

# Discovery of a primordial cancer in a primitive animal

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Tumour-bearing Hydra-Polyp (right) next to a healthy animal (left). Credit: Klimovich/ CAU

Every year around 450,000 people in Germany are diagnosed with cancer. Each one of them dreams of a victory in the battle against it. But

can cancer ever be completely defeated? Researchers at Kiel University (CAU) have now reached a sobering conclusion: "cancer is as old as multi-cellular life on earth and will probably never be completely eradicated", says Professor Thomas Bosch in his latest research results.

The study by an international team led by Bosch was published today (Monday, June 24) in the prestigious scientific journal *Nature Communications*.

The causes of tumours are the so-called cancer genes. As from when evolution started producing tumours is an issue that the scientists Tomislav Domazet-Lošo and Diethard Tautz from the Max Planck Institute for Evolutionary Biology in Plön have been investigating for several years, using bio-informational methods and databases that they have developed in-house. "During the search for the origin of the cancer gene, we unexpectedly made a discovery in the ancient group of animals", explains Domazet-Lošo. He is one of the authors of the present study and is currently working at the Ruder Bošković Institute and the Catholic University of Croatia in Zagreb. "Our data predicted that the first multi-cellular animals already had most of the genes which can cause cancer in humans." What was missing until now was, on the one hand, evidence that these animals can actually suffer from tumours and, on the other, the molecular understanding of the mechanisms of [tumour](#) formation in these simple animals.

## **Cause of tumours: error in the programming of cell death**

The research team led by the evolutionary biologist Professor Thomas Bosch from the Zoological Institute of Kiel University have now achieved an impressive understanding of the roots of cancer. Bosch has been investigating stem cells and the regulation of tissue growth in

*Hydra*, a phylogenetic old polyp, for many years. "Now we have discovered tumour-bearing polyps in two different species of *Hydra*, an organism very similar to corals", emphasises Bosch regarding the first result of the new study. This provides proof that tumours indeed exist in primitive and evolutionary old animals.



A stem cell marker gene is strongly expressed in tumour tissue. Credit: Klimovich/ CAU

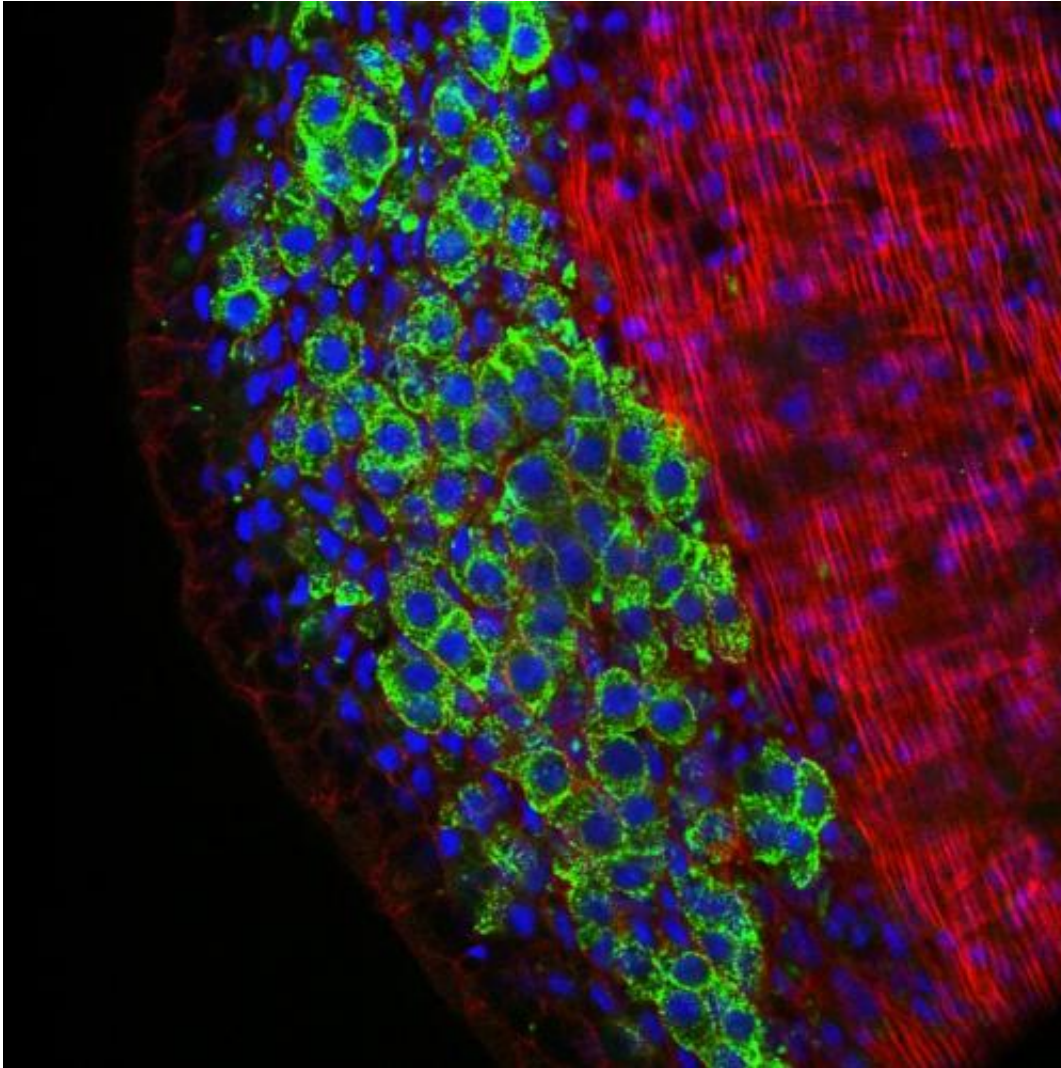
The team also tracked down the cellular cause of the tumours along the entire body axis. For the first time they were able to show that the stem cells, which are programmed for sex differentiation, accumulate in large quantities and are not removed naturally by programmed cell death.

