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Why Japan imported Ebola ahead of the 2020 Olympics

The deadly virus is one of five that have been brought to a secure laboratory.

Mark Zastrow

Japan is preparing for tens of thousands of international tourists to descend on Tokyo for the Olympic Games next year — and that includes being ready for unwanted biological visitors.

Last month, Japan imported Ebola and four other dangerous viruses in preparation for a possible outbreak at the event. The Japanese health ministry says researchers will use the samples, which include Marburg virus, Lassa virus, and the viruses that cause South American haemorrhagic fever and Crimean–Congo haemorrhagic fever, to validate tests under development.

The viruses' arrival represents the first time that pathogens rated biosafety-level-4 (BSL-4) — the most dangerous rating — have been allowed to enter the Japanese National Institute of Infectious Diseases (NIID), the only facility in the country operating at that level.

Japan's medical-science community welcomes the move. Although infectious-disease scientists say that the risk of an outbreak during the Olympics isn't much higher than at any other time, access to the live viruses will boost the country's capacity to handle infectious diseases in general — and to prepare for a bioterror attack.

Although the NIID's laboratory in Musashimurayama, Tokyo, was built to BSL-4 specifications in 1981, it operated as a BSL-3 lab for decades because of opposition from residents. In 2015, the health ministry and the Musashimurayama mayor agreed that it could operate as a BSL-4 lab, but the decision to import the five viruses was only finalized in July.

Japan's ability to study the most dangerous pathogens has lagged behind that of other advanced nations — both the United States and Europe have more than a dozen BSL-4 labs in operation or under construction, and China is building a network of at least five BSL-4 labs, with one already operational in Wuhan.

"This is a landmark time, a landmark event" for NIID, says Masayuki Saijo, director of the NIID department that is responsible for haemorrhagic-fever viruses.

But not everyone is pleased about the imported viruses. Some local residents have told Japanese media that scientists and the government are using the Olympics as a pretext to import the viruses. And Richard Ebright, a molecular biologist and biosecurity specialist at Rutgers University in Piscataway, New Jersey, says that BSL-4 labs can be prepared to handle outbreaks of hazardous agents without the need to bring them to the country ahead of time. Storing dangerous viruses, even in a highly secure lab, increases the risk of an accidental or deliberate release, he says.

What's the risk?

The NIID will use the live samples to validate tests it has developed to assess whether a person with one of the viruses is still infectious, says Saijo. The tests measure whether the patient is generating antibodies that are capable of neutralizing the virus in question, which would suggest that the patient is recovering, and not infectious, he says. If there is a person with one of these viruses at the games, such a test could provide valuable information for assessing whether they can be discharged from hospital, he says.

The development of these tests will boost Japan's preparedness for such an event or a bioterror attack, says Saijo. Other Olympic host nations didn't have to import these viruses specially ahead of the games because they already had the pathogens in BSL-4 labs. The NIID will also continue developing more sensitive and accurate tests after the games. Saijo says that he understands opposition

from local residents, but that the live viruses give Japanese researchers an important advantage in preparing against infectious diseases.

Elke Mühlberger, a microbiologist at Boston University in Massachusetts, thinks that a major outbreak of Ebola at the Olympics is unlikely because the infection is not transmitted through the air. But she says that Japan's plan to assess the NIID's tests with live viruses before the games makes sense, especially given the ongoing Ebola outbreak in the Democratic Republic of the Congo. "A report of an Ebola virus infection during the Olympics could have devastating consequences if the emergency responses were not professional," she says.

But Mühlberger is sceptical about the usefulness of neutralizing-antibody tests to evaluate whether a patient can be released. She says the easiest way to determine whether a patient is virus-free is to look at the amount of viral RNA in their body fluids. "I don't believe anybody would release a patient just because they have developed neutralizing antibodies," she says.

Animal research

Now that the NIID is allowed to handle BSL-4 pathogens, researchers there will also be able to study other dangerous viruses that might emerge in the region, says Mühlberger. The latest genome sequencing technologies are revealing that Ebola-like viruses are more common than previously thought, she says. Three in the same family were discovered in animals the last year: the Mengla virus in Chinese bats and two Ebola-like viruses found in fish in the East China Sea. "It is amazing how many animals are infected with viruses which are very closely related to very, very dangerous pathogens," she says.

It remains unknown whether these viruses can infect or harm humans, says Mühlberger. But their diversity is "pretty scary", she says. "These viruses are everywhere."

Virologist Ayato Takada at Hokkaido University in Sapporo, Japan, is also excited about being able to study BSL-4 pathogens in animals in Japan. Until now, researchers had to apply for access to BSL-4 labs overseas, which are in high demand. Takada hopes to use a second BSL-4 lab that is under construction at Nagasaki University in southern Japan and due to be completed in 2022.

But Ebright argues that the proliferation of BSL-4 labs around the world increases the chances that a deadly virus could be released in a bioterror attack. He thinks that some governments, including Japan, are using their BSL-4 labs to stockpile deadly agents to deter bioattacks from similarly equipped adversaries. Saijo says that the NIID is operated solely for public-health research.

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Updates & Corrections

- ***Correction 15 October 2019****: An earlier version of this story wrongly stated that the Japanese National Institute of Infectious Diseases (NIID) does not have space for animal studies. In fact, animal studies can be conducted at the NIID.*

http://bit.ly/2poB4IK

New drug-pricing data shows stunning hikes—one whopping 667% increase

One listed reason for raising prices was "market conditions."

Beth Mole - 10/14/2019, 11:42 PM

Pharmaceutical companies continue to raise prices on hundreds of drugs at rates well over that of inflation, according to a newly released report on drug-pricing data.

The data was made public thanks to a mandate from a California transparency law passed in 2017. Under the law, drug makers are required to report their price increases quarterly. This is the first report from the law and includes data on drugs that had price increases of 16% or more over their January 2017 prices.

The hikes in these cases are to the wholesale acquisition cost, which is the list price for wholesalers—they may not reflect how much

patients will pay out of pocket. Still, they can add to overall healthcare spending and drive up the costs of insurance.

Under the 2017 law, drug makers are also required to provide reasons as to why they're driving up costs.

Between 2017 and the first quarter of 2019, drug makers reported hundreds of price hikes. The report focuses on trends for a little over a thousand drugs. The median price increase overall was 25.8%. Generic drugs, specifically, had higher increases, with a median rise of 37.6%.

But some drugs stood out for having exorbitant hikes, as Kaiser Health News pointed out. A liquid version of generic Prozac (fluoxetine) went from $9 to $69 just in the first quarter of 2019—a 667% increase. The reason given was new production costs.

Likewise, a generic medication for attention deficit hyperactivity disorder (ADHD) called guanfacine, went from about $29 to $87 in the first quarter of 2019, a more than 200% increase. Guanfacine's maker, Amneal Pharmaceuticals, also listed production costs as a reason for the hike, as well as "market conditions."

The data shows that "even at a time when there is a microscope on this industry, [drug makers are] going ahead with drug price increases for hundreds of drugs well above the rate of inflation," Anthony Wright told KHN. Wright is the executive director of the California advocacy group Health Access.

Wright noted that the new reporting offers progress toward making drug pricing transparent. But critics note that it still doesn't reveal the true reasons drug makers are raising prices—whether there are drug shortages or changes in competition—and what the changes mean for patients. The reporting also faces challenges. The drug-maker industry group, PhRMA, has filed a lawsuit to overturn California's law. And earlier this month, the state of Nevada issued fines on drug makers for failing to comply with its drug pricing law, which passed in 2017.

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Fire blankets can protect buildings from wildfires

Existing blanket technology can protect an isolated building from a short wildfire attack, but technological advancements are needed for severe situations

Wrapping a building in a fire-protective blanket is a viable way of protecting it against wildfires, finds the first study to scientifically assesses this method of defense.

By rigorously testing different fabric materials in the laboratory and using them to shield structures that were exposed to fires of increasing magnitude, this research, published in *Frontiers in Mechanical Engineering*, confirms that existing blanket technology can protect structures from a short wildfire attack. For successful deployment against severe fires and in areas of high housing density, technological advancement of blanket materials and deployment methods, as well as multi-structure protection strategies, are needed.

"The whole-house fire blanket is a viable method of protection against fires at the wildland-urban interface," says lead study author Fumiaki Takahashi, a Professor at Case Western Reserve University, Cleveland, Ohio, USA, who teamed up with the NASA Glenn Research Center, U.S. Forest Service, New Jersey Forest Fire Service, and Cuyahoga Community College for this study.

He continues, "Current technology can protect an isolated structure against a relatively short wildfire attack and further technological developments are likely to enable this method to be applied to severe situations."

A burning need

Wildfires in urban and suburban settings can have a devastating effect on communities and pose one of the greatest fire challenges of our time.

People living and working in fire-risk areas contacted Professor Takahashi to find out if commercial products are available to help reduce the likelihood of structure ignition, which would reduce fire damage and improve public and firefighter safety. These pleas motivated the research and an initial investigation revealed that the concept of whole-structure fire blankets has been around for quite some time.

"I thought about a means to reduce wildland fire damage and found a U.S. patent 'conflagration-retardative curtain' i.e., a fire blanket, issued during World War Two. In addition, the U.S. Forest Service firefighters managed to save a historic forest cabin by wrapping it with their fire shelter materials," Takahashi reports.

An old flame-retardant

While there are anecdotal reports on the ability of fire blankets to protect buildings from fires, Takahashi's research highlighted a severe lack of scientific evidence to back up these claims. To rectify this, funded by a research grant from the U.S. Department of Homeland Security, the team conducted several experiments to test the ability of different blanket materials to shield structures against fires of increasing magnitude.

"The fire exposure tests determined how well the fire blankets protected various wooden structures, from a birdhouse in a burning room to a full-size shed in a real forest fire. We tested four types of fabric materials: aramid, fiberglass, amorphous silica, and pre-oxidized carbon, each with and without an aluminum surface. In addition, we conducted laboratory experiments under controlled heat exposure and measured the heat-insulation capabilities of these materials against direct flame contact or radiation heat."

A hot new industry

The laboratory and real-fire assessments demonstrate that fire blankets could protect structures from a short exposure to a wildfire, but also highlight the technical limitations of their existing form. Further technological advancements are needed in the areas of material composition, deployment methods and multi-structure protection strategies.

Takahashi explains, "The fiberglass or amorphous silica fabrics laminated with aluminum foil performed best, due to high reflection/emission of radiation and good thermal insulation by the fabric. New technology is needed to enhance the fire blankets' heat-blocking capability for an extended period to prevent structure-to-structure ignition. In addition, it will be more effective If dozens or hundreds of homes are protected by such advanced fire blankets at the same time, particularly in high housing-density Wildland-Urban Interface communities."

He concludes by suggesting communities potentially affected by wildfires work together to turn the concept of whole-building fire blankets into a reality.

"Fire blanket protection will be significant to those living and fighting fires at the Wildland-Urban Interface and presents entrepreneurs and investors with business opportunities. The implication of the present findings is that the technical community, the general public, and the fire service must work together to take a step-by-step approach toward the successful application of this technology."

https://www.frontiersin.org/articles/10.3389/fmech.2019.00060/

http://bit.ly/2MHyR3p

3000-year-old toolkit suggests skilled warriors crossed Europe to fight an epic battle

Bagful of bronze artifacts and tools found in the middle of the battlefield suggests that some of these warriors traveled from hundreds of kilometers away to fight

By Andrew Curry

Bronze Age Europe was a violent place. But only recently have scientists uncovered the scope of the violence, at a 3000-year-old

site in northern Germany, where thousands of well-armed young men fought with sophisticated weapons in what appears to be an epic battle. Now, a bagful of bronze artifacts and tools found at the bottom of the river in the middle of the battlefield suggests that some of these warriors traveled from hundreds of kilometers away to fight.

That suggests that northern European societies were organized on such a large scale that leaders could call warriors to distant battlefields, long before modern communication systems and roads.

This collection of bronze artifacts was contained in a pouch or box and lost on a battlefield 3300 years ago, archaeologists say. **Volker Minkus, Landesamt für Kultur und Denkmalpflege**

"It's extremely rare to find a box or pouch [like this]," on an ancient battlefield, says Thomas Terberger, an archaeologist with the Lower Saxony State Office for Cultural Heritage in Hanover, who describes the find with colleagues in a paper published today in *Antiquity*. "Somebody lost it there."

The battle raged in a narrow, swampy valley that runs along the Tollense River, in Mecklenburg-Vorpommern, 160 kilometers north of Berlin. Many of the artifacts sank below the water and so were preserved in pristine condition. Since the site was discovered in 1996, archaeologists have uncovered metal and wooden weaponry and more than 12,000 pieces of human bone.

The new find, unearthed in 2016, includes cylindrical fragments of bronze, along with a bronze knife, awl, and small chisel. The jumble of tools and scrap metal resemble someone's personal effects, rather than a ritual deposit or hoard. Archaeologists say the tools were likely in a bag or box that decayed. But the contents were held in place by the thick mud of the riverbed—until divers found them some 3000 years later.

Dozens of similar collections of scrap bronze, along with small tools for cutting it, have turned up in the graves of high-status warriors from much further south, along the northern foothills of the Alps from eastern France all the way to the modern-day Czech Republic. (At the time, bronze was the height of metallurgical—and military—technology.) But this densely-packed cluster of bronze objects is the first of its kind found this far north.

The new find supports the hypothesis that warriors traveled many hundreds of kilometers from their homeland to the battlefield, showing social organization on a grand scale. The artifacts fit with previous evidence that some bones found on the battlefield had a strontium content that didn't match isotopes found in people raised in the region.

