ONCOLOGY

The requirements of antimicrobial catheter lock solutions:

What should they do and what can they do?

Catheter lock solutions are instilled into central venous access systems to have certain effects in this location. These access systems can be either dialysis catheters, Hickman-type lines or port-a-cath systems. The latter are used mainly in parenteral nutrition and for the administration of medication in oncology patients. These access systems are approved as medical devices and are CE marked. The central venous access is inserted in the subclavian, jugular or femoral veins.

The use of Antimicrobial Lock Solutions have been recommended in the “Hygiene Guideline complementing the German Dialysis Standard” and in the Position statement of European Renal Best Practice (ERBP)”. Pure heparin solutions containing no antimicrobial agent do not meet this criterion. Antibiotics are associated with the development of resistancy which is a major drawback. Highly concentrated citrate solutions and taurodilin-citrate solutions are therefore conceivably useful in this application.

Highly concentrated citrate solutions (30% and 46.7%) cause major adverse effects such as cardiac arrests and embolisms that are a significant risk for the patient. TauroLock™ as an antimicrobial lock solution has proven useful in dialysis, oncology and parenteral nutrition for many years and has meanwhile become established in the prevention of catheter-related infections.

TauroLock™ prevents catheter infections:

ONCOLOGY

DIALYSIS

PARENTERAL NUTRITION

Rollex Group Australia Pty Ltd
NSW, QLD, ACT & WA Sales Office:
11 Vangeli Street, Arndell Park NSW 2148

VIC, SA, TAS & NT Sales Office
3/16 Curie Court, Seaford VIC 3198

Ph: 1300 880 441 | Fax: 1300 880 451
Mobile: 0413 556 848
Email: dpashuwala@rollexmedical.com

TauroLock™ is safe: The concentration of 4% citrate in TauroLock™ is safe and efficient - according to the recommendation of the FDA [ref.: FDA Warning Letter, April 2003]. No hypocalcaemic effects are observed in contrast to highly concentrated citrate solutions (30% resp. 46.7%) e.g. arrhythmia, cardiac arrest, emboli, tingling fingers and metallic taste. TauroLock™ is biocompatible and non toxic. In contrast to highly concentrated citrate there is no protein precipitation if using TauroLock™.

In-centre night dialysis program: a single-centre experience

Tania Burns, Shelley Tranter & Vishwas Raghunath

Submitted: 27 April 2017, Accepted: 9 June 2017

Abstract

The number of people receiving maintenance haemodialysis (HD) in Australia has increased from 251 per million population in 1995 to 515 per million population in 2014. In-centre night haemodialysis (INHD) was introduced in one unit as a response to the rising numbers of people requiring HD.

This study was designed as a quality project to evaluate a new service and its impact on the patients during the first 12 months of the INHD service. Patients were interviewed at initiation of INHD and then at six and 12 months. Thematic analysis was used to provide a descriptive account of receiving HD therapy in an in-centre environment at night.

Findings of the study showed that INHD has positive effects on physical health and lifestyle, but that patients also experienced new symptoms related to longer hours of dialysis and poor sleep quality. Patients felt isolated from the rest of the dialysis patients and adapted the INHD environment to suit their own personal needs.

INHD is a new approach to the delivery of HD treatments, which has been developed in response to the increasing demand for dialysis services. More study is required into this novel model of care to understand the risks and benefits of INHD to patients and staff, and to optimise the delivery of safe and effective HD.

Keywords

Haemodialysis, night dialysis, patient experience.

