

Confessions of a mortal Diver II

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Description

Here's a story from Richard Pyle (deepreef@bishop.bishop.hawaii.org) of a recent dive trip that nearly cost him his life (again).

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by Richard L. Pyle

Some Background

On Thursday, September 24th of this year (1998), I joined some friends of mine aboard a sailboat cruise to Necker Island, a tiny remote island several hundred nautical miles from the nearest civilization. We were on a 9-day expedition, which consisted of a three-day voyage to get there, three days of diving while there, and a three-day trip back home. I had my rebreather with me, and we had several objectives, but my primary objective was to compare the fish assemblages there with the assemblages found at the main Hawaiian Islands, and my real motivation was just to have good fun with good friends. We weren't certain what sort of diving habitats we would encounter, so I came prepared with the full set of equipment to do deep mixed-gas dives, but had no specific plans to do any such dives if circumstances didn't call for it. Several others on the trip were divers also, but all planned to use only regular air scuba gear on mostly no-decompression or mild decompression dives.

The three days to get to the destination were benign and pleasant. The weather was very favorable, and we were travelling down wind. The vessel was a 70-foot sailboat equipped with a compressor and other amenities for diving. We stopped at a couple of places on the way to look for some tiny pinnacles that came from 2400 feet up to within 60 feet of the surface. Unfortunately, they were not where the charts said they should be, and we didn't have time to spend looking for them in great detail, so we continued on our course.

We arrived mid-morning on Sunday, September 27th. Our first anchorage was about 100 yards on the lee side of the tiny island, on a small sloping ledge

that ran from 60 to 80 feet. The water was crystal clear, and the fish life was (were?) utterly AMAZING. It was an absolute spear-fisher's wet dream. More gray snapper ("Uku") and large jacks than I have seen anywhere in the human-inhabited Hawaiian waters - even better than Midway Atoll. Of course, there were also lots and lots of sharks. Mostly White-tip reef sharks, Gray reef sharks, and Galapagos sharks. I was actually amazed not only with the abundance of sharks (again, even more than what I've seen at places like Midway), but how close they would come. They were not in anyway aggressive - I think it was mostly the fact that I was on a rebreather that allowed me to approach so closely.

For the afternoon dive on Sunday, we motored out to the edge of the shelf. The island is surrounded by an almost perfectly-flat shelf ten miles in radius around the tiny rocky island (which itself is less than a mile long and a couple hundred yards wide). Along the perimeter of this shelf is a fabulous ledge about 90 feet on the top, and about 110-120 feet on the bottom, sloping down in some places to about 150-160 feet. Within a stone's throw of this ledge is an extremely precipitous drop-off to a thousand fathoms (6000 feet) or more. I spent about 90 minutes on the ledge with a PO2 setpoint of 1.4 or so, and saw all kinds of fish and many, many sharks. Out at this ledge, the most common shark species was the Galapagos, but a few of the other two species were also around. Again, throughout the dive they were extremely benign. There were usually about 5-7 Galapagos sharks in view at any given time, ranging in size from about 4 feet to about 6 feet in length.

Anyone who has spent a lot of time diving with sharks will know that there is a "comfort zone" at which the sharks stay, that is usually about 8-12 feet away from a diver. Galapagos sharks tend to have a narrower comfort zone - usually more like 5-8 feet (as anyone who has dived at Midway will know). On this dive, however, the Galapagos had a comfort zone with me of about 2-3 feet. They were LITERALLY swimming right in front of me, and on many, many occasions I could have just reached up and petted them as they swam by. I figured the extreme proximity was mostly due to the fact that I was diving with a rebreather. Although slightly disconcerting, the omnipresent sharks showed no aggressive tendencies, even when I collected fish specimens, so despite being alone on the dive (the scuba divers had already used up their precious bottom time early on), I wasn't terribly concerned. I ended the dive just before sunset, owing only a few minutes of deco. As I came up the decompression line attached to the boat, the sharks followed me up, but I wasn't concerned about them very much because they had been so benign the whole dive. All of a sudden, however, one of them (the largest) charged at me - not terribly fast, but fast enough to startle me. I was forced to physically kick it off as it approached. It seemed barely deterred by my foot in its face, and just then another one took a charge. For the next 5 minutes or so, the 7 or 8 sharks surrounding me (all within a 10-foot radius) started acting more and more agitated and taking turns at charges. On several passes I had to physically kick them off. I clipped my catch bucket with my specimens in it to the deco line, then moved up shallower. This split the sharks between me and the bucket. They were

coming up to the bucket and nuzzling it, then coming up at me for a pass. It was terribly unnerving, especially given the fact that the sun was setting, and I was all by myself in the water. When I only owed about 3 or 4 more minutes of deco according to my computer, I decided to call the dive. I made this decision based on the fact that the computer I use has proven extremely reliable for not getting me bent under a wide range of diving conditions, and the sharks were becoming increasingly unnerving. Back in the boat, I breathed pure oxygen for a few minutes just as a precaution, and while still a bit shaken by the shark activity, I was physically feeling wonderful.

