The Renal Society of Australasia Journal

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Aim and Scope

The Renal Society of Australasia Journal: Journal of the Renal Society of Australasia is the peak scholarly journal for nephrology nurses and associated professionals to share their ideas and their research to promote evidence-based, high quality care for persons living with renal disease. The Journal provides a national and international forum for the exchange of ideas, practice and research. It is a vehicle for ongoing education.

Articles are peer-reviewed by experts in the field of the submitted work. *The Renal Society of Australasia Journal* is a refereed journal and subject to blind review.

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The Editor welcomes the submission of articles, research papers, case reports, reviews and letters.

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Renal service users' and carers' collaboration to improve education and research in the UK: an update four years on

Melissa Chamney

Chamney, M. (2014). Renal service users' and carers' collaboration to improve education and research in the UK: an update four years on. *Renal Society of Australasia Journal, 10*(3), 102-105.

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Abstract

In 2010 an advisory group was formed of City University London academics, renal service users and carers to create the Kidney Research and Education Initiative. The main aim of the initiative was for renal service user and carer participation in all aspects of the group as well as becoming a centre of excellence for kidney care, education and research, with a specific focus on patient participation in research and teaching. Service users and carers can provide a wealth of knowledge and experience to the training of student nurses.

Keywords

Service users and carers, renal, student nurse education, collaboration.

Background

Academic institutions often involve service users and carers in curriculum planning and teaching activities and this is something the School of Health Sciences at City University curriculum development planning team decided was imperative when developing the latest undergraduate nursing curriculum in 2012. This pre-registration nursing programme has two routes, either BSc (Hons) Nursing or Post Graduate Diploma (PG Dip) in Nursing and each route has three pathways reflecting the three fields of nursing practice (Adult, Child and Mental Health). The Nursing and Midwifery Council (NMC) standards (2010) for pre-registration nurse education require nurse education providers to demonstrate how they involve service users and carers in the planning, delivery, teaching and evaluation of nursing curricula. Service users were involved on the panel during the approval process and continue to be involved with curriculum planning and its delivery, the strategic development of educational activities; recruitment of students, staff development, and the development of practice-based learning documentation and assessment strategies.

Renal National Service Framework

Historically, in the UK, kidney patients have led the way in many improvements to the care of others within the renal community and it was a kidney patient who initiated a coordinated effort by the renal community which led to publication of the first Renal National Service Framework (NSF) in 2004. The Renal NSF provided a solid foundation of principles from which the renal community could advocate for improved services and detailed the infrastructures required for a successful service, including coordinated structured support systems for renal service users. This was taken one step further with the publication of *Kidney Health: Delivering Excellence* (2012), where the renal community drew upon information gained from former NSF successes to articulate its aspirations for the future and provide the framework for a clear, long-term strategy to meet the needs of kidney patients.

Relationship-centred care

Within the School of Health Sciences, service user and carer involvement is strengthened by a set of values incorporated into the latest nursing curriculum based on a commitment to relationship-centred care (RCC), where health professionals and students value and attend to the relationships that form the context of care, including those among and between service users and carers. RCC is hoped to address the public concerns over a suspected lack of care and compassion within some circles of nursing practice and foster service user engagement in decisions about their care. The curriculum is also based on the Six Senses Framework (Nolan *et al.*, 2006) where students are taught alongside the senses framework and should experience a sense of:

- Security — to feel safe
- Belonging — to feel part of things
- Continuity — to experience links and connection

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- Purpose — to have a goal(s) to aspire to
- Achievement — to make progress towards these goal
- Significance — to feel that you matter as a person (Nolan *et al.,* 2006, p. 25)

Standards

The National Safety and Quality Health Service (NSQHS) Standards were developed by the Australian Commission on Safety and Quality in Health Care by discussion and partnership with a wide range of participants including health care professionals and patients. The primary aims of the *NSQHS Standards* are to protect the public from harm and to improve the quality of care provided by health service organisations. When nurses form partnerships with patients and carers, not only can a patient's experience of care be improved and their training can also be more effective (ACSQHC, 2012). These standards provide a useful basis to guide services, not only in Australia but also the UK, where the patient in this context is termed a 'service user'. This includes people who use, have used or have the potential to use health care services. The term 'carer' includes informal carers and parents/guardians of people who use health care services. The importance of involving service users and carers in the education of health and social care professionals has been well documented (Levin, 2004). City University has a long tradition of involving service users with long-term conditions and their carers in the teaching of student nurses in relation to renal care.

User and carer involvement

Involvement of service users and carers in education can test well-established opinions of health professionals, educate students to embrace a more user-centred approach and produce nurses capable of delivering improved and more relevant outcomes for service users and their carers (Tew *et al.*, 2004). Primarily for education providers, particularly those working in higher education, there is the need to meet national requirements such as the NMC (2010) for involving service users and carers in nursing programmes of study in a consistent and meaningful way.

Involvement means different things to different people. Incorporating service user and carer involvement within student nurse education is about influencing their training and helping students develop the personal and professional skills necessary to become better registered nurses and contribute to the improvement of services in the future. Meeting service users and carers outside clinical environments helps students gain a clearer understanding of how conditions can affect people's daily lives (Terry, 2011). It also provides a focus for students to be made aware of the countless tools and systems available to service users and carers to help them manage their long-term condition better so students can then use these to incorporate into the care of people with kidney failure and their extended family and friends (Expert Patients Programme 2012).

The widespread involvement of service users involved in the education and evaluation of a range of health and social care professionals has led to increased monitoring and regulation of service user involvement in the education and training of health and social care professionals (Chambers & Hickey, 2012). This includes assurances that service users and carers are aware of what their role entails, the commitment to their time and also the monetary remuneration (Staley, 2013).

Student nurse renal teaching

In 2010 the Kidney Research and Education Initiative (KREI) members began their involvement with teaching renal care to the pre-registration students in the second year of their programme. As well as involvement with teaching, they have also been involved in curriculum design and contributed to research grant applications (Chamney *et al.,* 2012). One of the KREI academic staff is now employed at Southbank University and has commenced teaching with the KREI service users and carers in 2014.

With this renal collaboration history in mind, in 2013 I decided to open this up further and introduce a programme manager's seminar series based on service user and carer perspectives that runs alongside the Long Term Conditions Module in year two of the nurse training for both BSc (Hons) Nursing and PG Dip Nursing students. The individual sessions include lived experiences of the individual with a long-term neurological condition, a renal condition, living with cancer, specialist support and management of an individual with dementia undertaken by a carer and showing videos of the individual suffering from dementia as she goes about her daily life.

The renal seminar is a mixture of information provided by the renal senior lecturer and a service user alongside photographs of the service user and his carer throughout their renal journey. Students ask interesting and sometimes extremely personal questions and particularly are keen to review his arterial venous fistula. These seminars have been positively evaluated and when the module runs again in late 2014, additional topics including tuberculosis will be added as tuberculosis is on the increase in the east end of London, where many nursing students undertake their clinical placement experience.

Curriculum development

KREI service users and carers have been involved in exploring user experiences of care and presenting this to classes of students for the past three years and have also been involved in the development of patient blogs and websites. Service users and carers were crucial in the development of patient scenarios and provided case study material for the long-term conditions module. The service users involved believe strongly in sharing their knowledge and thoughts with the nursing students. It has been reported as providing cathartic effects resulting from their involvement, including enhanced confidence, self-esteem and feelings of empowerment (Morgan, 2009). Another reason that

service users get involved is that they want to make a difference, to improve the services for themselves and other people and make a change, if possible (Beresford, 2013).

Research

During the past four years, many firsts have occurred with the KREI. Service users and carers were involved in two research grant applications addressing methodological issues. A National Institute Health Research (NIHR) grant was successful: Dr Helen Noble, Queen's University, Belfast. This grant provided £513,000 to undertake the PACKS study exploring quality of life, decision making, costs and impact on carers in patients with advanced kidney disease managed without dialysis.

Service users are regularly involved in health research studies as collaborators and there are an increasing number of service user-led research projects. Results and findings from these studies can offer a good emphasis for teaching and learning activities. The KREI membership is awaiting the outcome of the second grant applications relating to "*peer support of renal patients*" and the outcome of this will be known in September 2014.

Presentations

Members of KREI gave an oral presentation at the INVOLVE conference in 2010. INVOLVE is a national advisory group supporting public involvement in National Health Service (NHS), public health and social care research. The year 2014 saw an innovative seminar series commence at City University, "Exploring innovative approaches to involving patients, service users, carers and the public in health education and research". A renal service user and carer will present one of these seminar series with the renal senior lecturer to an audience of staff and students, not just from the School of Health Sciences but the University as a whole. A blog has been set up to promote and support the involvement of patients, service users, carers and local communities in all educational and research activities across the School of Health Sciences. It includes guidelines, suggestions, useful tips, resources, case studies, research and much more. https://blogs.city.ac.uk/communityengagement/seminar-series/ [accessed 20 March 2014].

At the National British Renal Society conference a presentation was given by two members of the KREI titled "An evaluation of patient and carer involvement in a renal nursing education and research interest group". Four members of the KREI also ran a workshop on "Benefits of service user and carer involvement in renal care" at the International European Dialysis and Transplant Nurses Association/European Renal Care Association (EDTNA/ERCA) conference.

Publications

In 2012, three service users and two academics were involved in the publication of an article "Renal health care professionals, patients and carers collaboration to improve education and research" (Chamney *et al.,* 2012) and the fourth edition of the *Renal Nursing* textbook for nurses (Thomas, 2014) included a chapter on "Patient and Carer Involvement in Renal Care", which four service users/carers of the KREI developed and are cited as the authors.

Other initiatives

KREI members were involved in initiatives, such as the Renal Patient Support Group (RPSG) on Facebook and the Enhancing Care and Saving Lives of people with chronic kidney disease (CKD) (ENABLE) study, which aims to improve the management of people with CKD, where the patient and carer group is chaired by a KREI member and service user. http://support.kidneyresearchuk.org/page.aspx?pid=341

Two other KREI members are the service user and carer representatives on the Adult Programme Committee at City University chaired by the Adult Programme Manager, which involves senior members of the academic team and students to allow all parties to be aware of the latest curriculum developments as well as being involved in changes within the nursing programme.

Evaluation

We had hoped to be able to evaluate the benefits of user involvement in a formalised way, but unfortunately due to constraints within KREI membership, including the deaths of two service users who had co-authored the previous KREI article (Chamney *et al.,* 2012), this was not able to occur prior to funding for this initiative ending. I am hopeful that the developments created during this time by a core group of people will continue into the future and that the development of KREI will influence renal education nationally. None of these things would have been possible without the formation of the KREI or the funding provided by the British Kidney Patient's Association (BKPA).

Conclusion

The past four years have highlighted that service users and carers can provide a wealth of knowledge and experience to the training of student nurses, not only those in the nephrology speciality but for all areas of nursing as has been shown by the introduction of the programme manager's lecture series earlier this year.

"There is great potential to promote the learning of patient-centred practice, interprofessional collaboration, community involvement, shared decision making and how to support self-care" (Towle *et al.,* 2010 p. 64).

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Evolving protocols: utilising free light chain filter treatment for multiple myeloma-associated acute kidney injury

Angela Henson

Henson, A. (2014). Evolving protocols: utilising free light chain filter treatment for multiple myeloma-associated acute kidney injury. *Renal Society of Australasia Journal, 10*(3), 106-109.

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Abstract

Acute kidney injury associated with multiple myeloma does not resolve with traditional haemodialysis, often resulting in stage five chronic kidney disease and permanent dialysis, which is an additional burden for patients with an uncertain future. The porous membrane of the high cut-off (HCO) haemodialysis filter is showing promising results in reducing levels of free light chains in serum and hence reverting acute kidney injury. This article focusses on the HCO haemodialysis treatment from a nursing perspective, outlining treatment frequency, anticoagulant and dialysate changes and the instigation of cytotoxic precautions. Experience gained with HCO filters has resulted in a protocol maximising patient safety and ensuring consistency in practice.

Keywords

Free light chain, multiple myeloma haemodialysis.

Disease manifestations and prognosis

Multiple myeloma (MM) is a type of cancer of unknown cause involving malignant plasma cells in the bone marrow. Although this cause of acute and later chronic kidney disease accounts for less than 2% of the dialysis patients nationally (Grace, Hurst & McDonald, 2011) and up to 10% internationally (Gondouin & Hutchinson, 2011), renal involvement in MM affects a staggering 30–50% of diagnosed patients. International data collection is being undertaken to evaluate if early treatment with high cut-off (HCO) haemodialysis filters may reduce the incidence of acute kidney injury (AKI) in this population. The challenge for the collaborating medical teams is to provide a timely diagnosis and instigation of combined treatments for both myeloma and renal impairment (Cockwell & Cook, 2012). Within our unit the instigation of free light chain (FLC) treatment is discussed by the renal consultant team with consideration given to the degree of AKI, including symptoms such as fluid overload, the patient's current state of health, and the level of FLCs evident. The timing of these interventions, coupled with the current health of the patients makes the course of the treatment and outcomes highly variable.

Cases of MM exhibit an overabundance of one particular immunoglobulin, kappa (κ) or lambda (λ). These immunoglobulins, known as FLCs reach a precipitation point either as MM develops or, because of declining kidney function related to infection, hypovolaemia, hypercalcaemia or medication reactions, resulting in AKI (Hutchinson *et al.*, 2011; Stringer, 2011). The level of FLC which triggers AKI is highly individual and influenced by the extent of compounding factors as mentioned (Hutchinson *et al.*, 2009).

FLCs are excreted in excess in the urine and consequently overwhelm the tubules of the kidney, which is then unable to process the increased amount of FLCs being produced. These FLCs precipitate with proteins to form waxy casts, which, in turn, block the flow of urine and cause interstitial inflammation. FLCs normally have a half-life of two to three hours, but due to impaired kidney function, increased levels will persist for two to three days or until treated (Pratt *et al.*, 2006).

The difficulty in removing the FLC relates to the relatively small size of the protein molecule, weighing κ 22.5kD and λ 45kD, respectively, which are found in similar concentrations in the serum, but with the majority (80%) found extravascularly (Gondouin & Hutchison, 2011). Therefore, traditional haemodialysis-related absorption or removal therapies have been unable to remove FLCs in significant quantities to prevent AKI. Plasma exchange procedures have shown minimal benefit due to the inability to consistently remove the destructive kappa and lambda light chains from both the intracellular and extracellular compartments (Gondouin & Hutchison, 2011). Plasma exchange may only remove 25% of FLCs, whereas specific FLC

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filters are predicted to remove up to 85% (Cockwell & Cook, 2012). Since 2009 the HCO filters with a molecular weight cut-off of 65kD have been more widely available in Australia (Cockwell & Cook, 2012).

The resolution of renal function is reliant on the early and ongoing reduction of FLCs with a 60% reduction (by day 21 after diagnosis) associated with recovered renal function in 80% of cases (Hutchinson, 2011*b*). However, if levels are not reducing, consideration needs to be given if FLCs are clumping into molecules of a higher molecular weight, which may not be able to be removed (Cockwell & Cook, 2012). Those patients that remain dialysis-dependent generally have poorer outcomes with mean survival rates being <1 year compared with those patients with MM alone [overall survival of around 44 months] (Cockwell & Cook, 2012).

Development of treatment methods

Availability of the HCO filters has enabled the unit to implement procedures and processes around the instigation and review of treatment and the required nursing care. Historically, as treatments were being trialled, various strategies were utilised, such as adding the convective force of haemodiafiltration (HDF) in an attempt to increase clearances.

Various strategies have been investigated including use of:

i. *Single filter with surface area (SA) of 1.1m^2 (utilising the dialysis principles of diffusion and absorption)*

ii. *Double filters increasing SA to 2.2 m^2 (utilising diffusion and absorption)*

iii. *Single filter (1.1.m^2 SA) and pre-dilution HDF (utilising diffusion, convection and absorption)*

iv. *Double filter (2.2.m^2 SA) and pre-dilution HDF (utilising diffusion, convection and absorption)*

v. *With increased product availability now a single filter with surface area 2.1m^2 (utilising diffusion and absorption), has resulted in the previous treatments becoming obsolete. This treatment is now solely utilised as the current treatment regime in our unit.*

An international FLC data registry (ReFLeCt) is in place to collate patient data, treatment variabilities and patient outcomes. This will add to the knowledge base established by the EuLITE study, a mulit-centred randomised controlled trial undertaken in the United Kingdom and Germany, the results of which are eagerly anticipated (Hutchinson, Cook, Heyne *et al.*, 2008).

