DAN: Your Dive Safety Association

ALERT Diver

Spring Edition 2010, Vol 2 No 2

SAFE DIVING ▪ IN-WATER RECOMPRESSION ▪ DAN SAFETY PARTNERS

Ten tips to make you a
SAFE DIVER

The facts behind
In-Water Recompression Therapy

Get to know your
DAN Safety Partner

Research Updates
The latest data and discoveries

DAN®
SOUTHERN AFRICA
DIVERS ALERT NETWORK

ISSN 2071-7628

A fond farewell

Dear DAN members

After being involved with diving and hyperbaric medicine for 23 years and running DAN Southern Africa for 14 of them (since 1996), I will be stepping down as president of DAN Southern Africa at the end of March 2011. It has been a privilege for me to be the founder of this wonderful organisation. I have enjoyed seeing it grow by the hands of the wonderful people who have, and continue, to work for DAN and for you – our members!

My medical career is taking a new turn into a new, exciting field of medicine that will require my undivided attention and, while I envisage that DAN will always be a big part of me, my limited availability precludes me from doing so in the capacity as president and managing director. I look forward to still contributing in a variety of forms to its ongoing international success. So it is not with a heavy heart that I am leaving, but with great anticipation for the future of our organisation. This is a fond farewell!

Importantly, DAN Southern Africa has a remarkable board, executive capacity and medical team. I often remind myself that I was more the witness of its success than the hand by which it came. Working with gifted and highly motivated people is a recipe for success, and I am grateful that DAN was always able to encourage individuals towards performing to the best of their abilities for the common good of the diving public, and our members in particular.

Francois Burman, our remarkable director of operations and finances, will be taking over the helm as the managing director. I welcome him to this position as a very highly qualified incumbent (as of 1 April 2011), and wish to thank him publically for being a most remarkable partner, friend and co-visionary in securing the success of DAN Southern Africa over many years. My vision often exceeded my grasp, but Francois has always been able to convert it into reality. Thank you, Francois! Indeed, I call upon all our DAN members to show him the same wonderful friendship, loyalty and support that you have always shown me!

Dr Jack Meintjes, as medical director, together with our wonderful team of diving physicians, will continue providing the professional diving medical support and advice through the hotline that you have all come to enjoy.

Helia van Zyl, Morné Christou, Dawn Carver, Sel-Marie Pereira and Toni McQuillen will also continue their tireless and enthusiastic support for the DAN membership and hotline services that we all depend on.

With all that being said, I would now like to direct your focus to this edition of *Alert Diver*. In it, you will find a variety of topics of great interest: We commemorate our board member, Barney de Villiers, who passed away at the beginning of June 2010, not only by recognising him as a wonderful person, but also by launching a unique DAN Southern Africa safety initiative for which he was a great inspiration – the Dive Safety Partners – Hazard Identification and Risk Assessment (DSP-HIRA) initiative.

We also recognise all the dive resorts, shops and operators who have made a firm commitment towards diving safety by joining as Diving Safety Partners, and we commence our series by introducing each of them to our DAN members so that you are aware of their services and details when you plan your next diving trip. Lastly, we also tackle some controversial subjects like surface recompression and emergency oxygen. There is much to absorb in this edition, so enjoy!

With that, until next time – safe diving!

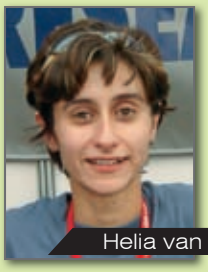
Dr Frans J Cronjé
President and CEO DAN Southern Africa

> *"It has been a privilege for me to be the founder of this wonderful organisation."*

THE TEAM


Dr Frans Cronjé


Francois Burman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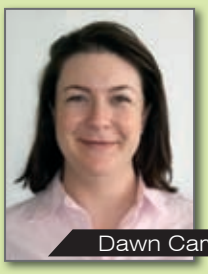
Morné Christou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FRONT COVER

Image by Cormac McCreesh

DAN PUBLICATION PHILOSOPHY

Alert Diver Southern Africa is a forum for ideas and information relative to diving safety, education and practice. Any material relating to diving safety or diving medicine is considered for publication. Ideas, comments and support are encouraged and appreciated.

The views expressed by contributors are not necessarily those advocated by DAN. While every effort is made to ensure the accuracy of information and reports in the *Alert Diver* Southern Africa, the publisher does not accept any responsibility, whatsoever, for any errors, omissions, or for any effects resulting therefrom. As to the best of the publisher's knowledge, contributors have not indulged in plagiarism. Although the utmost is done to avoid such occurrences, the publisher will not be held responsible for the contributors' or writers' indulgence in plagiarism. No part of this publication may be used or reproduced in any form, without the written permission of the publisher.

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SUBMISSIONS

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Please ensure that your material is sent to altertdiversa@dansa.org or to *Alert Diver* Magazine, Private Bag x 197, Halfway House 1685. Images should be 300 DPI and should be accompanied by a caption and the name of the photographer.

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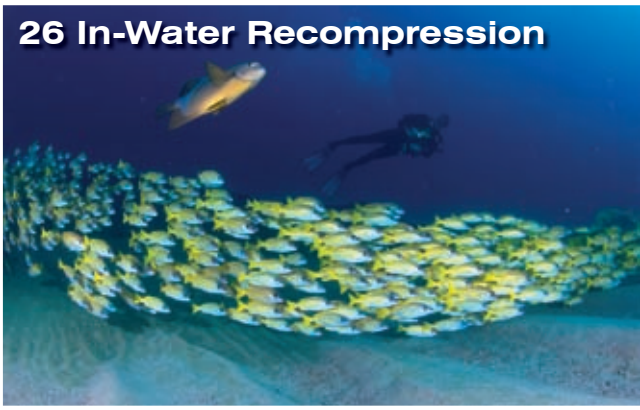

DAN Letters & Comments

Send your letters to:
Alert Diver Magazine
Private Bag X197
Halfway House 1685
or email to:
alertdiversa@dansa.org

Dear DAN-SA
I must confess that when I heard DAN-SA was going to stop importing *Alert Diver* Magazine, I was slightly disappointed after having enjoyed receiving the magazine as part of my membership for many years, but waited with some uncertainty for the South African version. It has now been three issues and I am truly impressed by the content of the magazine – it is relevant, informative and, most importantly, aimed at the South African diver!

I look forward to reading every future issue!

Robert
DAN member since 1999

Dear DAN-SA staff
Every year, one of the events I actually look forward to is renewing my DAN membership as it is so satisfyingly efficient and easy to do, and it is such a joy to find an organisation that operates so well.

Thank you all for a truly useful and excellent service!

Neil
DAN member

To the team at DAN Southern Africa
I joined DAN-SA six months ago and, after not having received my membership pack, I contacted the admin office and was promptly assisted by Sel-Marie who listened to my concerns and immediately assured me that my membership pack would be re-sent. I have since received it and would like to say thank you to Sel-Marie and the staff involved at DAN-SA for their efficient and friendly service.

We all know that conventional post is not always reliable, but what really impressed me was the way I was treated.

Thank you and keep up the good work!

Andrew
Satisfied DAN member

FISH FUNNIES

Sometimes fish have their funny moments too, you know.
Share your funny fish images with us by sending your image and funny caption to alertdiversa@dansa.org


Image by Louis van Wyk.

"Quickly – I can't hold it much longer!"

DR OCTO IT'S SPRING AGAIN

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Galileo is the ground-breaking, state-of-the-art computer platform by UWATEC.
From the advanced Algorithm that actually adapts to your diving conditions and behavior to the Dot Matrix screen with text messages, every feature represents the pinnacle of dive computer technology. Quite simply, you cannot get better.

What's even more impressive is that as new features become available, you can upgrade your Galileo SOL or Galileo LUNA from the Uwatec website. The new APNEA feature is available now for free and the impressive TRI-MIX module will be available soon, also at no cost.

Features: Flood-proof oil-filled construction. 330m Depth Rating. Energy efficient Dot Matrix screen. Full-Tilt Digital Compass. Infrared & free software. Personalised Screen Configurations & font size. Hoseless Gas Integration (optional on Luna). Heart Rate Monitoring with Algorithm adaptation (optional on Luna). PDIS – Actual Deep Stop Calculation. Predictive Multi Gas – 3 mixes (optional on Luna). User-replaceable battery. Simple cell-phone style interface for effortless navigation between features.

Galileo. State-of-the-art meets easy-to-use.

Deep Down You Want The Best

The DAN-SA Team

The Core Team of DAN-SA

DR FRANS CRONJÉ

Frans is the founder, president and managing director of DAN-SA.

FRANCOIS BURMAN

Francois serves as the financial and operations director for DAN-SA. He is currently responsible for the operational, technical, safety, financial and insurance aspects of DAN and its programmes. He serves as treasurer on the board of International DAN and is the technical consultant for IDAN.
francois@hydra.org.za

HELIA VAN ZYL

Helia serves as our DAN office manager where she is responsible for the operational aspect of DAN-SA's membership services and the staff.
helia@dansa.org

MORNÉ CHRISTOU

Morné manages special projects and marketing. He is also our Diving Safety Partners (DSP) Programme co-ordinator.
morne@dansa.org

DAWN CARVER

Dawn is responsible for supporting the DAN-SA medical information and emergency hotline during office hours. She works closely with Netcare when further assistance or evacuation is required and provides important quality assurance and customer care related to these calls.
danmedic@dansa.org

SEL-MARIE PEREIRA

Sel-Marie is our DAN membership services administrator. She is responsible for all aspects of membership administration, data capturing and sales.
sel.marie@dansa.org

TONI McQUILLEN

Toni serves as our membership services assistant and is responsible for assisting in the general day-to-day administration of DAN-SA membership as well as student membership.
toni@dansa.org

The DAN hotline is manned 24/7/365 by operators and doctors especially trained to deal with dive emergencies.

These are the doctors who take turns to be on call for the DAN-SA hotline:

The Medical Team of DAN-SA

DR JACK MEINTJES

Dr Jack Meintjes has served as the medical director of DAN-SA since 2007. Dr Meintjes has experience in hyperbaric medicine and has vast commercial diving medical knowledge and experience.

DR ISABEL DU PREEZ

Dr Isabel du Preez is currently one of the directors of the emergency rooms at Akasia Hospital in Pretoria. She has served as a DAN medical officer since 2006.

DR MIKE MARSHALL

Dr Mike Marshall serves as the medical director for the St Augustine's Hyperbaric Medicine Centre since its inception in 2000 and has been a part-time medical officer to DAN since 2002.

DR LOURENS DE KOCK

Dr Lourens de Kock is one of the partners in a busy diving, aviation and maritime medical practice in Cape Town.

DR GARY MORRIS

Dr Gary Morris is a general medical practitioner from Scottburgh, KwaZulu-Natal.

DR ROB SCHNEIDER

Dr Rob Schneider is a general medical practitioner practicing full time in emergency medicine in Pretoria.

DR CECILIA ROBERTS

Dr Cecilia Roberts has recently joined the DAN-SA medical team and serves as the medical director for the SUN Baromedical Facility. She is currently completing her BScMedScHons degree in Hyperbaric Medicine.

DAN Business Members Recognition Programme

Image by Cormac McCreesh.

Over the past ten years, DAN-SA has been helping divers in need. During this time, we have been partnering with dive operators through our Business Membership Programme to help their customers practise safe diving and to keep coming back to them for more dive safety equipment and training.

The DAN Business Membership Programme focuses on working with dive businesses that promote and teach dive safety. DAN business members receive many benefits in return for their support of DAN-SA. (Please note that DAN-SA does not provide any form of cover/insurance for a business – this is merely an affiliation programme.)

There is no charge to join DAN-SA as a business member; we just ask that the contact person be an active DAN member and provide proof that the business/club or organisation exists. We also accept applications for individual freelance scuba instructors or higher-level educators, as long as they are not employed by a school/club or organisation that is already registered as a DAN business member (we do, however, accept applications for multiple locations, i.e., more than one branch).

DAN-SA business members are easily identified by the logo they display on their premises:

DAN SOUTHERN AFRICA BUSINESS MEMBER

At the start of 2009, we improved the Business Membership Programme to include a Loyalty Recognition Programme, and divided the business membership into levels.

THESE ARE OUR PLATINUM LEVEL BUSINESS MEMBERS:

Bud and Cath's Scuba Academy
Reef Divers
Scuba City Dive and Travel
Underwater World

THESE BUSINESS MEMBERS HAVE ACHIEVED GOLD LEVEL STATUS:

2 Dive 4 Scuba
Africa Scuba Travel
Africa Seafaris
All About Scuba
Alpha Dive Centre
Coral Divers
Ecstasea Dive School
Fourways Scuba
Froggie Fever cc
Meyerton Scuba Diving Club
ODI Pretoria
Sandton Scuba
Scuba Scene
Scubaversity
Twin Palms Scuba

For more information on the Business Membership Programme contact DAN-SA: 0860 242 242 or mail@dansa.org

RED LEVEL BUSINESS MEMBERS are the entry-level business members. This does not necessarily mean that the business is new; it just means they have referred less than 100 members to DAN-SA (that we know of at least!).

All business members start out as red level business members. They earn three points for each new member they refer to DAN-SA, in addition to the other benefits.

GOLD LEVEL BUSINESS MEMBERS earn four points for each new member they refer to DAN-SA. In addition, they also receive a gold level certificate and additional recognition from DAN-SA. To qualify for this level, a business member must:

1. have referred >100 members to DAN since they registered; and
2. be active status business members.

PLATINUM LEVEL BUSINESS MEMBERS earn five points for each new DAN member they refer to DAN-SA. In addition, they also receive a customised banner to display in their dive shop.

To qualify for this level, a business member must:

1. have referred >200 members to DAN since they registered; and
2. be active status business members. AD


Image by Cormac McCreesh.

TEN

By Morné Christou

Last year on a plane trip back to South Africa, the gentleman sitting next to me asked if I was a DAN member after noticing the DAN shirt I was wearing. He introduced himself to me as John Dallas, a DAN member who has travelled and worked extensively over the globe. He mentioned that his favourite destination was Mozambique because it was still unspoilt and untouched by the mass of divers that visit places like the Red Sea.

Without letting on that I work for DAN Southern Africa, John decided to share why it is important to join as a DAN member if you are a diver.

10 **DAN is a non-profit organisation, which is great.** DAN is not out to make money off divers, unlike some insurance companies. DAN is an organisation run by divers to help divers, and that is what makes DAN the best buddy in the world!

9 **DAN is not owned by any of the training agencies.** In fact, they support DAN by distributing DAN literature and promoting DAN's services to agency members, but it is important to note that DAN is not owned by any agency or business.

8 **DAN offers many different cover packages to divers** but, more importantly, they offer travel assist benefits to non-diving family members free of charge. The main member only needs to register additional non-diving family members when applying for DAN membership. No other organisation or company offers this!

7 **DAN membership registration is simple and quick to take effect.** In fact, my membership took effect the same day I applied and I received my membership ID cards within three weeks. It is important that the DAN staff informed me that membership would only go into effect once payment was received. It is your choice to pay monthly or annually. You can get immediate coverage by calling 0860 242 242 (all major credit cards are accepted). In case of injury, your details will show up in the DAN database by membership number and by name. DAN is available 24 hours a day for diving emergency assistance by calling the DAN hotline on 0800 020 111 and giving your DAN number, your name or your identification number. Regardless as to whether or not you have your DAN ID card, your membership is active once DAN receives your application and proper form of payment.

6 **What a great service the DAN hotline was when I needed help!** While on a trip to Indonesia a few years back, I had a diving accident and the hotline staff and doctor on call made all the arrangements to evacuate me ASAP. The

REASONS TO JOIN AS A DAN MEMBER

DAN service didn't end with the evacuation arrangements. The hotline also made the necessary arrangements for me to receive chamber treatment, and continued to follow up to find out how I was doing and if I was satisfied with the service I was receiving. It goes without saying, I will never go on a diving trip without DAN. DAN was my lifeline when I needed help!

5 Many divers mention that they have primary medical coverage and want to know if they really need DAN cover. I always mention to them that their primary medical insurance may exclude scuba diving as a hazardous recreational activity. However, even if it covers scuba diving, it may only pay a minimal amount for chamber treatment. Many policies may not cover you when you are out of your region or out of the country. The most expensive component is usually the evacuation, and it is quite challenging to gain approval for a medical evacuation for a diving injury using a primary medical insurance company. When I had my problem in Indonesia, I tried to make use of my South African medical aid cover that had been specifically activated for overseas travel. I was unable to speak to anyone that could help me in arranging the necessary evacuation. This is where my DAN membership proved to be the absolute winner. DAN membership is recognised worldwide, and membership can be confirmed via the DAN-SA office during office hours or after hours through the emergency hotline.

