Historical Aspects of Peritoneal Dialysis in Australia: Useful Lessons for Current and Future Nursing Practice

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Abstract

Increasing numbers of people require renal replacement therapy for end stage renal disease (ESRD) in Australia. However, despite more than 25 years experience with peritoneal dialysis, the number of people using this modality as their primary treatment source is not increasing. This paper traces the historical development of peritoneal dialysis in Australia and in particular focuses on the evolution of the connect and disconnect systems. The role of the peritoneal dialysis nurse throughout the rapid changes that have occurred in this form of renal replacement therapy is explored together with the current challenges they face in order to educate people to safely self manage peritoneal dialysis in their homes.

Key Words
End Stage Renal Disease (ESRD), Continuous Ambulatory Peritoneal Dialysis (CAPD), nursing

Introduction

Continuous ambulatory peritoneal dialysis (CAPD) was originally promoted as a "continuous portable, simple and potentially inexpensive dialysis system" for treating patients with end stage renal disease (ESRD) (Popovich, Moncrief, Nolph, Ghods & Pyle, 1978, p. 455). This revolutionary, simple dialysis regimen showed initial promise and a viable alternative to the constant problem of limited in-centre haemodialysis places. Everyone with ESRD could potentially have CAPD, thus allowing relatively unlimited numbers of people who required dialysis therapy to have dialysis in their own homes safely and effectively. The nephrology nurses, who began to manage the CAPD programs in Australia, wholeheartedly embraced CAPD because they felt that they were able to make a significant contribution to the nephrology team in the form of patient education for home based dialysis therapy and improvements in the quality of life of people with ESRD.

The use of CAPD continues to be controversial for nephrology nurses, even after 25 years of experience in Australia. CAPD continues to play a significant role in the treatment of people with ESRD. However, the promise envisaged in that CAPD would suit everyone with ESRD has not been sustained even with progressive developments in peritoneal dialysis system connection technology. To appreciate the significant contribution that nephrology nurses make to a successful peritoneal dialysis program, this paper describes the journey that nephrology nurses have taken in the process of educating patients in the use of different peritoneal dialysis exchange systems. An overview of peritoneal dialysis in Australia is described and traces the evolutionary journey of CAPD. This will be followed by an examination of Peritoneal Dialysis (PD) nursing practice and the current challenges confronting these nurses as they endeavour to equip people with ESRD with the skills to perform their dialysis safely, effectively and independently in their own homes.

Peritoneal Dialysis in Australia

The number of people requiring replacement therapy for ESRD in Australia is increasing and as Winchester (2002) explains, this trend is due to the acceptance of the frail and elderly onto ESRD programs and the worldwide diabetes epidemic (Simeon & Bakris, 1997; Plummer, 2001). In 2002, for example, the mean age for new patients was 59.3 years with a median of 62.2 years of age (McDonald & Russ, 2003a)

McDonald & Russ (2003) further explain that the age range that had the greatest increase was the 65 - 74 age group with

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one third of all new patients having the co-morbid condition of Type II diabetes.

PD is an effective dialysis modality that can be tailored to the person's social situation (Heaf, 2004). However, several authors have indicated that despite repeated efforts to promote PD as an initial treatment for ESRD, the percentage of people receiving PD worldwide is decreasing (Troidle, Gorban-Brennan, Kliger & Finkelstein, 2003; Hall et al. 2004. In Australia only 14% of people with ESRD are receiving CAPD and a further 8% are being treated with automated cycler peritoneal dialysis (Excell, Johnson & McDonald, 2004).

A significant limiting factor in the growth of the number of people performing CAPD has been peritoneal dialysis related peritonitis (Troidle et al. 2003). Touch contamination of the dialysis ports at the time of connection or disconnection can result in infection of the peritoneal membrane (Thomas & Harris, 2002). To prevent this type of infection, patients in Australia are strongly advised to perform a sterile hand wash and apply an alcohol based hand rub prior to and during the dialysis connections. For those individuals on CAPD who have good eye to hand co-ordination and are using the one connection double bag exchange dialysis system, peritonitis rates can be as low as one episode every 24 months (Heaf, 2004). Yet peritonitis continues to be a major complication for many on CAPD and as Troidle et al. (2003) indicate "the overall outcome of peritonitis is unacceptable" p 428.

