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A study to elicit human diving response in cold water and to record the blood pressure adjustments in healthy voluntary participants on laboratory basis.

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ABSTRACT

Aim- To determine the blood pressure (BP) changes in a simulated dive.

Objective- To trigger human diving response in laboratory and to measure BP changes.

Material and Method- Thirty healthy volunteers with no cardio-respiratory illness participated in this study. To simulate dive in laboratory basis, the volunteers were asked to submerge their head in a water (at around 15 ^{o}C) filled plastic tub and hold their breath for 30 seconds. Their BP was measured using an automated instrument (Schiller's multipara monitor).

Results- Holding breath in cold water has shown a significant change in systolic BP from an average of 127.8 mmHg to 134.6 mmHg (p value 0.016). While the diastolic BP shown a nonsignificant change from an average of 76.7 mmHg to 80.03 mmHg (p value 0.17).

Conclusion- This laboratory-based study succeeded in eliciting human diving response and has made this complex response easy to perform, understand, and can be used in further studies involving drowning rescue. Additionally, it was observed that cold water diving leads to increase in systolic BP.

Keywords: Blood pressure, Simulated diving, Head immersion

INTRODUCTION

Studies of diving physiology and biochemistry made great progress in explaining the basic diving response of aquatic mammals and birds. Key components of the diving response (apnea, bradycardia, peripheral vasoconstriction, redistribution of cardiac output) were found in essentially all species analyzed and were generally taken to be biological adaptations. Initiatives in the form of, evolutionary study of the diving response, is synthetic, linked to both field and laboratory studies, to expand the framework of the original 'diving response' concept and to explain physiological change driven by directional natural selection. This present study is an approach to such studies.

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By eliciting this physiological response in the laboratory, we can understand this diverse response in our close approximation and can turn up to be a helpful aid in the adaptive response in rescue operation or in other health benefits.

MATERIALS & METHODS

Setting

Research Room, Department of Physiology, Baroda Medical College, Gujarat.

Design

This study is a cross sectional study.

Detailed research plan

Equipment and Setup

- 1 plastic tub - for facial immersion.
- Tap water - to fill the tubs.
- Ice - for decreasing water temperature.
- 1 thermometer - to measure water and room temperature.
- Schiller's multipara monitor-for measuring BP.
- nasal clip - to prevent accidental snuffing of water.
- Swimming goggle - to prevent oculo-cardiac reflex.
- 1 stopwatch - for accurately measuring duration of experiment.
- 1 towel - to wipe face.
- Software set up - for statistical analysis.

Inclusion Criteria

- Participants with no cardio-respiratory illness.
- Those who were willing to participate.

Exclusion Criteria

- Those who were not willing to participate.

Research methodology

Test was conducted by leaning over the lab platform with elbows resting on the lab platform and the head down. To measure BP, Schiller's multipara monitor was used(1). BP was recorded before and after the experiment. Participant must wear swimming goggle and must apply nose clip. Before conducting the test using water, temperature of the water is measured, and it is adjusted to the desired temperature of 15°C by adding warm tap water or ice. For immersion tests, participants were asked to immerse the face up to the temples. Experiment lasts for 30secs. Most participant were able to hold their breath this long without too much trouble, but participants were always free to stop the experiment anytime they experience discomfort. While

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performing the experiment, participant was appreciated being tapped on the back every 10 seconds by the timer, particularly when being asked to hold their breath, because it is easy for subjects to lose track of time during the experiment. Tapping helped participants to remain calm during the test because they had a better idea of when the 30-s test period would end.

RESULTS

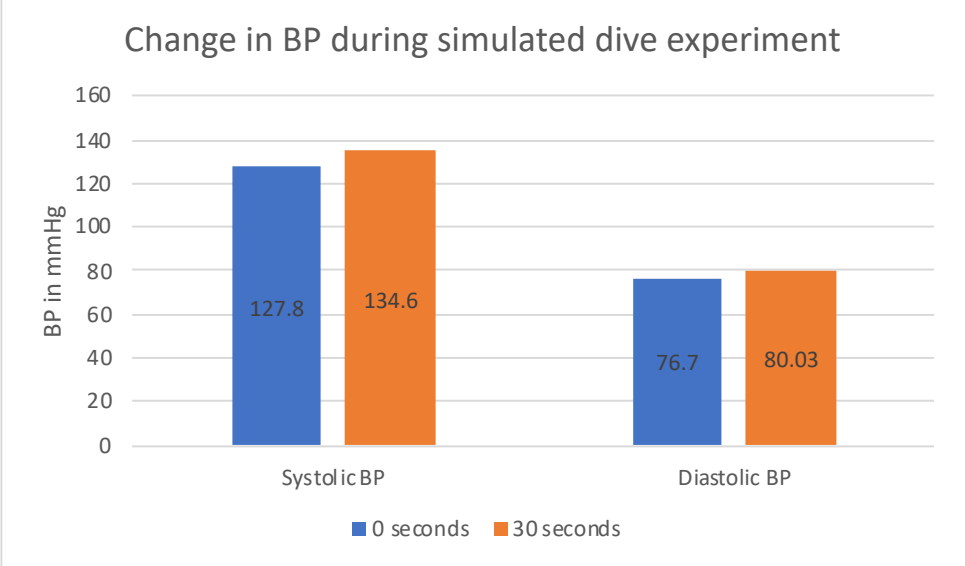
Table 1: Showing Age and Physical components of the study population.

