HIGH ALTITUDE FLIGHT HAZARDS AND DESIRABLE ACTION
R C Adkins

Case History

The owner of a Mooney Turbo 252 travels regularly between Perth and Sydney on business. The Mooney Turbo 252 is a single, turbo charged, piston engined aircraft. (Mooney is the maker’s name) Normal cruising speed is 195 knots and the range 1,820 nautical miles at 27,000 feet (all figures approximate). He usually tries to improve on his inaugural point to point speed record (homologated (confirmed and approved as a record attempt) by the Federation Aeronautique Internationale (FAI) which is the oldest aviation body in the world, having been founded in 1905, which has its headquarters in Paris), by cruising at around 27,000 feet to take advantage of the strong Westerlies. At these altitudes he has adequate supplies of, and breathes, oxygen for the entire flight. Because of the single pilot aspect, his wife insists that he take someone with him, so that there is a back up in the event of an oxygen problem, i.e., kinked hose, bottle runout, etc., with the attendant hypoxia problems. Both breathe oxygen for all the time that they are above 10,000 feet.

On the flight in question, his co-pilot was Mooney rated with considerable private pilot experience over many years. She had been for a “run” in the decompression chamber at RAAF Pearce, so was familiar with the symptoms of hypoxia.

The flight departed Jandakot at 0720 WST, with a flight planned time of 7.19 hours for the 1792 nautical miles to Bankstown, cruising at 27,000 feet, and that altitude was reached in approximately thirty minutes.

After about one hour and fifty minutes on the cruise, the co-pilot began to feel an uncomfortably gaseous or bloated feeling in the abdominal area followed by nausea (having never been airsick in her life) and needed to use THE bag. After another one hour and thirty minutes she began to experience aches and pains in the arms, so took a couple of Panadol, and after a while felt the same ache and pain in her legs. She tried alleviating the problem by flexing the arms and legs as much as possible, given the restricted space available.

The pilot became concerned, and proposed going down, but the co-pilot did not want to negate his record attempt and insisted that he keep going, although she was not feeling very bright.

At around Griffith, and about six hours and forty minutes into the flight (the winds having gradually dropped off), the co-pilot began to come good, and then helped to “run” the descent, timing, working out speeds, and over Bankstown Air Traffic Control Tower, logging the time and calculating the overall record speed which was increased by 7 knots to 207 knots.

On landing, the crew deplaned in the parking area and the co-pilot promptly collapsed on the tarmac as her legs gave way under her. Time now was 1800 EST. The total time in the air had been eight hours and thirty minutes.

Another woman pilot was there to meet them, and after propping up the co-pilot against a hangar door, went to the Flight Service Unit (FSU) for assistance, as they were nonplussed by her condition. The FS officer took action by ringing the Fire Station, knowing the staff were well versed in first aid, and they responded straight away. The co-pilot’s condition had them baffled, but they made her as comfortable as possible where she was, covered her up in their big warm jackets and then contacted the paramedics at Bankstown Hospital. (It is interesting to note that by this time the co-pilot was professing to be alright and just wanted to go and lie down.)

The paramedics responded with their ambulance, examined her, and on seeing marked bruising on her arms, declared that she probably had the “bends”, and took her off to the hospital.

By this time it was about 2000 hrs, and she was admitted to casualty. Over the next couple of hours she was examined, her low blood pressure and weak pulse noted and an intravenous drip started. Various calls were made to various people and departments, and eventually the decision was made to transfer her to Prince Henry Hospital, at Little Bay on the other side of Sydney, the diagnosis being suspected as the Bends.

Prince Henry Hospital has a Hyperbaric Unit for this and many other treatments, and after an hour’s ride in the
ambulance with the same medics, she was admitted there around midnight.

More examinations followed admission to the ward. At about 0200 hrs she was trundled out on the stretcher again (it was now pelting with rain so that they had to pull the blankets over her head to stop her getting drenched) and driven to the Hyperbaric Unit whose staff had by now come on duty to handle the case.

