

Our link with furry friends

Are dogs genetically programmed to be sensitive?

S ANVITA HANIKARAY ANVITA

Dogs have a special place in relating to humans. They collaborate in several activities – herding sheep, leading the blind, fetching game in the hunt, as trackers, watchdogs and companions. Trainability apart, they anticipate human need, are empathetic and many dog lovers are convinced that the furry friend understands their very speech.

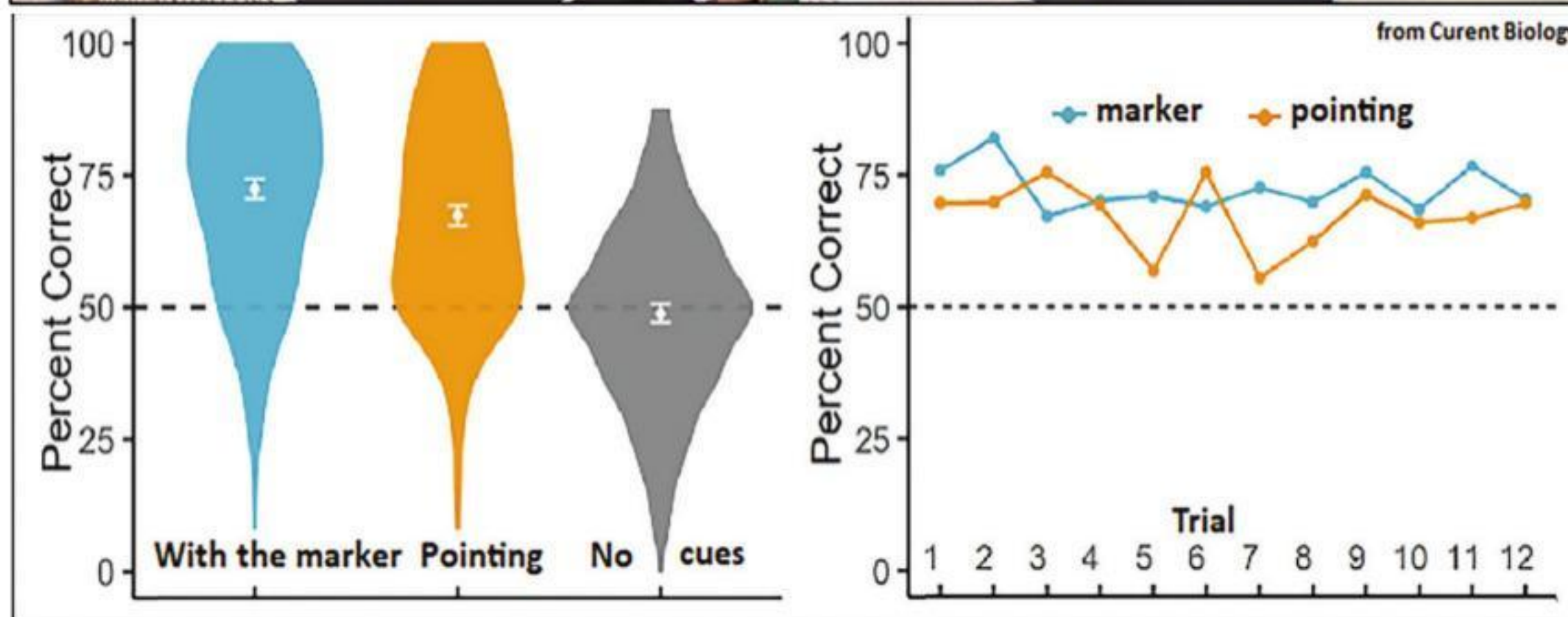
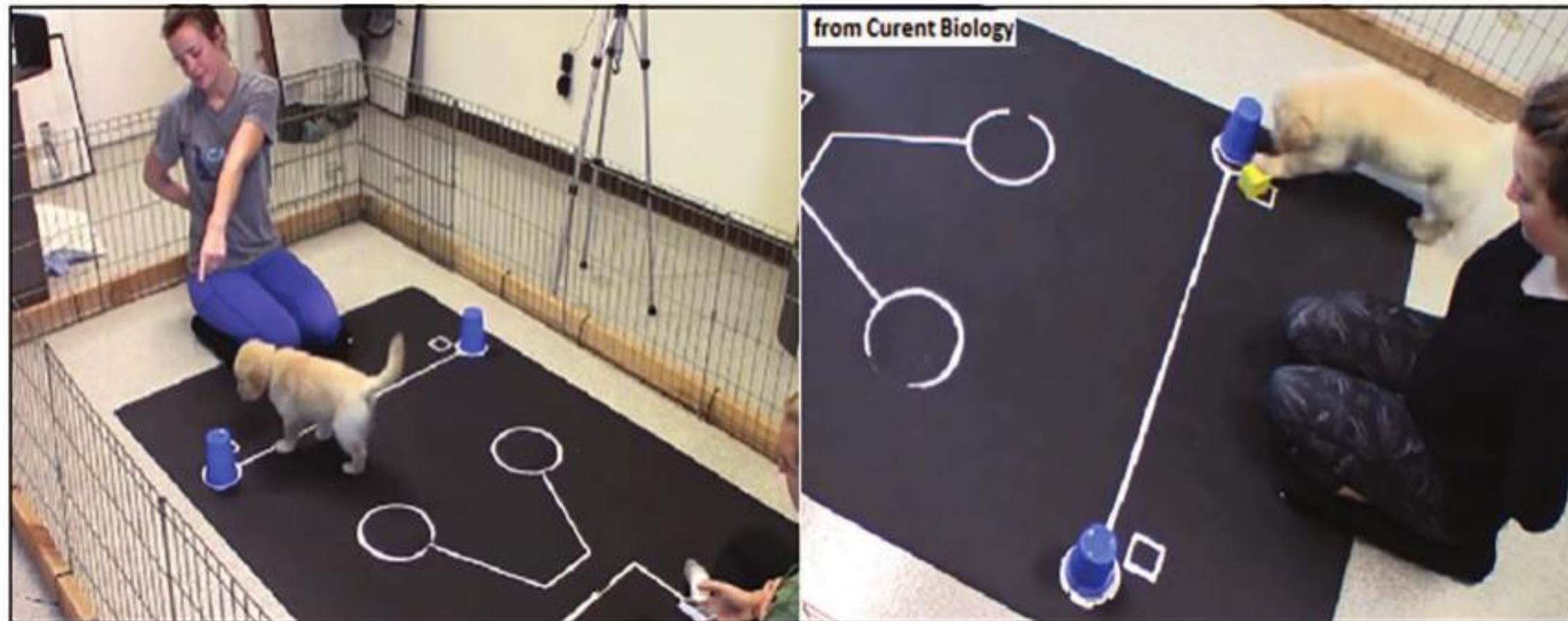
While this belief amuses friends and critics of dog lovers, Emily E Bray, Gitanjali E Gnanadesikan, Daniel J Horschler, Kerinne M Levy, Brenda S Kennedy, Thomas R Famula, and Evan L MacLean, from the University of Arizona at Tucson, University of California at Davis and "Canine Companions for Independence", a United States-based non-profit organisation that trains and provides assistance dogs, write in the journal, *Current Biology*, of their enquiry into whether the affinity of the dog to humans has a genetic basis.

That humans are so good at using their minds, the paper says, is in part because humans develop, very early, the ability to communicate and respond to each other. By the time a human child is two-and-a-half years old, the paper says, she is as good as the great ape in manipulating her physical surroundings. And as for reasoning and communication, she is miles ahead. The paper cites studies that show that even very young puppies, with negligible experience of human contact, can make sense of human gestures or other signs to locate hidden food -- a trait that does not exist in wolves raised by humans, one paper emphasises. And other studies that show that dogs can "follow the handler's gaze" in a way human babies do, once the intent has been indicated.