Background

The number of people receiving maintenance haemodialysis (HD) in Australia has increased from 251 per million population in 1995 to 515 per million population in 2014 (Australia and New Zealand Dialysis and Transplant Registry, 2016). The 2014 NSW Dialysis Capacity Audit has shown an increase of 4.6% per annum in the number of people receiving HD in public in-centre or satellite HD units, with 27% of units operating at or greater than 100% capacity (ACI Renal Network, 2016). Patients on maintenance HD continue to have a high morbidity and mortality, despite advances in dialysis technologies (Steenkamp, Rao, & Roderick, 2015). The symptom burden related to dialysis is high (S. Davison, Jhangri, & Johnson, 2006; S. N. Davison & Jhangri, 2010), including fatigue (Jhamb, 2009), disrupted sleep (Unruh et al., 2008) and depression (Hedayati, Bosworth, Kuchibhatla, Kimmel, & Szczech, 2006); often resulting in a low quality of life (Cruz et al., 2011). It is well known that longer and/or more frequent HD is associated with better clinical, biochemical and health outcomes compared to conventional in-centre HD (Korhenda, Gavaghan, Garfield, Poret, & Sood, 2012). With an ageing dialysis population, including an increased number of people with high levels of co-morbid disease, the philosophy of encouraging home-based renal replacement therapy (RRT) options such as peritoneal dialysis (PD) or home haemodialysis (HHD) as a first choice for RRT has become problematic. Many of these people are...
unsuitable to perform dialysis safely at home and consequently there is greater demand on in-centre and satellite HD facilities.

In-centre night haemodialysis (INHD) allows patients to dialyse for an extended period of time in a dialysis unit overnight. In comparison to nocturnal HHD, INHD is performed for extended hours but only three times per week, resulting in an increased dialysis dose, but with no increase in the frequency of dialysis sessions. The current literature supports the fact that INHD can be beneficial for the patient, with reported improvements in clinical (blood pressure and cardiovascular factors) (Alloatti, Molino, Manes, Bonfant, & Pelli, 2002; E. J. Lacson et al., 2012; Rocco et al., 2011), biochemical (anaemia and phosphate control) (David, Kuempers, Eisenbach, Haller, & Kielstein, 2009; Ok et al., 2011; Powell et al., 2009) and quality of life domains (Walsh, Culleton, Tonelli, & Manns, 2005). There is also evidence to show improvements in cognition (Jassal, Devins, Chan, Bozanovic, & Rourke, 2006), sleep quality (Koch et al., 2009), patient morbidity, hospitalisation rates and mortality (E. Lacson, Jr. et al., 2010) with the use of INHD.

The study renal service is situated in Sydney, Australia. It has a 32-station in-centre HD unit and 12-station satellite unit, and provided two HD shifts daily for six days in a week. The rising numbers, compounded by the unsuitability of patients for home therapies, resulted in these in-centre and satellite positions reaching capacity in early 2015. There was a need to provide HD for new end-stage kidney disease (ESKD) patients but no capacity to enlarge the built space. As a result of these circumstances, an INHD shift was developed, with eight people commencing in April 2015, expanding to 12 people in October 2015.

Literature review
Nocturnal HD has long been recommended for those patients who perform HD independently at home (Agar et al., 2003). It involves 6–8 hours of dialysis 3–7 nights per week (Toussaint, 2010) and its reported benefits include improvements in serum biochemistry, fewer food and fluid restrictions, improved sleep patterns, better sense of well-being, increased appetite and energy levels, clearer thoughts, improved memory and fewer medications (Agar et al., 2003; Thomas, Chan, Hunks, & Zheng, 2007). It has been suggested that people receiving ≥16 hours per week of HD have survival rates comparable with those of deceased donor transplant recipients (Pauly, 2013). Although later studies have not confirmed these findings, increased dialysis dose has been associated with better treatment and patient survival (Marshall et al., 2016; Tennankore, Kim, Baer, & Chan, 2014).

The use of nocturnal HD in a hospital or satellite unit setting has not been widely reported. One in-centre unit in Connecticut, USA, started INHD in May 2005, offering three-eight-hour sessions of dialysis per week to 16 patients (Troidle, Hotchkiss, & Finkelstein, 2007). A review after two years found decreased usage of phosphate binders, improved blood pressure control, lower ultrafiltration rates and quicker time to recovery after treatment. INHD did not appear to have any negative effect on quality of life and the patients rated it positively. Another paper from this unit reported difficulty sleeping as the major problem patients had with the programme (Troidle & Finkelstein, 2009b). Patients were sometimes unwilling to dialyse for the full eight hours, preferring to remain on the night shift but dialyse for shorter hours (Troidle & Finkelstein, 2009a).

