DISORIENTATION WITH MIDDLE EAR BAROTRAUMA OF DESCENT

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The occurrence of vertigo and disorientation is particularly hazardous to divers in the aquatic environment, especially when there is no physical contact with a companion diver or a communication line. It is aggravated when there is inadequate visibility, resulting in exceptional reliance being placed upon vestibular responses.

Sir Leonard Hill (1912) made reference to vertigo in two large series of occupational disease of caisson workers. Heller et al gave an incidence of 1.3% and described two different presentations, one included temporary deafness with vertigo lasting for some days and due to middle ear barotrauma of descent. The other was a Ménière-like complex of vertigo, vomiting and deafness which could persist indefinitely and was due to decompression sickness. The clinical differentiation of these two groups was clear. Barotrauma was experienced during compression, and could result in vertigo; decompression sickness developed during or subsequent to decompression. Many other causes of vertigo have subsequently been proposed, and verified before being included in the current aetiological classification from Edmonds et al (1973).

The vertigo associated with ascent, and related to pressure changes and barotrauma, has been adequately described by Lundgren (1965), Fields (1968), and Edmonds et al. This vertigo has been demonstrated experimentally by Tjernström (1973) and verified clinically and electronystagmographically by Edmonds et al. Lundgren used the term "alternobaric vertigo" for the production of vertigo and disorientation during ascent, related to a difference in pressure between the middle ear cavities. Lundgren also noted that some divers complained of vertigo during descent. These were in the minority. Terry and Dennison (1966) stated that vertigo was as frequent with descent as with ascent. No experimental or electronystagmographical verification of the vertigo with descent has been available, although it was included in the classification previously referred to.

VERTIGO IN DIVING - AETIOLOGICAL CLASSIFICATION

I. Caloric

(a) Unilateral external auditory canal obstruction
   (i) Cerumen
   (ii) Otitis externa
   (iii) Miscellaneous

(b) Tympanic membrane perforation
   (i) Shock wave
   (ii) Middle ear barotrauma of descent
   (iii) Forceful autoinflation

.../2. Barotrauma
2. Barotrauma

(a) External ear barotrauma of descent
(b) Middle ear barotrauma of descent
(c) Middle ear barotrauma of ascent
(d) Forceful autoinflation

3. Inner ear Barotrauma

(a) Fistula of the round window

4. Decompression Sickness

5. Miscellaneous

Due to Unequal Vestibular Responses

1. Caloric
2. Barotrauma
3. Abnormal gas pressures
4. Sensory deprivation.

In this classification, vertigo in diving was claimed to be possible from middle ear barotrauma of descent. Such objective evidence is now reported.

CASE REPORT NO. 1

This patient was a certified diver who frequently developed dizziness on descent. She commonly experienced difficulty in equalising the middle ear spaces and frequently resorted to nasal decongestants. There was no symptomatology suggestive of disorientation during ascent, and usually the sensation of dizziness reduced as she remained at a constant depth.

On examination, there was no conventional evidence of any abnormality in inner ear function, as she had normal pure tone audiograms and normal electronystagmograms to positional and bithermal caloric stimuli.

Dysbaric electronystagmograms, as described by Edmonds et al (1973) were performed, with the diver in the sitting upright position. These involved continuous electronystagmographic monitoring while the patient was subjected to changes in atmospheric pressure. The compression was at the rate of 9 metres per minute, to a depth of 18 metres. The patient was then kept at the depth of 18 metres for 2 minutes, and ascended at the same rate.
The electronystagmographic results verified the subject's observation of vertigo associated with compression, relieved by maintenance of pressure, and absent during decompression.

CASE REPORT NO. 2

This subject had difficulty in equalising both middle ear pressures during a recompression chamber descent. Because of the inability to achieve this middle ear equalisation, the compression was terminated at 3 metres. At that time the electronystagmographic monitoring, which was being performed in conjunction with another experimental aim, demonstrated severe nystagmus associated with the subjective complaint of vertigo. The diver was in the supine position. Vertigo was stated to persist for many minutes after the initial middle ear injury, and nystagmus was demonstrated to persist in a progressively decreasing degree, for approximately 12 minutes.

CONCLUSIONS

Experiment 1 demonstrated in an objective manner that vertigo and nystagmus are able to be precipitated with the middle ear pressure changes during descent.

Experiment 2 demonstrated that middle ear barotrauma of descent not only can initiate vertigo and nystagmus, but that this manifestation may continue and need not merely be transitory.

As there is no evidence of either abnormal cochlear or vestibular function prior to the dives referred to above, there is no reason to believe that the vestibular response is due to an underlying vestibular inequality. In both cases there is a history of inability in equalising the middle ear spaces, and it is presumed that the inequality of middle ear pressure is the cause for both the transitory and the persistent abnormal vestibular response. The transitory response could be the result of the unequal physiological stimuli i.e. unequal middle ear pressures. The persistent nystagmus may be related to more persistent barotraumatic pathology in the vestibules. These descriptions are thus similar in concept, although opposite in direction, to the "alternobaric vertigo" described by Lundgren and confirmed independently by Edmonds and Tjernström.

The value of the dysbaric electronystagmogram, to supplement routine vestibule function tests in aviators and divers, is again verified.

.../SUMMARY
Disorientation and vertigo, which develops in divers during descent, is objectively demonstrated with dysbaric electronystagmographic tracings. The inclusion of middle ear barotrauma of descent is verified as a valid aetiology in the classification of vertigo associated with diving, and may present as either a transitory or a more persistent disorder.
DIVE VELOCITY: 9.0 Metres per Min.

ON SURFACE

VALSALVA MANOEUVRE

LEFT SURFACE

METRES

SECONDS

0

0

1.5

0

10

2.0

20

3.0

30

300

720
REFERENCES