There she was placed in the recompression chamber, breathing 100% oxygen and with an attendant sent “down” to 18 m (60 ft) of sea water, where they stayed for two hours.

After this treatment she was returned to the ward and rested until examined by two specialists later in the morning. They had by this time definitely diagnosed her as suffering from altitude decompression sickness (DCS) after testing her reflexes thoroughly, and then sent her for another session in the chamber similar to the last, at 1400 hrs. Co-incidentally, one of the above (a professor), had experience of aviation bends going back to the Meteor/Vampire days.

All this time she was on the drip, and about 2000 hrs, it was determined that her kidneys were not functioning due to dehydration. A specialist arrived, as he put it most succinctly, “to kick start your kidneys”. This took about an hour and a half, by increasing the flow rate of the intravenous drip under pressure, and soon her system was back to normal.

Two more days in bed ensued, with many tests of reflexes and blood pressure and she was eventually released on the Thursday afternoon.

Discussion

Although the story may seem a bit long winded, it is an attempt to show things as they happened and the puzzlement of the various participants when confronted with an unknown situation in the air.

The writer has been engaged in civil aviation since 1948, including 33 years as an airline pilot, and had never heard of the bends in the air. Certainly he has flown pressurised aeroplanes for 26 years but apart from a “run” in the RAAF decompression chamber at Pearce Base (WA) in the early sixties, has never seen or read anything on the bends in civil flying. Even back then, flying DC3s for high altitude photography, at 25,000 feet, no mention was made of the possibilities of the bends.

And yet it appears from discussion since this occurrence, that there is quite a bit of high altitude flying taking place, such as survey/photography, etc., and a lot of people on the ground know of the problem.

Recently a parachutist set out to establish a new jump altitude record, but got the bends before leaving the aircraft. He was treated in the chamber, and later made another attempt with the same result, so abandoned the idea.

Further enquiries to Prince Henry have thrown up SPUMS, the South Pacific Underwater Medical Society, devoted to underwater medicine, whose April/June 1989 magazine issue has a six page article on “The Flying Bends”, which traces the history of it back to 1934, including the fact that prior to 1959 over 17,000 cases of altitude DCS were reported, of which 743 were serious with seventeen fatalities.

Admittedly, a lot before and since were very high altitude military flights but also a lot were quite lower. It is a great pity this information is readily available, but not to the ones actively involved.

The problem occurs because nitrogen is dissolved in the blood. As the ambient pressure falls bubble formation occurs in the gas saturated body tissues causing joint aches and itching, tingling, and sometimes, choking and spinal cord damage.

So, how to prevent it; how to recognise it; and what to do:

1 Anybody can get it, but a lot do not. Increasing age is a factor, susceptibility increasing nine-fold between the ages of 18 and 28 years. And females are three times more susceptible than males.

2 High rate of climb is a factor. However, pre-breathing with adequate 100% oxygen before flight goes a long way to combat it.

3 Be alert to the onset of a gaseous feeling in the stomach, and achy joints, and itching, and do not move limbs in an attempt to relieve the discomfort. That only helps to increase the severity of the problem. Apparent “bruising” could be a pointer.

4 Descend at once. The longer the exposure, the worse it gets. Threshold altitude for onset is around 18,000 ft but may be as low as 10,000 ft.

5 Do not be in a hurry to land. Head for where you think the best help is available. Immediate treatment is necessary.

6 Recompression chambers are situated at Sydney, Melbourne’s Alfred Hospital, HMAS STIRLING near Perth (and soon at Fremantle Hospital, WA), the Royal Adelaide and Royal Hobart Hospitals, Townsville and Darwin. So it looks like if you are...
in trouble, head for a capital city.

