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Toward Malaria Prevention and Control

TOWARD MALARIA PREVENTION AND CONTROL

Malaria is the most deadly vector-borne disease in the world. What can we as physicians learn about the current global disease burden and the biology behind this disease.

You are listening to ReachMD XM 160, The Channel for Medical Professionals. Welcome to a special segment - Focus on Global Health. I am Dr. Mary Leuchars, your host and joining me today from Atlanta is Dr. William Collins. Dr. William Collins is a Senior Biomedical Research Scientist at the Centers for Disease Control in Atlanta and he has been studying malaria now coming up to 50 years. Today we are discussing the biology behind malaria and its current global disease burden.

DR. MARY LISA:

Welcome, Dr. Collins.

DR. WILLIAM COLLINS:

Welcome, welcome I am glad to talk to you today.

DR. MARY LISA:

Now, you have been studying malaria for a long time. Firstly, I would like to review the different types of malaria for the physicians who may be listening who aren't as familiar as you may be with the different type there are.

DR. WILLIAM COLLINS:

Well, there are four basic types that infect humans. The most important is Plasmodium falciparum because it often can result in death of the patient. That's falciparum malaria. The other three are Plasmodium vivax, Plasmodium ovale, and Plasmodium malariae. Falciparum is primarily found in Africa. Vivax is worldwide, but generally it does not infect people with the Duffy-negative gene; so therefore is not found in many of your people in Sub-Saharan Africa and therefore it is found in other places of the world, South America, Asia, and Oceania. Ovale infects everybody, so it is found mostly though in Africa and in parts of the Islands of the South Pacific and some areas

of Southeast Asia. Malariae is also worldwide but is very seldom seen because it is not diagnosed very often, but it is found throughout Asia, sometimes in South America, and is very common in Africa. So, it probably is only would say is about 1 or 2% of infections are Malariae. Ovale is very rare, probably less than 1%. Vivax probably represents about 30% of the infections and falciparum makes up the majority probably about 60% of the infections you will find worldwide, but in Africa, it is the dominant thing and is responsible for most of the deaths in the world. Probably I would say there is 350 to 500 million infections a year, but as far as deaths are concerned, it is probably anywhere between half a million to a million deaths and those are in children primarily under 5 in Africa. It probably is found, malaria is found in over 100 may be up to 109 countries worldwide, probably slightly less than 50 of the world's population are exposed or can be exposed to malaria. That is because anyone in the tropical areas of the world can be exposed, but some of the temperate areas of the world still have risk of people becoming infected. So, it is still a major disease, and as far as United States is concerned we have about 1500 cases a year reported, but most of that is people who have come in as tourists or as immigrants and they are diagnosed once they come in to the country; very rarely that we get a transmission in the United States. We still have our mosquitoes, but we certainly don't have much transmission in United States. We have a rare chance of a local mosquito picking up malaria from the tourists or immigrants who comes in and then transmitted it to a local person in the country; and then we find it here at CDCs reported by a State Health Department or a physician who has a patient and then let us know about it and then we have systems of either diagnosing it at the State Health Department or the Local Health Department needs help , we then advice them on the proper treatments that can be given that proper drugs. Malaria can be treated; even drug-resistant malaria can be treated by the proper drugs if given proper notice on proper time.

DR. MARY LISA:

Ah ha. And of the disease burden that we talked about globally, what's the percentage shared by children?

DR. WILLIAM COLLINS:

Well, the disease for death and that is almost death occurs almost primarily in children under 5. Once the person or child survives the infection of malaria, 2 or 3 infections who are one who are under 5 they develop immunity and then can survive. So, most of the deaths occur in children under 5 if they survive early infections, then they develop immunity and then death occurs almost always if it occurs is in young children. Adults of course can die if they did not have malaria in childhood or early. So therefore in this country if we have a person who gets falciparum for the first time when they are adult they are in risk of dying, but people develop immunity to malaria after they have had it number of times in childhood or in adolescence.

DR. MARY LISA:

Dr. Collins, how is the incidence of malaria changing globally?

DR. WILLIAM COLLINS:

