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DIVING CANDIDATES AS THEY PRESENT FOR FITNESS TO DIVE ASSESSMENT DIVING MEDICINE CASE STUDIES

Part 1

Vanessa Haller and Guy Williams
with audience participation

Key Words

Asthma, cardiovascular, case reports, chest injury, fitness to dive, medical conditions and problems.

Guy Williams

Here are some thumbnail sketches of diving medical candidates as they walked in my front door in an area with quite a bit of dive training. All the medicals that I perform are the SPUMS recommended sports diving medical. If anyone wishes to make a comment or be somewhat critical of anything, please comment from the floor.

Case 1

This fellow, 18 years old, had wheezes when he was a child which is very common in Australia. In Australia, particularly the southern parts, probably 25% of children have wheezes at sometime. It is a very common presenting symptom in young children, particularly in my area. He thought he occasionally wheezed when he ran. His lung function tests were in the normal range, Forced Vital Capacity (FVC) 3.58 l (4.00) and Forced Expiratory Volume in one second (FEV₁) 3.03 (3.31). Because of his history of asthma and the query about exercise induced asthma, I performed a hypertonic saline challenge test which was negative. The candidate's lung function is measured before and after 0.5% saline solution is breathed through an ultrasonic nebuliser. A 15% drop is a positive result. This test is commonly performed in Australia. However in many other parts of the world an exercise test is more commonly performed. David Elliott would you care to comment on whether one should do hypertonic saline or exercise testing or both?

David Elliott, Guest speaker

Where I come from, which is the world of the commercial diver, pulmonary function is tested before and after six minutes of hard exercise. If the test results are virtually unchanged, and provided they have not got any triggers that could be active, then they are fit for diving.

Guy Williams

I passed this person. Does anyone disagree with that?

Simon Mitchell, Hyperbaric Physician, Brisbane.

Did you issue this gentleman with a SPUMS statement of health for recreational diving or did you write fit for diving on his RTSC (Recreational Scuba Training Council) statement?

Guy Williams

I always use the medical certificate in the SPUMS medical, which is that based on informed consent. I often give anyone with a history of asthma an article that Carl Edmonds wrote some years ago in Scuba Diving. It is extremely negative towards asthma and diving. I tell them to "Take it home and read it well, just so that you know why we have this interest in asthma and diving".

Simon Mitchell

Well in that case I agree entirely with your decision.

Henrik Staunstrup, Denmark

In Denmark we had a number of deaths from pulmonary barotrauma in asthmatics and the respiratory physicians, who use methacholine to provoke airway narrowing, suggested that we use that to test asthmatics. Why do Australians use hypertonic saline?

Guy Williams

I like to use hypertonic saline because I can do it myself in the consulting room. Methacholine testing has to be done in a respiratory laboratory which means another appointment and delay. Many patients want to have the results right away as they want to start their course that evening!

The conventional tests for possible airways hyper-responsiveness are histamine and methacholine challenges. In a clinically-based asthmatic population there is about an 80% positive rate. In a normal population, never had symptoms of asthma, there will be something like a 25% positive rate. Depending on the prevalence of the disease in the sample of the population one is examining there will be a lot of false positives if your respiratory specialists are trying to absolutely exclude anyone with asthma. If, on the other hand, one is trying to mimic the environmental triggers that the potential diver may be exposed to, then saline has some justification. Neither of the tests, to my knowledge, has any outcome to assess its actual validity as a discriminative test.

Deborah Yates, Respiratory Physician, Sydney

This is something which has been extensively discussed at the Australian and New Zealand Thoracic Society and, as a whole, the points that you make are true. There is really no evidence to implicate any sort of challenge testing with regard to diving. The reason that people do hypertonic saline challenges is because they are easy. They

replicate the apparent nature of diving and they are less often positive. As a group the Thoracic Society are not terribly happy about excluding absolutely everybody with asthma from diving. The other point is that, unfortunately, it is actually very difficult to use methacholine in Australia. It is not licensed for use and one has to get a special licence from the Therapeutic Goods Administration in Canberra, although it is actually quite an easy test to do. We are quite happy with hypertonic saline because a smaller proportion of people will be positive and those that are will have probably quite severe bronchial hyper-responsiveness but of course the fact is that bronchial hyper-responsiveness is not asthma. So a positive test it does not necessarily mean that somebody has asthma and therefore one should really take into account a whole lot of other things as well.

