2002 Albert Lasker Award for Clinical Medical Research

The 2002 Albert Lasker Award for Clinical Medical Research is shared by Willem J. Kolff and Belding H. Scribner for the development of renal hemodialysis, which changed kidney failure from a fatal to a treatable disease, prolonging the useful lives of millions of patients.

Editor-in-Chief’s Comments

On September 27, the 2002 Albert Lasker Award for Clinical Medical Research was presented jointly to Drs. Willem Kolff of the University of Utah and Belding Scribner of the University of Washington for their respective contributions to the development of the machine and vascular access that made chronic hemodialysis possible. The Lasker Award, often referred to as the “American Nobel Prize,” has often preceded the awarding of a Nobel Prize and represents the single highest award ever given to a nephrologist. (Dr. Joseph Murray, a transplant surgeon, was jointly awarded the Nobel Prize a few years ago for his role in the development of kidney transplantation.)

The Lasker Award jury chose wisely in selecting Kolff and Scribner for the award. Rarely, if ever, have the scientific contributions of two individuals translated directly into the saving of literally millions of lives as chronic dialysis has. Moreover, both Kolff and Scribner went on to make many more significant contributions after the ones recognized by the Lasker Award. Kolff was instrumental in the development of several more machines that sustained life, including the pump oxygenator, the aortic balloon pump, and the artificial heart. Scribner not only developed and taught the technology of chronic dialysis to an eager but skeptical world, he also defined the major clinical problems that beset this newly created group of patients now saved from death, and he vigorously investigated them in ways that led to much of what is now standard clinical practice in the management of patients with end-stage renal disease.

Their work also led directly to the development of nephrology as a clinical subspecialty, the formation of the American Society of Nephrology (for which Belding Scribner served as President in 1978), and the birth of this journal. It would be seriously remiss for JASN to fail to provide special recognition of this award to two of the great pioneers in the renal world.

In considering how best to do this and who might contribute to it, I was struck by the accuracy, lucidity, and elegance with which the Lasker Foundation itself described the two awardees and their achievements. I would urge all of our readers to enjoy reading the description of the awardees and their work as published on the Lasker Foundation website (www.laskerfoundation.org) and reprinted below with permission from the Albert and Mary Lasker Foundation.
tion. More importantly, all of us — nephrologists, patients, and students alike — should take the time to appreciate and applaud the incredible creativity, tenacity, and desire to reduce human suffering that characterized both Kolff and Scribner. We owe them not only sincere congratulations for their remarkable achievements but also much gratitude for the standards they have set and for what they have taught us all. Never before has nephrology been so honored.

The Lasker Awards

For 56 years, the Albert Lasker Medical Research Awards have celebrated scientists, physicians, and public servants whose accomplishments have made major advances in the understanding, diagnosis, prevention, treatment, and even cure of many of the great crippling and fatal diseases of our century. The Lasker Awards have come to be known as “America’s Nobels” and are the most coveted awards in medical science.

The Lasker Awards were inaugurated in the years following World War II by philanthropists Albert and Mary Woodard Lasker and were named in his honor. After Albert Lasker’s death in 1953, Mrs. Lasker continued as the guiding force behind the Awards. She also was a dominant figure in the five-decade quest to secure public support for medical research funding in America. Mrs. Lasker died in 1994, leaving as her major legacy a lifetime of powerful influence on health and science in America, in large part through her remarkable efforts to expand support for the National Institutes of Health.

In creating the Lasker Awards for Basic and Clinical Medical Research and Public Service, the Laskers sought to raise public awareness of the enormous value of biomedical research to a healthy society. The Lasker Awards focus keen attention each year on an elite community of remarkable basic and clinical scientists whose work has been seminal to understanding disease and the human being’s capacity to overcome it. Year after year, recipients of the Lasker Awards also are honored with the Nobel Prize for Physiology, Medicine, or Chemistry. Since 1962, more than half of those honored with the Lasker Basic Medical Research Award went on to receive the Nobel Prize, most within two years of receiving the Lasker Award.

Introduction of the Clinical Medical Research Award

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In one of her short stories, the Danish writer Isak Dinesen poses a provocative question: “What is man, when you come to think upon him, but an ingenious machine for turning, with infinite artfulness, the red wine of Shiraz into urine?” Well, when you come to think upon it, this remarkable conversion is carried out by a real ingenious machine, the kidney — a truly remarkable organ. The kidney not only cleanses the blood of toxic products like the red wine of Shiraz, but it also regulates with extraordinary constancy the volume and composition of the body fluids that bathe all the tissues.

Claude Bernard, the great physiologist of the 19th century, pointed out that it is this constancy of the internal environment, orchestrated by the kidney, that allowed animals to achieve a free and independent life. Homer Smith, the great physiologist of the 20th century, had a more watered-down view of the kidney: “Bones can break, muscles can atrophy, glands can loaf, even the brain can go to sleep without immediate danger to survival. But should the kidneys fail — neither bone, muscle, gland, nor brain could carry on.” This is the ultimate kidney-centric view of the world.