4 A number of insurance companies offer insurance but the advantage of being a DAN member is that DAN is your dive safety association. Because of this, you receive more than just dive emergency cover. You receive all the benefits of the membership: TravelAssist, periodicals and free access to medical information via the hotline.

3 Another benefit of DAN membership is the emergency evacuation service – DAN TravelAssist. DAN TravelAssist offers emergency transportation (by air if necessary) to a medical facility whenever you are travelling more than 100 km from home. You can use this service during any emergency – even a non-diving one. In order to use this membership benefit, you must first contact the DAN hotline before making any evacuation arrangements. This is an emergency evacuation service, not an insurance.

2 DAN does not spam you, sell your contact details to third parties, or make any solicitations. Your information is confidential and is not released to anyone. On a rare occasion, DAN may need to call you if a mailing or package is returned due to an address problem. You can list your work or home number with DAN, or elect not to list a number. Remember, DAN has your birth date for identification purposes. You will receive four electronic newsletters, for which there is always an "opt out" option if you prefer not to receive them by email.

1 DAN continuously helps to improve the safety of diving! DAN is involved with many safety programmes, such as the Diving Safety Partners and Recompression Chamber Assistance Programme. These programmes help to improve the safety at recompression facilities worldwide to ensure that all DAN members receive the best possible treatment when needed.

After hearing John's ten points on why every diver should be a DAN member, I realised that the work I have done to promote the organisation amongst divers was finally paying off. The other thing I realised was that, if John's opinions are anything to go by, it certainly appears that divers are extremely proud to be DAN members… and that's just the way we like it! AD

Contact DAN Membership Services for any queries or questions regarding your DAN membership.

Email: mail@dansa.org or call: 0860 242 242

Diving with BLOOD DISORDERS

By Dr Ernest Campbell and Dr Frans J Cronjé

Blood disorders and cancers are relatively common and may have an effect on fitness to dive. In this section, we address some of the more common problems and their potential consequences to divers.

SICKLE CELL ILLNESS

This is an inherited condition in people of mostly African heritage in which there are abnormal configurations of the red blood cells that have the appearance of sickles instead of lifesavers. They tend to clump in vessels causing loss of circulation and anaemia, and are triggered by low oxygen conditions. This causes severe pain, tenderness and loss of mobility, and is called a crisis. The condition can complicate the management of serious decompression illness and can be another cause of aseptic necrosis of bone or bone death.

Sickle cell trait is the name for a person who inherits one sickle haemoglobin-producing gene and one normal haemoglobin gene. Normal haemoglobin is called type A. Sickle haemoglobin is called type S. Sickle cell trait is the presence of haemoglobin AS on the haemoglobin electrophoresis (blood test detecting different types of haemoglobin). This will not cause sickle cell disease, but hypoxia, exercise and low blood flow will cause individuals with sickle cell trait to experience sickle crisis.

> *"Blood disorders and cancers are relatively common."*

Recommendations to divers and doctors certifying prospective divers concerning sickle cell illness have been under careful study and these recommendations are changing. Sickle cell traits indicate that an individual has haemoglobin types A and S present in the red blood cells. This situation usually does not cause a problem without very low oxygen tension.

Obviously, persons with sickle cell anaemia should not dive due to the increased risk of decompression illness and the increased risk of a sickle cell crisis. A person with sickle cell trait can be qualified for diving since he or she is not at any greater risk from oxygen deficiency in body tissues, in comparison with the ordinary diver. Should an individual with sickle cell trait become hypoxic while diving (out of air, drowning, equipment failure, etc.) then the cells would sickle. However, it would seem that the risk would be less from the sickling than from other aspects of the situation causing the hypoxia, such as drowning from unconsciousness caused by the hypoxia.

HEREDITARY SPHEROCYTOSIS AND THALASSAEMIA

Other anaemias caused by red blood cell abnormalities include hereditary spherocytosis or haemolytic anaemia and the thalassaemias. Hereditary spherocytosis is ordinarily a condition that manifests itself at birth or shortly thereafter. The red blood cells are spherical instead of in the shape of lifesavers. This causes them to be excessively fragile and subject to fragmentation with changes in blood chemistry, such as hyperbaric chambers and diving. There are three other possible dangers that could be averse to diving:

Anaemia, with the decreased oxygen-carrying potential of a lowered haemoglobin. People with anaemia, whatever the type, really have an oxygen-carrying problem. One should not dive if the ability of the blood to transport oxygen and off-load carbon dioxide is compromised in any way. Measurements of anaemia include the haematocrit (packed cell volume) and the haemoglobin concentration. Diving is precluded if the haematocrit is 37 or below, or the haemoglobin is 12 Gm/dl or below. This is to prevent hypoxia and loss of consciousness while underwater, which could lead to drowning.

Splenomegaly (enlarged spleen), with the possibility of traumatic rupture of the enlarged, fragile organ. The spleen should either be small or surgically removed before a diver can be certified as fit to dive. If a person has had the spleen removed, the diver should have full immunisations against the pneumococcus and should be aware of greater susceptibility to marine infections.

Thalassaemia or Cooley's anaemia is due to abnormal genes in the haemoglobin molecule and has many variants. Most of these have no clinical significance and do not relate to diving. However, one must infer danger if there is anaemia below Hb of 12 g/dl (O_2 transport) or if there is an enlarged spleen. Enlarged spleens can rupture from very minor trauma.

As with most blood diseases, the level of illness, response to treatment and many other factors have to be considered before allowing a person to dive. Many people with these conditions can dive without risk – if not severely anaemic or if there are no other intercurrent complications related to the breakdown of haemoglobin with resultant iron storage problems.

Obviously, one should not dive with a low haemoglobin level or if weakened or debilitated from the illness or the treatment of the illness. This can sometimes be quite severe.

Normal spleen

Splenomegaly

ANAEMIA AND DIVING

Anaemia can be defined as a reduction in the haemoglobin (the oxygen-carrying protein in the blood), the haematocrit (percentage of cellular content of 100 cc of blood) or total red cell number. In physiological terms, an anaemia is any disorder in which the patient suffers from tissue hypoxia due to the decreased oxygen-carrying capacity of the blood. We usually use the term "anaemia" to refer to an absolute anaemia, i.e., a reduction in red cell or haemoglobin mass.

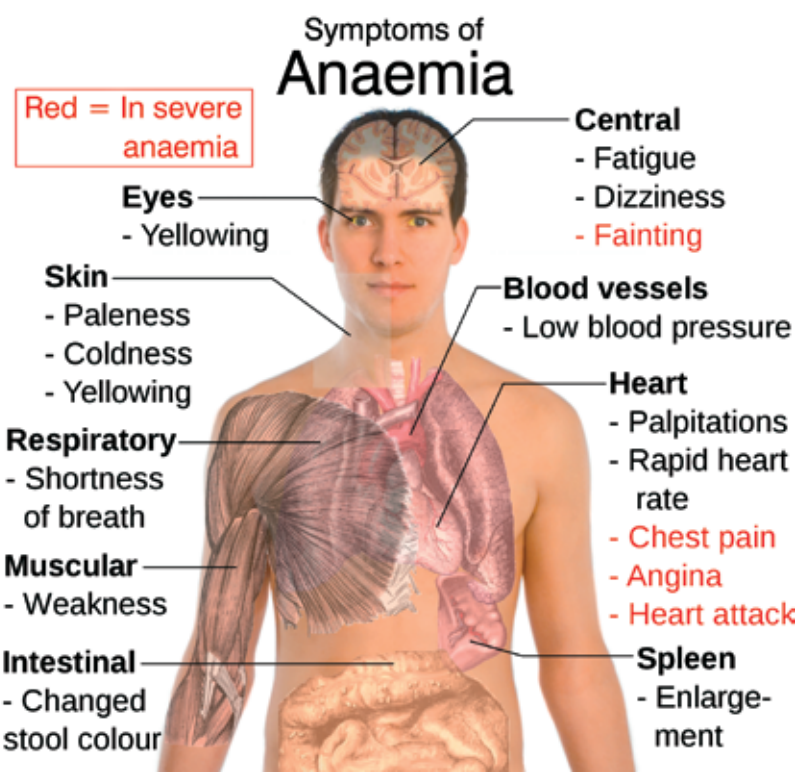
In an acute haemorrhage (blood-loss anaemia) the arterial pressure falls and the patient rapidly goes into shock simply due to a low blood volume. The sudden, rapid loss of 30% of the total blood volume often results in death, unless immediate medical care is given.

In a slowly developing anaemia (e.g., blood-loss anaemia), cardiac output increases and there is a decrease in haemoglobin oxygen affinity. Anaemia is a sign of disease, not the disease itself. The clinical effects include tiredness, lassitude, weakness, pallor and perhaps fever and low blood pressure. Shortness of breath and chest pain can occur after exercise. Yellow discolouration of the skin may occur in some anaemias.

Anaemia is dangerous to the diver due to the decreased content of oxygen by the red blood cell mass. Partial pressures are important because they determine the rate of diffusion of a gas, and therefore strongly affect the rate of gas exchange between the blood and alveolar air, however, tissues have to contain a certain amount of oxygen per minute in order to live – a need met by oxygen content, not oxygen pressure. The oxygen-carrying capacity of one gram of haemoglobin is 1.34 ml. Once oxygen molecules chemically bind to haemoglobin, they no longer exert any pressure. The lower the haemoglobin content, the lower the oxygen content, regardless of the arterial oxygen.

The greater the partial pressure of oxygen in the alveolar air of the lung, the more oxygen dissolves in the blood (a restatement of Henry's Law). Partial pressures change as a diver descends and ascends in the water column.

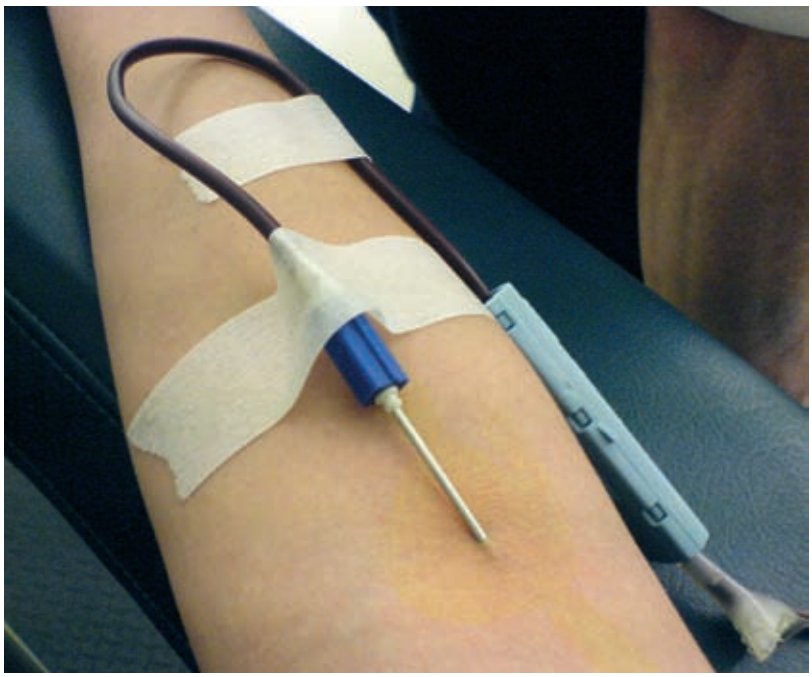
Anaemia is one of several conditions that the NOAA (National Oceanic and Atmospheric Agency) has determined to be relatively disqualifying to diving, and requires a case-by-case evaluation.



BLOOD DONATIONS

This information should apply to any type of diving since the effect depends on the haemoglobin in the red blood cell mass, rather than the partial pressures of gasses.

The donor's body replenishes the fluid lost from blood donation in 24 hours. If not anaemic, a person can dive after 24 hours of a blood donation. It may take up to two months to replace the lost red blood cells. Whole blood can be donated once every eight weeks. The most important part of the blood to the diver is the red blood cell, responsible for the transport of oxygen to the tissues. The fluid part of blood is replenished in about one day.



If the diver waits 24 hours and has a normal haematocrit (red blood cell percentage), then diving should be allowed.

Red blood cells are perhaps the most recognisable component of whole blood. Red blood cells contain haemoglobin, a complex iron-containing protein that carries oxygen throughout the body and gives blood its red colour. The percentage of blood volume composed of red blood cells is called the haematocrit. The average haematocrit in an adult male is 47%. There are about one billion red blood cells in two to three drops of blood, and for every 600 red blood cells, there are about 40 platelets and one white cell. Manufactured in the bone marrow, red blood cells are continuously being produced and broken down. They live for approximately 120 days in the circulatory system and are eventually removed by the spleen.

Aphaeresis is the process of removing a specific component of the blood, such as platelets, and returning the remaining components, such as red blood cells and plasma, to the donor. This process allows more of one particular part of the blood to be collected than could be separated from a unit of whole blood. Aphaeresis is also performed to collect plasma (the liquid part of the blood) and granulocytes (white blood cells). There is also a process of double aphaeresis where a doubled quantity of red blood cells (500 cc) are removed, returning all other blood components to the body. This might cause a drop in haemoglobin below normal ranges and require a wait before diving in order for the red cells to be reproduced – a period of about 120 days.

Approximately 10% of body iron stores are removed with each donation of 250 cc of red blood cells. When appropriate, iron supplements can be prescribed for patients making donations to help increase red blood cell count. Erythropoietin, a hormone, can also be given to stimulate the bone marrow into producing more red blood cells.

> *"Bleeding disorders constitute a wide range of medical problems."*

BLEEDING DISORDERS

Bleeding disorders constitute a wide range of medical problems that lead to poor blood clotting and continuous bleeding.

When someone has a bleeding disorder, they have a tendency to bleed longer than normal due to their inability to form a clot. The disorders can result from defects in the blood vessels or from abnormalities in the blood itself. The abnormalities may be in blood clotting factors or in platelets.

Blood clotting, or coagulation, is the process that controls bleeding. It changes blood from a liquid to a solid. It's a complex process involving as many as 20 different plasma proteins or blood clotting factors. Normally, a complex chemical cascading process occurs, using these clotting factors to form a substance called fibrin that stops bleeding. When certain coagulation factors are deficient or missing, the process doesn't occur normally.

Within seconds of an injury, tiny cells in the blood, called platelets, bunch together around the wound. Normally, blood proteins, platelets, calcium and other tissue factors react together and form what is called a clot, which acts like a net over the wound. Over the next several days to weeks, the clot strengthens and then dissolves or falls off as a scab when the wound is healed.

In people with abnormal bleeding, clotting factors are missing or don't work as they should. This causes them to bleed for a longer time in comparison with those whose blood factor levels are normal. Bleeding problems can range from mild to severe. A person with a bleeding abnormality exhibits certain symptoms that include: excessive bleeding and bruising, easy bleeding, nose

bleeds and abnormal menses. These people sometimes also suffer from scarring of the joints or joint disease, loss of vision, chronic anaemia (low red cell count) from blood loss, neurologic or psychiatric problems. In some cases, death may occur, which may arise due to large amounts of blood loss or bleeding in critical areas, such as the brain.

Some bleeding disorders are present at birth and are caused by rare, inherited disorders. Others are developed during certain illnesses (such as vitamin K deficiency or severe liver disease), or treatments (such as use of anticoagulant drugs or prolonged use of antibiotics). They can include haemophilia and other very rare blood disorders. Other causes of bleeding disorders include:

- Von Willebrand's disease, which is an inherited blood disorder thought to affect between 1% and 2% of the population.
- Immune system-related diseases, such as allergic reactions to medications, or reactions to an infection.
- Cancer, such as leukaemia (blood cancer).
- Liver disease.
- Bone marrow problems.
- Disseminated intravascular coagulation, which is a condition often associated with child bearing, cancer, or infection, in which the body's clotting system functions abnormally.
- Pregnancy-associated eclampsia, also known as severe toxicity of pregnancy.
- Organ transplant rejection.
- Haemophilia A and B, which are inherited blood disorders.
- Exposure to snake venom.
- Antibodies, a type of immune system protein that destroys blood clotting factors.
- Medicines, such as aspirin, heparin, Warfarin and drugs used to break up blood clots.

Congenital bleeding disorders are very rare, with the exception of haemophilia. Education about bleeding disorders has not been a priority of the medical community. Most have only been recently discovered.

