The Malaria Threat

You may often dream of the ultimate dive vacation, traveling halfway around the world to a much-heralded dive resort, where every dive is better than the last. You've set aside vacation money each month, so you certainly don't want anything to go wrong. The trouble is, you don't usually find ultimate dive spots in ideal locations. The abundant sea life, unusual coral gardens and tropical climates exist somewhere else, usually somewhere remote. In fact, many such dive sites are located in a band that extends from 45 degrees north latitude and 40 degrees south latitude, in an area called the "malaria zone." Such regions are remote to modern conveniences.

Contracting Malaria

The divers

Consider one of our DAN Member couples who took a dive vacation to Indonesia, which is in the malaria zone. They checked the website of the Centers for Disease Control and Prevention (CDC), which lists the risk of malaria in certain areas. When they called locals, the DAN Members were told there had been "no reported cases" of malaria in Indonesia for some time. Further, the residents reported that since they didn't take antimalarial medication and hadn't experienced the disease, they felt the area was relatively safe, a place of "minimum risk."

From these conversations, the divers concluded two things: 1) the area had a minimal risk of malaria; and 2) users of antimalarial drugs had reported rare side effects of mental cloudiness and hallucinations. Knowing these side effects would not go well with diving, the travelers decided to forego antimalarials. Before leaving, they had received all other recommended immunizations for travel to Indonesia. While in Indonesia, the couple stayed in an air-conditioned cottage with glass (not screen-only) windows and used insect repellent with DEET (N,N-diethyl-metatoluamide).

Both measures are generally helpful in protecting individuals from mosquito and other insect bites. In the early mornings, the husband would usually take a walk, and, in the evening, the couple returned to their cottage after dinner in shorts and short-sleeved shirts. The divers had a wonderful week, each day of diving far more exhilarating than the previous one. They logged 25 dives in 10 days, reporting that they never pushed their dive profiles. They both attested to consistently using bug repellent and reported feeling no mosquito stings. At the end of the week, they packed up their gear and headed home, having experienced a dream vacation.

The problem and treatment

The couple reported no problems on the flight home, but during the first week back the husband began to experience flulike symptoms, mostly generalized body aches and pains. At work he began to feel sluggish and took a couple of days off to recuperate. His blood pressure began to drop intermittently; his temperature rose rapidly, and he developed blurred vision. Concerned at this point that it was more than the flu, he suspected malaria. He went to the local clinic. After an exam, he was swiftly transported to a local hospital and into intensive care. After undergoing much blood work, transfusions, many intravenous and diagnostic procedures, the diver recalls awaking. It was 22 days later, and he had no memory of the previous three weeks or the fact that he had nearly died.

He remained in the hospital for 32 days, and then he was sent to a rehabilitation center for two and a half weeks. There he regained his strength, including the ability to walk and feed himself again. It took another four months before he recovered a "normal" level of energy and resumed working.

The discussion

These DAN Members did almost everything right, but they want all divers to know what they learned the hard way. For one, it's generally better to take the antimalarial drugs and tolerate possible side effects than suffer the disease itself. If they had to do it again, they said, they would have taken the antimalarials, even though there was not a specific warning for their areas and they felt the risk was minimal. Consider the following recommendations for traveling to an area with a known malaria risk:

- **Take the drugs**. Use the medication recommended for the area. Check the CDC website (www.cdc.gov/travel) and the World Health Organization (www.who.int/ ith) for the latest information on immunizations and country-specific health information. Take this information to your physician, who will then provide you with any prescriptions you'll need.
- **Use DEET.** Put a good DEET-containing1 mosquito repellent on the skin and outer clothing as well as on your mosquito netting.
- **Cover up**. While outside from dusk until dawn, cover exposed skin by using long-sleeved shirts and pants. If possible, avoid being outside between dusk and dawn entirely.
- **Get net**. If the situation warrants, use mosquito netting in your accommodations.This applies, for example, when you have only regular window screens or any opening that a mosquito could pass through.

Malaria has caused more deaths worldwide than any other infectious disease: It is the most serious infectious disease hazard to divers traveling to the tropics. To overcome doubt or worry you may have, it's best to take the antimalarial medication.

The Best Medication

The choice of an appropriate medication for treatment may require consultation with your physician or medical clinic while you're making travel plans – before you finalize them. Generally, your physician will temper his or her decision based on four criteria:

1. **The risk of malaria** – as determined by your destination and location within that particular destination, the time of year and length of the stay.
2. **Your traveler's profile** – more specifically, your age and pregnancy status, as well as any recent or previous medical or surgical history. Additional concerns address the purpose of travel, which suggests that adventurous travelers, missionaries and volunteers (e.g. Peace Corps) face a greater risk than business travelers.
3. **The effectiveness of the drug** – based on known areas of resistance.
4. **Your individual tolerance to the drug**.

Aralen (chloroquine phosphate), commonly referred to as "chloroquine," is considered effective as initial treatment for malaria in some areas. For the traveler adventuring into areas where Plasmodium falciparum malaria (considered the most serious form) is not present, chloroquine is often the drug of choice. Unfortunately, given the widespread distribution of P. falciparum, this drug has become less effective. For treatment, the drug is administered weekly, beginning at least one week prior to travel and continuing for four weeks after return. Common adverse reactions are gastrointestinal upset and headache, although some have complained of blurred vision, tinnitus (ringing in the ears) or dizziness.

Lariam (mefloquine hydrochloride), or "mefloquine," remains the popular choice of travelers to areas where P. alciparum is present. Its controversial reputation for adverse reactions has created concerns for the adventurous traveler who may be participating in riskier activities requiring fine motor skills and

coordination. As with any medication, divers who are not tolerating the medication need to consider the risks associated with the drug and dive safety. Some divers have reported that dive charter operators deny diving privileges to those using mefloquine, supposedly because its side effects may be difficult to distinguish from decompression illness. These reports have not been confirmed.

