The development of home dialysis in Australia

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Abstract

The history of the development of home dialysis provides a fascinating niche study in the history of nephrology. An understanding of the fundamental physiological and socio-economic background to it is essential if one wishes to acquire a balanced perception of the development of this form of treatment; and an understanding of the international background is necessary if one wishes to understand the history of its development in Australia

Key words:
Australia medical history, home dialysis, haemodialysis, peritoneal dialysis.

The physiologic and socio-economic background

Healthy people have continuously functioning kidneys. Continuous renal blood flow drives continuous glomerular filtration to produce continuous excretion of uraemic toxins. Continuous cellular activity creates continuous production of the several hormones that the kidneys secrete into the circulation to stimulate various crucial metabolic functions of the body. The very continuity that these processes provide leads to stability of function that is associated with health.

Treatment methods for patients suffering from renal failure must, if they are to produce outcomes that approximate health, approach as closely as possible to physiological continuity. Successful renal transplantation achieves this and so makes for one of the great advantages of that modality of treatment. The alternative modality – dialysis – faces a major challenge to provide continuity of function if it is to have any possibility of offering patients comparable outcomes to transplantation.

The two available forms of dialysis – haemodialysis and peritoneal dialysis – remain unequal in their ability to provide continuous treatment, although a trend has occurred over the years for them to approach progressively closer in their achievements. Both haemodialysis and peritoneal dialysis were initially intermittent procedures, producing staccato effects on the elimination of fluid and uraemic toxins. The earliest efforts at haemodialysis involved treatments of eight to ten hours duration performed once or twice weekly when serum levels of urea, creatinine, and electrolytes such as potassium rose to levels that immediately threatened life. The earliest efforts at peritoneal dialysis, reliant upon the use of peritoneal catheters that required replacement for each new cycle of treatments, occurred for 24 to 48 hours once each week or 10 days, again predicated upon the rise in levels of uraemic toxins to unacceptable heights.

Nephrologists unfortunately have allowed socio-economic considerations to drive their judgements regarding the optimal arrangement of dialysis treatment throughout the history of its development, in contrast to the attitudes that they have evinced regarding the development of renal transplantation. Whereas the costs and risks involved in transplantation have appeared as mere items that society and individual patients must inevitably shoulder in pursuit of medical progress, money and patient's personal preferences have long dominated thinking for dialysis. The production in the 1970s and 1980s by dialyser manufacturers of ever more efficient devices at relatively little increment in cost encouraged governments, hospital administrators and (in some overseas countries) avaricious clinicians to abbreviate haemodialysis treatments and limit their frequency. Pleading by patients, who so often begrudged every hour devoted to treatment that they regarded as inconvenient - but without which they would promptly die – provided comfortable justification. Typical haemodialysis schedules, having run for some six to eight hours twice weekly in about 1970, moved to five hours thrice weekly in many renal units by 1973, and then to four or three or even 2.5 hours thrice weekly by 1985. This made the treatments appear ever more attractive to administrators and patients, but progressively less continuous. Several years had to pass before declining survival and rehabilitation data demonstrated the fallacy involved and suggested that 'progress' was moving in the wrong direction.

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Peritoneal dialysis, however, was moving in the opposite direction to haemodialysis. Development of the permanently indwelling Tenckhoff catheter permitted easy access to the peritoneum and facilitated the introduction of continuous ambulatory peritoneal dialysis (CAPD). This technique provided a huge boost in popularity for peritoneal dialysis and immediately achieved the goal of continuous treatment. The persisting inability, on the other hand, of bio-technical engineers to develop any continuously functioning wearable haemodialysis device prevented that form of treatment from approaching peritoneal dialysis on that score. Clinicians who had insight into the physiology of uraemia worried, nevertheless, that if patients receiving haemodialysis were to achieve optimum results they needed to have more frequent and longer treatments. The result was that some of them - expanding upon observations made by a group of clinicians in Los Angeles who in 1967 had undertaken dialysis for five times each week started to move those of their patients who would agree to have six or even seven treatments per week for up to eight hours on each occasion (DePalma JR, Pecker EA, Maxwell MH 1969).

These issues of frequency of treatment inevitably influenced considerations about the venue in which treatment occurred. Patients who receive kidney transplants leave hospital as soon as they recover from the operation, then return daily for blood tests for several weeks, and progressively less frequently as weeks merge into months and into years. Patients who undertake CAPD or automated nightly peritoneal dialysis (APD) soon learn to perform the procedure on themselves in their own homes, attending for monitoring only once each two or three months unless some unexpected complication occurs.

Haemodialysis patients who dialyse in an institution, however, have to attend at least three times every week on a permanent basis. An obvious way to improve their well-being would be to train them to dialyse at home and, like the peritoneal dialysis and transplant patients, return only occasionally for monitoring.