When the kidneys fail, patients develop an intoxicating condition known as uremia, which produces nausea and vomiting, bleeding from the intestines, itching, convulsions, lethargy, and ultimately coma. Every year in the United States, tens of thousands of people suddenly develop acute failure of the kidney as a result of traumatic injuries from car accidents, severe burns, complicated pregnancies, and reactions to drugs. Every year, more than 90,000 people are also diagnosed with a chronic form of kidney failure caused by either long-standing hypertension or poorly controlled diabetes. This form of chronic kidney failure is called end-stage renal disease. Left untreated, both acute renal failure and end-stage renal disease produce uremia and death.

The development of an artificial kidney that could substitute for the body’s damaged kidneys constitutes one of the monumental life-saving advances in the history of modern medicine. Prosthetic devices for nonessential body parts, such as teeth, limbs, and even hair, have been available for centuries, but the artificial kidney is the only artificial device that can replace a vital organ on a permanent basis. The 2002 Lasker Award for Clinical Research celebrates the achievements of the two scientists who made all this possible: Willem Kolff and Belding Scribner.

Our story begins in 1938 at a small medical ward at the University of Groningen Hospital in the Netherlands. The physician in charge was Willem Kolff, who had just graduated from medical school. One of his first patients was a 22-year-old man in uremic coma. The young Dr. Kolff, then only 28 years old, watched helplessly for four days as the young man died in front of his eyes. He had no treatment to offer — if only he could find a way to remove the toxic metabolic wastes that accumulated in blood when the kidney failed. During the last day of the patient’s life, Kolff went to the University library and searched the literature for ways of purifying blood. To his delight and surprise, he found an article published 25 years earlier, in 1913, by a distinguished pharmacologist at Johns Hopkins University named John Abel, who described a procedure for dialyzing the blood of dogs and rabbits. The blood was taken from the animal, passed through a series of porous colloid tubes that were bathed in salt solution, and then put back into the animal. Clotting of the blood was prevented with an anticoagulant called hirudin that Abel extracted from thousands of leeches obtained from Parisian barbers. In 1924-28, the German scientist Georg Haas first attempted hemodialysis...
on several humans with acute renal failure, but the duration of the procedure (30 to 60 minutes) was too short for any significant therapeutic effect.

Stimulated by Abel’s concept of hemodialysis, Kolff was determined to develop an artificial kidney that would save the lives of uremic patients. He rapidly overcame two of the technical obstacles inherent in the Abel technique: heparin was substituted for the highly antigenic protein hirudin, and a thin cellophane membrane was used instead of a thick colloid tube. But then, Kolff faced an even more formidable obstacle: World War II had just broken out, and the Netherlands soon fell to Nazi Germany. Kolff was assigned to work in a 90-bed hospital in a small town called Kampen. Despite the difficult circumstances of Nazi-occupied Netherlands, Kolff miraculously cajoled an enamel manufacturing company to help him obtain scarce materials in order to construct the first artificial kidney. This machine, which came to be known as the “rotating-drum hemodialyzer,” consisted of 130 feet of cellophane tubing made from sausage casing, wrapped 30 times around a horizontal drum made out of aluminum strips. As the drum rotated through a bath of salt solution contained in an enamel tank, the patient’s blood was exposed to the dialysis bath, allowing rapid and efficient removal of the toxic wastes.

Between 1943 and 1944, Kolff treated 16 patients with acute kidney failure, but success was limited. The first unambiguous success came in 1945 with the 17th patient, a 67-year-old woman in uremic coma due to acute renal failure from Gram-negative sepsis. In one of the ironies of medical history, this patient was a Nazi sympathizer who had betrayed many of her Dutch countrymen to the Germans. After 11 hours of hemodialysis, the patient regained consciousness. According to Kolff, “I bent over and asked if she could hear me. She slowly opened her eyes and said, ‘I’m going to divorce my husband.’” Her kidneys began to produce urine, she recovered fully and, true to her word, she divorced her husband and lived seven more years before dying from another disease. Kolff had now achieved the first step in the conquest of kidney failure: the revolution of the drum had started a revolution that would ultimately improve the health of millions of people.

When World War II ended, Kolff donated all five of his artificial kidneys to hospitals in London, Poland, The Hague, Montreal, and Mt. Sinai Hospital here in New York City. This extraordinary act of generosity enabled physicians throughout the world to become familiar with the new technique of dialysis. He also provided blueprints of his “rotating-drum hemodialyzer” to George Thorn at the Peter Bent Brigham Hospital in Boston. This led to the manufacture of the Kolff-Brigham kidney, which was an improved stainless steel version of the original. The Kolff-Brigham kidney made it possible for John Merrill to establish the first major program for hemodialysis in the U.S. and paved the way for the first kidney transplantation by Joe Murray in 1954. Kolff-Brigham kidneys were also used during the Korean War to dialyze American soldiers who suffered massive wounds and posttraumatic renal failure.