Common side effects include sleep disorders, mood changes, nausea, diarrhea and headache, which usually occur within the first three weeks of use. If taken for the first time, mefloquine should begin at least three weeks prior to travel to allow for stabilization or for a timely change to another suitable drug. In general, side effects occurring within the first three weeks are unlikely to become worse in later weeks. Like chloroquine, mefloquine requires only a weekly dose, beginning at least two weeks before travel and continuing for four weeks after return. There are some safety data pertinent to use during pregnancy: It is generally agreed that it can be used safely during the second and third trimesters of pregnancy. However, many organizations recommend cautious use during the first trimester.

Malarone (atovaquone/proguanil) was first approved in the United States in 2002. Since that time, it has become the popular choice of travelers to areas where there are chloroquine-resistant strains. Adverse reactions commonly reported involve gastrointestinal upset, headache and dizziness. Although there are reports of newfound resistance among P. falciparum, malarone continues to enjoy a good reputation for malaria prophylaxis.

Plaquenil (hydroxychloroquine) has been used for many years in the treatment and suppression of malaria. The most common side effects are mild nausea, occasional stomach cramps and diarrhea.

Vibramycin (doxycycline) is among the most effective drugs tested in clinical trials and has shown strong effectiveness against P. falciparum malaria. As both an antimalarial and antibiotic, it can have a beneficial effect on reducing the incidence of other diseases such as travelers diarrhea. However, its dosing regimen and side effects often make it less appealing for the traveling diver. The most common side effects are gastrointestinal upset, photosensitivity (sun sensitization) and increased susceptibility to yeast infections for females.
Doxycycline is taken once daily, beginning at least one day before entering a malaria zone and should be continued daily for four weeks after departing the area. It is not recommended for pregnant women or children under 8 years of age.

ANTIMALARIAL DRUGS					
Drug	Dosage Interval	Duration before and after travel	Contra-indications	Common Adverse Reactions	Resistance
Aralen Chloroquine phosphate	Once weekly	2 weeks before 4 weeks after	Retinal or visual field changes	Headache pruritis	Resistance appears widespread

Lariam Mefloquine hydrochloride	Once weekly	1 week before 4 weeks after	Not for prophylactic use in patients with psychiatric disease or history of depression or seizures	Nausea / vomiting, vivid dreams, dizziness, mood changes, insomnia, headache and diarrhea	Resistance appears to be rare, but is known mainly in Southeast Asia
Malarone Atovaquoneproguanil	Daily dose	1-2 days before 7 days after	Prophylaxis in severe renal impairment	G.I. upset / pain, headache	
Plaquenil Hydroxychloro-quine	Once weekly	2 weeks before 8 weeks after	Long-term use in children. Retinal or visual field changes		
Vibramycin	Daily dose	1-2 days before 4 weeks after	Sunburn, G.I. upset, yeast infections		

Mechanism of Malaria

According to the World Health Organization (WHO), malaria kills from 700,000 to 2.7 million people each year. The organization reports 300 million to 500 million new cases annually. In the United States, of the 1,000 to 1,500 people per year to be diagnosed with malaria, most have recently returned from the malaria zone, which occurs in latitudes from 45°N to 40°S and stretches lengthwise across the globe. Worldwide, malaria is a leading cause of death and disease. Malaria is not transmitted from casual human-to-human contact. An illness caused by the parasite Plasmodium species, malaria is transmitted by the bite of infected female Anopheles mosquitoes, which bites from dusk to dawn.

With its bite, the infected mosquito releases saliva and sporozoites (the infectious stage of the parasite) into the victim. These sporozoites then invade the liver in this first stage of infection, known as the exoerythrocytic stage, or the stage prior to invasion of the bloodstream (exo- = outside; erythrocytic = pertaining to erythrocytes, or red blood cells). In the liver, the sporozoites go through an incubation period of one week to several months. They mature to merozoites (the motile, or moving, infective stage of the parasite), which are released from the liver cells. These merozoites then invade red blood cells in what is termed the erythrocytic stage. In the red blood cells, a merozoite undergoes chizogony – asexual reproduction by multiple segmentation – into many merozoites.

The infected red blood cells burst open, releasing a new crop of merozoites, initiating a “paroxysm,” a new cycle of infecting more red blood cells. This rupturing is what is responsible for many malaria flulike

symptoms. Because malaria affects red blood cells, it can be transmitted through shared use of needles, blood transfusion or from mother to developing baby. (The reference is to a developing fetus during pregnancy. See http://www.cdc.gov/malaria/pregnancy.htm.)

When the mosquito bites an already-infected person, it ingests the microscopic parasite in the person's blood. The parasite grows in the mosquito for a week or so and then is transferred through the mosquito saliva to the next person who is bitten. Types of malaria There are four species of the malarial parasite that infect humans: Plasmodium vivax, P. ovale, P. malaria and the most serious, Plasmodium falciparum. P. falciparum has 48-hour cycles and affects the brain, kidneys and gastrointestinal tract. Because of the tendency for infected red blood cells to clump together, P. falciparum can even affect blood vessels by clogging them up and cutting off the blood supply to vital organs. If the liver phase of the disease is not treated adequately, P. vivax and P. ovale can both cause a relapse from a dormant liver phase. P. malariae can lie dormant for years in blood cells – that's why you cannot donate blood if you have been exposed to malaria.

With reports from David Dubois, M.D.

What to do

Check the CDC website (www.cdc.gov/travel) and the World Health Organization (www.who.int/ith) for the latest information on immunizations and country-specific health information.
DAN Members can also call the DAN Info-Line to inquire about specific health warnings.