Review Article

History of home haemodialysis in Australia

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SUMMARY: Australia has had an active and slowly expanding home haemodialysis programme; however, this has failed to expand as rapidly as some other methods of treatment of end-stage kidney disease. The technique in Australia has always been a derivative from overseas experience, rather than innovative. It received some minor initial support from the report issued in 1968 by an ad-hoc Committee of the National Health and Medical Research Council on Rationalization of Facilities for Organ Transplantation and Renal Dialysis, but was ultimately disadvantaged because the report promoted transplantation over dialysis to an extent that proved markedly disproportionate to the number of patients who, in succeeding decades, would need maintenance dialysis treatment rather than transplantation. Nevertheless, each state in Australia established home haemodialysis facilities, but major interstate variations occurred in the uptake of the modality. The subsequent development of continuous ambulatory peritoneal dialysis and limited care dialysis centres appeared to have an important negative impact on home haemodialysis, although the recent introduction of daily dialysis is likely to have a positive influence in the future.

KEY WORDS: Australian medical history, dialysis, home haemodialysis.

INTRODUCTION

Regular haemodialysis for patients in their own homes is a well-established method of treatment for people who suffer from end-stage kidney disease. Many Australian renal failure patients have received their treatments in this way, to the extent that at one time a majority of chronic dialysis patients in Australia were haemodialysing at home. Support for this, in contrast to alternative approaches, has perhaps weakened in recent years, despite an increasing number of patients actually undertaking home haemodialysis and despite the advent of daily treatment methods that make the home venue virtually obligatory. The latter development provides particularly exciting prospects for the future and is likely to create an entirely new era for home dialysis. The coming revolution in this approach makes the present a pertinent time to review the history of home-based treatment in Australia. The present review will therefore examine the local experience with home haemodialysis, placing it in an international perspective and examining its relationship to other forms of treatment used for end-stage kidney disease.

INTERNATIONAL BACKGROUND

The earliest clinical application of dialysis was for the treatment of patients who suffered from acute renal failure. Kolff started treating patients in the Netherlands in 1943, initially unsuccessfully, although he had, by 1945, proven the value of the technique. Clinicians in several other countries also experimented with haemodialysis and peritoneal dialysis between 1946 and 1949. In 1960, Ruben and Doolan first used peritoneal dialysis to treat chronic kidney disease, while Scribner and his colleagues in Seattle developed a method of vascular access that made maintenance haemodialysis possible. Surgeons performed the first successful living donor kidney transplant operation in Boston in 1954 and followed this up with a successful cadaveric donor operation in 1962.

The idea of home haemodialysis allegedly originated in Japan in 1961 with Nosé and took off in 1964 when groups in Seattle, Boston and London virtually simultaneously started to apply it. Most haemodialysis was then done two or three times per week, but DePalma in Los Angeles increased the number of treat-
ments to five short runs per week in 1967 to introduce the idea of ‘daily’ haemodialysis for chronic kidney disease.\textsuperscript{13}

\section*{AUSTRALIAN BACKGROUND}

Australians showed a keen interest in dialysis from the time of its earliest clinical application, but – perhaps in keeping with the caution that has typified much of Australian clinical medicine – tended not to attempt it until others had shown its potential advantages. Thus, \textit{The Medical Journal of Australia}\textsuperscript{14} reviewed in detail Kolff’s book entitled \textit{New Ways of Treating Uraemia} when it was published in 1947, followed by further commentaries on the subject between 1951 and 1956.\textsuperscript{15–18}

John Dique, a pathologist at the Brisbane General Hospital, was the first person to dialyse a patient in Australia when he successfully treated a young woman suffering from post partum acute renal failure on an artificial kidney machine that he and his hospital’s electrical engineers had themselves constructed.\textsuperscript{19} He followed this up with treatments on a total of 20 patients who suffered from acute kidney failure between 1954 and 1959.\textsuperscript{20,21} Kirkland, a Sydney urologist, obtained an Alwall kidney machine for Sydney Hospital in 1957 and argued that each large city in Australia should have a renal unit with dialysis available.\textsuperscript{22} Whyte and Edwards, in the Kanematsu Institute at Sydney Hospital, then started a vigorous programme of research into the application of dialysis for acute renal failure.\textsuperscript{23–25} Facilities opened shortly after in Melbourne (Marshall\textsuperscript{26} and Niall\textsuperscript{27}), Adelaide\textsuperscript{28} and in 1962 at Prince Henry Hospital in Sydney.\textsuperscript{29} Peritoneal dialysis was also introduced in 1962 in Melbourne,\textsuperscript{30} Hobart\textsuperscript{31} and Sydney.\textsuperscript{32}