Risks to divers include barotrauma damage to air-filled spaces, such as the sinuses, ears or lungs from the bleeding that can occur in these organs, and the decrease in the oxygen-carrying capacity of the bleeder with anaemia. These individuals should be advised not to dive.

POLYCYTHAEMIA VERA

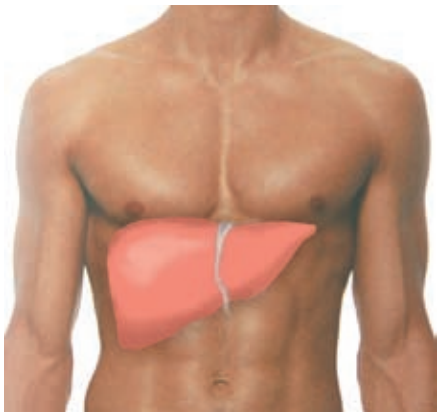
This is a condition in which the body produces too many red blood cells. There are few references to this condition in any of the major textbooks of diving or hyperbaric medicine. Some symptoms of the condition that might affect diving or mimic diving accidents include headaches, dizziness, itchiness (especially following a warm bath), fullness in the left upper abdomen, red colouration (especially of the face), shortness of breath, breathing difficulty lying down, symptoms of phlebitis or inflamed veins in the legs.

Other symptoms that may be associated with this disease include: vision abnormalities, red skin spots, bluish skin discolouration and fatigue. Complaints usually can be attributed to the expanded blood volume and hyperviscosity, which may manifest as weakness, headaches, light-headedness, visual disturbances, fatigue or shortness of breath. Easy bruising and bleeding are common. The face may be flushed and the retinal veins engorged.

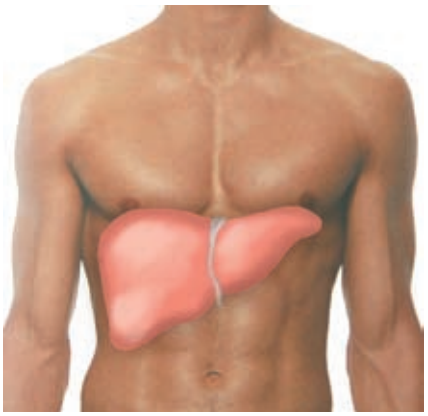
An enlarged liver is frequently seen and over three-fourths of the patients have a hugely enlarged spleen, a situation that would be extremely dangerous to a diver due to possible rupture from pressure from gear and weightbelts, or trauma from entry and exit on a dive.

Complications of the disease are mainly due to the increased thickness of the blood, increased clotting and increased blood volume. These include: thrombosis, stroke, heart attack and heart failure. The changes that occur due to increased partial pressures of gasses from the diving environment are not known. An increased risk for decompression illness can be theorised due to problems with blood flow.

Problems with clotting frequently occur because of abnormalities of platelet function. Divers with bleeding tendencies have an increased risk of haemorrhage associated with barotrauma to the ears, sinuses and lungs. It is also thought that there is an increased risk of a spinal decompression injury.



Normal liver



Enlarged liver

Hydrea (hydroxyurea), a medication used to treat polycythaemia, can cause some or all of the following side effects: nausea, vomiting, diarrhoea and drowsiness. It may also cause the following symptoms: fever; chills; coughing; lower back or side pain; painful or difficult urination; tiredness or weakness; sores in mouth or on lips; unusual bleeding or bruising; black, tarry stools; blood in urine or stools; small red spots on the skin; confusion; dizziness; convulsions; hallucinations; headaches; joint pain and swelling of feet or lower legs.

Another medication, Interferon, has numerous side effects that would be inimical to diving. Some of these side effects can alter a diver's level of consciousness and ability to make decisions and participate in buddy responsibilities. It is probable that most diving physicians would be quite reluctant to give their approval for this patient to dive, considering all the possibilities for disaster.

Treated polycythaemia with near normal blood counts, a normal sized spleen and none of the side effects of medication may be allowed to dive on a case-by-case basis, with the approval of the diver's attending physician.

> *"Divers with bleeding tendencies have an increased risk of haemorrhage."*

LEUKAEMIA

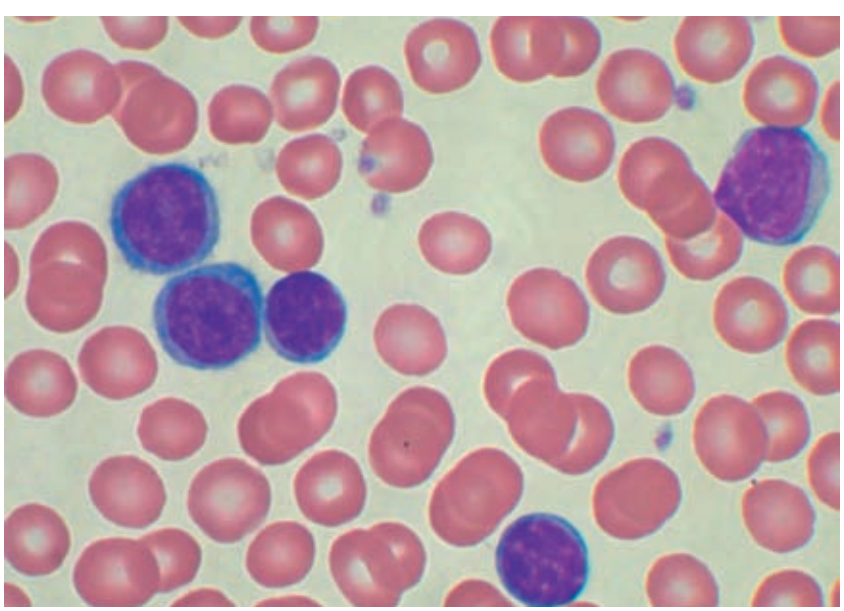
Leukaemia is a malignancy of the white blood cells. There are two main types: myelogenous leukaemia and lymphoblastic leukaemia. These can be acute and chronic in their effects on the individual. The most common type of leukaemia is chronic lymphocytic (CLL), indicating that the disease of the lymphocytes is slow in its effects on the body.

Acute leukaemia is the leading cause of cancer deaths in adults younger than 35 years old. Treatment is usually through anti-cancer drugs and/or by bone marrow transplantation.

All of the leukaemias, whether acute or chronic, are usually serious diseases that result in a limited lifespan. CLL patients often require no treatment and can do relatively well, and therefore should be assessed on a case-by-case basis. If acute leukaemia is in full remission and exercise tolerance is acceptable, scuba diving can be considered – otherwise risks are too high for it to be recommended. The side effects of chemotherapy and radiation treatments and other problems associated with the leukaemia make diving unwise.

Complications include anaemia, low platelets and low white blood cell count, depending upon the stage of the disease. A favourable response can be expected in most individuals treated with chemotherapy, radiation, or both. Individuals with leukaemia are very sensitive to infections because of changes in their white blood cell count.

Difficulties with diving that might be encountered stem primarily from the effects of the chemotherapy on the immune responses of the body and the possibility of bone marrow depression with anaemia and/or low platelet counts. One should not dive while there are any effects of the drugs on the immune system due to the possibility of overwhelming infection from marine organisms. The diver should not be debilitated or weakened from the illness or treatments so as to be unable to perform self and buddy rescue. Blood clotting parameters need to be checked so that haemorrhage from barotrauma will not be a factor.



Anaemia will need to be corrected so that there will not be any chance of hypoxia. If there were splenomegaly, there would be an increased possibility of rupture due to pressure from dive gear and boat re-entry (a common problem with boat re-entry is rib fracture due to wave action, weightbelt and boat transom trauma). The spleen contracts with simple immersion as part of the dive reflex causing an increase in the red blood cell mass. AD

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Safety Partners

The Diving Safety Partners (DSP) Programme started in the DAN Southern Africa region in KwaZulu-Natal, the Western Cape, Mozambique and Zanzibar. The programme recognises dive resorts and operators who have pledged and demonstrated a definite commitment to diving safety by ensuring that their staff are suitably trained in first aid; that they have appropriate first aid equipment and oxygen on site; that they provide diving safety briefings; that they have an effective emergency management plan and that they have a proper lost diver prevention procedure in place.

In this edition, we would like to introduce you to one of our DSPs – Barra Lodge Dive Centre. In every upcoming edition, we hope to share the details of up to five of our DSPs with you so that you are better able to choose operators who have a firm commitment to diving safety. To this end, we reiterate our invitation to our DSPs to contribute their details to us for this purpose, using this template. Dive shops, resorts and operators who would like to become DSPs, please contact Morné Christou at the DAN office.

> *"The programme recognises dive resorts and operators who have pledged and demonstrated a definite commitment to diving safety."*

To date, the following 26 dive operators have qualified for being recognised by DAN as DSPs:

SOUTH AFRICA

1. Adventure Mania, Sodwana Bay
2. Aliwal Dive Centre, Umkomaas
3. Amoray Diving, Sodwana Bay
4. Blue Vision Dive Centre, Umkomaas
5. Calypso Dive and Adventure Centre – Ushaka Marine World, Durban
6. Coral Divers, Sodwana Bay
7. Oceans Alive Diving, Umkomaas
8. Sea Escapes, Sodwana Bay
9. Sodwana Bay Lodge, Sodwana Bay
10. Triton Dive Charters, Sodwana Bay
11. Underwater Explorers, Cape Town

MOZAMBIQUE

12. Barra Lodge
13. Centro de Mergulho
14. Jeff's Palm Resort
15. Malongane Watersports
16. Oceana Diving
17. Libelula Resort

TANZANIA (INCL. ZANZIBAR)

18. Bahari Divers
19. Dive 710 – Pemba Island
20. East Africa Diving
21. Karafuu Dive Centre
22. One Ocean: The Zanzibar Dive Centre
23. Zanzibar Watersports
24. Mnemba Island Lodge
25. Peponi Diving
26. Scuba Libre

The Mozambique Travel Guide

Contributions by: Jo and Megan from Barra Lodge, and Toni and Morné from DAN-SA

> *"Pristine beaches, blue skies and a crystal effect to the water call us to dive."*

Pristine beaches, blue skies and a crystal effect to the water call us to dive.

Simply put, Mozambique is breathtaking, seducing us to return time and time again. The beaches are the sort of places you'd expect to find in the movies; somewhere you are tempted to find yourself stranded. The diving is so spectacular that you can't help but discuss your dives here for years to come. Mozambique will steal the heart of any diver, giving a sense of adventure and awakening the romantic side in all of us.

We are passionate about diving this country and start planning our next trip before we have even vacated our Mozambique accommodation.

There are so many places to dive here, you just don't know where to start. Why not start with the DAN recommendations? Our DSPs (Diving Safety Partners) are definitely the way forward. There is nothing better than knowing that when you are diving, DAN is right there with you. Our Diving Safety Partners are at the peak of the DAN programmes and they have complied with all the DAN requirements. When diving in remote locations, even though they are breathtaking, a dive accident can occur and having the emergency services is the one comfort we sometimes neglect to calculate in our trip planning. It simply makes sense to dive through one of the DAN Diving Safety Partners, knowing that, not only are you diving with a

professional and experienced concession who will allow you to enjoy your diving, but one that is safety conscious and has put measures in place to ensure that their clients receive the very best care available in an emergency situation. We have put together a travel guide, together with our DSPs in Mozambique. This is definitely the very best of both worlds...

BARRA LODGE DIVE CENTRE

Information complements of: Jo and Megan from Barra Lodge Dive Centre

Inhambane is situated 470 km northeast of Maputo, offering a setting of rusting, colonial architecture. Barra, a little way out of this once vibrant city, is simply stunning.

Your journey has ended, and after hours of what seems like a never-ending road (or perhaps you decided to fly to Inhambane Airport), you find yourself in this well kept secret, taking in the pure, untouched visual stimulation, surrounded by palm trees, white beaches and blue sea water. You most certainly won't want to leave your camera behind for this one; your friends may not believe such a spectacular place exists.

Barra Lodge itself is a paradise resort, allowing you to walk straight out onto the beach to enjoy views that simply leave you with a sense of peace. It is hard to believe that, in this third world country, there is a little gem of a resort, offering you professional diving and accommodation.

Barra Lodge Dive Centre prides itself on not only following the diving safety guidelines provided by DAN and the DSP Programme, but also by being a professional dive centre offering you some of what is fast becoming world famous for spectacular diving.

There are 16 different reefs, ranging in depth from 7–40 m, and the Barra Lagoon near the mangrove swamps, which has its own unique eco system.

Water temperatures range from 29˚C in summer to 22˚C in winter. Year round diving is available, even in the cooler seasons.

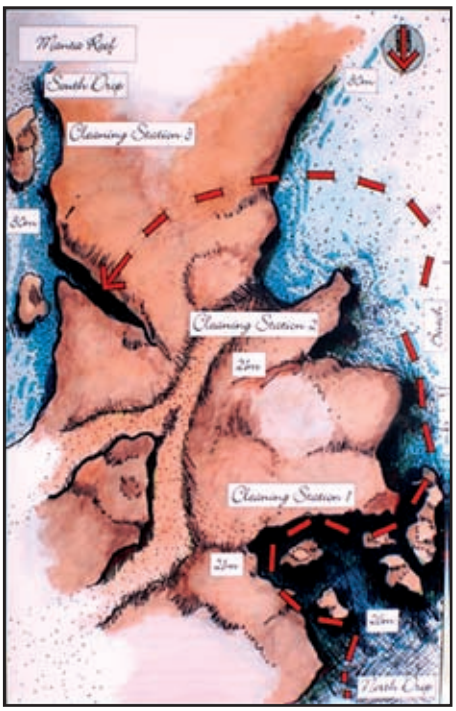
Visibility can range from 8-40 m, depending on the amount of life-giving plankton there is in the water.

Whale sharks are here year round and in abundance between November and March, offering divers and snorkellers an unforgettable experience. In the words of Jo: "Something in your soul goes incredibly quiet". These gentle giants can reach up to 12 m in length and weigh up to 20 t. But having the pleasure of sharing even a brief experience with them, under the specific guidelines laid out by Barra on how to interact with these creatures, certainly does emphasise the gentle giants they truly are.

Humpback whales can be spotted from the shores of a magnificent setting. Their migratory route is from June until November, providing us with an opportunity to see their acrobatics as they spout water from their blow holes and

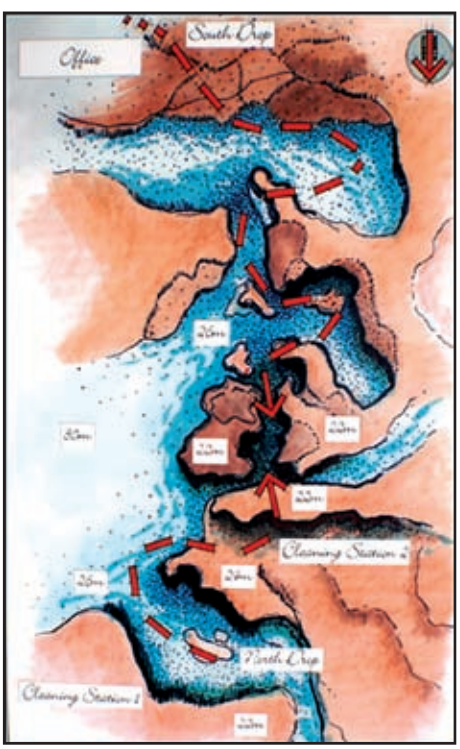
> *"Barra Lodge Dive Centre prides itself on not only following the diving safety guidelines provided by DAN and the DSP Programme, but also by being a professional dive centre."*

launch themselves out of the water. This is the sort of sight photographers thrive on. These amazing animals can cover a distance of 16 000 km on their migratory route, making it the longest known migration on earth. We have the rare opportunity to hear the males singing their haunting song from up to 2 km away. This lasts up to between 10 and 20 minutes, repeating continuously for hours. The pure size of these creatures is amazing. The females can be larger, often spotted with their calves, weighing in at between 25–40 tonnes!



Manta Reef.

The marine life you can expect to see at this tantalising destination is not only diverse, but abundant with rare and spectacular species, from soft and hard corals, to stunning overhangs, crevices and gullies. This place offers manta rays in abundance, Spanish dancers as well as rare shrimp species. The waters are abundant with rare and interesting fish species that will not only make your trip worthwhile, but will certainly keep you talking about it for years to come.



The Office.

There are far too many reefs to go into detail. We suggest getting in touch with Barra Lodge who has a thorough knowledge of these reefs and sea life. However, we will give you a taste of two of these seductive and spectacular reefs.

