Early Dialysis in Britain: Leeds and Beyond

John H. Turney, MA, MD, FRCP, Christopher R. Blagg, MD, FRCP, and John V. Pickstone, MA, MSc, PhD

In parallel with the experience in most countries, early clinical experiments with dialysis in Britain did not lead to general adoption of the treatment. After a decade, dialysis for acute kidney failure was re-established at Leeds General Infirmary under the direction of Dr Frank Parsons, who had been inspired by Dr John Merrill in Boston. The intervening period was not characterized by indifference to kidney failure, but was devoted to defining acute kidney failure and successfully applying “conservative” measures, such as dietary regimens based on the scientific understanding and teaching of the time. The circumstances influencing the start of dialysis therapy at Leeds in 1956 and subsequent events up to the early 1960s are discussed in relation to the national medical scene. Am J Kidney Dis. 57(3):508-515. © 2011 by the National Kidney Foundation, Inc.

From the 1Centre for the History of Science Technology and Medicine, Manchester University, Manchester, UK; 2Northwest Kidney Centers; and 3University of Washington, Seattle, WA.

Address correspondence to John H. Turney, MA, MD, FRCP, 35 The Avenue, Leeds, LS8 1JG, UK. E-mail: john.turney35@googlemail.com © 2011 by the National Kidney Foundation, Inc.

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To judge that a thing has substance and solid worth is quite easy, to comprehend it is much harder, and to blend judgment and comprehension is the hardest thing of all.

Georg Wilhelm Friedrich Hegel (1770-1831)
lar necrosis, lower nephron nephrosis, etc). Symptoms and especially urine volume (which was not necessarily measured accurately in the community or the heat of battle) were the basis of clinical decision making, so that most of the recognized cases had severe kidney injury and did not survive. (Only later would potential reversibility become a cardinal feature of AKI, in contrast to chronic kidney failure.)

Treatment focused on decreased urine volume and acidity of the urine, leading to widespread use of large volumes of fluid and of bicarbonate despite demonstrations that alkalinization was not beneficial, even in pigment nephropathy. Doubtless some cases of oliguria caused by prerenal AKI or sulfonamide crystalluria were helped, but most patients so treated were rendered dangerously edematous. If such patients were ever presented for dialysis, the treatment was often a valedictory procedure.

Dialysis was tried first in Britain at the Hammersmith Hospital in London, then developing as a postgraduate training center. The initiator was Eric Bywaters (1910-2003), who had described crush syndrome. From 1947, he pursued a distinguished career in rheumatology; however, his replacement, the physician Graham MacGregor Bull (1918-1987), shared his interest in the kidney. The group used one of Kolff’s own machines and was the third in the world to perform clinical dialysis. However, results of the dozen or so treatments were disappointing: here, as elsewhere, many patients either were treated too late or had chronic irreversible kidney failure. No more successful was the pathologist Michael Darmady (1906-1989) in Portsmouth, who had built his own replica of the Kolff rotating drum. Dialysis in the United Kingdom soon was abandoned because it appeared to be time consuming, onerous, dangerous, and without obvious benefit for patient survival. It was far from clear that hemodialysis was superior to other techniques that individuals had tried and abandoned, including peritoneal or intestinal irrigation and exchange transfusion. The lack of enthusiasm for the procedure was the norm across Europe and the United States, and even where machines were acquired, there is little evidence of widespread or repeated use. Opinion formers were either unconvinced of its utility or contemptuous of the new procedure, which appeared to be the antithesis of contemporary medical practice, itself based on observation, prognosis, and regimen, as it had been for centuries.

The idea that a machine could replace the function of a failed organ seemed radical because there was no comparable development in other areas of medicine. Opinion formers among physicians saw better prospects in the development of clinical physiology, including new dietary management. In the United Kingdom, as elsewhere, there was no cadre of renal physicians; the few with an interest were primarily physician-physiologists, such as Robert Platt (1900-1978) and Douglas Black (1913-2002) in Manchester, for whom dialysis was unacceptable. (One sees here the seeds of the conceptual divide between clinical scientists and artisan “dialyzers” that persisted in many jurisdictions.) Although Bull abandoned dialysis, he remained interested in AKI and developed a high-calorie, electrolyte-controlled, low-volume diet. This treatment may have been conservative, but it was not a negative or defeatist approach; it was appropriate clinical application of scientific knowledge. Such dietary manipulation later became a central part of the complete management of acute uremia as advocated by Merrill and others. The “Bull regimen” achieved reasonable results in patients with milder uncomplicated AKI, such as otherwise healthy young women with pregnancy-related acute uremia.