The problems associated with rejection initially made the prospect of renal transplantation as a definitive treatment for patients with chronic kidney disease appear dim to some Australian surgeons, in contrast to the position of maintenance haemodialysis. By 1964, the latter appeared to be the more realistic form of treatment.\textsuperscript{33} However, Knight\textsuperscript{34} and Lawrence and Marshall and Ewing\textsuperscript{35} were more optimistic about transplantation. Earlier transplants in 1956 and 1963 at the Royal Melbourne Hospital had been unsuccessful, and the first successful Australian transplant was performed in Adelaide in 1965.\textsuperscript{36} The Royal Melbourne group also started to achieve satisfactory outcomes in operations performed after April 1965.\textsuperscript{37} Their success stimulated the editor of \textit{The Medical Journal of Australia} to call, in 1966, for the National Health and Medical Research Council (NHMRC) to make an appraisal of developments for the treatment of irreversible renal failure to guide the Australian medical community in its approach to this problem.\textsuperscript{38} Prince Henry Hospital in Sydney, and shortly afterwards Sydney Hospital in conjunction with Royal Prince Alfred Hospital, also started transplant pro-

\section*{HOME DIALYSIS INTRODUCED TO AUSTRALIA}

The first Australian patient to start on home haemodialysis was a 39-year-old Sydney man, Peter Morris, who had become uraemic while travelling in the United States. He received haemodialysis treatment briefly at the University of Washington Hospital in Seattle before being transferred to the Royal Melbourne Hospital in November 1967, where he was taught to dialyse himself for 10 h overnight, three times each week. He returned to Sydney, resumed full-time work in January 1968 and subsequently established a company in Australia to import and service Drake–Willock dialysis equipment.\textsuperscript{39}

\section*{NHMRC REPORT ON DIALYSIS AND TRANSPLANTATION}

The suggestion that the NHMRC provide guidance about the treatment of renal failure in Australia led it to establish, in May 1968, an ad hoc Committee on Rationa
lization of Facilities for Organ Transplantation and Renal Dialysis. The report of the Committee, issued in October of that year, profoundly influenced the development of those facilities in the country over the next several decades.\textsuperscript{40}

The Committee had 12 members: five of them medical administrators; three surgeons whose subsequent careers showed their interest was primarily in transplantation; three physicians, some of whom were, on balance, probably more interested in transplantation than in dialysis; and one microbiologist. The over-riding focus of their report was on organ transplantation, with dialysis as a secondary (albeit necessary) modality of treatment. The report dealt in detail with organ donors, tissue typing, recipient selection for transplantation, training of transplant immunologists, transplantation ethics, legal aspects of transplantation, transplantation research and transplantation of organs other than the kidney.

It stated, in dealing with dialysis, that ‘Most cases of acute renal failure can be treated adequately by peritoneal dialysis’; that ‘Recurrent haemodialysis alone is an adequate but expensive form of treatment for end-stage renal failure’; that ‘In general, recurrent haemodialysis should be restricted to patients awaiting transplantation’; and that recurrent dialysis ‘should be restricted to centres where it can be carried out effectively – Organ Transplantation and Renal Units’. It did, however, recognize that ‘A small number of patients unsuitable for transplantation require recurrent haemodialysis as a definitive form of treatment’ and it suggested that home dialysis
could have advantages for such patients on the grounds of cost effectiveness and flexibility of scheduling. It made no mention of peritoneal dialysis as a modality for treatment of chronic renal disease and no proposals for research into dialysis.