Another unit in Toronto, Canada, also offered thrice-weekly, eight-hour overnight dialysis (Thomas et al., 2007). Patients reported many benefits of the programme, such as an improved memory and sense of well-being, fewer dietary restrictions and a better appetite. However, they also reported difficulty sleeping on dialysis, with the result that many used sedatives to sleep, and felt sore in the morning after sleeping in uncomfortable positions in case of triggering the machine alarms. Some patients also disliked the social implications of sleeping away from home three nights a week.

In a case-controlled study of 53 patients in Glasgow, Scotland, Powell et al. confirmed that people undertaking INHD showed an increased urea reduction rate (URR) and serum haemoglobin and, therefore, required less erythropoietin supplementation (Powell et al., 2009). In contrast to other studies regarding nocturnal HD, they did not find any difference in serum phosphate, blood pressure control or number of antihypertensive medications. Subjective observation found that people on INHD looked and felt better.

Doss and Schiller (2011) describe the practicalities of developing an INHD programme, including the importance of safe parking and the need for flexible scheduling arrangements to allow greater patient autonomy (Doss & Schiller, 2011). In a small pilot programme, two patients were offered eight hours of dialysis a night, six nights a week (Mudge, Helferty, Wallace, & Ouwendyk, 1997). The personal impact of sleeping away from home six nights was found to be a major drawback, although the patients also reported increased energy levels, less nausea, improved appetite and enhanced libido.

Research aims
The aim of this study was to investigate and describe the experience of INHD from a patient perspective during the first 12 months of the INHD service.

Methods
This qualitative descriptive study aimed to explore the experience of INHD from the perspective of the person on dialysis. The study was conducted between April 2015 and
November 2016. Interviews were used as the method of data collection, conducted at six-month intervals from the beginning of the INHD programme until the end of the first year. Semi-structured questions were developed from the literature to guide the interviewers. The interviews took place in the in-centre HD unit while people were waiting to start their night dialysis. Interviews were conducted by two clinical nurse consultants from the renal department who were known to the participants but who did not have a major clinical role in providing their care. The interviews were not audiotaped but the participants’ responses were scribed by the interviewers.

Ethical approval was obtained from the South Eastern Sydney Local Health District Human Research Ethics Committee to conduct the study as a quality project evaluating a new service and its impact on the patients.

**Participants**

Purposive sampling was adopted to recruit participants for this study. All patients on INHD were invited to participate. Criteria for inclusion on the INHD programme were:

- Able to perform a high level of self-care.
- Stable on usual dialysis regimen.
- Assessed as suitable for HHD but currently unable to dialyse at home due to social reasons.
- Willing to perform night dialysis.
- Would benefit from longer dialysis sessions.

During the study new people joined the cohort, resulting in a total of 14 participants who took part in interviews. Two participants were transplanted, so did not continue with INHD. Only four participants completed all three interviews (Table 1).

**Data analysis**

Data were analysed using a qualitative descriptive approach (Thorne, 2008). The interviews were transcribed and broad categories were identified within the data. Categories were initially broad in order to examine how the concepts within the data related to each other (Hsieh & Shannon, 2005). As experienced renal nurses, the researchers remained reflexive towards their own pre-existing knowledge of HD, and attempted to identify what the participants were communicating at that moment. Links and relationships between categories were identified and the data were organised into themes to provide an account of what it is like to have INHD from the participants’ point of view.

**Results**

**Demographic data**

The average age of the participants was 51 years, with ages ranging from 32 to 69 years. There were eight males and six females. Five participants were in paid employment and nine were unemployed. Six were married and eight were single.

The length of time they had been on dialysis ranged from eight to 94 months, with a median length of dialysis experience of 33 months. Previous dialysis experience included PD, satellite dialysis and in-centre daytime dialysis.

The interview data showed that INHD had both positive and negative effects on physical health and quality of life. The baseline interviews tended to be more positive, with the negative effects appearing in the second and third interviews as people settled in to the new therapy. A summary of the findings is provided in Table 2.

**INHD has a positive effect on physical health**

From the first interview, participants immediately reported the physical benefits of INHD. Seven of the 14 participants described having more energy or feeling less tired since commencing the INHD. Participants found their fluid balance was easier to manage and one person reported an improvement in appetite reflected in an increase in body weight. After just a few weeks on INHD, some participants verbalised that their nephrologists had seen improvements in their pathology results and blood pressure control. This had led to a reduction in the use of phosphate binders and antihypertensive medications, and in greater dietary freedom.

