AD-779 075

A PROPHYLACTIC PROGRAM FOR THE PREVENTION OF OTITIS EXTERNA IN SATURATION DIVERS

E. D. Thalmann

Navy Experimental Diving Unit
Washington, D.C.

23 April 1974

UNCLASSIFIED
Security Classification

AD-779075

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY *(Corporate author)*

U. S. Navy Experimental Diving Unit
Washington Navy Yard
Washington, D.C. 20374

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3 REPORT TITLE

A Prophylactic Program For The Prevention of Otitis Externa in Saturation Divers.

4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

5 AUTHOR(S) *(First name, middle initial, last name)*

E. D. Thalmann, LT, MC, USNR

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
23 April 1974	11	

8a. CONTRACT OR GRANT NO	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO	Research Report 10-74
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Experimental Diving Unit Washington Navy Yard Washington, D.C. 20374

13 ABSTRACT

A prophylactic regimen for the prevention of Otitis Externa was tested on 5 saturation dives. The dives totaled 78 days, no dive being shorter than 10 days. A total of 26 subjects participated in the dives.

The regimen consisted of irrigating the ear canals with a 2% acetic acid in aluminum acetate solution each morning and evening and after each head immersion. When compared to a set of base period dives of similar length, during which no ear prophylactic regimen was used, the incidence of otitis externa was markedly lower in the test dives.

The initial success of the prophylactic regimen is attributed to the strength of the acetic acid solution used and the regimented manner in which the irrigations were administered.

A review of the literature revealed that preparations similar to the one used in this study have been used successfully to prevent otitis externa during dives when the subjects were cooperative and used the preparations in a consistent and systematic way.

DD FORM 1 NOV 68 1473 (PAGE 1)

S/N 0101-807-6801

UNCLASSIFIED
Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Otitis Externa						
Ear						
External Otitis						
Prophylaxis						

U. S. NAVY EXPERIMENTAL DIVING UNIT
WASHINGTON NAVY YARD
WASHINGTON, D.C.

RESEARCH REPORT 10-74

A PROPHYLACTIC PROGRAM FOR THE PREVENTION OF OTITIS EXTERNA IN SATURATION DIVERS.

E. D. THALMANN, LT, MC, USNR

23 April 1974

SUBMITTED:

E. D. THALMANN
LT, MC, USNR

REVIEWED:

W. H. SPAUR
CDR, MC, USN
SENIOR MEDICAL OFFICER

APPROVED:

C. M. JONES
CDR, USN
OFFICER IN CHARGE

INTRODUCTION:

Otitis externa is probably the leading cause of diver morbidity in saturation diving. During the Tektite I program in 1969 otitis externa was the only medical problem encountered during the entire 60 day mission (3), and it was the leading cause of lost diving time on the Tektite II dive (1). At the Navy Experimental Diving Unit, the morbidity due to otitis externa far exceeds that of decompression sickness or other medical problems related to diving.

When seen in the usual clinical setting, the symptoms of otitis externa are usually not severe and the various treatment regimens as described in the literature are fairly effective in curing the disease (2, 4, 7, 8, 9, 10). Divers, however, present special problems. During saturation dives, they are either in the water or confined to a relatively warm (89-91°F), humid (50-100%) hyperbaric chamber and these conditions have been shown to be particularly predisposing to the development of otitis externa. Since mission and decompression requirements obligate the diver to long periods in the hyperbaric environment, both the severity and duration of the disease are increased once symptoms do develop. During saturation dives the disease often progresses to the point where systemic antibiotics are required to control the swelling, purulent discharge and high fever. The pain caused by jaw movement and the extreme tenderness of the external ear and regional lymph nodes make the use of a mouthpiece or full face mask all but impossible. Treatment at depth is only partially effective and significant improvement usually does not occur until after the diver has been on the surface several days.