The report recommended restricting the availability of facilities for the treatment of end-stage kidney disease throughout Australia to one, or at most two, Organ Transplantation and Renal Units in each state, with each such unit having a capacity to support a total of 25 dialysis patients. Its rationale for this was a prediction that 30 new patients per million of population would need treatment annually. It therefore assumed that a total of about 360 patients would need treatment throughout Australia at any one time for end-stage kidney disease, and it predicted that some 300 of these would receive transplants within 3 months of starting dialysis. It recommended the establishment of a national register of dialysis and transplant patients.

There can be little doubt that the conclusions of this report, promulgated with the imprimatur of the nation’s peak medical advisory body, were to have a profound and sustained influence on the provision of facilities for the treatment of chronic kidney disease in Australia; the focus was to be on transplantation, with dialysis as its handmaiden, but home dialysis was a minor possibility for the occasional patient who physicians had to treat, but could not transplant.

ESTABLISHMENT OF HOME DIALYSIS TRAINING UNITS

The acceptance by the NHMRC Committee of home dialysis as a suitable modality for treatment, albeit as a secondary form to transplantation, stimulated the establishment of embryonic home dialysis training facilities by hospitals in each of the Australian states over the following 4 years. These were opened as follows: in Victoria at the Royal Melbourne Hospital and The Austin Hospital in 1967–1968; in New South Wales in the eastern suburbs of Sydney in 1968–1970, initially at Lulworth House and subsequently at Duntrium in Darling Point, under the supervision of Sydney Hospital; in South Australia at the Queen Elizabeth Hospital in 1969–1970; in Tasmania at The Royal Hobart Hospital in 1971; in Western Australia at Royal Perth Hospital in 1972; and in The Australian Capital Territory at Royal Canberra Hospital in 1972.

The successful creation of these home training facilities was, in virtually every instance, due to the personal dedication of small groups of enthusiasts. Outstanding among these were Dr John Dawborn and Ms Sue Evans in Victoria, Dr John Stewart and Sister Thelma Neilsford-Jones in New South Wales, Dr James Lawrence and Sister Angela Howie in South Australia, Professor Trefor Morgan and Dr James Petrie in Queensland, Dr John Freeman in Tasmania, Dr Barry Saker in Western Australia and Dr Brian Hurley in Canberra.

The home training units each tended to equip their patients with American Drake–Willock single-pass dialysis machines. These were reliable and relatively easy to use, compared with the Travenol recirculating machines that several hospitals had previously used for their in-centre patients. A further advantage of the Drake–Willock machinery was the highly professional supply and servicing arrangements that the Australian agents for that company provided. Drake–Willock machines came to monopolize the Australian market for several years before other overseas suppliers (which included Gambro, Althin, Cobe, REDY, Baxter, B. Braun and Fresenius) made determined inroads into it. The initial dialysers used in most of the home training centres were Kiil flat plates that the patients learned to assemble for themselves before each dialysis. Disposable flat plate dialysers subsequently followed these, but by 1972 hollow fibre dialysers became available. The American Cordis–Dow Company introduced these to Australia, but later competition developed as various European, American and Japanese companies appointed Australian agents.

Funding of home dialysis posed a major problem throughout 1967 and 1968. The capital cost of the machines, followed by the recurring costs of disposable supplies, created a financial hurdle that most patients found insurmountable. Mr Peter Morris, who was personally committed to home dialysis, realized that someone had to devise a satisfactory solution to this problem if maintenance dialysis was ever to offer a reasonable solution to end-stage renal disease for the many patients awaiting, or unsuitable for, transplantation. He used his associations with the Lions Club movement to persuade the organization to take up the challenge of funding chronic kidney disease treatment as a major charitable exercise. The Lions Clubs performed this task from 1968 to 1972, by which time the issue had attracted considerable media attention that stimulated the then incoming Australian government under Mr Gough Whitlam as Prime Minister to fund home dialysis treatment for appropriate patients throughout the country. This apparent resolution of funding problems removed the principal impediment to a rapid uptake of the treatment. Universal government funding subsequently remained a lynch pin of the system, although the responsibility for it gradually moved from the Commonwealth to the State budgets and repetitive difficulties arose in several of the states over the issue.

