**REPORT DOCUMENTATION PAGE**

**AD-A197 268**

**4. PERFORMING ORGANIZATION REPORT NUMBER(S):**
NMRI 87-89

**5. MONITORING ORGANIZATION REPORT NUMBER(S):**

**6a. NAME OF PERFORMING ORGANIZATION:** Naval Medical Research

**6b. OFFICE SYMBOL:** (If applicable)

**7a. NAME OF MONITORING ORGANIZATION:** Naval Medical Command

**7b. ADDRESS (City, State, and ZIP Code):**
Department of the Navy
Washington, D.C. 20372-5120

**8a. NAME OF FUNDING/SPONSORING ORGANIZATION:** Naval Medical Research and Development Command

**8b. OFFICE SYMBOL:** (If applicable)

**9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER:**

**10. SOURCE OF FUNDING NUMBERS:**

**11. TITLE (Include Security Classification):**
TRANSIENT CARDIAC SINUS DYSRHYTHMIA OCCURRING AFTER COLD WATER IMMERSION.

**12. PERSONAL AUTHOR(S):**

**13a. TYPE OF REPORT:** Report No. 3

**13b. TIME COVERED:** FROM 1986 TO 1987

**14. DATE OF REPORT (Year, Month, Day):** 1987

**15. PAGE COUNT:** 2

**16. SUPPLEMENTARY NOTATION:**
Reprinted from: American Journal of Cardiology 59: 1421-1422, June 1, 1987

**17. COSATI CODES:**

**18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number):**
- Arrhythmia
- Cold
- Sinusoidal Node
- Immersion

**19. ABSTRACT (Continue on reverse if necessary and identify by block number):**

**20. DISTRIBUTION/AVAILABILITY OF ABSTRACT:**
- UNCLASSIFIED/UNLIMITED
- SAME AS RPT
- DTIC USERS

**21. ABSTRACT SECURITY CLASSIFICATION:**
Unclassified

**22a. NAME OF RESPONSIBLE INDIVIDUAL:** Phyllis Blum, Information Services Division

**22b. TELEPHONE (Include Area Code):** 202-295-2188

**22c. OFFICE SYMBOL:** ISD/ADM/INMR

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted.
All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED
Transient Cardiac Sinus Dysrhythmia
Occurring After Cold Water Immersion

THOMAS J. DOUBT, PhD
DOUGLAS L. MAYERS, MD
EDWARD T. FLYNN, MD

Reprinted from the June issue

The American Journal of Cardiology
Transient Cardiac Sinus Dysrhythmia Occurring After Cold Water Immersion

THOMAS J. DOUBT, PhD
DOUGLAS L. MAYERS, MD
EDWARD T. FLYNN, MD

A variety of cardiac dysrhythmias are known to occur as a result of accidental hypothermia. The overall incidence and types of human cardiac electrical disturbances that occur as a result of occupational exposure to cold water is uncertain. We describe a transient form of sinus dysrhythmia in 5 professional divers after 2 hours in cold water.

Five physically fit men (26 ± 5 years old, body weight 88 ± 14 kg, body fat 20 ± 6%) were participating in open water training dives with a diver propulsion vehicle. Each wore a standard neoprene wet suit and breathed compressed air to a maximum depth of 12 meters of sea water. Minimal physical exercise was involved during the 2-hour training sessions in 2°C water. Each diver made 2 dives, with an interval of 48 hours between dives. A 6-minute continuous rest pre-dive electrocardiographic tracing was recorded on magnetic tape before each dive and within 15 minutes of completion of the dive. A similar tracing was recorded on a nondiving day. Each tape was analyzed with the aid of a computer that calculated instantaneous heart rate from the corresponding RR interval. All electrocardiographic findings were normal except for the occurrence of abrupt sinus pauses. With respect to the preceding beats, sinus pauses were characterized by a single beat increase in the RR interval of at least 50%. After each pause, 1 to 3 beats were required for heart rate to return to its inherent frequency. At least 4 beats occurred at the inherent frequency before the next observed sinus pause.

Sinus pauses were evident in 9 electrocardiographic recordings (of a total of 25 recordings in the 5 divers), with pauses noted in 7 recordings obtained immediately after a dive and in 2 predive recordings. No tracings recorded on the nondiving day showed evidence of sinus pause. Four of the 5 divers exhibited 1 or 2 episodes of sinus pause in postdive recordings. The fifth diver had 8 episodes of sinus pause after his first dive and 15 after his second dive.

Figure 1 presents segments of the electrocardiogram recorded from the fifth diver. Although the postdive baseline recording contains shivering artifact, all
the complexes appear to be sinus in origin, with no marked diminution of P-wave amplitude or prolongation of the PR interval. However, the third postdive RR interval is noticeably increased, reflecting a sinus dysrhythmia. This type of recording was characteristic of all sinus pauses noted.

Figure 2 shows the RR intervals measured in the fifth diver on the second dive day. The 15 upward deflections in the postdive record are each due to the type of sinus pause shown in Figure 1. Most of the pauses were present during the first 2 minutes of the recording. A subsequent recording obtained 15 minutes later had no evidence of sinus pause.

This report describes a nonpathologic dysrhythmia associated with cold water exposure. Qualitatively similar fluctuations in heart rate have been noted immediately after brief treadmill exercise and were attributed to phasic alterations in vagal tone. Although no direct tests of vagal function were conducted in the present report, an abrupt change in parasympathetic tone may have contributed in some manner to the sinus pauses. A direct relation to exercise can be ruled out in the current findings because the divers were performing minimal work while underwater. Scuba diving itself was probably not a significant factor because of the relatively shallow depth. Dysrhythmias observed with scuba dives in pool water at 24 to 28°C tended to be ventricular or supraventricularextrasystoles rather than sinus pauses. We found no sinus pauses in a laboratory study involving immersion in 32°C water, suggesting that immersion alone was not a principal factor.

Exposure to cold water appeared to be the central factor related to the sinus dysrhythmia. Postdive decreases in skin and rectal temperatures of 5.3 ± 0.7 and 0.3 ± 0.2°C, respectively, indicate a loss of body heat that may have sensitized the sinus node, perhaps causing it to respond inappropriately to a normal reflex. For example, a normal respiratory reflex produces prolongation of the RR interval during expiration. Although we had no respiratory cycle measurements to correlate with the sinus pauses, none of the divers had visible signs of pronounced dysrhythmic breathing. Periodic subtle changes in breathing, particularly during expiration, may provoke an exaggerated response in a sensitized node that would result in an abrupt sinus pause. This hypothesis must await further testing.

No electrocardiographic records were obtained while the divers were actually in the water, and thus we could not document the dysrhythmia during the dive. Further, marked sinus dysrhythmia occurred in only 1 of 5 divers, for an incidence rate of 20% in this small sample group. In a subsequent study we noted sinus pauses during 55% of 60 immersions in 5°C water. Thus, abrupt sinus pauses are apparently relatively common during cold water diving. Although this form of dysrhythmia is considered benign, further laboratory investigations are necessary to document its physiologic mechanism.