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Sharks' Virus Killer Could Cure Humans, Study Suggests

"Remarkable property" already effective against six types of viruses.

Dogfish sharks ply the Pacific Ocean off Canada.

Photograph by Jurgen Freund, Getty Images

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Sharks aren't just tough on the outside—a substance in their bodies can stop viruses in their tracks, a new study says.

A cholesterol-like compound found in dogfish sharks' tissue has been shown to combat several viruses that cause hard-to-treat human diseases, such as dengue fever and hepatitis, a new study says. (Take a quiz on infectious diseases.)

Called squalamine, the compound is already in human clinical trials for cancer and eye disorders, and several hundred people have been exposed without major side effects.

The new study revealed that squalamine can also disrupt a virus's life cycle and prevent it from replicating in both tissue cultures and live animals.

Though there are plenty of drugs to treat bacterial infections, there are few pharmaceuticals that are effective against viruses. Current antiviral drugs are highly specific—each targeting just one strain of a virus—but strains can easily mutate and become resistant to the medication.

(See "New Drug Cures Multiple Viruses in Human Cells.")

"It's a whole new approach to treatment of viral disease," said study leader Michael Zasloff, of the Georgetown University Medical Center.

"It's very possible we could cure several diseases we [now] treat as chronic infections."

"Eureka Moment" For for Shark-based Antiviral Drug

Zasloff discovered squalamine in 1993 while searching for antibacterial agents in sharks, which are immune to some diseases, including all viruses.

(See "Sharks Carrying Drug-Resistant 'Bacterial Monsters.'")

He found that squalamine—which "looked like nothing else that had ever been described or discovered"—inhibits the growth of blood vessels, suggesting the molecule could potentially stop cancer cells from multiplying.

Human research eventually led to Zasloff's "eureka moment," when he realized squalamine can also disable viruses, he said. (Watch video: "How Flu Viruses Attack.")

"I could see [how it works against viruses] almost as if it were a moving picture," he recalled.

Squalamine is a positively charged molecule, so when it enters a cell, the molecule immediately sticks "like Velcro" to the cell's inner membranes, which have negative charges, Zasloff said.

By doing so, squalamine "pops off" any positively charged proteins that were attached to the cell membrane—an action that does no harm to the cell, Zasloff noted.

When a virus invades a cell, it expects those proteins to be present on the cell membrane. Without them, the virus can't reproduce.

"There is no other compound known to science that does this—this is a remarkable property," Zasloff said.

It's also one that has apparently served sharks well for hundreds of millions of years—and possibly explains the creatures' evolutionary success.

The shark's "antiviral defenses have been extraordinary," Zasloff said. "It has adapted a very remarkable immune system and stayed with it."

Squalamine Effective Against Human Viruses

In the study, squalamine thwarted infection of the dengue fever virus in human blood vessel cells and of hepatitis B and D in human liver cells—and with little harm to sharks. Shark tissue is no longer required to produce squalamine, which has been synthesized in the laboratory since 1995.

Zasloff and colleagues also discovered that squalamine inhibited yellow fever, eastern equine encephalitis virus, and murine cytomegalovirus in lab animals—in some cases curing the subjects, according to the study, published this week in the journal *Proceedings of the National Academy of Sciences*.

Current squalamine compounds can access only cells that have "chemical portals" to permit its entry, such as those in blood vessels, capillaries, and the liver. But a squalamine-based drug could potentially be tailored to fight a wide variety of viruses in other types of cells, he said.

The results "sounds promising" as antiviral drugs, said Todd Rider, a senior staff scientist at the Massachusetts Institute of Technology's Lincoln Laboratory and Division of Comparative Medicine.

"So far the researchers appear to have shown that squalamine is active against six viruses, although they also found that it does have some toxicity and other side effects in certain cell types at doses roughly comparable to those that were required for antiviral efficacy," Rider said by email.

"It will be interesting to see what additional viruses squalamine is or is not effective against, and whether the antiviral efficacy can be achieved without toxicity in any type of tissue."

Study leader Zasloff said, though, that all substances have some toxicity, and that clinical trials would reveal how safe the drug is for humans.

(Related: "Blockbuster Ocean Drugs on the Horizon? [2009].")

But based on its known safety so far, Zasloff predicts clinical trials for the antiviral will begin in people in about a year.

Sharks have been hiding squalamine in their bodies for 700 million years, he added. "Now it's a gift to us."