# CNS reactions at 51 ATA on trimix and heliox and during decompression

**R. VÆRNES, D. HAMMERBORG, B. ELLERTSEN, R. PETERSON, and S. TØNJUM**

*Norwegian Underwater Technology Center, Bergen, Norway; Institute of Physiological Psychology and Institute of Clinical Neuropsychology, University of Bergen, Norway.*

Værnes R, Hammerborg D, Ellertsen B, Peterson R, Tønjum S. CNS reactions at 51 ATA on trimix and heliox and during decompression. Undersea Biomed Res 1985; 12(1):25–39.—Two groups of divers (Group A and B) were compressed to 500 msw with trimix ($n$ = 3) and heliox ($n$ = 3). After 4 d at saturation depth Group A had a gas change to heliox. Both groups were followed with repeated neuropsychological and neurological tests during compression, at stable intermediate depths and at saturation depth. There were marked high pressure nervous syndrome effects during compression for both groups. Only tremor was inhibited by the nitrogen. In addition Group A was impaired due to nitrogen narcosis. During trimix and heliox saturation there was only some recovery in the EEG. Group B had a sustained high tremor during the saturation. On visuomotor and cognitive functions Group B performed up to predive level on the 3rd d at saturation while Group A was heavily impaired during the whole trimix saturation period. Although dizziness and tremor were the main symptoms in Group B, Group A reported concentration trouble, euphoria, and upset stomach during the saturation phase. Minor changes occurred in the EEG during the gas change. There was, however, a marked increase in postural tremor and recovery on cognitive tests relating to the elimination of the nitrogen. Up to the completion of the gas change no severe symptoms were reported. Six hours after the gas change, severe symptoms occurred with visual and auditory hallucinations and myoclonic jerks as the dominant characteristics. Some symptoms lasted for 12 h. During decompression there was a steady normalization in both groups.

trimix
high pressure nervous syndrome
gas change
nitrogen narcosis
EEG
hallucinations

Compression with helium and oxygen to depths greater than 150 meters of seawater (msw) can lead to EEG changes associated with somnolence and confusion (1). Previous studies on animals have shown similar changes as a prelude to the development of generalized seizures (2). This complex of tremor, EEG changes, and somnolence has been termed the high pressure nervous syndrome (HPNS) (3). Numerous deep dives, animal experiments, and pharmacological studies have been conducted in an attempt to elucidate the nature of this syndrome. Focus has been on possible etiology and possible methods to counteract it. Previous studies, especially in animals, have shown that HPNS can be counteracted by addition of a mild narcotic agent,

such as an increased partial pressure of nitrogen (4–6). In early studies, Bennett et al. (7) found that 25% and 18% nitrogen in a trimix breathing gas was effective in counteracting the HPNS symptoms, but the nitrogen caused symptoms of nitrogen narcosis. Subsequent work by Lemaire and Murphy (8) with 10% nitrogen, efficiently counteracted the HPNS and no symptoms of narcosis occurred according to their definitions of the two syndromes. These results were further confirmed in the Atlantis dive series (9, 10). However, there are some discrepancies between the conclusions drawn by Bennett et al. and the results from the Coraz dives performed by Rostain et al. (11). Although the first authors concluded that trimix suppressed the HPNS, data from Rostain et al. (11) indicated that nitrogen did not suppress the HPNS as such but caused suppression of some behavioral symptoms, while other signs, like changes in the EEG, were similar in heliox and trimix compression groups.

In the DEEP EX 81 dive, two groups of divers were compressed to 500 msw (51 ATA) with heliox ($n = 3$) and trimix ($n = 3$). Data from the compression period have been reported by Værnes et al. (12). In the present study we wanted to investigate the possible central nervous system (CNS) effects of trimix saturation, using 10% nitrogen, as compared to heliox saturation at 500 msw (51 ATA). Three problems were investigated: (a) What is the degree of CNS recovery on trimix and heliox saturation at 500 msw? (b) What happens during and after the removal of nitrogen at 500 msw: does this primarily cause reinforced HPNS reactions and/or are there any withdrawal effects of high pressure nitrogen? (c) Is there any difference between the groups after a gas change to heliox in the first group?

## METHODS

*Subjects.* Six males participated as subjects. The mean age was 32 yr (SD = 4). Four subjects had participated in a previous dive to 300 msw (13), DEEP EX 80. Five subjects were commercial divers and one an engineer who had participated in the previous dive.

### Experimental design

*The compression phase.* The subjects were subdivided into two groups (A and B) both of which were compressed to 500 msw (51 ATA). One group ($n = 3$) breathed trimix during the compression (Group A) with 10% nitrogen, and the other group ($n = 3$) breathed heliox (Group B). The compression profiles (12) were to be followed provided no severe symptoms occurred. As shown in Fig. 1 Group A was compressed 5 d before Group B.

*The saturation phase.* Group A stayed at 500 msw for 14 d. Group B, which was compressed 5 d later, stayed at 500 msw for 9 d (Fig. 1).

*The gas change.* On the 4th d gas change from trimix to heliox was started in Group A. The gas change started at 7 p.m. and was completed on the next day at 4 p.m. when the nitrogen concentration was reduced to about 2%. After the gas change, both groups were on heliox but it was important to differentiate between the groups due to the different conditions they had gone through.