We tried another similar ledge the next day (Monday), and had a whole day's worth of enjoyable, but otherwise uneventful dives...that is, until the last dive of the day. On that dive, I set out on my own for another 90-minute solo swim starting at 150 feet and working back up to 80 feet or so. The dive was absolutely magnificent! So peaceful on the rebreather, with no other divers around. It was one of those dives that reminds me why I truly enjoy diving in the first place. It was a real "feel happy" sort of dive. I had swam a very large circuit - maybe a quarter mile or so, finding all sorts of interesting ledges, overhangs, tunnels, etc. I ended up back at the anchor to the boat. As you might well imagine, the anchor on a 70-foot sail boat is a pretty large chunk of metal (several hundred pounds), and this one was connected to the boat by a giant chain which probably weighed close to a ton over its entire length. During the course of my dive, the current had picked up considerably, as had the wind and the chop at the surface. The anchor was wedged deeply under a ledge at 90 feet, so I knew we would have trouble pulling it up, but I figured I'd leave that problem for the boat captain to worry about. I swam up the anchor chain to the decompression line, and was just about to clip off the bucket with my fish specimens in it, when BANG! - it sounded like a gun-shot went off. I looked up to see this near ton of chain sinking rapidly to the bottom, and the boat drifting off. The chain had snapped near the bow of the boat. At that point, I had a split-second decision to make.....stay with the boat, or mark the spot where the anchor was. If I stayed with the boat, I'd probably have to break decompression and sit on the boat while we sorted the situation out. Thus, I clipped the fish bucket off to the deco line (attached to the boat), then bolted for the bottom. I deployed my sausage with my up-line reel, and tied the reel to a coral head. I then came back up the line and did most of my required decompression. The boat crew had instantly known what had happened, saw my float, and figured out what I had done.

It was getting late in the day, and there was less than an hour of daylight left. If we were to recover the anchor that day, we'd need to act quickly - so rather than do extra safety deco, I surfaced and got back in the boat. Knowing that I would be the one to go recover the anchor, I left the rebreather on my back, stayed in full gear, and continued to breathe pure oxygen. We quickly discussed our options, and developed a plan whereby I would first go back and find the anchor, then a free-diver would watch me and convey signals to the boat. The boat would come directly over me and

drop a 2-inch rope with a shackle at the end of it. 50 feet up the rope, there would be 40 lbs. of lead strapped on. The idea would be for the boat to drop the line with the lead near the anchor, and hold position. That would give me 50 feet of slack rope to work with on the anchor. When the rope was properly attached to the anchor, I'd give the signal to the free diver to tell the boat crew to hoist away.

The first part went as planned. I found the anchor, signaled to the free-diver, and the free diver directed the boat. The boat dropped the line, but it apparently got hung up on deck somewhere, and in the few seconds it took to free it, the boat drifted off a bit in the wind, current, and chop. The 40 lbs. of lead landed about 80 feet from the anchor, so I pulled like hell on the slack end of the line to make up the 30 remaining feet to the anchor. For about 10 solid minutes I worked harder than I ever have worked before underwater, trying to drag that 2-inch line with a 40-lb weight across a rocky bottom, while the other end of the 300-foot rope arched through 90 feet of water to a 70-foot boat. I got it *almost* all the way there, but couldn't get the last 5 feet because the boat was starting to drift off again. I signaled to the free-diver for more slack. Unfortunately, I didn't realize that, through 90 feet of water, in the fading sunlight, the free-diver could barely see me. He thought I was giving the signal to hoist away. Once the boat started pulling in the line, I had no choice but to let the line go.

I knew it would be a while for the boat to get the line up, realize the problem, then get into position again. I took the time to catch my breath and relax, make sure the rebreather was still working correctly (it was), and assess the situation. There were a few Galapagos sharks around, but none seemed too aggressive. Looking at the anchor, I realized that I could "walk" it out from under a ledge, down a slope, and clear it from the overhang. That would make recovery a LOT easier, so with a great deal of effort, I got the anchor down the slope and free of the ledge. This required first gathering up about fifteen feet of slack chain, which was very heavy. In any case, I spent the time with a fairly heavy workload. Eventually the boat came back for a second drop of the line. This would be our last attempt. It was getting so dark that the free diver couldn't see me any more. I slowly came to the surface (breaking a few minutes deco) to tell the boat where the anchor was - then dropped back down to the bottom. This time the rope landed near the anchor, and I only had to drag it about 10 feet (very heavy workload again), after which I quickly shackled it up to the anchor. I came up to start doing deco at 30 feet or so, and signaled the free diver to tell the boat to hoist away. Not wanting to be anywhere near that chain as it came up, I drifted back to find the up-line and sausage I had sent up earlier to mark the spot, and finish my deco there. Unfortunately, I couldn't find the line. I thought for sure I was exactly where I had put it, but it just wasn't there. It was starting to get very dark, so I decided that I just couldn't see it (I later found out the line had broken and the sausage had drifted away). I did my best to maintain position in the current, and finish off my required deco. Surprisingly, the computer indicated that only a few minutes were required, but given the

extra heavy workload and yo-yo profile, I figured I'd do some extra deco.

Just as I was beginning to worry about how the boat would find me without a reference float, I saw a rather large shark approach. There was just one, and I could see it was a Gray, not a Galapagos, so I wasn't worried. To my surprise, however, it came straight in for a close pass and then began classic threat-display posturing. This is the behavior known to Gray reef sharks where they drop their pectoral fins and start swimming in a highly exaggerated sinusoidal pattern. It is the behavior these sharks do just prior to attacking. Bolting Galapagos sharks may be unnerving, but that is NOTHING compared to a large posturing Gray reef shark - this was serious. I tried slowly backing away, but the shark continued to get more agitated. An acquaintance of mine named Mike DeGruy was in the presence of a posturing Gray reef shark once, and the shark ended up ripping his arm apart, nearly killing him. With this in mind, I looked at my computer, which said I owed a few more minutes deco. Taking all the issues into account, I again relied on the conservatism of the computer, ignored the heavy workload on the bottom, and got my ass back in the boat. Knowing that I was pushing my luck from a deco perspective, the first thing I did was grab some oxygen and start breathing it. I breathed it for nearly an hour straight, all the while assessing for any sign of bends, while watching the other crew recover the anchor. No symptoms. Lucky me - I cheated bends once again.

