of the head. Breathing was carried out by means of a compressed air cylinder strapped on the back, automatically adjusted to pressure. Diving was to a maximum depth of about 30 feet (i.e. two ats. abs.).

Seventy-one men attended the course in the present series, and of these 18 failed to complete the course for medical reasons, 14 because of ear complaints, and one because a blocked sinus produced pain due to barotrauma.

Traumatic lesions of the ear from shallow water diving fall under three headings:

(1) Perforation of the Drum.
(2) Reversed Ear (barotrauma).
(3) Red Ear.

The factors involved in the second of these headings has been described in detail by Jarrett (*B.M.J.*, August 19th, 1961). The third type has been in our experience the largest, and has been the one around which most of our interest has centred.

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Information was collected as follows:

Each man was seen and given a thorough medical before the course commenced. A chest *X*-ray was performed, and the ears were examined and any wax removed. Those with a previous history of chronic middle-ear disease, or who presented with otitis, a perforation, or a throat infection, were barred.

The ears were again examined after the compression chamber tests, and after the first day's diving.

Subsequently, any man who complained of his ears during the course was seen, and a routine examination was carried out on the completion of the course.

The three types of trauma presented in different ways. A typical case of each is described.

(1) *Perforation*

Sapper B., aged 23, had normal ear drums before diving; no P.H. of ear disease. He had never dived before. On the first day he completed to 60 ft. in the compression chamber without ill effect. On the second day he commenced diving and had pain in his ears between 20-30 ft. This wore off. On his second dive he had pain at about 15 ft. which he could not relieve by Valsalva's manœuvre. But he continued to the bottom, surfaced and again dived to 30 ft. The pain got worse, and on coming out of the water he noticed deafness. He felt as though something was sticking through his ear.

o/e. Rinné's: —R for both ears.
Weber's: equivocal.

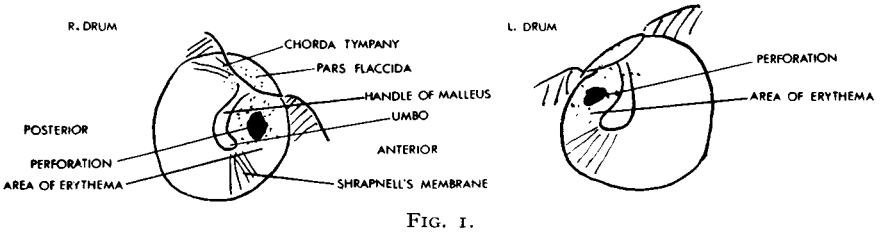


FIG. 1.

There was a small anterior perforation of both drums. Blood oozed from the left ear.

Treatment

The outer ear was gently mopped to clean. Sulphonamide was given prophylactically for 2 weeks orally. Healing had occurred in 5 weeks. Further diving was not advised.

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(2) *Reversed Ear*

L/Cpl. B., aged 26, had had previous diving experience. No P.H. of ear disease. Drums normal at the onset of the course. He had undergone compression without trouble.

On his first dive he descended to 30 ft. He was down some 20 minutes. On the second dive he found difficulty in clearing his ears. On returning to the surface, he noticed a lot of crackling in the left ear. He had been down about an hour in all. There was a mild discomfort in the left ear and slight deafness. There was a buzzing in both ears, and when he bent his head forwards, there was a sensation of fluid in the middle ear.

o/e. Rinné's: +R in both ears.
Weber's: heard loudest in the left ear.

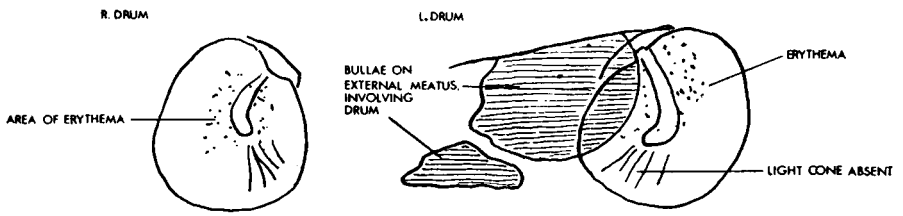


FIG. 2.

The right ear had a patchy erythema on the drum, but was otherwise normal. The left ear had bullae on the wall of the external meatus, involving the drum.

This man was taken off the course. The ear was washed out with 20 vol. hydrogen peroxide to clear the débris. No other treatment was given. The ear was normal within 2 weeks. (Jarrett recommends sulphonamides for these cases.) This man was allowed to dive again on a subsequent course without ill effect.