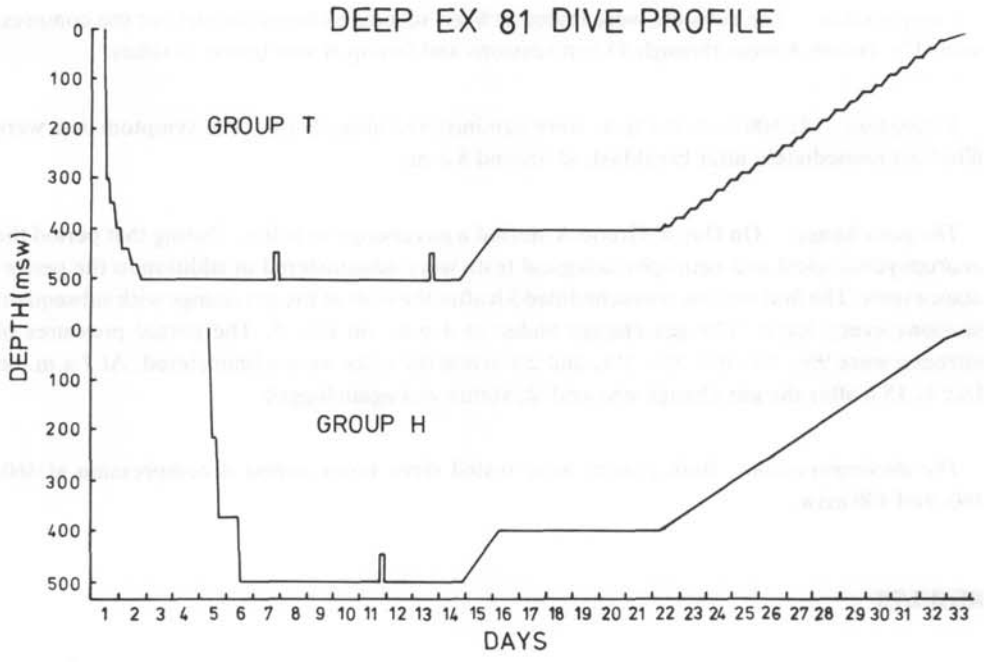



Fig. 1. DEEP EX 81 profile for Group A (trimix compression) and Group B (heliox compression). From Day 6 both groups were on heliox.

**Instrument description**

*The compression battery.* The following 5 tests were administered throughout the compression and during the saturation phase (Fig. 1): (a) electroencephalography with bipolar recording from both hemispheres (C3-F3 and C4-F4), data were Fast Fourier Transform (FFT) computer analyzed in 2 s epochs; (b) the static steadiness test for recording postural tremor; (c) the finger oscillation test for recording finger tapping speed; (d) the dynamometer test for recording hand grip strength; and (e) the Trails test for recording visuomotor coordination. For further description of the tests see Værnes et al. (12).

*Performance tests.* A battery of visuomotor and cognitive tests and a symptom questionnaire were administered during the intermission depths, during the saturation phase at 500 msw, and during decompression. The tests were arithmetic, reasoning, long-term memory, and perceptual speed (12).

**Test procedure**

The test procedure was the same for both groups. Predive testing including all tests, which were performed repeatedly during the 6 wk before the dive started. This was done to have a minimum of 5 predive test samples, to familiarize the subjects with the test procedures to be used in the chamber, and to stabilize learning effects.

*Compression.* The subjects were tested at fixed scheduled times throughout the compression (12). Group A went through 13 test sessions and Group B was tested 11 times.

*Saturation.* At 500 msw the tests were administered about 9 a.m. The symptom lists were filled out immediately after breakfast, at around 8 a.m.

*The gas change.* On Day 4, Group A started a gas change to heliox. During that period the neuropsychological and neurophysiological tests were administered in addition to the performance tests. The first session was scheduled 3 h after the start of the gas change with subsequent sessions every 3rd h. The gas change ended at 4 p.m. on Day 5. The partial pressures of nitrogen were 9%, 5%, 6%, 4%, 3%, and 2% when the tests were administered. At 7 a.m. on Day 6, 15 h after the gas change was ended, status was again logged.

*The decompression.* Both groups were tested three times during decompression at 460, 160, and 100 msw.

## RESULTS

### Saturation on trimix

*EEG.* For A1 there was a marked increase in 2–7 Hz activity and decrease in 8–13 Hz activity on Diveday 2 (Fig. 2). On Diveday 3 there were minor changes in relative power for theta and alpha band activity, and on Diveday 4 there was still no recovery in the power spectrum EEG.

For A2 there was a marked increase in slow-wave activity and inhibition of activity in the alpha band on Diveday 2 (Fig. 2). On Diveday 4 there was some recovery, with a relative decrease in slow-wave activity (Fig. 2). For A3 there was also a marked change in the EEG on Diveday 2 (see Fig. 2). On Diveday 4, however, there was some recovery characterized by a distinct center frequency in the lower alpha band.

*Static steadiness test.* There was no increase in postural tremor during the compression nor on reaching 500 msw (12). There was no increase in tremor when tested on Divedays 2, 3, and 4 (Fig. 3).

*Finger oscillation.* There was no change in finger-tapping speed during saturation on trimix.