We had a lot of fun talking about the exciting events of the day. I was a bit nervous about having two days in a row of breaking deco due to sharks (that's normally not supposed to happen), and sort of thought about how the heavy workload and long bottom times at 90-120 feet or so must be pushing my tissue loading out towards the limit. You would think this would cause me to be extra-super-duper careful for the remainder of the trip. You would think I would have thanked my lucky stars, and chilled out a bit. You would think.

The next day, Tuesday, was our last day of diving. I wanted to make it count. I did a mellow morning dive and scouted out the ledges under the boat with my video camera. Again, the same sort of ledge at the same sort of depths, and the same sort of benign daytime shark action. For the afternoon dive, we wanted to make sure we didn't end-up down current of the boat, so I and two of the OC divers shared a ride on a single DPV and made our way several hundred yards straight up-current of the boat. The boat was anchored at the "mouth" of a large underwater canyon - sort of like an ancient river basin. The reef was 80-90 feet on the top, and the bottom of the "river" channel was about 120 feet of pure white sand. It was a VERY obvious landmark to find the anchor, so I was cavalier about going way up current on the DPV. Once we got a few hundred yards up-current of the boat, the other two divers veered left with the DPV, and I swam by myself out along a nice-looking ledge to the right. I came across a fantastic stretch of ledge with lots and lots of fish. I stayed quite a long time, collecting a few specimens, and otherwise having a wonderful time. The workload chasing the fish and fighting the current was heavier than usual, so I decided I would do a lot of extra deco on this dive. Once I made that

decision, and in consideration of the fact that I had hardly seen any sharks at all this dive, I didn't mind allowing a larger deco obligation to accrue (yeah, I know - twisted logic). I waited until I owed about 30 minutes of deco, with a 30-foot ceiling before heading back to the boat.

It was getting late in the day so I started worrying a little about the sharks, but I didn't see any around. I decided to begin deco on my down-current swim back to the boat, so I rose up to about 50 feet while following the ledge contours back to the "river basin" where the anchor was. The current was starting to pick up a bit, so I was moving at a pretty good clip. I figured I should get back to the boat soon at this rate. Eventually I hit the river channel in the reef and followed it to where the anchor was. Problem was, there was no anchor. The topography looked pretty much like what I had remembered for the anchor spot, but the sun was now fading, and I was now up at 30 feet, and I couldn't see the bottom all that well. Perhaps the anchor line broke again? Not likely - we were using the 2-inch rope this time instead of chain. Maybe the anchor itself broke free of the bottom? I still owed 20 minutes of deco so I didn't want to go to the surface, but I finally decided I'd better locate the boat. Still no sharks, so things were O.K. I had some fish that I wanted to keep alive in my bucket. The fish would have died if brought straight to the surface. I had my backup reel and float with me, so I clipped the bucket to the end of my reel line, left it at 30 feet, and popped to the surface to look for the boat. I initially looked down current, but saw no boat. To my surprise, the boat was about 250 feet *up* current of me! I later figured out what happened was that I must have been following the wrong underwater river channel - there were apparently two of them side-by-side, and I had managed to find the wrong one on my way back to the boat.

At any rate, I now had a predicament. It was getting too dark to see the bottom, and I didn't have a compass with me. Should I go back to 30 feet and swim up-current toward the boat? That would probably be the best option from a deco standpoint, so I turned around to go back down and my heart nearly stopped when I was face-to-face with a large Galapagos shark. I mean he was REALLY close - like less than a foot away. Usually when a diver turns around to see this sort of thing, both the shark and the diver get startled; but this time, the shark was utterly un-phased. I, on the other hand, was reduced to a nervous wreck. I kicked the shark off and it veered away, and I saw about 6 or 7 more Galapagos sharks between me and my bucket. Once again it was decision-making time.

I basically had two options. The first would be to alert the boat of my situation, then drop back down and complete deco underneath my backup sausage. The boat could pull anchor and come get me. The problem was, it would have taken the boat at LEAST half an hour (maybe more) to haul anchor and come get me. The sharks were nastier than they had been the previous two days. The current was angled off the shelf and was strong, so by half an hour I would be out over blue water (and God knows what other sorts of beasties awaited there). The sun was setting, so it was dinner time in the sea. The surface was very choppy, and my backup sausage is small - what if

the boat couldn't find it in the dark? Next stop down current would have been the Marshall Islands. Bad news.

The second option would be to go for the boat and finish deco there. The problem with that plan was that I had just completed my third day of heavy-workload moderate-depth diving, with a series of yo-yo profiles and cut deco times with no safety margins. The boat was a good 250 feet up current (long hard swim). More bad news.

Even at the time, I was thinking to myself "What a classic miserable situation to be in!" Late in the day, hundreds of miles from civilization, down-current of the boat, on the surface owing 20 minutes of deco with lots of deco factors working against me, mean-ass sharks circling literally at my feet. It was almost funny. In any case, the first thing to do was alert the boat crew of my position. This was easily accomplished with my trusty air-horn on my BC (now permanent part of my equipment). I almost decided to go with the drifting deco option, when I saw the stern line float only about 30 or 40 feet away. Thank God for stern lines! That was the deciding factor - I would get back to the boat first, then finish deco under the boat. Much better option, all things considered. So I called for a free-diver to come help me, and to bring a spear. They missed the part about the spear. When Scott (one of the other scuba divers, who I didn't know before the trip but now have great admiration for as a level-headed, highly talented diver) arrived wearing only mask, wetsuit and fins, his first response was "Oh shit!" when he saw the sharks. By this time, with me swimming toward the boat against the current, my bucket and fish had been dragged up to the surface, The sharks had followed the bucket and were circling back and forth between it and me. It was pretty classic - above water I could see my bucket at the end of its line down-current of me bobbing at the surface, and all between me and it were these dorsal fins and tails of sharks thrashing around. Again, it was almost funny.