**Table 2: Summary of findings**

<table>
<thead>
<tr>
<th>Positive effects of INHD</th>
<th>On physical health</th>
<th>On quality of life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative effects of INHD</td>
<td>On physical symptoms</td>
<td>On sleep</td>
</tr>
<tr>
<td></td>
<td>Isolated and forgotten</td>
<td></td>
</tr>
<tr>
<td>The participants’ responses</td>
<td>Controlling the INHD environment</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1: Participant interview record**

<table>
<thead>
<tr>
<th>Interview 1 — May 2015 (n=11)</th>
<th>6-month follow-up</th>
<th>12-month follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Interview 2 — Sept 2015 (n=7)</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interview 3 — June 2016 (n=7)</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
INHD has a positive effect on life satisfaction
The greatest positive effect of INHD on quality of life was to allow people more time for non-dialysis activities. Because INHD is performed at night and is combined with sleeping, the daytime hours that were formerly allocated to dialysis were now available for other activities. In the baseline interviews, participants frequently commented on the benefits of having so much extra time. One participant who had previously adjusted his work hours to work three long days and two short days, described the freedom INHD gave him to work normal hours and have time to watch his children play sport on a Saturday. Another participant had time to play golf again, a pleasure he had to forgo while dialysing in the daytime. One busy mother found it easier to take care of her children on INHD as her husband was home with the children at night and went out to work when she arrived home in the morning. Another participant was able to return to full-time employment, which he had not been able to do when dialysing during the day.

INHD has a negative effect on physical symptoms
Concerns about vascular access were commonly reported. Six of the participants spoke about their fear that they would dislodge a cannula while they slept and had thought carefully about the position of their fistula limb and cannulae. Two participants carefully described a position they had found in which they could both sleep and which protected the cannulae, but at the second interview after six months of INHD, 50% of participants with fistulas in their arms still reported having aches and pains from subconsciously protecting their fistula while they slept. One woman with a graft in her thigh found it more comfortable to sleep in a chair to avoid rolling over and kinking the lines. Two participants had developed steal syndrome for the first time and one developed a new skin sensitivity to the paper tape used to secure the cannulae. Four of the participants reported having severe cramps.

INHD has a negative effect on sleep
The negative effects of INHD on sleep generated the largest amount of data at all three interviews, with three sub-themes identified: physical comfort, noise and light.

Physical comfort
Most participants chose to sleep in a bed for INHD. The space could not safely accommodate 10 beds, but as some people chose to dialyse in chairs, the area usually held at least eight people, leading one participant to comment that it was like sleeping in a dormitory. Participants discovered that there were two different widths of mattresses in use and the wider ones were coveted for a good night’s sleep. One man was troubled by the waterproof cover on the mattress and developed a system of using a double-bottom sheet to make the mattress less sticky. Adapting the sleep position to give the best sleep with the least problems for the fistula has already been identified in the theme regarding physical symptoms.

Noise
Noises that disturbed participants on INHD included the noises of the HD machine, the nurses and the other patients. The noise of the HD machine did not only include the machine alarm sounds, but also the usual working noise of the machine, which many of participants had not noticed before when dialysing during the day. The participants identified that one machine model had louder alarms than the alternative model. They even became so tuned in to the machine sounds that one particular machine was identified as noisier than the others.

Other noises highlighted included the nurses and other patients. In particular, patients who snored or coughed and set off the machine alarms were mentioned. Even the fact that the rubbish collectors came in early on a Saturday morning and made a lot of noise was noted as a disturbance to their sleep.

Light
Sleep was also disturbed by the variations in the light around the unit. Because the unit was mostly kept in darkness to allow people to sleep, the nurses had to use flash-lights while tending to patient care. The movement of the flash-lights was a source of disturbance to surrounding patients.

After spending time on INHD, people reported they did not sleep as well as they did at home. Although they appreciated having the extra time during the day, the trade-off was feeling tired because of poor sleep. In the baseline interviews, these disturbances were not major concerns, but in interview two and three (at six and 12 months) the effect of regular poor sleep had become more significant.