*Dynamometer test.* There was no decrease in hand-grip strength during the compression nor on reaching 500 msw (12). On Diveday 2 a 5% impairment was found with slight recovery on Divedays 3 and 4 (2.5% and 3%) (Fig. 3).

*Trails test.* There was a marked decrease in visuomotor speed during the late phase of compression (20%) and on reaching saturation depth (20%) (12). On Diveday 3 the mean impairment was 30% with a recovery to 11% on Diveday 4 (Fig. 3).

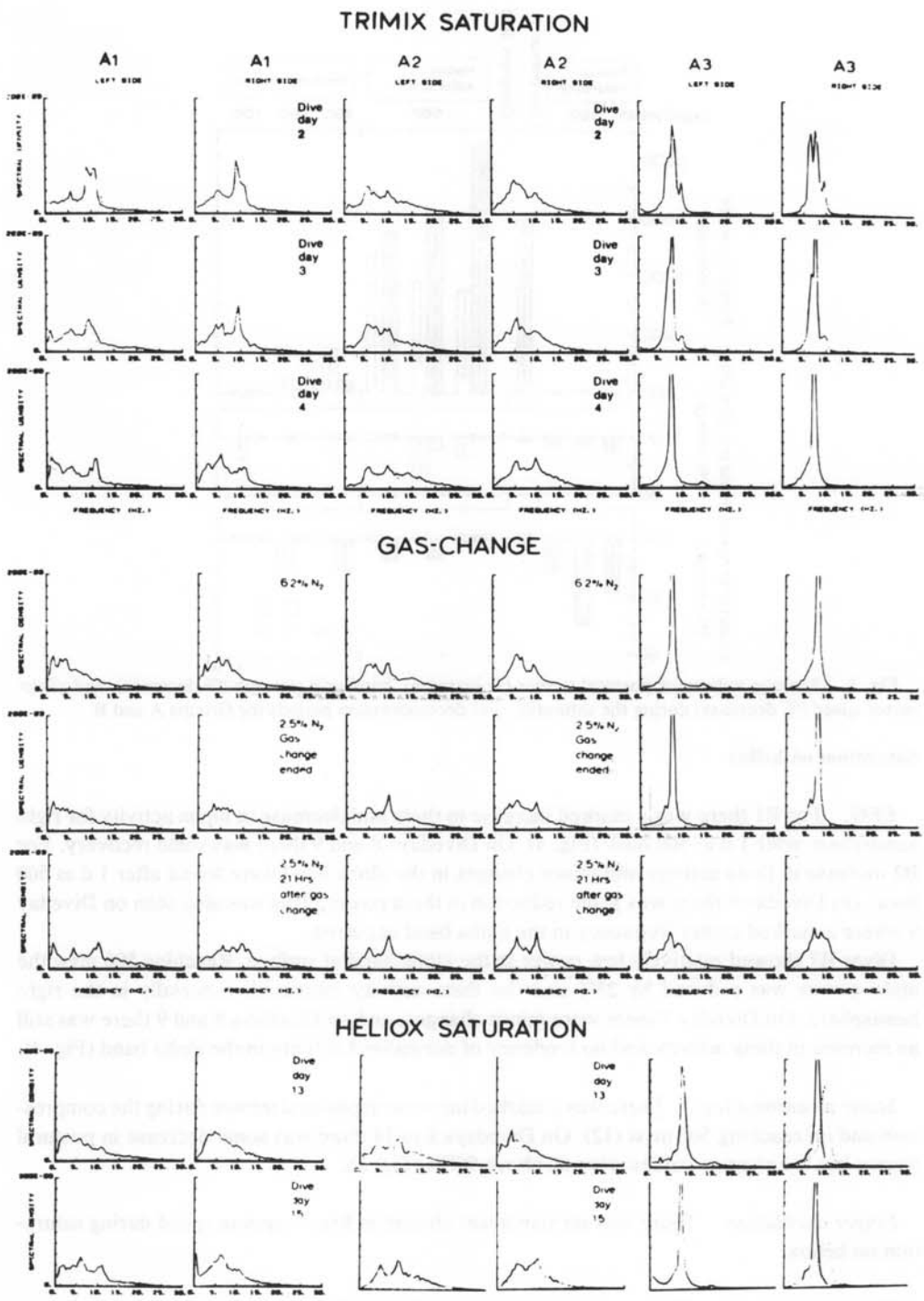



Fig. 2. Fast Fourier Transform EEG during the trimix saturation, the gas change, and the heliox saturation for Group A.

