Double Trouble

The Diver
This 43-year-old male is a divemaster with additional diving specialty certifications. He is in good physical shape with no significant medical history and no history of any previous dive injuries; he takes no regular medication. A diver for five years, he averages 40 dives yearly. Before the incident discussed below, he had made four dives that year.

The diver has a reasonable mix of diving experience, ranging from cold fresh water and Caribbean ocean diving. Five years ago, he was diagnosed with back muscle “strain” and treated successfully and has experienced no symptoms since. He exercises regularly without difficulty.

The Dives
The setting for the dive was a river deep enough to have a shipwreck. The water temperature was 18C and the air temperature was between 18-19 C. He reported visibility of about 3 meters, and he had to swim against a 4-knot current.

He made both dives with compressed air as his breathing gas, using a dive computer. This diver’s computer offers diver-selectable algorithms. His previous dives were in a warm ocean environment; he had selected the least conservative algorithm for that series of dives. He was using that same algorithm for the cooler dives on this day. We cannot say with any certainty whether the algorithm selection was a contributing factor, but it can be considered.

The first dive began at 10:53 a.m. and went to a maximum depth of 20 m, with a total bottom time of 41 minutes. This multilevel profile corresponded to the depth of the wreck. He made a three-minute safety stop at 5 m. He reported no problems during the dive.

The surface interval was 1 hour, 21 minutes, during which the diver reported that he felt chilled. He states that he did not bring adequate clothing. (Without knowing the diver’s actual temperatures or other data, we cannot state whether his feeling chilled had any bearing on later events. This is reported strictly as anecdotal.) The second dive began at 12:56 p.m. and went to a maximum depth of 22 m. The diver’s total bottom time was 48 minutes.

At approximately 20 minutes into the second dive, the diver’s mask was accidentally dislodged by his buddy. While he was recovering his mask and clearing it, he ascended 3 m rather quickly. His computer recorded this event. While recovering, he swallowed small amounts of water several times. His rate of breathing increased because he was experiencing mounting stress.

This diver maintained some control, however, avoiding panic. Once he had cleared his mask and resumed breathing comfortably, he rejoined his buddy, who was unaware of what happened. He continued the dive until he reached 68 bar, when his computer displayed a “mandatory safety stop” warning. The divers made a slower-thannormal ascent approximately 3-6 m per minute. At 5 meters, they extended their safety stop to five minutes. They surfaced at 1:44 p.m.

The Symptoms
At 4 p.m., some two hours after the last dive, he noticed tingling in his right leg. He packed his gear and drove home. When he arrived, he unpacked, rinsed and stowed his gear. The tingling did not intensify, but he began to experience increasing tenderness in the heel of his right foot. It was acute enough to make walking difficult. Despite his symptoms, he prepared dinner. When symptoms did not improve by 8 p.m.,

he became concerned.
At by his wife's urging, he contacted the DAN 24-Hour Diving Emergency Hotline. After reviewing his dive profiles, events and symptoms, the DAN Doctor referred him to a local hospital, which has a hyperbaric chamber and a staff that evaluates and treats injured divers.

He arrived at the hospital around 9 p.m. The attending physician consulted with both a pulmonologist (lung specialist) and neurologist.

The diver's symptoms did not appear typical of decompression sickness (DCS), but after reviewing his dive profiles and symptom development, the attending medical staff diagnosed his condition as DCS Type II. This required hyperbaric oxygen therapy — a U.S. Navy Table 6, which began at 1 a.m., nine hours after the onset of symptoms. The treatment ended at 6 a.m. During the treatment, the tingling greatly decreased in the right leg, but the tenderness in his right foot seemed to increase.

Three to four hours later, the hyperbaric physician re-evaluated the diver and concluded he had residual symptoms. At this point the physician called for a second treatment, this time a U.S. Navy Table 5. Following it, the symptoms that remained were transient and greatly reduced from his original presentation. An imaging study of the spinal column did not reveal an immediate secondary cause for his symptoms.

The physician recommended the diver make no dive plans for at least one month; in addition, he recommended that the diver not fly for one week and that he suspend strenuous exercises for a week.

The Complications
The diver continued to experience intermittent tingling in his right leg. It became most obvious during a six-hour car ride two days after his last treatment. Conscious of this potential problem, he followed the medical advice to wait a week before flying again.

The diver resumed his student flying instruction one week after his last treatment. His first flight (in a single-engine, unpressurized plane) went to a maximum altitude of 340 m; the diver had no further recurrence of symptoms. Two days later he flew again with roughly the same flight parameters and had no symptoms.

On his third flight (maximum altitude of 580 m after recompression treatment, the diver's symptoms returned at the same intensity he experienced initially. Subsequently, the symptoms resolved overnight. He returned to the hospital and was reevaluated by the neurologist, who ordered another MRI (magnetic resonance imaging). Following the imaging, physicians diagnosed a herniated disc between the fourth and fifth lumbar vertebrae. The neurologist and the hyperbaric physicians discussed whether the DCS could have caused the herniated disc but concluded that DCS did not likely cause it.

The tingling was still present a month after the initial injury. The hyperbaric staff elected to treat the diver again, this time with a U.S. Navy Table 9. This additional treatment did little to change his residual symptoms. He also started a physiotherapy program. Three months later, after he completed his physiotherapy, he returned to diving. He had no return of any symptoms.

The Summary
The exact role his back injury may have played in his dive injury will never be fully determined. Following general safety guidelines may help reduce the risk of DCS and may facilitate diagnosing other potential conditions/injuries. This diver did an excellent job of reviewing safety guidelines and they are worth sharing.

1. Dive computers are designed to maximize bottom time according to the actual profiles. To help maximize safety plan the dive(s) according to the conditions i.e. anticipated exertion at depth, temperature, etc.
2. Divers should avoid frequent changes in depth, but bottom or wreck topography can make that difficult. Proper planning and orientation to the dive site ahead of time may help avoid unnecessary depth changes. Taking advantage of a longer surface interval, always a good practice, allows more offgassing and can increase your safety margins.
3. Proper exposure protection should be considered. The effects of temperature and other associated factors are complex. There is information available regarding this topic (see footnotes). In general adequate exposure protection can be the difference between a comfortable dive and a miserable dive.
4. Make the deepest dive of the day first. This is especially important if conditions are arduous or you have any circumstance in which offgassing could be an issue. This is a general guideline. This particular diver's profiles are not the best example of reverse profiles as there is not a significant difference in pressure between 20 and 22 meters.
5. Maintain skills. The basic skills we are taught in open-water courses never really lose their value. When we have long absences from diving, a refresher course may prevent you from losing proficiency. Skills, especially when a diver experiences stress or a potentially critical situation, should be second nature.

Finally, we all learned to "plan the dive and dive the plan." A few minutes spent planning a dive can help prevent problems that may affect us for long periods. Not all emergencies or incidents are predictable, but a little forethought can provide a safer lifetime of diving.