JPAC 12-68

Joint UKBTS / HPA Professional Advisory Committee ([1]) Summary Sheet

1. Paper for the JPAC meeting on:	8 November 2012
2. Date submitted:	12 September 2012
3. Title (including version no.):	Decompression illness
4. Author(s):	Dr Susan Lumley and the SAC CSD
5. Brief summary:	The ever growing recreational diving industry, and a small commercial, one means that questions about fitness to donate post an incident are increasingly common. Dr Lumley has reviewed the evidence and the SACCSD has, after discussions on 9/8/12, made recommendations for a new entry for the DSG (both attached). A number of additional index items will point to this entry; Decompression illness, decompression sickness, the bends and caisson disease.
6. Action required by the JPAC: (What do you want JPAC to do in response to this paper?) e.g. • endorse a specific recommendation • advise where there is a choice of possible actions • advise on priorities within the work plan • provide a steer on policy	Discuss and endorse recommendation for additional entry.
7. Any other relevant information:	

([1]) **J**oint **U**nited **K**ingdom **B**lood **T**ransfusion **S**ervices and **H**ealth **P**rotection **A**gency **Professional Advisory Committee**

Recommendations for deferral criteria for whole blood and component donors following treatment for Decompression Illness (DCI).

These recommendations have been produced by at the request of the Standing Advisory Committee for the Care and Selection of Donors (SAC-CSD).

Report writing group

Dr Susan Lumley Associate Specialist, SNBTS Inverness Centre.

Clinical expert consulted:

Dr Donald Thomas Consultant in Anaesthesia and Hyperbaric Medicine, Hyperbaric Medicine Unit - NHS Grampian (www.hyperchamber.com).

Diving Associations from which opinions sought:

British Hyperbaric Association (www.marinerhosting.co.uk/bha),
Divers Alert Network, USA (www.diversalertnetwork.org),
Divers Emergency Service UK (www.londonhyperbaric.com),
Undersea & Hyperbaric Medical Society (http://membership.uhms.org/).
HSE (Regulator of Diving Regulations) (http://www.hse.gov.uk/diving/)

Blood Services from which opinions sought:

USA - American Association of Blood Banks (AABB) & New York Blood Centre (NYBC)
Australia
New Zealand
Canada

1 Remit

The remit of this paper was to propose a deferral guideline for donors who have received treatment for decompression illness (DCI). The proposed wording of the entry is provided as appendix 1.

2 Summary of recommendations

Following a review of available evidence outlined below I conclude that donors in any of the following categories :-

a) Still undergoing investigation or treatment.
b) Have had a myocardial or cerebral ischaemic event.
c) Unable to use the bleed facilities provided without risking their own safety or the safety of others.
d) Have to self-catheterize following significant neurological damage.
e) Continue to experience vertigo.
f) Have received anticoagulant or steroid therapy within the previous 7 days.
g) Have not yet returned to normal activities of daily living (e.g. routine housework, employment and/or driving).

Should not donate – ***categories a) to f) are all covered by other existing donor selection criteria.***

If none of the above apply, donors :-

a) who have no residual symptoms, or
b) whose resolution of symptoms is considered by the treating physician to have reached a plateau

may be accepted more than 24 hours from the date of the last recompression procedure, as long as the donor feels well and would otherwise fulfil the current medical donor selection criteria.

3 Background

3.1 The query

A query was put to the NHSBT with regard to “how long should a donor be deferred following treatment for ‘the bends’ ?”