Learning to cannulate veins and to operate a haemodialysis machine is rather more difficult for a layperson than is learning to perform peritoneal dialysis or to take anti-rejection medications for a transplant. The traditional consequence has therefore been that most patients who undertake haemodialysis never learn to perform it for themselves and so have to attend a hospital or satellite centre where nurses do it for them. The huge costs involved in providing buildings and staff in which to undertake such treatments, and the inconvenience to patients in travelling from their homes to receive them, has remained a major weakness of haemodialysis. Such considerations have, furthermore, run totally counter to the socio-economic imperatives that have traditionally driven dialysis. Many nephrologists concluded that the only way to resolve this tension was to decide that continuity of treatment, however desirable, was an unachievable goal. Their patients, though, paid a price: namely reduced rehabilitation and longevity, neither of which factors impacted forcibly upon either administrators or patients in the short term. A minority of clinicians and patients, however, adopted a radically different approach: to train the patients to run their machines for themselves in their own homes. There was nothing new in such an approach as some of the earliest maintenance haemodialysis patients had treated themselves in this way in the era before governments subsidised the costs of treatment (Baillod et al. 1965, Curtis et al. 1965, Merrill et al. 1964). It did, however, require dedicated nursing staff, functioning both as educators and as nurses, to train the patients. It also required sophisticated logistical systems to deliver consumable supplies to their homes, to service their machines, and to provide secure on-call back-up whenever necessary in order for them to remain confident that they were not in danger.

This, then, is the international physiologic and socio-economic background against which home dialysis developed.

The international practicalities

Willem Kolff performed the first successful haemodialyses on humans who were suffering from acute renal failure in the Netherlands in 1943, whilst physicians in several countries started undertaking peritoneal dialysis by the early 1960s (Kolff 1947, Drukker, 1986). Chronic renal failure, however, posed a particular difficulty for both forms of treatment because of inadequacy of vascular and peritoneal access devices. The invention in 1960 by Belding Scribner in Seattle of an external shunt opened the way to haemodialysis for this condition (Scribner et al. 1960), whereas reliable peritoneal access posed major problems until the early 1970s. The avalanche of patients suffering from chronic renal failure who presented for treatment as soon as this became feasible, balanced against the inadequacy of available facilities and financing, soon forced clinicians to seek innovative ways to address the issue. Groups in Seattle, Boston and London had realised as early as 1964 that one means of coping with the task was by training patients to perform the treatments for themselves in their own homes (Baillod et al. 1965, Curtis et al. 1965, Merrill et al. 1964). The Seattle group in particular promoted

this approach, whilst the British National Health Service also initially adopted it as a cost-effective form of treatment until the unrealistically high standards of accommodation that it decided were necessary made it reconsider.

The universal health insurance systems that existed in many Western European countries and in other countries such as Japan, Canada, Australia and New Zealand paid for treatments performed in hospitals when facilities were available, although patients in countries without established health insurance systems were less fortunate (and in many case still remain so). Certain wealthy countries that lacked universal health insurance systems, such as the United States, dealt with the situation by enacting special legislation to provide for necessary treatments at government expense. The sophistication and huge relative size of the American market for goods associated with dialysis then came to play an important role in the ways in which treatments were performed. This affected not only the United States but also every other country as the multi-national companies serving the field focussed upon American needs. The detail of the legislation passed there to provide for the needs of patients suffering from end-stage renal failure did little to encourage home treatment. Thus, although home dialysis initially burgeoned both in the United States and internationally, various vested interests soon started to militate against it. There were driven in part by physicians' personal economic interests, in part by the commercial interests of corporations that invested in satellite dialysis centres, in part by the traditional nursing ethos of providing empathetically for the every request by patients, in part by exaggerated fears of litigation if faults occurred, and in part by the innate fears of many patients of complex medical technology and procedures. They soon gained such momentum that a precipitate decline occurred in the numbers of patients treating themselves at home in most countries in which home programs had been established. Other countries, in which dialysis was only starting to become a possibility in the 1970s, failed to develop the expertise necessary to establish home programmes. This, then, was the international background against which home dialysis evolved in Australia.