	Mean	SD
Age (Yrs)	18.77	0.57
RT (°C)	33.75	0.67
CWT (°C)	17.92	0.96

RT-Room temperature, CWT-Cold water temperature

In our study thirty healthy male participants were enrolled in the study with mean age of 18.77 years. The physical components of our study were also kept in a close range before starting an experiment.

Figure 1. Change in BP during stimulated diving experiment.



As it can be seen in figure 1. Systolic BP and diastolic BP both shows increase in values after immersion in cold water for 30 seconds. On examining these data statistically, paired t test was applied, which demonstrated statistically significant difference in systolic BP from an average of 127.8 mmHg to 134.6 mmHg (p value 0.016) amongst participants. While the diastolic BP shown a nonsignificant change from an average of 76.7 mmHg to 80.03 mmHg (p value 0.17) Holding breath in cold water is significantly associated with change in systolic BP.

DISCUSSION

"Why is a house?" there are two classes of answers: *1*) "because man needs shelter" (ultimate cause) and *2*) "because man laid brick on brick" (proximate cause). Ultimate factors are those that lead to positive natural selection for a trait, whereas proximate factors refer to the

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mechanism by which the response is brought about within an individual. Thus, a physiological response is the product of both ultimate and proximate factors.

Biological data are inherently messy, even when measurement is precise. Individuals vary in their responses to any given perturbation. Statistical analysis was invented so that we can see beyond this individual variation to significant population trends. It is worth noting that this variation, if heritable, is the variation on which natural selection acts; without it, there would be no evolution.

The result of the experiment shows that diving reflex exists in human which does not develop immediately but becomes more pronounced with time. It indicates an increase in BP occurs in simulating dive. This result matches that of Reyners et al.(2). In most instance the BP increases due to vasoconstriction(3). However, the changes in the blood pressure can be variable depends on the part of the body exposed to the cold water and the habituation of the participant(4)(5). There is evidence in literature that the decrease in heart rate results from increased parasympathetic stimulus to the cardiac pacemaker(6)(7). The elicitation of the diving response by cold stimulation is derived from the upper part of the face innervated by the ophthalmic part of the trigeminal nerve (forehead and eye area)(8). There is an initial gasp reflex and hyperventilation followed by decrease in heart rate. Regular expose to this response in the form of cold shower results in habituation. One can escape from sudden immersion in water by keeping head out and by getting habituated to it. We can use these physiological responses to increase the effectiveness of self-rescue efforts, required by anyone who participates in recreational, commercial, or military activities in the oceans, lakes, and streams.

CONCLUSION

This laboratory-based study succeeded in eliciting human diving response and has made this complex response easy to perform, understand, and can be used in further studies involving drowning rescue. Additionally, it was observed that cold water diving leads to increase in BP.

REFERENCES

1. Hiebert SM, Burch E. Simulated human diving and heart rate: Making the most of the diving response as a laboratory exercise. Am J Physiol - Adv Physiol Educ. 2003;27(1–4).
2. Reyners AKL, Tio RA, Vlutters FG, van der Woude GF, Reitsma WD, Smit AJ. Re-evaluation of the cold face test in humans. Eur J Appl Physiol. 2000;82(5–6).
3. Zenner RJ, De Decker DE, Clement DL. BLOOD-PRESSURE RESPONSE TO SWIMMING IN ICE-COLD WATER. Lancet. 1980;315(8160).
4. Zbrożyna AW, Westwood DM. Cardiovascular responses elicited by simulated diving and their habituation in man. Clin Auton Res. 1992;2(4).
5. Frey MAB, Selm EA, Walther JW. Reflex cardiovascular responses to cold exposure of the face or foot. Jpn Heart J. 1980;21(5).
6. Gooden BA. Mechanism of the human diving response. Integr Physiol Behav Sci. 1994;29(1).
7. Lindholm P, Lundgren CEG. The physiology and pathophysiology of human breath-hold diving. Vol. 106, Journal of Applied Physiology. 2009.
8. Schagatay E, Andersson J. Diving response and apneic time in humans. Undersea Hyperb Med. 1998;25(1).

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