Nursing management

Once the diagnosis has been ascertained as a new or reoccurring presentation, the nephrologist will schedule treatments. Reoccurring disease is less likely to respond to treatment with HCO filters but may be considered dependent on the patient's clinical state. Once temporary central venous catheter (CVC) access is organised, liaison with the oncology unit is necessary in relation to the timing of chemotherapy treatments, and the resultant scheduling of HCO dialysis. Concurrent management plans including chemotherapy and HCO dialysis are considered essential to maximise efficiency of the treatment.

In preparing the filter and equipment, nurses need to ensure that the filter is thoroughly primed to minimise elevations in transmembrane pressure (TMP) during the treatment (which is indicative of clotting). Manufacturers advise to keep TMP greater than 100 mmHg to facilitate FLC flow across the dialyser membrane. Priming fluid is also forced across the membrane to ensure dialyser pores are fully open. Appropriate blood tests are taken (Table 1), the patient is connected to the machine, and treatment is commenced. The appropriate anticoagulant dose is administered with unfractionated heparin being the preferential medication due to ease of use, measurable effect and reversibility.

Table 1: Pathology monitoring regime

Time	Pathology
Pre-HDx	Free light chain (FLC) levels Electrolyte & liver function tests (ELFT) including phosphate, albumin & magnesium *(urgent)* Full blood count (FBC) Activated partial thromboplastin time (APTT)
4hr	ELFT inc. PO4, Alb., Mg *(urgent)* APTT
Post-HDx	FLC ELFT inc. PO4, Alb., Mg *(urgent)* FBC
Ongoing	Activated clotting times (recommended in units with available equipment)

The treatment lasts for eight hours, as extended time increases the rate of FLC removal from the serum, extravascular space and tissues. Blood flow rates ran at 250–300 ml/min dependent on the type of haemodialysis vascular access and patient tolerability, related to intercurrent illness. Blood flow rates remain at the established level for ongoing treatments in order to maximise blood/dialyser contact volume. Clinical observations including blood pressure, pulse, temperature, respirations and oxygen saturations are undertaken every 30 minutes during the first treatment. For ongoing treatments, the patients are individually assessed regarding their response to treatment in order to determine frequency of clinical observations.

Throughout the treatment pathology is reviewed and changes to dialysate occur (Table 2). Various complications, especially disequilibrium symptoms may become evident during the extended treatment time and nurses must independently assess for risk and manage these in consultation with the medical team (Table 3).

Optimum communication and documentation is required to monitor patient progress, evaluate treatment and ensure associated oncology and dialysis appointments are accurately planned. Scheduling of treatment is reviewed at three weeks and planned around guidelines included in Table 4.

Table 2: Dialysate concentration

Electrolyte	**Dialysate additions for extended treatment with HCO filter**
Potassium (K^+)	Additional of 4 mEq/L — diluted at a concentration of 1:35 parts with dialysis water
Phosphate (PO_4)	20–60 ml/5L utilising Fleet additive
Bicarbonate (HCO_3)	Machine settings are often reduced due to potential for alkalosis. Changing bicarbonate settings from the standard 35 i.e. +3 may be lowered to 33 (+1) and possibly as low as 30 (–2)
Calcium (Ca^{++})	Nil changes as results likely to be high due to MM

Once chemotherapy has commenced, patients are considered to be cytotoxic and appropriate precautions for staff safety need to be in place. This includes personal protection equipment for cytotoxic management, and education in the handling and disposal of wastes. Patients will remain cytotoxic for one week after the final dose of chemotherapy; therefore, this is ongoing through the HCO treatment regime.

Not only are patients nervous about pending treatments and their ongoing diagnosis, they are overwhelmed by the myriad of heath care professionals they encounter. It is the dialysis nurses' role to ensure information is clearly and accurately relayed and it is consistent with other team members. Education regarding cytotoxics is provided to the patient and family by oncology staff and reinforced by the nephrology nurses. Clear explanations are required regarding the HCO treatment, care of temporary CVC, and the increased risk of infections due to the patients' immunocompromised state.

Towards the completion of a treatment, intravenous albumin is routinely administered as serum levels decrease due to the high porosity of the HCO membrane (Table 3). On completion, final pathology tests are taken and the patient treatment is completed. The machine is cleaned with an additional, internal bleach disinfection to minimise any build-up of proteins in the dialysate lines. Once completed, dialysate lines are checked for residual bleach before the machine is used again.

Table 3: Nursing management

Treatment considerations for extended treatment time (8 hr) with HCO filter	**Nursing considerations**	**Rationale**
Potential for clotting	Monitoring clotting times and adjust anticoagulant as required	Extended treatment time increases clotting time and changes in coagulation result related to chemotherapy/anaemia
Potential for disequilibrium syndrome	Ensure urea levels reviewed prior to commencement of treatment and monitor patient for signs and symptoms	High urea level and consequent sudden decrease predisposes patients to disequilibrium syndrome
Variable fluid status	Fluid assessment at commencement of each treatment and regular medical consultation	Accurate assessment of ultrafiltration goal will minimise any risks of hypotension, cramps, nausea etc
Electrolyte imbalance	Daily monitoring and adjustments for first week then as individually assessed, dependent on extent of abnormalities	Electrolyte review identifies abnormalities and ensures appropriate dialysate prescription is administered and changed throughout treatment
Significant albumin loss	Monitor levels throughout treatment and electively supplement 1–2 bottles albumin 20% in last half hour of treatment (in line with the EuLITE study)	Due to the high porosity of the filter loss of albumin is evident and should be prevented (Hutchinson, Cool, Heyne *et al.*, 2008)

Patient data

MM is a devastating disease and, coupled with AKI, individuals are faced with multiple health challenges. Whilst FLC treatment aims to resolve the effects of AKI, the progression of MM is a dominant factor in the patient's state of health. Of the 10 patients that were managed in our unit from 2009 to 2012, three withdrew from treatment due to the consequences and negative health effects of MM. Whilst outcome data is beyond the scope of this article due to the small patient numbers, it is encouraging to note that 50% (5/10) of the patients were able to recover renal function and be independent of dialysis, 20% (2/10) remained dialysis-dependent and 30% (3/10) withdrew from treatment.

The age range of patients was 47–83 years, with an average of 64.7 years. Eighty per cent (8/10) were male. HCO dialysis treatment regimens ranged from five to 10 treatments, with most patients receiving the 10 treatments. The variation was related to individualisation of treatments based on patients' results, if a patient chose to cease treatment or was transferred to their home unit in a different city.

Treatment challenges

Disequilibrium syndrome occurred in one patient and was evident by headache, altered thought patterns and mild confusion and was related to due to the extended treatment time. This was negated in the remaining patients (5/10) by having consecutive, shortened haemodialysis sessions for several days prior to the commencement of HCO dialysis. Two patients had recurrence of MM with AKI so treatment was instigated at a lower level of renal decline; one patient did not required dialysis prior to treatment and one patient transferred from another unit and hence prescription of prior treatments were uncertain.

Due to the treatment initiatives to prevent complications (outlined in Table 4) patients did not experience any other side effects from the HCO treatment. However, one patient remained anaemic during this period and declined blood transfusions due to religious convictions. Nursing staff monitored the individual for signs of deteriorating health or increased symptoms but treatment and management of anaemia and changes in chemotherapy were managed by the oncology team.

Table 4: Treatment schedule

Frequency and duration of treatments
Daily for first six days then chemotherapy on the seventh day
Second daily for two weeks, chemotherapy as planned by oncology consultants around dialysis sessions
Three times a week for one week
Review and individualise prescription based on response to treatment Total treatments should be up to one month or a maximum of 18

Conclusion

Developing guidelines and nursing care parameters for the utilisation of HCO filters and eight-hour treatments has ensured ongoing safe practice in patient care. As new equipment and experience is evident, strategies need to be continually reviewed and potential risks identified. As we await further evidence, we will continue to be challenged in providing treatment to patients with MM and the variety of clinical symptoms that impact upon their kidney function.

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Nursing research in nephrology: opportunities and challenges

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Abstract

Over a number of years, several studies have attempted to define research priorities in nephrology. Priorities developed in these studies fall into two general categories: technology or basic science questions, and more broad themes focusing on quality of life. Importantly, those studies that have elicited patient and carer input have consistently identified communication strategies, symptom management, and caregiver burden as areas for improvement. Nursing and allied health staff are particularly well equipped and positioned to research the important questions in these areas.

Keywords

Nursing, research, nephrology.

Introduction

In all likelihood, chronic diseases will be a major cause of morbidity, death and disease over this century (McQueen, 2007). The number of new cases of end-stage renal disease increased 167% between 1989 and 2009, and is projected to further increase over the next 20 years (AIHW, 2011). Clearly then, the need for research into both disease pathogenesis and treatment is as important as ever.

Part of the success of the *RSAJ* is that it has provided encouragement and opportunities to communicate the work of nurse investigators. Examples published in this journal have shown that nursing and allied health staff have a key role in both investigator- and pharmaceutical company-initiated clinical studies. Opportunities exist at every stage of the clinical research pathway, and it is perhaps opportune to review those.

The questions that matter

As a scientist in nephrology, I am frequently asked for research ideas. This seems in many ways a strange question, because my expertise lies in mechanisms more than outcomes. Nevertheless, it is, of course, a question asked by all of us working in health care. Arguably, therefore, the most useful approach is to canvass the opinions of a large range of individuals involved in nephrology. This has been done formally over a number of years, and if nothing else these studies remind me how important it is to step back and re-evaluate what the important questions are. In doing this, three key studies stand out:

In 1999, the American Nephrology Nurses Association (ANNA) used the Delphi technique to identify nursing research priorities. The technique was a stepwise process of refining suggested topics. Ultimately, the investigators identified five priority areas: (1) nursing interventions to prevent vascular access infections; (2) nursing interventions to maintain vascular access patency; (3) educational needs of patients and families; (4) levels of nursing competence and the effect on patient outcomes; and (5) validation of nursing interventions to achieve patient outcomes (Lewis *et al.*, 1999).

Tong *et al.* (2008) importantly recognised that prioritisation of research agendas is traditionally driven by health professionals, with little input by consumers. To address this specifically, they used nine Australian patient focus groups to identify recurrent research topics, and reasons for their choices. Conducted in 2006, participants with chronic kidney disease (CKD) suggested seven research priorities: (1) prevention; (2) better access to and improvement in transplantation; (3) reduction in symptoms; (4) new technology; (5) psychosocial aspects of living with CKD; (6) whole body not organ-specialised care; and (7) improvement in dialysis and caregiver support. Reasoning was based on a number of motivations, including normalisation of life, altruism, economic efficiency, clinical outcomes and personal needs.

The above rationale was also incorporated in a study from the Canadian Kidney Knowledge Translation and Generation Network (CANN-NET) (CANN-NET, 2014). In 2012, a questionnaire was sent out to Canadians on dialysis, their care providers and the clinicians who look after them, asking them to share their ideas about the research that is required to meet their needs. Again, what was important about this study was that it involved patients and their carers, the rationale being that people

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on dialysis and those who care for them "live the disease", and therefore have an important role in helping us understand what they identify as research priorities.

The top 10 research questions identified from the project were: (1) What is the best way to enhance communication between health care professionals and patients and to maximise patient participation in decision-making? (2) How do different dialysis modalities compare in terms of their impact on quality of life, mortality and patient acceptability? (3) What are the causes and effective treatment(s) of, and ways to prevent, itching in dialysis patients? (4) What is the best strategy to increase kidney transplantation? (5) What is the psychological and social impact of kidney failure on patients, their family, and other caregivers, and can this be reduced? (6) What are the best ways to promote heart health in dialysis patients? (7) For people with kidney failure, what is the impact of each of the dietary restrictions (sodium, potassium, phosphate) on important outcomes including quality of life? (8) What are the best ways to manage symptoms in people on or nearing dialysis including poor energy, nausea, cramping, and restless legs? (9) What are the causes and effective treatment(s) of depression in dialysis patients? and (10) What is the best vascular access for people on haemodialysis?

In summary, research priorities developed in the above studies fall into two general categories: technology or basic science questions, and more broad themes focusing on quality of life. Importantly, those studies that have elicited patient and carer input have consistently identified communication strategies, symptom management, and caregiver burden as areas for improvement. An inescapable conclusion is that nursing and allied health staff are particularly well equipped and positioned to research these questions.

Approaches and evidence

Nursing science is a relatively new discipline when considered in light of medical and basic science research, which date back to the 18th century (Heitkemper, 2007). As in nursing research in general, the bulk of nephrology research is descriptive in nature, but it need not be so. The point is that if we want to understand what strategies are working in changing practice to be more evidence-based, then we must test these strategies (Wallin, 2009). This will require hypotheses, randomisation, and statistics, all of which are at first daunting, but rapidly become second nature. In each case they are simply the way in which a scientist eliminates bias. It is these techniques that provide the evidence base to nephrology, and the path to both preventing and improving outcomes in our patients.

Publication

Sharing our results with a broader audience advances our knowledge, and potentially improves our clinical practice. Professional journals like *RSAJ*, and indeed all nephrology journals are valuable both academically and as tools of communication and learning. Specialist journals such as the *RSAJ* importantly also provide local context. The interaction between primary, secondary, and tertiary health care providers, for instance, is vastly different, if not unique, in each country.

Translating best evidence into clinical practice

How this evidence is translated into clinical practice has always been complicated and perplexing (Grol & Grimshaw, 2003; Lenfant, 2003). The development of clinical care guidelines is now a major function of nephrology interest groups worldwide. Reviewing and providing weight to the published evidence is a key plank to developing these guidelines and highlights the importance of professional journals.

Nevertheless, implementation of guidelines is problematic with a number of publications highlighting poor uptake (Grol & Grimshaw, 2003; Lenfant, 2003). Again nursing staff have an important role to play here. Those strategies that work best are ones incorporating a multifaceted and interdisciplinary approach that involve a multiprofessional collaboration (Grol & Grimshaw, 2003). Finally, audit and assessment provide essential feedback (Grol & Grimshaw, 2003), and are in themselves a useful source of quality projects.

As the *RSAJ* celebrates its 10th anniversary, we are reminded how few new journals survive this milestone. Celebrating a decade of continuous publication is a credit to all involved. In 2014 the landscape of academic journals does not even resemble what it was in 2004, but many of the important problems in nephrology remain the same.

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Evaluation of a pre-peritoneal dialysis assessment and education programme

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Abstract

This study formally evaluated our pre-peritoneal dialysis (PD) programme to identify the benefits and challenges of the pre-PD period for patients and families and to discover aspects of the programme which required modification. Evaluation methods included retrospective analysis of patient data, including demographics, issues and outcomes. Patient stories were collected and analysed to ascertain the patients' experiences of the programme and preparedness for PD.

Data for 94 patients were analysed in this study. The average age was 61.6 years and the average eGFR at entry onto the pre-PD programme was 11 mmol/L. The main issue identified for 34 (36%) patients was poor eyesight and 30 (32%) had more than one issue. There were no patients in this study group who were rejected as suitable for a trial of PD. Of the 94 patients, 63 patients progressed to PD with an average time to PD catheter insertion being 61 days. Patient stories revealed three themes: "Support and guidance", "Making the best of a bad situation" and "Lots to learn". Overall, patients were satisfied and welcomed the support of the PD nurses, but, at times, found the information overwhelming.

Modifications have been made to the pre-PD programme and it will remain an integral component of pre-dialysis care with the aim of enabling a smooth and supported transition to PD.

Keywords

Pre-peritoneal dialysis education and assessment, pre-peritoneal dialysis pathway.