Historical Overview of Peritoneal Dialysis

Nephrology nurses have been integral to the development and success of PD programs both within the hospital setting and at home. During the 1970's intermittent PD became an alternative treatment option to haemodialysis (HD) for ESRD in Australia.

At that time, the patient was admitted to the renal unit for insertion of a hard straight rubber catheter and this was followed by hourly cycles of a dextrose rich solution (dialysate) manufactured in glass containers (Maxwell, Rockney & Kleeman, 1959; Boen, Curtis, Tenckhoff, & Shilipetar, 1964). This type of PD was administered in the hospital by the nephrology nurse and although patients were in hospital for the duration of the treatment, they were not actively involved. Hourly cycles (usually 20-30 per treatment) were considered the only available method for removing sufficient urea, creatinine, potassium and fluid to sustain life (Macdonald, 1997).

The first major development in the management of people receiving PD came in 1973 when Henry Tenckhoff and Thomas Schecter (Tenckhoff & Schecter, 1973) first described the use of a straight catheter made of silicone as a permanent access device for intermittent PD. The catheter could remain indefinitely within the peritoneal cavity, exit through the abdominal wall and could be inserted into the peritoneum either at the bedside or under a general anaesthetic. This catheter was refined in the early 1980s by adding two Dacron® cuffs which were fixed to the subcutaneous segment of the external lumen of the catheter (fig 1). The purpose of the cuffs was to provide a barrier which prevented bacteria tracking into the peritoneal cavity from the external point of entry, thus reducing the risk of exit site infection and peritoneal dialysis-associated peritonitis. Despite attempts by others to develop a superior method of accessing the peritoneal cavity, this original design continues to be used in renal units around the world (Caring for Australians with Renal Impairment, CARI Guidelines, 2004).

Figure 1. Peritoneal Dialysis Catheter

The next development was the introduction of the Continuous Ambulatory Peritoneal Dialysis (CAPD) system of PD. This method of extended dialysate dwell times meant that patients could have their dialysis continuously at home; no hospital bed was needed and the number of patients requiring CAPD treatment would not be limited by the availability of hospital resources. Popovich et al. (1978) were able to demonstrate that the continuous method of longer dwell times provided adequate removal of nitrogenous wastes and fluid to sustain life but they acknowledged that episodes of peritonitis would be a limiting factor.

The next evolutionary step was the introduction of plastic containers instead of glass bottles for the dialysate. Dimitri Oreopoulous (Macdonald, 1997) described how plastic containers could be folded and placed under the patients clothing during dwell phases. Having the plastic container attached to the dialysis transfer set maintained asepsis by protecting the spike from touch contamination. The use of plastic bags further facilitated the ambulatory nature of CAPD as this change in technology enabled people to move around freely in between cycles and avoided the need to carry heavy glass containers. This system was known in Australia as Travenol System I® (fig 1) and was the first CAPD system used in Australia. Although the use of plastic containers reduced the incidence of

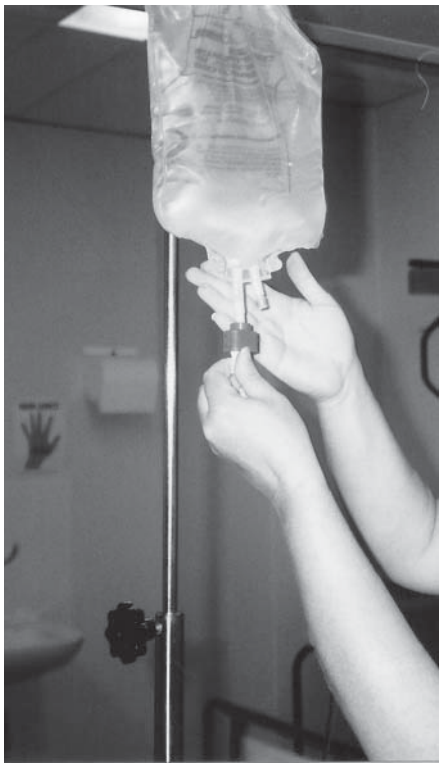

Figure 2. System III

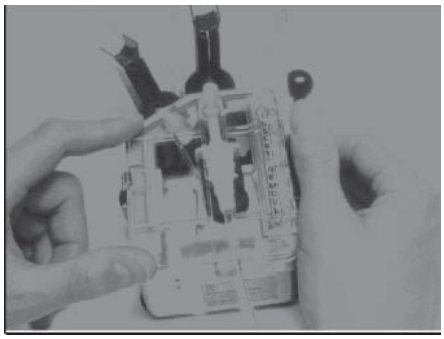

Figure 3. CXD

peritoneal dialysis-associated peritonitis (Macdonald, 1997), problems with the early spike connections resulted in accidental spike disconnection (Thomas & Harris, 2002). Namely, the spike could fall out of the plastic container as there was no locking device to secure the transfer set within the container.