Henrik Staunstrup

This just reflects the differences in the different parts of the world. In Denmark we do not use hypertonic saline challenges. Our specialists all use the methacholine test so that was what they recommended to us to use.

Guy Williams

Case 2

A 16 year old schoolboy who had been diagnosed as an asthmatic as a child and who had not used salbutamol (Ventolin) for three years came for a diving medical. His lung function test were FVC 3.70 (4.35), FEV1 3.12 (4.07) and FEV1/FVC of 84%. With his history of asthma and because he had used Ventolin until 3 years ago I gave him a hypertonic saline challenge test. Within a couple of minutes he dropped his lung function by about 30% and, although he denied it, was sounding quite wheezy and not looking as good as when he had walked in. I gave him some salbutamol (Ventolin), which reverses these people very quickly, and his lung function had returned to normal before I let him out of my clutches. On the basis on this, I thought that he had a significant risk of becoming seriously wheezy while diving and failed him.

I wonder, would this boy have been passed in other countries before he had the saline challenge test, or would he have passed afterwards, or would most people in most countries under most systems have passed him? David Elliott can you tell us what would have happened in England?

David Elliott

I still say that we should do the exercise tolerance test on everybody. This opinion came out of an UHMS meeting "Are asthmatics fit to dive?".¹ The person whose opinion we relied on was Mark Harris, who is familiar with the resuscitation of surfers but is primarily an asthma physician, who also looks after high performance athletes. It was his considered opinion that, providing a person has not got any known triggers and is not on medication other than corticosteroid, then the real hazard for the asthmatic is not barotrauma. The real hazard is not being able to get enough air to escape from an emergency situation. That is

why the exercise tolerance test is the one that is pushed and the considered view of pulmonary physicians was that if one has to go as far as any challenge test, one has already gone past the point at which the diving candidate should have been rejected.

Guy Williams

Case 3

This 18 year old student wheezed as a child. He had used salbutamol (Ventolin) from time to time. There was no history of exercise induced asthma. Lung function was FVC 4.75 (4.03), FEV1 4.34 (3.75). Perhaps because I had read something about exercise testing recently I got him to do an exercise test, running up and down a nearby hill, when he came back he looked as if he had been working quite hard. But there was no change in his respiratory function. So I assessed him as being fit. My practice is always to have a chat with these people about why asthma and scuba diving are a potential problem.

Barbara Trytko, Consultant in Intensive Care and Hyperbaric Medicine, Sydney

It is my understanding that a number of asthmatics do not actually get exercise induced asthma and under those circumstances the exercise test would not be positive. However if they are diving, when they breathe cold dry air, with a faulty regulator that is nebulising a bit of salt water they might, even with a normal exercise test in the dry, develop broncho-constriction and become significantly incapacitated.

Guy Williams

I find that asthma is commonly misdiagnosed. Many things are called asthma, and are not. I can recall one young lady who said she wheezed but only when she patted horses. She was otherwise fit and well. I could see no reason for her not to dive.

Many people have wheezed. I wheezed when I had bronchitis two years ago, but that is the only time I have wheezed in my life. That is not asthma.

The SPUMS policy on asthma and diving was formulated in 1995 at the Annual Scientific Meeting in Fiji.² The discussion suggested that the sub-group of asthmatics that we particularly wanted to identify were those with exercise induced asthma, because it was thought that they were the people most likely to get into trouble diving. It was also thought that the real problem was not ascent from depth, but the swim back to the boat in the choppy sea. This is where asthmatics get wheezy, short of breath and drown. Anyone who is having trouble staying on the surface is likely to drown and those few asthmatics that have died when diving have drowned.