MANTA REEF

Distance: 24 km
Maximum Depth: 30 m
Average Depth: 21 m

This spot definitely needs to be added to your must dive list, as this reef has become world famous, with stunning topography and close encounters with manta rays. There are three cleaning stations that seem to be popular manta destinations. The north drop-off is on Manta Pinnacles, the first cleaning station and a massive pinnacle of rock that rises from 26 m on the sand to 18 m on top. The wall is a steep drop of 8 m with a swim-through and a huge overhang, which hides a resident potato bass. Triggerfish cover the reef along with huge schools of yellow snappers, bigeyes, fusiliers and trumpetfish. There is also a rare possibility of sighting a Spanish dancer swimming mid-water here. Dive time dependent, we may continue to Manta Canyon, the third cleaning station, where mantas enjoy being cleaned by cleaner wrasse, goldies and butterflyfish. An occasional encounter with a devil ray is a nice way to end the dive.

The south drop is on Manta Canyon, a huge wall that drops down to 30 m on the sand, with lots of cracks and ledges to peak into for eggshell cowries, longnose hawkfish and giant moray eels.

What allows us to enjoy this reef is that currents or surge rarely affect this reef. Double tanking is an option on this reef because of the distance. The boat ride also offers us the opportunity to spot whale sharks and dolphins.

THE OFFICE

Distance: 10 km
Maximum Depth: 30 m
Average Depth: 23 m

The topography is reminiscent of Manta Reef, and Office even has its own manta cleaning station, so encounters with mantas are very common.

The actual site is a rock shelf that rises from the sea floor 70 m below. Our northern drop puts us at the top of a 3 m-high, huge, S-shaped wall. This wall has ledges and overhangs that provide homes to huge resident honeycomb morays, turtles and potato bass. Pinnacles of rock also jut out from the wall where multitudes of goldies, butterflyfish and moorish idols congregate to add lots of moving colour! At the bottom of the "S", three huge rocks come up from the sand, and provide divers with slim gullies and crevices to swim through while looking for devil firefish and sleeping whitetip and blacktip reef sharks. We have also seen the rarely spotted bowmouth guitarfish and leopard sharks at this reef, and you must also look out for two very inquisitive old woman angelfish who come up very close to check you out and then follow you on your dive, playing in your bubble trail!

CLOSING STATEMENT

Barra Lodge is not only a professional and safety-orientated diving centre, they have a wide range of activities, allowing divers to explore the wonders of this spectacular hide away. There is something for those with a milder side to life, and something for the more adventurous traveller seeking thrills. Visit www.barralodge.co.za for more information.

DAN recognises Barra Lodge as a Diving Safety Partner and its commitment to diving safety.

Look out for our next issue of *Alert Diver* – the DAN traveller highlight and features on our DSPs. AD

IN DENIAL

Image by Michael Hindley.

By Marty McCafferty

Small, easy-to-ignore symptoms are often the first signs of decompression sickness.

The diver was a 52-year-old female who had been certified for 19 years and logged more than 400 dives in locations throughout the world. She had no known medical history, took no medications and had no previous diving injuries. She and her dive group were on a liveaboard, travelling near an archipelago in the northern Indian Ocean.

> *"While returning to her cabin below deck, she appeared to have difficulty walking down the stairs; this caught the attention of the dive leader, who evaluated her and subsequently called DAN."*

THE INCIDENT

This diver participated in a series of ten dives over four days. All her dives were on air and conducted within her computer's no-decompression limits. The deepest dive of her series was to 96 ft, with her other dives all being to the same or shallower depths. On day three of the dive trip, she chose not to participate in two morning dives due to a headache, nausea and pain in both hips. She noted that the location of her hip pain was in the muscles, not the joints. Later that same day, she felt well enough to rejoin the group for three afternoon dives. Of note, she did not report the symptoms to the dive group leader.

Approximately one hour after the last dive, her headache, nausea and hip pain returned, along with a new symptom – thigh pain. There was no skin discolouration on either her hips or thighs. While returning to her cabin below deck, she appeared to have difficulty walking down the stairs; this caught the attention of the dive leader, who evaluated her and subsequently called DAN.

The symptoms reported to the on-call medic indicated possible decompression sickness (DCS) with neurological involvement, and the medic recommended immediate oxygen therapy. He also recommended a full evaluation by a dive physician as soon as possible and provided the location and contact information for the nearest hyperbaric facility. The group leader understood the recommendations and relayed them to the boat crew.

THE COMPLICATIONS

The liveaboard was not affiliated with a U.S.-based operator, and English fluency varied widely among the crew members. In addition to communication barriers, the crew members also appeared unfamiliar with the emergency oxygen equipment, which apparently contributed to a delay in oxygen administration. Ultimately, these issues were resolved, and the patient received high-flow oxygen via a non-rebreather mask. The vessel's remote location further complicated the scenario and prolonged the transit time required to reach an appropriate medical facility.

The diver received four hours of oxygen and noted a marked reduction in her symptom severity, and treatment was discontinued. During that time, a local dive physician was contacted by phone and, after a review of the symptoms, the physician recommended an evaluation to be followed by possible hyperbaric treatment.

The next morning (more than eight hours after the original onset of symptoms), the dive group leader contacted DAN with an update. The DAN medic emphasised the need for further evaluation due to the possibility of undetected neurological symptoms. Since the liveaboard was still several hours from the chamber, the boat crew arranged for a local speedboat to transport the patient quickly and safely to the hospital.

THE DIAGNOSIS

At the medical facility, the diver was evaluated and treated in a hyperbaric chamber following the U.S. Navy Treatment Table 5 (TT5). Her leg and hip soreness improved with the first treatment. She was brought back the next day for a subsequent TT5, and she noted additional improvement. After this second hyperbaric treatment, she was discharged back to the boat and instructed to refrain from diving for the rest of her trip.

Over the next three days, the residual soreness in her legs and hips resolved, and she returned home to the United States five days after her last treatment without any recurrence of symptoms. Within four months after the incident, she was deemed fit to dive and returned to diving without incident or symptoms.

THE DISCUSSION

Remote travel can complicate medical management. Limited facilities, long travel times and language barriers all affect a situation and how it is handled. Fortunately for this diver, the outcome was positive.

One of the many challenges facing practitioners of dive medicine is the often subtle presentation of DCS. Initial symptoms, such as hip pain or skin rashes, may be mild, and they are easily misattributed to non-diving-related causes. To complicate matters, people on dive boats want to dive and will deny or underplay symptoms in an effort to return to the water. It is every diver's responsibility to discuss symptoms with available dive staff or with DAN, even when the symptoms seem insignificant.

Try to refrain from self-diagnosis, and fight the temptation to downplay post-dive symptoms. As an example, the fact that this diver had difficulty walking down the stairs may not have been due to DCS, but it certainly wasn't normal, and it warranted evaluation.

If you experience any post-dive symptoms that could indicate DCS, and especially if you experience a combination of symptoms, stop diving immediately. Seek assistance from a dive professional or the DAN hotline on 0800 020 111 in SA and +27 82 810 6010 from outside SA. Continued diving may worsen the condition and may make treatment more difficult.

In addition, the location of a dive physician or the nearest medical facility should be in your emergency action plan. A final recommendation is to question your dive operator or resort regarding how they manage emergencies. Ultimately, each of us is responsible for our own safety, and the more prepared we are, the better off we'll be when trouble occurs. AD

Image by Cormac McCreesh.

SYMPTOMS OF DECOMPRESSION ILLNESS

Decompression illness (DCI) encompasses decompression sickness (DCS) and arterial gas embolism (AGE), and is unpredictable. Injured divers may have just one of the following signs and symptoms of DCI, or they may have several at the same time. These are the signs and symptoms of DCI:

- Numbness
- Headache
- Dizziness
- Nausea
- Pain
- Weakness
- Unusual fatigue
- Difficulty walking

Other signs and symptoms of DCI:

- Difficulty breathing
- Visual disturbance
- Decreased skin sensation
- Restlessness
- Itching/rash
- Paralysis
- Muscle twitching
- Unconsciousness
- Speech disturbance
- Personality change
- Altered level of consciousness
- Bladder/bowel problems
- Convulsions
- Hearing loss/ringing ears

SAFETY is the key!

Ten tips to make you a safer diver

Image by Michael Hindley.

By Morné Christou

Whether you are a new diver with new dive gear, or an experienced diver wanting to upgrade your old gear, before you jump into the water, DAN has a few safety tips to help make your dives memorable, fun and most of all, even safer. These tips and recommendations are not in any specific order.

> *"It is important not to dive outside your comfort zone and training."*

1 Your health.

Being fit and healthy is a key factor, not just on the day of the dive, but as a lifestyle. Diver fitness and visiting your local dive doctor for regular check-ups will ensure that you stay on top of your game in general, and especially when scuba diving.

2 Dive within your limits.

You are in control of your dive; we all know that you should plan your dive and dive your plan. Therefore, it is important not to dive outside your comfort zone and training. Don't let other divers push you beyond your own experience. Rather wait and get the specific training for the new diving environment you wish to enter.

3 Continued education.

Nothing is more important than expanding your own competence as a diver through better diving skills and knowledge. Your local DAN business member will be more than willing to assist you with additional dive training. Many of the instructors at these facilities are also trained to offer DAN training courses to help hone your dive safety skills.

4 Practise makes perfect.

Few divers are in the water every week of the year. Skills become rusty and many divers find that the first dive of a diving vacation is surprisingly stressful; much of it is spent on re-orientating themselves to the environment. This is quite an expensive and potentially hazardous way to achieve what a quick pool session would achieve in only a few minutes. Check-out dives in a pool are an investment; they are not an indictment of your skill, they are an opportunity to become "tuned in" again so that you can truly enjoy that first dive. Change your attitude towards skills practise.

Take the time to practise all the skills necessary when entering the water; you never know when you might need to use the skills you were taught. If you have been out of the water

for a while, make sure to follow the advice of a scuba instructor, and even complete a refresher course to revise your skills if necessary before diving – it is worth it.

5 Maintain your dive gear.

I'm sure you can still remember the excitement of purchasing your first set of dive gear. However, we soon fall into the habit of thinking about the gear like we do about our clothing. It is simply there to be used, and if a button pops, you have it fixed. Unfortunately, diving equipment is actually life-support equipment in a certain sense. Gear failure is not a trivial matter; regulator free-flow, power-inflators sticking, SPG hoses rupturing, and O-rings bursting are but a few of the maintenance issues that keep showing up in diving accidents. The best way to take care of your gear is to clean it after diving, always make sure that it fits and has no wear and tear or damage, and service it on a regular basis. Taking care of your gear will lessen the chances of malfunction while you are submerged.

6 Plan your dive and dive your plan.

Before travelling to a new dive site, know what to expect and plan for the dive conditions. A little research goes a long way. Get advice from experienced divers, it all adds to the experience and makes the diving safer and more enjoyable. A simple tip may change the whole trip! Make sure that you have the skills and gear to enjoy the dive safely. Also, don't forget your buddy! Plan your dive and dive your plan together, and stay within your dive limits. It's safer and great fun!

7 Remember your ABCs.

A) Air – it's important to continuously check your air supply while diving. The gulp on an empty tank is no way to end a dive! B) Buddy up on every dive and never dive alone. C) Clear your ears and sinuses to avoid barotrauma. S) Slow ascents – there is no rush to ascend the last 5 m of your dive. Take your time, do your stops, and just relax before ending your dive. You will find that it is safer, more enjoyable and more memorable if you do.

8 Visitors from another world.

The thrill of scuba diving is amongst the greatest experiences you will ever have. The excitement of discovering the underwater environment is truly amazing. To ensure that our future generations also have the opportunity to share these experiences, we need to respect the underwater plant and animal life. Therefore, it is essential for all divers to perfect their buoyancy to avoid damaging our reefs and underwater environments.

9 Awareness.

Stay in the moment. Divers can easily become distracted and think about other things other than the experience of their dive. Alternatively, others become so absorbed by the objects they are studying, or the photographs they are taking that they forget everything else. Remain alert and mindful when you dive. It's still a foreign environment for humans. In fact, the best divers are those who are aware of their surroundings, feel comfortable, and know where they are in the dive at all times. Make sure you know where the dive leader, dive group and dive boat is at all times.

10 Diving is fun.

We dive because it is fun and, for most of us, we wish we could dive more often. If, at any time, you are uncomfortable or unsure whether or not to join a dive group, rather call (i.e., cancel your participation in) the dive. You can always join another dive group or dive another reef on another day. When in doubt, don't! Using your best judgment and instinct will keep the sport both safe and fun. AD

> *"Know what to expect and plan for the dive conditions."*

Image by Michael Hindley.

IN-WATER RECOMPRESSION THERAPY

– the good, the bad or the ugly?

Image by Sean Sequeira.

By Dr Jack Meintjes and Dr Frans J Cronjé

DAN receives regular enquiries about the practice of in-water recompression (IWR) – especially by technical divers. Generalised responses would be inappropriate as we are aware of some individuals whose lives were saved (and catastrophic complications avoided) by the use of in-water oxygen recompression (IWOR). On the other hand, we also know of many who have deteriorated or have suffered critical delays in receiving appropriate care as a result of attempts to provide IWR – there have even been fatalities. So where does DAN stand on the topic?

By way of background, prompt recompression is the treatment of choice for decompression illness (DCI). However, it is impractical to have a recompression chamber at every dive site. Also, for the most part, DCI is quite rare. The primary challenges are therefore, what to do: (1) when the type of diving carries a high risk of DCI, such as deep technical diving; (2) when the dive site is so remote that evacuation to a chamber would be impractical or result in unacceptable delays; or (3) in situations where catastrophic decompressions have occurred, and death or serious disability is unavoidable unless immediate recompression is undertaken. These situations cannot be ignored. This is why it has become important to present the facts, discuss the realities, perform the necessary research on its practice, and develop the necessary industry standards for the practice of IWR.

> *"IWR is the emergency treatment for DCI where the pressure of the water is used in the treatment of the diver."*

Definition: In-water recompression (IWR) is the emergency treatment for DCI where the pressure of the water is used in the treatment of the diver. The diver is returned to depth to reverse accidental critical supersaturation (e.g., missed or explosive decompression) or to allow offending gas bubbles to shrink and, ultimately, to resolve.

WHY THE BIG FUSS?

IWR is potentially hazardous for a number of reasons. An unstable diver losing the ability to maintain their airway or a diver suffering cessation of spontaneous breathing both represent a catastrophe underwater with slim chances for survival. The inability to perform effective resuscitation, and impaired communications add to the complexity. Even if a voice communication system is used, the diver may not be aware of the symptoms:

- The weightless environment doesn't lend itself to a proper evaluation of motor functions.
- The effect of cold and the water itself will affect the diver's ability to detect areas of numbness (affected even more so by cold water).

It may thus be difficult (if not impossible) for the diver and the rest of the team to discern whether the DCS symptoms have improved, remain constant or are getting worse.

Hypothermia is another concern. IWR requires extended periods underwater. Even in tropical areas, hypothermia remains a risk.

Given that there are examples of both successful and fatal IWR, this is a subject in need of close scrutiny and careful application.

ADVANTAGES

The only real advantage of employing IWR is the improved outcome seen when DCI is treated earlier. Generally, the sooner the bubble-induced hypoxia, loss of circulation or direct pressure damage on tissue can be relieved, the better. While breathing oxygen, the inert gasses are eliminated more effectively, and the blood and tissues become oxygenated, thus addressing the direct cause and effects of DCI.

THE TREATMENT MIXTURE

The use of in-water recompression on air is hard to defend, with the exception of explosive, life-threatening decompression from depth where immediate return to pressure is the only hope for survival. For all other situations, in-water recompression on oxygen (IWOR) is the only therapy that has a favourable risk-benefit ratio. This is the only form of in-water recompression DAN is able to consider or endorse under strict conditions (these are elaborated at the end of this article). Adding inert gas may make a bad situation much worse. Furthermore, the elevated inspired partial pressure of the inert gasses will reduce the gradient for out-gassing and slow the rate at which they are eliminated from the body.

Although recommended, the use of 100% oxygen underwater is not without risk. Central nervous system oxygen toxicity can manifest when breathing higher partial pressures of oxygen, and convulsions underwater are worse than the original problem in need of treatment. So, one should adequately address the risk of convulsions underwater. Associated problems include loss of buoyancy control and loss of protection of the airway with subsequent drowning. To control the buoyancy, the diver should preferably be suspended securely in mid-water. The easiest way is to have the diver negatively buoyant and clipped to a shot-line, which is attached to a dive boat or large buoy on the surface as needed, and appropriate as is for the prevailing conditions. Various loops in the line will allow for a controlled ascent while still being secured.

