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DIVING ILLNESSES AND INJURIES

EYES AND DIVING

Dr Peter Cohen

The main eye problems have with diving are common sense ones. I think more problems come from divers on the surface than underwater. By this I mean, it takes 2.5-3 hours to get out there and you are under for an hour and then you come up and go home. I practice in a coastal suburb and I do see some divers - and people who go out on the ocean. The common problem I see is ultraviolet sunburn. They come in with the equivalent of a welder's flash with a sore eye. The treatment is quite obvious. Keep out of the sunlight for 2 days and the eye usually gets better.

The few professional divers that I know, just like professional fishermen and amateur or professional yachtsmen, get pterygiums. It amazes me that they get out there and there is a dead calm mirror ocean yet they never wear sunglasses. They end up with pterygiums. If you lop them off and the men go back onto the ocean they grow back. And they grow viciously and are very nasty.

Another problem that is practically confined to inexperienced divers is mask squeeze. I do not think an experienced diver will run into this problem. Mask squeeze can present some problems in that people may get, with severe mask squeeze, subconjunctival haemorrhages because the conjunctival vessels are unsupported. I consider sub-conjunctival haemorrhages are innocuous. I do see a fair number in my practice, not necessarily from diving but from any episode of raised venous pressure, and I generally tell them just not to worry. But with a severe mask squeeze they can get chemosis and the conjunctiva will prolapse outside the eye, which does tend to make people panic. However with a tulle gras dressing and an eye pad it should settle down without anything further needing to be done.

Coming on to people with medical eye problems that would be a contraindication to diving. One would be a very high myope who has a history of retinal detachment or retinal hole. I would very much predispose to getting either another hole or a retinal detachment. A retinal detachment in high myopes is a very severe thing. They often do not do well. Their retinas tear very easily as the retina is very stretched and the retina comes off easily. It is very difficult to get it back on. The technique of our surgery with retinal detachments, nowadays, is that we put encircling bands around the eye and we use a plomb, which is a piece of silicone which is pushed down to indent the sclera. We are trying to indent the sclera over where the hole is. With a high myope the sclera is very thin and you can easily perforate the eyeball. Then you are in more troubles than when you started.

The other thing that I am told would also be dangerous, but I have never been confronted with it, is a person with advanced glaucoma with a severe loss of visual fields. Both these conditions of high myopia and advanced glaucoma tend to occur in people who would not dive. So I do not worry about it too much. A high myope is not going to see very much underwater - so why dive? He is going to have trouble with what techniques we have trying to correct vision underwater.

On the whole I am consulted by divers about refractive errors. I am a myope, and I wear contact lenses underwater. But they do have their hazards which I will tell you about. A lot of people do wear lenses glued on to the mask, that is the only alternative. One girl I know actually has wired in, and sealed with some Araldite, a pair of spectacles so that they sit on her nose when she puts the mask on. But it is a very difficult thing to do. The problem with putting lenses in masks is that you have already got a restricted visual field from using the lens. The size of the lens is so large that you get peripheral aberrations, quite severe peripheral aberrations, in a lot of cases. If you are quite happy with having a further restriction to your visual field there is probably no trouble. A lens is adjusted to being a certain distance away from your eye. When you move it further away from the eye and glue it to a face mask and then start looking down and sideways through the lens you start to get oblique astigmatism and this really interferes with clear vision.

In my practice I am quite a fanatic. I believe in people wearing contact lenses. I seem to advise them all the time. Perhaps they think I am a nut because a lot of them lose them.

Over the years we have gone through a development of certain types of contact lenses. The first ones were the scleral lenses. This is the very earliest type of contact lens, and we still fit a few of them. They are made out of hard polymethyl methacrylate. They go right over the cornea and extend onto the limbus and under the eyelid. The first ones were made in about 1857. In those days they used glass. But these lenses were very difficult to construct. They have the advantage that they do not fall out underwater. One of the problems under water with any contact lens is that the lenses stick on with surface tension. If you flood your mask you can very easily have them come out. I do not fit these scleral lenses. I refer them on.

I know one ophthalmic surgeon in Sydney who does a few each year and he says that about his only call for these lenses, for optical purposes, is that he prescribes them for swimmers, especially water polo players where they really need to see what they are doing. They do have a practical role because they do not fall out. They can be used for cosmetic purposes as you can paint an eye over this lens for someone who has got a very scarred eye that is non-functioning. One problem with them is that they have a quite limited wearing time. Often the patient can only tolerate wearing them for 4 hours at a time. They are very difficult to make. To give you an example of why they are difficult to make. I will explain the procedure.