Mike Bennett, Hyperbaric Physician, Sydney

Maybe the respiratory physicians amongst us will know the answer, but is there any evidence that asthmatics suffer proportionally more disasters in the water than others who are struggling to stay afloat?

Paul Thomas, Respiratory Physician, Sydney.

There really is not very much in the way of evidence at all. This was brought up in our discussions at the Australia and New Zealand Thoracic Society, who have produced a statement on Asthma and Diving.³ I have tried to trawl through the literature looking for evidence of increased risks for asthmatics in diving incidents and I cannot find any. There is nothing on swimming and asthma risk, nor on very labile asthmatics and diving.

Paul Langton, Cardiologist, Perth

The best evidence comes from Douglas Walker's book on Australian Diving Deaths 1972-1993 which highlights what we know about the asthmatics who died.⁴ One died in an unrelated fashion (sudden cardiac death). The majority died on the surface (5 of 9), mostly from drowning whilst swimming in difficult circumstances. In only two cases was asthma considered a "significant factor" (both drowning), and there was only one case with confirmed pulmonary barotrauma. In a further case, the diagnosis of asthma was based on autopsy "changes in the lungs" rather than on any clinical history of asthma.

John Knight, Melbourne

The thing about the asthmatics who have been collected as dead bodies out of the Australian seas is that there have not been very many. One drowned because when he came ashore at the end of his dive he started to wheeze. Instead of walking around the little cove he went back into the water to swim across to get his Ventolin. He never got there. So acute asthma can really ruin your swimming.

Guy Williams*Case 4*

An 18 year old student who had wheezed a bit as a child. He gets quite a lot of hayfever. Lung function FVC 4.39 (4.49) FEV1 4.06 (4.20). Because of his history of wheezes he was given a saline challenge test, which was negative. I decided on the basis of that, that I had enough evidence to front the coroner and passed him with an informed consent.

Case 5

Now this one illustrates another point that might be relevant. He was a 27 year old tourist who was working in Australia on holiday. He was a college athlete who competes at a fairly high level. He claimed that he had exercise induced asthma when he ran and when he ran, he meant he was competing at maximal effort. He said that when he was at peak performance he felt a bit wheezy. His lung function was FVC 5.80 (5.40) FEV1 4.62 (4.54) FEV1/FVC 80%. We had a long discussion about asthma, the risks of asthma and diving and I did a saline challenge test on him which was quite negative. On the basis of an informed consent, with a history of perhaps exercise induced asthma there may be some risk above the normal, I passed him.

My assessment, based on a study of one or two, is that the average non-Australian diving candidate is much

more honest than Australian diving candidates. I do not know whether it is the dive shops or their mates, friends at school or other parties but I think that many diving candidates are informed by various parties that if you say you have had asthma, they are going to fail you. It seems to be particularly common amongst Australians that they like to bend the truth a little bit on these medical statements.

Case 6

A 27 year old fitter had hayfever and asthma as a child. He had not used bronchial dilators for years and years. His lung function was FVC 4.34 (4.84) FEV1 3.84 (4.18) FVC/FEV1 86%. I suspect that he was probably one of those who bent the truth a little bit as to how much trouble he really did have with asthma. When I did a saline challenge test, it dropped 30% very quickly and he became quite wheezy and was obviously uncomfortable and I failed him.

Case 7

A 17 year old student who gets hayfever and is wheezy when he has an upper respiratory infection. He claimed to get a bit of exercise induced asthma but I have found that exercise induced asthma is often misinterpreted as getting a bit puffed at the end of a run. Lung function was FVC 4.31 (4.35) FEV1 3.79 (4.07) FVC/FEV1 88%. I did a saline challenge test on him. And his dropped 15% over the duration of the test. According to the protocol that I use 15% is a cut off point so I failed him. Perhaps I may have been harsh.