Patients would then unwittingly reinsert the contaminated spike into the container and an episode of peritonitis appeared within a 48 hour period. To prevent accidental disconnection of the spike, nephrology nurses advised patients during the CAPD education phase to ensure no strain was placed on the spike/container connection when hanging the container up prior the infill phase. The CAPD education included advice that strongly recommended that disconnected transfer sets were not to be replaced but the patient was to attend the CAPD unit for a transfer set line change and further instruction was given in the recognition of the signs and symptoms of peritoneal dialysis related peritonitis.

The System II Travenol® system was introduced briefly in 1984 and incorporated a luer lock to twist the line into the container. This system, though designed to stop the transfer set from falling out of the dialysis container, had no impact on the peritonitis rate and was subsequently replaced by System III®. This peritoneal dialysis system, also developed by Travenol® (later Baxter Healthcare®,) employed a connection shield which locked the spike into a remodelled port of the dialysate container (fig 2). This technology greatly reduced the risk of spike disconnection and became the standard for CAPD for much of the 1980's and early 1990's.

To assist patients with dexterity and visual problems, Baxter Healthcare released onto the Australian market a number of innovative connection assist devices. The first was the Compact Exchange Device® (CXD). This small box shaped device assisted the patient to transfer the spike safely from the used container to the new container using a pull push lever (fig 3).

But this device had little or no impact on the peritonitis rates and further developments in exchange devices were aimed at sterilising the spike during transfer, resulting in the release of the Ultra Violet Exchange Device® (UVXD) (Baxter Healthcare) (fig 4). The UVXD bathed the spike in a continuous stream of ultraviolet light while the spike was being transferred from the used container to the new container.

The UV Flash® (Baxter Healthcare) later superseded the UVXD by directing the ultraviolet light to the spike using intermittent UV light pulses (fig 5).

Though helpful and innovative, these exchange devices added to the complexity of the exchange procedure, were heavy to carry, limiting the portability of the treatment and came at a significant extra cost to the patient. For these reasons many renal units in Australia did not use exchange devices and with the advent of the luer lock disconnect system these devices become obsolete.

In 1986, the System II 'O' Set ® (Baxter Healthcare) became available in Australia (fig 6). Disconnect systems had the advantage that there was no longer a requirement to wear the long transfer set and plastic bag under clothing during dwell phases. The long transfer set had been replaced with a shorter line known as the miniline transfer set. Nephrology nurses embraced this new technology enthusiastically. The 'O' Set system also introduced the 'flush before fill' principle which provided an opportunity where any technique related skin contaminants to be flushed into the drainage container, bypassing the patient and was instrumental in reducing peritonitis rates (Bazzato et al., 1993). The 'O' Set® system had an added feature in that for sterilisation purposes, each connection was placed in an organiser box containing bleach prior to each exchange. Unfortunately, repeated accidental flushing of bleach into the peritoneal cavity resulted in episodes of sclerosing peritonitis (Rigby, 1997). Consequently the use of this innovative connection system was short lived and very soon removed from the marketplace. When the system was removed, patients using the 'O' Set® system were transferred back to system III until other disconnect system became available.