"This shows people were a lot more mobile than we thought," says University of Aarhus archaeologist Helle Vandkilde, who was not part of the study. "The implication would be the objects accompanied people on the move."

The watery conditions below the surface also preserved bits of wood, including the awl's birch handle, which helped archaeologists date the finds. Within a few meters of the bronze objects, divers found more debris from the battle, including arrowheads, dress pins, a bronze knife with a bone handle, and a human rib and cranium. All the finds date to about 1300 B.C.E., supporting the idea that they were part of a single event.

The bronze scraps and chisel to cut them are suggestive of something else, too: The dawn of currency. "Metal objects are starting to become not only tools but money," Terberger says. "The fact that they had the possibility to trade with each other is something new."

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Soil on moon and Mars likely to support crops

Mars soil simulant comparable to soil on Earth

Researchers at Wageningen University & Research in the Netherlands have produced crops in Mars and Moon soil simulant developed by NASA. The research supports the idea that it would not only be possible to grow food on Mars and the Moon to feed future settlers, but also to obtain viable seed from crops grown there.

Wieger Wamelink and his colleagues at Wageningen University & Research, cultivated ten different crops: garden cress, rocket, tomato, radish, rye, quinoa, spinach, chives, peas and leek. The researchers simulated the properties of Lunar and Martian regolith and "normal" soil (potting soil from Earth) as a control.

Nine of the ten crops sown grew well and edible parts were harvested from them. Spinach was the exception. Total biomass production per tray was the highest for the Earth control and Mars soil simulant that differed significantly from Moon soil simulant. The seeds produced by three species (radish, rye and garden cress) were tested successfully for germination.

The article, "Crop growth and viability of seeds on Mars and Moon soil simulants", by Wieger Wamelink and colleagues has been published in De Gruyter's open access journal, Open Agriculture.

"We were thrilled when we saw the first tomatoes ever grown on Mars soil simulant turning red. It meant that the next step towards a sustainable closed agricultural ecosystem had been taken," said Wieger Wamelink.

The paper can be read for free, here: https://doi.org/10.1515/opag-2019-0051

https://bbc.in/33IwuEd

Deadly parasite 'jumped' from gorilla to humans

A rare and unfortunate sequence of events allowed a deadly type of malaria in gorillas to "jump" species and attack humans, according to scientists.

Hundreds of thousands of people die from malaria every year and *Plasmodium falciparum* - the type the researchers studied - accounts for most cases. African great apes were the original host to the parasite. But a chance genetic mutation about 50,000 years ago turned it into a threat to humans, experts have found.

Mosquito bites

The findings, published in the journal PLoS Biology, could help uncover new ways to fight malaria, the Wellcome Sanger Institute researchers hope.

Malaria is caused by a parasite that gets into the bloodstream when an infected mosquito bites humans - or animals. There are lots of different strains of parasite and one of the most important ones, which now affects only humans, is *Plasmodium falciparum*.

It switched host from gorillas at about the same time as the first migration of humans out of Africa, some 40,000 to 60,000 years ago, the researchers say. They studied the genetic make-up of different ancestral types of malaria parasite, focusing in particular on a gene called rh5 - the vital bit of DNA code that enables malaria to infect human red blood cells.

It is a target doctors are very interested in for developing new malaria vaccines. The researchers believe thousands of years ago, two types of malaria parasite happened to co-infect a gorilla and they exchanged some genetic material between them.

Plasmodium falciparum picked up the rh5 gene.

Lead author Dr Gavin Wright said: "This was a very rare event that led to so much death and disease in humans.

"We were quite surprised by the findings. It was very satisfying because it makes sense with lots of other research that has been done by colleagues. It provides this molecular explanation now as to how this jump could have occurred. "Rh5 currently is an important blood stage vaccine candidate for malaria and so if we can get any more information on this gene, that could really help us

in trying to combat this disease." He said the chances of the parasite mutating again soon were "very, very slim", although theoretically possible.

Nearly half of the world's population is at risk of malaria. The most cases and deaths occur in young children in sub-Saharan Africa, caused by *Plasmodium falciparum*.

http://bit.ly/2J24dAO

'I predict your words': that is how we understand what others say to us

Making predictions could be a key function of our brain to help us understand what is said to us quickly and efficiently, especially in noisy and complex contexts

We are at a fun but noisy party: how can we understand the words someone is saying to us despite the background music and voices? Thanks to the hard work of our brain and a special trick, it is capable of using: "predicting" the words that are said. Based on the first sounds that arrive at it directly, the brain makes a prediction, "suggesting" a solution. To say so is a new study by SISSA, in association with the universities of Liverpool and Cambridge, just published in the journal eNeuro. Thanks to an elegant series of experiments which involved the analysis of the electroencephalogram of a group of volunteers listening to precise groups of syllables, the study has shown how our auditory system, and the brain in particular, has a phenomenal ability to help us listen and understand in complicated, uncertain and noisy situations. Far from being a simple processor of stimuli, our brain seems to have a decisively proactive role, anticipating the possible word, and detecting readily any error in the prediction. The study is a further step in supporting a central idea in the cognitive neurosciences of recent decades that sees the brain as a proper "predictive machine".

Listening to unknown words: This is how the experiment was done

In the study, the scholars subjected a group of volunteers to different tests based on repeatedly listening to meaningless three-syllable words. Now and then, however, a specific syllable, the second or third, was changed. In these tests, the scholars then analyzed the brain waves of the subjects using electroencephalography and verified their pattern. When the repeated word was one they had already heard many times, the waves followed a precise pattern. When, instead, a variation occurred in the second syllable, a precise signal, called Mismatch Negativity or MMN, appeared in the brain waves, which is recorded when a prediction is not fulfilled. "This means that on the basis of the first syllable the brain had made a prediction on what could be the word that the people were hearing. When the prediction was disregarded, the signal MMN appeared" says Yamil Vidal, lead author of the study. The same signal also appeared when the third syllable changed. In this case, the MMN signal was bigger because, as the first two syllables were right, the surprise for the failure of the prediction was bigger. "This is very interesting" explains Vidal "because it tells us that the prediction is maintained over time, even far from the most immediate past".

Capture the meaning quickly

"The perception of what we listen to is a difficult task, because it requires a fast understanding of the meaning of an auditory signal which is actually very complex" says Vidal "The formulation of predictions could be an efficient solution to reach an accurate and fast understanding". Considering that the words the volunteers listened to were totally unknown "in these experiments we can see that our auditory system has a formidable ability to learn sequences of phonemes which make up new words and make predictions with these words, though, as in this case, there is no linguistic, semantic or syntax information to come to aid". When we learn a new language, this is probably what allows us to recognize and

understand new words, recently learned. "We started this research working with speech, but more generally, this ability to make predictions could be put into action in any other auditory experience, from music to any environmental sound. This is an extremely interesting issue we will investigate more deeply with further research".

http://bit.ly/2J3LmVN

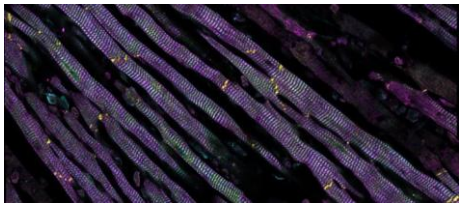
Tissue damage caused by a heart attack to be reduced by 30%?

Scientists from the Universities of Geneva and Lyon have discovered which molecule is held responsible for tissue necrosis due to an infarctus, and how to reduce the tissue damage by 30% in mice

Each year, heart attacks kill almost 10 million people in the world, and more than 6 million die from stroke.

A heart attack is caused by a clot that blocks the artery blood flow. Unirrigated tissues are deprived from the oxygen that is carried by the blood. Under these conditions, the affected tissues undergo a rapid necrosis. But why? Scientists at the University of Geneva (UNIGE), Switzerland, the University of Lyon and the Institut National de la Santé et de la Recherche Médicale (Inserm), France, discovered that the synthesis of a lipid, called deoxydihydroceramide, provokes the necrosis. This lipid accumulates in the absence of oxygen and blocks cellular functions. By inhibiting its synthesis in a mouse suffering a heart attack, the biologists were able to reduce the tissue damage by 30%. These results, published in Nature Metabolism, suggest a new model of treatment for victims of a heart attack or stroke.

Heart attack and stroke are the primary cause of death worldwide. When a blood clot forms, it blocks the blood vessel and blood circulation. The non-irrigated tissues no longer receive oxygen and rapidly undergo necrosis, from which they cannot recover. "But what causes the necrosis under these conditions?", asked Howard Riezman, Professor in the Department of Biochemistry of the Faculty of Science at UNIGE and Director of the NCCR Chemical Biology.



Immuno-staining of mouse heart cells under anoxia. Healthy striated heart muscle (lower left) gradually shows more and more signs of deterioration due to oxygen deprivation leading to fully necrotic cells (upper right). **Credit: © UNIGE**

Not all animals are so sensitive to the absence of oxygen, worms can live three days without oxygen, some turtles can live several months, and certain bacteria indefinitely. "That is why we sought to find the link between the lack of oxygen and tissue necrosis in mammals", continued the scientist.

A lipid that inhibits normal cellular function

The researchers saw that in worms a particular species of ceramide, deoxydihydroceramide, accumulated to dangerous levels under anoxia, that is when tissues were completely deprived of oxygen. "Ceramides are absolutely essential lipids for the body", points out Thomas Hannich, a researcher at the Department of Biochemistry of the Faculty of Science at the UNIGE. "Without ceramides, several essential functions would be defective, for example, our skin would completely dry out."

Nevertheless, upon an infarct, the synthesis of deoxydihydroceramide increases and becomes toxic for cells. "Using mass spectrometry, we observed that this ceramide blocks certain protein complexes and provokes defects in the cytoskeleton of cells and the proper function of mitochondria, causing tissue necrosis", continued Howard Riezman.

To confirm that deoxydihydroceramide was indeed responsible for tissue necrosis, the UNIGE team introduced a human mutation

causing a rare disease, HSAN type I, into the worms raising the amount of deoxydihydroceramide. The worms become hypersensitive to a lack of oxygen, confirming their discovery.

Can we reduce the impact of an infarct on the affected tissues?

Based on these results obtained by the UNIGE biochemists, Michel Ovize and his team from the University of Lyon injected an inhibitor of ceramide synthesis in mice just before a heart infarct. They found that the mice that received the injection have 30% less tissue necrosis when compared to control mice that received an injection without the inhibitor. "This reduction is quite impressive", rejoices Howard Riezman. This work opens new therapeutic perspectives for treatment of patients with vascular infraction.

This discovery could pave the way for a big advance in the development of treatments for heart attacks and stroke. The results obtained on mice are extremely encouraging and the ceramide synthesis inhibitor is a well-known substance, which has been tested in animal models. "Nevertheless, this molecule inhibits the synthesis of all ceramides" points out Thomas Hannich. This is why the researchers are now working on an inhibitor that will target more specifically deoxydihydroceramide, which is likely to have less side effects and maintain the normal body functions of ceramides.

http://bit.ly/31r3GOX

Strong storms can generate earthquake-like seismic activity

New geophysical phenomenon where a hurricane or other strong storm can produce vibrations in the nearby ocean floor

WASHINGTON--Researchers have discovered a new geophysical phenomenon where a hurricane or other strong storm can produce vibrations in the nearby ocean floor as strong as a magnitude 3.5 earthquake.

"We're calling them 'stormquakes,'" said Wenyuan Fan, an assistant professor of Earth, Ocean and Atmospheric Science at Florida State University and lead author of a new study detailing the findings in AGU's journal Geophysical Research Letters. "During a storm season, hurricanes or nor'easters transfer energy into the ocean as strong ocean waves, and the waves interact with the solid earth producing intense seismic source activity."

Fan and his colleagues analyzed nearly a decade of seismic and oceanographic records from September 2006 to February 2019 and found a connection between strong storms and intense seismic activity - vibrations in Earth's crust - near the edge of continental shelves or ocean banks.

Specifically, they found evidence of more than 10,000 stormquakes occurring from 2006 to 2019 offshore of New England, Florida and the Gulf of Mexico in the United States, as well as offshore of Nova Scotia, Newfoundland and British Columbia in Canada.

"We can have seismic sources in the ocean just like earthquakes within the crust," Fan said. "The exciting part is seismic sources caused by hurricanes can last from hours to days."

In the new study, Fan and his colleagues developed a new method to detect and locate seismic events and determine whether such events are stormquakes. They found 2009's Hurricane Bill, which made landfall on Newfoundland on August 22, produced numerous stormquakes off the coasts of New England and Nova Scotia.

Similarly, Hurricane Ike in 2008 caused stormquake activity in the Gulf of Mexico and Hurricane Irene in 2011 did the same near Little Bahama Bank off the coast of Florida.

Not all hurricanes cause stormquakes, but when they do, the stormquakes seem to be concentrated in certain hotspots, according to the study's authors. They detected no evidence of stormquakes off the coast of Mexico or along the U.S. East Coast from New Jersey to Georgia.

Even Hurricane Sandy, one of the costliest storms on record in the United States, did not spur stormquakes, according to the researchers. This suggests stormquakes are strongly influenced by the local oceanographic features and seafloor topography, Fan said.

"We have lots of unknowns," Fan said. "We weren't even aware of the existence of the natural phenomenon. It really highlights the richness of the seismic wave field and suggests we are reaching a new level of understanding of seismic waves."

Notes for Journalists

This paper is freely available through November 15. Journalists and public information officers (PIOs) can download a PDF copy of the article by clicking on this link: https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2019GL084217

Neither this paper nor this press release is under embargo.

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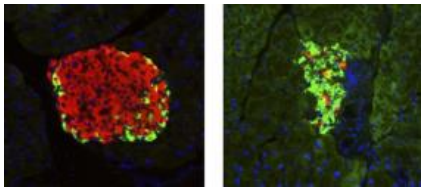
http://bit.ly/2N7TyFZ

Diabetes: A next-generation therapy soon available?

