

Beyond The Blue magazine – June 2006

Skin Bends – Cinderella Symptoms or a DCI trap for the unwary?

Skin manifestations of Decompression Illness (DCI) are of interest historically and clinically very important. My personal views and clinical management of them has of necessity changed in the last 33 years. I deal with some aspect of DCI on a daily basis, and within the last 20 years, skin bends have achieved a major diagnostic and preventive significance. What were once seen or reported occasionally could now be thought of as the most common symptom of DCI. . If by the end of this article you have gained a new respect for skin bends, then an objective will have been reached.

The Skin as an Organ

The outer layers of the skin are dead cells, constantly being shed, but the inner layers are vital and active. The largest organ of the body keeps the inside in, the outside out, is impermeable to many substances but easily penetrated by others and is waterproof. It has a copious blood supply, and is very responsive to the need for cooling – high blood flow, or retaining heat, low or absent flow as required. It is replete with sensors for heat and cold, light touch, pain, size and shape discrimination, pressure and vibration. It is damaged by prolonged immersion, excess heat or cold, and a variety of chemicals. It can mount allergic responses and demonstrate aspects of overall health and may become cancerous. Even in starvation it is separated from other tissues by fat cells. In some places it is tethered, e.g. in the palm, and in others is very mobile. In some places it is moved by muscles to show emotion and discomfort. It is much the same thickness all over, but has a wide functional adaptability. In good health it is self healing. Treat it well since its responses are indicators of your diving practice.

Some History- Skin Bends are not new.

Diving has a longer pedigree than compressed air tunnelling, but it is in reports on the latter that I found vivid early descriptions of skin bends. Paul Bert in *La Pression Barometrique*, (1877) cites a report of 1859 “*the frequent itching of the skin, fleas, as the workmen call it*” and later “*sometimes there was rather evident local swelling... the left breast of one workman suddenly swelled as to resemble the well formed breast of a woman*” The cause of all symptoms after diving and tunnelling was then up for discussion.

Snell writing of the first Blackwall Tunnel in 1896 described a case of swelling of the scrotum and abdomen, and later he says that itching of the skin is not so general, as his colleague, Dr Foley would have us believe. Whatever the frequency, skin and other symptoms followed decompression and a 1859 comment was “pay when you come out”

I began my work in hyperbaric medicine at the Second Dartford Tunnel (1973-77) and later at the Thames Barrier 1976-1982. My mentors in the Medical Research Council (MRC) Decompression Sickness Panel suggested that my approach to skin bends should be to treat them as a subsection of Type I bends. Only if accompanied by other symptoms did they need recompression. Their advice was based on many years of medical supervision and epidemiological surveys of tunnel workers. Bends then may or may not be reported and self-treatment, often by returning to the pressurised environment was frequent. Then as now both tunnelers and divers had the mistaken idea of “three strikes and you’re out”. However ongoing appraisal of decompression sickness symptoms and treatment in several centres produced a drive towards better recognition and reporting in divers and tunnelers. While there is a common primary cause – exposure to pressure – the various presentations of DCI due to dissolved gas arise in a number of ways which can be distinguished if a careful history is taken. This realisation may determine treatment, and is of real significance in assessing future fitness to dive and the investigations and therapies needed to establish or restore fitness

Diving medical texts from 1970 onwards frequently have good but short sections on skin bends and most describe the various forms with notes on their relative severity.

I suppose that the short sections mark Skin Bends as the real Cinderella. A good bend needs a good hurty pain or serious neurological symptoms. This means we physicians can write reviews of dramatic treatments and recoveries using favourite tables. Skin bends however do not make front page news, they are not life threatening and are usually just a nuisance. I now ask specific questions on skin bends. All too often they have been relegated to the dustbin of long past experience.