After inventing the artificial kidney, Kolff went on to become the world’s premier biomedical engineer, inventing the pump oxygenator for open heart surgery in 1955, the aortic balloon pump for treatment of cardiogenic shock in 1961, and the artificial heart that prolonged the life of Barney Clark for 112 days in 1982. As he approaches his 92nd birthday, Kolff refuses to rest on his laurels; he is as passionate as ever in his inventive quest for new body parts, now pursuing the artificial eye and the artificial ear.

The Kolff kidney solved the problem of acute renal failure, but what about the hundreds of thousands of patients with chronic end-stage renal disease for whom prolongation of life requires repeated dialysis three times a week forever? In the late 1950s, the conventional wisdom among kidney experts was that chronic intermittent dialysis would never be possible because of two insurmountable problems, one technical and one psychological. The technical problem was one of circulatory access; every time a patient was hooked up to a dialysis machine veins and arteries were damaged, and after six or seven treatments, physicians would run out of places to connect the machine. The psychological problem stemmed from the widely held mystical belief that a cellophane dialyzer outside the body could never permanently replace the complex functions of a normal organ. After all, according to the experts, the kidney was a sacred organ. Above and beyond its excretory function, it produces three essential hormones: erythropoietin for forming red blood cells, renin for maintaining blood volume and blood pressure, and hydroxylated vitamin D for preventing breakdown of the bones.

In 1960, the impossible suddenly became possible. The psychological and technical barriers to chronic dialysis came crashing down through the research of Belding Scribner, a young professor of medicine at the University of Washington in Seattle. Like Kolff, Scribner was a dedicated physician whose imagination was triggered by a patient who was slowly dying of end-stage renal disease. After a sleepless night agonizing over the fate of his patient, Scribner got out of bed at 4:00 a.m., and in a sudden flash jotted down an idea about how to solve the problem of circulatory access. His idea was elegant in its simplicity: sew plastic tubes into an artery and a vein in the patient’s arm for connection to the artificial kidney. When the dialysis treatment was over, keep the access to the circulation open by hooking the two tubes together outside the patient’s body via a small U-shaped device, made of Teflon. This U-shaped Teflon device, which came to be known as the Scribner Shunt, served as a permanently installed extension of the patient’s own circulatory system, shunting the blood from the tube in the artery back to the tube in the vein. Whenever the patient needed to be dialyzed again, no new incisions in the blood vessels had to be made. The Shunt was simply disconnected from the tubes in the patient’s arm, and the patient was hooked up again to the machine.

One of the key factors contributing to success of the Scribner Shunt was the use of the then-new material Teflon, whose non-sticky properties prevented clotting of the blood. Although it has been replaced today by improved methods of circulatory access, the Scribner Shunt was the technical breakthrough that transformed the outlook of patients with end-stage renal disease from a sentence of death to a prolongation of life. The first patient to receive a Scribner Shunt was dialyzed repeatedly for 11 years, and...
In 1962, Scribner established the world’s first outpatient dialysis center, now known as the Northwest Kidney Center. Almost immediately, the demand to treat patients vastly exceeded the capacity of the original six dialysis machines. To make matters worse, in 1962 insurance companies and Medicare did not cover the costs of chronic dialysis, which was $10,000 per year in 1960 dollars. Dying patients were clamoring to be dialyzed. Who goes on the machine first? Scribner suddenly found himself in one heck of a pickle. His solution to the allocation problem was novel and clever. The decision to choose who should live or die would be made, not by Scribner himself, but by an anonymous committee of citizens, appointed by the local Seattle medical society, that included five lay community leaders from various walks of life and two physicians outside of the kidney field. The creation of this bioethics committee — the first of its kind — was highly controversial at the time, but in retrospect it changed the thinking about accessibility of health care in the United States.

In another innovation, Scribner ushered in the era of home dialysis by developing a miniature portable dialysis machine with fail-safe devices that could be run by family members. Today, 40 years later, nearly 300,000 patients in the United States and 1.5 million worldwide are undergoing chronic dialysis either at home or at dialysis centers. The technology of chronic dialysis has become so sophisticated that thousands of patients with end-stage renal disease take holiday cruises to exotic places anywhere in the world. Next week, for example, the MS Rotterdam leaves New York City for a two-week ‘Dialysis at Sea Cruise’ to Bermuda and Barcelona.

The contributions of Willem Kolff and Belding Scribner revolutionized the treatment of kidney disease, saving and prolonging the useful lives of millions of people. To paraphrase Isak Dinesen, ‘What is the artificial kidney, when you come to think upon it, but an ingenious machine of Kolffian cellophane and Scribnerian Teflon for turning, with infinite artfulness, death into life?’