One places a small cup on the anaesthetised eye. There is a tube poking out from the cup. You get a 2 cc syringe and you squirt a quick setting substance down the tube. This gives you a mould of the front of the cornea. And from that negative mould you make a positive mould in plaster or something a bit harder than plaster. On that positive you start to make the lens. After which you start to grind the lens. It is a real hassle to make it and people must really want to have to make it. But for people who want to use contact lenses underwater in a situation where they could very easily lose them and they will be under for a short time they are a very practical answer.

The other types of lens that we have, and it has been around for a long while is the corneal micro lens which is made out of a hard material. The commonest material that is used is the same material from which scleral lenses are made, poly-methyl methacrylate. Nowadays they are mainly used in people with astigmatism and who are hypermetropic. Once upon a time they were the standard lens, before the soft lenses came in. The problem with them is that they are more easily lost and especially they are very easily lost in divers. You have just got to get the slightest amount of water in the eye and they lose surface tension and pop out. They have problems with adaptation. I have a continual parade of people who come in and say “I just cannot wear these things”. They are a lot harder on the cornea. Lately the materials they have been made of have changed so that the manufacturers say that they are of a semi-soft material. It is cellulose acetyl butyrate and has a higher oxygen transmission and is supposed to be better. But I am not quite sure. And we have got even later materials which I will not go into. The advantage of them over other lenses is that they are very easy to prescribe. The softer lenses in some people are quite hard to prescribe but these often are a bit easier. It depends on whether the patient has a lot of astigmatism or not. But the problem is that if people have high hypermetropic errors trying to prescribe our current plastics in soft lenses is a very difficult problem, if they want good vision and they want to wear contact lenses.

The soft lenses are the modern contact lenses. Someone added a water group on to the plastic molecule. That is what led to the start of the soft lenses. The interesting thing that it looks very easy to add water. It was done in Czechoslovakia and the firm that did it has since made about $600,000,000 out of putting that extra radical on the molecule. It is the dominant plastic that is now used in soft lenses. And soft lenses are a big business. They are very much a big business now. They are very flexible. They go over the corneal-scleral junction about 1.5 mm. Generally in a person who is myopic they are easy to prescribe. For someone who has myopic astigmatism they are reasonably easy to prescribe. And for people over about 50 years old who are long-sighted they are not too difficult. But our problem with them is that they have a low oxygen transmission and they are only about 38% water content. Which leads people who are often active in sport who want contact lenses to run into trouble. There have been some plastics which have come out over the last few years, that are 50% water content. They are claimed to be better. But I find that the problem is that as the water content of the lens goes up they become much more of a mechanical problem for the patients to look after. They tear very easily. They become also more expensive. We have even got up to the stage now of having a type of soft lens material that has 75% water content. The manufacturers of this material boast that it is a permanent wear lens. The interesting thing is that the ophthalmologists all refer to it as an extended wear lens because there is a problem with wearing these lenses all the time. With the normal soft lenses you have got to take them out every night. Clean them overnight and put them in the morning. But with these extended wear high water content lenses they are more oxygen permeable because of the high water content. The problem is that the lenses are not being disinfected. There have been a number of instances, even in Australia, where this has led to a number of corneal abscesses. You have only get to have one corneal abscess in a person who wants to wear a lens for cosmetic purposes to put you off these lenses for a very considerable period. The other big problem with a high water content lens is that, because of the high water content, they are very friable. The patients have to consult you quite frequently. You have got to be around all the time in case they run into trouble. You have got to see them once a month. It becomes both time consuming and expensive for the patient. So the practical application of these very high water content lenses, not the normal soft lens, is in aphakics and that is only in some people who are long-sighted. The biggest problem a lot of long-sighted people, really long-sighted people, have with contact lenses is that they cannot see the contact lens to put it in their eye, when they have got to put it in first thing in the morning.

Originally when the soft lenses first came out we could not prescribe corrections for astigmatism. We have reached the stage now when we use the same plastic and we can. We truncate it, that means we cut off the bottom of the lens. This helps the lens stay correctly positioned. We make it so that it is thicker at the bottom than at the top. The normal thing that happens with a normal contact lens when people blink is that it rotates. It spins around. And you can easily see what I mean when if you look at an eyelid closing slowly. It closes like a zipper from the outside to the inside. And that just spins the lens more or less inwards and upwards and out. The idea of making the soft lenses thicker at the bottom is so that every time they blink the lens settles down between blinks. It is not always easy to get these soft lenses sitting as you would like to think they should. We have various ways of doing it. We can make them even a little bit thicker at the bottom but this sometimes leads to problems in that they complain that every time they blink they can feel the contact lens between their eyelids and a lot of people really do not like it. We do get a lot of problems with these lenses.