INHD patients feel isolated and forgotten
Participants described a sense of disconnectedness from the day shift and a lack of continuity of care. The problems encountered by the night shift were different to those during the day. Some were practical matters, such as running out of blankets and cups. Others impacted their dialysis treatment. In order for the hospital dialysis water system to go through its routine daily cleaning schedule, all the patients had to be off the machines by 5.30 am. When there were problems on the night shift, participants indicated that they felt there was no one to speak to who would follow through on their concerns. The rotating roster meant that different nurses worked every night. People on INHD did not have access to support people, such as the nurse unit manager, vascular access nurse and administrative staff to help resolve the matters that concerned them.
In-centre night dialysis program: a single-centre experience

Controlling the INHD environment

It was interesting to note that by the second and third interviews the participants had developed strategies to adapt the INHD environment. In some cases this was to minimise disturbance and help them sleep while dialysing. The use of ear plugs was common as was the development of sleep positions that were the most comfortable for them and their fistula arms. Participants displayed a detailed knowledge of which machines were noisy, which beds were the most comfortable, which nurses talked loudly and which patients snored. On the request of the people who did not snore, the ‘snorers’ dialysed together in one area of the ward away from the rest. Participants also demanded that the loud machine model, and the one that worked more noisily, not be used at night.

A more extreme example of controlling the dialysis environment was seen in people who adjusted their dialysis hours. Three people insisted on dialysing for short hours similar to daytime dialysis so they could arrive late or go home early. Two others skipped one session a week on a fairly regular basis. They rationalised this by calculating that their weekly dialysis dose was the same as when they dialysed during the daytime. Many of the other participants regarded this behaviour as foolish.

Discussion

By offering INHD it was hoped that as well as providing a solution to the lack of space in the in-centre HD unit, people would be offered a dialysis therapy comparable to nocturnal HHD (Agar et al., 2003), and would therefore experience the same physical and social benefits (Pauly, 2013; Thomas et al., 2007). This study has showed that while people did experience some physical benefits of longer dialysis time, the restrictions of offering the service within the hospital meant that the improvements were not as great as with nocturnal HHD.

With nocturnal HHD people dialyse up to seven times a week, rather than just thrice, and nocturnal HHD sessions last up to eight hours each (Toussaint, 2010). Night HD that takes place within the hospital in-centre dialysis unit is restricted to three sessions per week by limitations of cost and practicality. The length of the INHD sessions is further restricted by the need for the hospital dialysis water system to go through heat cleaning and disinfection every 24 hours. As the unit is in constant use through the daytime, this limits the amount of hours available for the people on INHD.

Some of the physical benefits of nocturnal HHD were seen in this INHD population. There were reported improvements in serum biochemistry results, resulting in fewer food and fluid restrictions, fewer medications, increased appetite, increased energy levels and an improved sense of well-being (Agar et al., 2003).

Participants in this study also demonstrated some negative physical consequences to INHD. The two participants who developed steal syndrome for the first time concluded that it was related to the longer hours of dialysis and the diversion of blood away from the hand in their fistula arm. The cramps experienced by four of the participants may be the result of the differences in fluid and electrolyte movement in longer hours of dialysis. The cramps were managed by regulation of the dialysate sodium and temperature, but remained an intermittent problem. The participant who developed an allergy to the paper tape used to secure the cannulae concluded that the longer hours of skin contact had led to the development of a sensitivity as he had previously used this tape without incident.

The reported improved sleep patterns experienced by people dialysing at night in their own homes was not replicated in the in-centre environment. As with other studies looking at INHD (Thomas et al., 2007; Troidle & Finkelstein, 2009b; Troidle et al., 2007) the participants in this study reported having difficulty sleeping. INHD requires people to sleep in an environment that is not intentionally designed for sleep. The dialysis unit is built in the same footprint as the other hospital wards, but instead of two four-bedded rooms, the dialysis unit has one room with up to 10 beds or chairs. This means that in INHD more people are sleeping in closer proximity to each other than in a regular hospital ward. They are, therefore, more likely to be disturbed when another person requires attention.