By identifying a protein that helps regulate blood glucose and lipids, researchers at UNIGE hope for the rapid development of treatments more effective than current insulin therapy

Insulin, a hormone essential for regulating blood sugar and lipids, is normally produced by pancreatic β cells. In many people with diabetes, however, pancreatic cells are not (or no longer) functional, causing a chronic and potentially fatal insulin deficiency that can only be controlled through daily insulin injections. However, this approach has serious adverse effects, including an increased risk of life-threatening hypoglycaemia, and it does not restore metabolic balance. In order to improve therapy, researchers at the University of Geneva (UNIGE), Switzerland, have identified a protein called S100A9 which, under certain conditions, seems to act as a blood sugar and lipid regulator while avoiding the most harmful side effects of insulin.

This discovery, that can be read in Nature Communications, paves the way for better treatment of diabetes and could significantly improve the quality of life for tens of millions of people affected by insulin deficiency.



On the left, a pancreatic islet of a healthy mouse (in red, cells producing insulin). On the right, a pancreatic islet of an insulin deficient mouse (cells producing insulin are virtually absent). Credit: © UNIGE

Today, insulin injections are essential for the survival of patients with type 1 diabetes or a severe form of type 2 diabetes. However, this treatment is not without risk: overdose can trigger hypoglycaemia, i.e. a drop in blood glucose levels that can lead to coma or even death. But underdosed, it can lead to equally dangerous hyperglycaemia. In addition, insulin is involved in the control of ketones, elements that are produced when the liver breaks down lipids in the absence of sufficient glucose reserves, which become toxic in too large quantities. In addition, long-term insulin treatments cause excess fat and cholesterol in the blood and therefore increases the risk of cardiovascular disease.

As early as 2010, Roberto Coppari's team, a professor at the Diabetes Centre of the UNIGE Faculty of Medicine, highlighted the gluco- and lipid-regulatory properties of leptin, a hormone involved in hunger control. "However, leptin has proved difficult to use pharmacologically in human beings due to the development of leptin resistance", says Roberto Coppari. "In order to overcome this problem, we shifted our focus on the metabolic mechanisms triggered by leptin rather than on the hormone itself."

An effective protein despite its bad reputation

The scientists observed changes in the blood of insulin-deficient mice to whom they administered leptin and noted the abundant presence of the S100A9 protein. "This protein has a bad reputation because, when it binds to its sister protein S100A8, it creates a complex called calprotectin that causes the symptoms of many inflammatory or autoimmune diseases," says Giorgio Ramadori, a researcher at the Diabetes Centre of the UNIGE Faculty of Medicine and the first author of this work. "However, by over-expressing S100A9, we can, paradoxically, reduce its harmful combination with S100A8, hence dampening calprotectin levels."

The researchers then administered high doses of S100A9 to their insulin-deficient diabetic mice and found improved glucose management and better control of ketones and of lipids, two metabolic abnormalities that are common in people with insulin deficiency.

In order to better understand how this mechanism translates to human beings, Professor Coppari's team is currently conducting a clinical observation study, in collaboration with the Geneva University Hospitals, in patients with type 1 and type 2 diabetes presenting very high glucose and ketones levels. They want to identify the correlations between the level of S100A9 in the blood and the severity of symptoms. "In human beings, previous studies already indicated that increased S100A9 levels correlate with reduced diabetes risks; hence, these results further bolster the clinical relevance of our data. As such, we are currently working to progress to phase I human clinical trials to directly test the safety and efficacy of S100A9 in insulin deficiency", says Roberto Coppari.

Towards combined treatments

The team then made a second discovery: S100A9 protein only appears to work in the presence of TLR4, a receptor located on the membrane of certain cells, including adipocytes or immune system cells. "Why? For the moment, it remains mysterious", says Roberto Coppari. The researchers are currently working on a treatment that would combine low doses of insulin and S100A9 to better control glucose and ketones and limit high-dose insulin side effects. "We also want to decipher the exact role of TLR4 in order to offer a therapeutic strategy that achieves the delicate balance of optimal blood glucose, ketone and lipid control."

The stakes are high: tens of millions of people take insulin every day throughout their lives, a treatment that is often difficult to balance for both patients and caregivers. The new therapeutic strategy proposed by Roberto Coppari and his team could greatly improve their quality of life.

This work was supported by European Commission, the Swiss National Science Foundation, the Swiss Cancer League, the Louis-Jeantet Foundation, the Fondation Pour Recherches Medicales of the University of Geneva, the Bo and Kerstin Hjelt Foundation for Diabetes Research and the Gertrude Von Meissner Foundation.

http://bit.ly/31vNJqR

What gives a 3-meter-long Amazonian fish some of the toughest scales on Earth

Arapaima gigas *is a big fish in a bigger river full of piranhas, but that doesn't mean it's an easy meal.*

The freshwater giant has evolved armor-like scales that can deform, but do not tear or crack, when a piranha--which has one of the animal kingdom's most powerful bites--attacks. Researchers from UC San Diego and UC Berkeley describe the unique properties of the Amazonian *Arapaima* skin and its potential for man-made materials October 16 in the journal Matter.

Arapaima's adaptation naturally solves a problem that engineers face when attempting to develop synthetic armors. *Arapaima*'s

scales have a tough, yet flexible, inner layer bound by collagen to its mineralized outer layer of scales. Similarly, bullet-proof vests are made of several layers of flexible webbing sandwiched between layers of hard plastic. But man-made materials are bound using a third adhesive material, whereas the fish's scales are bound on an atomistic level; they grow together, weaving into one solid piece.

"A window may appear strong and solid, but it has no give. If something attempted to puncture it, the glass would shatter," says senior author Robert Ritchie, a materials scientist at UC Berkeley. "When nature binds a hard material to a soft material, it grades it, preventing this shattering effect. And in this case, the binding structure is mineralized collagen."

Other fish use collagen like *Arapaima* does, but the collagen layers in *Arapaima* scales are thicker than in any other fish species. The scales alone are each as thick as a grain of rice. Co-authors Yang, Quan, Meyers, and Ritchie hypothesize that this thickness is the secret to the fishes' defense.

They tested this by soaking cracked *Arapaima* scales in water for 48 hours, then slowly pulling the edges apart while adding pressure to a central point. As they added pressure, they observed that the part of the mineralized, hard outer layer expanded, cracked, then gradually peeled off. The scales then localized the crack, containing it and preventing damage from spreading in the twisting structural collagen layer. If the pressure did break through to the collagen, it deformed the layer instead of breaking it.

If humans can develop a flexible hierarchical structure that behaves like the collagen layer in the fish scales, Ritchie says that better, potentially impermeable, synthetic armors can be made. But he also acknowledges that this reality may be a number of years down the line.

Until then, Ritchie's team will investigate how *Arapaima*'s scales have adapted to prevent penetration from piranha bites as well as how nature behaves this way in other species.

This work was primarily supported by the Air Force Office of Scientific Research. The authors declare no competing interests.

Matter, Robert Ritchie et al.: "Arapaima Fish Scale: One of the Toughest Flexible Biological Materials" https://www.cell.com/matter/fulltext/S2590-2385(19)30229-2

https://nyti.ms/2OXqwLH

What Are the Benefits of CBD?

More than 60 percent of CBD users were taking it for anxiety, according to a survey of 5,000 people. Does it help?

By Dawn MacKeen

Illustration by The New York Times; Shutterstock

The CBD industry is flourishing, conservatively projected to hit $16 billion in the United States by 2025. Already, the plant extract is being added to cheeseburgers, toothpicks and breath sprays. More than 60 percent of CBD users have taken it for anxiety, according to a survey of 5,000 people, conducted by the Brightfield Group, a cannabis market research firm.

Chronic pain, insomnia and depression follow behind. Kim Kardashian West, for example, turned to the product when “freaking out” over the birth of her fourth baby. The professional golfer Bubba Watson drifts off to sleep with it. And Martha Stewart’s French bulldog partakes, too.

What is CBD?

Cannabidiol, or CBD, is the lesser-known child of the cannabis sativa plant; its more famous sibling, tetrahydrocannabinol, or THC, is the active ingredient in pot that catapults users’ “high.” With roots in Central Asia, the plant is believed to have been first used

medicinally — or for rituals — around 750 B.C., though there are other estimates too.

Cannabidiol and THC are just two of the plant's more than 100 cannabinoids. THC is psychoactive, and CBD may or may not be, which is a matter of debate. THC can increase anxiety; it is not clear what effect CBD is having, if any, in reducing it. THC can lead to addiction and cravings; CBD is being studied to help those in recovery.

Cannabis containing 0.3 percent or less of THC is hemp. Although last year's Farm Bill legalized hemp under federal law, it also preserved the Food and Drug Administration's oversight of products derived from cannabis.

What are the claims?

CBD is advertised as providing relief for anxiety, depression and post-traumatic stress disorder. It is also marketed to promote sleep. Part of CBD's popularity is that it purports to be "nonpsychoactive," and that consumers can reap health benefits from the plant without the high (or the midnight pizza munchies).

Just as hemp seedlings are sprouting up across the United States, so is the marketing. From oils and nasal sprays to lollipops and suppositories, it seems no place is too sacred for CBD. "It's the monster that has taken over the room," Dr. Brad Ingram, an associate professor of pediatrics at the University of Mississippi Medical Center, said about all the wild uses for CBD now. He is leading a clinical trial into administering CBD to children and teenagers with drug-resistant epilepsy.

Does CBD work?

"It's promising in a lot of different therapeutic avenues because it's relatively safe," said James MacKillop, co-director of McMaster University's Michael G. DeGroote Center for Medicinal Cannabis Research in Hamilton, Ontario.

Last year, the F.D.A. approved Epidiolex, a purified CBD extract, to treat rare seizure disorders in patients 2 years or older after three randomized, double-blind and placebo-controlled clinical trials with 516 patients that showed the drug, taken along with other medications, helped to reduce seizures. These types of studies are the gold standard in medicine, in which participants are divided by chance, and neither the subject nor the investigator knows which group is taking the placebo or the medication.

While there is hope for treating other conditions with the plant extract, Epidiolex remains the only CBD-derived drug approved by the F.D.A. Most of the research on cannabidiol has been in animals, and its current popularity has outpaced science. "We don't have the 101 course on CBD quite figured out yet," said Ryan Vandrey, an associate professor of psychiatry and behavioral sciences at Johns Hopkins University School of Medicine.

Does CBD help anxiety and PTSD?

For students with generalized social anxiety, a four-minute talk, with minimal time to prepare, can be debilitating. Yet a small experiment in the journal Neuropsychopharmacology found that CBD seemed to reduce nervousness and cognitive impairment in patients with social anxiety in a simulated public speaking task.

However, a double-blind study found healthy volunteers administered CBD had little to no change in their emotional reaction to unpleasant images or words, compared to the placebo group. "If it's a calming drug, it should change their responses to the stimuli," said Harriet de Wit, co-author of the study and a professor in the University of Chicago's department of psychiatry and behavioral neuroscience. "But it didn't."

Many soldiers return home haunted by war and PTSD and often avoid certain activities, places or people associated with their traumatic events. The Department of Veterans Affairs is funding its first study on CBD, pairing it with psychotherapy.

"Our top therapies attempt to break the association between reminders of the trauma and the fear response," said Mallory Loflin, an assistant adjunct professor at the University of California, San Diego and the study's principal investigator. "We think that CBD, at least in animal models, can help that process happen a lot faster." While large clinical trials are underway, psychologists say there isn't compelling evidence yet as to whether this is a viable treatment.

Does CBD help sleep and depression?

Up in the wee hours of the night, stuck watching videos of puppies? CBD may be promising as a sleep aid; one of the side effects of the Epidiolex trials for epilepsy was drowsiness, according to Mr. MacKillop, a co-author of a review on cannabinoids and sleep. "If you are looking for new treatments for sleep, that may be a clue," he said.

But he cautions that the side effects could have been because of an interaction with other medications the children were taking to control the seizures. So far, there hasn't been a randomized, placebo-controlled, double-blind trial (the gold standard) on sleep disorders and CBD.

A recent chart review of 72 psychiatric patients treated with CBD found that anxiety improved, but not sleep. "Over all, we did not find that it panned out as a useful treatment for sleep," said Dr. Scott Shannon, assistant clinical professor of psychiatry at the University of Colorado, Denver and the lead author of the review in The Permanente Journal.

Sleep can be disrupted for many reasons, including depression. Rodents seemed to adapt better to stressful conditions and exhibited less depressive-like behavior after taking CBD, according to a review in Journal of Chemical Neuroanatomy.

"Surprisingly, CBD seems to act faster than conventional antidepressants," wrote one of the authors of a new review, Sâmia Joca, a fellow at the Aarhus Institute of Advanced Studies in Denmark and an associate professor at the University of São Paulo in Brazil, in an email interview. Of course, it's difficult to detect depression in animals, but the studies that Ms. Joca and her colleagues reviewed suggested that in models of chronic stress exposure, the mice and rats treated with CBD were more resilient.

But without clinical trials in humans, psychologists say CBD's effect on depression is still a hypothesis**,** and not an evidence-based treatment.

Is CBD harmful?

"If you take pure CBD, it's pretty safe," said Marcel Bonn-Miller, an adjunct assistant professor at the University of Pennsylvania's Perelman School of Medicine. Side effects in the Epidiolex trial included diarrhea, sleepiness, fatigue, weakness, rash, decreased appetite and elevated liver enzymes. Also, the safe amount to consume in a day, or at all during pregnancy, is still not known.

