The current state of drug development:
Delivering medicine where and when it is needed

Known all over Japan for its black cat logo, courier company Yamato Transport began life primarily as a trucking company delivering large quantities of goods. Yamato's core business now includes express home delivery, through which customers can send something as small as a single apple. Yamato managed to successfully enter the home delivery business once dominated by the Post Office due to the precision of the services it provides. Customers can specify what they want to send, to whom they want to send it, and when they want it to arrive. When Yamato entered this field, this couldn't be obtained through parcel post, and that allowed the company's courier services to grow immensely. A similar thing is happening in the pharmaceutical world today, with research being conducted into what is called "drug delivery," but this isn't the Toyama* business model of home medicine delivery. In this way, we are discussing how scientists are researching how to deliver medicine directly to organs and other specific parts of the body.

The things we eat are broken down in the stomach to make it easier for our bodies to absorb the nutrients within. Some of those nutrients are absorbed through the intestines, while the rest travel through the liver into the bloodstream where they are carried around the body to be absorbed. Medicines taken internally are also absorbed in the same way. Injections skip right past the stomach, intestines, and liver to travel directly into the bloodstream. In both cases, once medicine enters the bloodstream it is distributed throughout the body, and delivered even to areas it is not needed. When anticancer drugs are delivered to parts of the body where they aren't needed, they destroy cells found there. That is one of the side effects of anticancer drugs. By being able to deliver drugs to specific areas, we can avoid such side effects and increase the effectiveness of a medicine. Tablets can be coated, and by adjusting the time it takes for the coating to dissolve, we can ensure the medicine is delivered to the affected area. Adding multiple layers of coating can ensure even more finely-tuned delivery of a drug where and when it is needed. Nanotechnology can be used to place medicine in microcapsules to make drug delivery to an affected area even more precise. Biotechnology techniques and various other methods are also being considered.

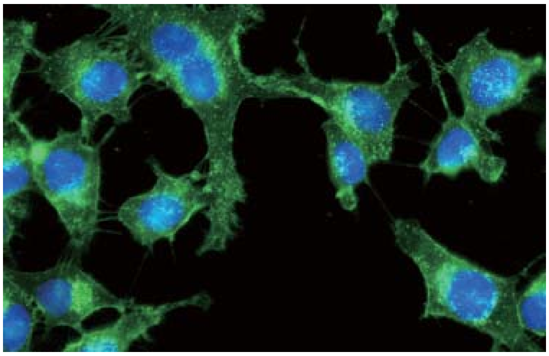
Image of medicine (green) reaching cancer cells (nuclei in blue)

Research into drug delivery systems (or DDS) aims to control the delivery of certain medicines to certain areas of the body at certain times. Engineering Professor Tsutomu Ishihara of Nihon University is researching two methods of DDS. The first is a capsule method, through which medicine is bound within nanoparticles for delivery to affected areas. If this method can be put into practical use, the burden on patients due to side effects could be greatly reduced. The other method Ishihara is researching involves the use of artificially-made nucleic acid molecules to control the genes at the source of a disease. This type of system could be useful in treating a wide range of intractable diseases.

In this way, drug delivery systems have become an absolutely essential part of modern pharmaceutical development. They require knowledge and techniques from not only the fields of medicine and pharmacology, but from engineering and manufacturing as well.

* Maeda Masatoshi was the second lord of Toyama Domain during the Edo period, and he created the *oki-gusuri* system in which medicines made in Toyama were sold around Japan. A collection of medicines would be handed over to a client, and a representative would visit the client regularly. Any medicines that had been used in the interim would be replenished, and the client would pay the resulting fee. It was a truly revolutionary system for the time. It eventually led to the creation of a nation-wide network selling Toyama medicines.

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東京工業大学大学院生命理工学研究科にて博士 (工学) の学位を取得。学術振興会特別研究員としてテキサス大学に留学した後、東京慈恵医科大学総合医科学研究センター講師、そして熊本大学薬学部特任准教授として勤務。2010 年より現職。工学部、医学部、薬学部に在籍して得た幅広い経験・知識を基に、民間製薬企業とも協業しながら「ものづくり」という工学的な見地から DDS 医薬品の研究開発に従事している。

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