3.2 Decompression illness (DCI)

Decompression illness (DCI) incorporates “Decompression sickness (DCS)” (the bends) and arterial gas embolism (AGE) (Bennett et al 2010). It can occur when diving, when working in a pressurised environment (tunnels et.), or in high-altitude / aerospace-related events. Most events reported by potential donors are likely to relate to diving incidents. During the descent to depth process, inert gas (either nitrogen or helium) in the inspired gas dissolves in the blood, and transfers from the circulation into the tissues down its concentration gradient. If ascent to normal atmospheric pressure is controlled, this provides adequate time for the inert gas to exit from the tissues via the bloodstream in soluble form, and then be expired in gaseous form via the lungs. If the ascent is too rapid, the decreased pressure allows the inert gas to return to gaseous form either within the tissues, or within the

circulation. Gas bubbles within tissues can lead to direct trauma by mechanical distortion of tissues, obstruction of blood flow or initiation of an inflammatory response, and within the circulation can lead to either gas embolism, or to activation of the kinin, complement, and coagulation cascades by endothelial activation (Levett & Millar 2008). Type I DCS affects the skin, lymphatics and musculoskeletal tissues, whereas the more severe Type II DCS can affect the nervous system, eyes and ears, lungs and circulatory system (Barratt et al 2002, Pulley SA 2009). Arterial gas embolism can occur due to pulmonary barotrauma, or when gas bubbles pass from the venous to the arterial circulation through e.g. a patent foramen ovale or atrial septal defect. Coronary artery emboli can lead to myocardial infarction, cerebral artery emboli can lead to stroke or seizures.

Treatment for DCI is a combination of re-pressurising the patient, and increasing the inspired partial pressure of oxygen, which facilitates the gradual removal of the retained inert gas. Some web sites and journal articles also mention use of nonsteroidal anti-inflammatory drugs (NSAIDs), steroids and anticoagulants (to combat the acute inflammatory response / DIC stimulated by the gas bubbles), although there appear to be no standard guidelines for their use (Levett & Millar 2008, Bennett et al 2010).

Complete relief of symptoms occurs in 50 to 98% of individuals depending on the severity, and period of time elapsed between development of DCI and recompression (Bennett et al 2010).

4 Methods

Evidence was sought from the following sources:

4.1 Blood services

4.1.1 United States of America – AABB & NYBC
4.1.2 Australia
4.1.3 New Zealand
4.1.4 Canada

4.2 Expert Opinion

4.2.1 British Hyperbaric Association (www.marinerhosting.co.uk/bha),
4.2.2 Divers Alert Network, USA (www.diversalertnetwork.org),
4.2.3 Divers Emergency Service UK (www.londonhyperbaric.com),
4.2.4 HSE (Regulator of Diving Regulations) (http://www.hse.gov.uk/diving/)
4.2.5 Hyperbaric Medicine Unit - NHS Scotland (www.hyperchamber.com),
4.2.6 Undersea & Hyperbaric Medical Society (http://membership.uhms.org/).

4.3 Review of literature

Medline / Embase search for relevant journal articles or reviews using a combination of "Decompression Illness", "Decompression sickness", "hyperbaric treatment", "diver" and "diving".

5 Results

5.1 Blood services

No current guidance related to blood donation following Decompression Illness could be found :-

a) within the UKBTS / Council of Europe guidelines
b) in web sites for the American Blood Services (AABB / NYBC) / Australian / New Zealand / Canadian Blood Services.

5.2 Expert opinion

No current guidance related to blood donation following Decompression Illness could be found in web sites for Diving agencies :-

- British Hyperbaric Association (www.marinerhosting.co.uk/bha),
- Divers Alert Network, USA (www.diversalertnetwork.org),
- Divers Emergency Service UK (www.londonhyperbaric.com),
- Hyperbaric Medicine Unit - NHS Scotland (www.hyperchamber.com),
- Undersea & Hyperbaric Medical Society (http://membership.uhms.org/).
- HSE (Regulator of Diving Regulations) (http://www.hse.gov.uk/diving/)

A request for information was e-mailed (when an e-mail address was provided) or submitted via the "Contact Us" link on each of these organisations' web sites (5.1.b and 5.2).
A response providing contact details for further discussion was received from Dr Donald Thomas, Consultant in Anaesthesia and Hyperbaric Medicine, Hyperbaric Medicine Unit - NHS Grampian (www.hyperchamber.com). His advice is summarised in appendix 2.