The origin of this capacity to read signals, whether it arose genetically, has not been adequately researched, the *Current Biology* paper says. The authors hence carried out trials with a substantial sample, 375 puppies, just over eight weeks old, on a battery of socio-cognitive experiments. The thinking, they say, was that if the skills of dogs in cooperating with humans are something they have because of biology, then, the traits should be clearly apparent even in very young dogs, and without calling for contact with humans or any training. And, there should be evidence of the ability being inherited.

The evolution of traits takes place due to selection. When some individuals in a group have a feature that confers a survival advantage, those individuals would thrive, doing better than the others, and if the trait were one that is inherited, their progeny would carry it on. Has social cognition in dogs arisen in this way? Well, it is true that some dogs are more socially adjusted with humans than others. Has this been a survival advantage? As dogs have been bred for ease of handling and being tamed, we could say the trait has been selected. And the third, whether the trait passes on to progeny -- this is the question that is to be examined.

The trials consisted of three stages. The first, the "warm-up", was for the subjects to get the



idea that there were treats to have in this exercise, hidden in goblets with lids. This done, a handler held the puppy a little away and equidistant from where two goblets were to be placed. The experimenter then concealed the treat in one goblet and placed the two goblets, some two metres apart, as shown in the picture. Now was the operative part. The puppy was released, and the experimenter drew the puppy's attention, made eye contact, and indicated the goblet that had the treat, by pointing, and by turning her gaze to the goblet. And the puppy was left to find the goblet and the treat.

The second version of this trial was the same as the first, except that this time, the experimenter indicated the goblet not by pointing or her gaze, but by placing a marker, a bright yellow cube, next to the goblet. In order to eliminate the possibility of the puppy finding the treat by scent, there was a control test of seeing how well the puppy did when it received no cues, of pointing, gaze or the marker.

The second trial was of the human interest, of finding what time a puppy spent looking into the experimenter's face, or staying within a short distance of her. For this, the experimenter stood outside the experiment area and recited a script to attract the puppy's attention. The time for which the puppy looked at her was recorded. She then stepped into the experi-

ment area and the time the puppy spent in proximity to her was recorded.

In the third trial, the puppy was set an "impossible" task -- the lid on the goblet was fixed, so that the puppy could not get to the treat. The idea was to see if and for how long the puppy gazed at the experimenter's face when this happened.

The results were that the puppies did benefit from the pointing, gaze and the marker -- they did positively better at finding the treat than when there were no cues. The picture displays the large areas that correspond to discovery of the treats when assisted by the cues, and the random distribution when there were no cues -- which shows that it was the cues that helped in the first two cases. The same result is displayed as a graph, showing better performance when assisted by the cues. As for the second trial, the puppies did gaze at the human when spoken to spend time with her. And with the "impossible" task, the social gaze was much shorter. Communicative behaviour is hence not there in early development.

Next, were the traits inheritable? This was looked at by drawing up a relatedness matrix of the 375 puppies, to work out what proportion of differences in traits could arise from heredity. In the case of human twins, the paper says, 47 per cent of the variance in cognitive ability

can be attributed to genetics. Among the puppies, 43 per cent of the variation in the pointing trial was found to arise from genetics. Attention to the experimenter's face was similarly heritable, but sensitivity to the marker cue was less so, and the ability to communicate, the "impossible" task, was the least.

The paper notes that the studies are valid, as puppies at eight weeks have spent time mainly with other puppies, with little possibility of learnt, human communication. As regards learning with practice, in the tasks, the paper notes that with 375 cases on hand, it was established that performance was the same from the very first trial and did not improve with experience. The mechanism by which the puppies get this sensitivity is not clear, but this much is -- that "dog social skills emerge robustly in early development and differences in these traits are strongly influenced by genetics."