The Australian background

John Dique, a pathologist who worked at the Royal Brisbane Hospital, was the first person to attempt to perform haemodialysis in Australia. He used a homemade kidney machine between 1954 and 1959 to treat a total of twenty patients who suffered from acute renal failure (Dique 1955, 1957, 1964). He had several outstanding successes. These, and the international experience, encouraged Keith Kirkland, a urologist at Sydney Hospital, to import a dialysis machine in 1957 with which to treat patients for acute renal failure (Kirkland 1957). He received requests, to which he acceded, to treat patients who were transferred from hospitals both in New South Wales and in other states, but immediately recognised the impracticality of this and argued for the provision of similar treatment in each state capital city. Facilities thereupon opened in Melbourne and Adelaide (Marshall 1961, Niall 1962, Whyte 1960). The arterio-venous shunt developed by Belding Scribner received immediate acceptance in Australia, with the result that several hospitals started accepting chronic patients. Surgeons in Adelaide, Melbourne and Sydney meanwhile were perfecting their skills at renal transplantation. They required patients who were in good physical condition and they recognised that the only way to achieve this in the face of severe uraemia was by dialysis, so maintenance dialysis came to be seen by many as a means of preserving chronic renal failure patients until they could receive transplants.

These developments led The National Heath and Medical Research Council to establish a committee in 1968 to advise on the whole situation regarding dialysis and transplantation throughout Australia. It reached the conclusion that transplantation should be the definitive form of treatment for chronic renal failure, whilst recurrent haemodialysis should in general be restricted to patients immediately awaiting transplantation. It accepted, however, that occasional patients who were unsuitable for transplantation deserved life-saving therapy and, in the interests of economy, proposed that they should have facilities made available to enable them to undertake home haemodialysis (National Health and Medical Research Council, 1968).

The report of this committee had a profound effect on treatment for renal disease in Australia. It cemented transplantation as the favoured modality of treatment for chronic renal failure, with great advantages for infrastructure development and research funding for transplant-related activities. It additionally created a local climate conducive to the development of home dialysis just at a time when support for that modality of treatment was waning in Europe and the United States. Attitudes in New Zealand closely mirrored those in Australia over this issue with the result that the Antipodean countries long remained the stoutest proponents worldwide of home dialysis treatment.

Establishing and maintaining home dialysis in Australia

Accepting the principal of home dialysis was one thing, but actually establishing it was an entirely different exercise. Australia, however, was extraordinarily fortunate over the identity of its first home patient. This was a Sydney man,

The development of home dialysis in Australia

Mr Peter Morris, who suffered from chronic renal failure that had worsened whilst he was visiting Seattle on a business trip. Members of Scribner's team there established him on dialysis, taught him how to dialyse himself, equipped him with a Drake-Willock machine, and then dispatched him back to Australia (George 2005). He initially went to Melbourne under the care of Dr John Dawborn, who had previously worked in Seattle. Dawborn soon arranged for him to return to Sydney to dialyse at home under the care of Dr John Stewart. Morris was a dynamic individual. He not only made a great success of his own treatment, but recognised that successful home dialysis needed a reliable back-up technical system and also needed appropriate funding. He arranged the first of these by establishing a branch of the Drake-Willock Company in Australia and ensuring that it ran efficiently. He arranged the second by persuading the Lions Clubs to raise money to purchase the machines and supplies that home dialysis patients required and which went unfunded from other sources.

The availability of these lines of logistic support was fundamental to success of the exercise. Hospitals in each of the Sates and in the Australian Capital Territory rapidly moved thereafter to provide training facilities: in Victoria at Royal Melbourne Hospital and the Austin Hospital (1967-68), in New South Wales by Sydney Hospital initially at 'Lulworth House' in the Eastern Suburbs (1968) and subsequently at 'Duntrim' also at Darling Point, in South Australia at the Queen Elizabeth Hospital (1969-70), in Tasmania at Royal Hobart Hospital (1971), in Western Australia at Royal Perth Hospital (1972), in the Australian Capital Territory at Royal Canberra Hospital (1972), and in Queensland at Princess Alexandra Hospital. Every one of these programmes was successful and in each case the success resulted from the development of a highly integrated level of cooperation between medical and nursing staff members. The doctors might have held responsibility for establishing the services, but the charge nurses and senior technical officers were the people who took actually taught the patients and created the supportive atmospheres that guaranteed success. The names of Ms Sue Evans who worked with Dawborn in Melbourne, Sister Thelma Neilsford-Jones who assisted Stewart in Sydney, and Sister Angela Howie who worked with James Lawrence in Adelaide loomed large in the early years of Australian home dialysis. The doctors principally responsible in other cities were Trefor Morgan and James Petrie in Brisbane, John Freeman in Hobart, Barry Saker in Perth, and Brian Hurley in Canberra. Several other hospitals in the major cities of the country later entered the group that offered home dialysis training.