Without a spear, Scott couldn't help me much. I was actually concerned about the well-being of my fish, so I sent him back to the boat to get a 2-lb weight to put in the bucket to keep the fish down under pressure. Meanwhile, I took my rebreather off my back, inflated the BC and counterlungs, positioned it under my belly, and started swimming like mad for the stern line. I decided to pretend the sharks weren't there, so I could concentrate on getting to the line. It's not like I could do a hell of a lot about them anyway. Fighting the current with all that gear and a 5-gallon bucket in tow, it was an EXTREMELY hard swim that lasted about 5 or 6 minutes. I finally got to the line, and clipped my rebreather off to it. At this point I had a moment to relax and assess how I felt, and as far as I could tell I was O.K. My stomach felt a bit ill (likely due to swallowing sea water in my fight back to the stern line - or so I reasoned), and I was a bit short of breath, but otherwise I felt O.K. I mustered the courage to look back at the sharks, which was a mistake because not only were they still there and still agitated, but one was in the midst of a charge on me (something that had no doubt been happening for my whole swim back to the stern line). Fortunately, most of the sharks were back at my bucket, about

30 feet behind me. The fish, being on the surface, were under a great deal of stress, and were no doubt sending signals that were getting the sharks excited. The sharks were continuously bumping the bucket, but at least they weren't bumping me.

Shortly thereafter, Scott arrived with the weight. At this time I had to voluntarily drift back to the bucket, among the sharks, and drop the weight in the bucket. That task was pretty damn spooky (as I started to drift back, Scott said something like "I wouldn't do that if I were you!"), but otherwise uneventful. The sharks were close and continued their passes, but they were still focused more on the bucket than on me. Freed of the burden of the rebreather and the bucket, I was able to quickly pull myself along the stern line back to the boat, while the crew hauled in the gear and fish. Back at the boat, I had a moment to catch my breath, and assess my situation. Although I felt fine, I knew I needed to get back down on oxygen to finish my deco, so I quickly climbed into the boat to get the emergency oxygen cylinder. One of the scuba divers had used it earlier as a safety margin on his deco, and the tank hadn't been refilled. It was a steel 50cf cylinder, and it had about 800psi left in it. I was about to re-fill it, when I suddenly noticed that I was getting shorter and shorter of breath, even though the opposite should have been happening. Also, my abdomen started cramping up very painfully. I realized that the symptoms were now getting very severe, very quickly, all within about two minutes of climbing into the boat. My breathing was now getting VERY hard - like I was breathing too much CO₂, except I had none of the other symptoms associated with CO₂. I had to act immediately, so instead of re-filling the oxygen cylinder, I grabbed it under my arm, put my mask and fins back on, and rolled over the side. I pulled myself down to about 28 feet and breathed the oxygen deeply. I was breathing very hard, and coughing violently (classic "chokes" bends symptoms) and my abdomen felt tight as a drum. Within about 2 minutes, my breathing slowed, the coughing abated, and I started to feel better. After about 20 minutes or so at 20-25 feet, I realized that it was almost dark, and the sharks were still there, and I felt fine - so I decided to get back in the boat.

I walked immediately to the stern of the boat and started breathing the rest of the oxygen. For the first 30 seconds or so I felt fine. Then, all of a sudden, my eyes were having trouble focusing. I couldn't get both eyes to align on the same subject. At about the time I started thinking "this is bad", my hands started getting uncoordinated. From that point on, the symptoms progressed at an INCREDIBLY fast rate. It was less than a minute from when I got in the boat until my eyes felt a little strange. Over the next *sixty seconds*, both arms and both legs started getting progressively weak and uncoordinated. In the time it took me to hobble from the stern to the mid-deck where the ladder is, my symptoms went from mild vision disturbances to near quadriplegia. I could not believe how fast they slammed me. With each breath I was feeling noticeably worse.

Naturally, my brain could only think of one thing: GET BACK IN THE WATER!
GET BACK IN THE WATER! GET BACK IN THE WATER! Unfortunately, I had

gotten

so bad in the preceding minute that there was no way I could get my fins on. By this time the crew was aware that something serious was up. All I could do was bark out commands: "Put my fins on." Someone did. "Find my mask." Nobody could. "Give me ANY mask!" Someone did. "Put it on my face." Someone did. At about this time I probably should have aborted the attempt to get back in the water. However, the symptoms had come on while breathing oxygen at the surface, so what choice did I have? For all I knew, continuing to breathe oxygen would leave me dead or permanently paralyzed. The oxygen tank had less than 200 psi in it so I asked someone to re-fill it. Meanwhile, I managed to roll myself over the side, and Scott jumped in to help me. My arms and legs were essentially useless at this point, and I was essentially a lump of flotsam bobbing on the surface, struggling to keep my head above water. I started fearing that I would drown. I was waiting for them to get the oxygen ready, while Scott was trying to hold me at the surface near the sailboat, which was pitching up and down about 4 feet. It was a really, REALLY messy situation.