The paper also notes that there are other species that show sensitivity in reading human gestures and communication. It would be instructive to see how far genetics contributes in these cases. The study could provide a model for biological bases of cooperative-communicative skills of humans too.

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PLUS POINTS

Mimics silk



A lab-created, plant-based material that mimics spider silk could replace single-use plastics in several consumer products, researchers say.

The material, which was developed in a University of Cambridge study, uses a new, energy-efficient approach to assemble plant proteins into materials that mimic silk on a molecular level. It is done by replicating the structures found in spider silk -- one of the strongest materials in nature -- using soy protein isolate, a protein with a completely different composition.

"Because all proteins are made of polypeptide chains, under the right conditions we can cause plant proteins to self-assemble just like spider silk," said professor Tuomas Knowles. He said that when spiders weave their webs, the silk proteins are dissolved in an aqueous solution, which assembles into a strong fibre through the spinning process requiring minimal energy.

Like the spider, researchers had to find a way to dissolve plant proteins so that they could be reassembled to mimic the properties of spider silk. Unfortunately, plant proteins are poorly soluble in water, but researchers developed an environmentally friendly and energy efficient method to dissolve the soy protein isolate in a mixture of water and acetic acid. Once the process is complete, and the solvent removed, the soy protein isolate is reassembled in the form of a water-insoluble, plastic-like film.

Avyaka Kamada, PhD candidate and first author on the paper said, "Very little is known about the self-assembly of proteins, and it's exciting to know that by filling this knowledge gap we can find alternatives to single-use plastics."

The study showed that the material had the strength equivalent to high performance engineering plastics, like low-density polyethylene. But unlike most plastic films, the new material can be composed at home, as no chemical modifications were made to its natural building blocks, and no toxic elements were added.

The new product will be marketed by Xampla, a University of Cambridge spin-out that focuses on developing replacements for single-use plastics and microplastics. Marc Rodriguez Garcia, postdoctoral researcher, study co-author and head of research and development at Xampla said, "Other researchers have been working directly with silk materials as a plastic replacement, but they're still an animal product. In a way we've come up with 'vegan spider silk' -- we've created the same material without the spider."

—The Independent

Beautiful science



When it comes to foraminifera -- forams, for short -- there is more than meets the eye.

These single-cell organisms form their shells using carbon and oxygen from their watery surroundings. In so doing, they also keep a record of the environmental conditions around them, such as water temperature and salinity. After they die, they sink into the seafloor and their shells are preserved in the sediment.

The shells in this image measure between 50 microns and 200 microns, about the width of one to two strands of human hair. The researcher who arranged them is Yan Yu Ting, a PhD candidate with the Coastal Lab at Nanyang Technological University's Earth Observatory of Singapore.

Yan said she arranged the forams in the shape of Singapore since they were found in a sediment core taken from the Kallang River basin in downtown Singapore. "These forams were deposited approximately 6,000 to 9,000 years ago," she said. Her image clinched the merit award at the 2020 Art Competition organised by NTU's College of Science.

—The Straits Times/Ann

THE DREADED FUNGUS

Mucormycosis is not contagious but can cause severe clinical symptoms

TAPAN KUMAR MAITRA

Mucor is a very common harmless fungus generally called "bread mould", while mycosis is a disease occurring due to the growth of a fungus.

Mucor grows on damp and favourable substratum, especially during rainy seasons, as a white cottony mould. As the fungus grows, the aerial hypha develops and its tip swells, looking like a pin. Then, it is called a "pin mould". In the early stages of growth, the plant body is white but with the development of sporangia, the colour of the mycelium changes to yellow, then yellowish brown and finally, black.

The tips of the aerial hyphae bear the sporangia, which become black when mature and then, the whole mycelium appears so. For that reason, the fungus, mucor, is called "black mould". It is then that the innocent and harmless mucor infects humans and leads to a fatal situation.

