Decongestant Use While Diving and Risk for Decompression Sickness

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Introduction

Cold exposure, dehydration, and aging are associated with increased risk for developing DCS. Vasoconstriction is the common link in all three. Vasoconstriction alters tissue perfusion kinetics which contributes to tissue supersaturation and consequent bubble formation upon ascent. It has also been demonstrated that intravascular bubbles, once formed, interfere with nitric oxide production in the endothelium which leads to vasoconstriction. Thus vasoconstriction plays an important contributing role as a risk factor for developing DCS.

It has been estimated that up to 50% of divers may use sympathomimetic decongestants while diving to prevent ear and/or sinus barotrauma. These drugs are pharmacological vasoconstrictors. Given the influence of vasoconstriction for both on-gassing and off-gassing, the question arises: Does the use of these drugs while diving enhance the risk for developing DCS? No studies have been conducted to assess this potential association. Current recommendations for safe usage of these drugs while diving are based on “gestalt”. This study was undertaken to investigate that question.

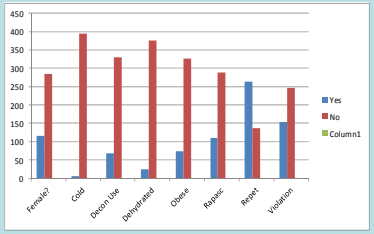
Methods

To explore the potential association between decongestant usage and development of DCS, a records-based, nested case-control study of 400 scuba divers was undertaken to compare sympathomimetic decongestant usage in divers treated for DCS (cases) with those who did not develop DCS (controls) after diving. Subject records were chosen from randomly selected years between 1983 and 2010.

The independent variable was decongestant use during an incident dive. Decongestants were defined as those medications which contained any of the following compounds: pseudoephedrine, oxymetazoline, phenylephrine, or xylometazoline. Usage was defined as that occurring within a 12 hour period prior to the incident dive. The dependent variable was DCS. Co-variables in this study included cold, dehydration, obesity, rapid ascent, repetitive diving, and violation of dive profiles. Both cases and controls were drawn from the same predetermined population and, therefore, both were representative of the source population from which they emerged while limiting selection bias. Cases were defined as those who were diagnosed and treated for DCS with records coded as ICD-9 (993.3). Controls had completed at least one dive immediately prior to presenting to the HTC for evaluation, and were diagnosed with a diving related problem other than DCS. They were randomly selected and matched with replacement on a 1:1 basis to cases based on age +/- 5 years. Bivariate and multivariate analyses were undertaken using Epi Info version 3.5.3.

Results

Univariate analysis of variables for the entire study population (n= 400)



Average age for cases= 35.7yrs; average age for controls= 36.1yrs
Sixty-nine divers (17.3%) used decongestants while diving

Bivariate analysis of variables vs DCS

Gender: OR= 0.8851; *p*= .5811
Cold: OR= 5.1026; *p*= .1076 (Fisher exact test)
Decon: OR= 1.4740; *p*= .1459
Dehyd: OR= 2.7268; *p*= .0232*
Obese: OR= 0.7166; *p*= .1984
Rapasc: OR= 1.1909; *p*= .4349
Repet: OR= 2.7950; *p*= .0000*
Viol: OR= 4.9357; *p*= .0000*

Odds ratios for dehydration, repetitive diving, and violation of profiles were statistically significant with bivariate analysis

Stratified Analysis Decongestant/DCS vs. Co-variables

Covariable	Crude OR	X^2, *p* value	Adjusted OR	X^2, *p* value
Cold	1.4741	1.8904, 0.1692	1.4477	1.5427, 0.2142
Obese	1.4741	2.3366, 0.1264	1.5050	1.9491, 0.1627
Dehyd	1.4741	1.8495, 0.1738	1.4388	1.5049, 0.2199
Rapasc	1.4741	2.0836, 0.1489	1.4689	1.7197, 0.1897
Repet	1.4741	2.9856, 0.0840	1.6080	2.5333, 0.1115
Viol	1.4741	1.1561, 0.2823	1.3525	0.8697, 0.3510

Stratified analysis found no statistically significant interaction between decongestant use and the other co-variables

Final Logistic Regression Model

Covariable	OR	95% CI	Coefficient	SE	Z-statistic	*P* value
Decon	1.431	[0.801, 2.555]	0.3585	0.2957	1.2122	0.2254
Dehyd	3.213	[1.213, 8.507]	1.1673	0.4968	2.3497	0.0188
Repet	2.338	[1.464, 3.735]	0.8495	0.2390	3.5551	0.0004
Viol	4.248	[2.693, 6.702]	1.4466	0.2326	6.2190	0.0000

Logistic regression was carried out to assess the degree of interaction between co-variables as well as to define the relative strengths and probabilities of their contributions for the development of DCS.

Discussion and Conclusions

In this study, only the risk factors of dehydration, repetitive diving, and violation of dive profiles were found to result in odds ratios of greater than 1 which were statistically significant. The independent variable of decongestant use, while having an odds ratio of 1.4, was not statistically significant and therefore may have occurred by chance. Given the sample size and the power of this study, it is reasonable to conclude that decongestant use while diving probably does not appreciably increase the risk for developing DCS.

This study is limited, however, due to the fact that it is a records-based investigation and is therefore highly dependent upon the quality and thoroughness of the information obtained at the time of presentation to the facility. Lack of notation of decongestant use was interpreted as nonuse for this study in order to avoid over-estimation of use. But it may also be true that in so doing, there may be actual underestimation of their use. For these reasons, additional effort should be placed upon exploring the hypothesis that use of sympathomimetic decongestants may enhance the risk for developing DCS.

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