I was physically a mess, but my mind kept re-assessing the situation - considering the options. I can honestly say that I was still clear-headed and thinking rationally. In such situations, my mind responds by distancing itself from the personal crisis and fools itself into acting as an outside observer, watching a movie, trying to think objectively. Given my history with respect to the topic of In-water recompression, and given the dire nature of the circumstances, the default no-brainer response by me would be to insist on being dragged underwater to perform IWR. But my brain was still working, and although severe paralysis was far and away the over-riding concern of the moment, I was also very cognizant of the risk of drowning. The trouble was, both alternatives seemed so hopeless that I was having difficulty deciding what to do. At this point (which was about 30 seconds after I rolled back into the water) there was still no oxygen ready. Scott looked at me and said "I'm not so sure this is a great idea." That was enough for me: I said, "O.K., get me back in the boat." By this time (less than three minutes after surfacing from my 20 minutes on oxygen), I was essentially a sack of Jell-O. I couldn't move my arms or legs. It took several people some very serious effort to drag me up the 4 or 5 feet into the boat, in the pitching sea. They rolled me onto the deck on my back and elevated my feet. I said: "I'll need lots of oxygen and lots of water - quickly!". By this time the oxygen was ready and I started breathing it deeply. I was given a pillow and a blanket, and someone came by with a cup of water. The captain of the boat brought me two aspirin (two nights previously I had explained to him some of the biochemical side of bends). He sat me up, shoved the aspirin in my mouth, and washed them down with water. Everyone on the boat seemed to know *exactly* what to do - it was amazing!

The next 15 minutes or so could only be described as terrifying. Here I was, lying on the deck of a boat, hundreds of miles from a chamber, almost totally unable to move. The symptoms were nearly identical to the serious bends I had twelve years ago, which means the insults were probably in the same regions. It had been very clearly explained to me that the last time I

was bent I had essentially used up all my redundant neurons to recover my ability to walk, and that if I ever got hit in a similar way again, chances for recovery would be extremely slim. The symptoms had come on *extremely* fast even while breathing oxygen on the boat -- who knows how worse they would continue to get? Moreover, why would they now suddenly go away?

At the time, I had absolutely no idea why....but miraculously, the symptoms went away anyway. In fact, after only 15 minutes of surface oxygen, I had nearly full strength and coordination back in my arms and my legs. At this point I started considering the option of getting back in the water. The sun had already set, the wind was picking up, the sharks could still be seen around the boat. I decided that if the surface oxygen was working now, I might as well let it continue to work.

Meanwhile, the captain was doing what he could to establish radio contact with Dr. Bob Overlock, the main bends doc in Hawaii (same guy who fixed me up 12 years ago, and who is now a good friend, and essentially the only medical doctor in the State whose opinions on bends and treatment I value more than my own). The Captain got through on the radio about 30 minutes after I started the surface oxygen treatment, by which time I was feeling essentially 100% better. I did whatever I could to assess my neurological deficit, both motor and sensory, and as far as I could tell, things seemed completely back to baseline. At that time I took a brief break from the oxygen to give Dr. Overlock a quick summary of the situation. Several people were suggesting alternatives for airlift back to the chamber in Honolulu, but we unanimously and independently came to the conclusion that, given the particular set of circumstances, such an attempt would be more risky than it was worth. We had plenty of oxygen and plenty of water, so I would continue the same treatment regime that had restored my function so quickly.

By this time, we started prepping the boat to head back to Oahu. Two of our crew were assigned as my tenders, and would take turns over the next several days keeping a close watch on me. After a full hour of surface oxygen, I took a break while we relocated down in the bunkroom of the boat. We had large-capacity oxygen cylinders rigged on deck, and we ran my 50-foot HP hose (normally used for surface-supply oxygen deco) down to the bunkroom with a regulator on the other end. I changed out of my wet clothes and got dry and warm in my bunk. The captain set up an intravenous line for saline solution, to get me hydrated as quickly as possible (as per Dr.'s instructions). Despite our best efforts with surgical tubing around my arm and whatnot, the only good vein I could get on my arm was right on the inside of my elbow. After a couple of attempts in the unfavorable conditions (low light, rocking boat, weak vein), the needle was in my elbow. This meant that I had to keep my right arm straight for as long as we had the I.V. line running. Also, we didn't have any medical tape, so we had to secure it in place with good old trusty duct tape.

By this time, the scary part was over, but as it turned out, the real hell was just about to begin. My instructions were to breathe oxygen for 2 hours

at a time, interspersed with 30-minute air breaks. After the first two hour segment, things were starting to get mighty uncomfortable. We were on our way back to Oahu, and the weather was deteriorating. Gale-force winds and 12-15-foot seas (by Hawaii measuring standards, which are much more conservative than the rest of the world's standards) caused the boat to pitch and roll 45 degrees. It was all I could do not to get tossed around the bunk room. I had woken up early that morning, and had dived hard all day, and it was now getting late in the evening. I was VERY tired. The rolling of the boat caused the "aroma" of the head and its storage tank to permeate the ship's hold somewhat, and combined with the omnipresent diesel fumes from the ship's engine (couldn't use sail power as our destination was directly up wind, and we needed to get there ASAP), all made for a decidedly unpleasant environment. On top of all that, pulmonary oxygen toxicity was starting to kick in. Most divers would not have experienced it that soon - but then again, most divers wouldn't have had three previous days in a row of multiple long-duration constant 1.4 PO₂ dives with high workloads and frequent surface oxygen binges. Shortly before the end of my first 2-hour oxygen stint, I made use of what came to be known as "my little yellow bucket" (which normally holds my drift line) and puked my guts out. This was just the first of dozens of puking episodes to come over the next few days.