EQUIPMENT CONSIDERATIONS

The airway may be protected to some extent by having a diver wear a full-face mask. The latter can also accommodate communication technology. However, these can only be used if the diver has been properly trained. Flooding or vomiting into a full-face mask presents a major hazard and the mask has to be removed to allow breathing from an alternative gas source if supplies run out.

Another possibility is to use a proper diving stage in a sheltered area (e.g., a bay). This allows better control of the diver's depth by the surface crew, and therefore means less responsibilities on the diver and attendant.

The best solution in ensuring depth control is to have a designated treatment area, where the bottom is also at the appropriate treatment depth (tides and swells permitting), thus allowing the diver to remain on the bottom and not risk unplanned descents. The challenge remains to carefully return to the surface, usually at 12 minutes per metre. Accordingly, some method for gradual retrieval has to be incorporated in the design of the treatment modality.

Communications should always be maintained; at a minimum through dive slates. This will allow for communication between the diver and the attendant, as well as communication with the surface support. It is essential to establish communication with medical experts early.

Perhaps the most important equipment consideration is the availability of appropriate quantities of oxygen with adequate reserves. The oxygen should be sufficient to support the diver (at depth) for the full duration of the treatment.

Once all these considerations are appreciated, it becomes obvious that IWOR is not a spur-of-the-moment affair, but rather a formal diving operation that should be planned with far greater care than a regular dive.

RECOMPRESSION TREATMENT OF DECOMPRESSION SICKNESS

There is virtually worldwide agreement that the standard recompression treatment for DCI is the U.S. Navy Treatment Table 6 (long oxygen table). This requires breathing 100% oxygen starting at 18 m (2.8 ATA) for a duration of five to eight hours. This is impractical and potentially dangerous to perform in the water due to the high risk of oxygen toxicity and hypothermia – even in tropical waters. As such, IWOR, by definition, is an incomplete treatment for DCI. All that may be achieved is a reduction in disability due to DCI. The necessity for definitive recompression treatment remains, and it must be part of the treatment plan. It is therefore, essential to consult medical experts as soon as possible for additional recompression therapy once the IWOR has been completed.

IWR TABLES

There are three published IWOR tables, namely the Australian, U.S. Navy and Hawaiian tables. These have minor variations, but the treatment is started at a depth of 9 m. The Hawaiian tables do allow for an air IWR-excursion of up to 50 m beforehand, but this should only be considered as a desperate, life-saving measure following catastrophic decompression. All three IWOR methods require large quantities of oxygen to

> *"Although recommended, the use of 100% oxygen underwater is not without risk."*

> *The benefits of surface oxygen therapy are well established.*

be available, with the diver breathing from a full-face mask or 100% oxygen closed-circuit rebreather, with regular purging of the system as inert gas is eliminated from the diver's body into the breathing circuit. The oxygen is supplied from the surface, and a diving buddy (tender diver) is available to monitor the condition of the diver throughout. A shot-line (heavily weighted dropline) is used as a reference for depth, with loops in the line where the diver can be secured for safety reasons. All these published procedures require a form of communication (i.e., through-water voice communications, electronic communications via the umbilical line or a simple pencil and slate). Surface support crew is required for the topside operation. Again, IWOR is not a dive that you can make up on the fly. Unless these specific protocols are followed, you are likely to cause greater harm than relief. Surface oxygen therapy may still be the best bet.

IS IWOR EFFECTIVE?

Given how little scientific data there is to compare conventional recompression therapy regimens, it should come as no surprise that there is even less to support IWOR. To date, the only publications on IWOR contain anecdotal reports and case-series. This is the lowest level of evidence in scientific research. Nearly all experienced technical divers admit to having used IWOR at some stage when questioned privately, and their comments are invariably favourable. However, this does not constitute proof of effectiveness and is insufficient evidence to promulgate generalised recommendations.

The matter of effectiveness is also complicated by the fact that DCI is a very dynamic disease. Many divers experience some improvement of their symptoms without any treatment, so it becomes impossible to tease out how much benefit was derived from IWOR. In all fairness, surface oxygen therapy may have been equally effective and a lot safer.

SURFACE OXYGEN THERAPY

Surface oxygen therapy remains the first aid treatment of choice for DCI following a dive to a maximum depth of less than 30-40 m. The benefits of surface oxygen therapy are well established. Less oxygen is required and many courses are available to train divers to use it effectively and safely. All diving operators should have adequate supplies of oxygen available for this purpose.

WHEN SHOULD ONE CONSIDER IWOR THERAPY?

The main consideration is the risk of delay to definitive treatment. As such, remoteness of the diving operation and thus, the distance and time from the nearest recompression facility, is usually the key issue. Generally, a delay greater than 16 hours becomes the tipping point in favour of IWOR if all the requirements to provide it safely are met. Importantly though,

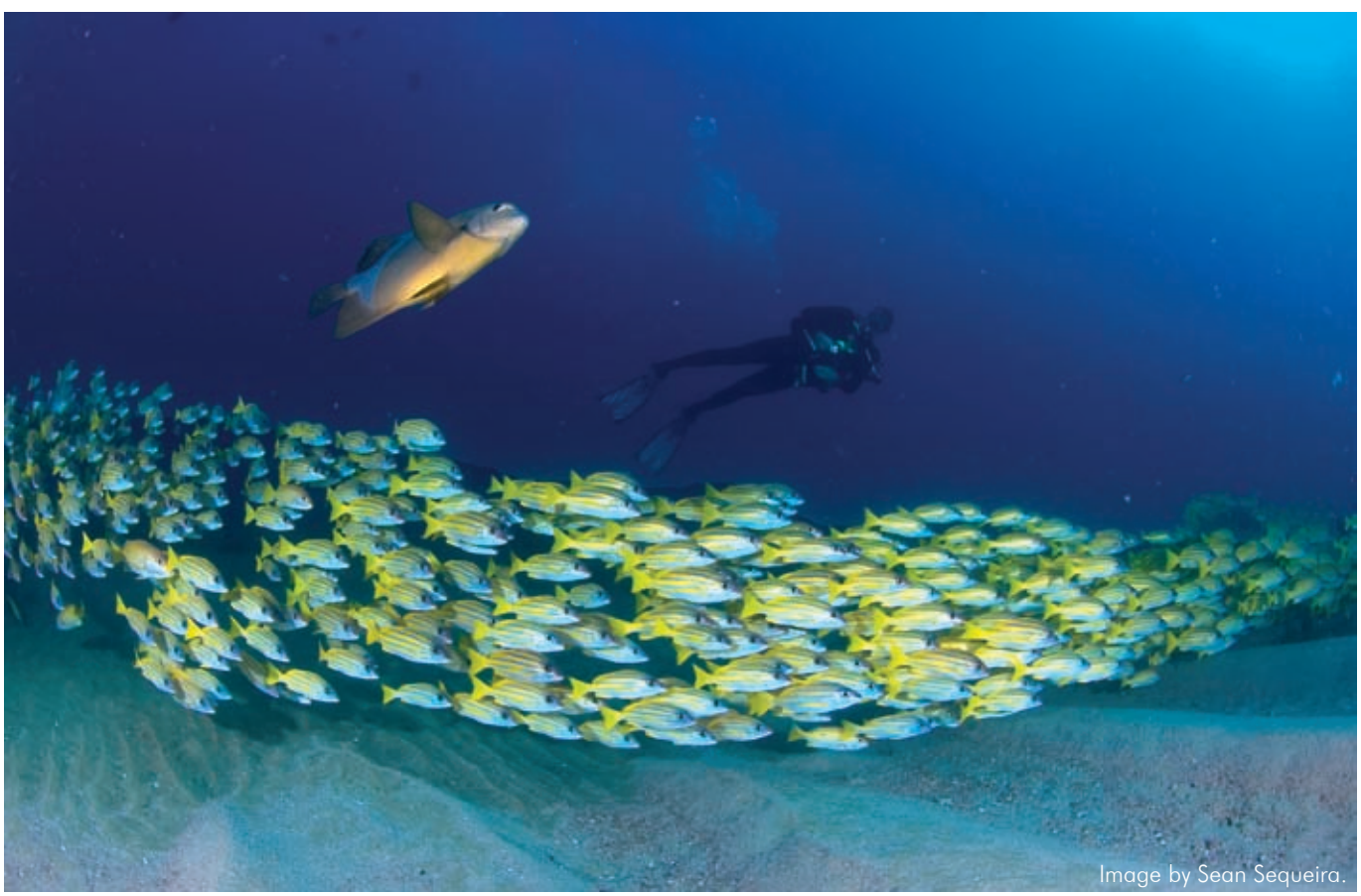


Image by Sean Sequeira.


Image by Sean Sequeira.

IWOR should never cause delays in medical assessment or evacuation to an appropriate medical or recompression facility. IWOR should never be attempted without having the proper equipment and personnel (people who know how to deal with the therapy and its potential complications) available.

Another major consideration is the condition of the diver when starting treatment and their willingness to go back in the water. Serious cases of DCS may deteriorate further underwater and require special consideration.

Divers who have symptoms shortly after surfacing from a deep dive may deteriorate rapidly. They are most likely to benefit from IWOR. Unfortunately, they are also the ones most likely to develop complications during IWOR.

Many deep technical dives are performed in relatively cold water, so care should be taken to ensure the diver is properly insulated.

OFFICIAL DAN-SA POSITION

DAN-SA can only support the practice of IWOR if proper equipment, procedures and personnel are in place. These include the following:

- If risk-benefit assessment favours using IWOR rather than evacuation.
- If dedicated equipment is available, serviceable and has been used safely and effectively in previous drills or treatments.
- If trained staff are available who can deal with the treatment and potential complications.
- If adequate oxygen is immediately available.
- If a safe environment is available.
- If adequate communication is available.
- If adequate thermal protection of the diver is in place.
- If airway protection is guaranteed.
- If an appropriate tender is available.

DAN aims to evaluate IWOR practices as part of our Diving Safety Partners Programme through the Hazard Identification and Risk Assessment (HIRA) process. Expert advice is available to those who wish to plan for IWOR.

As such, DAN-SA does not recommend IWOR unless this has been practised successfully in advance and all the conditions for providing it safely are met.

SUMMARY

The decision of performing IWOR should not be taken lightly. It should be planned and practised beforehand, ensuring that all the necessary equipment and support personnel are available. Proper procedures should be standardised and a recognised treatment table should be used. Regardless of the outcome, proper medical evaluation by medical personnel is always required and many cases may need additional recompression treatment in a chamber after the IWOR is completed.

IWOR is more of an art than a science and this requires skill and wisdom on when to apply it. AD

> *"IWOR should never cause delays in medical assesment or evacuation."*

BE PREPARED

Looking Beyond General First Aid Courses to Dive-Specific Programmes

By Eric Douglas and Dr Frans J Cronjé

Too often, divers and dive operations realise the need for training and education when something bad happens. Serious dive accidents are rare, but when they happen, they leave a lasting impression on everyone involved. From time to time, DAN Training receives a call from a dive operation that has recently experienced a dive accident. They are looking for training and equipment to better prepare them for any future mishaps.

While most dive operations are prepared with oxygen, there are still some out there that don't know how to use it properly, or haven't checked their equipment. Translation: it isn't ready to use.

Many of today's introductory, or basic, CPR and first aid courses describe the general skills necessary to care for a person involved in a medical emergency, but they typically fall short of a diver's needs because they aren't dive specific.

While a course might discuss providing oxygen first aid for a medical emergency, it is not the same as oxygen in a dive emergency. General oxygen programmes do not discuss sign and symptom recognition for decompression illness, nor do they discuss providing oxygen using a demand valve.

We know from DAN accident and fatality data that one of the biggest problems, or greatest benefits, for divers is early symptom recognition. Divers need to recognise the possibility of a dive emergency early, begin using oxygen and move an injured diver toward definitive care, probably at a hyperbaric treatment facility.

Unfortunately, symptom recognition remains a problem for divers. Typically, symptoms of DCI are present within an hour of the last dive, and most of them are present within six hours (according to DAN 2009 *Report on Decompression Illness, Diving Fatalities and Project Dive Exploration*). Even in cases in which divers report symptoms before the last dive (about 14%), divers return to the water anyway.

In addition, oxygen should be delivered in the highest concentration possible, with the least amount of waste. While non-rebreather masks are excellent delivery devices, especially in a situation where a diver cannot tolerate a demand valve, they are not the best choice for administering oxygen in a dive emergency.

The better oxygen delivery device for a conscious, breathing, injured diver is the DAN demand valve. It delivers greater concentrations of oxygen, helping to wash nitrogen out of the body quicker. It also doesn't waste oxygen, as does a constant-flow delivery device. It provides oxygen only when a diver inhales. This is especially important when a diver faces a long boat ride back to the dock before professional care can be given. And keep in mind that common oxygen components in general CPR courses do not typically address providing oxygen during rescue breathing.

While a scenario involving a non-breathing injured diver is rare, it does happen.

> "Unfortunately, symptom recognition remains a problem for divers."

RELYING ON EMERGENCY MEDICAL SERVICES (EMS) HELP WITHIN TEN MINUTES

A typical CPR and first aid programme is built around the understanding that EMS help will be available within a ten-minute window. Rescuers do not learn to provide care for extended periods; they simply learn to initiate care and then turn it over when professional help arrives. While this works fine in a land-based urban setting, it doesn't always apply to diving scenarios where divers are at a lake, river, quarry, beach or on a boat. Rescue times are often significantly longer than ten minutes at most of those locations. In the southern African region, this may be very long indeed, particularly in remote locations.

DAN TRAINING PROGRAMMES HELP FILL THE NEED

DAN developed several training programmes specifically to care for injured divers. Essentially, these programmes can be broken down into two categories: first aid and basic life support.

First aid programmes are exactly what the name suggests – programmes to give immediate aid to a person who has been injured. It may or may not be an emergency.

Basic life support is the skill set necessary to provide the care to support life, such as CPR, rescue breathing and AED use in the BLS-PRO Programme.

Oxygen First Aid for Scuba Diving Injuries and First Aid for Hazardous Marine Life Injuries qualify as first aid. Both programmes have elements of basic life support techniques included as well, in case the situation becomes more serious.

In the Oxygen First Aid Programme, students learn to recognise the signs and symptoms of a dive emergency. They also learn to provide care for an injured diver. Specifically, they learn

ABOUT THE AUTHORS

Eric Douglas is the director of training for Divers Alert Network (DAN). He has 15-plus years of diving experience and has been with DAN for five years. Eric feels he has one of the best jobs in diving because he helps to develop programmes that can be used by all divers to make diving safer for all of us.

Dr Frans J Cronjé is president and CEO of DAN Southern Africa.

how to deliver 100% oxygen using three different delivery devices, depending on the situation. Oxygen helps relieve the symptoms and improves symptom resolution after treatment in a hyperbaric chamber.

The Hazardous Marine Life Injuries Programme teaches how to deal with dive injuries, such as jellyfish stings, puncture wounds, scrapes, cuts and bites. It also addresses what to do in case an injury caused by a marine animal becomes more serious, either from bleeding or from a reaction to the venom injected into the wound.

Automated External Defibrillators (AEDs) for Scuba Diving is a DAN programme that is entirely basic life support in nature. It teaches divers how to respond to an emergency using an AED when someone's heart has stopped beating. While most CPR courses today include an AED element, DAN created its AED course in 2001 because most general AED segments do not address the specific situations divers face.

The DAN AED Programme also points out the need for this training and the need for the presence of AED units. Divers are rarely within ten minutes of professional emergency help. Every minute a person is in cardiac arrest, their chance of survival, even with CPR, decreases by seven to 10%.

Those three programmes make up the DAN Diving Emergency Management Provider (DEMP) Course. There is also an Advanced Oxygen First Aid for Scuba Diving Injuries component. This programme addresses more life support techniques for providing oxygen first aid. Divers have the option of taking these programmes individually, as standalone courses, or jointly as a single DEMP programme.

Most recently, DAN released the On-Site Neurological Assessment for Divers Programme. This is important training for divers as it helps physicians determine the extent of the dive injury, and guides them as they develop a treatment plan for the injured diver. Plus, capturing this information early (at the dive site before the injured diver gets to definitive care) helps the doctors understand how the injury has progressed.

BE READY FOR THE UNEXPECTED

Ultimately, the most important aspect of these programmes is being prepared. Waiting until a problem occurs and not knowing how to deal with it just doesn't make sense.