Introduction

The use of peritoneal dialysis (PD) has been in decline in Australia over the last decade (Blake *et al.*, 2013; Brown *et al.*, 2013). This is in part due to the increase in the frailty of our patients and the increase in the availability of satellite haemodialysis (HD) centres. In our unit there has always been an emphasis on home therapy first and our PD patient numbers have stayed steady and recently started to climb in comparison with the Australian average. Twenty-four per cent of our dialysis patients are on PD, compared to 19% reported nationally at the end of 2011 (Brown *et al.*, 2013).

Approximately 60% of patients enrolled in our renal service's pre-dialysis programme choose PD as their dialysis option. Once a patient who chooses PD progresses to stage 5 CKD, they commence on a PD pathway, which involves assessment and intensive education. This PD pathway is also offered as early as possible to patients who start dialysis urgently to allow for the smooth transition to PD from HD or acute PD.

Effective and timely preparation of patients for impending dialysis is an imperative in our PD service and it is assumed that patients will start PD well prepared and thus have fewer difficulties with training and lifestyle adjustment. The pre-dialysis period can be very stressful for patients and the stress levels influence dialysis modality choice and preparedness (Harwood *et al.*, 2010; Lo *et al.*, 2008). This is taken into account and support and education are commenced early to allow for optimum patient and family involvement. It is also ideal for patients to receive education before cognitive skills are compromised by more advanced symptoms of renal failure; for example, uraemia (Morton *et al.*, 2010; Bernardini *et al.*, 2006).

The significance of a pre-PD assessment in the literature is to identify whether patients are suitable and likely to succeed at home dialysis (Blake *et al.*, 2013; Home Dialysis Central, 2011; Chow, 2005; Chow & Bennett, 2001). The *Match D: Method to assess treatment choices for home dialysis* is a tool designed to assist health care workers in identifying patients suitable to

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perform home therapies (Home Dialysis Central, 2011). The Australian version of the tool was introduced subsequent to the development of our assessment tool and includes a check list for suitability criteria for self-PD, either continuous ambulatory PD or automated PD and stresses the need to encourage PD after assessing and eliminating barriers. Similarly, the main aim of our pre-PD assessment is to identify any issues that will impede successful PD initiation early and put strategies in place to rectify or modify them.

The pre-PD program

The pre-PD programme serves a number of purposes. Firstly, it provides the opportunity for patients and family to meet the PD staff who will be training and caring for them. The first interview is the first step in the development of a therapeutic relationship with the patient and family (Luongo & Kennedy, 2004). Secondly, the patient and family are educated regarding types of PD, training regime, patient roles, supply of equipment and fluid and pre- and post-PD catheter insertion management. They are supplied with a number of learning resources and encouraged to ask questions. The delicate balance of offering adequate information without overwhelming the patient is a challenge for the PD nurses (Luongo & Kennedy, 2004).

Thirdly, a thorough assessment is performed including a review of hearing, vision, dexterity and mobility. Any impairment is not seen as a deterrent to PD, especially in the elderly and the implementation of assisted PD can overcome many of these barriers (Brown, 2011; Tesar, 2010). Social supports and other psychosocial parameters are also addressed. The patient's support system, especially in the elderly is one of the keys to successful PD initiation (Chanouzas *et al.*, 2012; Lenci & Campbell, 2010).

The fourth action is the determination of *Staphylococcus aureus* (*Staph A*) status via a nasal swab to allow time for eradication therapy. Nasal carriage of *Staph A* is associated with an increased risk of *Staph A* exit site infection, tunnel infections, peritonitis and catheter loss (Bender *et al.*, 2006; Piraino *et al.*, 2005). If a patient has a positive culture, they will commence a week of mupirocin nasal cream application, withhold the cream for one week and then have a repeat nasal swab. If the repeat nasal swab is positive, the same treatment is repeated until the culture is negative (Bender *et al.*, 2006; Piraino *et al.*, 2005). As the initial culture may yield a false negative, a nasal swab is repeated prior to catheter insertion in all patients (Bender *et al.*, 2006).

Lastly, a check of vaccination status ensures that patients have undergone vaccination for hepatitis prior to dialysis initiation (Johnson *et al.*, 2009). Table 1 summarises the components of the pre-PD programme.

The initial pre-PD education and assessment process is conducted by the PD clinical nurse consultant or PD clinical nurse specialist and usually takes two to three hours to complete in one session or more. Once the patient and family have received the education, they are linked in with the service and are supported through the next phase — catheter insertion.

Issues and challenges raised during the assessment process are logged in an action plan to the patient's nephrologist, pre-dialysis nurse and in some instances the interventional nephrologist or vascular surgeon inserting the PD catheter. Some actions will be required by the patient, the carer or family, the nephrologist, general practitioner or the surgical team. The social worker and dietitian have been involved in the pre-dialysis process since the patient's initial visit and they might be called upon to have input into solving particular issues so that dialysis commencement runs as smoothly as possible.

The formal pre-PD programme incorporating patient assessment and education was commenced in 2009. After four years, there is enough data to formally review the programme. This paper presents our formal evaluation of the pre-PD programme, which was undertaken to identify the benefits and challenges of the pre-PD period for patients and families and to discover aspects of the programme which required modification.

Table 1: Components of the pre-PD assessment and education program

The pre-PD programme provides the opportunity for patients and families to:	
1. Meet the PD nurses and other key staff	
2. Receive education regarding:	• the training regime • patient/carer roles and responsibilities • supply of equipment and fluids • catheter insertion — pre- and postoperative management • home dialysis support
3. Undergo assessment including:	• dexterity • mobility • social supports and other psychosocial parameters • hearing and vision
4. *Staph A* status via a nasal swab is determined so that there is time for eradication therapy	
5. A check of vaccination status ensures that patients have undergone hepatitis vaccination prior to dialysis initiation	
6. A number of learning resources are given and questions encouraged	

Methods

Ethics approval was granted to undertake a low, negligible risk research study in November 2013. Data collected on patients enrolled in the pre-PD programme were analysed to ascertain the number of assessments conducted, the demographics of age, eGFR on initial enrolment and the number of issues assessed for action prior to dialysis commencement. The outcomes following initial enrolment were also identified.

Patient and family satisfaction with the programme was evaluated through six patient/carer stories, which were transcribed and themed. The patient story interview was an opportunity to hear the opinions, experiences, perceptions and fears of patients, their families and carers.

Only patients who were known to the service and enrolled on the pre-dialysis programme were included for analysis. Patients who were late referrals (<3 months prior to dialysis commencement) were excluded from the study.

Results

Data analysis

In total, 160 patients have undergone initial assessment and education for PD since 2009. Of these patients, 94 were enrolled in the pre-dialysis programme and had commenced a pre-PD pathway. It was these 94 patients who were included in this evaluation.

Of the 94 patients' assessment information analysed: there were 60 males and 34 females. The average age was 61.6 years, with an age range of 24–87 years. The Average eGFR on assessment was 11 mmol/L (range 3–23 mmol/L). There were 10 (10%) patients who attended an initial appointment at eGFR >15 mmol/L, 45 (48%) patients at eGFR 10–15 mmol/L and 39 (41%) were seen at eGFR <10 mmol/L.

Initial assessment and education was performed with an interpreter in five instances and in most cases a family member or carer was present. In regard to issues discovered during the initial assessment, 30 (32%) patients assessed had no issues identified. The main issue for 34 (36%) patients was poor eyesight. Two or three issues including vision or hearing deficits, dexterity and/or mobility issues and problems with lack of support or inability to have time off work for training purposes were identified in 30 (32%) patients. There were no patients in this study group who were rejected as suitable for a trial of PD. Four (1%) patients assessed had four or more issues identified. Of these four, one patient died before catheter insertion and three progressed to PD with a carer trained.

Patient outcomes

Of the 94 patients, 63 patients progressed to PD with an average time to PD catheter insertion being 61 days and a range from 0 to 578 days. At the end of 2013, 31 patients had not progressed to PD. Of the 31 that had not commenced PD, seven remained active on the pre-PD pathway, two underwent a pre-emptive transplant, six commenced HD (satellite or home HD) due to changing their preferred option over time and 10 opted for no dialysis and the Renal Supportive Care Programme. Six patients died or transferred out of service before the planned PD commencement. Table 2 presents a summary of patient outcomes.

Table 2: Outcomes for 94 patients who were on the pre-PD pathway

Outcome	n=
Progressed to PD	63
Did not progress to PD	31
Remain on a pre-dialysis pathway	7
Pre-emptive transplant	2
Commenced HD	6
Renal supportive care	10
Died/transferred or lost to FU	6

Patient stories

Six stories were collected from patients/carers following commencement of PD and prior to completion of training. The plan was to take 10 stories, but it was identified following six that the findings were identical and the same information was repeated. The interviews were held in a quiet area away from the main unit. All participants signed a consent form prior to providing their story. The average time for the stories was 12 minutes.

The patent and/or carer was asked: "What was your experience of starting PD?"

If they required further prompting, they were asked the question: "Do you think you were well prepared for PD?"

The patients' responses were scribed and then transcribed for analysis and the major themes were:

"Support and guidance":

Lots of information was provided but felt it was surmountable with help of PD nurses and family.

I was given clear and easy to understand resources.

I was taken by the hand and told I could do it.

"**Making the best of a bad situation":**

I did not want dialysis — nobody does.

I did not want to have dialysis but I felt prepared and supported by the PD nurses.

You just have to relax and learn.

"Lots to learn":

There was lots of information.

I could not concentrate so I am lucky my family came too.

Discussion

Most problems which preclude patients for PD can be overcome. Patients who are unable to have PD due to past

surgery or lack of carer have been counselled within the pre-dialysis programme to choose HD or the renal supportive care pathway. This results in patients embarking on the pre-PD pathway with a clear decision for PD and the desire to perform a home-based therapy.

The pre-dialysis period is a very stressful time for patients. Patients have described the period as overwhelming and the information required to process as equally burdensome. They appreciate receiving the information early so that they can synthesise it and start dialysis as prepared as possible.

The theme, *lots to learn,* was identified as needing some action. Traditionally, the initial education material was presented over a period of two to three hours dependent on patient need. The information provided commences with the basic concepts of PD and patients and family often have many questions, leading to an extension of the allocated interview time. In an effort to minimise the time the patient and family spend in one-on-one didactic education, the programme has been modified. Firstly, all patients receive information regarding the PD process during their pre-dialysis clinic appointments. Patients are requested to reread the pertinent information prior to initial interview and compile a list of questions requiring clarification. This provides more structure for the initial interview and aids in addressing the individual learning needs of the patient. The time period for the education session has been capped at two hours with a 10-minute break. If the education or assessment is not complete in the two-hour session, the patient will return for another interview. There is no limit to the amount of time the patient/family might need to cover the key principles and assimilate the information. The process is structured around the individual patient's learning needs.

Patients do not mind receiving the information early when eGFR <15 mmol/L but it has been identified that the renal function of some patients on the pre-PD pathway remains stable over a number of years. For this reason, the education and assessment is repeated yearly or as indicated.

Although the pre-PD pathway commences at eGFR ≤ 15 mmol/L, some patients attended for education and assessment earlier because they had specifically requested to meet the PD staff or have intensive education to assist in decisions regarding modality choice. An eGFR between 10 and 15 mmol/L remains the most appropriate window for education and assessment and allows for a switch to HD and vascular access creation if the patient changes his/her decision or physical circumstances change and they can no longer perform a home therapy. It can be difficult for patients with an eGFR <10 mmol/L to comprehend and retain the information discussed as cognitive skills are compromised by more advanced symptoms of renal failure and the anxiety leading up to catheter insertion. This finding supports those of Morton *et al.* (2010) and Bernardini *et al.* (2006). Patients that experience a sudden decline in renal function will always have education, even if it is immediately prior to catheter insertion.

Conclusions

Findings reveal that if pre-PD assessment and education is conducted in a timely manner there is time to mitigate issues regarding training. Patients who were enrolled in the pre-PD programme and were tracked on the pre-PD pathway felt supported and ready to commence dialysis.

The pre-PD programme will remain an integral component of pre-dialysis care with an aim of enabling a smooth and supported transition to PD. Evaluation of the pre-PD programme will be integrated into our yearly review of the PD service to ensure that we are providing the best possible support and evidence-based care for our PD patients.

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Can 2% chlorhexidine aqueous solution provide better infection control in PD exit site care when compared with 10% povidone-iodine: a single unit experience

Sarah Crawford & Ginger Chu

Crawford, S., & Chu, G. (2014). Can 2% chlorhexidine aqueous solution provide better infection control in PD exit site care when compared with 10% povidone-iodine: a single unit experience. *Renal Society of Australasia Journal, 10*(3), 116-119.

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Abstract

Background: Exit site infection (ESI) is a significant contributing factor to high mortality and poor treatment outcomes in peritoneal dialysis (PD) patients. The aim of this review of clinical practice was to compare the effectiveness of two commonly used antiseptic solutions in PD exit site care.

Objective: To investigate if 2% chlorhexidine aqueous is more effective in PD exit site care when compared with 10% povidone-iodine for treatment of acute and suspected ESIs.

Context: A community dialysis unit and nephrology ward in regional Australia.

Methods: A retrospective review was conducted to compare the infection rate of using two different antiseptic solutions on acute and suspected infectious PD exit site care. From February 2012 a change in clinical practice was implemented; all existing PD patients were switched to 2% chlorhexidine aqueous solution from 10% povidone-iodine for treatment of acute and suspected ESIs. Infection rates were retrospectively identified for patients using 10% povidone-iodine in 2011 and compared with the infection rates for patients using 2% chlorhexidine aqueous in 2012.

Results: ESI rate decreased from 14 episodes (average 1 in 69 patient-months) in 2011 to 5 episodes (average 1 in 165 patient-months) in 2012.

Conclusion: This project provides data indicating that chlorhexidine aqueous is a good alternative antiseptic solution in the management of PD ESI when compared with povidone-iodine. Chlorhexidine aqueous may be more suitable for use as the first-line antiseptic solution on acute exit sites and suspected ESI.

Keywords

ESI, infection, exit site, PD, chlorhexidine, peritoneal dialysis, povidone-iodine

Introduction

Peritoneal dialysis (PD) is an effective treatment for end-stage kidney disease (ESKD) and is a good choice for patients wishing to perform a home dialysis modality (Lee & Park, 2012). PD patients require a Tenckhoff catheter to be inserted into the peritoneal cavity via the abdomen in order to complete this treatment. One of the risks associated with PD catheter implantation is exit site infection (ESI) (Crabtree, Fisherman, Siddiqi, & Hadnott, 1999). ESI is a significant contributing factor to high mortality rates and poor treatment outcomes in the PD population (O'Seaghdha & Foley, 2005); inappropriately treated ESI can develop into a tunnel infection and progress to peritonitis (Hain & Chan, 2013). In many cases, this means increased patient care hours, hospitalisation, and in certain cases catheter removal and modality transfer (Firanek & Guest, 2010). With this in mind, the development of superior infection prevention strategies is integral to the long-term success of PD (Lockwood, Hodgkinson, & Page, 2004).

Literature review

A review of the literature was conducted using a CIAP search system. Search terms used were: Betadine, povidone-iodine 10%, chlorhexidine gluconate 2%, aqueous solution, peritoneal

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dialysis, PD, exit site, ESI, central venous dialysis catheter (CVDC) and haemodialysis. The search was limited to full text articles printed in the English language and published between the years 1990 and 2013.

An antiseptic solution is recommended for exit site care to reduce numbers of microorganisms and avoid ESIs. The use of different antiseptic solutions for PD exit site care has been well discussed by Wong, who concluded that when choosing an antiseptic solution the goal of cleaning should be taken into consideration (2003). It is suggested that clinicians need to have a good understanding on the use of antiseptic solutions at different phases of wound healing; however, there is no clear recommendation on the best antiseptic solution for PD exit site care.

Povidone-iodine has been a favourite in wound management and PD exit site care due to its broad spectrum of germicidal activity including gram-positive and gram-negative bacteria, fungi and viruses (Atiyeh, Dibo & Hayek, 2009). However, research has identified that 10% povidone-iodine is cytotoxic in open wounds and delays wound healing (Wong, 2003; Tomlins, 2008). Apart from the risk of cytotoxicity to the patient, povidone-iodine can be absorbed through the percutaneous and mucous membrane, which can cause hypothyroidism and should be avoided with pregnant women, infants and patients with thyroid disorders (Thornton Spann, Taylor, & Weinberg, 2003; Atiyeh, Dibo & Hayek, 2009). Therefore, it is important that an alternative antiseptic solution is available to this patient cohort.