In the inpatient setting the nurses were obliged to check on the patients and the machines every hour. While participants acknowledged that the nurses tried hard to be quiet, many of them were disturbed by the nurses rounding hourly or when they were assisting another person. Even the lighting of the unit proved to be a distraction. When the INHD service began, much thought was given to how the unit should be lit during the night. It was decided that for people to get the best possible sleep the main ward lights would be turned off as soon as the patients were on the machine, with the nurses’ station lit by desk lamps. While the darkness did help people get to sleep, it proved problematic for the nurses who did not have enough light to conduct hourly machine checks, and care for people needing attention. The flash-lights used by the nurses to enable them to carry out their work duties safely sometimes disturbed people’s sleep.

The participants resorted to various measures to control their environment and maximise the quality of their sleep, including dialysing less than the prescribed amount of hours (Troidle & Finkelstein, 2009a). People enjoyed the freedom that INHD gave them during the day, but many of them learned that it came at the cost of sleep deprivation, poor quality of sleep and feeling hungover the next day. As well as the practical satisfaction of having more free time, many of these activities
have further reaching effects of improved self-esteem, increased income and less dependence on others.

The feeling of isolation from the rest of the dialysis unit has not been reported before in the literature on INHD. The in-centre unit in this study uses a combination of primary nursing and team nursing as its model of care during the day. Each nurse has their own primary patients, and 3–4 primary nurses are combined in teams. In this way novice HD nurses are supported and there is team member cover when staff are absent (Dobson & Tranter, 2008). Due to the challenges of rostering a service that runs on alternate nights, different staff members are allocated on duty each INHD shift. It is possible that the lack of continuity in the staff exacerbates the feelings of isolation felt by the patients.

**Limitations of the study**

There are several limitations to this study. It is a single-centre study with a small number of participants from one metropolitan hospital in Sydney, Australia. As it was originally designed as a quality activity to evaluate the new INHD service in the first year of its existence, the interview answers were handwritten by the interviewers and the actual words used by the participants were not recorded. More data may have been revealed if the interviews had been recorded and transcribed verbatim. For various reasons, including transplantation, transitioning back to day shift and not attending dialysis on the day of the interview, only four of the 14 participants completed all three interviews, which is a limitation in describing the longer term experience of INHD. Although many findings were reported by multiple participants, it is not certain that data saturation was reached. As such, the findings may not be said to be generalisable, but rather transferable.

**Implications for practice**

The impact of INHD on sleep suggests that careful attention needs to be given to the environment. Factors such as the comfort of the beds or chairs; warmth; proximity to other patients; noise; and light need to be considered. As well as maximising the quality of the patients’ sleep, a safe and practical work environment for the staff must be maintained.

This study emphasises the importance of good communication with INHD patients. While rostering for a service that runs every second night is challenging, there may be benefits to patient care by having nurses that work the night shift regularly who can follow through and develop the INHD service. It may be helpful to identify a key nurse to whom the patients can report their concerns and trust to follow through.

**Implications for further research**

The implementation of INHD presented many practical challenges that are beyond the scope of this paper to describe. Future research could measure the quantitative evidence of the physical benefits of INHD such as pathology results and medication usage. It would also be interesting to describe the experience of INHD from the perspective of the nurses who provide the service or relate the practical challenges of starting the service within an existing facility.

**Conclusion**

This study has described the experience of INHD from the perspective of the people who receive it. There are many positive effects of IN-HD on the patients’ quality of life such as more energy, fewer fluid and dietary restrictions, fewer medications required and more time during the day to spend in activities such as work, caring for children or hobbies. The patients reported the negative effects of IN-HD are physical aches and pains, disruption to sleep and feeling isolated and forgotten. Although patients appreciate having extra daylight hours for activities of their own choosing, many recognise that it comes at the cost of reduced quality of sleep. People on INHD modify their environment to maximise their sleep.

INHD is a new approach to the delivery of HD treatments which has been developed in response to the increasing demand for dialysis services. More study is required into this novel model of care to understand the risks and benefits of INHD to patients and staff, and to optimise the delivery of safe and effective HD.

**Acknowledgements**

Prof Mark Brown, Tracey Blow and the staff of the haemodialysis unit at St George Public Hospital.

**References**


In-centre night dialysis program: a single-centre experience