Dive injuries and fatalities are rare, but they do happen. Don't get caught unprepared. Be armed with the right training. AD

> *"Don't get caught unprepared. Be armed with the right training."*

Medical queries and answers...

Note: Many of the original questions and answers have been altered slightly to ensure confidentiality.

This issue: Emergency oxygen, hot tubs and cold divers, ear problems and more.

Q While diving about two months ago, I scraped my forearm against coral. Other than the initial cut and bleeding, I haven't experienced any significant pain. It wasn't fire coral, so I've had no burning or itching, and the swelling lasted only about ten days. It still gets red once in a while, and I have some discolouration of my skin in that area. Is there anything I can do to speed the healing or to help return my skin to its normal colour?

A Whenever you brush against coral, its outermost layer of fine, sand-like grains will invade skin tissue where the surface has been broken. Unless you vigorously cleanse the area with soap and water to remove these tiny particles, they become embedded beneath the top layer of your skin. Because the sand-like granules are foreign bodies, it is possible that your body may work them out of your skin as small surface eruptions, possibly causing infection, redness and a rash. Your body's defenses will encapsulate the material, and eventually the discolouration should fade. So in answer to your question, there's probably nothing you can do to expedite healing; it is simply a matter of time.

Joel Dovenbarger, BSN

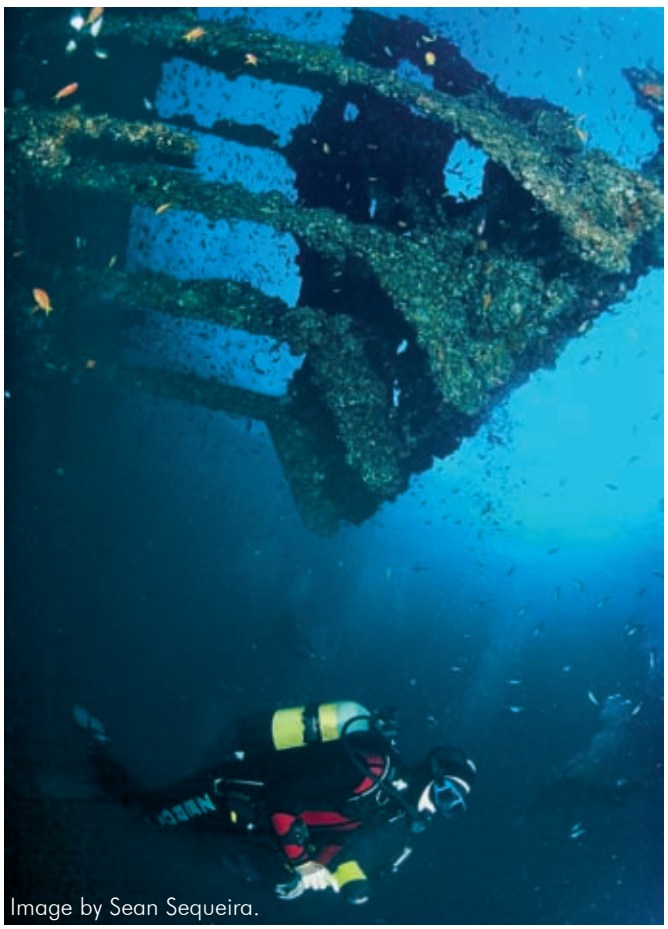


Image by Sean Sequeira.

Q What possible impact does soaking in a jacuzzi (hot water with massaging jets) have on off-gassing and DCS? I see a lot of people going straight from the dive to the hot tub. Is this safe?

A Getting into a hot tub immediately after diving does alter decompression stress. As with many factors, the net response can be positive or negative, depending on the magnitude of the inert gas load and the heat stress. The hot tub or hot shower will warm the extremities and enhance peripheral circulation which might facilitate inert gas washout (or inert gas elimination).

Large inert gas loads, however, can be problematic. Since the solubility of gas is inversely related to temperature, tissues will hold less in solution as they warm. Warming tissue with significant gas loads can promote bubble formation. Since the warming of the superficial tissues precedes the increase in blood flow, such bubbles can pose problems before the increased circulation can remove them.

There is no simple formula to compute what constitutes a minor, significant or substantial peripheral inert gas load. The actual conditions vary as a function of the individual, thermal protection, physical activity and dive profile.

My approach is to stack as many factors as possible in my favour to compensate for the Murphy effect we frequently see in decompression sickness. I encourage a simple rule of thumb – delayed gratification. Enjoy the thought of the hot tub or shower for a while instead of jumping in immediately. An interval of 15 to 30 minutes should help you avoid some of the risk, as will keeping more conservative dive profiles. Another compromise would be to employ a lower temperature in the hot tub or shower.

Neal Pollock, Ph.D.
DAN medical information specialist

Q I am curious if DAN has a position on how to handle a diver who has surfaced with a decompression obligation but is asymptomatic for DCS? There seems to be no consistent recommendation on the correct procedure.

A This issue has long prompted very spirited discussion among experts, but very little consensus. The data available clearly supports the use of surface oxygen for symptomatic individuals, but there is little or no data relevant to asymptomatic divers and, in our experience at DAN, there is no one-size-fits-all solution for the innumerable scenarios and events that can occur. Obviously, in-water recompression is not recommended as a viable plan outside of the military/commercial operations theatre.

DAN encourages each dive operator, scientific group or organisation to work with local medical authorities to develop their own specific policies. There are problems and advantages to either approach. Based on our experience at DAN, neither the wait-and-see approach nor the prophylactic oxygen approach has been verified to alter any outcome. DAN is available for consultation through the medical information line to any group or organisation that wants to develop a policy. In an emergency, we can also provide you with contact information for local dive medicine experts. Our medical staff is always on call for emergencies to answer case-specific questions via the DAN emergency hotline: 0800 020 111 in SA or +27 828 10 60 10 internationally.

Marty McCafferty, EMT-P, DMT-A
DAN medical information specialist

Q Is it safe to breastfeed an infant after diving?

A Yes, it is safe. A mother's breast milk is not adversely affected by diving, and there is no risk of decompression sickness for the infant. Although nitrogen accumulates in all of the tissues and fluids of the mother's body, washout of inert gas occurs quickly after a safe dive. Insignificant amounts of nitrogen may be present in the mother's breast milk, but it is inert and poses no risk to the infant. However, because of the possible risk of bacterial growth on the skin under a suit, careful cleansing of the breast after diving and before feeding may help prevent systemic illness.

Maida Taylor, MD MPH FACOG

Q On a recent dive trip, my husband had problems clearing his ears, and by the second day he complained of muffled hearing, a constant buzzing sound and trouble with his balance. We stopped diving, waited an appropriate surface interval and flew home to see an ear, nose and throat specialist. The doctor found excess mucus behind my husband's eardrum; it had hardened and turned black. He made an incision, removed the mucus and expressed amazement that my husband had experienced no problem flying. Can you tell me what happened and if my husband can dive again?

A These symptoms are consistent with middle-ear barotrauma, which is associated with the inability to equalise the middle-ear air space when diving. This is usually due to variable degrees of eustachian tube dysfunction and most commonly caused by a problem like a recent cold, allergies or any type of irritation, which inflames the mucous membranes and causes swelling and mucus discharge.

The pain, muffled hearing, buzzing sounds and difficulty with balance can all be caused by pressure and, in this case, appear to be from a fluid build-up in the middle-ear air space. The constant pressure exerted by the fluid on the inner ear is what produced your husband's symptoms. It also seems that the barotrauma was sufficient enough to cause bleeding into the middle ear; this is why the mucus turned black. Bleeding indicates a fairly serious injury, so your husband was fortunate that he didn't rupture his eardrum or one of the internal membranes of the ear, which could result in decreased or a permanent loss of hearing.

The small incision in the eardrum, or myringotomy, was necessary to drain the ear of excess mucus and provide an opening to ambient air, which can help dry out the middle ear. If the ear was full of blood and other tissue fluids during the flight, an increase in symptoms would not have necessarily occurred, since the lower pressure in the aircraft cabin would have been transmitted through the fluid-filled middle-ear chamber.

Only time will tell if your husband can return to diving. Depending on the severity of the injury, your husband should wait at least six months and then return to his physician for a complete examination, including a hearing test (return sooner if there are infections, or hearing or balance problems). If the specialist determines there is no permanent damage to your husband's eustachian tubes or structures of the middle ear, chances are he can dive again.

If your husband is cleared to resume diving by his physician, it's important to take steps to prevent this injury from happening again. The safest approach to preventing middle-ear or sinus barotrauma is to avoid any discomfort in these air spaces. Equalise before you feel pressure. If you feel pain, damage has already occurred. Be sure to make slow, steady descents, and equalise early and often as you go. If you cannot clear your ears, it's best to sit out the dive and not risk another injury.

Joel Dovenbarger, BSN

First Aid Refresher

Emergency Oxygen

Every diver should know how to administer emergency oxygen – do you?

Emergency oxygen is the first line treatment for both decompression sickness (DCS) and arterial gas embolism (AGE). It's so important that dive operators and professionals consider a working oxygen unit as standard safety gear. It is also important that every diver should know how to administer emergency oxygen. Assuming you've assessed the scene and completed the initial assessment of basic life support, follow these simple steps:

> *"It is important that every diver should know how to administer emergency oxygen."*

STEPS FOR OXYGEN DELIVERY

- Turn the oxygen on slowly with one full turn.
- Check the pressure gauge on the tank to make sure the cylinder is full.
- Inform the injured diver that oxygen may help.

State: "This is oxygen, and it may make you feel better. May I help you?". If the injured diver is unresponsive, permission to help is assumed.

- Continuously monitor the injured diver.
- If conscious, place the diver in a position of comfort.
- Provide non-caffeinated, non-carbonated and non-alcoholic fluids.
- Keep the injured diver out of the sun.
- If unconscious, put in recovery position or on back to provide care.

DEMAND INHALATOR VALVE

- Constant-flow setting should be in the "off" position.
- Take a breath from the demand valve and exhale away from the mask.
- Place the mask over the injured diver's mouth and nose.
- Instruct the injured diver to breathe normally from the mask.
- Instruct the injured diver to hold the mask to help maintain a tight seal.
- Monitor the injured diver and the oxygen pressure gauge.

NON-REBREATHER MASK

- Stretch oxygen tubing to avoid kinks.
- Attach oxygen tubing to barbed constant-flow outlet.
- Set constant-flow control to 15 litres per minute (ℓpm).
- Prime mask reservoir bag.
- Place the mask over the injured diver's mouth and nose.
- Adjust the mask to ensure the seal and prevent oxygen leakage.
- Instruct the injured diver to breathe normally.
- If reservoir bag deflates, increase flow rate to 25 ℓpm.

ORONASAL RESUSCITATION MASK (NON-BREATHING DIVER)

- Prepare the oronasal resuscitation mask.
- Remove oxygen tubing from the non-rebreather mask.
- Attach oxygen tubing to the barbed constant-flow outlet on the multifunction regulator and the oxygen inlet on the oronasal resuscitation mask.
- Set constant-flow control to 15 ℓpm.
- Use mask to deliver supplemental oxygen during CPR.

Remember, a refresher does not take the place of actual training. If you are not trained in administering oxygen, consider taking the DAN Oxygen First Aid for Scuba Diving Injuries Course. AD

DAN Training & Education COURSES OFFERED

Entry-level courses

OXYGEN FIRST AID FOR SCUBA DIVING INJURIES

As a recreational diver, you can receive training to provide vital first aid that can make a difference to a scuba diver with decompression illness. The DAN Oxygen Provider Course provides entry-level training in the recognition and management of possible diving-related injuries using emergency oxygen first aid.

OXYGEN FIRST AID FOR AQUATIC EMERGENCIES

This course trains non-divers and professional rescuers (such as lifeguards) to recognise near-drowning/submersion incidents and other aquatic medical emergencies and to provide basic life support, including the use of oxygen first aid.

FIRST AID FOR HAZARDOUS MARINE LIFE INJURIES

Serious hazardous marine life injuries are rare. Most divers experience minor discomfort from unintentional encounters with fire coral, jellyfish and other marine creatures. This course teaches divers to minimise these injuries and reduce diver discomfort and pain.

AUTOMATED EXTERNAL DEFIBRILLATORS FOR SCUBA DIVING

More than 10% of all dive fatalities are actually caused by cardiovascular disease, according to DAN dive accident and fatality statistics. This course teaches divers and other interested parties to provide care for sudden cardiac arrest including the use of an automated external defibrillator (AED).

AUTOMATED EXTERNAL DEFIBRILLATORS FOR AQUATIC EMERGENCIES

When a person drowns, they may or may not inhale water. They normally enter cardiac arrest because of the inability to breathe. This course teaches interested parties to provide care for cardiac arrest by using an automated external defibrillator (AED).

DIVE ACCIDENT FIRST AID FOR NON-DIVERS

NEW

This programme is designed for non-divers and teaches them how to recognise the warning signs of decompression illness and help provide care for a diver involved in a dive emergency.

Intermediate courses

BASIC LIFE SUPPORT FOR DIVE PROFESSIONALS

The remote nature of dive accidents, whether a few hours from shore or days from civilisation, frequently requires more advanced levels of care than are offered by traditional or entry-level CPR programmes.

ON-SITE NEUROLOGICAL ASSESSMENT FOR DIVERS (Pre-requisite: Oxygen First Aid for Scuba Diving Injuries)

Learn how to conduct a neurological assessment on a potentially injured diver in this course. The information gained in this assessment can help convince a diver of the need for oxygen first aid, and help a dive physician determine the proper treatment.

ADVANCED OXYGEN FIRST AID FOR SCUBA DIVING INJURIES (Pre-requisite: Oxygen First Aid for Scuba Diving Injuries)

This advanced-level programme is designed to train existing DAN oxygen providers to use the MTV-100 or a bag valve mask while providing care for a non-breathing injured diver.

Advanced courses

DIVE MEDICINE FOR DIVERS (Pre-requisite: DEMP and NEURO)

NEW

When you want to know more than just basic first aid techniques, Dive Medicine for Divers is your next step. Ultimately, more knowledge and a better understanding of how our bodies react to the pressures and stresses of diving lead to safer dives as we understand our limitations and the limitations of the situation.

Combination courses

DIVING EMERGENCY MANAGEMENT PROVIDER PROGRAMME

Learn the knowledge and skills from several courses in one single approach to dive emergency management.

Leadership programmes

INSTRUCTOR QUALIFICATION COURSE

To become a DAN instructor, you must complete the DAN Instructor Qualification Course (IQC). Instructor candidates will complete a core module that offers more information about DAN and explains how to teach DAN programmes. Candidates will then complete the course module for each DAN training programme they are interested in teaching.

INSTRUCTOR TRAINER WORKSHOP

This programme teaches scuba diving instructor trainers to teach the DAN Instructor Qualification Course and train DAN instructors. Only DAN staff members and examiners can offer this programme. AD

Contact a DAN instructor in your region to take any of these courses. A full list of instructors is available from DAN-SA on 0860 242 242 or www.dansa.org under training.

ST. AUGUSTINE'S HYPERBARIC MEDICINE CENTRE

St Augustine's Hyperbaric Medicine Centre (SAHMC)

The St Augustine's Hyperbaric Medicine Centre (SAHMC) was officially opened in late 2000, becoming Durban's first hospital-based hyperbaric oxygen therapy centre, and South Africa's second such centre with a multi-place chamber. Since then, this unit has actively managed injured divers from all over southern Africa and the Indian Ocean region. To date, a total of more than 820 treatment hours have been racked up in the chamber, a significant portion of this being in the treatment of divers.

Strategically placed in St Augustine's Hospital below the level-1 trauma unit and in close proximity to the operating theaters and ICU, this centre is ideally situated to attend to any of the clinical indications for recompression and hyperbaric oxygen therapy. These clinical problems can either be due to acute conditions (e.g., burns, crush injuries and DCI) or chronic conditions (e.g., non-healing wounds, bone infections and radiation damage).

The centre houses a ten-man, multi-place chamber, certified to a pressure of 7 ATA (equivalent to a depth of 60 m of sea water). The chamber has a custom-built "walk in" door, allowing for the easy access of wheelchair and trolley patients. Also, the chamber is equipped for the management of ventilated patients requiring intensive care level monitoring.

The chamber and the control systems were manufactured entirely in South Africa according to the international standards of the ASME II and PVHO guidelines. In 2006, the chamber was accredited by the Southern African Underwater and Hyperbaric Medical Association (SAUHMA) as meeting the required international standards of safety and proficiency for managing patients.

