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The Early History of the Treatment of Renal Failure

by Haemodialysis and Transplantation in the UK

A Memoir by John Hopewell

Early History of the Treatment of Renal Failure

by Haemodialysis and Transplantation – UK

Before 1960 there was virtually no treatment for the common problem of end-stage renal failure in the United Kingdom. By 1970 every region had a unit capable of treating it by haemodialysis and transplantation, which have continued as complementary treatments to the present time.

This development, a notable and rapid advance in clinical practice, deserves historical record.

There are differences between dialysis and transplantation: dialysis is a medical treatment based on physical, chemical and engineering principles, and is applicable to acute and chronic renal failure. Transplantation emerged from surgical and immunological concepts, and is applicable only to chronic or end-stage renal failure. It would not be surprising if they had developed somewhat remotely from each other, and such an assertion has occasionally been made. It may well have been true for their earliest origins worldwide. It was not so for their emergence in the United Kingdom, where they took place predominantly in some half-dozen centres, albeit not at the same pace in each, to become complementary therapies. I believe that the intertwined stories of their origins have not been adequately recorded and should be told as a single narrative. I write this memoir in the knowledge of omissions, hoping it may serve as a framework for a definitive history.

To describe the relationship of these origins, it is necessary to go back to the beginning of clinical haemodialysis in the UK, which will be familiar to many, and to proceed to the history of transplantation and of maintenance dialysis.

This timetable may help to clarify the order of events.

Year	Dialysis		Transplantation	
	Acute	Maintenance	Isograft	Allograft
1947	Hammersmith			
1955				St Mary's
1956	Leeds			
1957	(Halton) Newcastle			
1958	*Several units order Twin coils (see text)			
1959	Royal Free Edinburgh			Leeds Royal Free
1960			Edinburgh	
1961		Royal Free		
1962				Hammersmith
1963		Newcastle		
1964		Charing Cross Leeds		

*Edinburgh, Glasgow, Belfast, Dublin, the London

Acute Renal Failure

As a medical student I had seen patients with acute renal failure from crush injury resulting from the air raids on London, for whom little could be done except to call in the consultant from Hammersmith Hospital to advise on fluid and electrolyte balance. In 1946/47, treatment by dialysis became available at Hammersmith Hospital. Dr. Eric Bywaters had initially trained as a histopathologist. During the bombing of London in 1941 he became interested in the histopathology of the kidney in acute renal failure caused by crush injury, and Hammersmith Hospital, where he worked, became a reference centre for cases of renal failure. Later he developed an interest in rheumatic disease to which he devoted a distinguished career. The suggestion that a small renal unit should be set up at Hammersmith was made first in a letter to Professor McMichael (Professor of Medicine) from AM (Jo) Joekes towards the end of the War. [1] Jo was then part of an MRC inter-services unit engaged in finding a new treatment for malaria. He was related to Willem Kolff and was known to be interested in renal disease, so was sent a copy of one of Kolff's earliest papers. He therfore was one of the first in the UK to appreciate the potential of the artificial kidney as shown by Kolff's early contributions. His suggestion found favour, and a unit was set up under the consultant direction of Dr. Bywaters.One of the artificial kidneys which Kolff had hidden from the occupying forces in Holland had been earmarked for Hammersmith Hospital. In 1946 Dr. Bywaters went to Amsterdam to collect it.

The laborious task of setting up and using the machine seems to have been undertaken in great part by Joekes, by this time a senior lecturer at Hammersmith together with his colleague, Ken Lowe. [2] Early results however did not establish its superiority over the dietary and electrolytic treatment then being refined and advocated by Bull and Borst, despite the nausea and mouth ulcers occasioned by their regimen. Joekes himself, although continuing to devote his experience to the development of dialysis as consultant to the renal units at RAF Halton and St Phillips (the Institute of Urology), has always said that at the time he was unconvinced that the artificial kidney would continue to play a major role in treatment. The one at Hammersmith was virtually abandoned until later in 1957 when Prof. Ralph Shackman started using it again in his department of urology.