All units initially used Drake-Willock single-pass machines for home treatments despite several having used Baxter recirculating machines previously for their in-patient treatments. Other companies - including Gambro, Cobe, Althin, Braun, REDY, and Fresenius - entered the market at a later stage. Some of the earliest patients initially used Kiil flat-plate dialysers, but hollow-fibre dialysers introduced by the Cordis-Dow Company in 1972 soon superseded these, with many other hollow-fibre manufacturers later entering the competition for sales. The Lions Clubs continued assisting with funding until 1972 when this became an issue in a Federal election, after which governments (initially the Federal government directly, but later State and Territory governments) assumed responsibility.

Establishment of the Australian and New Zealand Dialysis and Transplant (ANZDATA) Registry enabled interested people to observe development of home dialysis and to contrast it with development of other forms of treatment (ANZDATA 2008). The total number of home haemodialysis patients in 1971 was 39. This increased successively to 466, 568, 615 and 942 respectively in 1977, 1987, 1997, and 2007. This persistent growth may appear impressive, but seems less so when compared with the huge increase in the total dialysis population. Home haemodialysis in fact accounted for 17% of patients in 1971, rising to 52% in 1977, then falling in successive decades to 23%, 12% and 9.8% by 2007. The introduction of CAPD in the late 1970s was the initial reason for this loss of popularity for home haemodialysis, but should not be deplored since it had a strongly positive element as a result of providing continuous treatment for patients in a domiciliary setting.
The progressive development of satellite (limited care) institutional haemodialysis units throughout the country starting from the early 1980s, however, had a contrary effect. No patients were receiving that form of treatment in 1977, but the figures rose in successive decades to 16%, 28% and 45%. The figures for treatment in major hospital centres fell from 83% in 1971 to 48% in 1977 and then to 30%, 29% and 24% in successive decades.

The final tally of all this treatment was that 31% of Australian maintenance dialysis patients received home treatment in 2007, approximately twice as many by peritoneal dialysis as by haemodialysis. These gross figures, however, hid major disparities that existed between the various States and Territories in their use of various forms of treatment. The uptake of peritoneal dialysis at home in 2007 ranged from 8% of chronic dialysis patients in the Northern Territory to 27% in Tasmania, and of haemodialysis from 1% in South Australia to 15% in New South Wales. The total numbers of patients on dialysis treatment at home ranged from 12% in the Northern

Territory to 41% in New South Wales. One can speculate on the reasons for these significant differences, but it seems likely that a combination of local socio-economic factors, local physician preferences and local availability of training facilities may have played important roles. Despite all of this, the uptake of home dialysis treatments was markedly higher in Australia in 2007 than it was in most other countries.

Recent developments

The situation with home dialysis is, however, not stable. Some recent developments have occurred, the influence of which is yet to be reflected in published statistics. A worldwide movement is overtaking dialysis, with many clinicians and several of the manufacturing companies becoming deeply interested in the area. This results from a realisation that time on treatment and frequency of treatments are likely to play far more important roles than are further improvements in the efficiency of dialysers, and that the high cardiovascular mortality rate of dialysis patients demands active rectification. Such considerations have led international leaders in the field to promote arrangements that provide patients with much more dialysis than previously occurred. They are influencing nephrologists and thereby patient preferences. Alternate daily haemodialysis, rather than thrice weekly dialysis, has become much more popular with patients who dialyse during waking hours, and indeed a tendency has developed for many patients to move to four or five dialyses per week during waking hours, sometimes for as long even as six hour treatments. Automated overnight peritoneal dialysis has been available and widely used since about 1990. Occasional patients were also trained in the 1960s and early 1970s to perform haemodialysis at home overnight whilst asleep. Safety arrangements for this have improved and the approach has recently regained support following publicity about substantial and successful trials of it conducted in Canada. Several renal units in Australia, pioneered in particular by the Geelong Unit under the supervision of John Agar, have recently trained patients for this treatment and have achieved notable success with it (Agar 2005). The long hours and frequency of such treatments make home the ideal place to undertake them, although systems have also been developed locally to provide them in centres.

Conclusions

Australian renal services have for long tended to favour home dialysis treatment to a greater extent than have many overseas services. Socio-economic factors have often influenced them in this whilst also playing a role in creating disparities between the various States and Territories in the uptake of this modality of treatment. An important attraction of home treatment has been the prospect that it in general permits longer and more frequent haemodialysis treatments than does institutional treatment, whilst the conduct of maintenance peritoneal dialysis in other than a home setting is inevitably unattractive. The development of increasing numbers of satellite dialysis centres throughout the country has tended to militate against an even greater uptake of home treatment with, as an undesired consequence, the likelihood that shorter and more discontinuous treatments may well militate against the rehabilitation and longevity of patients treated in them. The recent development of long slow nocturnal haemodialysis offers exciting prospects for future development of improved dialysis treatment schedules that most patients are likely to prefer to perform at home.

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