The literature review revealed minimal research into the use of chlorhexidine for PD exit site care, despite strong evidence from the literature of CVDC and surgical interventions supporting the use of this solution (Bhavan & Warren, 2009; Mimoz *et al.*, 2007; Nishihara, Kajiura, Yokota, Kobayashi, & Okubo, 2012). Moreover, povidone-iodine shows less reduction in colonising skin micro-flora and shorter residual activity when compared with chlorhexidine (Thornton Spann, Taylor, & Weinberg, 2003; Bhavan & Warren, 2009); for this reason, chlorhexidine was considered by the project team as a potentially better solution for PD exit site care.

Project aim

To investigate if 2% chlorhexidine aqueous is a more effective antiseptic solution for acute and suspected infectious PD exit site care when compared with 10% povidone-iodine.

Ethical consideration

Ethics approval was sought due to this project requiring the introduction of a new treatment product and photographing the exit site, and was approved by the Research Ethics and Governance Unit. (HNEHREC Reference No.12/02/15/5.09).

Definitions

There is no current standard definition for acute exit site, as units have different duration of break-in period after catheter insertion (Kopriva-Altfahrt, Konig, Mundle, Prischl, Roob, Weisholzer & Vychytil, 2009). The acute exit site was defined by the project team as the time from the break-in period; usually two weeks post-operation, until the catheter has been inserted for three months. After the three-month period, the exit site is considered healed appropriately to continue with chronic exit site care.

The International Society for Peritoneal Dialysis (ISPD) guideline recommends that healthy chronic PD exit sites do not require regular antiseptic solution; soap and water with daily dry dressing should maintain the cleanliness of exit sites (Li *et al.*, 2010; Tomlins, 2008). As such, in this study the 2% chlorhexidine was only applied to acute exit site and chronic exit sites when pain or inflammation was identified, and regular antiseptic solution was not encouraged as a daily cleansing product for healthy chronic exit sites.

ESI was defined as "the presence of purulent drainage, with or without erythema of the skin at the catheter-epidermal interface." (Li *et al.*, 2010. p. 394). For the purpose of this project, we categorised the definition ESI into early- and late-stage ESI. Early-stage ESI was defined by the presence of pain or redness at the exit-site, and late ESI was defined by inflammation and/or purulent drainage at the PD exit site, confirmed by a positive wound swab and requiring treatment with antibiotic therapy. The Twardowski criterion scales for exit site appearance (Texido & Arias, n.d; Twardowski, 1996) was used by the project team to grade the patient's exit site appearance to identify early signs of ESIs.

Methods

A 12-month retrospective review was conducted in a nephrology ward and large community dialysis centre responsible for an average of 100 PD patients. The project team consisted of a clinical nurse consultant, a home therapies unit team leader and three community home visiting nurses. All patients were switched to 2% chlorhexidine in 2012, excluding patients who were: (1) under 18 years of age,;(2) allergic to chlorhexidine or povidone-iodine solution; (3) outreach home dialysis patients living outside the local catchment area.

All patients had their exit site photographed at the initial consultation to identify what each patient's normal exit site looked like. The photo of the patient's exit site was taken by either the home visiting nurse or the research team member, and entered by the home training team leader in password-protected software.

The patient's exit site was reviewed and monitored for 12 months by a home visiting nurse at each visit. The Twardowski scoring system was used by the project team to identify exit site condition and this was also recorded into PD-specific computer software, together with the picture of the patient's exit site appearance (Twardowski & Prowant, 1996). Pathology wound swabs were used to confirm suspected infection.

Data analysis

PD ESI data were collected by the home therapies unit team leader and recorded using Centre of Excellence PD outcomes data computer software owned by the Baxter Medical Company.

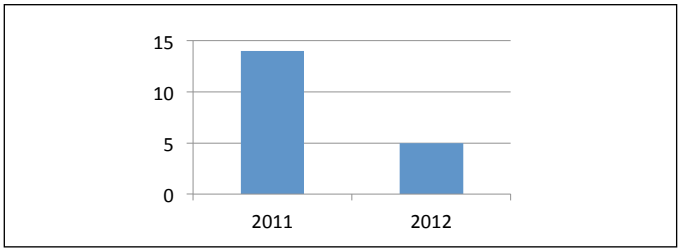
The Centre of Excellence program was introduced by the Baxter Company in 2008 for PD units to keep a record of all key aspects of PD care, including ESI rate, and to promote excellence in PD care across Australian and New Zealand

dialysis units. It is recognised software used in various PD units across Australia at the time of study. Unit staff reviewed the data monthly, and the ESI is calculated as patient-months, with the nominator being episodes of infection and denominator as patient numbers.

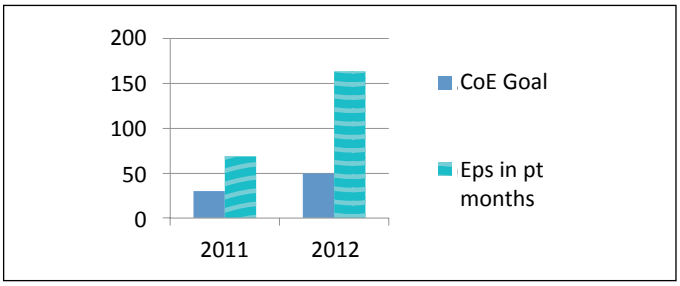
The aggregate rate presented by Centre of Excellence programme was 1 in 30 patient-months in 2011 and 1 in 50 patient-months in 2012. The ISPD recommended the goal of 1 infection in 50 patient-months being the minimum achievable goal for all PD units (Piraino, Bernardini, Brown, Figueiredo, Johnson, Lye, Price, Ramalaskshmi, & Szeto, 2011). The unit's ESI infection rate was benchmarked against these goals.

Results

Twelve months after switching all suitable patients to 2% chlorhexidine aqueous for acute exit site and suspected ESI care, the PD ESI rate decreased from 14 episodes in 2011 to 5 episodes (Graph 1). Due to the variations in PD patient numbers, we also compared the infection rate per patient-months. This result shows the improvement from 1 in 68.6 patient-months to 1 in 163.4 patient-months (Graph 2).



Graph 1: PD ESIs



Graph 2: Infection rate per patient-months

Discussion

There has been limited research directly comparing different antiseptic solutions to PD exit site outcomes in the last decade. The most comprehensive analysis on the use of antiseptic solutions at the acute PD exit site was an article published in *Peritoneal Dialysis International*, which indicated that povidone-iodine is cytotoxic in open wounds and delays the wound healing process (Wong, 2003), and chlorhexidine was found to be low in toxicity when used as a skin antiseptic solution.

The result from our project indicated that 2% chlorhexidine solution may be more effective in managing PD exit site care when compared with 10% povidone-iodine. Even though the results have shown a significant improvement in preventing ESIs when 2% chlorhexidine was used, the authors would like to acknowledge that there are many variables during the project that could potentially contribute to the outcomes presented.

Firstly, the design of a retrospective review has limited the power to directly compare different antiseptic solutions to similar groups of patients (Polit & Beck, 2010). It was not a randomised controlled trial, and the basic characteristics of the two groups reviewed were not comparable with respect to influencing factors such as: age; level of PD knowledge; co-morbidity; and social support, all of which have a significant impact on ESI rates.

Secondly, many studies have shown that chlorhexidine is more effective against gram-positive than gram-negative bacteria; whereas povidone-iodine is broad in both gram-positive and gram-negative bacteria (Atiyeh, Dibo, & Hayek, 2009; Wong, 2003). Without knowing the major organisms that caused ESIs during the review period, the result represents all ESI cases.

Moreover, Bender, Bernardini & Piraino (2006) stressed the importance of home visits in reducing the risk of infection in PD patients. Throughout this project, the team was able to standardise the home visiting nurses' practice in PD exit site care, and increase the number of home visits for patients identified as at high risk of contamination. The authors believe this significantly contributed to reducing the number of ESIs, along with the implementation of using 2% chlorhexidine solution. Further limitations of this project included a small cohort of patients suitable for inclusion and decreased numbers of patients commencing on PD throughout the review period.

In summary, this project provides a small-scale, retrospective comparison between 2% chlorhexidine and 10% povidone-iodine in PD exit site care in a single unit. The results indicated that the introduction of 2% chlorhexidine may be effective in preventing ESI. A larger, longitudinal, randomised controlled trial will be required in future to validate the long-term use of 2% chlorhexidine and its benefits in PD exit site care.

Conclusion

The data presented from this change of clinical practice appears to be promising; however, this does not exclude the limitation of a retrospective review and small patient population. Following the positive outcomes offered through this study, 2% chlorhexidine aqueous has now been implemented as the first-line antiseptic solution for PD exit site care in our local health district. PD ESI rates have remained consistently low. The project team will continue to monitor ESI rates to determine the long-term effectiveness of chlorhexidine on PD exit site care.

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The challenges in preventing infection in peritoneal dialysis: a nurse's viewpoint

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Abstract

The success of a peritoneal dialysis (PD) program depends on a multitude of factors, and prevention of infection is one then. Despite advances in connectology, peritonitis is still the Achilles' heal of PD. The aim of this paper is to review the role of the nurse in preventing infection in PD.

Keywords

Nursing, prevention and control, peritoneal dialysis.

Introduction

The role of nursing in peritoneal dialysis (PD) ensures the prevention of peritonitis and exit site infections by developing sound policies and procedures and effective patient education (Prowant, 1996). However, the successful and effective management of PD requires a multidisciplinary approach with a comprehensive education and training programme and appropriate support systems (Finkelstein, 2006). Nurses are also responsible for maintaining peritonitis data, as well as directing or participating in quality improvement activities. The aim of this paper is to review the role of the nurse in preventing infection in PD, focusing on the major risk factors. These risk factors are divided into three major categories: catheter, patient and programme management.

Catheter-related risk factors

Catheter type, surgical team experience and pre- and postoperative care may influence outcomes. To date, there is no definitive study demonstrating that any catheter type has been proven to be better than another, although evidence is that surgically placed, double-cuff, straight catheters display better survival rates than coiled catheters (Hagen, Lafranca, Izermans, & Dor, 2014; Stylianou & Daphnis, 2014). Importantly, a key to successful chronic peritoneal dialysis is permanent and safe access, and a trusting partnership between the renal patient and renal health care professional (Flanigan & Gokal, 2005). Internationally this has manifested in an increase in the nurse's role coordinating PD catheter insertion under local anaesthesia, ensuring patients have a prompt and safe access in place and having the same practitioner from assessment to discharge (Bowes, 2010).

Infection prevention can be categorised into preoperative, postoperative and chronic care. Preoperative care starts as soon as the patient has decided on PD, with training to be done before or after catheter implantation. Training patients before or after 10 days of catheter implantation has a significant impact on peritonitis rates, as compared to training patients within 10 days immediately after catheter implantation. (Figueiredo *et al.*, 2014). Other preoperative aspects involve prophylactic antibiotics, bowel preparation, laxative use, and exit-site (ES) location determination, preferably downward facing (Bender, Bernardini, & Piraino, 2006; Cho & Johnson, 2014; A. Figueiredo *et al.*, 2010; Piraino, Bernardini, & Bender, 2008; Piraino *et al.*, 2011; Segal & Messana, 2013). Nurses, surgeons and patients should work together to decide the best ES, evaluating patients in the supine and seated positions: avoiding waistline, skin folds and scars, and also giving consideration to the choices and sleep pattern of the patient (Piraino *et al.*, 2011).

Immediate postoperative care involves dressing and catheter immobilisation; chronic ES care involves the use of *Staphylococcus aureus* prophylaxis and daily care of the catheter. One of the most important preventive care measures in post-catheter insertion is the immobilisation or anchoring of the catheter to promote healing and reduce trauma (Bender, Bernardini, & Piraino, 2006; Bernardini, & Bender, 2008). Dressing changes should be avoided in the first week. However, if these are needed, for a soaked or contaminated dressing, only the PD nurses using aseptic technique and a non-irritating cleansing agent should perform this. The dressing should be kept dry and changed only once a week, during the early healing phase,

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except if bleeding, infection or wetness is suspected, using a non-irritating agent (Dombros *et al.*, 2005). There is, however, no evidence to verify that a particular dressing or cleansing agent is superior (Bender *et al.*, 2006; Cho & Johnson, 2014; Piraino *et al.*, 2008; Segal & Messana, 2013). Chronic care of the ES should begin once healing is complete, usually two or more weeks. An international survey showed that gauze was used most frequently for postoperative dressings (75% of adult and 65% paediatric centres), followed by semipermeable dressings (16% adult and 30% paediatric centers) and occlusive dressings (8% adult and 4% paediatric centers). Although the type of dressings used varied by location and differed in paediatric and adult programmes, these differences were not significant (Prowant, Warady, & Nolph, 1993).

Spanish research involving a randomised controlled clinical trial with 60 patients compared ES care using saline and povidone-iodine versus polyhexanide, finding a reduction in peritonitis rates with 1 episode/37 patient-months for the povidone-iodine group in comparison to 1 episode/102 patient-months for the polyhexanide group (Nunez-Moral *et al.*, 2014). Of promise was a small study using sodium hypochlorite (Alcavis 50) to scrub the transfer set connection before and after a PD system connect/disconnect (Clere, 2014; Funes, 2009). Evidence exists to support the use of topical antibiotics either at the catheter ES, intranasal, or both; however, the use of topical antibiotic ointments should be avoided for a polyurethane catheter ES (Piraino *et al.*, 2011; Tacconelli *et al.*, 2003; Xu, Tu, & Xu, 2010). Studies have shown that topic mupirocin ES application is more effective than its intranasal use in reducing *S. aureus* peritonitis (Tacconelli *et al.*, 2003; Xu, Tu, & Xu, 2010). As an alternative to mupirocin, gentamicin cream has also been effective in preventing *S. aureus* infection; despite not been available in many countries, it has show its effectiveness (Bernardini *et al.*, 2005). Johnson *et al.*, comparing the daily application of Medhoney gel at the ES and intranasal mupirocin once a month, have shown that the infection rates and peritonitis were no different between the groups, although the Medhoney group presented more skin irritations and were more likely to withdraw from the study (Johnson *et al.*, 2014). Clearly, nurses should be involved at the start of patient decision making, being aware of catheter types and new technology, participate in development and implementation of protocols and then to assure patient safety through the first phase of treatment.

Patient-related factors

Patients should be allowed to choose the preferred dialysis modality based upon a timely and complete pre-dialysis education. Motivating patients to be involvement in the decision-making process improves compliance (Bernardini, 2004; Bernardini, Price, & Figueiredo, 2006; Figueiredo, Santos, & Creutzberg, 2005). One of the major recommendations of the ISPD guidelines for patient training is the using adult learning techniques (Bernardini, Price, & Figueiredo, 2006). A survey of PD nurses demonstrated that only 31% of respondents had a formal background in adult education (Bernardini, Price, Figueiredo, Riemann, & Leung, 2006). To achieve such goals, dialysis nurses should have some adult learning knowledge to be able to prepare well-designed training and educational programmes using both active and passive methods (Hall *et al.*, 2004; Knowles, 2009).

Adult learning requires the identification of the type of learner, in this case the patient or care partner, and the capacity to plan the training. The key to teaching adults is to provide new information that is relevant and usable within a relatively short period of time. There are several instruments assessing type of learning; the traditional model will classify adults as having a visual, aural, read/write and kinaesthetic style of learning. It is important to understand that learning requires changes in behaviour, habits, knowledge and attitudes; the patients' background and previous experience will have an impact on the process of learning (Knowles, 2009). Knowledge of different styles of learning will help the professional to prepare better training to meet the difference in learning styles (Almeida, 2010). It is important to make the distinction between education and learning. Education should result in changes in knowledge and skills, and the educator is the agent who presents stimuli and reinforcement, while learning is the act or process by which behavioural change are acquired (Knowles, 2009).