Well, there has been a tremendous amount of efforts, and probably the last 10 years and specifically in the last 3 to 4 years in Africa to try and drive malaria down. Now a number of years ago, there was a global effort to eradicate malaria and at least bring it under control in other parts of the world, and it was extremely successful except in Sub-Saharan Africa because of the infrastructure or are lack thereof and the tremendous problem, it was thought that it was impossible, but in the last just says 5 years or so, there has been a concerted effort in Africa. The non-government agencies, the World Health Organization; and now there is a tremendous effort. There is a President's Program, the President's Malaria Initiative. There is the Gates Foundation; there is the Rollback Malaria, World Health Organization. There is actually billions of dollars now being spent in Africa in a three-pronged effort to distribution of bed nets on unprecedented scale, insecticide-treated bed nets are being distributed by the millions. In Ethiopia alone there has been millions and millions of bed nets distributed to try and get children in particular to sleep under bed nets. There has been a widespread distribution in a

number of countries of treatment of homes with insecticides. That effort was effective back in the malaria eradication days in the more developed countries and that brought malaria under control and actually eliminated it from many of the developed countries through the use of insecticides by treating the walls because the mosquitoes rested on the walls of houses. Now in some areas of world that doesn't work. If the mosquito feeds only outdoors while having treating the inside walls of the house where the insecticides does not work. But in the areas that has houses and people sleep indoors in the houses then that works. If a person sleeps outdoors on a hammock like in many of the tribal areas and the mosquito feeds outdoors while having spraying the house does not really do that well. But it's being used in Africa now again the use of the insecticides and it is being quite effective. But the efforts of the Gates Foundation, non-government agencies, and the President's Rollback Initiative, the President's Malaria Initiative having quite an effect in many parts of the Africa now.

DR. MARY LISA:

Dr. Collins, could we just review the lifecycle of sporozoae once it is injected into the blood streams by infected mosquitoes?

DR. WILLIAM COLLINS:

Well, the cycle has been well known for a long time that when the mosquito feeds on the infected patient, the sexual stage actually takes place inside the gut of the mosquito and after it develops the infective stage, the sporozoae concentrates in the salivary glands of the mosquito and they are injected when the mosquito feeds, and very few of them are injected actually. They go down the salivary duct which is very, very narrow, so that is only probably anywhere from, well to say 1, but probably from 10 to 50 are injected into human when the mosquito feeds, and this is the basis for the vaccines that are being developed. The first-stage vaccine, the first barrier, if you can stop the sporozoa from invading the liver, but what happens is the sporozoae gets into the blood stream and it invades the liver, and it does it very quickly actually, probably within periods from 30 seconds to several minutes, it will begin to invade the liver cell; and once it gets in the liver cells, its fairly protected against any antibody that is directed against it, but if the barrier is put up there, the sporozoae is inside the blood stream, and if you have the antibodies present at that point in time, you can stop the infection right away; and that is the first vaccine that people started working on, and that has been in development for about 20 years, to stop the sporozoae before it gets into the liver because the sporozoa does not cause the disease at all. It just goes into the liver and starts developing there and the liver stage does not cause disease at all. Its a resting stage so to speak where the parasite multiply for a period of about a week to 10 days in the liver, where it is multiplying to say probably anywhere from 5000 to 10000 new parasites for each sporozoae. It multiplies and then after about 1 week to 10 days, that stage ruptures and that's what invades the red cells, its meront or the merozoites, a lot of people will call it merozoites, some call it meronts, but that stage then invades the red cell and that starts what we call the disease forming stage because those then invade red cells and every 48 hours if it is either vivax, ovale, or falciparum destroy a red cell and it multiplies at the rates of about somewhere between 10 to 20-fold multiplication every 48 hours, destroys another generation of red cells, there are multiplication of about 10-fold destruction of red cells every 48 hours. So you can see within the matter of a short time, you are destroying huge numbers of red cells. Every 48 hours you have a 10-fold destruction of red cells, and they reinvade red cells and then 48 hours later, you get another cycle, and that's what causes the fever and destruction and the disease is the destruction of all the red cells by these multiplications within the red cells of the malaria parasites. In the process, they produce a stage that will again infect mosquitoes, as the mosquitoes feed on the blood and you have the cycle again of asexual development. The sexual stage always occurs in the gut of the mosquito, which produces again a stage that will infect another human.

DR. MARY LISA:

If physicians, Dr. Collins who want to update their knowledge more about malaria, is the CDC website a good place to start?

DR. WILLIAM COLLINS:

Yes, we have a DPDx it is called, it is a website that you can go through which has not only information on malaria, but we have a book in there on the primate malarias. It is a disc. It is a 300-some-page book on the primate malarias. If the person wants to access to text book on all the malarial parasites, which not only discusses the human malaria parasites but the monkey parasites because some of the monkey parasites can go into humans also, but that is another subject altogether, but we have all the information anyone might be interested in on diagnosing of human malarias in that on DPDx website at CDC which is available on the internet.

DR. MARY LISA:

My thanks very much to you Dr. William Collins for being our guest today. We have been discussing the biology and also the global disease burden of malaria.

I am Dr. Mary Leuchars. You have been listening to the special segment – Focus on Global Medicine on ReachMD XM 160, The Channel for Medical Professionals. We welcome your comments and questions through our website at www.reachmd.com, which now features our entire medical show library in on-demand pod cast. Thanks for listening.

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