The fungus has become known by its new name, black fungus. Therefore, mucor is the black fungus and the fungal disease is called mucormycosis. Many of the human fungal infections are opportunistic or in other words, they occur in conditions with impaired host immune mechanisms. Such conditions include defective neutrophil function, administration of corticosteroids, immune-suppressive therapy, and immune-deficiency states (congenital and acquired). Common fungal infections are mycetoma, candidiasis and very rarely, mucormycosis.

Mucormycosis or black fungus disease

It usually affects people whose immune systems have been compromised. These clinical features are noticed during mucormycosis -- nasal blockage, bleeding and discharge from the nose are initial features. On endoscopic visualisation of the nasal cavity, unmistakable black "eschchar" (slough or dead tissue)-coated masses will be present, which gives away the diagnosis.

As the disease progresses, the palate is destroyed as a large, black necrotic mass may be seen on opening the mouth. When the orbit is involved, there will be proptosis (protrusion of eyeball), loss of movements of the eyeball with consequent double vision. Eye pain and redness with blindness can follow.

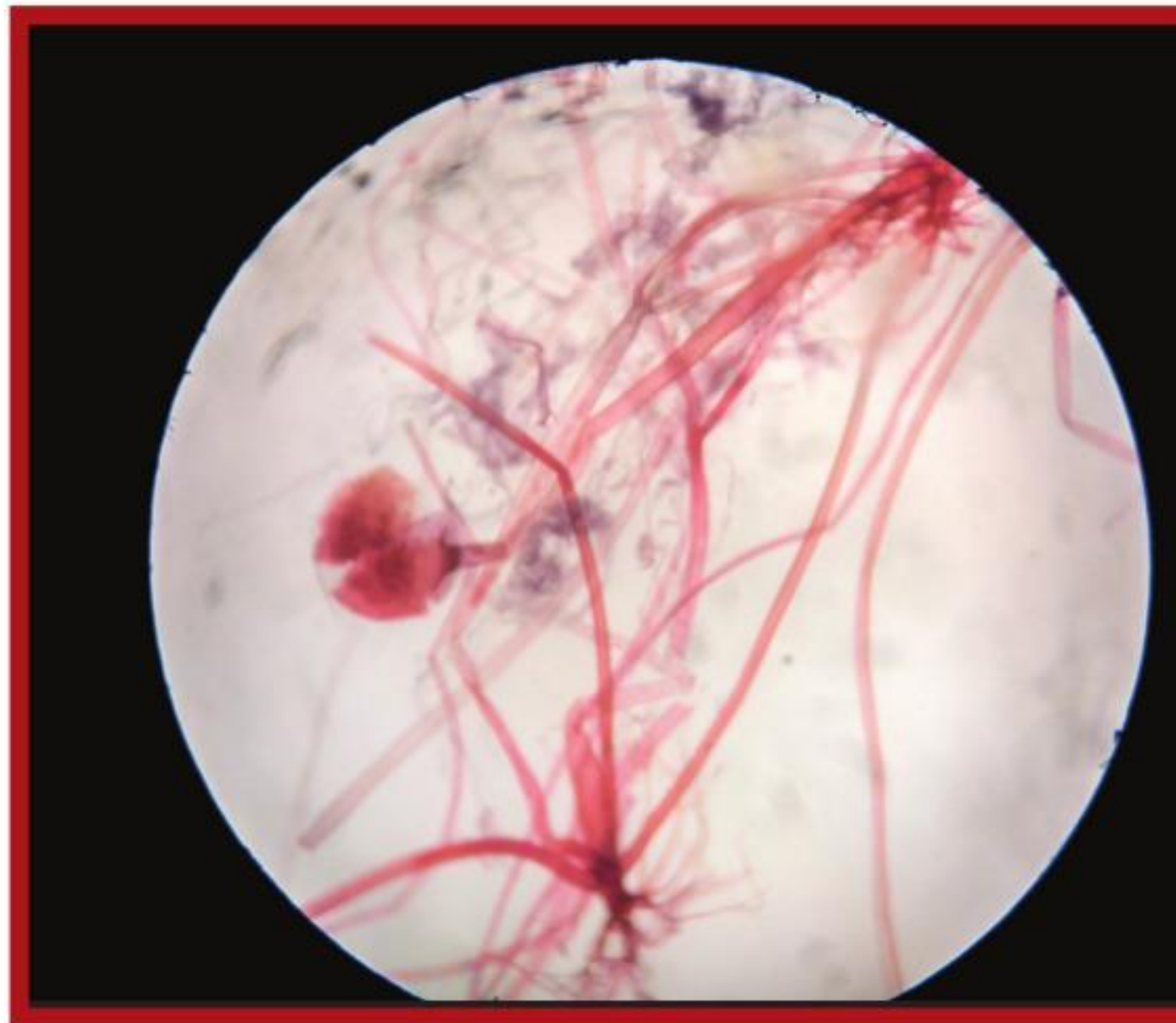
If the brain is invaded due to blood vessel blockage, there will be strokes, haemorrhages and even death. Patients can also have headache, drowsiness, limb weakness and seizures. If the fungus goes in through a cut or burn, it can cause local infections. But if it goes in through the sinus, it can affect the eyes and eventually the brain, leading to a fatal condition. This disease is not contagious -- it doesn't spread from one person to another.

