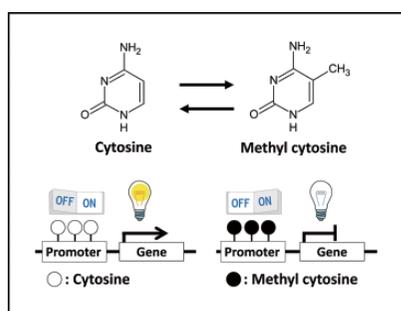


Early Detection of Cancer using Smartphones

Hippocrates was a doctor in ancient Greece, and he called the disease cancer karkinos. This Greek word also happens to be the origin of the name for the stellar constellation*1 known in English as Cancer. The word karkinos means “crab”, and Hippocrates gave the disease that name because breast tumors are hard like crab shells, and the blood vessels around the tumors look like crab legs. Humanity has suffered from malignant*2 tumors since ancient times, and the disease and the constellation have shared the same name for a long time, too. Over the years, people have suggested various phenomena as being causes of cancer. For example, cancer was an occupational disease for chimney sweeps – such as those seen in the film *Mary Poppins*. (The film was set in 1910) *3. In the 18th century, there were indications that cancer could be connected to the soot in the chimneys. In the modern day, we now know that various types of cancer are caused by mutations in genes and/or abnormalities in switch states – mechanisms that control gene function.

With the expansion of industrialization since the industrial revolution, chemical substances in the atmosphere and in our food have increased, and exposure to those substances can result in the onset of cancer. Chimney soot is one such substance. The human genome contains approximately 22,000 genes, and different parts of the body use different genes. For example, one type of tissue may use 8,000 genes, while the remaining 14,000 are inactive. Factors such as exposure to chemical substances and living an unhealthy lifestyle can switch off one or more genes that are normally active. This can cause cancer to develop.

Wataru Yoshida is a senior assistant professor at Tokyo University of Technology, and he studies gene switching. DNA contains adenine (A), thymine (T), guanine (G) and cytosine (C). When a methyl group (CH₃)



Cytosine methylation of the genetic switch mechanism

is added to cytosine (C), the mechanism is called DNA methylation and it functions as a switch. When DNA methylation occurs, the switch is turned off, but without DNA methylation, the switch remains on. Yoshida combined a human protein with a luminescent*4 firefly protein to develop an artificial protein, the emission peak of which is changed when bound to methylated DNA. He uses this artificial protein to study abnormalities in genetic switching.

In the future, Yoshida intends to use his research to produce a practical and simple test for cancer screening. One of his ideas involves mixing a small amount of blood with a reagent*5. A smartphone could then be used to capture an image showing any color change in the mixture, which would function as a way to screen for cancer. Many cancers are now curable if detected at an early stage.

However, people usually undergo cancer screening only once a year, and screening is not a guaranteed means of successfully detecting cancer. Sometimes, cancer is detected too late for treatment, but by turning Yoshida's idea into reality, cancer screening could be carried out more easily and more frequently, which would lead to earlier detection of cancer.

*1 Constellations are groups of stars that make a pattern in the sky.

*2 Malignant means “bad” or “dangerous”.

*3 This is a reference to the original 1964 film not the more recent *Mary Poppins Returns*.

*4 An object is luminescent when it shines with its own light.

*5 Reagents are substances or compounds added to a system to cause or test for a chemical reaction.



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専門は、DNAの配列変化によらない遺伝子発現を制御・伝達するシステムを研究するエピジェネティクス、及び核酸工学、遺伝子工学。開発したゲノムDNAメチル化レベル絶対定量法に関する論文は分析化学に関する学術雑誌「Analytical and Bioanalytical Chemistry」に掲載された。また、本学術雑誌のYoung Investigators in (Bio-)Analytical Chemistry特集において、分析化学分野で活躍する世界中の若手研究者の一人として紹介された。

吉田研究室のHPはこちら→