Dialysis, then, was out of favour until the mid-1950s, when there was a revival of interest, largely attributable to developments at Leeds General Infirmary (LGI). Leslie Pyrah, surgeon at that hospital and an influential personality, had played a leading part in the establishment of urology as a specialty in the UK. He arranged for his registrar, Frank Parsons, to visit Chicago in 1955 to work with Prof. Charles Huggins. Parsons

spent the last three months of his visit at the Peter Bent Brigham Hospital, Boston, to learn all he could about the use of the drum-coil artificial kidney and a machine was ordered. On his return to Leeds the dialysis unit was started, although with something less than grudging support from the medical establishment in England. This is dealt with fully in Stewart Cameron's History of the Treatment of Real Failure by Dialysis.3 But by dint of energy, singleness of purpose and technical ability Parsons built up a wide experience from a series of some 70 cases of acute renal failure, with results that gave conclusive evidence of the value of dialysis. This work was carried out in association with Brian McCracken who as medical lecturer contributed medical expertise and experience.4

The next renal unit, established in 1956/57, was that at the RAF at Halton.5 It was led by Wing-Commander (Sir) Ralph Jackson and Jo Joekes was appointed as a consultant, and it was he who recommended the adoption of the Baxter Twin-Coil Kidney for the unit. This machine proved to be simpler to use. It became generally recognised that dialysis was needed for the more severe cases. Impatient at not being able to refer their patients for dialysis, several centres decided to start their own units. It is often remarked that many renal units were started by urological surgeons, and this was so in roughly half those under consideration here. Notable among these was Victor Dix, urological surgeon at the London Hospital. Having referred a patient elsewhere for dialysis, to find that he had been treated only by renal decapsulation, Dix resolved to set up his own unit. (Prof.Mary) Mollie McGeown, in an account of events in Belfast and Dublin, describes how the urological surgeon in Belfast, JM Megaw, had not accepted the decision that the population of Northern Ireland was not big enough to need a renal unit, and so enlisted her to set one up for him, which she did with such notable distinction.6 Leslie Pyrah (Leeds), Ralph Shackman (Hammersmith), J Cosbie Ross (Liverpool) and the author (Royal Free) are mentioned elsewhere. In 1958/59, there was something of a rush to establish renal units, almost exclusively using the twin coil kidney - a decision largely based on the Halton experience. This model was ordered for Dublin, Belfast, Edinburgh, Glasgow, the London and Royal Free Hospitals. Of these new units, that at the Royal Free, planned from the time of my appointment in 1957, was unique in being set up for the development of transplantation and maintenance dialysis to treat end-stage renal failure. This purpose was fulfilled at an early date by the fortuitous addition to the team of Roy Calne and Stanley Shaldon, respectively to set up these two services, which are both described below in the appropriate sections.

The exception to the choice of the twin-coil dialyser was made in Newcastle by Prof. (Sir) George Smart, supported by John Swinney,

who was later to become urological surgeon, and a pioneer of transplantation in the north of England. Smart, who had a most distinguished career, was perhaps best known for his interest in the reform of medical education. As Professor of Medicine in Newcastle he was determined to bring standards up to the forefront of modern practice and saw the need for a renal unit. An Alwall artificial kidney was chosen there for interesting reasons: the long-standing sea trade links between Newcastle and Scandinavia, and Prof. Smart's personal friendship with many physicians there, resulted in his knowing of Alwall's pioneering work at an early date. The artificial kidney arrived and first used in February 1959 [7], a few months before David Kerr was appointed as a senior registrar in Newcastle. Previously a hepatologist with Sheila Sherlock at Hammersmith, Kerr was told that he would be in charge of the new unit "in his spare time". The Alwall kidney functioned reasonably well, but after a few months Kerr persuaded his chief that a twin-coil machine was needed and the change was made.