E-mail responses were received from Divers Alert Network, HSE, and Undersea & Hyperbaric Medical Society, and from the AABB, the NYBC, the Australian and Canadian Red Cross Blood Services, and from the NY Blood Centre (appendix 3)

5.3 Review of key literature

No articles could be found to combine blood donor / donation with any combination of decompression illness / diving etc. The background information at 3.2 above was sourced from a number of review articles as per references provided.
The current guidance from HSE on returning to diving (for professional divers) is detailed at appendix 4.

6 Discussion

6.1 Would accepting donors lead to an increase in adverse reactions?

- Anaemia – Haemo-concentration can occur during DCI (particularly related to diving) due to a variety of factors (Bennett et al 2010). However, this would be addressed during recompression treatment (with oral / IV fluids as required), and it is unlikely that by 24 hours following treatment, if an individual felt well enough to volunteer to donate blood, they would have residual haemo-concentration which might lead to them passing the haemoglobin test when their true haemoglobin was in fact lower than the BSQR limits. Conversely, deep saturation dives can lead to a reduction in haemoglobin concentration (related to hyperoxia) (Thorsen et al 2001) – but this would potentially just result in deferral of the donor by them failing the pre-donation haemoglobin test.
- Aggravation / recurrence of symptoms – decompression sickness is due to the physical effect of gas bubbles in the tissues or circulation. Once this has been treated, subsequent lowering of the haemoglobin (by blood donation) would not be expected to precipitate a recurrence.
- Ischaemic events – individuals who have suffered significant DCI events such as MI / stroke would be excluded permanently on the basis of current donor selection criteria.
- Injury - individuals who continue to experience vertigo due to vestibular DCI and those with significant physical disability due to significant neurological DCI would be excluded on the basis of current donor selection criteria.
- Haemorrhagic / thrombotic event - individuals who underwent treatment with anticoagulants (not routine) would be excluded on the basis of current donor selection criteria if within the preceding 7 days.

6.2 Would allowing donors to make whole blood or component donations following treatment for Decompression Illness have any impact on recipient patient safety?

- Infection risk - individuals having to self-catheterise as a result of significant neurological DCI would be excluded on the basis of current donor selection criteria, as would those having received steroid treatment (not routine), if within the preceding 7 days.
- Inert gas exposure – there is no risk to the recipient from inert gases as these are completely removed during recompression treatment.

6.3 Are there any additional considerations for apheresis platelet donors?

Individuals having been treated with nonsteroidal anti-inflammatory drugs (NSAID) during recompression therapy (not routine) would be deferred for the usual 48 hours on the basis of current donor selection criteria. There are no other implications for component donors.

7. Conclusions and Recommendations

For donors not otherwise deferred by current donor selection criteria (as in 6.1-6.3 above), and who have felt well enough to resume normal activities of daily life, and present themselves as blood donors, the options are either :-

- a deferral period of 24 hours following final treatment, as suggested by Dr Thomas (appendix 2), and which would meet the suggestions made by other Blood Services (appendix 3), or

- a longer deferral period in line with that applied by the HSE for individuals “returning to diving” (appendix 4)

Although the HSE guidance suggests that the period away from diving for those diving in the *recreational* sector should be longer than for professional divers, this is because of the nature of their diving patterns and profiles, and the lack of supervision - not because of any inherent difference in their illness or recovery period.

Return to diving after a DCI event potentially involves repeat exposure to the original insult (i.e. further tissue damage by gas bubbles), whereas donating blood does not. On this basis, it would seem overly cautious to apply the same deferral period for blood donation as for returning to diving.

My recommendation would therefore be that the DSG entry for Decompression Illness should be worded as in appendix 1, with a 24 hour deferral following final treatment being sufficient for donors who would otherwise meet donor selection criteria, and who have returned to normal activities of daily life.