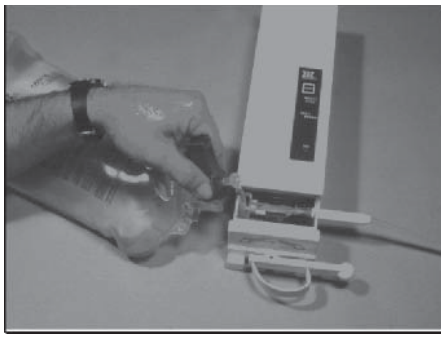

Figure 4. UVXD

Figure 5. UV Flash

The next innovation was the Ultraset® which was released in Australia in the early 1990's. This bleachless disconnect system came with a closed drainage bag attached. However, two connections were still required at each exchange; one to the new container and one to the miniline. The Ultraset also utilised the "flush before fill" principle to flush touch contaminants from the two connection sites into the drainage container (Burkhart, Hylander, Durnell-Figel & Roberts, 1990). However, this system was considered too expensive to use in most renal units in Australia. Instead the "Basic Y" ® (Baxter Healthcare) was released onto the market where the patient kept their empty used container. This system required three connections at each exchange; a connection to the new container, the miniline and to the used container (Harris, Yuill, Connolly & Hunt, 1997). Multiple connections complicated the dialysis exchange procedure and increased the risk of episodes of touch contamination peritonitis despite the use of the flush before fill principle.

In 1994, Freeline Solo® (Baxter Healthcare) was released onto the Australian market. The Freeline Solo was revolutionary in that the new dialysate and drainage container were already attached to the tubing set and only required the patient to make one connection to the miniline. Successful clinical trials demonstrated that the extra cost associated with the one connection double bag disconnect system was outweighed by the significant reduction in peritonitis rates (Harris, Yuill, Connolly & Hunt, 1997). For example, Keirnan, et al. (1995) demonstrated in their study that patients using the one connection double bag disconnect system experienced only one episode of peritonitis every 33.9 patient months compared to the Ultra Y-set® (Ultraset®) (Baxter Healthcare) one episode of peritonitis every 11.7 patient months As a result of these prospective randomised clinical trials, one connection double bag systems have become the standard CAPD system in Australia.

From a cost point of view, PD has been described as a significantly cheaper form of renal replacement therapy than HD. However, cost analyses have demonstrated that although PD is less expensive than HD as a renal replacement therapy, these reductions in costs are negated by the number and frequency of complications (Blake, 2002). Blake suggests that the optimum approach is to offer patients PD initially and then arrange an orderly transfer to haemodialysis when complications arise. This approach is associated with a higher patient survival rate due to the well known advantage that PD preserves renal function longer than HD (Blake, 2002). Unfortunately, the orderly transfer of patients from PD to HD is sometimes delayed due to the unavailability of HD spaces. On these occasions nephrology nurses must use their ingenuity to keep patients as healthy as they can, whilst on a dialysis modality that no longer suits them.

Figure 6. O set

Nursing Practice Issues

As new CAPD units were being set up in Australia in the early 1980's, a small group of nephrology nurses in selected renal units were given "on the job education" on how to educate CAPD patients and manage them in their homes (Hall et al. 2004).

Nephrology nurses had to learn the intricacies of the new dialysis connection systems and then teach the patients the various complexities of the different CAPD exchange systems. As well, the other important facets of managing CAPD at home included education about the dietary, fluid and medication regimens associated with CAPD treatment as well as the early recognition of complications such as peritonitis (Klang, Bjorvell, Berglund, Sundstedt & Clyne, 1998; Curruthers & Warr, 2004). Nephrology nurses use a partnership model in their patient education programs as successful CAPD depends upon the patient taking responsibility for their dialysis regimen and diligence in problem solving. When CAPD was first introduced in Australia, postgraduate education related to CAPD was unavailable. Even today this deficiency in CAPD nurse education continues (Hall et al. 2004). The most common method of problem solving was for the CAPD nurse to telephone other CAPD nurses to discover how they handled similar problems.

Patients requiring CAPD need to have sufficient knowledge, and skills to enable

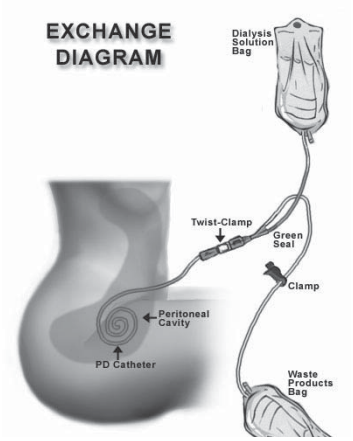

Figure 7. Freeline Solo

them to carry out the treatment in their home without the direct supervision of the CAPD team (Klang et al. 1998). The nephrologist is responsible for prescribing the dialysis therapy and takes the overall responsibility for the patient's care. However, the CAPD nurse has the duty of care of delivering the correct dialysis prescription and teaching the patient or significant other how to perform their dialysis safely so that they can return home (Hall, et al. 2004). Clearly, nephrology nurses in Australia have taken this up challenge willingly and enthusiastically.

