Head Transplants

Equipping old minds with new bodies--whether you call it head transplantation or body transplantation--is not outside science's ken. How would it work?

By Robert J. White

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My colleagues and I have already taken the first steps toward human head

Livers, lungs, hearts, kidneys...and, most recently, hands. With such rapid advances in the field of human transplantation, researchers such as myself are now beginning to consider what some have previously deemed unthinkable: transplanting a human brain. I predict that what has always been the stuff of science fiction--the Frankenstein legend, in which an entire human being is constructed by sewing various body parts together--will become a clinical reality early in the 21st century. Our modern-day version of the tale will include the transplantation of the human brain with all its complexity preserved. But the brain can't function properly without the plumbing of the body and the wiring of the head. So brain transplantation, at least initially, will really be head transplantation--or body transplantation, depending on your perspective.

Are we ready for head transplantation? The technology to carry out the procedure in humans already exists.

The concept of head transplantation has always held a certain fascination for experimental surgeons. As early as 1908, American physiologist and pharmacologist Charles C. Guthrie grafted the head of a small mixed-breed dog onto the neck of a larger one whose own head remained intact. Similarly, in the 1950s Russian scientist Vladimir P. Demikhov transplanted the upper body of a mixed-breed puppy--including the forelimbs--to the neck of a much larger dog by connecting the pup to the other dog's neck blood vessels. At least one of Demikhov's famous "two-headed dogs" reportedly survived as long as 29 days after the surgery.

It was not until 1970, however, that a mammalian head was successfully transplanted onto a mammalian body that had already had its own head removed. This was first accomplished by my colleagues and me in a nonhuman primate--a rhesus monkey. When the monkey awakened from anesthesia, it regained full consciousness and complete cranial nerve function, as measured by its wakefulness, aggressiveness, and ability to eat and to follow people moving around the room with its eyes. Such monkeys lived for as long as eight days. With the significant improvements in surgical techniques and postoperative management since then, it is now possible to consider adapting the head-transplant technique to humans.

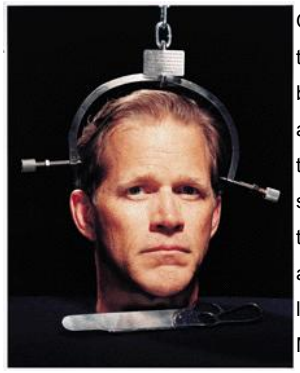
transplantation.

A surgical protocol for head transplantation in humans would require very little alteration from that used in monkeys, although it would need to be scaled up because of the difference in body size between the two species. In fact, the procedure would be easier to perform in humans than in monkeys, because the blood vessels and other tissues of a human are larger than those of a monkey, and surgeons have much more experience operating on the human anatomy.

Maintaining an adequate, uninterrupted flow of blood to the brain would be absolutely essential during all stages of a human head-transplant operation because the brain, unlike other solid organs, cannot survive being separated from its blood supply (at least at normal body temperature). Surgeons would monitor the brain's activity--an indirect way to assess blood flow--during the procedure using electroencephalograph electrodes placed on the scalp. Each patient's head would also be placed in a circular clamp to allow it to be stabilized and moved safely.

Heads Off To You

The procedure would be conducted in a specially designed operating suite that would be large enough to accommodate equipment for two operations conducted simultaneously by two separate surgical teams. Once the two patients were anesthetized, the two teams, working in concert, would make deep incisions around each patient's neck, carefully separating all the tissues and muscles to expose the carotid arteries, jugular veins and spine. The surgeons would then place catheters coated with heparin, a drug that prevents blood clotting, into each of the blood vessels to ensure that the brain received sufficient blood flow and, therefore, oxygen. After removing bone from the spine of each patient's neck, they would cut open the protective membranes surrounding the spinal cord, exposing it. Following separation of the spine and cord, the head of one patient would be removed and transferred to the tubes that would connect it to the circulation of the second patient's body, which would have had its own head removed.



It's not beyond science's reach to put someone's head on a new body. The surgical procedure could prolong the lives of people who have been paralyzed.

Once this critical maneuver was completed, the blood vessel tubes would be removed one by one, and the surgeons would sew the arteries and veins of the transplanted head together with those of the new body. The spinal columns would then be fastened together with metal plates, and the muscles and skin would be sewn together layer by layer.

My colleagues and I have already taken the first steps toward human head transplantation. We have developed pumps and devices to lower to 10 degrees Celsius (50 degrees Fahrenheit) the blood circulating to the head that is being prepared for transplantation. Such cooling slows the metabolism of the brain so that its blood supply can be cut off for up to an hour during surgery. The greatest hurdle remaining is how to prevent the body from rejecting the new head, and vice versa. It is unclear at this point whether the drugs now used to prevent rejection following transplantation of organs such as livers and kidneys will work for an entire

body.

Longer Life For The Paralyzed?

Who might benefit from a head transplant? The first candidates for the procedure will probably be people who have been paralyzed from the neck down because of an accident. For reasons that are still unclear, such individuals often die prematurely of multiple-organ failure. Although transferring a paralyzed person's head to another body would not--at least at this point in the development of the technology--allow them to move or walk again, it could prolong their life. And many hope that in the 21st century, physicians will find a way to heal severed spinal cords, so those who have their heads transplanted onto a new body might someday receive sensory information from and gain motor control over it.

Where will bodies for head transplantation come from? The recipient body would be someone who has been declared brain dead. Such individuals already serve as multiple-organ donors, so there should be no strikingly new bioethics considerations for head transplantation.

But how well will we as a society accept the concept that human brain transplantation involves transplanting the mind and spirit? Are we willing to acknowledge that the human brain is the physical repository of the soul, something this operation implies? These are the questions facing us as we go in reality where Mary Wollstonecraft Shelley went only in fiction.

Author

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Photographs: Justine Parsons