References

1. Barratt DM, Harch PG, Van Meter K “Decompression Illness in Divers: A Review of the Literature” The Neurologist 2002;8:186-202.

2. Bennett MH, Lehm JP, Mitchell SJ, Wasiak J “Recompression and Adjunctive Therapy for Decompression Illness: A Systematic Review of Randomized Controlled Trials” Anaesth. Analg. 2010;111:757-762.

3. HSE - The medical examination and assessment of divers (MA1) – www.hse.gov.uk/diving/ma1.pdf 2011

4. Levett DZH & Millar IL “Bubble trouble: a review of diving physiology and disease”. Postgrad Med J 2008 84: 571-578.

5. Pulley SA “Decompression Sickness” www.emedicine.medscape.com updated 2009.

6. Thorsen E, Haave H, Hofso D, Ulvik RJ “Exposure to hyperoxia in diving and hyperbaric medicine – effects on blood cell counts and serum ferritin.” Undersea & Hyperbaric Medicine. 2001; 28(2):57-62.

Appendix 1 – Proposed Draft Wording for DSG Entry

Decompression Illness

Obligatory **Must not donate if :**

a) Undergoing investigation or treatment.

b) Has had a resulting myocardial or cerebral ischaemic event (heart attack / stroke).

c) Has to self-catheterize.

d) Unable to use the bleed facilities provided without risking their own safety or the safety of others (donors must not be bled in a wheelchair).

e) Experiencing vertigo.

f) Has received anticoagulant or steroid therapy within the previous 7 days.

g) Has not yet returned to normal activities of daily living (e.g. routine housework, employment and/or driving).

Discretionary If recompression treatment ended more than 24 hours previously, the donor feels well enough to have returned to work / normal daily activities, neither steroid nor anticoagulant drugs have been taken within the previous 7 days, and either :-

a) response to recompression treatment was complete, and the donor is asymptomatic,

b) muscle (e.g. limb pain), skin (e.g. lymphatic swelling), or mild neurological symptoms (such as weakness or numbness) have improved as much as expected by the treating physician,

c) arterial gas embolism has responded fully to recompression treatment, with no evidence for myocardial or cerebral ischaemic event (heart attack / stroke)

the donor can be accepted.

See if Relevant

Anticoagulant Therapy
Cardiovascular Disease
Central Nervous System Disease
Disabled Donor
Epilepsy
Investigations
Nonsteroidal Anti-Inflammatory Drugs
Self-Catheterization
Steroid Therapy
Vertigo

Additional Information Decompression illness incorporates “Decompression sickness” (the bends) and arterial gas embolism. Most events reported by potential donors are likely to relate to diving incidents. The symptoms are caused by bubbles of inert gas (either nitrogen or helium) forming within the tissues (skin, muscle, nerves), or within the circulation, due to inappropriately rapid ascent from depth. This can lead to a broad spectrum of symptoms from mild muscle cramps at one end, to paralysis, heart attack or stroke at the other.

Treatment is a combination of re-pressurising the patient, and increasing the inspired partial pressure of oxygen, which facilitates the gradual removal of the retained inert gas. Additional treatment with nonsteroidal anti-inflammatory drugs (NSAIDs), steroids and anticoagulants may sometimes be used.

Complete relief of symptoms occurs in 50 to 98% of individuals depending on the severity, and period of time between development of symptoms and treatment.

Donors who have suffered significant medical problems (heart attack, stroke, paralysis etc.) would be deferred on the basis of this outcome.

Donors with milder symptoms which have either resolved completely, or are considered by the treating physician to have improved as much as they are going to, can be accepted as long as they meet the above criteria, and they have felt well enough to return to normal activities of daily life (housework, employment, driving etc.).

Reason for Change

This is a new entry.

Appendix 2

Information and opinion provided by Dr Donald Thomas, Consultant in Anaesthesia and Hyperbaric Medicine, Hyperbaric Medicine Unit - NHS Grampian (www.hyperchamber.com).