PROGRESSIVE RISE OF HOME HAEMODIALYSIS

One valuable outcome of the NHMRC report was the establishment of the Australian and New Zealand Dialysis and Transplant Registry (ANZDATA) that collected and
correlated information about all maintenance dialysis and renal transplant patients throughout the country. Its annual reports provide data that identify the development of each modality of treatment and evidence of trends and interrelations between these. The following numerical information is largely derived from these reports.\textsuperscript{41}

The total number of patients receiving home haemodialysis in Australia has risen progressively over the years throughout the whole period that this type of treatment has been available. Thirty-nine patients were undertaking home-based treatment in 1971, and their absolute numbers increased to 466 in 1977, 568 in 1987, 635 in 1997 and 763 in 2002. However, this increase was disproportionately small compared with the rise in numbers of the total dialysis population of the country, namely 18 dialysis patients per million population in 1971, rising to 64 per million in 1977, 112 in 1987, 279 in 1997 and 366 in 2002. The percentage of patients on home dialysis, in contrast to other forms of dialysis treatment, therefore fell from 17 to 52% between 1971 and 1977, but then fell to 23% in 1987 and was as low as 12% by 1997. It subsequently remained reasonably steady at between 11 and 12%.

The technical ability to manage patients on home haemodialysis throughout Australia progressively increased over the corresponding period. Thus, the number of renal units throughout the country that were managing patients on home haemodialysis rose from five in 1971 to 25 in 1977, 30 in 1987 and 1997, and to 38 (out of a total of 61) by 2002. However, the percentage of the total patient load managed by each renal unit by means of home haemodialysis (in contrast to other forms of dialysis) fell progressively over the same period. Five Australian dialysis units had no patients on home haemodialysis in 1978, and by 2002 this had risen to 23 Australian renal units that had no patients on home treatment. Most Australian renal units had more than 30% of their patients on home haemodialysis treatment in 1978, whereas by 2002 most units that undertook home haemodialysis treatment had fewer than 10% of their patients at home. The highest documented percentage of patients ever recorded by any single large centre was that of Concord Repatriation General Hospital, in Sydney, which in 1983 achieved close to universal home treatment of an unselected cohort of patients by using techniques that included an expensive, but particularly user-friendly, set of equipment.\textsuperscript{42} Its percentage, however, also subsequently fell, as did the national trends, when it was obliged to revert to less expensive equipment.

Major interstate variations occurred over the years in commitment to home dialysis treatment. Home haemodialysis has always been more popular in New South Wales (where 55% of patients were receiving this form of treatment in 1978, and 19% in 2002) than in other states. The Australian Capital Territory had corresponding figures of 32 and 12%, followed by Victoria (36 and 8%), Queensland (33 and 5%), South Australia (27 and 4%), Western Australia (37 and 3%) and Tasmania (69% in 1978, but falling to 2% by 2002). The Northern Territory has had only very occasional home patients (0 and 0.4% in these respective years).

However, a major innovation that involved home haemodialysis occurred in 2001 when Agar and his colleagues in Geelong instituted a nocturnal ‘daily’ (mostly six nights per week) haemodialysis programme.\textsuperscript{43} The exigencies of this treatment meant that home treatment was obligatory. Its outcome in Australia, as elsewhere, was highly successful with benefits to patients that significantly outweighed those of the three times weekly haemodialysis that had been the former norm. Several other renal units subsequently took up the challenge of providing this form of treatment, although the ultimate place that it will come to hold in the armamentarium of available dialysis techniques still remains unclear until dedicated machinery to perform it becomes generally available in the country.

**COMPETING MODALITIES OF TREATMENT**

The above figures show that the total number of patients receiving dialysis treatment for end-stage kidney disease in Australia has risen inexorably over the years, but the contribution of home haemodialysis has languished in recent times. The consequence of this is that, of the 6812 patients receiving maintenance dialysis in Australia on 31 December 2001, only 756 of these were undertaking home haemodialysis.

The other three possible modalities of dialysis treatment are as follows: peritoneal dialysis (either by the continuous ambulatory peritoneal dialysis (CAPD) method, or by using an automated method, but both of these involving treatment at home); limited care haemodialysis in a satellite centre with some nursing assistance; and haemodialysis with full nursing and medical assistance provided in a hospital. The fourth possible method of treatment of end-stage kidney disease is by kidney transplantation. Comparison of the contributions of each of these forms of treatment with home haemodialysis is instructive.