(3) *Red Ear*

Spr. R., aged 21, had had no previous diving experience. No P.H. of ear trouble. He descended to 20 ft. in the compression chamber but was unable to clear. His ears were painful for about 2 hours afterwards. He felt a swishy feeling in both ears on moving his head.

o/e. Rinné's and Weber's tests: normal.

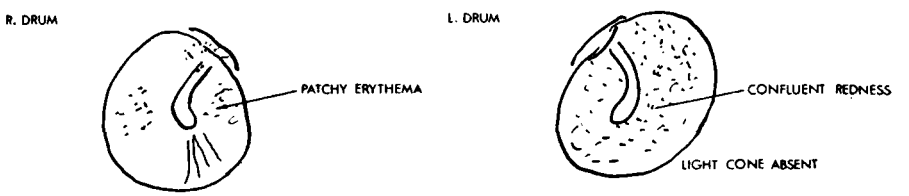


FIG. 3.

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Both drums were diffusely red and bruised. There was no perforation. The external canals were normal.

No treatment was given. The ears were normal in 5 days. Further diving on a future course was allowed.

L/Cpl. L., aged 23, had had no previous diving experience. He completed to 60 ft. in the compression chamber without ill effect. On the following day he dived a number of times, and was seen routinely afterwards. He had no complaints.

o/e. Both drums had a generalized erythema and bruising. There was no perforation. There were small petechiae on the wall of the medial part of the external canal.

This man was allowed to continue the course, and at the end of 2 weeks his drums appeared perfectly normal, in spite of continuous diving in the interval.

Discussion

Perforation

Three cases were seen. They occurred in those men who in spite of being unable to clear their ears continued to dive; a foolish action which all had been warned against. All were given prophylactic sulphonamides, and the perforations quickly cleared without complication. Further diving was not recommended.

Reversed Ear

Five cases were seen. They occurred basically as a result of the fact that the non-porous rubber used, and the C-type hood worn closely over the ear created a negative pressure in the external meatus, causing petechiae and bullae to form in the external canal. This condition is rare in shallow water diving where the men do not go so deep and are not down so long. These cases would not occur if porous rubber were used for the suits, for then a negative pressure could not develop (Jarrett). No treatment was given apart from the initial washout with 20 vol. H_2O_2. All quickly returned to normal, and were allowed to continue diving after healing had occurred.

Red Ear

The third type of lesion interested us most since it occurred relatively commonly in those divers diving for the first time. It did not occur in experienced divers. "Red Ear" consisted of hæmatoma in the drum itself, found in mild cases patchily, especially in the pars flaccida and in the posterior quadrant, but in severer cases it was confluent over the whole drum. The medial part (bony) of the external canal also occasionally showed petechiae or a mild erythema.

Curiously this lesion rarely produced any pain; a slight difficulty

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experienced in clearing often being the only complaint. Often the condition was found during the routine examinations. In this present series 12 cases were seen.

The bruising was considered to be due to the repeated trauma of pressure changes on a "virgin" drum unused to this kind of treatment. It invariably cleared in a few days even if diving were continued. Often it was found after the compression chamber trials, and so could not be due to the type or hood worn, since on these occasions none were. At the beginning of the series men who presented with a red drum were automatically taken off the course, but as time went on it was realized that this was a relatively normal phenomenon, and they were allowed to continue diving. Indeed, 38 per cent. of the series showed the condition in some degree, this being approximately 50 per cent. of those who had never dived before. The drum soon seemed to become hardened to this kind of stress.

A factor as yet unexplained is the appearance of petechiae in the outer ear in some of the cases after the compression trials (i.e. before any diving in suits and hoods had been performed). This finding was identical with the description of a mild barotrauma as described by Jarrett but obviously could not be caused by negative pressure in the external ear. It is suggested that the cause may be due to minor trauma to the vessels supplying the lateral part of the drum (the deep auricular branch of the external maxillary), which also supply the bony part of the external canal. There is a continuous layer of epithelium extending over the periosteum of the bony canal and the fibres of the tympanic membrane, beneath which hæmorrhage could presumably track.

Summary

Three types of aural trauma are described as met in shallow water diving. It is concluded that both reversed ear and perforation are conditions largely avoidable by proper training of the diver, and use of correct equipment. The condition of "Red Ear" is discussed and described, and is considered to represent a relatively normal reaction of the "virgin" ear to pressure trauma. It does not require treatment, and is compatible with continuing the diving course.

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