Simon Mitchell

We use 20%. I just wanted to go back to the previous case. It appears to be a case of childhood asthma with no wheezing on the history or use of broncho-dilators for years. Now some people would say, and I am probably one of them, that on the basis of that history I would have passed him to dive without doing a test. Do you challenge everybody who has got any history of asthma, because that appears to be what that case indicates.

Guy Williams

The answer is that it depends on how I assess the honesty of the candidate in talking to them.

Simon Mitchell

I totally agree with that.

Guy Williams

Often in medicine one has a little voice that says, I should do this to this person. I can do the tests relatively easily. I quite like doing them because I give the candidates a real earbashing on diving medicine while they are doing it. And it is partly out of interest.

Simon Mitchell

Would you necessarily test someone with a childhood history of asthma with no medications for 10 years?

Guy Williams

It really depends on how I assess the honesty of the candidate. When I do diving medicals I do everything myself so I spend a fair bit of time with the candidate. I feel that because it is known locally that I do everything myself, and therefore it can be done relatively quickly, they seem to refer me all the difficult ones. The failure rate in recent diving medicals has probably been 25% which is just getting ridiculous and it has all been for asthma.

Case 8

A 22 year old plumber with hayfever who had wheezed as a child. No history of exercise induced asthma. He surfed regularly and never wheezed. I did a saline challenge test on him and he dropped about 20% in 6 minutes. Does anyone have any comments on this chap who actively partook in watersports and could swim and splash and get dumped in the waves. He denied all histories of wheezes but he has obviously got reactive airways. Did I fail him unfairly?

Unknown speaker

Can I be the devil's advocate. With people with vision problems, we just have them dive with their corrective lenses or contact lenses. Is there any good science behind not telling people to use their inhalers before they go for a dive and letting asthmatics that are on the borderline dive?

Guy Williams

I think the thing at the back of our minds is that I like to do things that are in the ballpark of what my colleagues are doing and so I can find somebody else to come with me to the coroner's court and say that I did the right thing. A year or two ago, someone on the SPUMS diving doctors list did a medical on a man who did not declare a history of asthma and I gather had normal lung function. Shortly after his course he died diving and it was thought that asthma and panic was responsible. The doctor was grilled in the Coroner's Court and he really did not enjoy that. The lawyers gave him a hard time trying to blame him for passing the deceased. A lot of the things that we do are based on what our colleagues do, and whether we can get other people to come to the Coroner's Court and say "Well I would have done the same thing".

Is it alright to have a puff of Ventolin (salbutamol) just before you dive? Is there any scientific evidence that it is not good practice?

Simon Mitchell

There actually is some data that suggests that a bronchodilator just then is a bad idea.⁵ Brian Hills showed that the use of a bronchodilator, theophylline, not only dilated the airways but also dilated the vasculature and allowed venous nitrogen bubbles to traverse the pulmonary bubble filter. Although the deleterious effects of that happening have not been proven, it is theoretically a bad thing. So probably not a good idea.

Guy Williams

At the previous meeting in 1995, it was suggested by a number of respiratory physicians that budesonide (Pulmicort) taken prophylactically blocked the response to hypertonic saline and exercise. Would somebody, with normal lung function, whose only medication is budesonide which is controlling their asthma perfectly, be fit to dive? Should you pass them? I do not. I think most people would fail them, but perhaps we are failing them unnecessarily.

Simon Mitchell

I would fail them because I would view their asthma as potentially not being well controlled.

Henrik Staunstrup

Divers on Pulmicort in Scandinavia who have normal lung function are allowed to dive. But they have to go through a methacholine test and if they still have normal lung function they are considered as having normal lungs so they can keep on diving.

Guy Williams

Here is a problem that is becoming increasingly common and it gives cardiologists something to talk about.