Continuous ambulatory peritoneal dialysis became available in Australia in the late 1970s and the automated versions of peritoneal dialysis somewhat later. No patient was undertaking home peritoneal dialysis in 1977, but it was undertaken by 31% of the Australian chronic dialysis population 10 years later. The figure remained constant over the following decade (31% in 1997), but thereafter fell in relative terms to 25% by 2002. A total of 1769 Australian patients were performing maintenance peritoneal dialysis at home on 31 December 2001.

Limited care (satellite) haemodialysis started developing shortly after CAPD. No Australian patient was
receiving this form of treatment in 1977, but 16% received it in 1987 and the figure rose to 28% in 1997 through to 37% in 2002. A total of 2420 Australian patients were receiving limited care haemodialysis on 31 December 2001.

In contrast, hospital-based haemodialysis declined in relative importance, at least in numerical terms. Eighty-three percent of patients received hospital-based haemodialysis in 1971, 48% in 1977, 30% in 1987, 29% in 1997 and only 27% in 2002. A total of 1825 Australian patients were receiving hospital-based haemodialysis on 31 December 2001.

Renal transplantation was less successful than dialysis in accommodating the large numbers of Australians who reached end-stage renal failure in the final decades of the 20th century. A total of 304 transplant operations (from both deceased and living donors) were performed in 1977, 407 in 1987, 502 in 1997 and 504 in 2004. Transplants were therefore sustaining only 5466 of the 12 278 end-stage kidney disease patients in Australia at that time. This contrasted with the various forms of dialysis that were sustaining 6812 patients. The total reflected an aggregate of 633 people per million of population who were receiving renal replacement therapy.

DISCUSSION

This overview of the development of home haemodialysis in Australia, and its relationship to alternative methods of treatment, raises some interesting issues.

Dialysis has occupied a predominately derivative, rather than innovative, position in Australian medicine. Australian physicians have often had a keen interest in foreign developments in this field and have adopted these once their benefits have gained acceptance, but have rarely themselves initiated the crucial advances. ‘Progress’ in Australia has therefore tended to mean uptake of other people’s inventions rather than local invention. Furthermore, the rate of acceptance of overseas developments has often lagged behind uptake elsewhere. In the case of home dialysis, this represented a delay of about 3 years; others in the United States and the United Kingdom introduced the technique in 1964, but the first Australian patient did not start treatment until late 1967. Whether a country is wise in displaying no identifiable benefits. The disadvantage is denial of effective treatments to some patients for protracted periods from which, if a less sceptical attitude had prevailed, they might have benefited.

The report of the NHMRC ad hoc Committee on Rationalization of Facilities for Organ Transplantation and Renal Dialysis had a profound influence on the ability of Australian medical practitioners to provide renal replacement therapy over the ensuing four decades. Some implications continue to reverberate even now; one is the idea that dialysis has a role merely as a handmaiden to transplantation, with transplantation always offering a potentially better outcome for every patient than maintenance dialysis would. The whole thrust of the report was to portray maintenance dialysis as a complementary treatment, hardly worthy of consideration as an end in itself. It implied that life for a kidney failure patient who was unsuitable for transplantation was not worthy of living, so treatment should not be offered or at most should only be offered with the greatest of reluctance. The idea that the two forms of treatment might be complementary to each other, rather than competing with each other, while implicit in the thinking subsequently expressed by at least one member of the committee, was not reflected in the overall report. Home dialysis did receive limited support, but that support paled into insignificance because of the focus of directing subsequent logistic and research effort and money largely towards transplantation. However, the massive dependence that each new cohort of end-stage kidney disease patients would develop upon maintenance dialysis, rather than upon transplantation, within a few years after the NHMRC issued its report, showed its questionable insight to many neutral observers.

The development of home dialysis in Australia relied initially on the efforts of a small group of enthusiastic physicians and nurses, several of them heavily influenced by the pioneering experiences of the American nephrologists associated with the University of Washington in Seattle. The local pioneers in turn fostered a limited number of younger renal physicians to continue their work. However, ability to train patients to undertake dialysis at home and maintain them there requires skills that differ markedly from those necessary for practicing many other types of medicine. Prominent among these are an ability to help patients and their families cope with the social stresses that can arise. The techniques involved do not necessarily come intuitively to physicians and nurses, so professionals who have not had the advantage of working with others who have wide experience in home dialysis might never acquire the understanding necessary to support the technique. Such exposure is not compulsory in either renal physician or renal nursing training in Australia, and the relatively poor uptake of the treatment might in part result from this.