Prevention and treatment

As black fungus infections are on the rise; the knowledge of prevention and treatment is very important. Wearing masks is compulsory as fungal spores found in air can easily enter the body through the nose. People who work at or visit construction sites should especially pay attention to this.

Once a clinical and radiological diagnosis is made, endoscopic evaluation of the nasal cavity can confirm a fungal lesion. Immediate surgical debulking is a must. The entire nasal cavity needs to be scoured and all fungal, necrotic tissue needs to be removed. If the orbit is involved, surgeries as drastic as exenteration of the eye socket contents may be required. If the infection has spread to the brain, surgical intervention should be undertaken a couple of hours after diagnosis.

In tandem, medical management with antifungal drugs, namely the injection liposomal amphotericin B, needs to be initiated. Older form amphotericin deoxycholate is significantly nephrotoxic. The liposomal cousin, however, is safe and effective. Posaconazole tablets/suspension and intravenous forms are available



and are used in lieu of amphotericin, if the latter is not tolerated by the patient.

Following several weeks of intravenous medication, depending on response, the patient is put on oral posaconazole sustained release tablets for several months. Isavuconazole is also an alternative drug that can be used. Drugs are stopped after clinical and radiological clearance of the disease. During treatment, judicious use of steroids (keeping blood sugar levels under control), antibiotics, and other antifungal drugs need to be continued.

Broad-spectrum antibiotics not only wipe out the potentially pathogenic bacteria but also the protective symbionts and commensals. Antifungals like voriconazole inhibit Aspergillus but mucor remains unscathed and thrives due to lack of competition.

Relationship between mucormycosis and Covid-19

Doctors believe mucormycosis, which has

an overall mortality rate of 50 per cent, may be being triggered by using steroids, a life-saving treatment for severe and critically ill Covid-19 patients. Steroids reduce inflammation in the lungs during Covid-19 and appear to help stop some of the damage that can happen when the body's immune system goes into overdrive to fight off the novel coronavirus. But they also reduce immunity and push up blood sugar levels in both diabetic and non-diabetic Covid-19 patients. It is thought that a drop in immunity could be triggering the cases of mucormycosis.

Mucormycosis can occur any time after Covid-19 infection, either during hospital stay, or several days to a couple of weeks after discharge. Covid-19 damages the airway mucosa and blood vessels. It also causes an increase in serum iron, which is extremely important for the fungus to grow.

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