Medical dilemmas: the old is new

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Reflecting on discovery, invention and politics after many years in medicine, I feel that my colleagues and I have been fortunate. We have been able to contribute to the revolution in technology and medicine that has enabled artificial organs to be devised and improved. We have also seen the ethical dilemmas that arise from our inventions, and notice the weaknesses of the current practices and see important areas that should be addressed. In this brief commentary, I will discuss the inventions that my colleagues and I made, the medical problems that motivated these discoveries and related ethical concerns.

My interest in hemodialysis began when I attended a talk in 1950 at the Mayo Clinic (where I was on the faculty as assistant to staff)[1]. The lecture was given by young nephrologist at the Brigham & Women's Hospital in Boston, John P. Merrill, who discussed the new dialysis technology available and the work he was doing using a variant of the Kolff rotating-drum artificial kidney. Despite my interest, it was not until 1953 that I was able to work on dialysis myself. As a new faculty member at the University of Washington, I obtained funding to get a Skeggs/Leonard[2] artificial kidney. I quickly appreciated that although acute hemodialysis was a wonderful technology, it did not enable treatment of the largest group of individuals with fatal kidney disease: those with end-stage renal disease. Continued improvements in artificial kidney design did not help. Chronic hemodialysis was not possible because there was no good method to permit repeated circulatory access to both arterial and venous blood. In the 1950s, circulatory access for acute hemodialysis damaged the arteries and veins so they could not be readily re-used. A practical solution, we thought, was the use of arterio–venous (AV) shunts that could be attached surgically and removed temporarily for each dialysis session. The idea of a removable AV shunt was good because with decreased resistance to flow through the shunt (compared with that of a capillary bed), there would be an increase of flow through the vessels that would enlarge the arteries and veins. The 'seasoned' vessels would then lead to better blood flow through the artificial kidney, and the physiological cost would be modest—some 'wasted' blood flow when the shunt was in place. If the shunt worked as envisioned, it would produce reusable access points to arterial blood, enable sufficient pressure and flow to perfuse the artificial kidney and provide venous attachment of the shunt to enable venous return. AV access would then no longer destroy the vessels. However, we had to invent two essential elements to make shunts practical. First, we developed a non-sticky 'U' tube to provide a slippery surface so that clots would not form on it between dialysis sessions. We used Dupont plastic Teflon, then recently invented, for this tube. We custom-formed and bent the shunt from Teflon tubing for each patient so that it would fit the patient's vascular anatomy[3]. This was removed at the time of dialysis, and the arterial and venous connection was attached to the artificial kidney. The second invention was a robust but flexible coupling so that the stiff Teflon shunt would not damage the arteries and veins during the patient's normal routine between dialysis treatments. A fast-attaching but small stainless steel Swagelok plumbing fitting was held positioned on a small stainless steel plate and was attached with a flexible silicon rubber coupling to the artery or vein. Both elements were essential to our early success[3–5]. Figure 1 shows one of the first of these connections fitted on the arm of our first chronic hemodialysis patient, Clyde Shields. This AV shunt made chronic hemodialysis possible in 1960. Figure 2 shows our first three patients after 10 years of chronic hemodialysis. Today, an AV fistula is used to provide an internal AV shunt[6]. Although the technical achievements that we initiated permitted people to live who otherwise would have died, issues raised by the early work remain. Three of these are discussed here: Who should be treated? When is science and technology self-serving? How much dialysis is enough?