Patients are treated with re-pressurisation until :-

- symptom-free. It is recognised that inert gases can pool, possible in splenic vessels, and symptoms can recur within 24 hours. Thus patients are kept in or near the hospital for this first 24 hours. If there has been no recurrence of symptoms by this time, they are discharged with no follow up required.

  Dr Thomas' opinion - at this stage, no adverse effect should arise from donating blood.

- until no further improvement in symptoms (plateau). Daily treatments continue until any measurable deficit or self-reported symptoms show no further improvement. These patients are then discharged with no follow up required.

  Dr Thomas' opinion - at this stage, no adverse effect should arise from donating blood.

In one recent case of AGE with resolution of acute symptoms (no resulting MI / stroke) – the patient reported ongoing general lethargy, and was unable to return to work for several weeks after completion of treatment. ***Dr Thomas felt that the "return to work" (or normal activities of daily life) should be included as part of the assessment of an appropriate deferral period.***

Appendix 3 - responses to e-mailed query.

1. Diving Associations

Divers Alert Network, USA (www.diversalertnetwork.org),

Thank your for your e-mail and professional interest in DAN. It is important to know that once a diver receives initial hyperbaric oxygen therapy any residual inert gas is completely expelled. This is true even if they have residual symptoms. In the case of severe neurological symptoms i.e. paralysis, urinary retention, reduced muscle strength blood donation may not be advisable. In most cases the symptoms are resolved with treatment and do not pose any long term problems. What is unique to diving is with the initial decompression insult, divers historically manifest an increased hematocrit. It is believed that this occurs to plasma lost due to vascular epithelial insult. Once hematocrit levels are normal then they can be considered as a potential donor.
If we can be any further assistance do not hesitate to contact DAN.

HSE (Regulator of Diving Regulations) (http://www.hse.gov.uk/diving/)

HSE is a Regulator of Diving Regulations and what you require is well beyond the effect of diving on health and health on diving, which really is our remit. I am certainly not aware of any "evidence-based guideline" on this. Perhaps in the world of Haematology there may be such an expert?

Undersea and Hyperbaric Medical Society (http://membership.uhms.org/).

The Chair of our HBO Committee commented: "I would think that if the person felt ok and their vital signs were ok, blood donation would be ok following DCS."

He would also like me to forward your inquiry to a colleague at Duke University for further comment. He or I will be in touch with a further response. I hope this is of help to you.

Further response awaited

2. Blood Services

AABB
I wanted to let you know that we working to get you as informative a response as possible. As you can imagine, our Standards do not address deferrals for decompression sickness, but I have an inquiry out to the chair of our Donor History Questionnaire Task Force regarding this issue, and I will share her response with you as soon as I have it. If there is any consensus on the topic or if there is any information in the literature, I hope to be able to provide that information to you. Is this issue tied to a particular donor, or is it something that comes up frequently among your donor population? I'm just curious – in my 11 years at AABB, I haven't seen a question dealing with decompression sickness in donors yet! (Which is also why we do not have the information you are requesting on hand.)

Further response awaited.

Australian Red Cross Blood Service
This is the response from our "Donor and Product Safety Policy Unit":
The Australian Red Cross Blood Service does not have a specific policy on donors after treatment for decompression sickness. In the event that such a donor presented, it is therefore likely that we would apply the general rule of accepting the donor only after full recovery and completion of all treatment. At that point we would see no need for any component restrictions.

Canadian Blood Service
a) I have confirm with our Head Office that we do not have any guidelines regarding deferral for decompression sickness.
Each case would be assessed by the Medical Director on an individual basis.

b) You could try the Defence and Civil Institute of Environmental Medicine in Toronto as they have physicians more familiar with decompression sickness , although they would not be experts in TM .
There is a California internet structured group of TM MD's / Blood Centre MD's whom may have specific opinions , could pass your query around for advice. I will see if my staff can get you their email as I do not recall it .
Good luck and sorry we couldn't find a similar case question with a decision in our files . We don't get a lot of divers here due to the fierce climate .

c) The DCIEM in Toronto is this country's sole training facility for physicians in advanced diving medicine . I took the course in '88 , practised in that field only until '90 ,so I'm no longer current but someone there may be able to assist you in your search .
You could also search under hyperbaric chamber facilities, try diving associations (PADI , etc.)