Transplantation

Experimental

It is time to describe the origins of clinical transplantation in the UK and to relate them to those of haemodialysis. It seems appropriate that the first significant contribution was that of animal experiment. W.J. Dempster had trained in Edinburgh medical school, where he was a contemporary of (Professor Dame) Sheila Sherlock. On leaving the RAF after the war he sought further surgical training, as did so many of his contemporaries. Sheila, now working at Hammersmith, suggested he apply there. He did so successfully, and Prof. Ian Aird set him the task of investigating the fate of canine renal allografts, which later he wryly described as the worst job in the hospital.[8] His animal work was carried out at the Buckston Browne Farm, the animal laboratory of the Royal College of Surgeons of England, and he published over a hundred papers and reviews between 1953 and 1977. These included observations on the histological features of the rejection reaction; confirmation that it was an immune response mediated by serum antibodies; demonstration of the effect of irradiation; tolerance; the graft versus host reaction, and graft preservation. His work brought him worldwide recognition among fellow workers in the field although his contributions tend to have been overlooked, partly as the result of his warning against clinical transplantation just as it was due to take off. Below I introduce an argument that he may have been right after all. [9] In a history of research on organ transplantation, reference must be made to (Prof. Sir) Michael Woodruff who started thinking about its problems while he was in a Japanese prisoner of war camp after the fall of Singapore in 1942. He found an old copy of Rodney Maingot's

"Postgraduate Surgery" and, after reading about the fate of skin allografts he decided that if he survived he would investigate the phenomenon. On taking up the Chair of Surgical Science in Edinburgh (1956) he listed immunological tolerance and the effects of antilymphocytic globulin as his top two priorities for research as quoted in his autobiography. 10 His clinical transplant programme is mentioned below.

Perhaps the most important experimental work, which led to successful clinical transplantation was made by (Professor Sir) Roy Calne. He had been appointed as surgical registrar to the Royal Free Hospital in1958, when the renal unit there was already being set up to undertake long term dialysis and transplantation, without any clear idea of how this was to be done. His interest in transplantation had been inspired by a lecture by Prof. Peter Medawar. It was arranged with Professor Slome for him to carry out research work at the Buckston Browne Farm.11 Hitherto the rejection reaction had either been left untreated or managed by the fearsome measure of total body irradiation (TBI), a relic of the early animal studies such as those of Lennox(pathologist) and Boag (radiologist), researching the fate of skin grafts in rabbits. 12 This was also used by Calne in his first trials. Ken Porter (St.Mary's) then drew his attention to the recent paper by Swartz and Dameshek13 demonstrating the effect of 6 mercaptopurine on preventing antibody formation after the injection of human serum in the rabbit. Calne decided to see if it was equally effective for whole organ allografts and confirmed that it was indeed so in a successful series of canine renal allografts.14 This subsequent application of his findings is described under the section on clinical transplantation.

Clinical

Philip Clark, speaking to a conference held at Leeds in 2006 to celebrate the 50th anniversary of the first haemodialysis there, mentions an "unofficial" transplant in 1949 by Dickson Wright (surgeon, St. Mary's Hospital, London), who once told me the same story after a long dinner, and he added that the operation had been conducted in a nursing home in St. John's Wood and that he had joined the graft to the brachial artery. The graft never functioned and he was not proud of the intervention. I do not think that the story of this case, almost apocryphal, warrants a place in a recorded history which is intended to be as accurate as possible, so the first recorded case of clinical transplantation in the U.K. is generally regarded as that by Prof. Charles Rob performed the operation in 1955 at St. Mary's Hospital, London with WJ Dempster from Hammersmith joining him for the occasion. Although transplantation is not a suitable treatment for acute renal failure, this

