BODY FLUID LOSS DURING DIVING WITH THE HOT WATER SUIT

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INTRODUCTION

Already in the beginning of a saturation dive, i.e during the compression phase, urine production is increased. This "hyperbaric diuresis" has been described in all dives where diuresis has been determined (1). If the fluid loss caused by this diuresis is greater than fluid intake hypohydration may occur. The effect of immersion on urinary salt and water excretion is also well established (2). Such increases in body fluid losses might result in a general dehydration.

In addition, we have previously observed a body fluid loss of more than 3 kg during 3.5 hours of diving with the open hot water suit (3). We argued that this dehydration, amounting to 4-5% of the body weight (BW), was caused by sweating and/or osmotic effects of the hyperosmotic sea water continuously flushing the skin surface. Head out immersion experiments in thermoneutral (34.5°C) and warm (38°C) sea water confirmed these earlier findings and clearly indicated that moderate increments of skin and core temperature induced a significant sweat production (4). Since evaporation of this sweat do not take place in water hyperthermia may also develop.

If such fluid losses are sustained during a dive, a severe dehydration could develop which will not only affect divers performance but also endanger their safety, Thus, if the diver is partly dehydrated prior to diving due to the hyperbaric diuresis and then looses body fluids equivalent to 4% of his body weight, both his physical and mental performance will probably be markedly impaired at the end of the dive (5, 6). It should be emphasized that during a normal saturation dive (or "lock-out" period) the diver do not *drink* any fluid.

With the present study we wanted to perform similar measurements with the traditional open hot water suit during both surface oriented (SUR) and saturation (SAT) diving to examine whether significant hypohydration also occured outside the laboratory; i.e. in operational diving.

METHOD

Data from 129 shallow SUR dives, lasting for 60-240 min, were collected at two Norwegian diving schools educating professional divers. From two diving support vessels (one working offshore and one inshore) data from 128 **SAT** dives (120-240 min; depths equivalent to 100 and 50 metres) were also evaluated. The open hot water suit (HWS) was used in all dives. With this technique surface heated sea water is delivered via the "umbilicals" to hoses sewed into the suit material at rates of 10-20 l/min. These hoses are perforated with many holes so that the warm water (approximately 37-40°C) continuously floods the skin surface. Body weight (BW) was determined prior to and after the dive. In addition, thermal comfort and/or oral and hot water temperatures were determined. In **SAT** diving food and fluid intake between the weighing sessions were also measured.

RESULTS

The main results are shown in Table 1. During both SUR and SAT diving about 30% of the divers experienced BW reductions of more than 2% of initial BW. The greatest BW loss was 4.6 kg (3.0 kg/hour and 5.5% of BW) and 4.2 kg (1.1 kg/hour and 5.8% of BW) during SUR and **SAT** diving, respectively. Calculated body fluid loss

Table 1. Calculated body fluid losses during surface oriented (SUR) and saturation **(SAT)** diving using the traditional hot water suit.

Study	No. of dives	Dives with fluid loss* greater than 2%	3%	4%	5%	Total (>2%)
SUR	129	19	9	1	2	31
SAT	128	25	15	3	3	46
Total	257	44	24	4	5	77

*Calculated from BW and a metabolic weight loss of 0.035kg/h.

was greater than *2%* in *77* out of *257* dives. In **14%** of the dives (33 of *257)* this fluid loss was greater than *3%.* Body core temperature was determined as oral temperature in *16* SUR dives and varied between 35.9 and 37.1°C. No significantrelationships was observed between the BW changes and the other measured parameters like thermal comfort, oral temperature and hot water temperature.

CONCLUSIONS

It should be emphasized that these divers did not drink until after the dive. Most of the observed weight loss is probably caused by sweating. This is in accordance with observations made by Hertig et al. *(7)* who found that sweating in warm water increased significantly when salt (NaCl) was added to the immersion water. With fluid losses greater than 3% of initial BW both mental and physical performance will be markedly reduced at the end of the dive (5, 6). To compensate for *this* hypohydration, intervals for fluid intake and possibly the **use** of dry suits (if the hyperosmotic sea water should be proven to be a significant contributor) as an alternative to the HWS, should be seriously considered. Special drinking regimes prior to diving could only partly countermeasure dehydration and unwanted performance decrements.

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