7 Going flying after scuba diving is a no no. A dive to 15 m (50 ft) then a climb to 1,000 m (3,000 ft) can cause onset.

8 Do not be put off if the sufferer appears to recover and wants to be left alone - GET HELP.

In the case reported above, the pilot, without knowing it, did all the right things (as I see it, the victim being my wife). He offered to go down, but the co-pilot said no. Landing at, say Ceduna, would only have compounded the problem with further delays, before being flown out to one of the above locations. Although he did not descend, (which medically is best), this was probably a good thing, as he kept his tailwind, thereby increasing his range, and so not having to land short of the best help.

What a help to have somebody to meet you! The woman friend said she would meet her friend (the co-pilot), and even though they were an hour late from losing the winds, she was still there. They were tired after all their problems and the long flight, and somewhat confused by it all. She took over and set the help chain in motion, ensuring swift and adequate action was taken.

Overall, a frightening experience for all concerned, but hopefully now a lot more people will have some idea of what it is all about, and what to do.

After all, a lot of people on the ground appear to know about the “Flying Bends”, why not the poor old pilots?

Last but not least, the Prince Henry Hospital Hyperbaric Unit treats, not only DCS, but gas embolism, carbon monoxide poisoning, cyanide poisoning, hydrogen sulphide poisoning, cerebral oedema, crush injuries, compromised skin grafts, non-healing wounds (skin ulcers are said to virtually heal before your eyes), radiation necrosis, soft tissue infections, osteomyelitis and gas gangrene. Does your doctor know that?

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The article has appeared AOPA Magazine for October 1989 (Aircraft Owners and Pilots Association) on page 108. Co-incidentally, another article on the Bends, entitled “What a Fizzer” appeared on page 122. The address of AOPA is PO Box 1065, FISHWYCK A.C.T. 2609. It is reprinted here with minor changes to make it more easily understood by divers. We are grateful for Mr Adkins permission to reprint.

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BUBBLE GROWTH IN BIOLOGICAL SYSTEMS

Brian Hills

Introduction

No diver likes to think that bubbles have formed in his body during any decompression, especially one which has proved asymptomatic. The same philosophy tends to apply to those who formulate the diving tables which are the ultimate product resulting from experience and research into the mechanisms of decompression sickness. Although the wording accompanying the presentation of methods for calculating decompression tables may sound plausible, it is equations and not words which are used in the computation and these may not necessarily say the same thing. Before discussing the fundamentals of bubble growth it is therefore desirable to identify the vital aspects which could affect the final product - the diving tables.

Spectrum of approaches to decompression formulation

Most calculation methods used today are still variations of the original Haldane theme whereby the mechanism leading to “the bends” is only triggered when some critical condition is violated. In most approaches this is a ratio1 or ‘M’ value which may be a constant2 or vary with depth3. In keeping within these “trigger points” for clinical manifestations, there is mathematical symmetry. In other words the same equations are used to estimate gas elimination as were selected to estimate gas uptake. Hence mathematical symmetry implies that no gas phase has formed during decompression because this would change the physics of the system and that must, in turn, be reflected in the mathematics. Hence, whether stated or not, most popular approaches to the formulation of decompression tables still follow the popular philosophy of assuming that “the bends-free diver must be bubble-free”. This assumption tends to be obscured when it is emphasized how the ratio or “M” value can reflect the volume of gas which could be released from solution in returning to equilibrium from a state of supersaturation.1,4 However this is a potential volume and not an actual volume, so the use of such “trigger points” still assumes that the bends-free diver is bubble-free.

The validity of mathematical symmetry was first questioned following some classical experiments by Hempleman14 reviewed in detail later; while this investigator went further and used the actual volume of gas ‘dumped’ from solution as the indication of the imminence of “bends”. At least, it is based upon gas volume in so far as this parameter determines the pressure differential in tissue bending or otherwise distorting a nerve ending to induce the pain characteristic of Type I decompression sickness.7,14 Human experiments having shown a well defined threshold of injection pressure for pain induced by extravascular air. Thus there is a wide spectrum of approaches to