operation involved a patient who developed this condition following a septic abortion.[15] Unsurprisingly the operation was not a success, but it started a tradition of transplantation at St. Mary's, where later Prof (Sir) Stanley Peart inspired the formation of an impressive team with Ken Owen (Urology), John Kenyon (Vascular Surgery), Ken Porter (Pathology) and Leslie Brent and James Mowbray (immunology). Barry Hulme, who had trained in Birmingham, established a haemodialysis unit there in 1971[16], thus completing the resources for treatment of chronic renal failure, which has continued and developed to the present times. Their first transplant was performed in August 1959. Peritoneal dialysis was used in the preparation for operation in 4 of 17 early cases. The five longest survivors were from 31 to 85 days postoperatively. They described four cases of obliterative arteritis in these 17 cases. [17] F.Peter Raper, surgeon and urologist at Leeds General Infirmary (LGI), is described in "Lives of the Fellows" (Royal College of Surgeons of England) as having "latterly become deeply involved with FM Parsons in the problems of renal transplantation…." It appears that his "involvement" went very much deeper than this. Philip Clark (ibid, above) described a series of nine cadaveric transplants carried out by Raper between July 13th 1959 up to his untimely death in 1966. In view of his outstanding surgical technique and his experience in treating renal artery stenosis, he had been a natural choice for Frank Parsons to enlist in a programme of transplantation. His first case received total body irradiation pre-operatively; the next two had cyclophosphamide alone, and in the remainder a combination of cyclophosphamide and steroids. His results were perhaps as good as could be expected without effective immunosuppressant chemotherapy, or, as in his earlier cases, the back-up of maintenance dialysis. One patient survived for eight months with a functional graft, sadly to die of a viral infection. This work was undertaken to test the effectiveness of cyclophosphamide as an immunosuppressive agent, and despite its negative finding it must earn Peter Raper a more prominent place in transplantation than he is currently accorded.[18] From 1964, Philip Clark, Bob Williams, Philip Smith, David Pratt and Geoffrey Wilson carried out fourteen transplants up to 1972, using immuran with steroids. Eight grafts failed within the first year, of which one was re-transplanted and three returned to maintenance dialysis. Six grafts survived over a year, for varying periods up to twelve years, and five of these dying of causes other than graft failure.[19] Frank Parsons had begun maintenance dialysis at the LGI in 1964, initially to prepare patients for transplantation.[20] After 1973 maintenance dialysis and transplantation were centred on St.James's Hospital by a decision of the Ministry of Health. This service became fully operational in 1973 following the appointment of Prof. Geoffrey Giles, with Stanley Rosen, who had been transplant nephrologist at the LGI and St.James's Hospital since January,1967. The further history of maintenance dialysis at St.

James's Hospital is given in the relevant section.

By the time I was appointed as a surgeon to the Royal Free Hospital in 1957, with a commitment to start a department of urology, I was familiar with Jim Dempster's work, and had seen a Kolff machine in Stanford being used to help patients with polycystic disease. I realised that a new department of urology would need to have a renal unit equipped for haemodialysis and transplantation working in association with it. An objection to this was made on the grounds that London's two existing renal units were enough for its needs. I explained that they were treating acute renal failure, whereas that this was planned for the treatment of chronic renal failure by long term dialysis and transplantation. The Board of Governors agreed to the project and set aside a sum of £2,500 for the artificial kidney and its installation. (Minutes of the Board of Governors, Royal Free Hospital. Jan:1959). The unit was functional in 1959 with the arrival of a Baxter twin coil artificial kidney: it was housed in a cubicle erected within a "Nightingale" ward. The first dialyses were performed on cases of acute renal failure resulting from septic abortion, mainly by Dr. Melvin Ramsey the superintendent of the department of infectious disease.

The fortuitous arrival of Roy Calne on the scene has been described in the "Experimental" section above. His findings gave us the confidence to proceed with clinical transplantation of the cadaveric kidney. The first two cases we conducted together were prepared by haemodialysis but proved unsuccessful. On November 1st 1960 I carried out a live donor transplant using 6-mercaptopurine and predisolone as immunosuppressants. There was evidence that these drugs controlled the rejection reaction but the recipient died at seven weeks and was found to be suffering from miliary tuberculosis.[21] This case can be described as the first clinical allograft conducted in a unit set up for the purpose, backed by preliminary research studies that had confirmed the effectiveness of the immunosuppressive used. Calne had left just before that case, to pursue further research in Francis Moore's department of surgery at the Peter Bent Brigham Hospital in Boston. There he showed azathioprine to be best immunosuppressant agent then available, finally convincing Dr.Murray to use it in clinical transplantation. From then on, following Calne's work with Dr.Murray in Boston, chemotherapy gradually became accepted worldwide as the key to successful immunosuppression, leading on to the whole field of organ transplantation. Roy Calne's recognition of this, the conviction and energy with which he demonstrated, first by his experimental studies on the use of 6-MP, and later clinical studies, has already been described here. His role in the story is of such importance that a note must be made of his future career. On his return from Boston in !962 he worked at St. Mary's Hospital before gaining a consultant appointment at

Westminster Hospital, London where he setup a Transplantation unit in collaboration with Dr. Loughridge's Renal unit in Prof. Milne's Academic Department of Medicine. He moved from this appointment to the Chair of Surgery in Cambridge, where of course his major interest was in transplantation, notably of the liver and pancreas. He was elected FRS and received a knighthood, but even these honours scarcely conferred on him due recognition for his contribution to making organ transplantation a routine treatment.