In an attempt to individualise PD training, nurses should be aware of barriers to self-care, such as decreased vision, hearing, manual dexterity, mobility, strength, language barriers, dementia or poor memory amongst other possibilities (Oliver *et al.*, 2010). Chow and Bennett have developed a tool for pre-training assessment that aims to identify the candidates' existing and potential health-related conditions that would undesirably affect the success of the home dialysis training. The use of such a tool will help nurses plan for a more suitable and individualised training (Chow & Bennett, 2001).

Nurses are responsible for the bulk of PD training. While there are no studies evaluating the education or abilities of the trainer, nurses may be more likely to possess the qualities required (Bernardini, Price, & Figueiredo, 2006). Coles and Uttley have state in a previous International Society for Peritoneal Dialysis (ISPD) recommendation that a six- to eight-week orientation in PD and assignment to a mentor who observes the nurse performing patient education would be ideal (Coles & Uttley, 1994). Nonetheless, there is conflicting information regarding the experience of PD nurses in the occurrence of peritonitis. Yang *et al.* (2012) showed that patients trained by nurses with advanced experience in general medicine prior to working with PD was associated with a lower risk for first-episode gram-positive peritonitis, but was not significantly correlated with all-cause peritonitis risk. In contrast, Chow *et al.* (2007) observed a negative association between the length of time in practice of the trainer and peritonitis incidence.

There remains no consensus about how long the training time should be or the ideal timing or locale of training, making it difficult to define recommendations of particular standards of patient training that would ensure best PD outcome (Bernardini, Price, & Figueiredo, 2006). Data from the Brazilian Peritoneal Dialysis Multicenter Study (BRAZPD), analysing more than 2000 patients, suggests that training patients for at least 15 hours gives a better outcome. The incidence of peritonitis was higher in patients with up to 15 hours of training (0.32/year at risk or 1 episode/38 patient-month) than for patients trained for more than 15 hours (0.26/year at risk or 1 episode/46 patient-month). The method of training was the standard of care of each unit. In general, training methods in Brazil are based on didactic material provided by industry, with verbal instructions on how to perform exchange safely and how to recognise contamination or infection. (Figueiredo *et al.*, 2014).

The autonomy encouraged for PD patients may lead patients to modify their therapy or to be non-adherent with treatment (Hollis *et al.*, 2006). Younger, employed, smokers and diabetic patients are more likely to be non-compliant or to make modifications, such as: decrease the number of exchanges per day; adjust fill volume; choose a dry day; and reduce time on APD (Blake *et al.*, 2000; Hollis *et al.*, 2006; Kutner, 2001). Patient non-compliance with the treatment is known to be a reality and is a well-discussed topic among health care professionals; however, its identification is not always obvious (Bernardini & Piraino, 1998) and there is a lack of understanding as to how to manage and improve this situation (Griva *et al.*, 2014; Leggat, 2005; Nevins, 2005).

A correlation exists between infection and the amount of time patients were late for training appointments (Chow, Szeto, Leung *et al.*, 2007). Two studies conducted in different countries demonstrated that at least 70% of PD patients were compliant in performing 90% of bag exchanges when an inventory was carried out, either during home visits or via a telephone call (Bernardini & Piraino, 1998; Figueiredo *et al.*, 2005). A further investigation aimed to analyse patient compliance and retraining needs through an assessment of patient knowledge using a questionnaire and home visits, revealing important aspects of non-compliance. Only 66% of the questions were answered correctly, with women performing better than men. Some 25% of patients were partially compliant with their drug therapy, 23% were non-compliant with exchange protocol procedures, 29% of patients needed reinforcement of knowledge and ability to correctly perform exchange, and a significant association was found between compliance and incidence of peritonitis. The authors concluded nearly half the patients needed retraining (Russo *et al.*, 2006). A more recent publication demonstrated similar results, with 67% of patients showing an average compliance with the procedures for performing a CAPD exchange (Mawar, Gupta, & Mahajan, 2012).

Retraining patients is a recommendation from the ISPD, although it is not clear when this should be done after initial training so further research is needed. Clear recommendation exists for patients who are returning to PD from hospitalisation, infection or changes in mobility or dexterity. This retraining should include dialysis exchange procedures, hand hygiene, recognition of signs and symptoms of peritonitis or education on contamination and exit-site care (Bernardini, Price, & Figueiredo, 2006; Piraino *et al.*, 2011).

There is no recipe on how we can improve treatment adherence, Kutner has suggested that patient education, continuous supervision, support and encouragement and formal treatment of depression and anxiety can help patients to deal with such a complex treatment (Kutner, 2001).

Non-modifiable risk factors for PD infections include race, indigenous racial origin, diabetes, chronic lung disease, poor residual kidney function and extremes of age; Nessim, Bargman, Austin, Nisenbaum, & Jassal, 2009; Piraino *et al.*, 2011) Modifiable risk factors such as obesity, smoking, hypokalemia, hypoalbuminaemia, depression, constipation, vitamin D deficiency, transfer from haemodialysis (HD) to PD, immunosuppression therapy and diverticulitis have been considered modifiable risk factors for peritonitis; Piraino *et al.*, 2011) can be addressed somewhat by the PD nurse.

Programme management

The success of a PD programme depends on a multitude of factors, with each programme needing to identify its special context, deficiencies and qualities, and strategise accordingly. Safe, effective and ethical nursing requires sufficient staffing numbers and an appropriate use and mix of competent nurses available for patient care; the effectiveness of methods for determining nurse staffing is unknown for chronic kidney disease patients, either HD or PD. Most formulae to determine the nurse–patient ratio are based in general nursing and hospitalised patients and not for chronic self-care outpatients. Bernardini has suggested that a time-orientated score system be used to grade PD nurses activities (Bernardini, 2009). Whilst the roles and responsibilities of nurses differ across health systems and between countries, there is a large variation in the nurse-to-patient ratio around the world (1:15–200 or more); on the other hand, there is common agreement amongst all, particularly patients and public, that nurses must be properly educated and trained, meaning a postgraduation course or having an experienced mentor (Coles & Uttley, 1994; Finkelstein, 2006). The success of a PD programme is dependent upon having specialised nurses with appropriate skills in assessing and training patients for PD, adequate treatment monitoring, and having sufficient resources to provide continued care in the community (Finkelstein, 2006).

As workloads increase, the number of distractions and interruptions tend to increase, and each interruption is associated with a 12% increase in procedure failure and clinical errors by nurses (Wolfe, 2011). Studies examining adequacy of staffing have found an association between high patient-to-

nurse ratios and several adverse outcomes (Petrosillo *et al.*, 2001; Saxena & Panhotra, 2004; Shimokura, Weber, Miller, Wurtzel, & Alter, 2006). It has been established that understaffing can decrease hand washing (HW) frequency and duration among HD nurses; associated with increased workload (Petrosillo *et al.*, 2001; Saxena & Panhotra, 2004; Shimokura *et al.*, 2006). The same can be expected to happen with PD nurses and patients.

Excellent hand hygiene (HH) is most important for the safety of all patients (Piraino *et al.*, 2011). The World Health Organization (WHO) recommends five moments for HH for health care professionals; in PD it should be done before any examination of the patient's exit-site by the patient, family members, or health care team members (Boyce & Pittet, 2002; Piraino *et al.*, 2011). The WHO advocates that HH should to be performed by washing with non-antimicrobial or antimicrobial soap and water or 60–80% alcohol gel (Pittet, Allegranzi, Boyce, & Experts, 2009). A systematic review has demonstrated that non-compliance with HH guidelines is a universal problem and calls for action (Erasmus *et al.*, 2010). Despite the WHO recommendations, there is still a large variation in instructions given to patients, as little is known regarding aspects of HH for PD patients. The 2005 ISPD Guidelines state that antibacterial soap and water are recommended in many centres, while the 2010 ISPD Guidelines do not suggest any specific method for HH in detail (Piraino, 2005; Firanek & Guest, 2011; Li *et al.*, 2010). Some studies investigating HH with PD patients have found that rubbing hands with an alcohol gel is more efficient than either HW with a non-antimicrobial soap or the combination of HW plus alcohol gel rub (Figueiredo, de Siqueira, Poli-de-Figueiredo, & d'Avila, 2013; Siqueira, Figueiredo, Poli de Figueiredo, & d'Avila, 2012).

Since the introduction of PD, the bag-exchange procedure has been performed often with patients and/or nurses wearing disposable face masks. Interestingly, there is no evidence to support wearing masks to prevent infection. In many countries, such as the USA, China, Spain and most of Central and South America, its use is mandatory during bag exchange, recommended by the manufacturers. There are only two studies evaluating the role of the face mask in PD patients and no differences in the incidence of peritonitis were found, whether patients used face masks or not (Figueiredo, Poli de Figueiredo, & d'Avila, 2000, 2001). The 2011 ISPD position statement on reducing the risks of PD states that face masks are optional, in agreement with an international diversity for this practice (Piraino *et al.*, 2011). A Cochrane review on disposable face masks for the prevention of wound infection in clean surgery suggests there is no difference in infection outcome between wearing and not wearing masks (Lipp & Edwards, 2005).

Research assessing the impact of the bag-exchange procedure on risk infection concluded that not wearing a face mask and cap were independent risk factors for peritonitis (Dong & Chen, 2010). This study design did not specifically aim to compare the use, or not, of face masks and all patients had received previous instruction to use them. It was found that more than half the subjects washed their hands improperly, whilst 11.5% of patients did not wear a face mask and cap as trained, demonstrating non-compliance. Furthermore, no significant difference was observed in the incidence of peritonitis when comparing those 15.4% of patients failing to fully cover the nose or hair, assuming that correct face mask use should cover the nose. Another study concluded that the most commonly compromised step in performing a bag exchange was not wearing a face mask (68%) and the least common was not washing hands (25%); however, it should be pointed out that among the episodes of peritonitis there were three caused by *S. aureus* and coagulase-negative *Staphylococcus*, both skin microorganisms associated with touch contamination (Mawar *et al.*, 2012).

Home visits by nurses is a recommendation of ISPD, but again no evidence exists on its value in preventing infections. A study about home visits stated that all patients should have at least an initial home visit, and further visits if needed, and no difference was found between routine and needed visits (Ponferrada *et al.*, 1993). The compliance with this recommendation has some barriers as we are not clear about frequency that they should be done, staffing numbers and economics to perform it and intrusiveness felt for some patients (Farina, 2001). Phone call monitoring has been used to reduce morbidity in heart failure patients with similar results in PD patients, and home telehealth has been proven to contribute to improved health outcomes and cost of care in high-risk dialysis patients (Aliti, 2007; Domingues, Clausell, Aliti, Dominguez, & Rabelo, 2011; Minatodani & Berman, 2013; Nayak, Karopadi, Antony, Sreepada, & Nayak, 2012).

Conclusion

In summary, infection can cause significant morbidity and PD nurses play an important role in preventing its occurrence. Special attention to details, catheter implantation, patients' risk factors and management of a PD programme emphasising protocol adherence, staff training, and patient selection and training may minimise infection risk and improve outcomes. The focus on patient safety must be of ultimate importance to nurses.

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Improving outcomes in peritoneal dialysis exit site care

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Whittle, A., & Black, K. (2014). Improving outcomes in peritoneal dialysis exit site care. *Renal Society of Australasia Journal, 10*(3), 126-132.

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Abstract

Background: Benchmarking infection rates for peritoneal dialysis (PD) catheter-related infections is mandatory for good patient care. There is no current established benchmark for PD exit site infections (ESIs). The Royal Hobart Hospital (RHH) PD unit established our own benchmark at 1/25 patient-months and in 2009 the PD ESIs reached 1/21 patient-months, which prompted investigation into our current exit site (ES) care routine.

Method: A quality improvement process was used to implement a more structured approach to the existing ES care plan. Particular changes included pre-Tenckhoff catheter insertion nasal swabs for the patient and primary carer, treatment for *Staphylococcus aureus* incidence using mupirocin, emphasis and education on hand hygiene, and a change to chlorhexidine body wash around the ES during showering, with medihoney applied around the ES, and regular review of our infection rates with the consultant infectious diseases and consultant nephrologist.

Results: ESI rates improved from 1/20.8 patient-months to currently 1/203 patient-months in March 2014. Development of a protocol on care of the adult with a Tenckhoff catheter was the culmination of this quality improvement activity.

Conclusion: A structured, quality improvement approach was beneficial to the success of this project. Continuous monitoring of outcomes to patient care against a benchmark is essential to any unit's quality improvement programme.

Keywords

Exit site care, infection, peritoneal dialysis guidelines, Tenckhoff catheter.

Introduction

The International Society for Peritoneal Dialysis (ISPD) position statement on reducing the risk of peritoneal dialysis (PD) catheter-related infection states:

> *For a peritoneal dialysis (PD) program to be successful, close attention must be paid to preventing PD-related infections (defined as exit-site infections, tunnel infections and peritonitis)* (Piraino *et al.,* 2011, p. 614).

The ISPD defines exit site infection (ESI) as:

> "The presence of purulent drainage, with or without erythema of the skin at the catheter epidermal interface. Peri-catheter erythema without purulent drainage is sometimes an early indication of infection but can also be a simple skin reaction, particularly in a recently placed catheter or after trauma to the catheter" (2005 update p. 111).

Therefore, it is best practice within PD units to monitor catheter-related infections, exit site (ES), tunnel infection and peritonitis. There is a well-established benchmark for peritonitis rates by ISPD (2010) and Caring for Australasians with Renal Impairment (CARI) Guidelines (Walker 2014), which is 1/18 per patient-month (ppm), but none exists for ESI rates. Our unit established our own benchmark for ESIs at 1/25 ppm.

The problem

In 2009 regular review of our catheter-related infections showed a doubling in ESIs (19 infections) from 2008, which related to 1/20.8 ppm. This provided the impetus for us to look at the method by which we were caring for the ES of our patients.

Established practice and outcomes — pre-2010

There was no input from microbiology or infection control on catheter-related infections and, importantly, there was no formal policy of care of the Tenckhoff catheter (Jose *et al.,* 2010).

The pre-PD pathway included an initial home visit, which was carried out to assess the home environment for storage, place of dialysis, and hand hygiene facilities. Nasal screening for *Staphylococcus aureus* was not routinely performed prior to insertion of the Tenckhoff catheter. One dedicated surgeon was used for catheter insertion, whereby the catheter exit tunnel site was placed downward-facing, immobilised and an intraoperative antibiotic was given.

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We had already established a care routine for the first two weeks postoperatively, where the patients are visited prior to hospital discharge by an expert PD nurse and written instructions are given and explained to the patient. The ES, catheter and suture line are monitored, but undisturbed if no abnormality is detected and the patients are advised not to shower, and to avoid wetting the dressing when bathing. "Calculation of peritonitis rates should be standardised and should be clearly defined in any publication on peritonitis. Most observers would start to calculate the time at risk for peritonitis as the first day of training; some might consider the date of catheter insertion to be the starting point. The former is probably preferable, because the latter might lead to falsely low rates, especially in centres that place the catheter many weeks or even months before the start of training." (Piraino *et al.,* 2011, p. 616). Therefore, data collection for catheter-related infections at the Royal Hobart Hospital (RHH) commences at two weeks postoperatively, when education for catheter care is complete and the patient is independent in the care of their catheter.

All education and training for PD was undertaken within the home environment, allowing risk assessment for structural and environmental hazards. Thus risks could be identified quickly, and constructively resolved with the cooperation of the patient. Verbal instructions and practical demonstrations were given for ES care where the patient followed a routine using chlorhexidine 1% hand cleaning solution to clean ES during showering and after used Medihoney® (Derma Sciences) at the ES with a Cutiplast™ (Smith & Nephew) dressing to cover. Our use of Medihoney® originally started in 2007.

Regular three-monthly visits occurred to meet each patient and their partner in their home to check on various areas of therapy management including hand hygiene, ES examination, and record keeping (blood pressure, weight, bowel care, ultrafiltration and dialysis prescription), discussing trends and blood results.

Verbal instructions were given on signs and symptoms of peritonitis and ESI, and what to do if they were suspicious one had occurred. The ES examinations are undertaken as part of our proactive management, allowing base line establishment and regular monitoring.