Good reviews are found in *The Physician's Guide to Diving Medicine*, Plenum Press 1984, Bennett & Elliott, 4th Ed 1993, and the various editions of Edmonds and Pennyfather, *Diving and Subaquatic Medicine*. My own contributions to the medical literature, a chapter in *Occupational Health Practice*, 3rd Edition 1989, and some advice encapsulated in UK Diving and Tunnelling legislation (1997 and 1996) were more dogmatic than most. In the OHP article, skin rashes, bruising mottling, itching and swelling of the limbs or trunk were placed in an intermediate group between the old Type I and Type II with a footnote that all intermediate and type II symptoms should be treated as serious decompression illness. This approach can be justified if all those with certain or possible symptoms of DCI should be recompressed. DCI mimics and is mimicked, and skin bends may not be the only symptom.

Skin Bend or something else?

If you notice or develop a problem with your skin after a dive, follow the rule – *it's a bend until proved otherwise*.

So you're not sure whether or not you have a "Cutaneous Manifestation" or skin bend. What are the signs and symptoms of the several types?

1. The old tunnelers called it "fleas" Just an itchy sensation. Can be a small, localised or generalised. Affects the trunk, arms hands face and legs. It is commonly thought to follow dry dives Comes on shortly after the dive and may last a few minutes or a few hours. There is nothing to be seen on the skin.
I had this for a few minutes after an 80 metre dry dive on air but not after Heliox.
2. Itchy sensation possibly with folliculitis (inflammation of the hair follicles), attributed to bubbles in the skin
3. A red rash over the trunk chest shoulders, back and upper abdomen. May last several hours. It itches.
4. A more serious diffuse raised red rash, angry looking with little papules – blisters.
5. Marbling of the skin – the best way to describe this is to refer you to the illustrations. This was my first case of skin bends in 1973. It had been present for 24 hours when he asked for advice before returning to work. No prizes for guessing my advice. He was otherwise symptom free. The mottling went in another 48 hours. In some cases this form of skin bend is associated with more serious symptoms and really does require urgent medical advice.
6. Localised swelling as described in Paul Bert's book and later by Snell. It comes on quite soon after a dive, may be on one side or both. The skin is stretched and the swelling can be indented by pressure. The natural history is for the swelling to track down the trunk, causing discomfort on the upper abdominal wall, then a need to let out the belt and then a requirement for some scrotal or equivalent support. (Skin bends like all DCI are not gender specific.)
Finally, it may track down the thighs, legs and rarely into the feet.

Sometimes you feel you can be sure it is not a skin bend but may be a diving related illness. Try these (some are obvious):-

- Mask Squeeze – your face and eyes will tell it all
- Suit squeeze – deep red lines corresponding to folds and bands of tightness in a badly fitted suit or inadequately controlled dry suit
- Allergy to stabilisers in the material of your suit or under suits – develops where your skin is in contact with the material, usually after a few uses.
- Contact with toxic sea life, eg fire coral, some jellyfish
- Careless exposure to sunlight
- Mediastinal Emphysema - free gas in the neck – caused by pulmonary barotrauma. It crackles under your fingers like broken eggshells.

Or non-diving related

- Scabies or other skin parasite
- Herpes Zoster or shingles

So you think you have a skin bend. What do you do now?

You are sure, not sure or just do not know. As in medicine, where 10 are gathered together there will be at least eleven opinions. If you are talking about it you have at least admitted to yourself or persuaded your colleague that there is a problem. Do not blame the symptoms on the medicine you took last week or a bad bowl of mussels.

If you are on a dive boat, you should have O₂ available – use it if you are reasonably sure of the diagnosis and your distress justifies it. Then speak to a diving doctor, preferably one with a chamber attached so that if things go pear shaped, you will not be arriving unannounced.

If you are close enough to the chamber and the symptoms are thought to warrant it, you may be recompressed. My experience is that this is effective only in the first hour or two. Otherwise you sit it out for a few hours or a few days. In the world of modern diving, your skin bend now needs proper evaluation by a diving physician .