Case 9

This 63 year old man was quite an experienced diver. He had been diving for 17 years. He had a small anterior infarct a year before I saw him during a clean up dive in one of the local bays. The chest pain actually occurred on the surface and his buddies, who were nurses, thought it sounded cardiac and called an ambulance. He had an angioplasty and a stent. When I saw him he had returned to normal activities. He was back at work. He was back at the gym where he went regularly and he was exercising at the same level he had been to before. His post-angioplasty and stent exercise and thallium tests were negative. When he came to see me before resuming diving he was on Capoten (captopril), Pravachol (pravastin sodium) and aspirin. He came with copies of all the various reports from his cardiologist and local doctor. We had a long chat trying to inform him of the potential risk of diving now that he was back to a normal life again. I told him that I thought he was safe to resume diving, although if he had a sudden arrhythmia or a massive heart attack while he was diving he was likely to die. He was happy with that. In some ways he probably has the advantage that unlike most of us he knows what his coronaries are like. Does anyone have any comments on returning to dive after coronary artery surgery, coronary artery stents?

Unidentified speaker

I not only do scuba medicals, but I am also the chief medical assessor for CAMS motor sport in Victoria and we have got exactly this sort of problems with people who want to take up motor racing again. This man would be allowed to go motor racing, not at a senior level, but certainly for club meetings. I would allow him to dive if he wanted to.

Paul Langton

A couple of minor points. Firstly one needs to know his left ventricular function which they would know, and you do need to know what exercise capacity he reached but he could probably give you that verbally.

There are a couple of key issues in a case like this. One is that the vast majority of myocardial infarctions occur on the basis of a sub-critical stenosis, a 30% or 40% lesion which will not be picked up by an exercise stress test or a thallium test. This is a level of stenosis which many of us in this room will have.

So the negative stress and thallium tests are of little reassurance. Most infarctions occur either from an acute sympathetic nervous system stimulation, i.e. from unaccustomed exercise or in the early morning. The rest of them are probably from an inflammatory type stimulus which we cannot do anything about.

But we can prevent the sympathetic nervous system stimulation with a beta blocker. If, in the absence of contraindications, someone was going to engage in any sort of very vigorous physical activity I explain to them the mechanism of infarction and recommend they be on a beta blocker.

I tell all divers that they should be swimming fit before they start diving. Once you are swimming fit the unaccustomed component becomes less of an issue, but I tell males over 45, females over 55, and anyone else who might be at high risk, that they should have at least an exercise stress test before taking up any physically demanding exercise. Because you want to pick out the one that has got asymptomatic but critical coronary disease because they do die quite regularly.

Simon Mitchell

I would be worried about immersion induced pulmonary oedema. I have treated five cases and three were on beta blockers. For that reason I would suggest that it is not wise to dive while you are beta blocked.

Bill Brogan, Perth.

If I could present a series study of two. I have coronary artery problems although I have never had any major cardiac problem and I am on 40 milligrams of atorvastatin calcium (Lipitor) a day to reduce my cholesterol.

I think the key things in this sort of assessment are

- a I have had a good life and so if I do die doing something I enjoy doing, that is fine by me.

- b I have been diving for 52 years and I have got some idea of what I am doing, what I can and cannot do.

My son, 44 years old, has had a triple bypass. He is also medically qualified and in his clinical opinion now after 2 years, he is fit to dive again and is diving. My son is also pretty experienced.

Surely these are the factors we are going to look at in evaluating these things, which comes back to informed consent. What does the patient know and how sensible is he? And how experienced.

Guy Williams*Case 10*

One of the doctors in our area who has a very small ventricular septal defect (VSD) and I prevailed upon her to have an echo and a stress echo, more out of interest than anything else, to prove that she had no left to right shunt which, of course, she did not and I gather with small VSDs that situation probably never occurs. On the basis of an informed consent, and she could make quite an informed consent as a medical practitioner, she did a dive course. She has stopped diving because she took up sailing.

Case 11

This 43 year old is a fanatical triathlete, performing at a fairly high level. He had congenital complete heart block and a bipolar pacemaker has been inserted. He brought along the details of his pacemaker. The manufacturer recommends that, with that particular model pacemaker, you dive no deeper than 30 m (100 ft) on the basis that below 30 m their studies have shown there was some deformation of the case but performance did not alter. On the basis of an informed consent and subject to that depth limitation which he was more than happy with, I passed him as being fit to dive. Anyone have any comments?