Review period — early 2010

To commence this quality improvement initiative, staff met in 2010 to review the existing care plan. Firstly and most importantly we recognised that we did not have a formal policy for care of the adult with a Tenckhoff catheter. To formulate a robust policy, we undertook a search for published evidence or guidelines. Part of our analysis revealed that the predominant causative organism for ESIs in our unit in the preceding years was *S. aureus*; therefore it was recognised input from other relevant departments within the hospital was imperative.

Meetings were instigated with the microbiology, infection prevention and control units for drafting advice for the new policy. Some points of reference from these units that were supported by evidence from the literature (Mehta *et al.,* 2013) were an appropriate plan for nasal swabbing and subsequent treatment and further swabbing for *S. aureus*-positive results, including ongoing, long-term ES and nasal swabbing. Regular six-monthly meetings commenced with infection prevention and control unit to monitor catheter-related infections and review guidelines such as our peritonitis guideline.

Change implementation phase — late 2010 Eradication of *S. Aureus*

The home therapies staff commenced pre-catheter insertion nasal swabbing for patient and carer. Any incidence of *S. aureus*-positive cultures were treated with the use of chlorhexidine body wash daily and nasal mupirocin three times a day for one week and re-swabbing a week later (Mehta *et al.,* 2013). If that swab was positive for *S. aureus,* another week of nasal mupirocin was commenced and further re-swabbed. We now have a formal algorithm directing the management of nasal and ES swabs, (Figures 1 and 2).

Involvement in national trials

The RHH renal unit enrolled in the Honeypot trial in 2010, which was a randomised, controlled trial of ES application of Medihoney™ Antibacterial Wound Gel for the prevention of catheter-associated infections in PD patients (Johnson *et al.,* 2013). The unit continued the use of Medihoney™ on the ES for those patients who were not enrolled with the Honeypot trial. The trial group concluded that they could not recommend a practice change to Medihoney in non-diabetic patients (Johnson *et al.,* 2013). We have maintained our standard practice with continuation of Medihoney for ES management as our results to date have not indicated a need to improve or adjust our management protocol.

Change in hand hygiene regime

During the year, a hand hygiene policy was introduced at the RHH, which followed the World Health Organization (WHO) recommendations (WHO, 2009). We adopted this policy for our patients, which involved further education, including supplying each patient with copies of the WHO guidelines, (Figure 3). This time was felt to be very beneficial to reinforce hand hygiene with each patient and the importance of carrying out the hygiene properly.

In November 2010, our unit applied to be involved in the Kidney Health Australia (KHA) — CARI Guideline Antibiotic Implementation Project, called, "Improving Prophylactic Antibiotic Use to Prevent Infections in New Peritoneal Dialysis (PD) Patients in Australasia". The study purpose is to identify the barriers to adhering to the CARI guidelines relevant to prophylactic antibiotic use in new PD patients in Australia

Figure 1

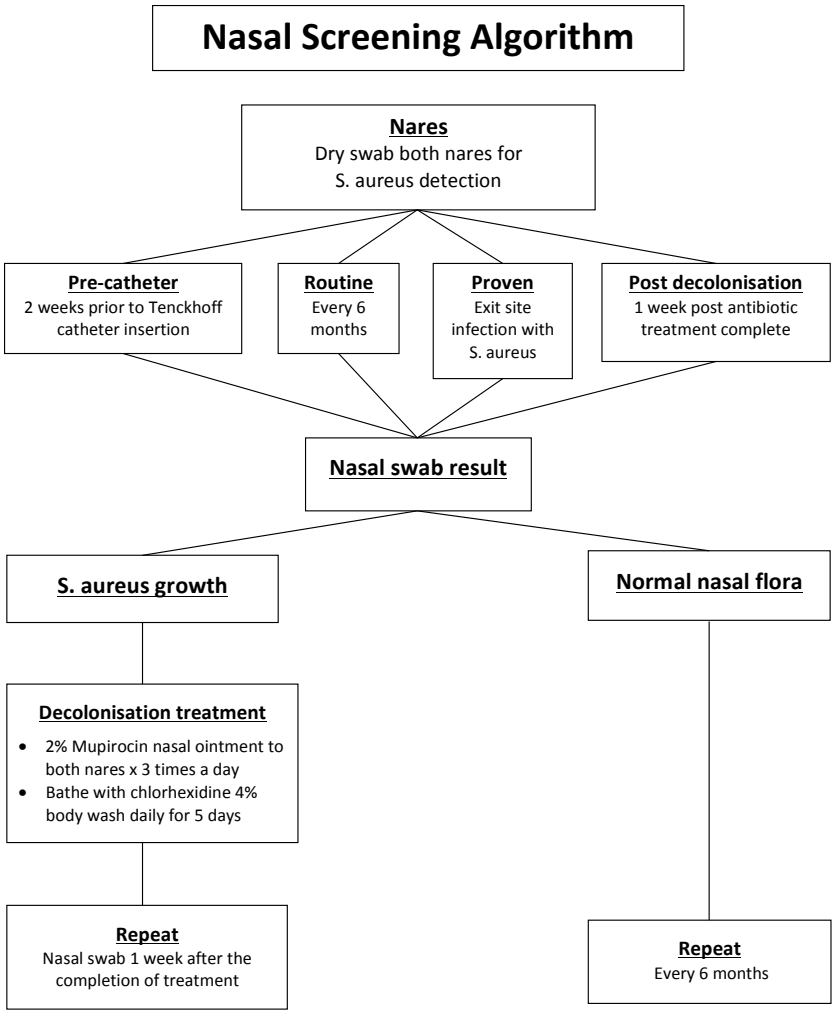


Figure 2

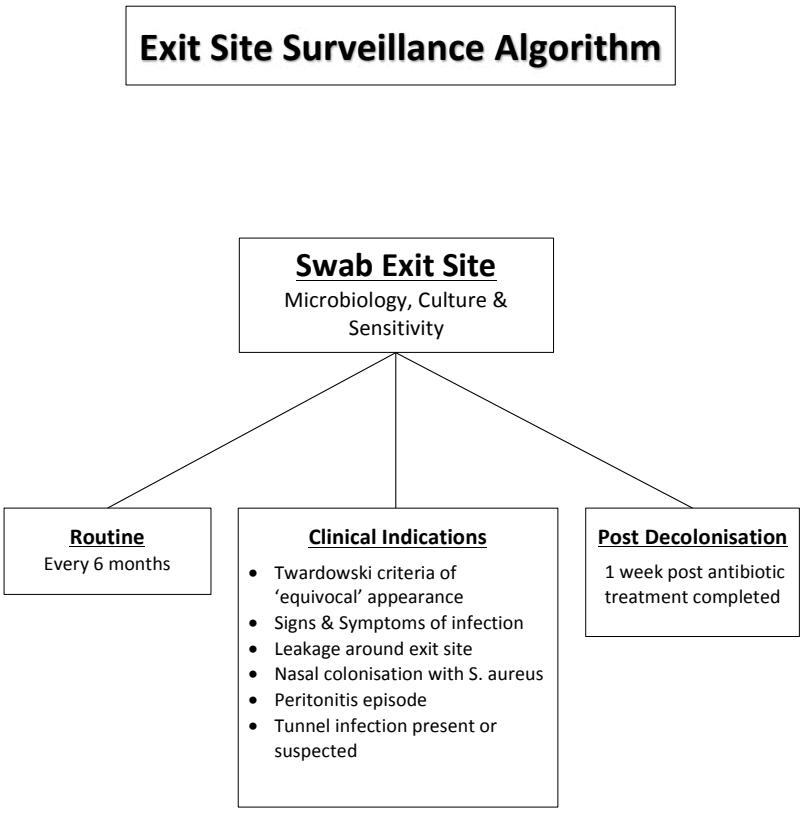


Figure 3

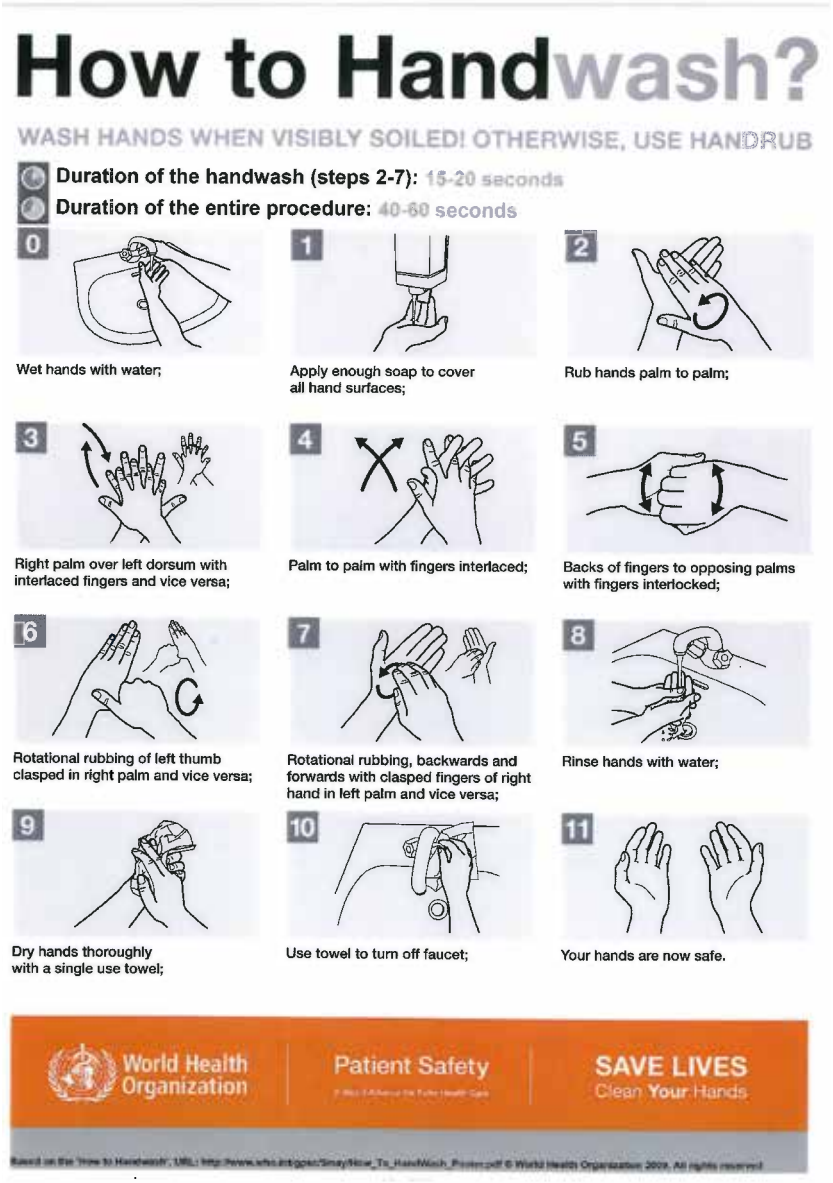


Table 1

Ongoing exit site care
Shower with exit site dressing on, washing all of your body.
Take off dressing and allow water to run over exit site.
Using gauze soaked with Microshield 2® body wash, wash gently around exit site and allow water to run over exit site.
Observe exit site for redness or signs of infection.
Step out of shower attending your exit site first.
Dry exit site with another piece of gauze before drying the rest of your body.
Apply medihoney and cutiplast® dressing.
Anchor catheter with tape where catheter falls naturally.
Dry the rest of your body.

and New Zealand and to develop and implement strategies to increase the use of appropriate antibiotics in new PD patients. This involves regular communication and several face-to-face meetings of all eight participating centres.

In 2011 we were successful in our application to be involved in the KHA — CARI Guideline Antibiotic Implementation Project. Participating in both this project and the Honeypot trial benefited our unit because of the increased networking opportunities with interstate and international PD units, generating ideas between units to focus on our practice.

Attending the meetings also highlighted the issue that although each unit was striving for best practice and good outcomes for their patients, each unit's method of care was different and that there is a lack of evidence-based, definitive guidelines for the care of the Tenckhoff catheter, although recommendations are available from the ISPD.

Patient education

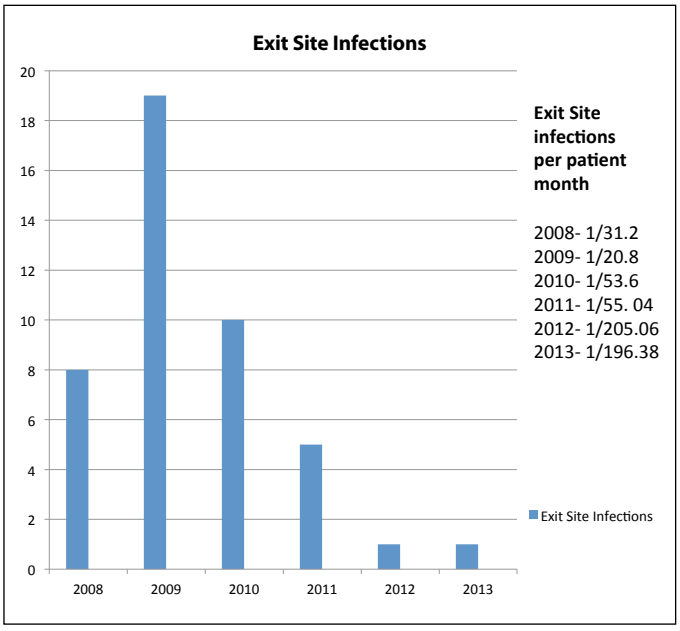
As the policy for care of the Tenckhoff catheter evolved, changes were initiated as the review team identified new information. Apart from previously mentioned changes, we supplemented verbal and practical demonstration for education of ES care with written instructions about how to care for the ES during showering (Table 1, unit-generated).

At the end of 2010, after we had instigated the above changes, we had halved the incidence of ESIs from 19 to 10, which collated to 1/53.6 ppm.

Consolidation time — 2011
Increasing support and Information

During 2011 we introduced personal information folders for each patient. This suite of education materials has been designed to facilitate prompt detection and early management of complications by our patients. The suite includes troubleshooting guideline algorithms for ES leaks and suspected ESIs (Figure 6 and 7, unit-generated). Also included are quick guides to APD and CAPD procedures (unit-generated), ES care (Table 1, unit-generated), Bristol stool chart (Lewis & Heaton, 1992), back care (2010, unit-generated), WHO hand hygiene charts (WHO 2009) and "Staying well on Peritoneal Dialysis "(unit-generated) with contact information.

Figure 4



Change in skin cleanser

Further practice changes occurring during 2012 were that our PD and haemodialysis units changed the cleaning solution to Chlorhexidine 2™ skin cleanser in line with the International Centre for Disease Control (CDC) guidelines for prevention of intravascular catheter-related infections (O'Grady *et al.*, 2011). The chlorhexidine is used for hand washing and to clean the ES with gauze while showering, without harming the integrity of the catheter (Covidien, n.d.; Johnson and Johnson, 2011).

Re-enforcing education

Education and support were targeted when we commenced PD master classes for our patients that involved inviting patients and partners to come to our Karingal home renal therapies unit once a year, where we conducted refresher education sessions and scenarios in a fun, non-threatening environment. These sessions provided reinforcement of infection prevention strategies related to PD and also psychosocial support for the patient and carer.

Results

In 2012 and 2013 our unit had one incidence each year of ESI collating to 1/202 ppm and 1/196 ppm respectively (Figure 4). To date (April 2014), our ESI rates are running at 1/203 ppm. Also, during this time, we have experienced a corresponding drop in peritonitis rates over this same period, from 1/15 ppm in 2009 to 1/81 ppm in 2013 (Figure 5).