Many prophylactic measures have been tried by the Navy Experimental Diving Unit including alcohol, acetic acid with alcohol or glyceral acetate, and otic antibiotic preparations both with and without steroids. None of these had proved particularly successful in lowering the incidence of otitis externa and because of this experience, the Navy Experimental Diving Unit had no regular program for the prevention of otitis externa.

METHODS:

The ear prophylaxis described in this paper was initially tested on a 16 day 1000 foot saturation dive and has subsequently been used on a 32 day 1600 foot and three 10 day 300 foot saturation dives. During the course of these five dives, a total of 26 subjects participated in the program. All of these dives were performed in a research hyperbaric chamber with wetpots and the subjects each had 3 to 4 hours of total immersion during each dive. On all dives, the chamber temperature varied between 87-89°F and the humidity between 50-90%.

The ear prophylaxis was made a part of the daily dive protocol and rigidly followed by each diver throughout the dive. The program was started 2 days before compression and terminated upon surfacing. The prophylaxis routine was performed each morning and evening as well as following each immersion. The routine consisted of irrigating the ear canals with a 2% acetic acid in aluminum acetate solution (Domeboro Solution, Dome Laboratories) as follows; with the head turned to one side, one ear canal was filled with solution and was allowed to remain in the canal 5 minutes by the clock. This procedure was then repeated for the other canal. After the solution had run out of the ear canal, the external auditory meatus was dried with a towel, no other special drying procedures being used.

Ear cultures were obtained several times during the 1000 and 1600 foot dives with Calgiswabs® to minimize trauma to the meatal epithelium. Water cultures from the wetpot were collected in sterile 4 oz. bottles.

Otoscopic examinations were done pre and post dive but were not done during the dive unless symptoms of otitis externa developed. Earache, irritation or discharge of any type were considered symptoms of otitis externa until proven otherwise.

RESULTS:

No clinical evidence of otitis externa was present during any of the 5 dives on which the prophylactic procedure was used. During all of these dives, the divers had several hours of head immersion. The water was cultured several times during the 1000 and 1600 foot dive and consistently grew numerous E.Coli or proteus species.

All but two ear cultures grew Staphlococcus epidermitis. The two exceptions were one culture on the 1600 foot dive which grew pseudomonas and one culture from the 1000 foot dive which grew gram negative rods preseumably E.Coli from the water in the wetpot.

Three of the divers on the 32 day 1600 foot dive were noted to have some creamy white patches on the walls of their ear canals and eardrums. Cultures of these patches grew Klebsiella and Aerobacter species and fungal cultures were negative. No clinical signs or symptoms of ear infection was noted in any of these divers, and because of this the above organisms were presumed to be saprophytic.

No adverse effects of the irrigating solution were noted on any of the dives. Two divers on the 1600 foot dive had their canals become plugged with what appeared to be cerumen and cellular debris about 20 days into the dive. Curretting was required to clear this debris and once cleared, it did not recur.

DISCUSSION:

Table 1 reflects the experience of NEDU with otitis externa since August 1972. Dives from August 1972 through January 1973 were used as baseline dives because the incidence of otitis externa was well documented and because it was known that no special prophylactic measures were used. As can be seen from Table 1, the incidence of otitis externa on dives lasting more than 3 days ranged from 25% to 75%. The two 3 day dives were probably too short to permit the development of otitis externa and this is consistent with the observation that the symptoms of otitis externa usually take 48 to 96 hours to develop. The five dives on which the prophylactic regimen was used showed a 0% incidence of otitis externa which was a radial departure from the usual pattern of long saturation dives at the Navy Experimental Diving Unit.