Recently, the F.D.A. sent a warning letter to Curaleaf Inc. about its "unsubstantiated claims" that the plant extract treats a variety of conditions from pet anxiety and depression to cancer and opioid withdrawal. (In a statement, the company said that some of the products in question had been discontinued and that it was working with the F.D.A.)

Dr. Smita Das, chair of the American Psychiatric Association's Council on Addiction Psychiatry's cannabis work group, does not recommend CBD for anxiety, PTSD, sleep or depression. With patients turning to these to unproven products, she is worried that they may delay seeking appropriate mental health care: "I'm dually concerned with how exposure to CBD products can lead somebody into continuing to cannabis products."

Some CBD products may contain unwanted surprises. Forensic toxicologists at Virginia Commonwealth University examined nine e-liquids advertised as being 100 percent natural CBD extracts.

They found one with dextromethorphan, or DXM, used in over-the counter cough medications and considered addictive when abused; and four with a synthetic cannabinoid, sometimes called Spice, that can cause anxiety, psychosis, tachycardia and death, according to a study last year in Forensic Science International.

Earlier research found fewer than a third of 84 products studied contained the amount of CBD on their labels. Some users of CBD have also failed drug tests when the product contained more THC than indicated.

This year, 1,090 people have contacted poison control centers about CBD, according to the American Association of Poison Control Centers. Over a third are estimated to have received medical attention, and 46 were admitted into a critical care unit, possibly because of exposure to other products, or drug interactions. In addition, concern over 318 animals poured into the American Society for the Prevention of Cruelty to Animals' Animal Poison Control Center.

Is CBD a scam or not?

A few drops of CBD oil in a mocha or smoothie are not likely to do anything, researchers contend. Doctors say another force may also be at play in people feeling good: the placebo effect. That's when someone believes a drug is working and symptoms seem to improve.

"CBD is not a scam," said Yasmin Hurd, director of the Addiction Institute of Mount Sinai in New York City who led a double-blind study of 42 recovering heroin addicts and found that CBD reduced both cravings and cue-based anxiety, both of which can cycle people back into using. "It has a potential medicinal value, but when we are putting it into mascara and putting it into tampons, for God's sake, to me, that's a scam."

https://wb.md/31vR0q9

Drug Delivers 'Remarkable' Reduction in Head Injury Deaths

Early Treatment May Save 'Hundreds of Thousands of Lives Worldwide'

Pauline Anderson

Tranexamic acid (TXA) (multiple brands), an antifibrinolytic used to treat or prevent excessive blood loss, significantly reduces mortality from traumatic brain injury (TBI), results of a large, multicenter, randomized control trial show.

Investigators found that administering TXA within 3 hours of head trauma was associated with a 20% reduction in deaths among those with mild to moderate TBI, with no evidence of adverse effects or complications. However, there was no apparent reduction in mortality among those with severe head injury.

"This is a landmark study. After decades of research and many unsuccessful attempts, this is the first-ever trial to show that a drug can reduce mortality after traumatic brain injury. Not only do we think this could save hundreds of thousands of lives worldwide, but it will no doubt renew the enthusiasm for drug discovery research for this devastating condition," study coinvestigator Antonio Belli, MD, neurosurgeon and professor of trauma neurosurgery, University of Birmingham, United Kingdom, said in a statement.

Results of the CRASH-3 study suggest that "all trauma patients should get tranexamic acid at the scene of the injury or as soon as possible thereafter," study coinvestigator Ian Roberts, MB, professor of epidemiology and public health, London School of Hygiene and Tropical Medicine, told *Medscape Medical News.*

The study was published online October 14 in the *Lancet.*

TBI Rising

It is estimated that more than 60 million new cases of TBI occur worldwide every year, and the number is rising. Motor vehicle accidents and falls are the main causes.

Intracranial bleeding is a common complication of TBI. Ongoing intracranial bleeding can lead to an increase in intracranial pressure, as well as brain herniation and death. TXA reduces bleeding by inhibiting the enzymatic breakdown of fibrin blood clots.

Several studies in surgical patients "show that if you give them tranexamic acid just before the surgeon cuts them, they bleed less than if you give them a placebo," said Roberts.

Research has also shown that TXA reduces risk of bleeding in women with postpartum hemorrhage.

An earlier study — the CRASH2 trial — showed that in patients with trauma and major extracranial bleeding, administration of TXA within 3 hours of injury reduced bleeding deaths by one third. However, even a short delay in treatment led to a reduction in benefit. On the basis of these results, TXA was included in guidelines for the prehospital care of patients with trauma. However, those with isolated TBI were excluded.

"People wondered whether tranexamic acid would be effective in isolated TBI," said Roberts. "There was no evidence that it's effective in patients with just head injuries."

Injury Severity a Factor

For the study, 12,737 patients from 29 countries were randomly assigned to receive either TXA or matching placebo within 3 hours of TBI. The primary endpoint was head injury death in hospital within 28 days of injury. There were 2560 deaths; the median time to death was 59 hours after injury.

Researchers had outcome data on 9127 patients. Among these, the risk for head injury–related death was 18.5% among the patients who received TXA and 19.8% among those who received placebo (risk ratio [RR], 0.94; 95% confidence interval [CI], 0.86 – 1.02).

A sensitivity analysis excluded patients whose Glasgow Coma Scale (GCS) score was 3 and those with bilateral unreactive pupils.

"For all intents and purposes, these patients are considered unrecoverable at baseline, so before they even received trial treatment," said Roberts. "They were obviously going to be equally distributed between groups and dilute any treatment effect."

In this sensitivity analysis, the rate of head injury–related death was 12.5% in the TXA group, compared to 14.0% in the placebo group (RR, 0.89; 95% CI, 0.80 – 1.00). "When we excluded these patients who were unsurvivable before treatment, there was a bigger treatment effect; the benefit was larger," said Roberts.

Although the sensitivity analysis excluded patients with bilateral unreactive pupils, patients with unilateral unreactive pupils were not excluded. "If we had excluded those individuals, the treatment effect would get even bigger," said Roberts.

"The treatment looks very good at preventing head injury deaths where there's a potential for benefit, so in people who are salvageable, it's very effective. But the closer you get to unsalvageable, the less and less effective it gets," he said.

No Adverse Events

With regard to time to treatment, for patients who received the intervention within an hour of injury, the RR of head injury–related death was 0.96 (95% CI, 0.79 – 1.17); for those who received the intervention more than 1 to 3 hours after injury, the RR was 0.93 (95% CI 0.85 to 1.02); and for those who received the intervention more than 3 hours after injury, the RR was 0.94 (95% CI 0.81 to 1.09).

The investigators note that patients who are treated soon after TBI often have more severe trauma, and so the effect of time to treatment may be confounded by injury severity.

After adjusting for GCS, systolic blood pressure, and age, early treatment was more effective than later treatment in patients with mild or moderate head injury (P = .005), but there was no obvious effect of time to treatment among patients with severe head injury (P = .73). The drug is more effective in less severely injured patients because "you can only prevent something that hasn't already happened," said Roberts.

"It's probably less effective in severely comatose patients because they have already bled into their brain. The most potential for benefit is in patients with mild or moderate head injury who are bleeding more slowly into the brain," he said.

The analysis also showed a substantial reduction in head injury–related deaths within 24 hours of the injury in treated patients.

The findings should make guidelines simpler — perhaps with the recommendation that all trauma patients receive a 1-g injection of TXA as soon as possible after a head injury, said Roberts. Ideally, treatment should occur at the scene of the accident or in the ambulance on the way to the hospital, he added.

The researchers assessed the effect of TXA on disability in survivors by comparing the mean Disability Rating Scale score between the TXA and placebo groups. The mean scores were similar between groups and for patients treated within 3 hours and after 3 hours of treatment.

The risk for vascular occlusive events and other complications was similar for both groups. There was no evidence that TXA increased fatal or nonfatal stroke. The risk for seizures was similar between groups, as was the number of other adverse events.

"We know this intervention is safe; there are absolutely no side effects whatsoever," said Roberts.

Remarkable, Practice Changing

In an accompanying editorial, Andrew P. Cap, MD, PhD, US Army Institute of Surgical Research, Fort Sam Houston, Texas, described the findings as "remarkable" and said they "will change practice."

It represents "an enormous effort in studying a difficult clinical problem," said Cap.

Together, CRASH-3, CRASH-2, and the trial of women with peripartum hemorrhage involved more than 53,000 patients in the study of the effects of TXA on bleeding. "The results of each study independently and together are clear: tranexamic acid reduces risk of death due to bleeding, regardless of the cause," he writes.

Future studies might explore the effects of increased TXA doses in bleeding patients, or possibly alternative routes of administration, such as intramuscular administration, which might facilitate earlier intervention, he added. It may also be worth considering combining the antifibrinolytic effects of TXA on bleeding with blockade of bradykinin receptors, which could reduce brain edema and potentially yield greater reductions in mortality.

Commenting on the study for *Medscape Medical News*, TBI specialist Frank Conidi, MD, immediate past president, Florida Society of Neurology, and director, Florida Center for Headache and Sports Neurology, said he was "quite impressed" with the number of enrolled patients, which provided "significant power" to the results.

Although it's "wonderful" that the study showed a positive reduction in patient mortality, "the real outcome that you want to look at is disability and quality of life," said Conidi. "From a clinical perspective, I think there is potential for patients with higher GCS scores, especially given the low adverse event profile."

Conidi said he would like to know whether the medication's efficacy differed among patients with different subtypes of bleeding,

for example, intracranial hemorrhage, subarachnoid hemorrhage, epidural hematoma, and subdural hematoma.

The study was funded by the JP Moulton Charitable Trust, the National Institute for Health Research Health Technology Assessment, Joint Global Health Trials, the Medical Research Council, the UK Department for International Development, the Global Challenges Research Fund, and the Wellcome Trust. Roberts, Belli, Cap, and Conidi report no relevant financial relationships.

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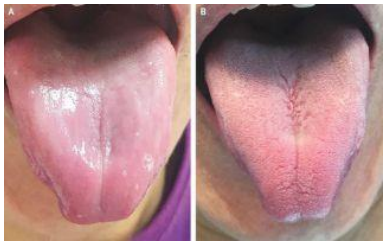
http://bit.ly/2J3qiPp

Why Did This Man's Taste Buds Disappear?

His tongue's strange appearance would turn out to be a sign of an underlying blood condition.

By Rachael Rettner - Senior Writer



When a 64-year-old man stuck out his tongue for a physical exam, doctors could immediately tell something was off: Instead of a typical, textured tongue, his was smooth and shiny. It didn't take long for them to recognize why: The man's taste buds were missing.

***A man's tongue was missing "papillae," or the small bumps on the tongue that often contain taste buds (A). After treatment, the man's tongue returned to normal (B).* (Image: © The New England Journal of Medicine ©2019)**

His tongue's strange appearance would turn out to be a sign of an underlying blood condition that required a relatively simple treatment, according to a new report of the case.

The man, who lives in Singapore, went to the doctor after he experienced pain and redness in his tongue along with a burning sensation around his lips, which had lasted six months, according to the report, published today (Oct. 16) in The New England Journal of Medicine.

Doctors from the National University of Singapore observed that the man's glossy tongue was missing "papillae," the small bumps on the tongue that often contain taste buds.

The man's symptoms fit a condition called atrophic glossitis, or inflammation of the tongue that leads to changes in color and texture, including the loss of many papillae, according to Healthline.

But what had caused the atrophic glossitis? Blood tests revealed an important clue: The man's levels of vitamin B12 were very low.

He was diagnosed with pernicious anemia, a condition in which a person has low levels of red blood cells due to a deficiency in vitamin B12. In some cases, people develop pernicious anemia because their immune system attacks a protein needed for the absorption of vitamin B12. Indeed, further tests showed the man had the autoimmune form of the condition.

Red blood cells contain a protein called called myoglobin that is important for the health of muscles, including the tongue muscle, according to Healthline.

Fortunately, pernicious anemia is usually easy to treat, according to the National Institutes of Health. Patients receive large doses of vitamin B12 in the form of shots or high-dose pills.

In the man's case, he received shots of vitamin B12, and within one month, his tongue was back to normal. He will continue to need regular vitamin B12 shots to keep him from developing a vitamin B12 deficiency.

http://bit.ly/32BdPdy

Frequent drinking is greater risk factor for heart rhythm disorder than binge drinking

Drinking small amounts of alcohol frequently is linked with a higher likelihood of atrial fibrillation

Sophia Antipoli: Drinking small amounts of alcohol frequently is linked with a higher likelihood of atrial fibrillation than binge drinking, according to research published today in *EP Europace*, a journal of the European Society of Cardiology (ESC).[1]

'Recommendations about alcohol consumption have focused on reducing the absolute amount rather than the frequency,' said study

author Dr Jong-Il Choi, of Korea University College of Medicine and Korea University Anam Hospital, Seoul, Republic of Korea. 'Our study suggests that drinking less often may also be important to protect against atrial fibrillation.'

Atrial fibrillation is the most common heart rhythm disorder and raises the risk of stroke by five-fold.[2] Symptoms include palpitations, racing or irregular pulse, shortness of breath, tiredness, chest pain and dizziness.[3]

A prior meta-analysis found a linear correlation between alcohol and atrial fibrillation: risk increased by 8% for every 12 g of alcohol (one drink) consumed per week.[4] But it was not clear which is more important: the total amount of alcohol or the number of drinking sessions.

This study examined the relative importance of frequent drinking versus binge drinking for new-onset atrial fibrillation. The analysis included 9,776,956 individuals without atrial fibrillation who underwent a national health check-up in 2009 which included a questionnaire about alcohol consumption. Participants were followed-up until 2017 for the occurrence of atrial fibrillation.