Interestingly, these tumours affect only female *Hydra* polyps and resemble ovarian cancers in humans.

"When undertaking more detailed molecular analyses of the tumours we found a gene that becomes active dramatically in tumour tissue and that normally prevents the [programmed cell death](#)", explains Alexander Klimovich, a scholarship student at the Alexander-von-Humboldt Foundation at the Zoological Institute of Kiel University and co-lead author of the current study regarding the second finding of the study.

"As a non-functioning [cell death](#) mechanism is also made responsible for the growth and spread of tumours in many types of human cancer, striking similarities appear here to cancer in humans", continues Klimovich.

The third finding of the scientists was to show that [tumour cells](#) are invasive. This means that if tumour cells are introduced into a healthy organism, they can trigger tumour growth there. Therefore Bosch reaches the following conclusion from his research into *Hydra* species: "The invasive characteristic of cancer cells is also an evolutionary old feature."



A microscopic view into Hydra's tumour. Blue: nuclei of tumour stem cells. Green: marker for stem cells that are pre-programmed for gender differentiation. Red: cytoskeleton of the cells. Credit: Anton-Erxleben / CAU

## Tumours have deep roots in evolution

The funds that are being deployed throughout the world in the campaign against cancer are enormous. It was estimated that in the US alone, more than 500 billion dollars were invested in [cancer research](#) by 2012. The worldwide research has led to improved preventative, diagnostic and

treatment methods, which can definitely record successes. However it is precisely as far as some frequent tumours are concerned where only slow progress has been achieved. Every second person affected by cancer still succumbs to the disease today. In Germany alone every fourth person dies of cancer and this trend is rising. (World Cancer Report 2014) These figures were an incentive for the National Institute of Health in the US to launch a network of Physical Science-Oncology Centers, a new initiative that seeks to bridge intellectual barriers between diverse scientific disciplines. Paul Davies, a well-known theoretical physicist and popular science writer who now leads one such center in Phoenix, Arizona, recently concluded: "Clearly, we will fully understand cancer only in the context of biological history." (*The Guardian*, 2012)

According to the research team led by Bosch, the findings of primordial tumours in *Hydra* are a breakthrough step in that direction: "Our research reconfirms that primordial animals such as *Hydra* polyps provide an enormous amount of information to help us understand such complex problems as '[cancer](#)'. Our study also makes it unlikely that the 'War on Cancer' proclaimed in the 1970s can ever be won. However, knowing your enemy from its origins is the best way to fight it, and win many battles", says Bosch.

**More information:** Tomislav Domazet-Loso, Alexander Klimovich, Boris Anokhin, Friederike Anton-Erxleben, Mailin J. Hamm, Christina Lange & Thomas C.G. Bosch (2014) Naturally occurring tumours in the basal metazoan *Hydra*. *Nature Communications*.

Provided by Kiel University

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