One of the greatest rewards for being a CAPD nurse is to teach a person with ESRD, who was critically ill, how to perform their CAPD safely and effectively and then to facilitate their return home to their family in a reasonable state of health and rehabilitation. However, nephrology nurses are often disappointed when patients come off the CAPD program due to complications. Strong relationships between the patient, their families and the nephrology nurse are formed during the education process and home management phase

Current Challenges

CAPD programs would not be possible without the specific contribution of dedicated nephrology nurses who are responsible for the initial CAPD education as well as continuing management and support on an outpatient basis (Farina, 2004). Throughout all of these developments in CAPD, nephrology nurses have been working as part of the multidisciplinary team meeting the many challenges that present in educating patients who enter the CAPD program (Klang, et al. 1998). Some of these challenges include developing appropriate patient education/teaching strategies and assisting the increasing number of Indigenous Australians (McDonald & Russ, 2003b) and older patients with ESRD (Bevan, 2000).

The nephrology nurse has the responsibility for the individual tailoring of the PD education program to suit different learning styles and developing methods which will make the PD experience a success. Hall et al. (2004) compared an adult learning theory-based curriculum with that of the standard CAPD education program. Their study found that even though the adult learning theory-based education was longer (29 hours) compared with standard CAPD education (22.6 hours), there was no statistical significance in the peritonitis rate.

However, the dropout rate from CAPD for the group who undertook the adult learning theory-based education was significantly less than the standard education group. This was due to the earlier detection and treatment of CAPD related peritonitis episodes. These earlier interventions resulted in less catheters being removed.

Despite the risks associated with PD, increasing numbers of Indigenous Australians with ESRD, living in remote locations, are offered CAPD. This treatment has the advantage of enabling the person to return to their community and continue their dialysis regimen with the support of family and friends. However the ability to create and maintain a sterile technique in these remote communities is influenced by the limited access to fresh running water and other sanitation conditions. These issues may account for the high number of catheters (52%) being removed due to peritonitis (Lim, 2004). Rural nephrology nurses are constantly challenged to devise methods which will assist these people stay within their community and maintain their dialysis therapy safely and effectively.

The success of PD is however, threatened due to the increasing number of elderly and frail people being admitted to peritoneal dialysis programs. The inability of this group of patients to perform PD safely has a significant impact on their risk of developing CAPD related peritonitis. Increasingly significant others (e.g. family members) must take the responsibility for the success of the dialysis therapy. If no other person comes forward, many elderly people find that they have to enter some form of residential or hostel care primarily to have their dialysis managed. Nephrology nurses are also constantly challenged to create innovative methods in order to keep elderly people with ESRD on CAPD in their homes.

From a different perspective, Heaf (2004) suggests that some 20% of patients presenting with ESRD will be unsuitable for peritoneal dialysis either due to abdominal problems such as herniation or multiple abdominal operations, physical disabilities such as hemiparesis from previous cerebrovascular accidents, or psychological problems such as dementia or depression. However, Shetty & Oreopoulos, (2000) indicate that these potential problems should not be a total contraindication to peritoneal dialysis. Often a peritoneal dialysis catheter is inserted and peritoneal dialysis is commenced on a trial basis (Winchester, 2002). PD is not suitable for all patients with ESRD and only has a limited efficacy in even the most motivated and dexterous individuals (Blake 2002). This issue is significant with the growing numbers of the frail and elderly and Indigenous Australians, entering PD programs on a trial basis. Timely decisions need to be

made as to how and where these people are going to be dialysed when CAPD fails.

Conclusion

Since the introduction of CAPD in Australia, the contribution of nephrology nurses within the renal treatment team remains largely invisible. Nephrology nurses demonstrate significant knowledge, skills and ability to equip patients to perform their dialysis safely and independently. Nephrology nurses must continue to be proactive in their practice (Bull & Fitzgerald, 2004) so that other members of the renal team, including, nephrologists can more fully appreciate the contribution these nurses make to a successful CAPD program.

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