The number of drinking sessions per week was the strongest risk factor for new-onset atrial fibrillation. Compared with drinking twice per week (reference group), drinking every day was the riskiest, with a hazard ratio (HR) of 1.412, while drinking once a week was the least risky (HR 0.933). Binge drinking did not show any clear link with new-onset atrial fibrillation.

'Our study suggests that frequent drinking is more dangerous than infrequent binge drinking with regard to atrial fibrillation,' said Dr Choi. 'The number of drinking sessions was related to atrial fibrillation onset regardless of age and sex. Repeated episodes of atrial fibrillation triggered by alcohol may lead to overt disease. In addition, drinking can provoke sleep disturbance which is a known risk factor for atrial fibrillation.'

In keeping with other studies, weekly alcohol consumption was related to atrial fibrillation. There was a 2% increase in the risk of new-onset atrial fibrillation for each gram of alcohol consumed per week. Compared to mild drinkers, those who drank no alcohol, moderate, or high amounts had 8.6%, 7.7%, and 21.5% elevated risks respectively.

Dr Choi said the protective effect of mild drinking needs to be confirmed. 'It is not clear if this is a true benefit or a confounding effect of unmeasured variables,' he said.

He concluded: 'Atrial fibrillation is a disease with multiple dreadful complications and significantly impaired quality of life. Preventing atrial fibrillation itself, rather than its complications, should be our first priority. Alcohol consumption is probably the most easily modifiable risk factor. To prevent new-onset atrial fibrillation, both the frequency and weekly amount of alcohol consumption should be reduced.'

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Disclosures: None declared.

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http://bit.ly/2N0orvX

The U.S. Should Tighten Vaccination Mandates

Existing religious and philosophical exemptions endanger public health

As of late August, there had been more than 1,200 cases of measles across 31 U.S. states this year. It's a dispiriting comeback for a disease that was declared eliminated in this country in 2000. If the disease has not stopped spreading by the time you read this, the U.S. will likely have lost this status. The illness has been cropping up

mainly in pockets of unvaccinated people. Those who choose not to immunize their families are placing at risk not only themselves and their children but also others who cannot be vaccinated because they are too young or have medical issues.

There isn't an iota of doubt that vaccines are an overwhelmingly safe and effective way to prevent measles and other diseases, including mumps, rubella, poliomyelitis and pertussis. All 50 states mandate that children entering school get immunized unless they have a medical exemption. Yet almost every state also offers religious exemptions, and more than a dozen offer personal belief/philosophical ones as well. California, Mississippi, West Virginia, Maine and, most recently, New York State have gotten rid of all nonmedical waivers. The others must follow suit. It's imperative for protecting public health.

It doesn't take many unvaccinated people to cause an outbreak. Measles was one of the first vaccine-preventable diseases to reappear because it is so contagious; the threshold for resistance to a disease conferred by sufficient community-wide levels of immunity or vaccination—so-called herd immunity—is 93 to 95 percent. If vaccination levels fall below that threshold, an infected person can cause an outbreak.

Hesitancy about vaccines is nothing new. People have questioned inoculations since Edward Jenner discovered the smallpox vaccine in 1796. Today vaccines are partly a victim of their own resounding success. People rarely, if ever, see once common diseases such as measles and polio, so they don't understand their potential danger. On top of that, relentless misinformation campaigns have touted such false claims as the idea that vaccines cause autism. Numerous studies have shown they do not. The discredited researcher Andrew Wakefield introduced this idea in a now refuted study, and celebrities such as Jenny McCarthy and Robert F. Kennedy, Jr., have given it credence. And social media has made it easier than ever for vaccine deniers to find like-minded networks of people to confirm their false beliefs.

Despite the existence of religious exemptions to vaccines, most major faith groups in the U.S. do not prohibit vaccination, and many religious leaders encourage it. Nevertheless, a large number of this year's measles cases occurred in ultra-Orthodox Jewish communities in the neighborhood of Williamsburg in Brooklyn and in Rockland County, New York. (It's not just the Jewish community: the majority of New York City schools with relatively low rates of measles vaccination among students were Muslim or Christian academies or alternative-learning institutions.) The outbreak in New York City was declared over in September, but cases have persisted in Rockland County.

Many people who choose not to vaccinate believe no government should force them to put medicine into their bodies or their children's. They frame the choice as a personal right, but they are not taking into account the rights of others, including their own children, to be free of disease. When it comes to balancing the two, we need to consider the needs of the community as well as those of the individual. The Supreme Court ruled in *Jacobson v. Massachusetts* that states have the authority to require vaccination against smallpox, and in *Prince v. Massachusetts* it reaffirmed that the right to religious liberty does not include the right to expose a child or the community to disease.

Some experts argue we should just make it more difficult to obtain religious and philosophical exemptions. But unless the exemptions are removed completely, there will always be people who want to use them. Partial elimination, as the Washington State Senate enacted in the case of philosophical exemptions for the MMR (measles, mumps and rubella) vaccine alone, is also shortsighted because it sends the message that some immunizations are less

important than others. The only surefire solution is to eliminate nonmedical exemptions to recommended vaccines.

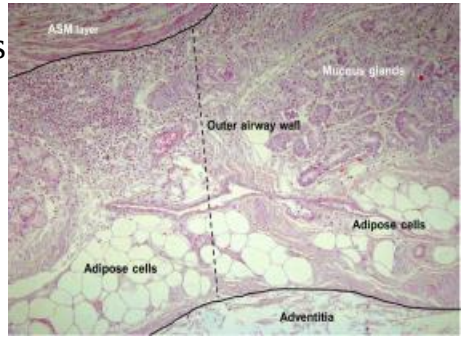
People who cannot be vaccinated for medical reasons—such as those with compromised immune systems—should of course remain exempt. But there is no legitimate argument against vaccination for the vast majority of healthy people, and there are many powerful arguments in favor of it. Refusing to vaccinate is not a matter of freedom. It's a matter of public safety.

http://bit.ly/32xeHQi

Study provides first evidence that fat accumulates in the lungs of overweight and obese people

Researchers have shown for the first time that fatty tissue accumulates in the airway walls, particularly in people who are overweight or obese.

Scientists already know that people who are overweight or obese are more likely to suffer with wheezing and asthma, but the reasons for this have not been completely explained. The new study, published in the *European Respiratory Journal* [1], suggests that this fatty tissue alters the structure of people's airways and this could be one reason behind the increased risk of asthma.



Micrographs (x200) of the (A.) outer airway wall, between the airway smooth muscle (ASM) layer and the airway adventitia (dashed line) showing adipose tissue and mucous glands and (B.) inner airway wall (submucosa), between the basement membrane and ASM layer (dashed line) in a case of fatal asthma stained with haematoxylin and eosin. Inflammatory cells were counted within the inner airway wall. **European Respiratory Journal**

The study's author is Mr John Elliot, a senior research officer at Sir Charles Gairdner Hospital in Perth, Western Australia. He said: "Our research team studies the structure of the airways within our lungs and how these are altered in people with respiratory disease.

"Looking at samples of lung, we spotted fatty tissue that had built up in the airway walls. We wanted to see if this accumulation was correlated with body weight."

The researchers examined post-mortem samples of lung that had been donated for research and stored in the Airway Tissue Biobank. They studied samples from 52 people, including 15 who had no reported asthma, 21 who had asthma but died of other causes and 16 who died of asthma.

Using dyes to help visualise the structures of 1373 airways under a microscope, they identified and quantified any fatty tissue present. They compared this data with each person's body mass index (BMI).

For the first time, the study showed that fatty tissue accumulates in the walls of the airways. The analysis revealed that the amount of fat present increases in line with increasing BMI. The research also suggests that this increase in fat alters the normal structure of the airways and leads to inflammation in the lungs.

Co-author, Dr Peter Noble, an associate professor at the University of Western Australia in Perth said: "Being overweight or obese has already been linked to having asthma or having worse asthma symptoms. Researchers have suggested that the link might be explained by the direct pressure of excess weight on the lungs or by a general increase in inflammation created by excess weight.

"This study suggests that another mechanism is also at play. We've found that excess fat accumulates in the airway walls where it takes up space and seems to increase inflammation within the lungs. We think this is causing a thickening of the airways that limits the flow of air in and out of the lungs, and that could at least partly explain an increase in asthma symptoms."

The team are looking for new ways to study and measure fatty tissue in the lungs. They want to confirm the relationship with

respiratory disease and to find out whether the effect can be reversed by weight loss therapy.

Professor Thierry Troosters is President of the European Respiratory Society and was not involved in the study. He said: "This is an important finding on the relationship between body weight and respiratory disease because it shows how being overweight or obese might be making symptoms worse for people with asthma. This goes beyond the simple observation that patients with obesity need to breathe more with activity and exercise hence adding to their ventilatory burden. The observation points at true airway changes that are associated with obesity.

"We need to investigate this finding in more detail and particularly whether this phenomenon can be reversed with weight loss. In the meantime, we should support asthma patients to help them achieve or maintain a healthy weight."

http://bit.ly/2MPWBlG

Parasite paralysis: A new way to fight schistosomiasis?

Scientists have isolated a natural chemical that acts as a potent kryptonite against parasitic worms that burrow through human skin and cause devastating health problems.

In a paper publishing October 17 in the open-access journal PLOS Biology, a research team led by Phillip Newmark at the Morgridge Institute for Research describe the successful characterization of this chemical, which could help in finding new ways to fight the neglected tropical disease schistosomiasis.

Schistosomiasis, also known as bilharzia, is caused by schistosome infection and affects more than 240 million people in Africa, Asia and parts of South America. In this work the scientists focused on one phase of the schistosome life cycle that could be an intriguing target for preventing infection. Schistosomes seek out freshwater snails as hosts in order to produce millions of tiny fork-tailed creatures called cercaria, which are then unleashed in the water and seek out mammals to infect. Their frenzied swimming allows them to penetrate human skin in minutes.

The story started nearly 40 years ago, when a 1981 paper by Margaret Stirewalt and Fred Lewis of the Biomedical Research Institute in Rockville, Maryland, described the intriguing fact that tiny aquatic creatures called rotifers also live on these snails and release a chemical compound that paralyzes schistosome cercariae on contact. Despite this tantalizing report, scientists had not probed its biochemistry further in the intervening decades.

In the new paper, the Newmark lab and collaborators in Jonathan Sweedler's laboratory at the University of Illinois at Urbana-Champaign report their successful effort to purify and chemically define this molecule, calling it "Schistosome Paralysis Factor" (SPF). Lead author and UW-Madison graduate student Jiarong Gao placed SPF in various concentrations in water and demonstrated that the compound immobilized the cercariae, which promptly sank to the bottom of the water and remained in that state. Further, she showed that cercaria exposed to SPF were unable to infect mice.

Newmark says the results could open a promising new path to controlling schistosomiasis. Currently only a single drug, praziquantel, is used to treat infection and is given to millions of school children each year. But it only kills adult schistosomes and does not stop reinfection.

"Any time you're talking about treating that many people with just one drug and no alternative, you're really concerned about the ability of the parasites to develop resistance," Newmark says. "And that's becoming more and more of an issue as the geographic range of the parasite may be spreading and hybrids between human- and livestock-infecting schistosome species are being reported."

Peer-reviewed; Experimental Study; Animals

Please use this URL to provide access to the freely available article in PLOS Biology: *https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3000485*

Citation: Gao J, Yang N, Lewis FA, Yau P, Collins JJ III, Sweedler JV, et al. (2019) A rotifer-derived paralytic compound prevents transmission of schistosomiasis to a mammalian host. PLoS Biol *17(10): e3000485.*
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http://bit.ly/32xqSmW

Deet gives humans an 'invisibilty cloak' to fend off mosquito bites

DEET may chemically 'cloak' humans from malaria-carrying mosquitos, rather than repel them

Since its invention during the Second World War for soldiers stationed in countries where malaria transmission rates were high, researchers have worked to pinpoint precisely how DEET actually affects mosquitos. Past studies have analyzed the chemical structure of the repellent, studied the response in easier insects to work with, such as fruit flies, and experimented with genetically engineered mosquito scent receptors grown inside frog eggs. However, the Anopheles mosquito's neurological response to DEET and other repellents remained largely unknown because directly studying the scent-responsive neurons in the mosquito itself was technically challenging and labor-intensive work.

Johns Hopkins researchers have now applied a genetic engineering technique to the malaria-transmitting Anopheles mosquito, allowing them to peer at the inner workings of the insect's nose.

"Repellents are an amazing group of odors that can prevent mosquito bites, but it's been unclear as to how they actually work. Using our new, engineered strains of Anopheles mosquitoes, we can finally ask the question, How do the smell neurons of a mosquito respond to repellent odors?," says Christopher Potter, Ph.D., associate professor of neuroscience in the Solomon H. Snyder Department of Neuroscience at the Johns Hopkins University School of Medicine.

"Our results from Anopheles mosquitoes took us by surprise. We found that Anopheles mosquitos 'smell' neurons did not directly respond to DEET or other synthetic repellents, but instead these repellents prevented human-skin odors from being able to be detected by the mosquito. In other words, these repellents were masking, or hiding, our skin odors from Anopheles."

The group's research was published Oct. 17 in *Current Biology*.

"We found that DEET interacts with and masks the chemicals on our skin rather than directly repelling mosquitoes. This will help us develop new repellents that work the same way," says Ali Afify, Ph.D., postdoctoral fellow at the Johns Hopkins University School of Medicine and first author on this paper.

When researchers then puffed a scent that the mosquitoes could detect, such as the chemicals that make up the scent of human skin, onto the insects' antennae, fluorescent molecules engineered by the group to be expressed in the antenna would light the neurons up and be recorded by a camera, showing that the mosquito's nose detected the signal.