Evaluating Cutaneous Manifestations after diving

Any DCI symptom after a dive, whether treated actively or not, should be reviewed. I will assume in this article that the skin bend has fully resolved. I wrote above that I thought the skin bend is the most common form of DCI but not the most commonly reported as acute illness. One patient a few years ago had done about 800 dives and had skin bends after almost 600 of them. The diver's assessment of these recurring skin itches and rashes was that they were normal after diving. After treatment for a more severe DCI, review suggested that a PFO was present. It was identified and closed. There has been a further episode of DCI but no more skin troubles. This was an extreme case but the numbers of skin bends reported at routine examinations or in post treatment reviews are surprisingly large and helps explain why they should be evaluated carefully.

A bends review should cover the nature and extent of the dive, the work done, diving conditions, condition of equipment, rates of ascent (not such a problem if you use dive computers) and a basic review of fitness including body composition. The modern love affair with the Body Mass Index is insufficient for this or any purpose. If relevant I use a combination of skeletal proportion, body fat by skinfold measurements and muscle girths. The impression is that people with higher proportions of body fat have more skin bends. Both skinnies and fatties may have PFO's of which more later.

Depending on whose dissertation you read, skin bends (1 –5 above) may all be due to gas bubbles in the skin or cutaneous circulation, or the release of histamine and serotonins etc. The marbling is without doubt bubble mediated. The swelling in No 6 is due to bubbles obstructing lymphatic capillaries, and so it is lymphatic bends.

Timing of the onset of the skin bend(s) may be important in allowing a diver to return immediately to diving. However most appear within a few minutes or within 2 hours of the end of the dive no matter how long or deep. The onset will to some extent be dependent on depth and duration, as well as gas mix. Technical diving, use of helium mixtures or other highly diffusible gases will not increase the risk unless the subject is for instance on air in a helium filled chamber when “isobaric counter diffusion” may supersaturate the skin and cause bubbles and symptoms.

One skin bend is like a single swallow. Summer has not come and the victim may not be susceptible to bends. DCI is a multifactorial condition, it strikes randomly so a post bend review can allow an immediate return to diving or a deferment for investigation. The victim may simply have dived in an unwise and provocative manner, or have been led astray, lucky not to have a more serious illness.

Lots of skin bends – so needs investigation.

Actually two or more will do, especially if you have also had other forms of DCI. I wrote above that reappraisal of cases of DCI has allowed a number of distinct mechanisms to be postulated for the various presentations. All dives, of any depth, will be attended by bubbles during decompression, even when deco stops are not required. You will of course do the safety stops as recommended by your particular diving discipline or organisation.

Careless? Irresponsible? Disregarding the protocols? You need a psychiatrist, not a diving doc. If committed to safety and following current recommended decompression profiles, your skin hit is probably unprovoked or undeserved. (My oldest active diving patient is 76).

Dr Wilmshurst shrewdly recognised that many bends fell into the undeserved category, were usually neurological, most commonly spinal with a history of skin bends. He found a high proportion of right to left shunts in the heart, the commonest defect being a patent foramen ovale or PFO. His experience and that of other hyperbaric physicians in Europe and the US with a special interest in this aspect of bends now means that such cases require formal testing for a PFO. Papers published as long ago as 1943 showed that 25 - 30% of the population have a PFO although those with a significant defect number only 1 – 1.4%.

A history of several skin bends suggests an undue sensitivity and high risk of a serious DCI unless pre-emptive closure is done. Murphy the lawgiver ordains that such DCI will occur well away from a chamber and may be largely irreversible. It may be preventable. Primary assessment for possible PFO is a low risk procedure using echocardiography and bubble contrast. The decision to close depends on a more invasive procedure with some risk. Not all right to left shunts can be closed since they are not all PFO or atrial septal defects.

Many statements made above are applicable to all DCI. Most DCI is sufficiently noisy in a clinical sense to demand assessment and treatment. Skin bends are clinical church mice but may have greater long-term significance than a promptly treated fully resolved neurological hit. To have a bend means that that days’ decompression was not appropriate. To have many bends, even if only (?) skin bends indicates potentially dangerous and unacceptable risk factors in need of identification. Be wary for yourselves and your colleagues.

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