Michael Woodruff in Edinburgh had performed the first successful isograft in the UK for chronic renal failure on one of a pair of identical twins (October 31st1960).[22] His second case was an allograft from a brother to his sister, prepared by total body irradiation. Despite successful graft function, the recipient died from infection, and he postponed further transplantation until 1962 when Dr. Murray visited him and described the successful use of azathioprine and prednisolone in clinical transplantation. Woodruff followed his advice, resuming transplantation and at the time of his retirement in 1976, 127 patients had received transplants.[23] Despite this early start in transplantation, maintenance dialysis was fully established only in 1966.[24]
The success of chemotherapy as immunosuppressant seems to have been generally accepted after the visit of Dr. Murray described above, St Mary's adopting it routinely from October 1963.[25] At Hammersmith the first clinical transplant was performed in 1962. [26] I have no record of the details of the immunosuppression used, but one must presume that it was similar.

This is a history of events in the UK, but it may be said that the transplantation teams in France made the change at much the same time.

Robert Sells began transplantation at Sefton General Hospital, Liverpool in 1972 where a maintenance dialysis service had been set up by John Goldsmith in 1965/66, as described in the section below.

Maintenance dialysis

It is generally agreed that In the UK maintenance dialysis was first introduced by Stanley Shaldon at the Royal Free Renal Unit in Spring 1961. It was begun in Newcastle in 1963, Leeds and Charing Cross Hospital in 1964, with Liverpool following in 1965/66. Some account of these is given below.

Effective vascular access was the key to success, and this is acknowledged to have been started by Nils Alwall, who introduced an arterio-venous shunt which afforded repeated access to the

circulation. However its effective life was only about six weeks, and again the value of Aiwall's work was slow in gaining wide recognition. The potential of the Teflon coated a-v shunt was generally appreciated in Europe only after Dr.Scribner, at the First Congress of Nephrology, in Evian (September 1960) described his success with the shunt that he had developed. His account inspired confidence that the problem of vascular access was on the way to being solved.

Royal Free

I have described how the RFH unit was planned since 1957 to treat end-stage renal failure by transplantation and maintenance dialysis. The former aim was initiated by Roy Calne, who "seconded" himself to the unit as described above. The second aim was to be met by a second good fortune when Stanley Shaldon joined the team in 1960. He had come to the hospital as a registrar, specialising in hepatology, with Sheila Sherlock in 1959 on her appointment to the new chair of medicine. Thus he was "seconded" to the renal unit, virtually as its consultant nephrologist. Stanley and I attended the conference at Evian, he to read a paper based on previous studies. On hearing Scribner's paper, Shaldon was determined to set up maintenance dialysis at the Royal Free. He made a practical start in the Spring of 1961 using his own design of twin femoral catheters.[27, 28] His work in developing this service, as well as that of home dialysis at the Royal Free has been an important factor in his recognition as a pioneer in this field. His later foundation of the National Kidney Centre (1966) is outside the subject of this memoir. it is hoped that this and further details of other units may be attached in a later publication.

Newcastle

It may have been expected that in Newcastle with its early application of dialysis for acute renal failure, and also its links with Alwall, would have led to an early start in setting up maintenance dialysis. In fact it was started in December 1963, to be plagued from the outset with problems which were ultimately discovered to arise from the high aluminium concentration in some of the local water supplies.[29, 30]

Charing Cross

Prof. Hugh De Wardener, who had recently been appointed to the Chair of Medicine at Charing Cross, was also at Evian, and has stated that he was not entirely convinced by Scribner.[31] It was only after the subsequent International Congress of Nephrology in Prague in 1963 that he decided to set up maintenance dialysis. He sent a team to Seattle to receive a full training and on its return, they set up the unit at Charing Cross, the first successful case being reported as in August

1964.[31, 32] His unit was unique in being started without earlier work on dialysis for acute renal failure, and not starting transplantation until 1969.[33] Observations about this are made in the "Discussion" below.

