

Effects of Wet and Dry Flotation REST on Blood Pressure and Plasma Cortisol

**John Turner, Jr., William Gerard, John Hyland,
Pamela Nieland and Thomas Fine**

Flotation Restricted Environmental Stimulation Therapy (F-REST) has been used successfully in the treatment of several stress-related disorders (Fine & Turner, 1982, 1985a; Rzewnicki et al., 1990; Koula et al., 1990). In F-REST (henceforth, REST) an individual lies supinely in thermoneutral buoyant fluid with minimal photic, auditory and tactile stimulation (Lilly, 1977). Deep relaxation reportedly accompanies REST (A. Barabasz, M. Barabasz, Dyer & Rather, 1990; Turner & Fine, 1983; Suedfeld, Ballard & Murphy, 1983). Relaxation has been shown to be associated with decreased activity of the adrenal axis (Davidson et al., 1979; Michaels, Huber & McCann, 1979; Jevning, Wilson & Davidson, 1978; McGrady et al., 1981). Plasma cortisol can be measured as an indicator of this axis, and levels have been shown to decrease during REST (Turner & Fine 1983; McGrady et al., 1987). In addition, a decrease in blood pressure has been a common finding in previous REST studies (Jacobs, Heilbronner & Stanley, 1985; Fine & Turner, 1982; Kristeller, Schwartz & Black, 1982; Suedfeld, Roy & Landon,

1982), indicating that, along with plasma cortisol, blood pressure can be a reliable index of the REST effect.

Despite the encouraging findings of physiological responses to REST, little is known regarding the mechanisms underlying REST effects. For example, which aspects of sensory restriction are necessary for the relaxation response to occur? In one study, Turner et al. (1989) found no differences in the blood pressure and cortisol response to REST whether light was present or absent in the REST environment, raising the possibility that absence of light is not a critical aspect of REST. How important are tactile stimulation, quiet, buoyancy and thermoneutrality? In order to begin addressing these questions, the present study compares blood pressure and plasma cortisol responses in standard flotation REST and in a modified version of REST in which the floater is separated from the fluid by a pliable plastic polymer membrane.

Materials and Methods

Nineteen healthy volunteers, ages 22-34 years, were recruited from a class of medical students. Twelve subjects were male, and seven were female. None of the subjects had experienced relaxation training previously. The subjects were on summer vacation, and no major stresses were reported during the study. All subjects were told they were participating in a study of physiological changes associated with relaxation. Subjects were randomly assigned to a REST-Wet or REST-Dry group. REST-Wet was an ovoid fiberglass chamber (Enrichment Enterprises Inc., Huntington, New York) 2.5 m long, 1.8 m wide and 1.1 m high. Subjects floated in a saturated epsom salt solution, specific gravity 1.28. The tank temperature was maintained at $34.5 \pm 0.3^\circ\text{C}$. The chamber was completely enclosed, eliminating light. Subjects floated nude in a supine position. In this position the ears were submerged resulting in a marked reduction of sound perception.

The REST-Dry environment was a rectangular chamber (Relaxation Dynamics, Inc., Boulder, Colorado) similar in dimensions and

conditions to REST-Wet with several exceptions. First, a pliable, 15 mm. plastic polymer membrane separated the floater from the fluid, a MgSO_4 solution at 1.20 sp. gr. This condition was associated with tactile stimulation and low humidity. Second, subjects wore underclothing in the chamber. Third, thermoneutrality (comfort, with no perspiring) was approximately 29.5°C in this environment. Fourthly, although the sound level in the air was $<20\text{ db}$, the ears were exposed to the air, i.e., hearing was not attenuated by submersion.

The repeated-measures experimental design compared baseline vs. end-of-treatment (henceforth, treatment) in the REST-Wet ($n=10$) and REST-Dry ($n=9$) groups. The study period was five weeks, with two weeks of baseline and three weeks of treatment. Each subject experienced eight REST sessions, 40 min. each. Sessions were every third day during treatment. Baseline consisted of four visits, three days apart, in which blood pressure was measured and blood samples were taken. This procedure was also done during the treatment phase on non-session days between the last four sessions.

Systolic and diastolic blood pressure was measured five minutes after arrival while sitting quietly. Each reported value is the average of three measurements, taken two minutes apart, and calculated as mean arterial pressure ($\text{MAP} = 1/3 (\text{S-D}) + \text{D}$). Blood sampling consisted of two venous samples per visit, taken 20 minutes apart, after blood pressure. Samples were taken from the forearm via heparinized vacutainer. They were iced and centrifuged, and the plasma was frozen until assay for cortisol, using a radioimmunoassay kit (Code COD2, Diagnostic Products, Los Angeles, California). Assessment of anxiety was made in each subject before and after REST sessions 1 and 8 using the Spielberger State Anxiety Scale (STA Form XI).