New York Blood Centre
a) Thank you for your question regarding donor eligibility and decompression sickness. We do not have a policy on this, but have discussed it amongst ourselves and are reaching out to our national blood center colleagues. We will have our thoughts to you shortly.

b) This is an interesting question unfortunately we do not have any relevant experience with this issue. I would suggest you contact the AABB to see if they could throw a wider net to get you an answer.

c) After peaking our interest, we did discuss this issue among our physicians here. The consensus was that we would accept the donor once they were feeling well and healthy. Let us know if you find out anything interesting.

Appendix 4 – Current HSE Guidance for "Return to Diving" for Professional Divers.

HSE guidance on return to diving for professional divers is provided at www.hse.gov.uk/diving/ma1.pdf excerpt shown below :-

Recommended periods away from diving following decompression illness

The recommended minimum times away from diving after successful treatment with no sequelae are as follows:

Simple Decompression Illness, Limb Pain, Skin 'Bend', Lymphatic Swelling, Fatigue etc.	
Uncomplicated recovery	24 hours
Recurrence/relapse requiring further recompression	7 days
Neurological Decompression Illness	
Altered sensation in limbs only	7 days
Audiovestibular, motor disturbance	28 days
Other	
Pulmonary decompression illness	28 days

Decompression Illness (final SAC recommended wording)

Obligatory

Must not donate if:

a) Undergoing investigation or treatment or are still symptomatic

b) The illness has been complicated by conditions that exclude the donor from donation.

Discretionary

If recompression treatment ended more than 24 hours previously, the donor feels well enough to have returned to work / normal daily activities, neither steroid nor anticoagulant drugs have been taken with the previous 7 days, and:

a) muscle (e.g. limb pain), skin (e.g. lymphatic swelling), or mild neurological symptoms (such as weakness or numbness) have stabilised and the donor has been discharged, accept.

b) arterial gas embolism has responded fully to recompression treatment, with no evidence for myocardial or cerebral ischaemic event (heart attack / stroke), accept.

See if Relevant Anticoagulant Therapy
Cardiovascular Disease
Central Nervous System Disease
Disabled Donor
Epilepsy
Investigations
Nonsteroidal Anti-Inflammatory Drugs
Self-Catheterization
Steroid Therapy
Vertigo

Additional Information

Decompression illness incorporates “Decompression sickness” (the bends) and arterial gas embolism. Most events reported by potential donors are likely to relate to diving incidents. The symptoms are caused by bubbles of inert gas (either nitrogen or helium) forming within the tissues (skin, muscle, nerves), or within the circulation, due to inappropriately rapid ascent from depth. This can lead to a broad spectrum of symptoms from mild muscle cramps at one end, to paralysis, heart attack or stroke at the other.

Treatment is a combination of re-pressurising the patient, and increasing the inspired partial pressure of oxygen, which facilitates the gradual removal of the retained inert gas. Additional treatment with nonsteroidal anti-inflammatory drugs (NSAIDs), steroids and anticoagulants may sometimes be used.

Complete relief of symptoms occurs in 50 to 98% of individuals depending on the severity, and period of time between development of symptoms and treatment. Donors who have suffered significant medical problems (heart attack, stroke, paralysis etc.) would be deferred on the basis of this outcome.

Donors with milder symptoms which have either resolved completely, or are considered by the treating physician to have improved as much as they are going to, can be accepted as long as they meet the above criteria, and they have felt well enough to return to normal activities of daily life (housework, employment, driving etc.).

Reason for Change

This is a new entry.