Patients are treated under the supervision of hyperbaric physicians, Dr Michael Marshall and Dr Craig Springate. Qualified technical and paramedic staff operate the chamber and tend to the patients during treatments. In addition, the centre houses an advanced wound care facility that provides care for patients with various types of problem wounds. The centre is on 24-hour standby throughout the year for diving or medical emergencies that require hyperbaric oxygen therapy.

NOTE: DAN recommends that divers always contact the DAN hotline before taking an injured person to a recompression facility in order to: (1) assess the nature of the problem and to determine the most appropriate method of transport for the individual; (2) assess the need for emergency medical management, diagnostic assessment and stabilisation prior to possible recompression; and (3) assess the availability of the chamber at the time (i.e., other treatments may be in progress). As a general principle, DAN recommends that injured divers be taken to the nearest emergency medical facility. If recompression is required, this can be arranged subsequently. AD

Assessing Basic Vital Signs

Assessing vital signs (vitals) is a key component of good first aid. It consists of taking a series of simple measurements that provide data about a body's functioning. These measurements can help reveal how sick or hurt a patient is and, when taken over time, whether he or she is getting better or worse. While the full meaning of these measurements might elude the lay provider, a carefully documented series of vitals can be very helpful to the healthcare professionals who will eventually take over the care of an injured person.

Vital signs can be helpful even to first aid providers with limited medical training. Sets of vitals that are outside normal ranges typically indicate the need for some treatment or possible evacuation to a higher level of care. As an example, anxiety, elevated heart rate, elevated respiratory rate and pale, cool, clammy skin may indicate shock, a potentially life-threatening medical condition. Shock is relatively easy to address, but it can go unnoticed if vitals aren't monitored. Vital signs that move increasingly further from their normal range over time may indicate an even more urgent need for evacuation.

> *"An injured person's mental status or level of responsiveness is probably the most important vital sign."*

TIME

Thorough documentation of vital signs allows caregivers to observe trends, and is helpful when making treatment decisions.

To organise and keep track of your measurements, it is very important to document the time of day, along with each set of vital signs. This allows you (or a subsequent caregiver) to make comparisons between sets of vitals and observe trends in the patient's condition. The frequency with which vitals are taken depends on the patient's condition. Seriously injured or ill patients should have their vital signs reassessed every few minutes, while hourly checks are reasonable for those who are stable.

LEVEL OF RESPONSIVENESS

An injured person's mental status or level of responsiveness is probably the most important vital sign. Since the brain has top priority in the body's distribution of resources, a decline in its status is especially important to recognise. To assess a patient's level of responsiveness, begin talking to the person. If the person is able to respond to you, ask him the following questions:

- What is your name?
- Where are we?
- What time is it (approximately)?
- What happened?

Answers to these four questions allow you to gauge a patient's orientation to person, place, time and event. If the patient can answer all four appropriately, he would be considered "alert and oriented to person, place, time and event" or, more commonly, A+Ox4 (read "A and O by four"). In addition to quantifying the patient's level of responsiveness, it's also helpful to write down a qualifying term. Helpful qualifiers include "irritable", "anxious" or "combative". Words like these help round out your description of the patient's mental status.

In the event that an injured person is awake and can respond to you but does not know the answers to any of these questions, that person can be considered alert but disoriented.

A The patient is awake

V The patient responds to verbal stimulation

P The patient responds to painful stimulation

U The patient is completely unresponsive

AVPU Scale.

A common scale used to describe a person's mental status is the AVPU scale. AVPU is an acronym that stands for alert, verbal, painful and unresponsive. The paragraph above describes patients who have an A rating on this scale, but sometimes ill or injured people are not alert. If the person does not respond when you attempt to engage them in conversation, talk louder. In a loud voice, ask if they are OK.

If the person responds to this elevation in volume, they can be considered responsive to verbal stimulation, or V on the AVPU scale. The

person doesn't have to respond verbally to be considered V; they may simply grimace or open their eyes, but any response to sound means they are V. If the person does not respond to your verbal stimulus, you should assess their responsiveness to pain. It is important not to cause harm, but simply elicit a response. A good way to do this is to pinch the patient's tricep, just above the elbow. If this causes the patient to respond, by moving or groaning for example, the patient is a P on the AVPU scale. Finally, a patient who does not respond to verbal or painful stimulation is considered unresponsive, or U on the AVPU scale.

PULSE

A strong heartbeat is required to ensure an adequate supply of oxygenated blood to the body's tissues. To assess the pulse in an unconscious person (V, P or U on the AVPU scale), use the carotid artery in the neck. Place two of your fingers gently on the patient's trachea and slide them laterally. Do not reach across the trachea (use the near side), and do not try to assess on both sides of the neck at once.

You should feel the pulse in the carotid artery right next to the trachea. In a conscious patient (A on the AVPU scale), it is best to find the radial pulse on the wrist; this is less invasive. To find the radial pulse, place two of your fingers where the base of the patient's thumb meets their wrist. The pulse will most likely be between that spot and the most prominent tendons of the wrist.

If you are having difficulty finding the heart rate, you may be pressing too hard or not pressing hard enough. Once you locate the pulse, count the number of beats in 15 seconds. Multiply this number by four, and you'll have the patient's heart rate in beats per minute.

In addition to the rate, it's important to document the rhythm and quality of the pulse. The rhythm will be either regular or irregular, and the quality will usually be described as strong or weak. Most healthy adults have a resting heart rate of between 60 and 100 beats per minute, regular and strong. People experience a natural elevation in their heart rate when performing exercise or in stressful situations. The heart beats faster to ensure sufficient oxygenation of tissues, allowing the body to respond quickly in emergencies. A person's pulse may be elevated shortly after an emergency, but this should stabilise in people who are not seriously injured.

RESPIRATION

Since the body can survive for only a few minutes without oxygen, it's important to check the function of the respiratory system. If a person knows you are trying to count their respirations, they will probably change their rate of breathing and skew your measurement. To get around this, transition smoothly to counting respirations as soon as you are finished checking the pulse. Once you have counted the heart rate, shift your focus to the breathing. Leave your fingers on their wrist, but watch for his or her chest to rise. If you're unable to detect respirations by watching the chest, it might be helpful to watch the abdomen or the shoulders instead. Folds of the patient's clothing might also aid your observation of respirations.

Since respirations are less frequent than heartbeats, count respirations for 30 seconds, then double the number to achieve an accurate result. As with pulse, measuring the rhythm and quality of respirations is important. Rhythm will be either regular or irregular. Words like "unlaboured", "gasping", "wheezing" or "laboured" are used to describe the quality of respirations. An adult at rest typically breathes between 12 and 18 times per minute, regular and unlaboured.

SKIN

Skin is the body's largest organ, and it can be an excellent window into the body's functioning. If the skin is pale, cool and clammy, this is a sign that the body's resources (i.e., blood) are being diverted to more vital organs. When assessing the skin, you should take note of three different characteristics: colour, temperature and moisture.

Skin colour, of course, varies widely among individuals, but there are non-pigmented areas of the body where all humans are pink. The most accessible of these places is the inside of the bottom lip. Take a look and note whether the colour is indeed pink or some other colour. It might be pale if the person is cold, blue if they are hypoxic, red if they are hot or even yellow if they are suffering from some illness. Temperature and moisture of the skin are best assessed on the abdomen. This is generally more consistent there than using the hands or the face. The abdomen should be warm and dry, so if it's cool, cold, hot or moist, this is especially important to document.

Level of responsiveness, pulse, respirations and skin condition are by no means the only vital signs, but they are important and relatively easy to assess. The only equipment necessary to measure these is a watch, a pen and paper. Other vital signs include blood pressure, lung sounds, pupils and body temperature. Though training, experience or equipment may limit your ability to care for an injured buddy in a remote environment, assessing basic vitals is something just about anybody can do to help.

DAN FIRST AID TRAINING

In addition to instruction on gathering vital signs, these DAN courses also teach students how to provide necessary treatment in a variety of scenarios. AD

ON-SITE NEUROLOGICAL ASSESSMENT FOR DIVERS

This course teaches the basic steps of recording pulse and breathing rates. Abnormal findings may signal that the body is in distress and may benefit from immediate oxygen treatment.

DIVE MEDICINE FOR DIVERS: PART 1

This course teaches divers how to evaluate breath sounds using a stethoscope. Unequal breath sounds in a diver with breathing difficulty may signal lung barotrauma or a collapsed lung.

DIVE MEDICINE FOR DIVERS: PART 2

This course teaches the skill of measuring blood pressure. As with abnormal breathing or pulse rates, abnormally high or low blood pressure may signal the onset of shock or some other condition that requires medical attention.

BASIC LIFE SUPPORT

Also known as BLS, this course includes airway-management skills, such as the log roll and recovery position, one-rescuer cardiopulmonary resuscitation and additional skills, like caring for a choking patient, controlling bleeding and caring for a patient in shock.

DIVING EMERGENCY MANAGEMENT PROVIDER (DEMP)

Learn the knowledge and skills from several courses contained in one single approach. These courses are: Automated External Defibrillators (AEDs) for Scuba Diving, Oxygen First Aid for Scuba Diving Injuries, Advanced Oxygen First Aid for Scuba Diving Injuries and First Aid for Hazardous Marine Life Injuries.

Barney de Villiers
a man of great vision
9 August 1948 to 9 June 2010

By Dr Frans J Cronjé

It was with great sadness that DAN Southern Africa received notification of the sudden passing of our friend, mentor and colleague – Prof Barney de Villiers – on 9 June 2010.

Prof Barney was a highly-regarded academic at the University of Stellenbosch, where he served as a specialist in community health and occupational medicine, and as vice dean of the Faculty of Health Sciences. In addition to his many important contributions to academic and occupational medicine, particularly in the field of radiation, Prof Barney was a champion for hyperbaric medicine and for Divers Alert Network. He served on the board of DAN Southern Africa for the past four years and also as chair for the International DAN Research Retreat in Brussels in April 2007. The passion and vision he brought to DAN-SA was evident in the many opportunities he created, both nationally and internationally. He was instrumental in the development of a strategic partnership between the University of Stellenbosch and International DAN to foster training in diving and hyperbaric medicine.

Prof Barney will be remembered for many good things: his keen sense of humour, sharp wit and canny wisdom; his exceptional ability to inspire and lead; and his ability to integrate information across a wide range of disciplines. He had an incredible mind, vast knowledge and an exceptional memory. Prof Barney had a unique love and compassion for people. He was someone who enjoyed creating opportunities for others and putting them first. He always had time to discuss a matter of importance in a most personable way. He had the rare ability to describe complex subjects in lay language and made them comprehensible to all. When asked what his interests were, his truthful response was always, "I am interested in everything!". Indeed he was…

Given a choice, Barney's life ended as he would have wanted it to. After spending an evening dining with his lovely wife, Anntesia, whom everyone knows he loved more than life itself, he collapsed from a leaking aortic aneurism. After responding well initially to surgical care, he took a turn for the worse and passed away on the night of 9 June without suffering or loss of dignity. He has left a huge void, big shoes to fill, and many dear family members and friends who hold his memory amongst their fondest. He will be sorely missed. AD

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CHEMICAL OXYGEN RELEASE: AN EVALUATION OF UTILITY

By Dr Neal W Pollock

Divers Alert Network, Durham, NC 27705

Oxygen is a primary first aid tool to manage decompression sickness following compressed gas diving (Ref 1). Securing adequate supplies in remote locations can be problematic, given the prohibition against the transport of pressurised cylinders on commercial aircraft, and the inconvenience and expense of ground transport. Alternatives to pressurised gas sources include oxygen concentrators and chemical oxygen-releasing devices. Oxygen concentrators rely on electrical power – plug in or battery. Chemical oxygen release requires no external power. We previously reported on a chemical oxygen releasing system that had an inadequate supply volume for field utility (Ref 2). This article summarises the evaluation of a newer chemical oxygen-releasing device. Full details can be found in the published report (Ref 3).

> *"The emOx is a portable, non-pressurised oxygen delivery system developed by Green Dot Systems, Inc. (South Africa)."*

SYSTEM DESCRIPTION AND BASIC OPERATION

The emergency oxygen device (emOx) is a portable, non-pressurised oxygen delivery system developed by Green Dot Systems, Inc. (South Africa). The unit is marketed as being useful for first aid use until professional medical assistance is available. Advertising focuses on the absence of a pressurised storage container, high purity of delivered oxygen, total flow duration, and long shelf life of the reactants. We evaluated the performance of the emOx system under controlled laboratory conditions.

The emOx device is similar in appearance to a 15 inch high, five inch diameter thermos bottle (Figure 1). A flexible supply line connects the top of the assembly to a simple patient mask. Single dose packs of two chemicals are mixed with water in the large chamber and the components are assembled. Oxygen and heat are released through chemical reaction. Oxygen is flowing as long as bubbles are seen through the transparent cap. Multiple reactant packs are available for repeat use.

Figure 1: emOx non-pressurised oxygen delivery system.

METHODS

We conducted seven unmanned trials under stable, standard, indoor laboratory conditions. The device was operated in compliance with manufacturer instructions. The simple face mask was replaced with monitoring equipment to measure the output.

All components were measured, and activation carried out in a standardised manner for each trial. Trial data were captured through a computerised data acquisition system. Gas flow was measured continuously and averaged over sequential 60 second periods until the flow decreased to zero. Total volume was computed from the minute average flow readings. Temperatures were measured on the outside wall of the reaction chamber. Samples for delivered gas temperature and humidity were drawn from the gas stream at the approximate position of a patient mask. Values were reported as mean ± standard deviation with ranges in brackets.

RESULTS

The total weight of the system was 5.8 lbs (2.65 kg) with one set of reactants (including water). Each additional set of reactants added approximately 2.0 lbs (0.9 kg).

The mean flow rate (measured to the last non-zero minute average) was 1.75±1.58 (0.05-6.75) $L \cdot min^{-1}$ (ambient temperature and pressure, saturated with water vapour; ATPS) (Figure 2). Oxygen was released for 23±6 (18-35) minutes. The time it took for the flow rate to exceed 2.0 $L \cdot min^{-1}$ was 15.7±6.4 (11-29) minutes. The flow rate remained above 2.0

ABOUT THE AUTHOR

Neal W Pollock, Ph.D., is a research director at DAN and a senior research associate at the Center for Hyperbaric Medicine and Environmental Physiology, Duke University Medical Center, Durham, NC.

L·min^{-1} ATPS for only 6.4±1.0 (5-8) minutes (transiently peaking at 5.93±0.56 (5.23-6.75) L·min^{-1} ATPS before quickly falling to zero). The total oxygen yield was 40.4±2.6 (37.7-44.4) L.

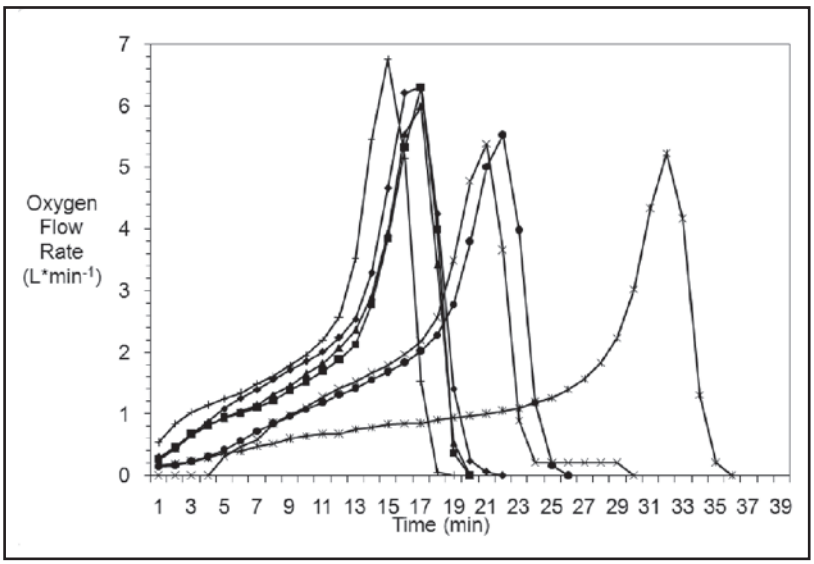

Figure 2:Oxygen flow produced by emOx non-pressurised oxygen delivery system in unmanned trials.

Reaction canister outside wall temperatures reached 54.7±7.4 (46.4-64.9)°C. Gas temperature measured at the approximate position of a delivery mask varied little from ambient temperature at any point in the reaction cycle.