Home dialysis in Australia has also suffered from a failure of the health care system to provide comprehensive and secure funding arrangements. This failure arises to a significant degree because of ambiguities created by the division of funding for health care between Federal and State governments. The general rule is that the Federal government has responsibility through the Medicare system to fund (or at least to subsidize) office
consultations and pharmaceutical items used by non-in-patients. The State governments have the responsibility to fund (or at least to subsidize) the treatment provided for in-patients in public hospitals. Most home haemodialysis patients start their treatment and receive their training in a public hospital (or a facility associated with a public hospital). They receive their follow up by physicians working as consultants at that same public hospital. They receive their supplies to their homes and they seek routine and emergency nursing and technical support from the public hospital. The State governments receive financial grants from the Federal government to enable them to provide machines, consumable supplies and consultative support, but the mechanisms by which they receive this money discourage them from providing treatment for an ever-expanding pool of patients, except as charges against the general revenue of the public hospital with which a patient is associated. The consequence has been to leave the financing of home dialysis in several States in a condition of chronic crisis.

A further difficulty has arisen from a lack of dialysis equipment purposely designed for home use. Australia manufactures no dialysis machines and relatively few consumable items, and depends very heavily on imported equipment. This might well lie at the heart of the lack of local innovation previously mentioned. Government policies (especially with regard to remuneration of renal physicians) in many countries of the world, including most of those whose markets are crucial to the manufacturers of dialysis equipment, have traditionally made home dialysis an unattractive proposition. The consequence is that much dialysis equipment is manufactured with in-hospital use as a primary goal, and with the ability to handle many complex and intensive situations. Such equipment is poorly adapted to home use, so it militates against a wider application of the technique. Non-self-sufficient countries such as Australia are then particularly disadvantaged. However, this situation might change in the foreseeable future as the striking success of home-based daily dialysis (whether slow nocturnal haemodialysis or brief high-efficiency haemodialysis) in improving patient outcomes might oblige its reconsideration by many who presently lack a commitment to it.

The absolute number of home haemodialysis patients in Australia has continued to increase slowly over the past three decades despite all of these impediments. Nevertheless, the percentage of dialysis patients treated on home haemodialysis has decreased progressively since the late 1970s. Two concurrent events that accompanied this decrease were as follows: the development of CAPD; and the opening of many government-funded limited-care dialysis centres. Whether these events have had a causal relationship on the slow development of home haemodialysis remains to be proven, but some of their implications are certainly worth noting. Patients conduct CAPD and related automated peritoneal dialysis treatments for themselves at home. These provide a valuable and entirely legitimate alternative to home haemodialysis that is often in the interests of the patients involved and that is reasonably cost neutral to home haemodialysis, so any decrease in the uptake of home haemodialysis that might result from them is unexceptionable. However, limited-care haemodialysis is not necessarily in the same category. It is more expensive than home treatment and more counter-productive with regard to rehabilitation. Its advantage to the patient’s renal physician is that it often relieves the physician of having to grapple with complex and time-consuming social difficulties that successful achievement of home treatment would require to be resolved. Resolution of those difficulties (that commonly are quite unrelated to kidney failure and that are bedevilling the patient’s whole enjoyment of life) will often demand personal skills that many renal physicians do not have (or at least have not developed), so the simplest solution for the physician is to acquiesce in the patient’s natural fears of taking personal responsibility for an unknown and threatening treatment, and to offer government-funded limited-care treatment as a compromise. If this is a reason for the slow development of home haemodialysis in recent years it is a morally and economically less legitimate one than is the rise of peritoneal dialysis. One indeed wonders how many patients would choose limited care if they had personally to pay the additional costs generated by it over home haemodialysis.

The conclusion that this analysis of the history of home haemodialysis in Australia suggests is that it has developed slowly and against considerable odds, but it remains an important and viable modality of treatment, one that has a reasonable prospect of becoming increasingly important in the future, especially if government and commercial inhibitions lessen.

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