Decompression Illness in United States Air Force High-Risk Occupations

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Introduction

Although the physics of decompression sickness (DCS) is well understood, an individual's unique response to bubble formation in the body places the United States Air Force's (USAF) Airmen and missions at risk. We identified 123 decompression sickness diagnoses in the USAF between the years 2006-2010. From these cases we attempted to identify differences in the prevalence of DCS in the two occupations that routinely perform high-altitude duties (U2 pilot, hypobaric chamber technician) and potential associations with reported tobacco and alcohol use.

Methods

Using a case control-control study design, we identified every active duty member diagnosed with DCS between 2006-2010 utilizing the USAF electronic medical record. "Exposure" was defined by a mission requirement of greater than 35,000 ft. Table 1 shows the occupations and number of DCS cases in that time period. Each case was matched to three controls. The controls were randomly selected from USAF active duty members and were matched to cases by race, age, sex, and rank. Reported tobacco use and alcohol use was also collected. Odds ratios for DCS were calculated based on exposure and Chi-square or Fisher's exact tests were performed to test hypotheses of DCS association with the two high-altitude occupations, and reported tobacco or alcohol use.

Results

We reviewed a total of 492 individuals in which 123 DCS cases matched 3:1 to 369 controls. There were 36 cases of DCS in our exposed group (eight U2 aviators and 28 hypobaric technicians). Of the non-exposed group, 87 Airmen were diagnosed with DCS and 368 were not. DCS was 150 times more likely in the hypobaric occupations as compared to controls matched for age, sex, rank and race (OR=150.6; 95% CI 28.3-3131, p<0.0000001).

There was no statistically significant association between tobacco use and DCS (Chi-square 0.504, p = 0.4776).

There was no statistically significant association between alcohol use and DCS (Fisher's Exact 1.727, p = 0.651).

Results (cont'd)

Table 1.
Occupations and the Number of DCS Cases in the USAF 2006-2010

DESCRIPTION	DCS
Aerospace Physiology, Aerospace and Operational Physiology (4M0X1)	28
Pilot Trainee (92T0)	9
Fighter Pilot (11FX)	8
Recce/Surv/Elect Warfare Pilot (11RX)	8
Mobility Pilot (11MX)	7
Trainer Pilot (11KX)	6
Loadmaster, Aircraft Loadmaster (1A2X1)	5
Aerospace Physiologist (43AX)	4
Airborne Battle Management, Airborne Operations (1A4X1)	3
Airborne Mission Systems (1A3X1)	3
In-Flight Refueling (1A0X1)	3
Pararescue (1T2X1)	3
Air Battle Manager (13BX)	2
Aircrew Life Support (1T1X1)	2
Bomber Navigator, Bomber Combat Systems Officer (11BX)	2
Flight Engineer (1A1X1)	2
Mobility Navigator, Mobility Combat Systems Officer (12MX)	2
Recce/Surv/Elect Warfare Officer (12RX)	2
Basic Enlisted Airman	2
Airborne Cryptologic Linguist (1A8X1)	2
Acquisition Manager (63AX)	1
Aerial Gunner (1A7X1)	1
Air Force Operations Staff Officer (16GX)	1
Aircrew Flight Equipment (1P0X1)	1
Communication-Computer Systems Operations (3C0X1)	1
Fighter Navigator, Fighter Combat Systems Officer (12FX)	1
Fire Protection (3E7X1)	1
Force Support (38FX)	1
Heath Professions Scholarship Program Medical Student (92M0)	1
Helicopter Pilot (11HX)	1
Intelligence (14NX)	1
Logistics Plans (2G0X1)	1
Materiel Management (2S0X1)	1
Munitions Systems (2W0X1)	1
Personnel (3S0X1)	1
Security Forces (3P0X1)	1
Student Officer Authorization (92S0)	1
Survival Equipment (2A7X4)	1
Technical Applications Specialist (9S100)	1
Vehicle and Vehicular Equipment Maintenance (2T3X1)	1

Note: *Air Force specialty codes are in parenthesis.*

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Conclusion

As expected, the odds ratio for developing DCS of those working as U2 pilots or hypobaric technicians was extremely high. These occupations are known to have multiple high altitude exposures. We were not expecting the significantly higher prevalence in hypobaric technicians when compared to the U2 pilots. Hypobaric technicians accounted for 78% of the DCS cases in the high-risk category.

We expected no association of DCS with tobacco use or alcohol use. Though alcohol use can cause dehydration, which is a risk factor for DCS, we did not find a statistical difference between cases and controls in our study. Physiologically, tobacco use may have an impact on divers' DCI due to an overall decreased lung function, but it was not expected to contribute to bubble formation in altitude induced DCS (Van, 2010).

Finally, we did not expect the high number of DCS cases outside the two high-risk USAF occupations. While DCS in fighter pilots and mobility pilots is rare, it could be explained by their limited exposure to altitudes near Armstrong's line, the point where total atmospheric pressure equals the body's vapor pressure (63,000 ft.) (Davis, 2008). We could not identify the cause for the high number DCS in maintenance and support personnel without access to individual medical records.

Future Study

We plan on performing chart reviews to verify the diagnoses and better define the cases to better explain why there were more cases in hypobaric technicians than U2 pilots. Finally, we plan to identify the cause of DCS within the occupations that do not appear to have occupational exposure to altered atmospheric pressure. DCS is a rare disease so it is unclear why these cases occurred or if and how they could be prevented.

References

Davis, J., Johnson, R., Stepanek, J., & Fogarty, J. (2008). Physiology of Decompressive Stress. In *Fundamentals of Aerospace Medicine* (4th ed., p. 724). Philadelphia, PA: Lippincott Williams & Wilkins.

Vann, R. D., Butler, F. K., Mitchell, S. J., & Moon, R. E. (2011). Decompression illness. *Lancet, 377*(9760), 153-164. doi:10.1016/S0140-6736(10)61085-9