Leeds

Following his influential work on acute renal failure, it might have been expected that Frank Parsons would be in the forefront in the treatment of chronic disease. Christopher Blagg of Seattle, working with Parsons at the time, has written that they sent to Seattle in 1960 to obtain two teflon shunts. These were tried and unfortunately gave very disappointing results. A unit decision was taken, that the workload from acute renal failure placed a sufficient burden on resources that they could not then undertake the development work necessary to make a success of maintenance dialysis at that time.[34] Frank Parsons attended the conference in Prague and with Christopher Blagg's encouragement resumed maintenance dialysis, which was finally fully functional in 1964. It was initially used to prepare patients for transplantation.[20] It then proved so successful as to exert an undue pressure of beds on the L.G.I., and this was one of the factors leading to the Ministry of Health's decision to move transplantation and maintenance dialysis to St. James's Hospital, Leeds. Stanley Rosen as transplant nephrologist was in charge of the dialysis, later to include home dialysis, and the unit ultimately extended its services over a wide area in the north east of England.

Liverpool

The Renal Unit at Sefton General Hospital, Liverpool, had been initiated by the senior urological surgeon, J. Cosbie Ross who sent his senior registrar to the Mayo Clinic in 1959, from where he returned with a Skeggs Leonard Artificial Kidney.) John Goldsmith was appointed as nephrologist to the unit in 1960. He had been trained in Sheffield and had gone to Cleveland to study with Kolff in 1959. There he had attended a presentation by Scribner in the U.S.A. earlier in 1960 than the Evian meeting. On his appointment as consultant nephrologist at Sefton he set up a programme of haemodialysis , starting maintenance dialysis in 1965/66. Unfortunately with the closure of Sefton General Hospital records were lost and this date cannot be verified exactly.[35]

Hammersmith

Geof Chishom considered the use of Teflon shunts at an early date [36]but I have no details of the introduction of maintenance dialysis, except that it was not set up at the time of the first transplant there in 1962

Discussion

I have outlined the history of haemodialysis and transplantation as they grew up side by side in the earliest units that saw their establishment with an account of some of their pioneer figures. Some observations arise from the account.

Of the two pre-eminent units, Hammersmith and Leeds, both with an early start in haemodialysis for acute failure, it may be thought surprising that they were not equally ahead in developing maintenance dialysis. I have also given Prof. Blagg's little-known and interesting reason for how this came about in Leeds. It may well be that the Hammersmith unit found itself in the same position, namely having such a heavy burden in treating acute renal failure, by reason of its early start in this field.

Another important point may be observed, that in two of the units where maintenance dialysis was established early as a routine service (Royal Free and Charing Cross), the introduction of transplantation tended to be delayed. At the Royal Free Hospital, transplantation had been started in 1959/1960, giving Roy Calne the opportunity to launch his work on chemotherapy which has opened up the whole field of organ transplantation. However, when reliable maintenance dialysis became available, I thought it offered a better chance of survival for the patient than transplantation at that time. Stanley Shaldon, too, did not then accept that the results of cadaveric transplantation were justifiable for its use at that time. We resumed transplantation in 1968, chiefly at the request of our patients. In the intervening years I was occupied by forming the London Transplant Group, which became an almost nationwide organization for the exchange of donor kidneys, ultimately to become the National Kidney Registry. Toward the end of the 1960's, Leslie Brent of the British Society of Immunology, and I realised that both bodies were planning to become a British Transplantation Society and we had support from each to form a single society under that name. Its inaugural meting was held at the Royal Free Hospital on 12th April 1972, when Sir Peter Medawar was elected as the first president.