Data were subjected to two levels of analysis. Two-way repeated-measures ANOVA was used to determine differences across sessions. Specific differences were determined by Tukey test and F-test (Zar, 1984).

Results

Mean Arterial Pressure

In both REST-Wet and REST-Dry groups ANOVA established no differences among sessions within baseline or within treatment. In other words, MAP did not change during baseline or during the portion of treatment which was monitored. Therefore, across subject averages were pooled for sessions 1-4 and for sessions 5-8. MAP results are presented in Table 24-1. There were no differences in MAP between baseline REST-Wet (83.05 ± 0.97 mm Hg) and REST-Dry (82.50 ± 0.77 mm Hg). MAP in treatment was significantly lower than in baseline in both groups ($p < 0.05$ Tukey test). MAP values in treatment averaged 77.5 ± 1.52 for REST-Wet and 74.83 ± 1.42 for REST-Dry.

Table 24-1

Effect of Brief, Repeated Flotation REST on Mean Arterial Pressure

CONDITION	n	<u>Mean Arterial Pressure (mm Hg)</u>	
		BASELINE ^a	TREATMENT ^c
REST-Wet	10	83.05 ± 0.97^a	77.05 ± 1.52^b
REST-Dry	9	82.50 ± 0.77^a	74.83 ± 1.42^b

^a Pooled values across visits 1-4 (baseline) or 5-8 (treatment).

^b Different from baseline, repeated measures ANOVA ($p < 0.05$, Tukey test).

^c Different from baseline, repeated measures ANOVA ($p < 0.01$, Tukey test).

Plasma Cortisol

ANOVA established no differences among sessions within baseline or within treatment for either REST-Wet or REST-Dry. In other words cortisol did not change during baseline or during the portion of treatment which was monitored in either group. Therefore across-subject averages were pooled for sessions 1-4 (baseline) and pooled for sessions 5-8 (treatment) in each group. Plasma Cortisol data are presented in Table 24-2.

There were no differences in plasma cortisol levels between REST-Wet and REST-Dry in baseline. There was no difference between baseline and treatment levels of plasma cortisol in the REST-Dry group. However, plasma cortisol was significantly ($p < 0.05$, Tukey test) lower in treatment than in baseline in the REST-Wet group.

Initial levels (before session 1) of state anxiety (SA) were greater in REST-Wet (ave. score = 43.1) than in REST-Dry (ave. score = 34.2) (Table 24-3). SA decreased within sessions for all sessions, with changes

Table 24-2

Effect of Brief, Repeated Flotation REST on Plasma Cortisol

CONDITION	n	<u>Mean Arterial Pressure (mm Hg)</u>	
		BASELINE ^a	TREATMENT ^a
REST-Wet	10	17.00 ± 0.06^a	14.29 ± 0.54^b
REST-Dry	9	16.70 ± 0.78	17.55 ± 1.26

^a Pooled A and B samples averaged across sampling sessions 1-4 (baseline) or 5-8 (treatment).

^b Different from baseline, repeated measures ANOVA ($p < 0.05$, Tukey test).

Table 24-3

Effect of Flotation REST on State Anxiety

Condition	n	STATE ANXIETY SCORE ^a					
		SESSION 1			SESSION 8		
		PRE	POST	Δ	PRE	POST	Δ
REST-Wet	10	43.1	28.0	-15.1	35.7	24.4	-11.3
REST-Dry	9	34.2	28.5	-5.6	32.3	31.7	-0.7

^a Spielberger STA-XI state anxiety scale scores.

being greater in REST-Wet than in REST-Dry and greater in session 1 than session 8 for both groups. Comparison of pre-session SA revealed no significant differences between sessions 1 and 8 in either REST-Wet or REST-Dry. However, both groups showed a numerically lower SA score in pre-session 8 than in pre-session 1 and the change was larger in REST-Wet than in REST-Dry. Subjective reports indicated that both REST-Wet and REST-Dry were relaxing. Falling asleep was reported more frequently in REST-Dry (19% of sessions) than in REST-Wet (8% of sessions).