Besides the general unpleasantness of the vomiting, there was a real concern for dehydration as well. The I.V. was pumping away, but it was being offset by the vomiting. Also, because I was breathing direct open-circuit oxygen, my mouth and throat were constantly getting very dry and irritated. I needed to drink some water for my mouth, but if I swallowed too much of it, it would just cause me to puke again. The pulmonary oxygen toxicity was getting worse and worse. All the classic symptoms - irritation in the lungs, shortness of breath, coughing, and most notably, nausea. It was obviously toxicity, because it would get worse as the oxygen segment went on, then would back off during the air breaks. After about 5 or 6 hours of the oxygen therapy, another problem started creeping in, which I can only attribute to very low blood pressure. It got to the point where I could not raise my head more than a few inches above my pillow without feeling extremely light-headed and faint. Trying to get to the head was an amazingly arduous ordeal (even though it was only about 5 feet from my bunk). First, I felt absolutely MISERABLE! Rarely have I felt that bad before, just in terms of general nausea and malaise. Moreover, as soon as I tried to sit up (let alone stand up) I'd nearly pass out. The boat was pitching so heavily, that even perfectly healthy people had a hell of a hard time staying vertical - even while holding onto something. On top of all this, I had to be very careful to not bend my right arm, lest the I.V. needle tear into my elbow. Just thinking back on it now makes me feel extremely uncomfortable.

After eight hours of oxygen, I thought I might actually die. My stomach felt like a wet rag, and my abdominal muscles were fatigued to the point of exhaustion (no doubt from all the vomiting) But the oxygen was the main culprit. Normally, in situations like this, the limiting factor in providing oxygen to the patient is the supply of oxygen. In this case, I had barely

touched our oxygen supply. I probably could have breathed the oxygen for the entire 3 days without running out of the stuff. Trouble is, after about 24 hours of pure oxygen at 1 ata, you start running the risk of pulmonary edema. Pulmonary edema is the "dark side" of pulmonary oxygen toxicity. We are taught as mixed-gas divers that pulmonary oxygen toxicity makes you feel bad, but is not life-threatening. The CNS toxicity is what we're always worried about in terms of getting killed. However, if left unchecked, pulmonary toxicity can kill a person. What happens is that the lungs get so irritated that the alveoli start to fill with fluid (edema). As they fill with fluid, less and less oxygen can be transferred to the blood. If they fill enough, the diver can get to a point of no return where, 100% oxygen is needed just to avoid hypoxia, but with that much inspired oxygen, the edema continues to worsen. If it gets bad enough, the patient must decide between death by hypoxia or death by drowning, but in any case, death becomes inevitable (at least this is my understanding of the pulmonary edema problem as it relates to oxygen toxicity).

I hadn't spent 24 hours on oxygen at 1 ata, but I *had* done three days of long exposures to 1.4 before-hand. With each cycle of breathing oxygen, the pulmonary symptoms were getting worse and worse and worse. My tenders, who were *extremely* helpful despite enduring miserable conditions themselves, were last instructed to "keep giving him oxygen". When I started mumbling about taking a longer break from the oxygen to recover a little, they were pretty adamant to follow doctor's orders. In fact, we had gotten a set of ear plugs which I stuffed up my nose to help make sure I was breathing only the oxygen - especially if I were to fall asleep. I knew the oxygen supply wasn't going to run out, so I kept persisting for a break. Finally, I had to, as best I could, explain what pulmonary edema was and how it might apply in this situation, and how it might kill me. They weren't sure if I was just delirious, or if I knew what I was talking about. Finally, they agreed to give me an oxygen break. Over the next two hours my condition improved somewhat, so they decided they had made the right decision.

With the cessation of the oxygen, I thus began the long road to feeling like a human being again. The vomiting continued with decreasing frequency for the next 24 hours or so. Over that time, I was slowly able to ingest water, and eventually the I.V. was removed. Slowly my blood pressure started to come back. However, even though my body was coming around somewhat, the boat continued to pitch unbelievably, and since I lacked the energy to go top-deck I had to endure it in the unpleasant atmosphere of the bunk room. Three and a half days, non-stop, 24 hours a day. Among all the fun times I've had in my life, this experience was most certainly not among them.

We finally pulled into the loading dock on Oahu Saturday morning at 2am (I had been bent Tuesday evening). During the journey home, I did everything I could to assess my neurological condition. Sensory seemed fine (using a hypodermic needle to prick various parts of my arms and legs). Strength seemed fine (except for the general whole-body fatigue that was shared by everyone on that boat, given the conditions of the ride home). Reflexes seemed fine. Coordination was, as best as I could determine, fine also. The

only thing I couldn't do (and an acid test for lower-body neurological deficit) was test my balance. The boat was rolling so badly and without a break, that nobody on it could keep their balance without holding onto something for dear life. Thus, when we finally got to the dock, I was anxious to get to terra firma and assess my balance for the first time since the bends symptoms.

I jumped to the dock, and promptly fell flat on my ass. I tried to stand up, but could not for the life of me stay standing - I kept stumbling over. For obvious reasons, I took this as a very, VERY bad sign. However, it soon became evident as others jumped ashore, that NOBODY (save for the Captain, and Scott, both of whom had many more hours at sea than the rest of us) could stay upright without holding onto something. After that rolley-polley 80 hours at sea, we all had a bad case of "sea legs". We looked like a bunch of drunks staggering around the parking lot. As it slowly wore off, I convinced myself (and later confirmed) that it was, indeed, just sea-legs, and not neurological residuals from the bends.

My house is only about a 10-minute drive from the dock, so I got a ride home, picked up my truck, and came back for my gear (hoping not to get pulled over for drunk driving). My stomach felt like it was made of tissue paper, and every muscle in my body ached, and the whole world was rocking back and forth, but otherwise I was O.K. Very, very tired, but O.K. The next morning I woke up and my room was spinning. I felt a bit off center all morning, but felt good enough to drive in for a visit with Bob Overlock. I told him the story, and he left it up to me whether or not I felt a trip in the chamber would be worth it. I thought not, and he agreed. Over the next few days, I gradually regained my feeling of well-being. I am writing this on Thursday, October 8 - nearly a week after getting back from the trip; 10 days after the bends. To the best of my abilities to determine things, I am fully restored to pre-trip health (except for some cuts and bruises). I plan to take at least another week off from diving, then maybe start slowly again.