When chronic hemodialysis first became available in 1960, the resources available for treatment were limited. To decide who should be treated, a two-committee process was established in Seattle[7,8]. The first committee was composed of physicians charged with determining who was suitable for the new treatment based on medical and psychiatric criteria. The second committee was composed of seven anonymous individuals, representing a cross-section of the community, who chose which patients among those deemed suitable by the first committee would be offered dialysis[9]. The second committee considered personal factors such as age, achievement, future potential and many intangible factors. Only a few individuals could be treated because of the limited resources available. Each decision to treat one individual rather than another offered the possibility of a longer life for the one chosen, and each decision not to treat an individual made an earlier death a near certainty for the one not treated. The decisions were made in a manner similar to those made by a triaging medical officers in war, except that the second committee based their decisions not on the need to return wounded soldiers to battle but on the social and community values that they shared. Those two committees were both criticized and praised. We have never had a national or international forum in which to discuss the issues of allocation of scarce medical resources. Given the economic, racial, political and religious ramifications of every decision, perhaps no moral high ground or final ethical resolution could be found. Our improved treatments do not address the question of who should be treated when the resources are inadequate or the question of when treatment should be stopped. Such moral and ethical issues must be decided primarily by society, and

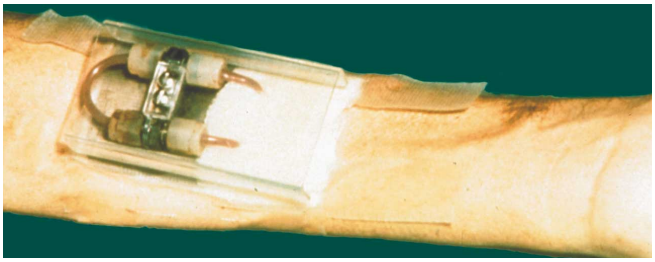

Fig. 1 Scribner Shunt. The invention that made chronic hemodialysis possible in the early days was the removable U-shaped Teflon shunt[3] (left) connecting an artery to a vein in the arm of a patient. Courtesy of University of Washington Archives.

Fig. 2 Celebration of the first three long-term patients on chronic hemodialysis on the tenth anniversary of chronic hemodialysis in Seattle, 1970. Left to right: Harvey Gentry (our second patient, age 32), Clyde Shields (age 49), me and Rolin Heming (our third patient). These and other patients benefited from our inventions and the work of many health care professionals, volunteers and family members who dedicated themselves to the patients. Courtesy of University of Washington Archives.

not by us alone, the medical caregivers. But the issues must be addressed squarely and openly.

The history of hemodialysis demonstrates another moral problem: the business model of health care. Early on, funding for this expensive care came from federal support for the treatment of end-stage renal disease, which unfortunately also provided a potential financial motive in the hemodialysis treatment choice[10–12]. Just as HMOs should not make money by not treating patients, physicians should not have their income linked to treatment choices. Although free enterprise does provide incentive for invention, it also allows opportunity for corruption. Political oversight of ethical issues has not served us well. Should physicians and scientists be considered impartial if they stand to profit financially from their work? Who should own our medical institutions? What should be the role of for-profit organizations in medicine?

As a nephrologist, I would like to know the extent to which the poor survival of hemodialysis patients in the United States results from the shortening of dialysis time[10]. The central issue is what the 'dose' of dialysis should be[11] and how this should be measured. Debate over these issues will continue[12–15]. Unfortunately, financial interests are commingled with research interests, making impartial assessment of the data difficult.

Thus, although we have accomplished much, we still have much to do to improve the lives and well being of our patients. We owe them more than large-scale, profit-oriented, expensive dialysis centers. We owe them dialysis that is health-oriented, cheaper and anti-hypertensive, and that provides the option of home- or center-based care to all patients. We owe them continued research into dialysis methods and improvements.

These questions and related issues cannot be answered easily, but all, including physicians, must address them. Difficult life-and-death decisions must continue to be made, but we must find a way to discuss them without subjugation to politics or religious beliefs. We must recuse ourselves from self-serving decisions when as scientists and physicians we are trusted to be impartial. Science and medicine improve life for many of us, but bring into renewed focus difficult issues for humanity. The unpatented discoveries for which Wilhelm Kolff and I are now honored have contributed to our technical achievements, but force us to revisit older questions: How can health care be provided ethically when resources are limited? How can life-saving care be compatible with a dignified death?

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