Using this odor-detecting setup, the researchers found that different scents, including chemical bug repellents such as DEET, natural repellents such as lemongrass, and chemicals found in human scent had different effects on the neurons.

When the researchers puffed the scent of DEET alone onto the mosquitoes' antennae, the fluorescent molecules in the mosquitoes'

neurons did not light up, a sign that the mosquitoes could not directly "smell" the chemical. When exposed to the chemicals known to make up human scent, the neurons "lit up like a Christmas tree," says Potter. And notably, when human scent was mixed with DEET, simulating the effect of applying the repellant to the skin, the neuronal response to the mixture was tempered, resulting in a much lower response. About 20 percent the power of the response to human scent alone.

Looking to gain insight into why this happened, the researchers measured the number of scent molecules in the air reaching the antenna to find out how much 'smell' was present for the insects to respond. They found that when combined with DEET, the number of human scent molecules in the air decreased to 15 percent of their previous amounts. "We therefore think that DEET traps human scents and prevents them from reaching the mosquitoes," says Afify. Potter and his team say they suspect that this effect is enough to mask the human scent and keep it from ever reaching the mosquito's odor detectors.

The investigators caution that their study did not address the possibility that DEET and similar chemicals likely also act as contact repellents, possibly deterring Anopheles through taste or touch. The group also did not look at DEET's effect on other species of mosquito -- issues the researchers say they plan to tackle in future experiments. "The sense of smell in insects is quite remarkable in its variety, and it is certainly possible that other types of mosquitoes such as Aedes mosquitoes, which can transmit Zika or Dengue, might actually be able to detect DEET. A key question to address would be if this detection is linked to repulsion, or if it's perceived as just another odor by the mosquito," says Potter.

The researchers say they also plan to study the specific chemical receptors in the brain responsible for detecting natural odors like lemongrass.

Anopheles mosquitos are the most prevalent carrier of the malaria-causing parasite Plasmodium, which spreads from person to person through infected bites. Malaria killed an estimated 435,000 people in 2017, according to the World Health Organization (WHO).

Other researchers involved in this study include Joshua Betz of the Johns Hopkins University Bloomberg School of Public Health, Olena Riabinina of Durham University and Chloé Lahondère of Virginia Polytechnic Institute and State University

This research was funded by the Department of Defense (W81XWH-17-PRMRP), The National Institute of Allergy and Infectious Diseases (R01AI137078), a Johns Hopkins 2018 Catalyst Award, a Johns Hopkins Malaria Research Institute Pilot Fund and a Johns Hopkins Malaria Research Institute Postdoctoral Fellowship.

The authors declare no competing interests.

http://bit.ly/2pzJIEE

Distant exoplanets not so different to Earth

Analysis finds terrestrial geochemistry and geophysics is far from unique.

Barry Keily reports.

At least some exoplanets are geophysically and geochemically similar to Earth, researchers have found.

A team led by Alexandra Doyle of the University of California, Los Angeles, made the finding after analysing the atmospheres of six dead stars which had sustained impacts from asteroids or mini-planets falling out of orbit and smashing into them.

Such dead stars, known as White Dwarfs, are the remnant cores left behind after the ageing stars eject their hydrogen-rich outer layers. The result is a body about half the mass of the Sun and roughly the size of the Earth.

The surfaces of White Dwarfs comprise leftover hydrogen and helium. Any heavier elements, such as magnesium, iron and oxygen, are pulled towards the centre by gravity. However, spectrographic analysis reveals that in 50% of dwarfs with an effective temperature of around 25,000 degrees Celsius such elements remain as traces in the atmosphere. They are a tell-tale sign that at some point, rocky bodies smashed into them.

By analysing the relative frequencies of these added elements, Doyle and colleagues were able to assess the effect that oxygen previously played in the formation of the now destroyed baby planets, known as planetesimals.

The degree of oxidisation – known as fugacity – in rocks is a key indicator of the geochemical processes that formed them. For rocky bodies in the solar system – Earth and Mars, for instance – fugacity is approximately five orders of magnitude higher than that in the hydrogen-rich gas of the sun.

The results showed very similar measures – indicating that the geochemistry of the Solar System is by no means unique, and may, indeed, be very common in the universe.

“Our data indicate that rocky exoplanets constructed from these planetesimals should be geophysically and geochemically similar to rocky planets in the Solar System, including Earth,” they conclude.

For those playing at home, the White Dwarfs investigated are classified as: SDSS J104341.53+085558.2, SDSS J122859.92+104033.0, SBSS 1536+520, GD 40, SDSS J073842.56+183509.6, and LBQS 1145+0145.

The research is published in the journal *Science*.

https://wb.md/32yiWLg

Knee, Hip Steroid Injections May Speed Joint Damage in Some Patients

Steroid injections may do more harm than good for some people.

Veronica Hackethal, MD

Steroid injections are frequently used to relieve pain associated with osteoarthritis of the knee and hip, but new evidence suggests the treatment may do more harm than good for some people. Experts now stress the need for better informed consent about potential risks and benefits of injections.

Data from more than 450 patients who received intra-articular corticosteroid injections for osteoarthritis at Boston University show that the treatment may speed the pace of osteoarthritis and contribute to joint destruction. The article was published online October 15 in the journal *Radiology*.

"We are now seeing [that] these injections can be very harmful to the joints, with serious complications such as osteonecrosis, subchondral insufficiency fracture, and rapid progressive osteoarthritis," senior author Ali Guermazi, MD, PhD, said in a press release. Guermazi is chief of radiology at the Veterans Affairs Boston Healthcare System and professor of radiology at Boston University School of Medicine.

Some patients may be more prone than others to poor outcomes from the treatment, but it's not yet known how to identify these people. The researchers stress the importance of informed consent, and urge radiologists to take x-rays before administering steroid injections, in order to identify underlying problems that may contribute to adverse events.

"Intra-articular corticosteroid injection should be seriously discussed for pros and cons. Critical considerations about the complications should be part of the patient consent, which is currently not the case right now," Guermazi added.

Long-term Data Has Been Lacking

The first-line treatment for osteoarthritis, which most commonly affects the hip and knee, is conservative pain control, but many patients eventually need joint replacement. Yet people with osteoarthritis are often older and have multiple medical problems that make them ineligible for surgery or long-term treatment with acetaminophen or nonsteroidal anti-inflammatory (NSAIDs) medication.

Steroid joint injections have been widely used for decades to treat patients like these, and others with inadequate pain control. While short-term complications are rare, most studies on the long-term effects are of low quality. Some evidence from animal and human laboratory studies suggests steroid joint injections may contribute to

progression of osteoarthritis. Professional societies differ on whether or not to recommend steroid joint injections for osteoarthritis.

Therefore, Andrew Kompel, MD, also from Boston University School of Medicine, and colleagues reviewed the records of 459 individuals who received at least one corticosteroid injection in the hip or knee joint in 2018 at an inner city hospital in Boston.

Overall, 8% (n = 36) of patients experienced an adverse joint event after receiving a steroid joint injection. These individuals ranged in age from 37 to 79 years (mean age, 57 years) and most (72%) showed moderate osteoarthritis at baseline. They received an average of 1.4 injections and developed joint complications anywhere between 2 to 15 months after injection, with an average of 7 months.

The authors identified four main adverse joint events after steroid joint injections. The most common was accelerated progression of osteoarthritis, found in 6% of individuals (n = 26).

The second most common adverse joint event was subchondral insufficiency fracture, found in 0.9% (n = 4) of individuals. Subchondral insufficiency fracture has traditionally been thought to occur in older individuals with weak bones, but recent evidence suggests it may be more common and affect younger patients.

The condition is potentially underdiagnosed due to lack of awareness. Delayed diagnosis can lead to joint damage and eventual joint replacement. Diagnosis is important before giving steroid joint injections, which can impair healing in these kinds of fractures, according to the authors. In addition, osteonecrosis and rapid joint destruction each affected 0.7% (n = 3) of patients, respectively.

Osteonecrosis refers to decreased blood flow to the bone that can cause breakdown of the bone, eventual fracture, and need for joint replacement. Patients with osteonecrosis but without fracture sometimes receive steroid joint injections. The authors emphasize the need to inform such patients that steroid joint injections could potentially worsen their condition.

They also note that rapid joint destruction and accelerated bone loss may occur after the first steroid injection and in patients without evidence of underlying disease on x-ray. In these patients, they suggest closely reviewing the need for injection and repeating x-rays before giving further injections.

The authors conclude: "The radiology community should actively engage in high-quality research to further understand these adverse joint findings and how they possibly relate to [intra-articular corticosteroid] injections to prevent or minimize complications."

In an accompanying editorial, Richard Kijowski, MD, of the University of Wisconsin School of Medicine and Public Health, notes several limitations of the study, including the small number of patients and lack of standardized methods.

"The report is neither a prospective clinical trial nor a retrospective observational study…The objective is to educate radiologists that the intra-articular corticosteroid injection they routinely perform with little, if any, thought about long-term safety may cause more harm than benefit," he writes.

He agreed with the authors about the importance of informed consent. "Patients might be more than willing to take the small risk of an adverse joint event requiring eventual joint replacement for the possibility of at least some degree of pain relief after intra-articular corticosteroid injection," he concludes. "However, patients have the right to make this decision for themselves, and this requires radiologists to discuss all potential risks and benefits with the patient when obtaining written informed consent." The study authors acknowledge that they could not determine whether these adverse joint events were already present when patients had their steroid joint injections, or if the injections caused these problems.

One or more authors owns shares in and/or has been a consultant for one or more of the following: Boston Imaging Core Lab, TissueGene, Merck Serono, Pfizer, AstraZeneca, Galapagos, and/or Roche. Kijowski has disclosed no relevant financial relationships. *Radiology*. Published online October 15, 2019. Full text, Editorial

http://bit.ly/2J6luIW

Increase health benefits of exercise by working out before breakfast -- new research

By changing the timing of when you eat and exercise, people can better control their blood sugar levels

According to a new study, published in the Journal of Clinical Endocrinology and Metabolism, health scientists at the Universities of Bath and Birmingham found that by changing the timing of when you eat and exercise, people can better control their blood sugar levels.

The six-week study, which involved thirty men classified as obese or overweight and compared results from two intervention groups (who ate breakfast before / after exercise) and a control group (who made no lifestyle changes), found that people who performed exercise before breakfast burned double the amount of fat than the group who exercised after breakfast.

They found that increased fat use is mainly due to lower insulin levels during exercise when people have fasted overnight, which means that they can use more of the fat from their fat tissue and the fat within their muscles as a fuel. To test proof-of-principle the initial study involved only men, but future studies will look to translate these findings for different groups including women.

Whilst this did not lead to any differences for weight loss over six weeks, it did have 'profound and positive' effects on their health because their bodies were better able to respond to insulin, keeping blood sugar levels under control and potentially lowering the risk of diabetes and heart disease.

Building on emerging evidence that the timing of meals in relation to exercise can shift how effective exercise is, the team behind this study wanted to focus on the impact on the fat stores in muscles for individuals who either worked out before or after eating and the effect this had on insulin response to feeding.

Dr Javier Gonzalez of the Department for Health at the University of Bath explained: "Our results suggest that changing the timing of when you eat in relation to when you exercise can bring about profound and positive changes to your overall health.

"We found that the men in the study who exercised before breakfast burned double the amount of fat than the group who exercised after. Importantly, whilst this didn't have any effect on weight loss, it did dramatically improve their overall health.

"The group who exercised before breakfast increased their ability to respond to insulin, which is all the more remarkable given that both exercise groups lost a similar amount of weight and both gained a similar amount of fitness. The only difference was the timing of the food intake."

Over the six-week trial, the scientists found that the muscles from the group who exercised before breakfast were more responsive to insulin compared to the group who exercised after breakfast, in spite of identical training sessions and matched food intake. The muscles from those who exercised before breakfast also showed greater increases in key proteins, specifically those involved in transporting glucose from the bloodstream to the muscles.

For the insulin response to feeding after the 6-week study, remarkably, the group who exercised after breakfast were in fact no better than the control group. Co-author Dr Gareth Wallis of the University of Birmingham added: "This work suggests that performing exercise in the overnight-fasted state can increase the health benefits of exercise for individuals, without changing the intensity, duration or perception of their effort. We now need to explore the longer-term effects of this type of exercise and whether women benefit in the same way as men."

The Physiological Society, The Rank Prize Funds, and The Allen Foundation funded this work. It is published in the Journal of Clinical Encocrinology and Metabolism.

http://bit.ly/2Mx746T

Japan Has an Illegal Seafood Problem

Japan's loose fisheries laws make it a destination for illegal, unreported, and unregulated seafood.

by Jess Mackie

At 407,000 square meters, the world's largest wholesale seafood market is in Tokyo, Japan. This comes as no surprise given that Japan is the world's largest consumer of high-value fish, such as bluefin tuna, and the third largest seafood importer after the European Union and the United States. This voracity makes Japan vulnerable to importing large amounts of illegal, unreported, and unregulated (IUU) seafood, and according to a recently published study, its lax traceability requirements all but guarantee that illegal seafood has a market in the island nation.

In 2015, the year examined by the study, Japan imported an estimated US $1.6- to 2.4-billion worth of seafood caught from illegal and unreported sources. By weight, this estimate accounted for 24 to 36 percent of the country's wild-caught seafood imports, placing Japan on the high end of the global average of 15 to 30 percent.

To reach this finding, researchers consulted more than 100 scientists, crew members, port agents, ship captains, distributors, and seafood auditors—all of whom were intimately tied to fisheries and supply chains. These confidential sources provided estimates of how much IUU product makes its way into Japan, data the researchers bolstered by visiting select ports and analyzing available import records.

