The Hyperbaric Incident Monitoring Study (HIMS): An International Study of Incidents Occurring in Hyperbaric Medicine Units

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Abstract Summary of Thesis

This thesis analyses incidents that occurred in Hyperbaric Medicine Units or as a consequence of hyperbaric oxygen exposure with the aim of developing recommendations for safety improvement in hyperbaric medical practice. Analysis of the health care literature demonstrates that medical error is of significant concern and that investigation into its causes through the use of "near miss" anonymous voluntary incident reporting is an effective method for safety improvement. Review of the hyperbaric literature demonstrated that the systematic collection of incidents was limited to retrospective anecdotal reports, mainly those involving morbidity or mortality and that a comprehensive review of hyperbaric safety issues has not previously been conducted. This study presents a comprehensive review of incidents that have been reported in the hyperbaric literature and data from 200 reports of incidents collected from a convenience sample of 45 Hyperbaric Medicine Units representing 17 countries for a 20 month period. The reports provided information on factors that contributed to and minimised the incident and allowed the reporter to give a narrative description of the incident. An integral feature of the study design was a structured education and data feedback system for the study participants.

The data was analysed by classifying the incidents, statistically reviewing the associations between incidents and contributing factors, reviewing the narratives and minimising factors and relating them to clinical experience and the hyperbaric literature. Consistent with current hyperbaric literature, this study showed that ear barotrauma is the most frequently reported patient complication of hyperbaric treatment. The second most frequently reported complication is oxygen toxicity. Complications not previously identified in the hyperbaric literature included, stress reactions in patients having witnessed an oxygen toxicity seizure, oxygen hood deflation, aggressive patient in the chamber, risks associated with training exercises in the chamber, the forceful ejection of a monoplace chamber plug, vision loss in the form of hyperopia, and pulmonary oxygen toxicity in staff. From the data, the study presents recommendations for quality improvement, research, policy and procedure development, education, and equipment design modification. The continuation of the HIMS research is recommended with suggestions for improving the study.

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

Signed: _ **Date:** 11/05/01

Dedication

This research thesis is dedicated to fellow hyperbaric colleagues who have suffered injury or have died as a consequence of their work in hyperbaric medicine, and especially to Ben, my friend who has shown great courage to overcome his injury and continue to work in hyperbaric nursing. Joyce Vause (deceased as a result of attendant decompression illness), Mary Ann, and the nurses who perished in the Galeazzi chamber fire have inspired me to strive for the improvement of occupational health and safety for hyperbaric attendants.

Tribute is extended to those patients who have suffered or died as a result of hyperbaric treatment.

Remembered too are hyperbaric clinicians who have been involved in these incidents and live with the consequences of them, many of whom were "the last link" in the chain of events or system errors that culminated in an incident on a particular day.

The tragedy encountered by these people should not be forgotten but branded in our minds and inspire us to put safety first in the special work that we do.

Acknowledgments

This study has evolved as a result of several influences. First, my parents who have supported me, promoted the advancement of my education and instilled in me the ethics "to always do your best whatever you set out to do" and "you can lose your possessions but no one can ever take away what you have learnt".

Second is my professional duty of care to provide safe care and a safe environment to my patients. My role as a nurse and supervisor has put me in a position to have myself caused medical err, counselled others who have erred, and cared for those who are the victims of medical error.

Third, is the promotion of nursing research from the Department of Clinical Nursing. Particularly, I would like thank Professor Alan Pearson who suggested that I formalise my research into Masters Degree study and Mary Fitzgerald, my supervisor, who has demonstrated enduring patience and compassion as I humbly learn to research and write.

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Since launching HIMS internationally, there are many people that have contributed to the study. The individuals that have submitted reports of incidents have contributed the most, as they have shared an experience in their work that will lead them to improving safety for others.

My sincere gratitude goes to the "Persons On The Spot" (POS) in the study, who logistically make the study happen from their location. The HIMS International Coordinators have invested great effort to make this study a truly international effort through their promotion, presentations, and translations. Dick Clarke, Peter Mueller, Cuauhtemoc Sanchez, Ann Charlotte Grönqvist, Folke Lind, Lief Aanderud, Aud Jorunn Thorsen, Michael Michael, Ole Hyldegaard, Jordi DeSola, and Jurg Wendling have been especially helpful. These individuals are genuinely committed to the continual improvement of safety in hyperbaric internationally.

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Mostly, I would like to thank my husband, Ralf. Many days and nights over the past four years, he has been left to deal with caring for our young girls, all the domestic duties of a family, and sacrificed his leisure time and our time together so I could study. His selfless commitment to my ideals has tested and demonstrated a most powerful bond for which I am forever grateful and humbled.

I would like to thank my three beautiful girls, Amanda, Jessica, and Sophie. They too have sacrificed much time with me. While I can't make up for those valuable moments of their youth, I hope that some day, they too will grow to understand the value of education.

Hopefully, this small contribution from my research will serve to improve safety in hyperbaric practice.

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Abbreviations

ABPM	American Board of Preventative Medicine
ACGME	Accreditation Council on Graduate Medical Education
AICD	Automatic Implantable Cardioverter Difibrillators
AIMS	Australian Incident Monitoring Study
ANZHMG	Australian and New Zealand Hyperbaric Medicine Group
APSF	Australian Patient Safety Foundation
ASRS	Aviation Safety Reporting Systems
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ASNZ	Australian New Zealand Standard
ATA	Atmospheres Absolute
BIBS	Built-in-breathing system
BHA	British Hyperbaric Association
BNA	Baromedical Nurses Association
CAQ	Certificate of Added Qualification
CDRH	Center for Devices and Radiological Health
CNS	Central nervous system
CPI	Cardiac Pacemakers Incorporated
DAN	Divers Alert Network
DCI	Decompression Illness
DipDHM	Diploma in Diving and Hyperbaric Medicine
ECG	Electrocardiograph
FAA	Federation Aviation Administration
FDH	Food and Drug Administration
GAIN	Global Aviation Information Network
HIMS	Hyperbaric Incident Monitoring Study
HTNA	Hyperbaric Technicians and Nurses Association
ICU	Intensive Care Unit
ISMP	Institute for Safe Medication Practices
IV	Intravenous
JCAHO	Joint Commission of Accreditation of Healthcare Organisations
MDR	Medical Device Reporting
NBDHMT	National Board of Diving and Hyperbaric Medical Technology
NFPA	National Fire Protection Association
OBD	Overboard dump
PA	Pulmonary artery
POS	Person on the spot
PRP	Product Reporting Program
PVHO	Pressure Vessels for Human Occupancy
SPUMS	South Pacific Underwater Medical Society

UHMS	Undersea and Hyperbaric Medical Society
UMS	Undersea Medical Society
USA	United States of America
USAF	United States Air Force
USN	U.S. Navy or United States Navy
USP	United States Pharmacopeial