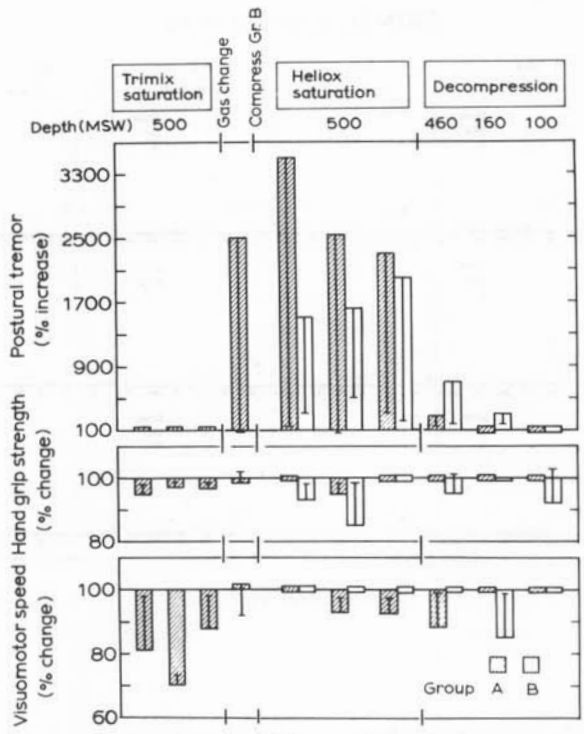



Fig. 3. Average values for postural tremor (% increase), hand-grip strength (% decrease), and visuomotor speed (% decrease) during the saturation and decompression periods for Groups A and B.

**Saturation on heliox**

*EEG.* For B1 there was a marked increase in theta and decrease in alpha activity for right hemisphere after 1 d at 500 msw (Fig. 4). On Divedays 8 and 9 there was some recovery. For B2 increase in theta activity and minor changes in the alpha band were found after 1 d at 500 msw. On Diveday 8 there was some reduction in theta power. This was also seen on Diveday 9 where a marked center frequency in the alpha band occurred.

Diver B3 showed relatively low power in the alpha band at surface. Reaching 500 msw the alpha power was reduced by 25% and the theta activity increased, especially in the right hemisphere. On Diveday 7 there were minor changes, and on Divedays 8 and 9 there was still an increase in theta activity and no tendency of normalized activity in the alpha band (Fig. 4).

*Static steadiness test.* There was a marked increase in postural tremor during the compression and on reaching 500 msw (12). On Divedays 8 to 14 there was some decrease in postural tremor but the average values were all above 900% (Fig. 3).

*Finger oscillation.* There was no significant change in finger-tapping speed during saturation on heliox.

*Dynamometer test.* There was an impairment in hand-grip strength during compression on heliox and on reaching 500 msw (20%) (12). There was a recovery (8% impairment) on Diveday 8. On Diveday 12, however, some further impairment occurred (15%).

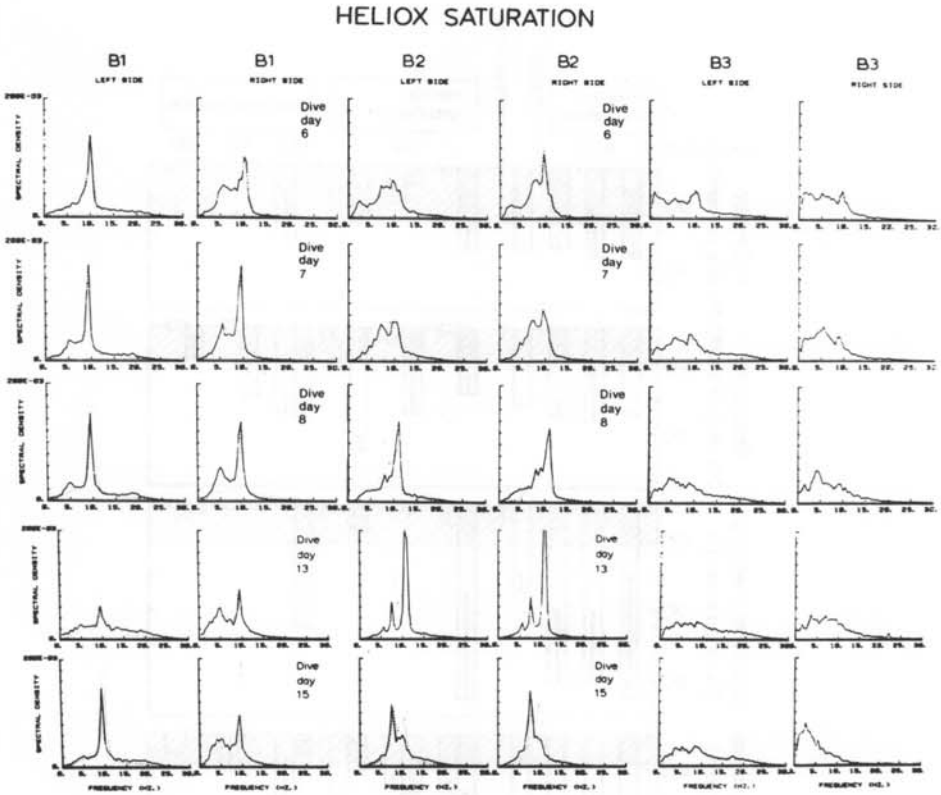



Fig. 4. Fast Fourier Transform EEG during the heliox saturation for Group B.

*Trails test*. There was no impairment in visuomotor speed when tested at 500 msw (12), nor impairment in this function during the saturation period compared to predive values (Fig. 3).

**Performance tests: Comparisons between trimix and heliox saturation**

*Arithmetic*. Group A showed 23% impairment on Diveday 2. Group B, however, performed at predive level after 1 d at 500 msw (Diveday 8). After 4 d on trimix the impairment was still below 20% whereas only a 10% decrement was found after 4 d on heliox (Fig. 5).