Discussion

Brief, repeated REST-Wet and REST-Dry sessions were associated with decreased MAP, while plasma cortisol was decreased only in REST-Wet. These results confirm previous reports of REST-Wet effects on MAP and cortisol (Turner & Fine 1991; Turner et al., 1989; Fine &

Turner, 1982). The similarity in MAP responses may reflect the occurrence of a relaxation response in both Wet and Dry REST. This is supported by subjective report and state anxiety data for both conditions of REST.

However, there were many differences between Wet and Dry REST which may be reflective of the differential cortisol response in the two groups. The difficulty lies in establishing a causative link between one or several of these differences and the cortisol difference. The present study does not permit this determination. Nonetheless, it may be useful to describe similarities and differences between REST-Wet and REST-Dry in the context of the observed effects on MAP and cortisol.

One of the first considerations is whether the different MAP and cortisol responses in REST-Wet and Dry are a matter of degree or type. For example, if MAP responds more readily to relaxation than cortisol, it is possible that REST-Wet was simply a stronger mediator of relaxation, passing the threshold for both responses. Alternatively, REST-Wet and Dry may be mechanistically different, tapping different aspects of the relaxation response, and thus affecting cortisol differently. The anxiety scale results tend to support the former possibility, since anxiety reduction was greater in REST-Wet than REST-Dry. This is potentially complicated, however, by the fact that anxiety was greater in REST-Wet at the outset i.e., before session 1. It has been our experience over numerous studies that a majority of subjects have at least mild anxiety prior to their first experience of REST-Wet, since it is an unknown to them. With few exceptions this did not persist beyond session 1.

The possibility that REST-Wet and REST-Dry act via different mechanisms is suggested by the EEG study reported elsewhere in this book by Fine, Mills and Turner. Both EEG amplitude and percent of time in alpha and theta frequencies were different during REST-Wet than during REST-Dry. Such differences in EEG could reflect differential influences of Wet and Dry conditions on regulation of MAP and cortisol. A further potentially complicating aspect of the EEG issue, however, is that sleeping occurred in a percentage of REST sessions. Normal nocturnal sleep in man has been associated with decreases in both MAP (Lydic, 1987) and cortisol (Weitzman et al., 1971). The

cortisol response is probably too slow to have reacted by the end of the REST session. The MAP response may have been rapid enough that the REST decrease could be due to sleep in those subjects who slept. Examination of MAP responses in individual REST sessions, however, showed no difference between sessions with and without sleeping.

There were several physical-sensory differences between REST-Wet and REST-Dry, with the former unquestionably being associated with greater sensory restriction. Although the sound level was potentially greater in REST-Dry, both conditions were very quiet. The occurrence of sleep more than twice as often in REST-Dry as compared to REST-Wet would suggest that sound was not a major limitation to relaxation in REST-Dry.

Although the actual REST-Dry temperature was approximately 4°C cooler than in REST-Wet, the subjects reported feeling thermoneutral in both conditions. In other words the physical conditions dictated the temperature difference, but the temperature experience was similar in Wet and Dry. There remains the issue of the air-fluid interface, however. In REST-Wet the sensation of such an interface disappears when the temperature of the 100% humidity air and water are equal. The interface feeling between the 50% humidity air and the pliable membrane does not disappear. This provides some thermal input and probably contributes information for spatial orientation.

Perhaps the greatest single difference between sensory input in REST-Wet and REST-Dry is the contact with the fluid in the former and its absence in the latter. Floating in the fluid with its associated distribution of pressure equally to all points and the loss of sense of lying on a surface results in a marked attenuation of proprioceptive, kinesthetic and spatial information. Floating on a pliable membrane does not attenuate this information to nearly as great a degree.

The results of the present study do not permit firm conclusions as to why subjects in both REST-Wet and REST-Dry showed decreased MAP, and only those in REST-Wet showed decreased cortisol. We hypothesize that the response difference is more likely a matter of degree for several reasons. First, previous studies have shown that MAP and cortisol changes in response to REST-Wet were significantly correlated (Turner et al., 1990). Secondly, REST-Wet clearly provides

greater reduction in sensory input than does REST-Dry. Thirdly, in a study comparing effectiveness of REST-Wet and biofeedback-assisted relaxation (a method completely different from REST that involves active learning) in decreasing MAP and hormones in hypertensives, both reduced MAP and only REST reduced the plasma cortisol, renin activity and aldosterone. It was suggested that REST was associated with deeper relaxation than biofeedback. While the simplest explanation for the findings of the present study is that REST-Wet is a more powerful relaxation tool than REST-Dry, with the response differences being a matter of degree, further studies will be required to test this hypothesis.

Acknowledgment

Partial funding of this study was provided by Needmor, Inc., Boulder, Colorado.