Figure 5

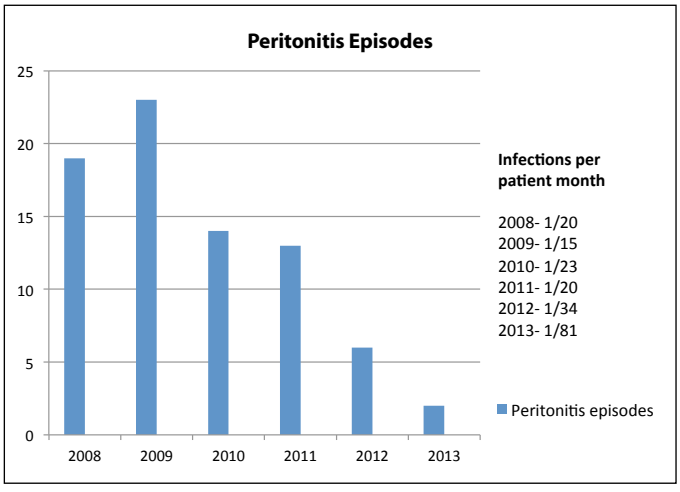
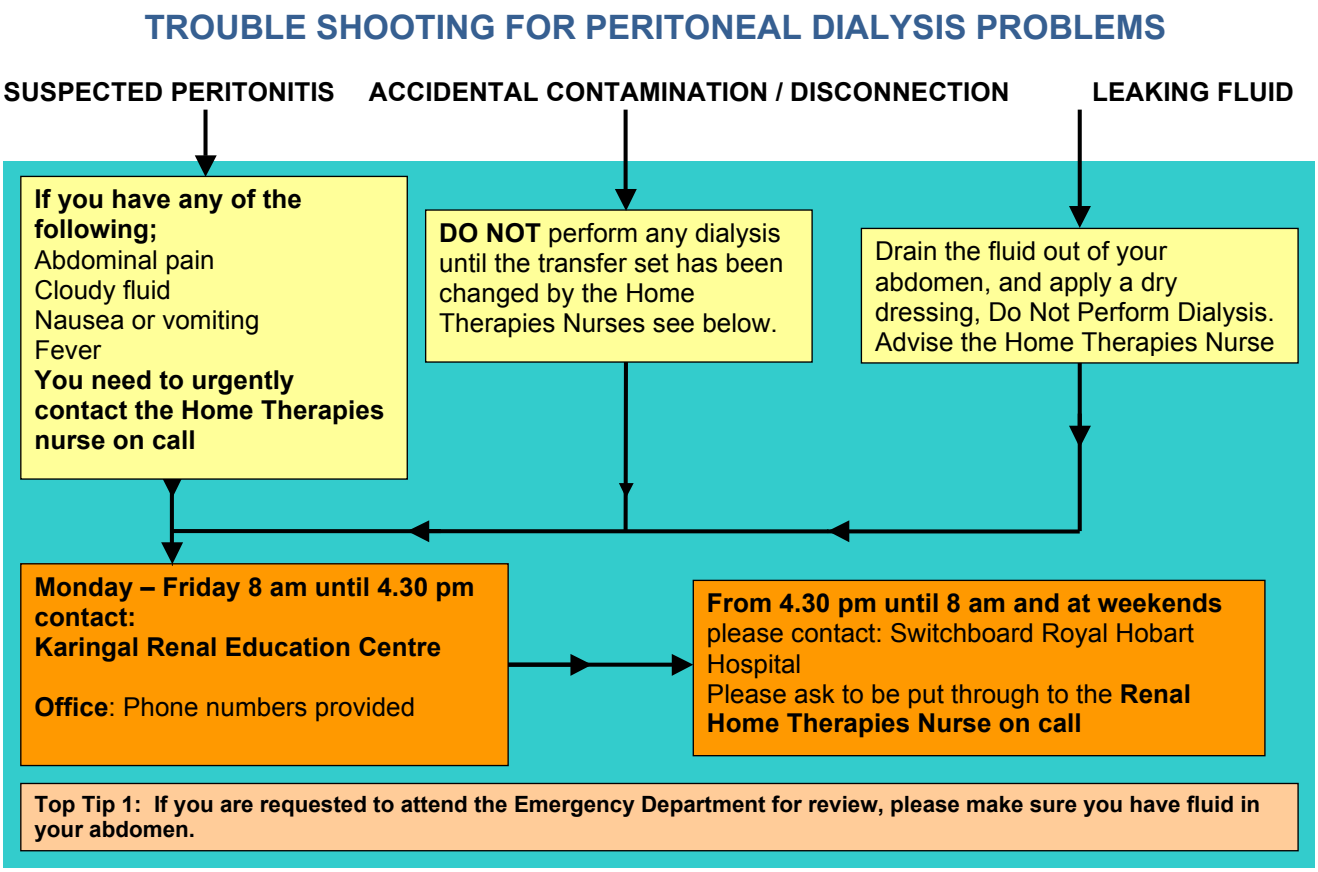


Figure 6



Discussion

This was a quality improvement initiative over three years during which we have implemented several changes to show such an improvement in our incidence of ESIs and peritonitis rates. The main areas of practice change were concentrating on hand hygiene, a more rigorous ES/nasal swab reporting and treatment routine to reduce the incidence of *S. aureus* and also changing the solution used to wash the ES. The master classes have consolidated the education and enhanced psychological support for patients and carers and are now a fixture in our work calendar. At a management level, the involvement of the microbiology and infection prevention and control units has increased the robust nature of our review process in reporting catheter-related infections.

Assessment of the patient's home pre-catheter insertion and training in the home environment remain within the programme because we feel that there are very positive outcomes from this practice. The predominant reasons are the environmental risk assessment and environmental familiarity for the patient during education. The *S. aureus* ESIs have been decreased to zero, possibly due to the nasal/ES screening programme we have implemented. Though it is not an obvious outcome, the master class days have been shown to be beneficial, with our patients feeling that they are supported in their endeavours at dialysis. The culmination of these activities in 2013 was the implementation at the RHH of the Clinical Guideline for the Care of the Adult with a Tenckhoff Catheter.

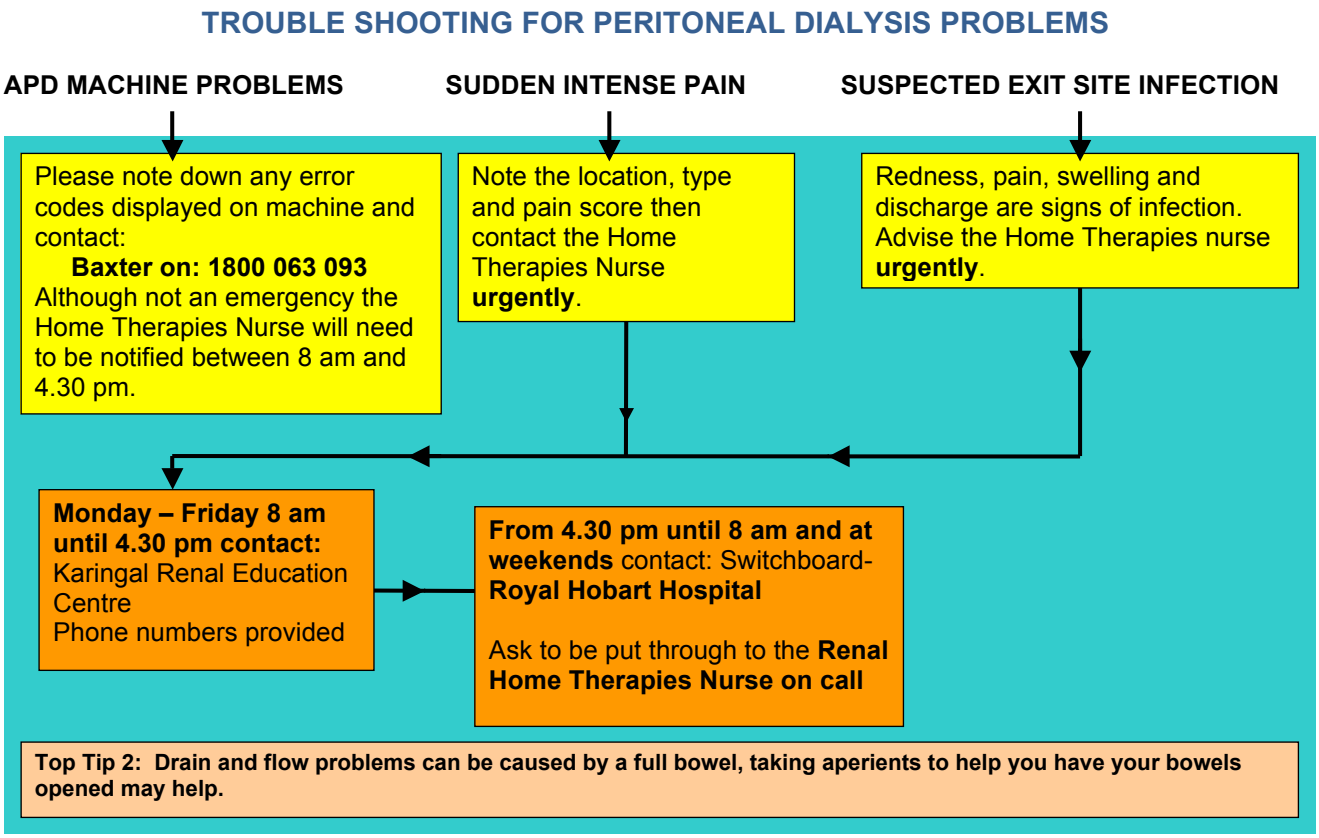
Conclusion

The quality improvement process was extremely beneficial in identifying areas that required change and providing a plan to follow.

A limitation to the quality improvement process was that we were unable to specify one specific change which improved our ESI rates as possibly all the changes together resulted in the improvement. Or, conversely, choosing to concentrate in this specific area of care improved the rate of incidence.

Looking forward, we aim to remain vigilant in monitoring catheter-related infections through the quality improvement process, as close scrutiny of each incidence improves outcomes for the present time and changes future practice. Also, as we are involved in the KHA-CARI Antibiotic project we are awaiting the outcome of the new guidelines/recommendations that will be implemented following the results of the project.

Figure 7



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Predictors of malnutrition in Australian haemodialysis patients and comparison of dietary protein intakes to national guidelines

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Piccini, S.*, Fairburn, A.*, Gill, E., Budgeon, C. A., & O'Sullivan, T. (2014). Predictors of malnutrition in Australian haemodialysis patients and comparison of dietary protein intakes to national guidelines. *Renal Society of Australasia Journal, 10*(3), 133-140.

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Abstract

Background: Malnutrition is an important concern for patients undergoing dialysis therapy. We aimed to investigate predictors of nutritional status in a population of in-centre Western Australian haemodialysis (HD) patients and compare dietary protein intakes to national guidelines of 1.2–1.4 g/kg body weight/day.

Method: Dietary intakes were assessed by diet history interview for 35 in-centre patients receiving HD (mean age 65.2 ± 13.1 years; median dialysis vintage 3 [IQR 22] months). Patient Generated Subjective Global Assessment was used to classify patients as well-nourished or malnourished. Patient characteristics, co-morbidities and dialysis vintage were investigated along with biochemical data. Logistic regression was used to determine which factors were independent predictors of malnutrition.

Results: Out of the 35 patients, 54% (n=19) were classified as well-nourished with 46% (n=16) malnourished. Increased body mass index, protein intake and albumin were independently associated with lower odds of malnutrition. A mean protein intake of 1.05 ± 0.33 g/kg/d was observed in the well-nourished group compared with 0.86 ± 0.28 g/kg/d for the malnourished group. Only one patient in each group (malnourished and well-nourished) was within the recommended protein intake guidelines (1.2–1.4 g/kg/d).

Conclusion: Malnutrition remains a problem for HD patients, and dietary protein intake is an important predictor. However, our findings suggest that patients may be well-nourished at protein intakes lower than the current Australian guidelines. Further research investigating the application of the international protein intake guidelines of 1.1–1.2 g/kg/d for maintenance of nutritional status in clinically stable dialysis patients in Australia may be useful.

Keywords

Malnutrition, haemodialysis, dietary intake, dietary protein.

Introduction

Protein-energy malnutrition is an important concern for patients with chronic kidney disease (CKD) undergoing dialysis therapy, with prevalence as high as 75% in some groups (Desbrow *et al.*, 2005; Kalantar-Zadeh *et al.*, 2003; Kopple, 1999). Malnutrition is an independent predictor of morbidity and mortality in dialysis patients (Atilano-Carsi *et al.*, 2012; Chan *et al.*, 2012; Kopple, 1994) and leads to poor dialysis outcomes, including decreased quality of life (Laws *et al.*, 2000). Poor nutritional status is multifactorial and often associated with inadequate consumption of protein and energy, inflammation, co-morbidities, and dialysis vintage (Qureshi *et al.*, 1998). Medical nutrition therapy ensuring adequate dietary protein intake plays an important role in the management of patients

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undergoing haemodialysis (HD). International guidelines recommend regular nutritional assessments of HD patients (Ash *et al.*, 2006; Fouque *et al.*, 2007; National Kidney Foundation, 2000; Voss, 2005; Wiggins, 2002). This allows for early recognition of malnutrition risk and has been shown to reduce the prevalence of malnutrition (Campbell *et al.*, 2009).

There is currently some discrepancy in guidelines for recommended protein intakes for dialysis patients. The Kidney Disease Outcomes Quality Initiative (KDOQI) and the Dietitians Association of Australia Evidence Based Practice Guidelines (EBPG) for the Nutritional Management of Chronic Kidney Disease recommend a daily protein intake of between 1.2 and 1.4 g/kg/d (Ash *et al.*, 2006; National Kidney Foundation, 2000; Voss, 2005). As the most recent, local, evidence-based practice guideline, this range is widely used in Australian dietetic practice at the time of writing. However, European, British and Canadian guidelines recommend a lower dietary protein intake of 1.1–1.2 g/kg/d protein intake for clinically stable HD patients (Fouque *et al.*, 2007; Levin *et al.*, 2008; Naylor *et al.*, 2013). A review of the literature suggested that survival for CKD patients is highest with a protein intake across these ranges, of between 1.0 and 1.4 g/kg/d (Fouque *et al.*, 2011)2011. A recent systematic review which investigated the nutrition prescription required to achieve positive outcomes in CKD has reviewed the EBPG guidelines in relation to the subsequent international guidelines, and recommended caution when applying the 1.1–1.2 g/kg recommendation to less well patients (Ash *et al.*, 2014). Therefore, we believe more local studies looking at protein prescriptions and outcomes of 1.1–1.2 g/kg in HD patients are justified.

Although there have been studies in the eastern states of Australia investigating malnutrition in dialysis patients, to our knowledge there have been no published studies conducted in a Western Australian population. The aim of this observational study was to investigate predictors of malnutrition in an in-centre group of HD patients in Western Australia and compare their dietary protein intakes to the Australian guidelines.

Method

Study design

An observational study of HD patients was conducted at the in-centre HD unit at Sir Charles Gairdner Hospital, Western Australia, from June to August 2011. Ethics approval was granted from the Human Research Ethics Committees at both Sir Charles Gairdner Hospital and Edith Cowan University.

Population

Patients included in the study sample were those new to dialysis, undergoing maintenance dialysis, or transferred from different modalities. Exclusion criteria included patients under 18 years of age, non–English speaking patients and those who lacked the capacity to consent for themselves. Data was collected from all in-centre HD shifts (morning and afternoon patients attending both Monday/Wednesday/Friday, and Tuesday/Thursday/Sunday shifts) to provide a representative sample of patients.

Nutrition status

The presence or absence of malnutrition was determined using Patient-Generated Subjective Global Assessment (PG-SGA), a validated nutritional assessment tool for use in dialysis patients (Desbrow *et al.*, 2005). Using this tool, patients were categorised into three groups: well-nourished (A), moderately malnourished (B), or severely malnourished (C). The PG-SGA has been found to have a high reliability, sensitivity and specificity when compared to other validated nutritional assessment tools for HD populations (Ash *et al.*, 2006; Campbell *et al.*, 2009; Desbrow *et al.*, 2005; Ottery *et al.*, 2002; Persson *et al.*, 1999).

Dietary intake

Patients' dietary intake was estimated via dietary history interview to determine usual dietary intake over the past six months. A standardised nutrient-specific checklist was used to cross-check types and frequency of food consumed to determine daily energy, protein, potassium and phosphorus intakes. Food models and standard household measures were used to assist participants recall portion sizes. Table 1 displays the recommended energy, protein, potassium and phosphorus intakes for HD patients as per the Evidence Based Practice Guidelines for the Nutritional Management of Chronic Kidney Disease and the Clinical Practice Guidelines for Nutrition in Chronic Renal Failure (Ash *et al.*, 2006; National Kidney Foundation, 2000; Voss, 2005).