*Reasoning*. There were also great differences between groups on this test. While Group A was markedly impaired on trimix, Group B was at predive level after 1 d on heliox at 500 msw (Fig. 5). This difference was sustained 4 d after reaching saturation.

*Long-term memory*. The same tendency was found for long-term memory. Group A was markedly impaired on trimix saturation (>50%), but Group B had only a 5% impairment after 1 d on heliox at 500 msw and with a normalization after 4 d (Diveday 12) (Fig. 5).

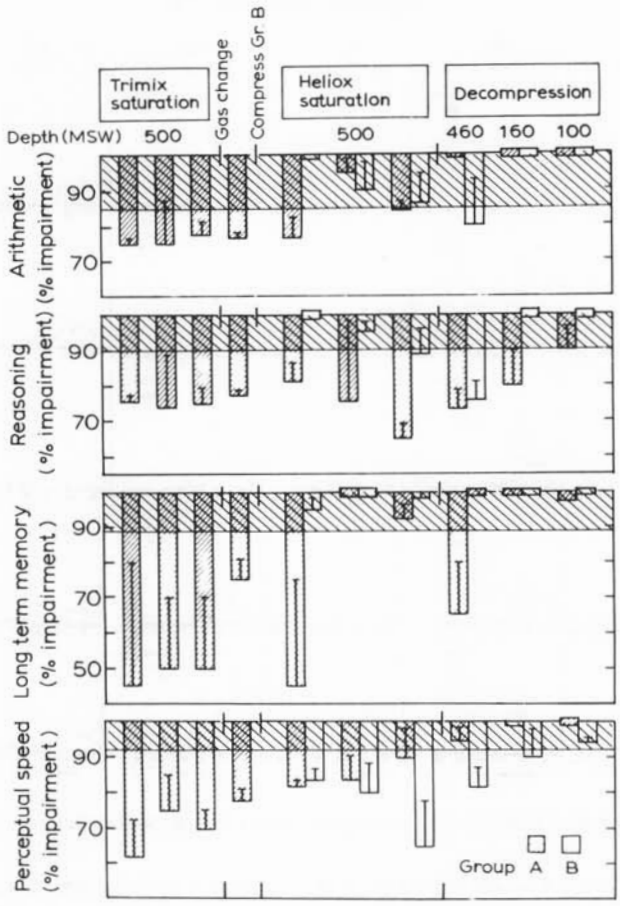



Fig. 5. Average impairments on cognitive performance tests during saturation at 500 msw and decompression for Groups A and B. *Lines* included on *bars* represent 1 SD of the mean; the *crosshatched* area represents 1 SD of control values.

*Perceptual speed.* Both groups were impaired on perceptual speed after 1 d at 500 msw (Fig. 5). After 4 d at depth there was some recovery in Group A from 38% to 30% but a slight further impairment was found in Group B from 16% to 20% (Fig. 5).

**Status questionnaire: Subjective symptoms during trimix and heliox saturation at 500 msw**

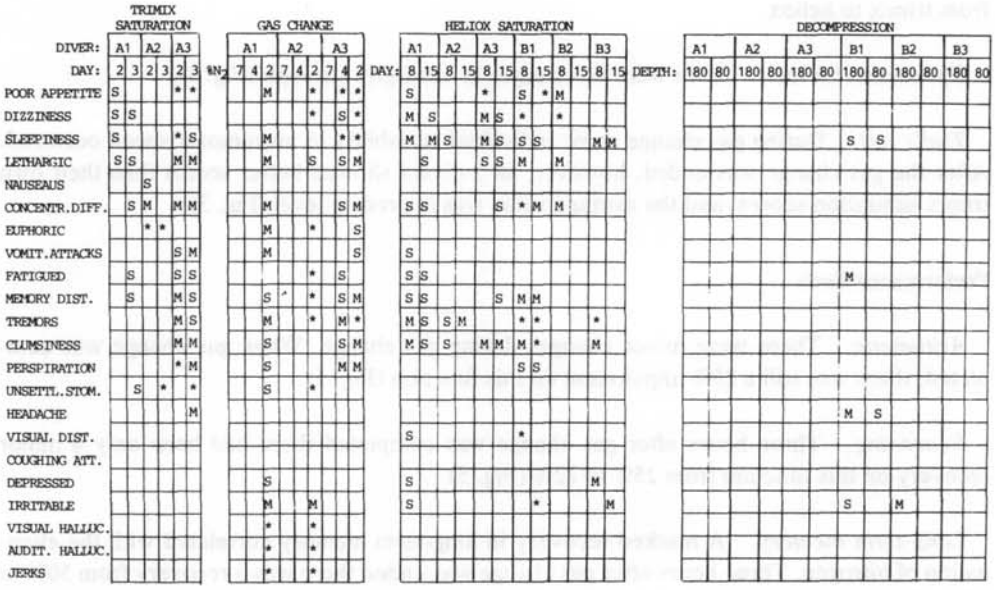
For reports of subjective symptoms during the compression phase see Værnes et al. (12).

On the 2nd d of saturation 2 divers in Group A reported severe symptoms. One diver reported euphoria and the other reported poor appetite, sleep disturbances, and perspiration. On the 3rd d the 2 divers reported severe unsettled stomach in addition to the other symptoms described. The 3rd diver also reported some trouble with unsettled stomach on that day (Table 1).