RETROSPECTIVE

I can think of dozens of little mistakes that I made throughout the dive trip that led to the ultimate outcome. Most of them are pretty obvious. For example, I should have had a compass if I was going to do a lot of distance-swimming diving. Also, I had my surface-supply oxygen rig available - but I didn't have it set up and ready to deliver oxygen. I suppose it could be argued that some sort of shark protection device could have been used, but that one is debatable. Probably most significantly, we should have had the small inflatable chase boat set-up and ready to go. That alone would have solved many of the problems encountered during the trip. However, all these little mistakes fall under the one REAL mistake I made this trip. I kick myself for this, because not only should I know better, but in fact I DID know better a few years ago, but have since forgotten. The mistake I made was that I neglected to take dives to depths of 90-120 feet seriously.

Years ago, after I had been making trimix dives for quite a while, I started catching myself getting cavalier about doing dives in the 90-120 foot range. For any trimix diver, this is an easy trap to fall in. For many of us, 100 feet is fairly far up a long list of decompression stops. After a dive to 400 feet, arriving at 100 feet is like arriving to a safe haven. So, it occurred to me, years ago, that 90-120 feet was probably my most dangerous depth range, because it was deep enough to get in serious trouble, but shallow enough by comparison to the helium dives that it was hard for me to take them seriously. Buried deep within the TechDiver email archives are some posts from me ranting on about this very issue.

Problem is, I forgot. I forgot about that little rule of thumb. I fell back in the trap of "Oh, it's only a hundred feet or so....no big deal." No big deal if I end-up down current of the boat, because I can always break deco and swim to the boat. No big deal if the sharks get nasty, because I can always break deco and get to safety. No big deal if I have to work hard on the bottom, because hey - it's *only* about a hundred feet deep. What's the big deal? The big deal, of course, is that 100 feet is PLENTY deep enough to suffer crippling bends - even using constant-PO2 rebreathers. This is especially true if the workloads are high, and the profiles are yo-yo, and no safety margins are incorporated. I was reminded of this reality (rendered extraordinarily obvious in hindsight, but remarkably obscure at the time - which tends to be the case for most causes of accidents) from this incident, and I do not intend to every allow myself to forget it again.

My big concern is: what else have I forgotten? There are some topics that we discuss on the email lists to the point where they become so obvious that they are branded on our minds. We get bored of discussing these issues over and over again, so we stop discussing them. Eventually, after months or years of carefully avoiding topics which we thought had already been beaten to death, we allow the new topics of the day to clutter our minds and nudge aside the basic obvious tenets. Things such as "yes, 100 feet is plenty deep to get into serious trouble". So, perhaps we should not object so strongly to reminding ourselves of some of these old "obvious" issues, and let some discussion topics rear their heads again from time to time.

This incident also allowed me to re-evaluate some thoughts on bends and bends treatment. Of particular note, I am thinking now that blood distribution within the diver's body may play a much larger role in bends symptoms than I previously gave it credit for. I'm not just talking about perfusion issues - I'm talking about how blood redistributes in a diver's body depending on whether the diver is submerged in water, or exposed to the full effects of gravity on land. When a dive is underwater, the effects of hydrostatic pressure essentially eliminate the effects of gravity on the blood distribution. The result of this is that the diver's blood initially pools in the body core. In time, the body compensates for this by dilating vessels in the lower portions of the body, and constricting vessels in the upper parts of the body. When a diver suddenly leaves the water and returns

to the world of gravity, there is a sudden rush of blood from the body core to the lower extremities. It takes a few minutes for the body to compensate for this by re-adjusting blood vessel dilation levels in different parts of the body. The net effect is a sudden loss of fluid from the body core immediately upon exiting the water.

Consider what happened: I violated 20 minutes of deco, then spent 10 or 12 minutes working hard as hell at the surface, trying to get back to the boat. No symptoms throughout this entire ordeal. I get back to the boat, catch my breath, and feel fine. However, within a minute or two of leaving the water, climbing into the boat, I start getting chokes and abdomen pain - with rapid progression. I get back in the water and the symptoms go away very soon. Could be explained by the breathing of oxygen, or the increased ambient pressure, or both. But what about the role of re-immersion and it's gravitational/hydrostatic effects on blood distribution in the body?

Now, 20 minutes of pure oxygen at 20-25 feet and I feel great. All things considered, my body is probably better-off at this point than it was when I made my first break of deco down-current of the boat. Maybe not - maybe it's worse - but it couldn't be that much worse - the oxygen and pressure must have had at least some therapeutic effect. The issue is, within a minute of getting back in the boat *while breathing oxygen*, the symptoms returned more suddenly and more severely than they had come on in the first place. This, despite the fact that 10 minutes of hard labor (but still with my body in the water) immediately following the dive led to no symptoms; yet less than a minute after climbing in the boat following oxygen at 20 feet, I get whacked like a sledge hammer. Also keeping in mind, the symptoms came on *while* breathing oxygen, sitting in an upright position. Next, I botch my IWR attempt and breathe oxygen on the deck of the boat - this time lying down with my feet elevated. The *only* difference really between the situation where breathing surface oxygen led to severe symptoms, and breathing surface oxygen led to reversal of symptoms, was the position of my body. Lying down with my feet elevated, I had as close to an immersion-distribution of blood in my body as any position under the influence of gravity.

The onset of symptoms did not seem correlated tightly with fast ascents, or heavy workloads at the surface, or even breathing or not breathing oxygen. They were, however, *tightly* correlated with climbing out of the water and into the boat. Maybe this gravitational effect on our blood distribution immediately after immersion has a much larger role in bends symptoms than most of us give it credit for. Nothing in my recent experience in any way "proves" this, but Dr. Overlock has been telling me for years that this particular aspect of post dive effect (gravity and the hydrostatic effects of blood distribution on the body) may play a very big role in bends manifestation.