Across the nations, a few physicians persisted with dialysis, notably John Merrill in Boston, whose efforts would be vindicated by the results obtained by Boston trainees in the Korean War. Not only did Merrill produce publications advocating the management of AKI, including dialysis, but also, and perhaps more significantly, he welcomed and trained a number of enthusiastic visitors from around the world.

Identifying the shared characteristics of the early dialysis enthusiasts and what differentiated them from the majority is problematic. A number in Britain and Europe were surgeons, entering a medical field with a
different background. Self-evidently they were intrigued by the mechanics of the treatment, focused on the practicalities of its application, and only subliminally accepted the preceding basic science. Surgeons were not only more likely to be faced with severe AKI, they also were the first to recognize the limitations of the “conservative” approach in such cases. They achieved mutual support and recognition within their own highly selected clique by both informal contact and the early establishment of registries and societies separate from the scientific mainstream.

Continued clinical enquiry also began to change the understanding of AKI, including reversibility, and a clear demonstration of the course of AKI established the essential role of dialysis in tiding over the oligoanuric patient during the period of decreased kidney function. The interdependence of AKI and dialysis provided a paradigm, repeated in other specialties (eg, assisted ventilation and temporary pacemakers), of a disease and its technology defining each other. Without dialysis, severe AKI almost inevitably would have been fatal; without the inherent reversibility of acute renal failure, there would have been no demonstrable benefit to justify persistence with the use of dialysis before the advent of the technology for the long-term maintenance of end-stage renal disease.

AKI was not only the corollary of medical risk taking, the trade-off from adventurous treatments in more vulnerable patients, it also was a consequence of incompletely successful treatment. Therefore, for example in Korea, the policy of rapid evacuation and surgery with aggressive fluid resuscitation halved the mortality of the severely wounded, but the survivors were at great risk of developing AKI, their metabolic state being exacerbated by the use of large quantities of stored blood. Whereas the Korean experience may have been the most dramatic example of changing practice justifying dialysis, similar changes were accumulating in civilian practice: antibiotics, fluid therapy, less “expectant” treatment, and earlier (eg, in postabortal sepsis) and more aggressive (eg, cardiovascular) surgery all ensured an increasing number of desperately ill survivors. In Britain, the formation of the National Health Service (NHS) in 1948 may have facilitated referral of patients, thus encouraging the formation of specialist centers in hospitals with established or growing reputations.

In Britain, as noted, renal medicine had attracted limited interest (of the 27 founding members of the Renal Association in 1950, only 3 were physicians). However, some urologic surgeons continued to show interest in the application of technology to uremia, perhaps building on the early experiments with clinical peritoneal dialysis by one of their colleagues, or perhaps because they were faced with renal problems more often than other specialists. A trainee surgeon from Leeds, Frank Maudsley Parsons (1918-1989), spent time with Merrill in Boston and returned enthused by the procedure. Charitable funds purchased a Kolff-Brigham rotating drum and, with the active support of the rest of the hospital, the first of many dialyses was performed at Leeds General Infirmary in September 1956.

It is not unreasonable to ask why dialysis in the United Kingdom should restart in Leeds, a northern industrial city. Leeds General Infirmary, founded in 1765, was a well-endowed voluntary hospital that, unlike many long-established institutions, was not only solvent but also wealthy when incorporated into the NHS in 1948. By 1939, the British hospital service had consisted of 2 elements: the long-established “voluntary” institutions, funded by charity and then additionally by workers’ insurance schemes, and the rate-funded hospitals that mostly had been workhouse infirmaries for paupers, but after 1929 had been developed as municipal services. Much of the voluntary sector was in financial trouble, in main because of the recession of the 1930s, the situation being partially relieved by government intervention through the wartime Emergency Medical Service, which improved the funding of the hospitals generally. Through the postwar period of austerity, much of the UK hospital service returned to financial crisis, from which it was rescued somewhat by the start of the NHS in 1948.
mainly because of workers’ payments; they were financially viable and in 1948 had considerable endowment funds. As one of the compromises facilitating establishment of the NHS, the teaching hospitals retained considerable independence: not subject to local or regional bureaucracy, but directly funded by and answerable to central government. They were each managed by a Board of Governors, little changed after nationalization, and composed of local worthies; the hospital administration was small and expected to support the extremely influential consultant medical staff, who now received a salary but continued to behave more as patrons than employees. Crucially for our story, the teaching hospitals were allowed to maintain their endowment funds, from which they could support their physicians’ research.