In the Heliox Group all 3 divers reported symptoms the 2nd d of saturation. While Divers B2 and B3 reported severe dizziness and tremor, respectively, Diver B1 reported, in addition

**TABLE 1**

SUBJECTIVE SYMPTOMS DURING TRIMIX SATURATION, THE GAS CHANGE, THE HELIOX SATURATION, AND THE DECOMPRESSION FOR GROUPS A AND B




to severe visual disturbances, severe concentration problems and clumsiness (Table 1). On Diveday 15 only 1 diver, B1, reported severe symptoms. These were severe tremor, clumsiness, poor appetite, and some problems with concentration. Diver B2 was symptom-free whereas B3 had some problems with sleepiness and irritability (Table 1).

### Gas change from trimix to heliox

*EEG.* Fifteen hours after the gas change had started, the partial pressure of nitrogen was 6.2%. For A1 there had been no change in the power spectrum EEG as compared to the EEG-recording at trimix saturation (Fig. 2). Three hours after gas change was ended, there was still an unchanged power-spectrum with inhibition of the alpha band. There was, however, some recovery in the EEG 21 h after gas change was completed. A center frequency was building up in the alpha band and a decrease in slow-wave activity was seen, particularly in the left hemisphere (Fig. 2). For A2 there was no change in the EEG when the partial pressure of nitrogen was 6.2%. Three hours after gas change was ended there was a minor recovery in the left hemisphere EEG (Fig. 2). After 21 h there was a further recovery with a center frequency in the alpha band in both hemispheres and decreased slow-wave activity. For A3 the EEG had stabilized during trimix saturation with a marked center frequency 3 Hz below the alpha band center frequency found in the predive samples (Fig. 2). When the partial pressure was 6.2% there was no change in the EEG. After 21 h there was an inhibition of the 7 Hz frequency and a relative increase of slow waves for both hemispheres.

*Static steadiness.* During gas change there was a pronounced increase of postural tremor occurring 15 h after gas change had started (6.2% $N_2$) (Fig. 3).

*Finger oscillation.* There was no change in finger-tapping speed during the change of gas from trimix to heliox.

*Dynamometer test.* There were no changes in hand-grip strength (Fig. 3).

*Trails test.* During gas change some individual variability in visuomotor speed occurred. After the gas change was ended, however, all 3 divers showed better scores than their own trimix saturation scores, and the average value was at predive level (Fig. 3).

**Performance Tests**

*Arithmetic.* There were minor changes during gas change. When gas change was completed, there was still a 25% impairment on this function (Fig. 5).

*Reasoning.* Three hours after gas change was completed there had been only a minor recovery on this function from 25% to 22% (Fig. 5).

*Long-term memory.* A marked recovery in long-term memory correlated with the elimination of nitrogen. Three hours after gas change was ended there was a recovery from 50% to 25%. However, the memory capacity was still markedly below predive values (Fig. 5).

*Perceptual speed.* Three hours after gas change was completed there was some recovery from 30% to 22% (Fig. 5).

**Status questionnaire: Subjective symptoms during the gas change from trimix to heliox**

After 12 h (7% $N_2$) no subjects reported symptoms. Three hours later (4% $N_2$) A3 reported poor appetite and sleepiness and tremor and perspiration problems (Table 1). When gas change was completed, all 3 reported symptoms during the night. Two subjects reported severe symptoms as visual and auditory hallucinations. The symptoms started 6 h after the end of gas change, at 10 p.m. Both subjects also had severe myoclonic jerks. The hallucinations were exemplified by birds, moving objects in the chamber, music, and voices. The next morning all 3 reported tremor, and 2 reported dizziness and sleep disturbances.

**Saturation on heliox ($n = 6$) for both groups and the decompression**

Although all 6 divers were on heliox after gas change, we will still identify them as the A1 to B3 divers.

*EEG.* The FFT analysis of the EEG from Day 13 revealed increased slow-wave activity for A1. On Day 15 this slow-wave activity was slightly reduced (Fig. 4). For A2 there were minor changes in the EEG on Day 13. In the left hemisphere a center frequency in the alpha band could be seen, whereas power in the slow-wave band dominated in the right hemisphere. On Day 15 there were minor changes (Fig. 2). For A3 there had been a marked increase in

lower alpha band activity on Day 13 (Fig. 2). On Day 15 this was unchanged, and the center frequency was still 3 Hz below predive values.

For B1 there was some recovery in the EEG shortly after saturation (Fig. 4). On Days 13 and 15 clearcut center frequencies in the alpha band could be seen, but there was still increased slow-wave activity in the right hemisphere. For B2 there was recovery in the EEG on Day 13. There was a marked center frequency in the alpha band (more than normal) and decrease of slow wave. On Day 15, EEG was clearly normalized (Fig. 4). For B3 there were minor EEG changes both on Day 13 and Day 15, with gross increase in slow wave on the right side (Fig. 4).

*Static steadiness.* As previously mentioned, there was a marked increase in postural tremor in Group A after the gas change to heliox. On testing 3, 7, and 9 d (Divedays 8, 12, and 14) after the gas change, there were some further increases on Diveday 8 with some reductions on Divedays 12 and 14. On Diveday 14 the two group averages were 2300% (Fig. 3). During decompression there were normalizations in both groups with a total recovery at 100 msw.