The success of the ear prophylaxis program can probably be attributed to two factors: the strength of the acetic acid solution and the regimented manner in which the irrigations were performed. Although Owen demonstrated that an acetic acid solution as dilute as 0.3% inhibits the growth of ear pathogens (18), solutions this dilute have not had much success in preventing otitis externa. Wright has used very dilute (0.25%-0.3%) acetic acid in alcohol solutions in two studies, one with humans (12) and the other with guinea pigs (11), and in both cases it was ineffective in preventing otitis externa. However, a 5% acetic solution was used by Jones to successfully control otitis externa in swimmers at summer camp (6), and 5% acetic acid, 50% alcohol, 5% tannic acid was used in the Tektite II program to keep the incidence of otitis externa down to 8.8% in those who used it while the incidence in non-users was 64% (1). The Domeboro Otic solution used in this

TABLE 1

OCCURRENCE OF OTITIS EXTERNA AT NEDU SINCE AUG 72

DATE	DEPTH (feet)	DURATION (days)	#DIVERS	# EARS IMMERSED	TOTAL #EARS with otitis externa	%INCIDENCE OF otitis externa	MEAN TIME of onset from first immersion
Base Period Dives							
AUG 72	1000	17	4	8	7	78%	3 days
DEC 72	200	3	6*	10	0	0%	——
JAN 72	200	4	5*	8	2	25%	3 days
JAN 73	200	3	6*	10	0	0%	——
JAN 73	200	5	6*	10	4	40%	2 days
Test Dives							
FEB 73	1000	16	5*	8	0	0%	——
APR 73	1600	32	6	12	0	0%	——
FEB 74	300	10	5	10	0	0%	——
MAR 74	300	10	5	10	0	0%	——
APR 74	300	10	5	10	0	0%	——

*DIVING MEDICAL OFFICER DID NOT IMMERSE HIS EARS AT ANY TIME. AT NO TIME DID HE DEVELOP OTITIS EXTERNA.

study contains 2% acetic acid and there are several papers describing success using acetic acid solutions of this strength (2, 4, 10). Hutchison used Domeboro solution as prophylaxis against otitis externa in guinea pig ears (5) and found it ineffective. However, the experimental design probably subjected the guinea pig ears to predisposing conditions much more severe than would be encountered on a saturation dive.

Even more important than the strength of the irrigating solution is the method of irrigation. No matter what method of prophylaxis is used, unless it is applied in a consistent manner its effectiveness will be curtailed. Jones stressed the importance of a 5 minute contact time for the irrigating solution (6). The divers in the Tektite II program, however, followed a more leisurely procedure having only a 2 minute contact time and irrigating ears only after the last dive of each day. Their incidence rate (8.8%) was higher than ours (0%) but their series included 34 subjects and their immersion times were longer than those in this study.

Since the primary mission of the dives on which the prophylactic regimen was tested was to successfully complete the experiments outlined in the dive protocol, no attempt was made to do a controlled study. The purpose of the prophylaxis was to prevent otitis externa and not to do a clinical evaluation of otic preparations. Since the initial regimen met with success, no other preparations were tried and as a result no conclusion can be drawn concerning the merits of the Domeboro Otic versus other solutions. From reading the literature and from talking to others who have instituted prophylactic programs similar to this one, there is no reason to suppose that the aluminum acetate which is used as the drying solution in the Domeboro Otic solution offers any specific advantage over alcohol.

The results of the cultures done during the 1600 and 1000 foot dives deserves only brief mention. The wetpot cultures grew coliforms as would be expected and cultures of the divers' ears grew mainly gram positive flora. There was no shift from gram positive to gram negative flora. Wright and Alexander (3) have noted a shift of the ear flora from gram positive to gram negative coincident with the development of otitis externa.

Acetic acid irrigations for the prevention of otitis externa are not new by any means and yet many programs using these solutions have met with little success. The concensus of several of those who have tried instituting prophylactic programs for the prevention of otitis externa was that infections arose in those who failed to follow the prophylactic regimen. We are particularly fortunate in being able to closely supervise the divers and insure that all divers follow the program exactly as instructed.

CONCLUSIONS:

A 2% acetic acid in aluminum acetate irrigation solution is effective in preventing otitis externa in saturation divers if administered in a regimented and closely supervised manner.

This regimen has proved safe and to date no undesirable side effects have been noted.

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