At Leeds, the distinguished urologic surgeon Leslie Pyrah (1899-1995) established a research unit on metabolism in surgery, jointly funded by the Medical Research Council (MRC) and the Board of the Leeds General Infirmary. His assistant, Frank Parsons, was paid to conduct metabolic research, but when the unit began to work on dialysis, there was tension with the MRC. When Parsons presented his dialysis proposals (knowing that the machine was already in transit across the Atlantic), Sir Harold Himsworth, Secretary to the MRC, is reputed to have replied: “Our advisors say there is no place for an artificial kidney in British medicine. Parsons, try it, but remember the country is against you” (Fig 1). The MRC would not have bought the Brigham-Kolff dialysis machine or supported beds, facilities, or medical and nursing staff, but the Board of Governors paid at least half of these costs from their local charitable funds and there also was support from other physicians, who gave up beds (particularly in the locally financed Metabolic Ward directed by Dr Brian McCracken of the Department of Medicine, who then managed dialysis patients; Figs 2-4). That the dialysis unit was established within a research unit provided essential technical support, particularly for biochemistry, and Leeds was fortunate to possess a prototype commercial flame photometer, an instrument that radically improved the speed and accuracy of electrolyte estimations.

Dialysis made an inauspicious start at Leeds: the first patient, moribund with AKI after multiple trauma, died during the procedure, probably from what would later be called dialysis disequilibrium syndrome. However, the dialysis team rapidly became adept, attracting large numbers of patients and achieving excellent outcomes. Following Merrill’s example, Parsons advocated a holistic approach to AKI, focusing on diet (using Bull’s regimen) and fluid balance, reserving dialysis for the most catabolic or biochemically deranged patients. From their analysis of clinical and biochemical parameters, informed by their unrivalled experience, the Leeds group proposed a management plan for AKI that became de facto universal practice until the advent

Figure 1. Koff-Brigham rotating drum dialysis machine at Leeds, 1956. (L to R): Sir Harold Himsworth, Secretary Medical Research Council; Dr Frank Parsons; and Sir Donald Kaberry, Chairman Board of Governors, Leeds General Infirmary. Reproduced from Cameron with permission of Oxford University Press.
of continuous renal replacement therapy a quarter of a century later. The greatest difficulty was vascular access; each dialysis required the insertion of rigid handmade canulae by cutdown, which eventually rendered the vessels unreusable. Practice was to dialyze to biochemical normality and then maintain the patient using conservative measures until the metabolic derangement necessitated repeated treatment or diuresis and recovery occurred. To improve efficiency, the Kolf-Brigham machine was modified further at Leeds to achieve a 3.5-m² surface area and increased blood flow. If patients with delayed renal recovery or end-stage renal failure reached a point when they could no longer be attached to the dialysis machine, treatment was withdrawn and terminal care was given. The wider adoption of percutaneous kidney biopsy (previously biopsy had been performed as an open surgical procedure, no problem for a urologic unit) allowed earlier confirmation of recoverable AKI and selection of patients for dialysis. Earlier and more frequent intervention, so-called prophylactic hemodialysis, although not differing in principle from the Leeds regimen, had to await more efficient technology and, crucially, improved vascular access. The relatively low intensity of dialysis and undernutrition meant that survivors had a prolonged convalescence, but more importantly, patients were vulnerable to potentially fatal complications, particularly hospital-acquired infection. The appearance in the early 1960s of the “first” epidemic of multiresistant Staphylococcus aureus nearly forced the closure of the Leeds unit, but by increasing the intensity of dialysis and enforcing aseptic practice, the frequency of infection was decreased by 40% and mortality by 60%, changes in practice that still resonate in the 21st century.