DISCUSSION

Oxygen delivery systems appropriate for first aid use must be reliable, easy to use, easy to transport and able to provide sufficient volume and flow rates for the conditions of treatment. Nominal flow rates recommended for treatment with continuous flow systems are often in the 10-15 L·min^{-1} range. Rapidly deployable but limited oxygen supplies could be appropriate for some urban or suburban settings with readily available emergency medical services support. Remote settings or situations in which rapid EMS response could not be relied upon demand greater oxygen resources.

Reliance on traditional pressurised sources of oxygen can create transport difficulties. The concept of chemical oxygen release is compelling since it avoids both pressurised vessels and power supply challenges. High purity oxygen can be released by stable and safe reactants. The problems, however, remain limited oxygen flow rate and total yield.

The emOx portable, non-pressurised oxygen delivery system is compact, robust and easy to use as long as all three reactants are available. Unfortunately, the total oxygen yield for a set of reactants is extremely limited – approximately 10% of that provided by a single "D" size oxygen cylinder. Practically, this extremely limited supply would likely be ineffective in treating most medical conditions. Additionally, the slow and variable time required for the oxygen production rate to climb, despite careful standardisation of activation steps, brings into question any benefit of rapid deployment in advance of EMS arrival. Ultimately, the time spent dealing with the device and not spent paying attention to other needs of the patient does not seem justified for the limited benefits delivered.

The final issue is that delivered gas was not warmed substantially above ambient temperatures as promised. Despite very high reaction chamber temperatures, heat transfer along the length of the standard delivery line provided a nearly complete equilibriation with ambient temperature. Thus, any treatment benefit of warmed inspired gas to a patient would not be realised.

CONCLUSIONS

Increasing the number of alternatives to pressurised oxygen sources for the effective delivery of first aid oxygen is desirable. Unfortunately, our testing of the emOx system indicates an extremely limited mean oxygen flow rate, an extremely limited total oxygen yield and a problematically inconsistent timeline of oxygen release. Based on these results, we concluded that the emOx device does not provide an adequate source of emergency oxygen. Our experience led us to conclude that the practical benefits of powdered chemical oxygen-releasing systems for first aid or emergency medical use may remain marginal at best. We speculated that future efforts to replace compressed gas sources would be more productively directed at improving oxygen concentrator technology. AD

"Based on these results, we concluded that the emOx device does not provide an adequate source of emergency oxygen."

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DAN RESEARCH UPDATES

The latest analysis, data and discoveries

By Dr Richard Vann

DAN's mission is recreational diving safety. The research department supports this mission through field, epidemiological and experimental studies that seek to shed light on the issues related to fatalities, injuries and the risks of decompression illness (DCI). Here are the findings from some of our recent projects.

DIVE FATALITIES RESEARCH

DAN Research maintains an active surveillance programme for dive fatalities. A recent investigation of 947 diving-related deaths from 1992 to 2003 found that the principal injuries preceding death were asphyxia (33%), arterial gas embolism or AGE (29%), and cardiac incidents (26%) (Ref 1). Deaths due to asphyxia and AGE were associated with entrapment, insufficient gas, rapid ascent and equipment trouble. For cardiac incidents, associated factors were age and a history of cardiovascular disease.

A review of fatalities among insured DAN members also provided some interesting insights, particularly regarding associations with the age of the diver (Ref 2). Annual death rates for insured DAN members were stable during 2000-2006, with a mean of 16.4 deaths per 100 000 members. Fatality rates increased dramatically with age. Among divers 15-25 years of age, the fatality rate was less than 10 per 100 000 members, but increased to 30 per 100 000 among divers 65 years of age and older.

Women under the age of 55 were much less likely to die while diving than were men, but among divers 65 years of age and older, there was no difference in the death rate between the sexes.

To better understand the specific role of age in these deaths, we went back to the associated injury data and this time looked at the trends by dividing members into two age groups: those over 50 and those under 50. In this analysis, we found that older divers were three times more likely to die from asphyxia, four times more likely to die from AGE and 13 times more likely to die from cardiac events when compared to the under-50 dive group.

The high association of cardiac incidents with older divers is of particular concern since the general diving population is aging.

HIGH-RISK DIVING GROUPS

DAN fatality surveillance also tracks small, high-risk recreational diving populations, such as cave and rebreather divers. Cave diving deaths decreased during 1969-2007 and now account for only about 5% of annual U.S. and Canadian fatalities reported to DAN. Rebreather fatalities, however, have increased since 2000 and now account for about 6% of known deaths.

ANALYSIS OF DCS CASES

Helping divers understand, avoid and find proper treatment for DCI was the primary reason for DAN's founding. DCI is a broad category of pressure-related injuries that includes both AGE and decompression sickness (DCS), with DCS (aka "the bends") being the most common malady. DAN is notified of about 1 000 U.S. and Canadian DCI cases per year, and processes insurance claims for approximately one-third of these.

Analysis of the DCS claims among DAN members from 2000-2007 found an average rate of 217 cases per 100 000 insured members, with an annual decrease in claims of approximately 12 cases per 100 000 members during the period. The claims rate was very low for divers in their early teens, rose to 350-400 cases per 100 000 members for divers in their 20s and declined with age thereafter. For women, the claims rate was lower than for men by about 60 DCS cases per 100 000 members.

In future columns, we plan to bring you updates from ongoing DCI/DCS research projects including:

- A joint effort between DAN Research and DAN Medical Services to investigate first aid and therapy options that provide the best long-term outcomes for divers affected by DCI.
- The collection of depth-time profiles from recreational and technical divers to study the overall DCS incidence and identify profiles with the highest DCS probability.
- The establishment of a centre of excellence for DCS probability modelling in co-operation with Duke University's mechanical engineering department and the U.S. Navy.

EXPERIMENTAL DIVING RESEARCH

Also in future columns, look for updates on the experimental diving research underway in the chambers of the Duke Center for Hyperbaric Medicine and Environmental Physiology. Projects include:

- How immersion and exercise affects the DCS risks of flying after diving.
- How elevated oxygen partial pressures affect carbon dioxide narcosis.
- A recently completed study that found the prescription drug Cialis increased the risk of CNS oxygen toxicity in rats (Ref 3). AD

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DAN

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Ask Your DAN Instructor How To Get Involved

SAFETY TIP

Oxygen and someone trained in its use should be available at every dive site and on every boat.

24 HR EMERGENCY HOTLINE

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OXYGEN UNITS

DAN SOFT-SIDED OXYGEN UNIT

The Soft-Sided Oxygen Unit uses a compact, water-resistant nylon case, which was exclusively designed for the unit. New from DAN, the Soft-Sided Oxygen Unit was created for divers and professionals who do not require a waterproof case for their oxygen unit. It contains the same components as the standard Rescue Pack Extended Care. The case includes a front pocket and a zippered top lid for easy access to the cylinder. An adjustable shoulder strap and top haul loop provide two easy carry options, and a nylon daisy chain runs down the back of the case, making it simple to secure in your vehicle or boat.

DAN RESCUE PACK EXTENDED CARE

Ideal for dive sites and larger dive boats. Includes: 1600 Pelican waterproof case, brass multifunction regulator, demand valve with hose, Luxfer Jumbo-D cylinder, oronasal resuscitation mask (DAN pocket mask), hand-wheel with chain, non-rebreather mask, silicone Tru-Fit mask. Dimensions: 61.6 cm X 49.3 cm X 22 cm; weight: approximately 6.4 kg (case only); delivery time: 60 minutes.

DAN RESCUE PACK

Ideal for shore-based diving and training activities. Includes: 1450 Pelican waterproof case, brass multifunction regulator, demand valve with hose, Luxfer M9 cylinder (248.22 ℓ), oronasal resuscitation mask (DAN pocket mask), silicone Tru-Fit mask, hand-wheel with chain and a non-rebreather mask. Dimensions: approximately 40.6 cm X 33 cm X 17.4 cm; delivery time: 20 minutes.

DAN DUAL RESCUE PACK EXTENDED CARE

Includes: Two Luxfer Jumbo-D cylinders, 1600 Pelican waterproof case, brass multifunction regulator, demand valve with hose, oronosal resuscitation mask (DAN pocket mask), hand-wheel with chain, non-rebreather mask, silicone Tru-Fit mask. Dimensions: 61.6 cm X 49.3 cm X 22 cm; weight: approximately 6.4 kg (case only); delivery time: 120 minutes.

FIRST AID KITS

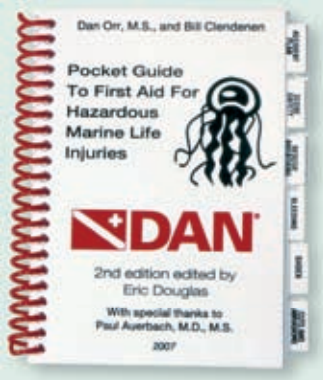
NEW

POCKET GUARDIAN PLUS FIRST AID KIT

Personal-sized DAN Pocket Guardian First Aid Kit now protected by a 1050 Pelican™ case for those on or around the water. Perfect for your dive bag or backpack.

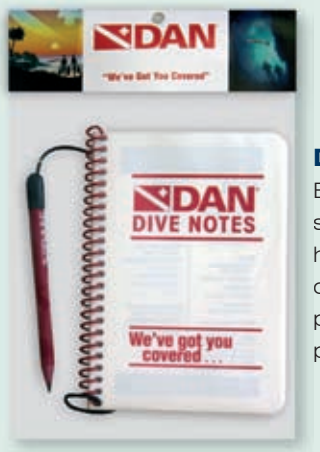
Kit includes:
2 4x4 sterile dressings
2 3x3 sterile dressings,
2 conforming gauze bandages
1 elastic bandage with Velcro
3 butterfly closure strips
6 adhesive bandages (1" x 3")
3 adhesive bandages (2" x 3")
1 triangular bandage
1 adhesive tape 1" x 10 yards
3 antiseptic towelettes
3 double antibiotic ointments
2 sting-relief pads
3 aspirin (325 mg)
2 acetaminophen (500 mg)
3 antihistamines
1 disposable razor
1 folding scissors
1 splinter picker forceps
1 wound-cleaning syringe with catheter
1 pair nitrile examination gloves.

BOOKS AND GAMES



DAN POCKET GUIDE TO FIRST AID FOR HAZADOUS MARINE LIFE INJURIES

This waterproof booklet covers 15 first aid topics relating to marine animal injuries. By Dan Orr and Bill Clendenen, with advice from Dr Paul Auerbach. 32 pgs; spiral bound.



DAN DIVE NOTES

Better than a dive slate, this notebook has 30 pages of durable waterproof paper. Plastic UW pencil included.

CLOTHING

POLAR FLEECE DAN TOP

Gear up for the cooler summer days with one of these great, lightweight quarter zip polar fleece tops. The shirt is made up of rapid-drying fabric that regulates heat and releases moisture. Available in black only. Sizes: S to XXXL.

NEW

LADIES' T-SHIRT

These new ladies' t-shirts have only recently been released, and are great for the warmer spring days. Sizes: S to XXL.

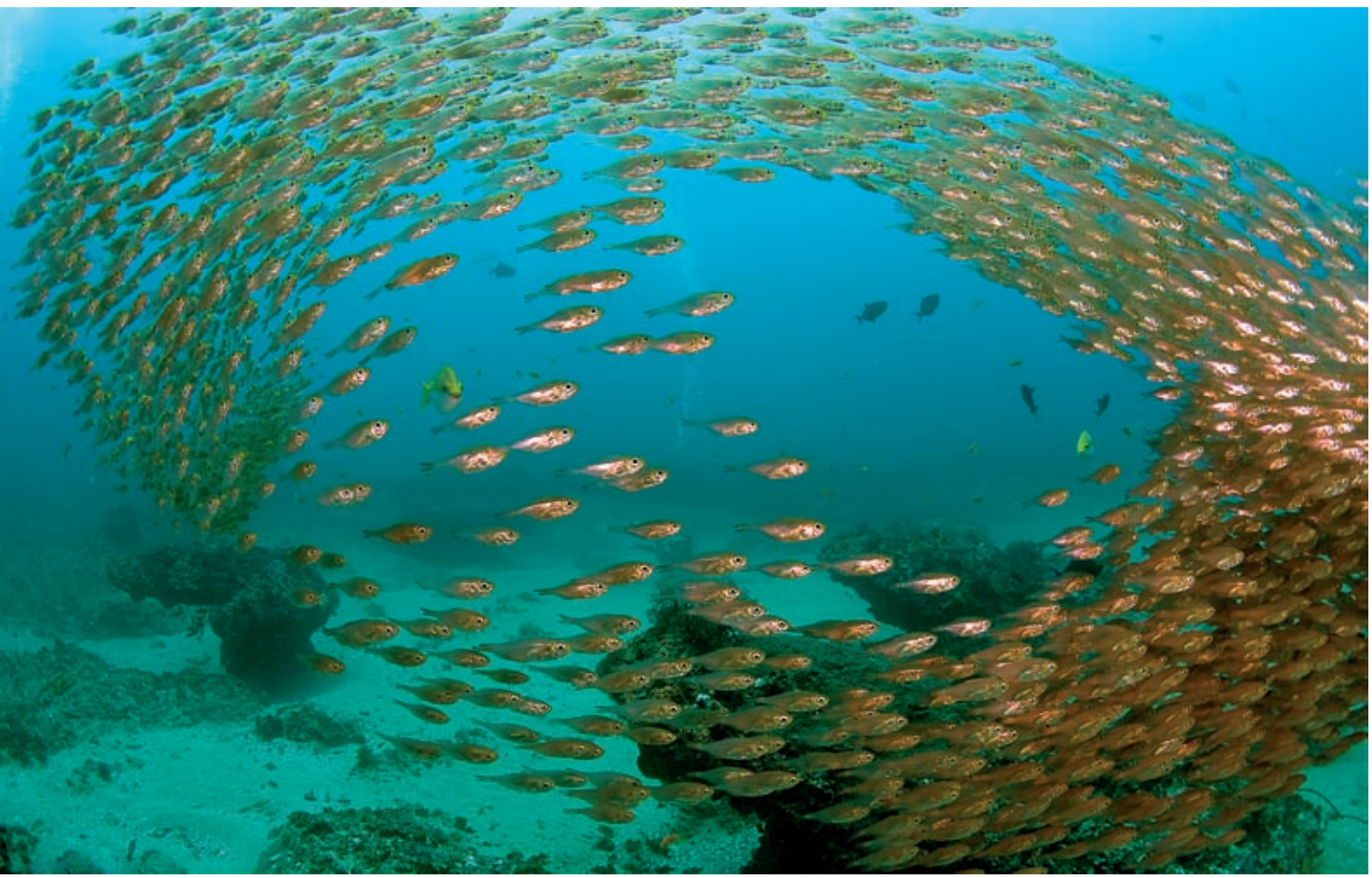
ACCESSORIES

DAN SURFACE SIGNAL KIT

One safety precaution no diver should be without, surface signal kits offer a variety of functions. The DAN surface signal kit features an orange safety sausage with lpi attachment, dump valve and a reflective strip that runs the length of the tube, a feature unique to the DAN signal tube. The DAN logo is featured (also in reflective ink) on the front at both the top and bottom of the tube; the bottom logo includes DAN's emergency hotline number and is visible in both the rolled and unrolled position. Encased in a mesh pocket at the base of the tube is a Wind Storm® whistle, a signal mirror and a chemical light stick. The signal tube can also double as a secondary lift bag.

ALL ORDERS CAN BE PLACED AT YOUR NEAREST DIVE SCHOOL OR AT DAN-SA ON 0860 242 242

The Shoal



DAN member Cormac McCreesh submitted this edition's Parting Shot. This is his story...

"

This photo of glassy sweepers was taken at Fish Basket Reef at Ponta Mamoli, southern Mozambique. These poor creatures were being harassed by an emperor snapper and several lionfish. Consequently, they huddled up to avoid the attacks, and in so doing, they made some really interesting formations and dances in front of my camera as they tried to use me as protection from the provocations. What a spectacular shot this turned out to be!

"

***Parting Shot* gives you a chance to share your interesting dive stories and images with us.**

Have you encountered a rare or exciting activity underwater and captured it? Has an underwater event just added that something extra to your dive and you have a photo? If so, all you have to do is send through your high resolution image (300 DPI) along with your story (including a brief description of your creature, location of dive site and pertinent photo information) and contact details to partingshot@dansa.org and your submission could appear in the next edition of *Alert Diver*!

All images submitted for the *Parting Shot* become the property of DAN.

DAN CONTACT DETAILS

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