If this does turn out to be a really important factor, then I can see a couple of interesting implications:

1) Perhaps our last deco stop should not be at 10 or 20 feet, but should be at the surface. Maybe we should spend some time floating on the surface before climbing out of the water. Perhaps more importantly, maybe we should always lie down with our feet elevated following a dive, to allow our circulatory systems to gradually adjust to the sudden change in hydrostatic effects and gravity, instead of slamming our bodies with a major blood-shift at the exact worst time to induce bends (following a dive).

2) This one interests me more. Perhaps there is an alternate form of "In-Water Therapy" in response to decompression illness symptoms that bridges the gap between surface oxygen only and full-blown IWR. Maybe one alternative treatment is to allow the diver to float at the surface and breathe pure oxygen. This lacks the benefits of increased ambient pressure afforded by IWR, but reduces the risk of drowning carried by IWR. If the effects of immersion on the circulatory system do play an important role, then this could be a WHOLE lot better than simply breathing oxygen on the boat. Perhaps, when I had returned to the water for my botched attempt at IWR, symptoms would have been restored better while floating at the surface breathing oxygen than they were for me lying on the boat. Indeed, what if the amazing success rate of air-only IWR has little to do with increased ambient pressure, and much to do with hydrostatic effects of immersion on the body's blood distribution? Maybe breathing oxygen (or even air) at the surface would be almost as effective as IWR? What would we call this treatment? Maybe "IWSO" - In-Water Surface Oxygen.

Food for thought.

Finally, I'll describe a rather funny side-story to this bends incident. One of my deep rebreather diving companions is Joe Dituri, who works for the USN. Apparently, Tuesday evening he received a call relating to a possible request for a military C-130 to go out to French Frigate Shoals in the northwestern Hawaii Islands and pick up an injured civilian diver, should the need arise. He knew I was diving in the northwestern Hawaiian Islands, but not at French Frigate Shoals, so he didn't think much of it. (What he didn't know was that FFS is the closest place to Necker where a plane might be able to land, and one of the options being considered for my air evacuation was to get me to FFS and fly me back to Oahu by plane instead of a helicopter pickup directly from the boat.)

Meanwhile, Bob Overlock, who was notified Tuesday night, is on the University of Hawaii Diving Control Board (as am I). The boat we were on has often been chartered for use by U.H. projects, so he thought I might have been making an official U.H. dive (which, thankfully, I wasn't). Therefore, he felt it was his duty to call Dave Pence, the U.H. Diving safety officer. Now, Dave is a very good friend of mine, a SUPERB diver, as student of Joe's. The three of us (Joe, Dave and I) dive together often, and Dave has served as a safety diver for us. Dave is also very-much a mother-hen type person, as his job essentially dictates. Dave had done charters on this same boat before to other northwestern Hawaiian Islands, and he knew I was onboard this boat at Necker.

After hearing of my situation, Bob Overlock felt compelled to call up Dave to find out if it was a U.H. matter. He did not mention my name, but simply asked "Do you have any official U.H. divers in the northwestern Hawaiian Islands." Given this, and given the person placing the call, and given Dave's knowledge of me diving in the northwestern Hawaiian Islands, combined with his uncanny ability to put two and two together, Dave responded "No, but how is Rich doing?" Bob couldn't tell him without explicit permission from me (which he couldn't obtain because of the tricky radio connection). This, of course, left Dave feeling very uneasy about my well-being. That prompted him to call Joe. Joe, as soon as he heard this, recalled the possible request for an airlift, put 2 + 2 together himself, and both got very worried about me.

Now Joe and Dave had a predicament: "Do we tell Lisa?" As they knew, Lisa teaches at U.H., which makes it very difficult for her to solo-care for Cara when I am out of town. She was going through a bit of a hell week of her own, dealing with grading mid-term exams for 160 students. There was nothing Lisa could do about my situation, and no way for her to contact me until the boat returned several days later. If Joe and Dave told her I had been bent, and that they had no idea how I was doing, that would have TOTALLY wrecked Lisa's week. She would have been going nuts wondering what was happening, with no way to find out. So, Joe and Dave finally decided *not* to tell Lisa, because, they figured, if I could radio Dr. Overlock, I could also radio-contact Lisa, if I felt she needed to know (which, of course, I did not).

Making this resolution, however, did not ease the concerns of Joe and Dave for my well-being. Surely, they thought, if it was serious I would call Lisa. When I staggered home at 2am Saturday morning, Lisa woke up and I told her it was an "eventful" trip, and I would fill her in on the details the next day. Before going back to sleep she said: "Oh, by the way, Joe's been leaving messages every day. What's up?" Of course, Lisa's schedule was so thick that week that she was never home, so Joe never actually talked to her. I listened to the message machine and heard message after message from Joe to the effect of "Hi Lisa, it's Joe.....umm....just wondering if there is any word from Rich about his trip. Well....umm...give me a call if there is. Bye." At this point, I had no idea that Dave and Joe knew of my predicament, so Lisa and I just decided Joe must have missed his daily phone conversations with me, and was calling Lisa just for the hell of it. In fact, he was fishing for details, in case I had contacted Lisa directly. The fact that Lisa never returned Joe's calls (she was averaging 3 hours sleep every night, so really didn't have the time that week), probably made Joe even more concerned.

Anyway, we all had a good laugh afterwards, and we all got clear on the point that, if there's nothing Lisa can do in the event I get hurt, and there's no way for her to get more information right away, then she just plain doesn't want to know about it. Especially if it's mid-term exam week.