At Charing Cross, a maintenance dialysis service was set up first, but transplantation was not developed until Grant Williams was appointed some five years later in 1969. Thus it is arguable that de Wardener at Charing Cross made the same judgement, finding maintenance dialysis to be a safer treatment than transplantation at that time. Mortality appears to have been significantly less than it was in units undertaking transplantation without maintenance dialysis available. More or less the same opinion is expressed by Roy Calne when he wrote that in the early 1960's he did not consider transplants from live donors to be

justifiable, and restricted his practice to cadaver kidneys at that time.[37]

Thus hindsight suggests that the ideal sequence would have been to establish maintenance dialysis services and then to introduce transplantation. This was achieved somewhat fortuitously, at the Royal Free, Charing Cross, Liverpool and probably Newcastle, while others in St Mary's, Leeds, Edinburgh and the Hammersmith undertook transplantation before they developed a chronic dialysis program. In the long run this has become only of some historic interest.

I wrote above that Jim Dempster's warning against clinical transplantation in the late 1950s was justified. I say no more than that he had a feeling that the stage was not yet set for safe transplantation, and in that view he was correct, before the introduction of maintenance dialysis and chemotherapy for rejection. It was not until these provisions were met that patient survival from transplantation could be regarded as completely acceptable.

One final point might be recorded. The introduction of the artificial kidney was greeted with scepticism and even hostility by some members of the medical establishment- that experienced in Leeds is mentioned above. One London professor of medicine has been recorded as opining that it would never establish a permanent place in the treatment of renal failure. Sir Netar Mallick has described[38] how Sir Robert Platt in Manchester, who had been presented with an artificial kidney, passed it over to the urologists, presumably under the leadership of Mr. Thomas Moore, for their use. I think no such adverse feeling resulted from the introduction of clinical transplantation - though it is wryly remarked that now, fifty years later, it would not enjoy so smooth a path.

I hope I have given an account which helps to sort out the somewhat tangled story of the two modes of treatment as they developed together in the United Kingdom. I am well aware that there are omissions and probably inaccuracies in my record - for example I made only scant reference to the related immunological history, because I am not competent to do so, and their application to clinical work became particularly significant just after the events which I have described. They have been well summarised in the History of the BTS.

I am particularly indebted to the BTS for accepting my memoir on to its website, and thereby attracting comments on omissions and corrections which will lead to a definitive history. Information sent to the website would be warmly welcomed, and should be sent to secretariat@bts.org.uk

I send my sincere gratitude to all the colleagues who have helped – their number can be gauged from the "Personal Communications" in the references, and also to my wife Dr Rosemary Radley-Smith, who has helped in all aspects of writing the memoir, but particularly with the references, which I could never have compiled by myself. send my sincere gratitude to all the colleagues who have helped – their number can be gauged from the "Personal Communications" in the references, and also to my wife Dr Rosemary Radley-Smith, who has helped in all aspects of writing the memoir, but particularly with the references, which I could never have compiled by myself.

1. Joekes AM (2009) Personal communication

2 The artificial kidney; its clinical application in the treatment of traumatic anuria.
Bywaters EG, Joekes AM.
Proc R Soc Med. 1948;41:420-6.

3 Cameron JS (2002) *History of Renal Failure by Dialysis.* Oxford: Oxford University Press

4 The artificial kidney.
Parsons FM, McCracken BH.
Br J Urol. 1957 29:424-33.

5 Treatment of renal failure in a unit with facilities for haemodialysis (twin-coil artificial kidney). Results with 80 patients.
Jackson RC, Bunker NV, Elder WJ, Joekes AM.
Br Med J. 1960;2:1909-16

6 Renal replacement therapy in Ireland--the Belfast experience. 2nd J Creery Ferguson Memorial Lecture of the Royal College of Physicians of Ireland on the occasion of the bicentenary of the Royal Victoria Hospital--7th March 1997.
McGeown MG.

7 The Alwall artificial kidney: an assessment after one year.
Hall M, Kerr D, Smart G, Ashcroft R, Elliott W, Swinney J.

Br J Urol. 1961;33:41-55.