Barbara Trytko

There have been studies done in the hyperbaric environment that demonstrated that although permanent pacemakers worked very well up to three atmospheres, beyond that some do fail unpredictably.⁵ The interesting thing was when pressure was reduced they restarted working perfectly normally again.

Guy Williams

Another problem group has appeared recently, those who as children have had congenital defects repaired.

Case 12

This 26 year old student had his patent ductus repaired when he was quite small. He was otherwise fit and well. So I passed him.

Case 13

This 28 year old farmer had a hole in his heart (ASD) repaired as a child. Again I could find no reason not to pass him.

Case 14

This 40 something year old diver, who happens to be a doctor, had the misfortune to be stabbed in the chest by one of his patients during a consultation. As a result he had bilateral tension pneumothoraces and a penetrating wound to his heart. His right main bronchus was severed. The

necessary surgery was done through a sternotomy. Now he has asked me "Can I dive again". We had a bit of a chat about informed consent and I suggested that he have a proper diving medical. Other than having survived those injuries he a normal person. At the moment he is not diving. In people who have had open heart surgery and penetrating chest wounds we worry about adhesions and other things that may predispose them to a pulmonary over-pressure event. Are these people at any significant extra risk when they want to dive, or if they want to dive again?

Paul Thomas

From the point of view of his pneumothorax he should not have underlying structural lung disease so you would think that he should not be at risk. If one has got blood in ones chest that often causes scarring between the two layers of pleura so therefore one is much less likely to have another pneumothorax. The other point is that the scarred lung will be abnormal and there is the possibility of an over-pressure event, but I do not know of any information about the risks.

Guy Williams

It seems to me that he fits within concept of informed consent. That one can explain the risk to him and he can decide for himself what to do. I think his extra risk is probably not all that high. But, as we discourage people with penetrating chest injuries from diving, there is no evidence.

Cathy Meehan

The Australian standard says that a penetrating chest injury is an absolute contraindication, so you have to be really careful.

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DIVING CANDIDATES AS THEY PRESENT FOR FITNESS TO DIVE ASSESSMENT DIVING MEDICINE CASE STUDIES Part 2

Vanessa Haller and Guy Williams
with audience participation

Key Words

Barotrauma, cardiovascular, case reports, decompression illness, dysbaric osteonecrosis, injury, medical conditions and problems, pulmonary barotrauma, spear fishing.

Vanessa Haller

General practitioners do a lot of the screening of new divers but we also see them after they have been diving for years when they come in with problems. Unfortunately we cannot do much to prevent them diving or from continuing to dive and sometimes we need some help in how to deal with these problems.

Case 15

I only met this gentleman two weeks ago, when I was visiting his mother. He is a 46 year old professional underwater photographer. This story came up in conversation. About 8 years ago, in South Australia, he had some sharp pain in the left side of his chest with a little bit of shortness of breath, but he ignored this, thinking that it was muscular. The next day he went for a dive and was separated from his buddies. He was in a bit of a surge. He surfaced to look for them and became short of breath on the surface, so feeling that he was better at depth, he went back down again, because then he was less short of breath. Eventually he had to surface because he was running out of air. When he surfaced he had severe shortness of breath, severe left sided chest pain and collapsed. Obviously on the day before the dive he had had a spontaneous pneumothorax which had become a tension pneumothorax by the time he reached hospital. He had a surgical repair of his pneumothorax. Six weeks later he was given the OK to continue diving and for the last 8 years has been diving quite successfully with the repaired pneumothorax.

Diving is his income. He has no obvious bullae on chest X-ray now. Would anyone like to comment on this?

Unidentified speaker

A spiral CT or a MRI for studying the lung should be done.

Deborah Yates, Respiratory Physician, Sydney

I know what respiratory physicians might do but that might not be what is recommended by diving specialists. I think this man is actually at a significant risk. Whenever anybody has had a single pneumothorax I always worry about disease on the other side. His surgical repair should mean that he should not have another one that side. But I