Anastasia Telesetsky, an environmental lawyer at the University of Idaho whose work focuses on marine policy and who was not involved in the study, says she was not surprised by these findings, considering the marine species arriving in Japan's ports. For instance, crabs from Russia have been associated with illegal fisheries for decades, according to the study. Even after Japan and Russia reached an agreement in 2014 to curtail IUU crab, the study shows that poached crab from Russia still made its way into Japan, albeit at a reduced level.

Although Japan imported a large amount of IUU product from Russian fisheries in 2015, the highest volumes originally came from China and the United States. As much as 55 percent of Chinese squid and cuttlefish came from illegal and unreported sources, as did 15 to 22 percent of Alaska pollock, a species commonly used in products like fish sticks.

Alaska pollock exemplifies the risks inherent in global supply chains, says Tony Pitcher, a fisheries scientist at the University of British Columbia and coauthor of the study. In fact, he says only two or three percent of Alaska pollock is caught illegally by US vessels. (Reaching zero percent, he says, is all but impossible for any fishery.) But that pollock goes to other countries, primarily China and Vietnam, for processing, where it gets mixed with illegally sourced pollock from Russia. That's why, post-processing, Alaska pollock enters Japan with an elevated IUU content. Though the Russian fishery has made some improvements in recent years, Pitcher says it's still in part controlled by criminal organizations operating unlawfully.

Telesetsky, whose work has explored the connection between organized crime and IUU fishing, says fish is a convenient commodity for laundering. "It's really easy to hide," she says, "because how can you tell if one tuna was caught legally and one was not? They look the same." The lack of transparency at processing plants, as well as at other links in the supply chain, means that these sites are at risk of being targeted by illegal fishers,

says Pitcher. “These loopholes are exploited by the people who are trying to launder their products.”

Pitcher attests that changes at processing plants, through which a significant portion of the world’s wild-caught seafood passes, can help address IUU fishing. “If the countries importing the seafood demand that they will only take things with catch documentation, then the processing factories will have to comply,” Pitcher says. And since these plants already abide by strict microbiological standards, the added regulation wouldn’t be onerous, he says.

In the past decade, the European Union and the United States have been working to close these loopholes by implementing stronger import measures. The United States’ 2018 Seafood Import Monitoring Program (SIMP), for instance, requires an importer to provide sufficient data such that a species at risk of being caught illegally can be traced back to its source.

And just last year, Japan significantly amended its fisheries laws for the first time in 70 years. The changes reflect a growing effort to protect overfished species in domestic waters by increasing penalties, imposing individual quotas on fishing vessels, and introducing a science-based total allowable catch system. Yet the country still lags behind the European Union and the United States when it comes to traceability standards, Pramŏd Ganapathiraju, a fisheries consultant and the study’s lead author, says in an email.

To effectively curtail IUU fishing at a global level, the top five seafood importers—the European Union, the United States, Japan, China, and South Korea—must require documentation for imported seafood across the entire supply chain, including at processing plants, Ganapathiraju says. Otherwise, it’s possible that “tight measures in one country divert IUU products to other countries where such verification measures are lacking,” he says, likening the upshot to the balloon effect—a term often used to describe the shifting patterns of drug traffickers, in which law enforcement squeezes them out of one area only for them to crop up somewhere else.

Japan may be on its way to matching the standards set by the European Union and the United States, however. Another piece of legislation may include traceability measures like those in SIMP. It would be another step toward reforming Japanese fisheries laws, and a necessary one, given that the country’s affinity for fish isn’t likely to go away. Last year, Tokyo’s iconic fish market moved across town from Tsukiji to Toyosu as the city prepares for the 2020 Olympics. The space is over one and a half times larger than the old location, and in its first auction, a single bluefin tuna sold for a record-breaking $3-million.

http://bit.ly/2J1xStN

Candidate Ebola vaccine still effective when highly diluted, macaque study finds

Scientists hope findings mean vaccine supplies could stretch farther

WHAT: A single dose of a highly diluted VSV-Ebola virus (EBOV) vaccine--approximately one-millionth of what is in the vaccine being used to help control the ongoing Ebola outbreak in the Democratic Republic of the Congo (DRC)--remains fully protective against disease in experimentally infected monkeys, according to National Institutes of Health scientists. The NIH investigators completed the vaccine dosage study using cynomolgus macaques and an updated vaccine component to match the EBOV Makona strain that circulated in West Africa from 2014-16. The study appears in Lancet's *EBioMedicine*.

Nearly 250,000 people have received the investigational VSV-EBOV vaccine since August 2018 as part of a "ring vaccination" program to help stem the outbreak. The vaccine appears to be safe and highly effective. The manufacturer has announced that it has submitted a biologics license application to the U.S. Food and Drug

Administration. VSV-EBOV is based on a live-attenuated vesicular stomatitis virus and delivers an EBOV protein to elicit protective immune responses. With the continued need to vaccinate individuals in the DRC and surrounding countries, a potential shortage of VSV-EBOV vaccine is a concern and further dose adjustment is a possible solution.

Scientists from NIH's Rocky Mountain Laboratories (RML), part of the National Institute of Allergy and Infectious Diseases, tested several dosage strengths, including one with 10 million plaque-forming units (PFU). They determined that a vaccine with 10 PFUs was just as effective as the highest dose tested (a dose which was still lower than the one currently in use in the DRC). They vaccinated macaques 28 days prior to infecting them with a lethal dose of EBOV and then monitored the animals for 42 days after infection. Even the macaques given the lowest dose appeared completely protected from disease due to EBOV.

The scientists say their study findings could help make more vaccine available for more people and may reduce adverse reactions to the vaccine because of the smaller amount of active ingredient. Such reactions can include injection site irritation, headache, fatigue, fever, chills, myalgia, and arthralgia. Demonstrating that the vaccine appears effective with adjusted dosing also could ease the burden on vaccine production.

The authors say that although results from preclinical and clinical studies can differ, these promising findings in macaques of complete protection with a lower-dose VSV-EBOV vaccine help support the possibility of similar clinical trials in people.

ARTICLE: *A Marzi et al. Single low-dose VSV-EBOV vaccination protects cynomolgus macaques from lethal Ebola challenge. EBioMedicine DOI: 10.1016/j.ebiom.2019.09.055 (2019).*

WHO: *Heinz Feldmann, M.D., Ph.D., chief of NIAID's Laboratory of Virology, and Andrea Marzi, Ph.D., lead author, are available to comment on this study.*

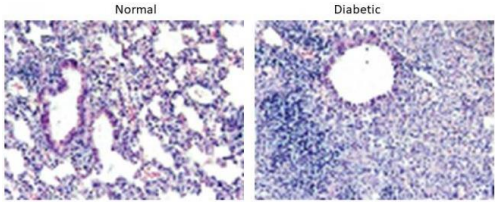
http://bit.ly/33JeIAP

Why respiratory infections are more deadly in those with diabetes

Researchers outlined immune dysfunction in mice that leads to more severe respiratory infections in those with diabetes

Since the Middle East respiratory syndrome coronavirus (MERS-CoV) first emerged in Saudi Arabia in 2012, there have been more than 2,400 confirmed cases of the infection, resulting in greater than 800 deaths - an alarming fatality rate of 35 percent. For this reason, researchers have been eager to identify any risk factors that contribute to the development of severe or lethal disease.

Current clinical evidence points to diabetes as a major risk factor in addition to other comorbidities including kidney disease, heart disease, and lung disease.



Lung sections from 21 days after infection with MERS-CoV in normal mice (left) and diabetic mice (right). We find that normal mice resolve the inflammation faster than diabetic mice leading to prolonged weight loss and disease in the diabetic mice. **University of Maryland School of Medicine**

Researchers from the University of Maryland School of Medicine (UMSOM) and the Johns Hopkins University School of Medicine have demonstrated in a new study, published earlier this week in the Journal of Clinical Investigation Insights, how diabetes contributes to mortality from MERS-CoV infections, and the finding could shed light on why other respiratory illnesses like the flu or pneumonia might strike those with diabetes more severely.

They investigated the connection between diabetes and MERS-CoV in a mouse model and discovered that although the virus did not replicate more readily in the diabetic mice compared to the healthy controls, the diabetic mice exhibited a delayed and prolonged inflammatory response in the lung. Diabetic mice had lower levels

of inflammatory cytokines and fewer inflammatory macrophages and T cells. This indicates that the increased severity of MERS-CoV infection in patients with diabetes was likely due to a malfunction in the body's response to infection.

"Understanding how diabetes contributes to disease severity following MERS-CoV infection in this context is critical," said Matthew Frieman, PhD, associate professor of microbiology and immunology who is the corresponding author of the study. "Our next step is to determine what drives the altered immune response in diabetics and how to reverse those effects with therapeutics for treatment of patients."

Follow up research could also explore whether health care providers should double their efforts to manage and stabilize glucose levels in patients with diabetes experiencing a dangerous respiratory infection and whether better management would help mitigate the effects of these infections.

"This is an important finding for patients with diabetes and physicians who treat them," said UMSOM Dean E. Albert Reece, MD, PhD, MBA, who is also the Executive Vice President for Medical Affairs, University of Maryland and the John Z. and Akiko K. Bowers Distinguished Professor. "We have long known that diabetic patients have worse outcomes when they get a serious infectious disease, but this new insight on immune function could pave the way for better treatments."

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A new pesticide is all the buzz

The EPA has approved the first-ever bee-distributed pesticide for the US market

Rachel Fritts

Bees' fuzzy yellow bodies and hairy legs are custom-built for picking up pollen. Nothing can distribute the yellow powder more efficiently—something farmers that shell out for commercial beehives every growing season know all too well. And starting with this fall's growing season, bees may be given some cargo to carry on their outbound journey to the blossoms: pesticides.

On August 28, the EPA approved the first-ever bee-distributed organic pesticide for the US market—a fungus-fighting powder called Vectorite that contains the spores of a naturally occurring fungus called *Clonostachys rosea* (CR-7). CR-7 is completely harmless to its host plant and acts as a hostile competitor to other, less innocuous fungi. It has been approved for commercial growers of flowering crops like blueberries, strawberries, almonds, and tomatoes.

The beauty of Vectorite is that it mimics a "locally appropriate natural system," said Vicki Wojcik, director of Pollinator Partnership Canada. "It's an interesting twist… where care for the health of the pollinator is actually vital because it is your actual vector."

Hitching a ride

Farmers around the world pollinate their crops with rented hives—honeybees for fields and bumblebees for greenhouses. It's big business, too. California's almond farmers alone rent over a million commercial beehives to pollinate their trees every year.

Vectorite piggybacks on that system. Before bees buzz off to work, they trundle through a tray of powder placed by the hive exit. Then the bee just needs to do what it does best. Each time the bee lands on a flower, a little bit of the pesticide is knocked loose. Both bumblebees and honeybees are capable of spreading Vectorite up to 400 yards from their hive.

Once it's delivered by the bees, CR-7 quickly embeds itself within the plant, establishing a natural defense system against common fungal diseases including *Botrytis cinereal* (grey mold) and *Sclerotinia sclerotiorum* (white mold). If the spores of these or a number of other pathogens land on the plant, CR-7 blocks their

development. Since bees are always on the lookout for newly blossomed flowers, they are more likely to deliver the fungicide earlier than traditional periodic spray methods, boosting its effectiveness.

Bee vectoring, as it's called, is a great option for organic farmers, but Ashish Malik hopes that more conventional farmers will adopt the technology as well. Malik, CEO of Vectorite manufacturer Bee Vectoring Technologies, said flowering crops like strawberries, sunflowers, and almonds are ideal candidates because bees are already a key part of their business model. If farmers do adopt the system, it would also be good news for native pollinators. Bee vectoring "has virtually no environmental impact," said Roselyn Labbé, a greenhouse entomologist with Agriculture and Agri-Food Canada. The natural pesticides that the bees are capable of spreading without harm to themselves, she said, "are all over nature anyway."

High efficiency

Bee vectoring could also save growers money in the long term due to its comparative efficiency, Labbé said. "You're essentially delivering very small amounts in a very targeted way." In Canadian trials where bumblebees distributed an organic insecticide called *Beauveria bassiana* to greenhouse crops like tomatoes and strawberries, just 1.3% of the pesticide was needed relative to traditional methods. Bee Vectoring Technologies, meanwhile, claims that Vectorite with CR-7 requires just one teaspoon to every 4.5 pounds of traditionally sprayed pesticide to be effective. Bee-vectored pesticides have other benefits as well, including lower health risks for farmers.

But they won't replace spraying entirely. Bee vectoring "would not work for a late-season disease where there's no longer a flower, or a leaf disease or root disease," Malik said. The technology is also unlikely to be adopted by growers of crops like corn and soy that don't already use commercial beehives for pollination.

Wojcik and Labbé said that bee vectoring is an exciting new tool that could work well with an old farming practice known as integrated pest management. Farmers using IPM implement low-impact measures on an as-needed basis, minimizing cost and negative effects on the environment and human health. "The theory of using biological control is nothing new," Wojcik said. "In the '60s and '70s, there was an enormous push to take this approach."

For farmers wanting to integrate bee vectoring into their own IPM strategy, the biggest barrier to adoption is the current lack of options. "Growers want to be able to choose from a number of different agents to be able to attack a different type of pest," Labbé said, including insects or a broader range of fungal pests.

So far, only Canada, the EU, and now the US have a bee-vectored pesticide approved for commercial growers. And the pesticide approved in each country can only protect against a handful of potential threats. Canada's *Beauveria bassiana*, for instance, protects against insect pests like thrips and aphids but not fungal pathogens like gray mold. But Malik is hoping that Vectorite will soon be approved in other countries, and his company is researching additional fungal and bacterial spores that can work alongside CR-7, defending against a wider array of fungal pathogens as well as insect pests.