8 Dempster WJ (2006) Personal communication

9 Transplantation: some British pioneers
Brent Leslie

J Royal Coll Phys, London. 1997;31:434-441

10 Woodruff Michael (1996) *Nothing Venture, Nothing Win*. Edinburgh: Scottish Academic Press.

11 Calne RY (1998) *The Ultimate Gift.* London: Headline

12 Prolongation of survival of skin homotransplants in the rabbit by irradiation of the host.
Dempster WJ, Lennox B, Boag JW.
Br J Exp Pathol. 1950;3:670-9

13 Effect of 6-mercaptopurine on antibody production.
Schwartz R, Stack J, Dameshek W.
Proc Soc Exp Biol Med. 1958;99:64-7.

14 The rejection of renal homografts. Inhibition in dogs by 6-mercaptopurine.
Calne RY.
Lancet. 1960;1:417-8

15 Immediate post-operative anuria in a human renal homotransplant.
Joekes AM, Porter KA, Dempster WJ.
Br J Surg. 195;44:607-15.

16 Hulme B (2009) Personal communication

17 Obliterative vascular changes in four human kidney homotransplants.
Porter KA, Thomson WB, Owen K, Kenyon JR, Mowbray JF, Peart

WS.
Br Med J. 1963;2:639-45.

18 Cyclophosphamide in renal homotransplantation.
Parsons FM, Fox M, Anderson CK, Markland C, Clark PB, Raper FP.
Br J Urol. 1966;38:673-6.

19 Smith PC (2009) Personal Communication

20 Routine use of the Scribner shunt for haemodialysis.
Clark PB, Parsons FM.
Br Med J. 1966 4;1(5497):1200-2.

21 Three clinical cases of renal transplantation.
Hopewell JP, Calne RY, Beswick I.
Br Med J. 1964;1:411-3.

22 Transplantation of a kidney from an identical twin.
Woodruff MF, Robson JS, Ross JA, Nolan B, Lambie AT.
Lancet. 1961;1:1245-9.

23 Long survival after renal transplantation in man.
Woodruff MF, Nolan B, Anderton JL, Abouna GM, Morton JB, Jenkins AM.
Br J Surg. 1976;63:85-101

24 Turner, Neil (2009) Personal communication

25 Human cadaveric renal transplantation. Report of twenty cases.
Mowbray JF, Cohen SL, Doak PB, Kenyon JR, Owen K, Percival A, Porter KA, Peart WS.
Br Med J. 1965;2:1387-94.

26 Jackson PCG and Chisholm A (2009) Personal communications

27 Haemodialysis by percutaneous catheterisation of the femoral

artery and vein with regional heparinisation.
Shaldon S, Chiandussi L, Higgs B
Lancet. 1961;2:857-9.

28 Early attempts at rehabilitation of terminal uraemic patients by periodic haemodialysis.
Rae AI, Pomeroy J, Rosen SM, Silva H, Shaldon S.
Br J Urol. 1965;37:325-30.

29 Regular haemodialysis in the treatment of chronic renal failure.
Kerr DN, Elliott RW, Swinney J.
Proc R Soc Med. 1966;59:667-70.

30 Dialysis encephalopathy, bone disease and anaemia: the aluminum intoxication syndrome during regular haemodialysis.
Parkingson IS, Ward MK, Kerr DN.
J Clin Pathol. 1981;34:1285-94.

31 de Wardener
HE http://www.*cybernephrology.ualberta.ca/ISN/VLP/Trans/deWardener* 32 Prototype maintenance haemodialysis unit.
Evans DB, DeWardener HE, Curtis JR, Storey JM, Jennings PJ.
Lancet. 1965;1:1012-3.

33 Grant Williams (2007) Personal communication

34 Blagg CR (2008) Personal communication

35 Goldsmith HT (2009) Personal communication

36 The Scribner arteriovenous fistula for haemodialysis.
Chisholm GD.
Br Med J. 1961;2:30-3.

37 Calne RY (1963) *Renal Transplantation.* Baltimore: Williams & Wilkins

38 Crowther S M, Reynolds L A, Tansey E M. (eds) (2009) History of Dialysis in the UK: c. 1950-1980. Wellcome Witnesses to Twentieth Century Medicine, volume 37. London: Wellcome Trust Centre for History of Medicine at UCL: p. 23.