Someday, a scientific dream will become reality

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Cars have wheels, but not legs, and airplanes have wings that do not flap. Biologically inspired systems mimicking natural materials or living matter have been attracting great attention for years. Unique surfaces mimicking antifouling shark skins or self-cleaning lotus leaves are famous and widely used, but must we mimic nature all the time?

Recent artificial mechanical hearts have successfully increased survival by longer than 5 years in many patients, and a new era of nonpulsatile ventricular assist devices, which are quite unnatural, has come. Small-sized implantable rotary blood pumps have popularized the clinical use of ventricular assist devices as destination therapy. Based on recent developments in regenerative medicine, bioartificial hearts have become among the most-sought methods for treating a large number of patients with heart disease. In 1992, a polymeric actuator was proposed as the artificial muscle. A hydrogel changed its shape in response to electric stimulation and demonstrated a worm-like motion.¹ Recently, skeletal muscles have been able to be supported by mechanical equipment, such as the Hybrid Assistive Limb, in response to living body signals.² Thus, scientists have attempted to use unnatural materials to substitute for or support organs and tissues.

Along with stem cell research developments, bioartificial organs have become attractive and appear realistic, but they must be compared with other strategies to determine their efficacy and reality. Lundberg and colleagues³ present in this issue of the *Journal* many possible elements for a bioartificial heart. They introduce the stingray's motion by using the phototactic guidance of muscle cells, which is a very attractive and interesting achievement. However, it remains far from the human heart in terms of movement and power. A 3-dimensional structure is very important, and decellularization accompanied by autocell or induced pluripotent stem cell seeding (ie, recellularization) appears quite reasonable. However, many trials selected a coronary artery route for removal and injection of cells, which may result in the different localization of different functional cells. Use of a 3-

Photograph, from left to right, of Tetsuji Yamaoka, Soichiro Kitamura, and Yusuke Kambe

Central Message

In the race to create new human heart alternatives, mechanical hearts are surely the front runner, followed by pig xenografts and bioartificial hearts. Mimicking nature is not important.

See Article page 748.

dimensional bioprinter to reconstruct a beating heart is at the very primitive stages. Moreover, the lifespan of transplanted cells is reported to be quite short when cells are injected into the tissue through blood flow. On the other hand, artificial mechanical hearts have actually prolonged patients' lives and will further progress rapidly. Xenoheart transplantation primarily from pig hearts is on its way to becoming a realistic choice for treatment of end-stage heart failure. Baboons with alpha galactosyl transferase knockout and human CD46 transgenic pig heart xenografts have survived longer than 1 year now.⁴

Certainly it is important for scientists to maintain the dream of creating bioartificial human hearts through regenerative procedures despite many presently existing obstacles. We hope that National Institutes of Health-funded studies will begin soon to promote the research to make dreams come true. We need many runners in the race to a destination of human heart alternatives.

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