News of the success of the Leeds unit was disseminated rapidly, and its members became overwhelmed by the unexpected number of patients referred from far and wide. When dialysis recommenced at the Hammersmith in 1957 (again under urologists), Leeds served the northern half of the British Isles, the patients often being transferred by overnight train. Patients frequently were referred late in the course of their illness, necessitating emergency dialysis as soon as they arrived at the Leeds General Infirmary. Most referrals from outside Leeds and Yorkshire had pregnancy-related AKI. The disproportionately large number of pregnancy-related cases also was seen in the United States and France. Thus, in Boston, at least half the female patients
with AKI were in this category (a third of the total patients reported), and of these, half were related to abortion. Obstetric AKI is now a rarity in developed countries with legalized abortion, but clearly was a major concern in the 1950s and 1960s, reflecting not only relatively unsophisticated management of obstetric complications (toxemia, hemorrhage, fetal death, etc) and problems with mismatched blood transfusions, but also the relatively common illegal practice of abortion induced by chemical or surgical means.46,47 Outcomes in these otherwise fit young women were dramatic.48

Arguably, had the early dialysis units been presented with predominantly elderly patients, the complex medical and surgical problems, and the comorbid conditions now so familiar, outcomes would have been so much worse that dialysis would not have been acceptable. However, some young obstetric cases had irrecoverable bilateral cortical necrosis: in the late 1950s, the moral problems of discontinuing their dialysis therapy stimulated the Leeds group to attempt cadaveric kidney transplant.49

The move to adopt dialysis was endorsed by very positive public attitudes. By the late 1950s, the national economic position was improving and medical advances received wide acclaim. The Leeds group fostered a close relationship with the regional and national press, generating considerable public interest, evidenced by charitable donations. The British Broadcasting Corporation’s ground breaking series Your Life in Their Hands combined live and recorded material to showcase up-to-the-minute medical practice, thus establishing the future pattern of worldwide medical broadcasting. To the surprise of all (particularly the medical profession, whose reception initially was cool), the series was an immediate success, attracting up to a third of the adult population at a time when television ownership was far from universal. After a broadcast from the Leeds General Infirmary in April 1958 that featured a dialysis procedure and interviews with physicians and patients, provision of dialysis facilities became a hot topic.

Leeds and the Hammersmith were soon joined by the Royal Air Force, whose mobile dialysis unit provided a civilian and military service for many years. The national situation in 1958 was assessed by James S. Robinson and Hugh A.F. Dudley (before they became professors of medicine and surgery specializing in nephrology and transplantation, respectively); their report detailing the case for the establishment of dialysis at Edinburgh Royal Infirmary50 shows that Leeds was treating 3 times as many patients as the other 2 units, but even so, this averaged only 7 patients per
month, suggesting the rarity of AKI. However, the workload was considerable: a dialysis session took 8-14 hours, required 2 physicians and a nurse, and demanded constant monitoring, the machines having none of the safety devices that became necessary with the advent of mass dialysis.

Gradually, on an ad hoc local basis, dialysis was set up in a number of teaching hospitals throughout the United Kingdom, but these centers were subtly different from the earliest ones. They were staffed not by surgeons, but by physicians interested in the entire spectrum of kidney disorders and their treatments. None opted for the rotating drum dialyzer; they preferred the new Kolff-Travenol twin-coil machine, which was smaller, less expensive, and more efficient, with the first use of off-the-shelf disposables. For maintenance dialysis therapy, the Travenol twin-coils gave way to flat plate dialyzers, such as the Kiil, but remained the workhorses of AKI dialysis for years.

The dialysis centers appeared to be adequate for the demands of acute patients, but were ill prepared for the tsunami of chronic kidney disease that overwhelmed the British units after the demonstration in Seattle that end-stage renal disease could and should be treated using long-term dialysis. This sea change in renal medicine not only forced technologic development, it also required changes in the practice of dialysis: maintenance therapy brought new complications, and in the management of dialysis, physicians gave way to patients, technicians, and nurses.

These and other developments were the subject of a recent seminar in the series Wellcome Witnesses to Twentieth Century Medicine (transcript freely available at www.ucl.ac.uk/histmed/publications/wellcome_witnesses_c20th_med/vol_37). At this event, patients, caregivers, nurses, technicians, and physicians reminisced about the early days of dialysis in the United Kingdom, using their experiences to personalize a challenging, but exciting, period. Such records of participants deepen our understanding of the history and how our present was built.

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