*Finger oscillation.* There was no change in finger-tapping speed during the late saturation on heliox and the decompression for the two groups.

*Dynamometer test.* Group A performed at about predive levels on this variable during the saturation period on heliox and the decompression (Fig. 3). Group B, however, showed a 20% reduction up to the 6th d of saturation (Diveday 12). On Diveday 14, performance was at predive levels (Fig. 3). During decompression, slight impairments were found (5% and 7%).

*Trails test.* Group A performed at predive level on visuomotor speed on the 1st d at heliox saturation (Fig. 3). On Day 6 and 8, however, the group showed some impairment. Group B performed at predive level during the whole saturation period, from the 2nd d of saturation.

**Performance tests**

*Arithmetic.* There was a recovery in arithmetic performance in Group A from a 23% impairment on Diveday 8 to 5% on Diveday 12. At Diveday 14, however, there was a further impairment (16%), but during decompression Group A functioned at predive level. Group B had still some impairment (20%) at 400 msw, but this normalized at 160 msw (Fig. 5).

*Reasoning.* There was no recovery in Group A. On all 3 test days at heliox saturation there was marked impairment (Fig. 5). Group B performed around predive level on Divedays 12 and 14, but a 24% impairment was found at 460 msw. At 160 and 100 msw, Group B functioned at predive level whereas Group A still had a 10% impairment at 100 msw (Fig. 5).

*Long-term memory.* Group B performed at predive level during the whole saturation period and decompression (Fig. 5). Group A showed a marked impairment on the 2nd d at heliox saturation (46% reduction, Diveday 8, Fig. 5). On Divedays 12 and 14, however, they performed at predive level. During decompression both group averages were at predive levels except for a 35% impairment at 460 msw for Group A.

*Perceptual speed.* Both groups were impaired on this variable (15%–20%) during the whole heliox saturation period (Fig. 5). During decompression, Group A functioned at predive level and Group B normalized from 15% at 460 msw to 6% at 100 msw.

**Status questionnaire: Subjective symptoms during the heliox saturation and decompression for Groups A and B**

In Group A, only A3 reported severe symptoms on Day 8, namely, poor appetite. Common symptoms for all A-group divers were sleepiness, tremor, and clumsiness. During decompression the divers in Group A did not report any symptoms. In Group B all 3 divers reported severe symptoms on Day 8. These were tremor, dizziness, concentration difficulties, and visual disturbances. On Diveday 15, B1 reported severe tremor, clumsiness, and poor appetite. Diver B3 reported some problems with irritability and sleepiness. During decompression, B1 was much fatigued and had headaches. Diver B2 reported some problems with irritability (Table 1).

## DISCUSSION

In the heliox group, a marked increase in tremor and EEG slow waves and reduction in hand-grip strength were found during the compression to 500 msw. The trimix group, Group A, did not show increased tremor or loss of hand-grip strength but the EEG changes were similar to those seen in the heliox group. On cognitive tests, the trimix group (Group A) was markedly impaired in reasoning and long-term memory, whereas only a mild impairment was seen in the heliox group (Group B). Dizziness and other HPNS symptoms occurred in both groups during compression. For further discussion of the compression phase see Værnes et al. (12). During saturation on trimix there was some recovery in the EEG, but no Group A diver had returned to predive values by the 3rd d of saturation. The same was seen in the heliox group. For postural tremor there was still a significant difference between the two groups, but there was some recovery in the heliox group on the 3rd d of saturation. The same tendency was seen on hand-grip strength. The most striking difference between the two groups occurred in cognitive functions. The heliox group, Group B, performed up to predive levels on the 3rd d of saturation, whereas the trimix group, Group A, was significantly impaired on several tests on the 3rd d of saturation. Both groups reported symptoms on the 2nd and 3rd d of saturation. The main symptoms in the heliox group were tremor, clumsiness, and dizziness, and the trimix group also reported concentration difficulties, upset stomach, euphoria, and reduced appetite.

Minor changes in the EEG during the gas change from trimix to heliox occurred, mostly affecting one of the divers. There was, however, a marked increase in postural tremor indicating that the nitrogen had had an inhibitory affect on the tremor. The impaired cognitive functions that were observed up to the gas change indicated that the nitrogen had a marked narcotic effect even after 2 d of saturation. For long-term memory there was a recovery after the elimination of the nitrogen. During the early phase of gas change there were no changes in severe symptoms. In the evening, however, when the gas change was completed, some symptoms occurred, and during the 12 h after the gas change severe symptoms were reported by 2 of the divers. The symptoms indicate a withdrawal syndrome. In general it seems that narcosis was eliminated and that some HPNS-related symptoms occurred, but the main problem at this stage of the dive was the symptoms that occurred during the 12-h period after

completion of the gas change. These symptoms may be compared with those seen during withdrawal from alcohol, opiates, and CNS depressants (14). Withdrawal from CNS depressants, particularly short- or intermediate-acting barbiturates and meprobanate (Miltown) yield a very similar syndrome to that observed by us: anxiety, hallucinations, and cramps with a latency time of 12–16 h. Withdrawal from alcohol or opiates yields quite a different picture. The symptoms observed fit a "mild" category of withdrawal symptoms according to the categories described by Schuckit (14).