Soft lenses are reasonably cheap and easy to make. When I mean by cheap is that the price is around $100 to $114 for a normal spherical correction. But these special astigmatism lenses in Sydney are $184 a pair. And you really would think twice about diving with them on, when you have got a very good chance, if you flood your mask, of losing them. For unlike the complete spherical lens these lenses will float off easily. We can make the same lens, completely spherical with the ballast just incorporated in a part that we would normally cut off. However I find I run into fitting problem.

Some attempts have been made and are still being made, and I am sure as time goes will be successful, of making silicone lenses. That is using silicone rubber. The problem with silicone rubber is that it is hydrophobic, it repels water. We were at one stage told these were the ant's pants for people after a cataract operation. They are easier to put in as the silicone lens is semi-rigid. Because they are hydrophobic and repel water the manufacturers put a chemical on the outside so that they would not repel water. If you do not you would get the tears sitting as little balls of water on the front of the contact lens, therefore interfering with vision. I was not the only one involved in this trial and we prescribed them. After about a year the patients all came back because the chemical had come off the front of the lens. Which was embarrassing when they had paid $150 for a pair of contact lenses. At the moment attempts are still being made, and some have been successful, to get these silicone elastomer lenses in some form that we can put into people that does not have all the disadvantages of the soft lenses.

The biggest disadvantage of the soft lenses is that they do take a fair bit of maintenance. We have got to spend about 10 minutes a night looking after them properly, sterilizing them. It does not worry me but it is a trial for some people.

That is basically all I want to say about eye problems of diving. As I said most problems are optical, not so much related to medical problems.

EAR AND DIVING

Dr Bill Hurst

I was asked to talk tonight about the ear. It is very difficult to talk to a group like this on topics that we have had year after year, You all know just about as much about ear barotrauma as I do. So I thought I would change it around and talk about dizziness because most people talk about deafness.

THE EXTERNAL EAR

When water that is either above body temperature or below body temperature enters the external ear convection currents are set up in the semicircular canals. This fools the ear because the fluid is moving either up or down depending whether your are using cold water or warm water. The vestibule on that side or the lower canal on that side thinks that there is motion, and because the opposite ear has not got an equal and opposite stimulus it throws the computer between the ears into confusion. Then we become dizzy. If in any way you get cold water into one ear more than the other you may get a caloric response. This will last only a short time. It is a true rotating nystagmus and it will settle down as the water warms up. Things that will cause this are wax blocking one ear or ear plugs. I put wax first because no diver in their right senses puts plugs in their ears. You do occasionally get some fool who has been scuba diving with ear plugs in and then you have to fish a plug out of the ear about six inches in. This causes quite a bit of trauma.

THE MIDDLE EAR

You all know the problems of descent and ascent, Eustachian tube obstruction and traumatic perforation. When you get a traumatic perforation there is exquisite pain, acute pain. Then you get a caloric stimulation. You get pain and immediate vertigo. Now the things that will cause a perforation are forceful auto-inflation, or more usually the fool who keeps going down when he has got pain in his ear. He keeps going down, down, down, and eventually it pops. He comes up screaming like a Polaris missile. The same can happen in ascent, this is the reverse Eustachian tube problem. Usually it is a passive mechanism in that as you are coming up the air goes down the Eustachian tube and escapes. I think that I might omit discussing locking on descent because someone might like to ask a question about that at the end of the discussion.

If you get a traumatic perforation while you are diving, the treatment is do nothing, unless you have a discharge from your ear. Strangely enough if you get a perforation in salt water usually there is no infection. This is true in the Melbourne waters. I am sure you would get a high plankton count in the middle ear here and you would probably get it infected. Certainly if you perforate your ear in fresh water, as we see often in water skiers, then you can get a discharge from the ear only a couple of hours after that injury. It is quite dramatic. In fact a lot them come in and they think that the water is still draining out of their ears from the incident. If you get a perforation you can also get cold water pouring into the middle ear and the caloric effect is even more dramatic than it was when it just goes into the external ear, because the cold water is close against the vestibule.