Their timing may be right. "There is a lot of interest in bee vectoring as a technology by growers," Labbé said.

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Report: More than half of all US doctors get money from pharma each year

The payouts aren't changing despite newer disclosure requirements.

Beth Mole

Drug makers and medical device makers are still spending between $2.1 billion and $2.2 billion a year to woo doctors into prescribing and using their products, according to a new investigation by ProPublica.

Between 2014 and 2018, more than 600,000 of the approximately 1.1 million doctors in the US received at least one payment from industry in any given year. The payments were for things including speaking fees, consulting, meals, gifts, travel, and royalties.

While thousands of doctors have made $100,000 or more, more than 2,500 received $500,000 or more in the five-year period—and those payments do not include royalties. More than 700 received at least $1 million.

The data comes from the first full five-year period of the federal Open Payments Initiative, a part of the 2010 Affordable Care Act that requires companies to disclose such payments. The idea behind the initiative was that such transparency might dissuade industry payments to physicians, which research has shown time and again influences prescribing and care practices.

But researchers and industry watchers see little change in spending levels and the number of physicians accepting payments.

"It makes me wonder whether patients are using this information or whether physicians are even aware this information is out there," Dr. Joseph Ross, a professor of medicine and public health at Yale who has studied pharmaceutical marketing, told ProPublica. "It's almost like it's not happening."

In an email to ProPublica, a spokesperson for the industry trade group Pharmaceutical Research and Manufacturers of America (PhRMA) defended the continued practice, writing:

It is not necessarily a negative that the numbers have remained generally flat over the past five years… That statistic appears to be consistent with companies' belief that their interactions with physicians have been and remain legitimate, even when subjected to sunshine.

The data also includes how much drug makers have spent to promote specific drugs to physicians over the five years. In 2018, drug makers shelled out $17.9 million to promote blood thinner Xarelto to doctors, $12.6 million to promote diabetes drug Farxiga, and $12.2 million to promote the immune-suppressive drug Humira. Those figures do not include money for research funding or royalties.

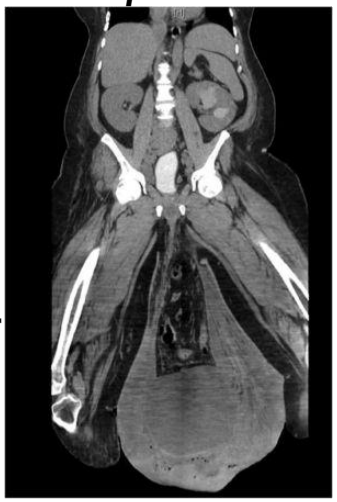
A 2017 analysis on the drugs that prompted the most physician-promotion payments from doctors found that they tended to be drugs that are "less likely than top selling and top prescribed drugs to be effective, safe, affordable, novel, and represent a genuine advance in treating a disease."

http://bit.ly/2oOeh9G

Man has massive, rotting scrotum removed after avoiding doctors for decades

Doctors believe he had an untreated parasitic infection.

Beth Mole



After three decades of progressive symptoms, a 43-year-old man from Panama was rushed into emergency surgery with a massively swollen scrotum that hung past the level of his knees and had begun to rot and ooze foul-smelling pus, a team of Texas doctors report. When he arrived at the hospital, he had a fever of 102.2 °F (39 °C) and rapid heart rate, as well as extensive swelling and thickened skin in his scrotum and upper right leg. He also had two open wounds in his scrotum.

***Enlarge** / CT imaging illustrating impressive scrotal edema and massive inguinal hernia.* **Dowd et al.**

Further imaging of his abdomen and pelvis revealed a large hernia containing part of his colon, as well as a huge abscess, considerable tissue damage, and fluid collection. (You can see NSFW images of his condition here)

Fearing the ravages of gangrene and sepsis—a life-threatening response to infection—the doctors quickly wheeled him to an operating room to try to remove the rotting flesh. Pathologists examining tissue from his scrotum found extensive inflammation and that some of his skin had begun to liquify.

Though days of intravenous antibiotics seemed to improve his surgical wounds, his painful infection lingered. Doctors made the call to remove his left testicle and scrotum, as well as repair his hernia with a biological mesh. Doctors also performed plastic surgery in subsequent operations to repair his perineum and penis, which had become "buried" by his extremely large scrotum.

After four weeks in a rehabilitation facility, the man was reported to be "healing well with satisfactory cosmetic and functional outcomes."

Diagnosis

Though blood testing did not definitively determine what caused his extreme case, the doctors suspect that it started with untreated lymphatic filariasis, a parasitic disease caused by roundworms that are transmitted by mosquitoes bites.

Once delivered to the body, the worms take up residence in the lymph system, causing inflammation. Though most infected people show no symptoms, some can go on to develop lymphedema (tissue swelling), elephantiasis (skin and tissue thickening), and such scrotal swelling, called hydrocele. Left untreated, dysfunction of the lymphatic system can pave the way for bacterial infections to set in.

By the time the man arrived in the hospital, he reported that he had come to rely on a walker to get around and that his mother took care of most of his daily needs.

His case, published online this month in the journal Urology Case Reports, is rare in the developed world—but challenging to treat.

In their conclusion, the doctors, led by Katherine Dowd of the Texas health system Baylor Scott & White Health, write, "This case highlights the management of a patient requiring emergent intervention and multidisciplinary approach in the acute care setting." With their treatment plan, "the patient was spared prolonged wound care, painful dressing changes, without sacrificing cosmetic and functional outcomes."

According to the Centers for Disease Control and Prevention, lymphatic filariasis affects more than 120 million people in 72 countries in the tropics and subtropics of Asia, Africa, the Western Pacific, and parts of the Caribbean and South America. In the Americas, the disease is endemic in only Haiti, the Dominican Republic, Guyana, and Brazil.

Urology Case Reports, 2019. DOI: 10.1016/j.eucr.2019.101013 (About DOIs).

http://bit.ly/2py3zUL

Fireball That Flew Over Japan in 2017 Was Tiny Piece of Giant Asteroid that Might One Day Threaten Earth

At some point in the next 10 million years, the giant asteroid might follow the little shard and slam into Earth's atmosphere itself.

By Rafi Letzter - Staff Writer

In the early morning of April 28, 2017, a small fireball crept across the sky over Kyoto, Japan. And now, thanks to data collected by the SonotaCo meteor survey, researchers have determined that the fiery space rock was a shard of a much larger asteroid that might (far down the road) threaten Earth.

The meteor that burned over Japan was tiny. Studying the SonotaCo data, the researchers determined that the object entered the atmosphere with a mass of about 1 ounce (29 grams) and was just 1 inch (2.7 centimeters) across. It didn't threaten anyone. But

small meteors like this are interesting because they can offer data on the bigger objects that spawn them. And in this case, the researchers tracked the little rock back to its parent: an object known as 2003 YT1.

2003 YT1 is a binary asteroid, composed of one large rock about 1.2 miles (2 kilometers) across orbited by a smaller asteroid that's 690 feet (210 meters) long.

Discovered in 2003, the binary system has a 6% chance of hitting Earth at some point in the next 10 million years. That makes the object what researchers call a "potentially hazardous object," even though it's unlikely to hurt anyone in your lifetime.

A still from a video shows a fireball passing over Kyoto, Japan after 1 a.m. on April 28, 2017. © SonataCo Network)

The binary didn't pass by Earth in 2017, so there wasn't an immediately obvious link between the meteor and its parent. But the researchers studied how the fireball moved across the sky and were able to reverse-engineer the object's orbit through space, pinning it to 2003 YT1 with a high degree of certainty.

The researchers said they aren't sure how the little rock split off from 2003 YT1 but believe it's part of a larger stream of dust that got flung off of the asteroid. And they offered a few potential explanations for how that stream formed: Maybe tiny micrometeorites routinely strike the bigger asteroid in the binary, fragmenting it like bullets striking a rock wall. Or maybe changes in heat cracked one of the asteroid's surfaces, spitting small pieces into the dark.

One scenario the authors offered is that the shards are a result of the process that formed the 2003 YT1 system in the first place.

Most people likely imagine asteroids as great, big rocks, scaled-up versions of the stones they'd find here on Earth. But 2003 YT1, the authors wrote, is more likely a "rubble pile," a jumble of stuff loosely bound together by gravity that coalesced into two orbiting bodies at some point in the last 10,000 years. The forces holding the masses together as individual asteroids are likely weak, and as the two piles spin chaotically around one another every couple hours, they could fling more of themselves into space.

There are other, more exotic possibilities, the authors wrote. Water ice might be sublimating (turning from solid to gas) off one of the asteroids' surfaces and reforming as small balls of ice in open space. But that and other models are unlikely, the researchers wrote.

For now, we know that Earth has been visited by a little piece of a big asteroid. And that little piece is likely part of a stream of other little pieces that sometimes enter the Earth's atmosphere unnoticed. And at some point far down the road, that big asteroid might follow its small children and slam into Earth. That fireball would be much, much bigger.

The paper describing these findings has not yet been peer-reviewed. A draft was published Oct. 16 in the preprint journal arXiv.

http://bit.ly/2W3sDPp

Toad disguises itself as deadly viper to avoid attack

Toad imitates one of Africa's largest vipers in both appearance and behavior

by Taylor & Francis

The first study of a toad mimicking a venomous snake reveals that it likely imitates one of Africa's largest vipers in both appearance and behavior, according to results published in the *Journal of Natural History*.

The Congolese giant toad, a triple cheeseburger-sized prize for any predator, may use its ability to mimic the highly venomous Gaboon

viper to escape being eaten. The viper has the longest snake fangs in the world and produces more venom than any other snake.

"Our study is based on ten years of fieldwork and on direct observation by researchers lucky enough to see the toad's behavior first-hand. We're convinced that this is an example of Batesian mimicry, where a harmless species avoids predators by pretending to be a dangerous or toxic one," says Dr. Eli Greenbaum from the University of Texas at El Paso. "To fully test our hypothesis, we'd have to demonstrate that predators are successfully duped, but this would be very difficult in the wild, where the toads are only encountered rarely. However, based on multiple sources of evidence provided in our study, we are confident that our mimicry hypothesis is well-supported."

A side-by-side comparison between a subadult toad and subadult Gaboon viper from an aerial perspective, showing the similarities in appearance.
Credit: Taylor & Francis

The researchers made comparisons between the appearance of the toad, found in central African rainforests, and the viper, which is more widespread in central, eastern and southern Africa. Using live wild-caught and captive specimens, as well as preserved museum ones, they found that the color pattern and shape of the toad's body is similar to that of the viper's head. Most striking are two dark brown spots and a dark brown stripe that extends down the toad's back, the triangular shape of the body, a sharp demarcation between the tan back and dark brown flanks, and the species' extraordinarily smooth skin for a toad. Because the Gaboon viper is capable of causing deadly bites, would-be predators likely avoid the similar-looking toads to ensure they don't make a lethal mistake.

An image of the toad species (Sclerophrys channingi) that is thought to mimic the viper, based on extensive observations. Credit: Konrad Mebert

Some mimics are exclusively visual, but for the Congolese giant toad, getting the look right is only part of the impersonation. If a Gaboon viper feels threatened, it will often incline its head and emit a long, loud warning hiss before it actually makes a strike. Similarly, Congolese herpetologist Chifundera Kusamba observed the toad emitting a hissing noise resembling the sound of air being slowly released from a balloon. Over a century ago, American biologist James Chapin observed a bow display by the toad, where the front limbs no longer prop up the viperine-shaped body, which looks similar to the cocked head of a snake threatening to strike.

The final part of the impersonation is getting the location right. Even the best impression will only work if predators of the harmless species are familiar with the venomous one. The researchers compared the geographical range of the toad and viper in the Democratic Republic of Congo (DRC) and found that the Congolese giant toad does not seem to occur in areas where the Gaboon viper is absent. The researchers identified 11 locations in the eastern rainforests where the range of both species overlaps.

Based on speciation dating estimates from genetic data, the Congolese giant toad and Gaboon viper first evolved at about the same time in the early Pliocene about 4–5 million years ago. Considered with their similar appearance, behavior, and overlapping geographic distribution, the toads and vipers likely coevolved together, further supporting the mimicry hypothesis.

"Given the relatively large size and therefore calorific value of this toad compared to other species, it would make tempting prey to a large variety of generalist predators, including primates and other mammals, lizards, snakes and birds," says Kusamba, from the Centre de Recherche en Sciences Naturelles, DRC. "Many of these

predators use vision to find their prey, and because the viper is deadly venomous, they probably recognize the distinctive, contrasting markings from a considerable distance and avoid the toad because of them, receiving a threatening hiss if the appearance doesn't put them off."

Perhaps the best-known examples of Batesian mimicry are in butterflies, where around a quarter of over 200 Papilio swallowtail butterfly species are non-toxic impersonators of toxic ones. Other examples from the animal kingdom include comet fish that fool predators into thinking their tail is a moray eel's head, the Brazilian galliwasp lizard that mimics a toxic millipede, and zebra sharks that take on the coloration and undulating movements of venomous sea snakes. Many harmless snakes mimic venomous ones, and some caterpillars, legless lizards, and even birds are able to do so. However, the current study is the first to identify an amphibian mimicking a venomous snake.

Explore further

More information: *A remarkable example of suspected Batesian mimicry of Gaboon Vipers (Reptilia: Viperidae: Bitis gabonica) by Congolese Giant Toads (Amphibia: Bufonidae: Sclerophrys channingi). Journal of Natural History.*
doi.org/10.1080/00222933.2019.1669730
Journal information: Journal of Natural History