These observations are interesting in view of the experiments done on reversal of narcosis in animals. Brauer et al. (15) found that barbiturates, particularly sodium phenobarbitate, partially prevented HPNS convulsions. Animals thus protected could be exposed to much higher pressures without showing the severe convulsive syndrome. In work with squirrel monkeys it was found that barbiturates, like inert gases, were considerably more effective in preventing the convulsions than preventing the tremor of stage 1 (16). In view of these results, some of the severe symptoms in our subjects could be interpreted both as a HPNS reaction and a withdrawal-from-CNS-depressant reaction. However, the latency time indicates that it most probably was a withdrawal symptom.

During the saturation on heliox, the EEG did not differentiate between the two groups. Subjects in both groups showed marked changes in the EEG, as compared to predive values. For postural tremor there was a marked difference between the two groups up to the 2nd d of heliox saturation. On Diveday 14, however, the groups were more or less similar on this variable. On the cognitive tests, Group A took longer than Group B to return to predive values at heliox saturation. All these test results were within one standard deviation of predive values in both groups at the last saturation testing, except for perceptual speed. In both groups, some subjects reported severe symptoms up to the last day of saturation. In addition to tremor and poor appetite, these symptoms were concentration difficulties and sleepiness.

Trimix seemed to have a beneficial effect on some clinical symptoms: it reduced the postural tremor, minor myoclonic jerks, and hand-grip strength was normal. This finding is in agreement with observations made by other investigators (4–6, 17, 18). Severe myoclonic jerks, however, seemed to be one of the withdrawal symptoms when the nitrogen was eliminated. During the trimix saturation period, behavioral impairment and drowsiness were observed. Other investigators have reported that trimix accentuated EEG changes (11), but this was not confirmed in the present study. The dissociation between postural tremor and EEG changes have been reported earlier (19), and this dissociation suggests different origins of these phenomena. Previous reports have also shown that postural tremor is reduced by narcotic agents (20, 21) in a similar manner to high pressure nitrogen. In the present study, the suppression effect became evident when the nitrogen was eliminated. An instant and marked increase in tremor was observed. In addition, one subject who had a marked predive tremor showed reduced tremor during the whole trimix saturation period.

From the results obtained during the compression in DEEP EX 80 (13) and DEEP EX 81 (12) to 300 and 500 msw and the saturation results in this study, it may be concluded that the HPNS observed with the trimix mixture is different from that observed with the heliox mixture. The HPNS does not seem to be a homogenous entity. Some subjects were severely impaired during compression but functioned well at stable depth, whereas others functioned normally during compression but had severe problems during the gas change at saturation depth. The considerable variability among subjects concerning both HPNS and narcosis and nitrogen withdrawal underscore the importance of research on individual susceptibility to the hyperbaric environment.

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Værnes R, Hammerborg D, Ellertsen B, Peterson R, Tønjum S. Réactions du système nerveux central pendant des plongées à l'héliox et trimix à 51 ATA et durant la décompression. Undersea Biomed Res 1985; 12(1):25–39.—Deux groupes de plongeurs (Groupes A et B) furent comprimés jusqu'à une profondeur équivalente à 500 mètres d'eau salée (msw) avec des mélanges respiratoires à l'héliox ($n$ = 3) et trimix ($n$ = 3). Après 4 jours à la profondeur de saturation, le Groupe A fut soumis à un changement de mélange à l'héliox. Les deux groupes furent soumis à des tests neuropsychologiques et neurologiques à maintes reprises durant la compression, à des profondeurs intermédiaires stables et à la profondeur de saturation. *Compression:* Il y eut des effets marqués du syndrome nerveux des hautes pressions (SNHP) durant la compression chez les deux groupes. Seul le tremblement fut inhibé par l'azote. De plus, le groupe A fut affecté par la narcose à l'azote. *Saturation:* Durant les plongées à saturation avec des mélanges respiratoires à l'héliox et trimix, il y eut un certain degré de recouvrement dans l'EEG seulement. Le Groupe B manifesta un tremblement élevé soutenu durant la saturation. La performance du Groupe B pour les fonctions visuomotrices et cognitives atteignit le niveau d'avant-plongée au troisième jour de la saturation, tandis que le Groupe A fut sévèrement affecté durant toute la période de saturation au trimix. Le vertige et le tremblement furent les symptômes principaux chez le Groupe B, mais le Groupe A rapporta une difficulté de concentration, de l'euphorie et des troubles d'estomac pendant la phase de saturation. *Changement de gaz:* Il y eut des variations mineures dans l'EEG durant le changement de gaz. Cependant, une augmentation marquée dans le tremblement de posture et de rétablissement survint dans les tests cognitifs en rapport avec l'élimination de l'azote. Jusqu'à la finition du changement de gaz, aucun symptôme sévère ne fut rapporté. Six heures après le changement de gaz, des symptômes sévères survinrent, dominés par des hallucinations visuelles et auditives et des spasmes myocloniques. Certains symptômes durèrent 12 heures. Durant la décompression un rétablissement soutenu vers la normale fut observé chez les deux groupes.

trimix
SNHP
changement de gaz
narcose à l'azote
EEG
hallucinations

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