Anthropometric measures

Height, current weight (dry) and weight history was taken from participants' medical records. Body mass index (BMI), was calculated as weight (kg)/height (m)^2. Dry weight was used to calculate dietary requirements for underweight patients and those within their healthy weight range. For participants above the recommended BMI range of 23–26 kg/m^2 (on dialysis) (Ash *et al.*, 2006; National Kidney Foundation, 2000), adjusted body weight was determined via the formula: [(current weight – ideal body weight) x 0.25] + ideal body weight was used to determine energy, protein and potassium requirements (Ash *et al.*, 2006). Amputees' adjusted weight was calculated using the formula: [(100 – % amputation) / 100] x body weight for original height to allow for absent limbs (Mahan & Escott-Stump, 2008).

Biochemistry and medical history

Pre-dialysis serum albumin, bicarbonate, corrected calcium, creatinine, C-reactive protein, phosphate, urea and potassium levels were taken from participants' latest routine monthly blood tests. HD commencement date was used to determine dialysis vintage. The Charlson co-morbidity index was used to describe co-morbidity burden and calculated for each participant from medical history data (Liu *et al.*, 2010). Depending on the participants' age and number of co-morbidities, a score ranging from 1 (low co-morbidity) to 11 (high co-morbidity) was assigned (Liu *et al.*, 2010).

Statistical analysis

Summary statistics of continuous variables are presented as means and standard deviations or median and range for non-normally distributed variables. Baseline characteristics were compared using fisher exact tests and independent sample t-tests. The Mann Whitney test was used when the data was non-normal. Univariable and multivariable regression was conducted. Binary logistic regression was used to determine which variables were associated with malnutrition (well-nourished SGA-A vs. malnourished SGA-B and C). For the multivariable analysis, all variables were placed into the model initially, and variables that were significant at the 5% level were retained. Adjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated for this model. Data were analysed using the R environment for statistical computing (A Language and Environment for Statistical Computing. Vienna, Austria: R Foundation for Statistical Computing, 2013).

Results

The total number of patients at the in-centre HD unit over our study period was 66. Of these, we were able to approach 49 patients who were eligible for the study, 36 of whom gave their consent to participate. One patient was excluded as dry weight was unable to be established, making the final cohort 35 patients.

Participants were 69% male (n=24), with a mean (SD) age of 65.2 (13.1) years and a BMI of 27.3 (6.8) kg/m² (Table 2). According to PG-SGA classifications, 54% of our dialysis patients were well-nourished (A) and 46% were malnourished (B and C). Of the malnourished population, 87.5% were moderately malnourished (B) and 12.5% were categorised as severely malnourished (C).

Associations with malnutrition

Univariable associations with malnutrition are shown in Table 3. BMI, co-morbidity status, albumin, and phosphate intake were significantly associated with nutritional status in univariable analysis. The multivariable model showed that lower BMI (p=0.027), albumin (p=0.046) and dietary protein intakes (p=0.030), were independently associated with increased likelihood of malnutrition. Although significantly associated with nutrition status, phosphorus intake was excluded in the multivariable model as it was closely correlated with protein intake (r=0.64).

Dietary intake and nutritional status.

Dietary intake data from our patient group was compared to recommended energy, protein, potassium and phosphorus intakes as per the Evidenced Based Practice Guidelines for the Nutritional Management of Chronic Kidney Disease (Ash *et al.*, 2006) and the Clinical Practice Guidelines for Nutrition in Chronic Renal Failure (National Kidney Foundation, 2000). As shown in Table 4, 91% and 94% of our study group did not reach the recommended intakes for dietary energy and protein, respectively. The mean protein intake of the well-nourished group was 1.05 g/kg/d, while the mean protein intake of the malnourished group was 0.86 g/kg/d. Only one patient from each group (well-nourished and malnourished) was within the recommended protein intake guidelines (1.2–1.4 g/kg/d with a proportion of 5.26% vs 6.25% respectively). Two patients in the well-nourished group and one patient in the malnourished group had a protein intake of over 1.4 g/kg/day. The biggest difference in the percentage of each group meeting a level of protein intake was for 1.0 g/kg/d or greater (63% for the well-nourished group and 25% for the malnourished group). A statistical comparison of this difference showed that patients with protein intakes of ≥1.0 g/day were significantly more likely to be well-nourished compared to patients with intakes under this level (chi-square, P=0.024).

Discussion

Prevalence of malnutrition

Our results support previous observations that a high prevalence of malnutrition exists in patients who are undergoing dialysis (Qureshi *et al.*, 1998). Forty-six per cent of patients in our sample were malnourished, with 40% classified as moderately malnourished and 6% as severely malnourished. The relatively higher rate of malnutrition in our sample compared to previous reports (Campbell *et al.*, 2005; Campbell *et al.*, 2007; Cianciaruso, Brunori, Kopple *et al.*, 1995; Cianciaruso, Brunori, Traverso *et al.*, 1995; Cupisti *et al.*, 2004; Lawson *et al.*, 2001) may be attributable to the particular characteristics of the hospital in-centre HD population including higher levels of co-morbidity and increased age. Our study sample also included patients who were new to dialysis, and these patients may be more malnourished than those undergoing maintenance dialysis. As most previous studies only included maintenance dialysis patients, the difference in malnutrition rates may reflect the difference in patient type. Although the optimal timing for dialysis initiation requires further investigation, evidence supports a beneficial role of the continuous supply of residual renal function for good nutritional status (Rosansky *et al.*, 2011). Our results reflect the patients undergoing HD at the time of the study and further reinforce the importance of malnutrition screening and assessment in HD units for both new and maintenance patients.

Predictors of malnutrition

As expected, dietary protein intake was a significant, independent predictor of nutrition status. In the body, primary roles for protein include enzymes, structural protein hormones and immunoproteins (Mahan & Escott-Stump, 2008). An adequate dietary protein intake can be difficult to achieve in some HD patients due to nutrition impact symptoms including poor appetite, early satiety, dry mouth, taste changes and nausea. Likewise, we also observed an inverse relationship between albumin level and risk of malnutrition. Albumin is the most plentiful plasma protein which helps to maintain plasma oncotic pressure and also acts as a transport protein (Mahan & Escott-Stump, 2008). Low albumin levels in dialysis patients can be difficult to interpret and may reflect protein malnutrition in clinically stable patients; however, they are often more

indicative of other morbidity factors including inflammation, over-hydration, infection, and chronic disease (Bergström, 1995). There is, however, a strong association between low serum albumin and mortality and poor outcomes in dialysis patients (Kalantar-Zadeh & Ikizler, 2013). We also found an independent inverse association between BMI and risk of malnutrition in our HD patients, likely due to muscle wasting that occurs in malnutrition. Interestingly, higher BMI has been found to be associated significantly with increased risk for initial development of CKD (Gelber *et al.*, 2005). This may be related to effects of excess body fat on factors such as blood pressure, inflammation and hyperfiltration caused by insulin resistance (Ejerblad *et al.*, 2006).

A positive association between nutritional status and dialysis vintage has been shown in previous studies (Chertow *et al.*, 2000); however, we did not observe this within our sample. Although the mean length of time on HD was lower in the malnourished group, the difference between groups was not significant and this may be attributable to a high transit of well patients to satellite dialysis units.

Dietary intake

In Australia, the Evidenced Based Practice Guidelines for the Nutritional Management of Chronic Kidney Disease (Ash *et al.*, 2006) and the Clinical Practice Guidelines for Nutrition in Chronic Renal Failure (National Kidney Foundation, 2000) recommend a daily protein intake of 1.2–1.4 g/kg/d. However, our results suggest that not all participants with dietary protein intakes under 1.2 g/kg/d appear to be at increased nutritional risk. Although this may be due to participants under-reporting their usual intake (Lee & Nieman, 2007), it also raises the important question of whether all clinically stable HD patients require a daily protein intake of 1.2–1.4 g/kg/d (Ash *et al.*, 2006; National Kidney Foundation, 2000), or whether some patients can maintain adequate nutritional status at a lower intake.

Recent epidemiological studies have shown that dialysis patients' survival only becomes impaired when protein intake is below 0.9 g/kg/d and that survival is highest for a protein intake between 1.0 and 1.4 g/kg/d (Fouque *et al.*, 2011). This is supported by our findings, which indicated that the 1.0 g/kg/d or greater category represented the biggest difference between well-nourished and malnourished HD patients (Table 4) (63% of the well-nourished group consumed 1.0 g/kg/d or greater per day, compared to 25% of the malnourished group, P=0.024). Our findings appear to better align with international guidelines (Fouque *et al.*, 2007; Levin *et al.*, 2008; Naylor *et al.*, 2013), which recommend dietary protein intakes of 1.1–1.2 g/kg/d in clinically stable dialysis patients. In addition, a review of the literature found maintenance HD patients with protein intakes of ≥1.0 g/kg/d had increased survival rates than those below this level (British Dietetic Association Renal Nutrition Group, 2011).

It must be remembered that there may be clinical indications for increased protein intake in dialysis patients, including concomitant disease such as sepsis, liver disease or pressure ulcers. However, although adequate protein intake is essential, with the increasing rates of overweight and obesity in the HD population, it may be prudent to ensure excessive protein and food intake is not encouraged in patients who do not require it. This data highlights the importance of all HD patients receiving individualised dietetic assessment of anthropometry, co-morbidity, nutritional status and dietary intake to ensure appropriate dietary prescription.

Strengths and limitations

Strengths of our study included uniform laboratory measurements, with all laboratory data obtained from a single facility, and comprehensive nutritional assessments. Trained researchers conducted nutritional assessments and double entry of data and analysis was used. The diet history method of recalling a patient's long-term diet and pattern of food intake throughout the day is considered to be reliable and valid, and suited to a clinical setting (Tapsell *et al.*, 2000, 2002). It also provided the opportunity to clarify any issues (Tapsell *et al.*, 2000). A study investigating reproducibility of diet histories found this method to be suitable for older subjects (Hankin *et al.*, 1990), which is relevant, given our population's mean age of 65 years. A small sample size was an important limitation of this study, and our participation rate of 53% means that we are unable to give a representative description of the entire patient population. The small numbers restricted the ability of our study to detect statistically relevant effects. As we included all available HD patients in our study, our results are not directly applicable to dialysis populations that only consist of new patients or only consist of maintenance patients. In addition, limitations of using the dietary history method include under-reporting and inaccurate recall, which may lead to inaccurate estimates of nutrient consumption (Lee & Nieman, 2007).

Practical applications

Our results suggest that dietary protein intake, albumin and BMI are important independent predictors of malnutrition in Western Australian HD patients. This study provides support for further research investigating the application of international protein intake guidelines of 1.1–1.2 g/kg/d (Fouque *et al.*, 2007; Levin *et al.*, 2008) for maintenance of nutritional status in clinically stable dialysis patients in Australia.

Table 1: Recommended energy, protein, potassium and phosphorus intakes as per the Evidence Based Practice Guidelines for the Nutritional Management of Chronic Kidney Disease and the Clinical Practice Guidelines for Nutrition in Chronic Renal Failure

Nutrients	Daily recommendations
Energy	125–146 kJ/kg IBW
Protein	1.2–1.4 g/kg IBW
Potassium	1 mmol/kg IBW
Phosphorus	<1000 mg

Abbreviations: IBW = ideal body weight

Table 2: Acute dialysis population characteristics and serum biochemistry by nutrition status (as assessed by the PG-SGA)
Values shown as mean (standard deviation) unless otherwise stated

Variable	All (n=35)	Nutritional status		P-value
		Well-nourished (n=19)	Malnourished (n=16)	
Age (years)	65.2 (13.1)	61.3 (12.7)	69.8 (12.4)	0.057
Sex				
Male	24 (68.6%)	12 (63.2%)	12 (75.0%)	0.452
Female	11 (31.4%)	7 (36.8%)	4 (25.0%)	
BMI (kg/m^2)	27.3 (6.8)	29.7 (7.2)	24.3 (5.1)	0.014
Dialysis vintage (months)*	3 [1–210]	3 [1–172]	3 [1–210]	0.851
PG-SGA Score	7.3 (5.2)	4.16 (3.47)	11.06 (4.49)	<0.001
Charlson Co-morbidity Index[1]	5.7 (2.2)	4.74 (1.69)	6.88 (2.19)	0.003
Type of patient				
New to dialysis	9 (25.7%)	4 (21.1%)	5 (31.3%)	0.958+
Ongoing dialysis	15 (42.9%)	9 (47.3%)	6 (37.5%)	
Acute dialysis	7 (20.0%)	4 (21.1%)	3 (18.7%)	
Rebound	4 (11.4%)	2 (10.5%)	2 (12.5%)	
Dialysis day				
MWF	24 (68.6%)	13 (68.4%)	11 (68.8%)	0.649
TTS	11 (31.4%)	6 (31.6%)	5 (31.2%)	
Serum biochemistry				
Kt/V or OCM	1.48 (1.17)	1.71 (1.76)	1.3 (0.29)	0.394
Potassium (mmol/L)	4.86 (0.79)	5.02 (0.62)	4.68 (0.94)	0.216
Phosphorus (mmol/L)	1.73 (0.62)	1.83 (0.64)	1.61 (0.59)	0.31
Corrected calcium (mmol/L)	2.37 (0.25)	2.39 (0.16)	2.36 (0.33)	0.739
CaxPO4 (mmol/L)	4.10 (1.41)	4.52 (1.40)	3.59 (1.30)	0.067
Creatinine (µmol/L)	606 (237)	679 (252)	518 (189)	0.043
Pre-urea (mmol/L)	21.5 (7.0)	22.8 (7.3)	19.9 (6.5)	0.242
Albumin (g/L)	33.5 (5.9)	35.8 (4.7)	31.0 (6.4)	0.018
Bicarbonate (mmol/L)	22.2 (3.22)	21.4 (3.8)	23.2 (1.9)	0.111
C-reactive protein (mg)	31.6 (45.5)	23.6 (36.4)	39.6 (53.3)	0.361

* non-parametric-median [range] recorded

[1]Charlson Co-morbidity Index as described by Liu *et al.* (2010)

+Fisher exact test was used to determine significance

Abbreviations: BMI, body mass index; PG-SGA, patient-generated–subjective global assessment; MWF, Monday, Wednesday & Friday; TTS, Tuesday, Thursday & Saturday; Kt/V, dialysis adequacy; OCM, online clearance measurement.

Table 3: Results of univariable and multivariable logistic regression analysis to identify associations with malnutrition

Variable	Univariable analysis		Multivariable analysis		
	OR	95% CI	OR	95% CI	P-value
Age (years)	2.03	0.96–4.29			
Sex					
Male	1.75	0.40–7.58			
Female	1				
BMI (kg/m^2)	0.34	0.12–0.91	0.13	0.02–0.79	0.027
Dialysis vintage (months)	0.89	0.44–1.78			
Charlson Co-morbidity Index	3.56	1.37–9.24			
Type of patient					
Ongoing dialysis	1	.			
New to dialysis	1.88	0.35–13.24			
Acute Dialysis	1.25	0.18–6.94			
Rebound	1.50	0.16–13.75			
Dialysis day					
MWF	1.02	0.24–4.26			
TTS	1	.			
Dietary intakes (per/day)					
Energy	0.73	0.36–1.47			
Protein	0.51	0.23–1.12	0.16	0.03–0.84	0.03
Potassium	1.87	0.41–8.60			
Phosphorus	0.3	0.12–0.79			
Serum biochemistry					
Kt/V or OCM	0.65	0.22–1.93			
Potassium (mmol/L)	0.63	0.31–1.30			
Phosphorus (mmol/L)	0.68	0.32–1.43			
Corrected calcium (mmol/L)	0.88	0.43–1.80			
CaxPO4 (mmol/L)	0.43	0.17–1.12			
Creatinine (µmol/L)	0.46	0.21–1.01			
Pre-urea (mmol/L)	0.63	0.29–1.36			
Albumin (g/L)	0.33	0.12–0.91	0.34	0.12–0.98	0.046
Bicarbonate (mmol/L)	2.15	0.78–5.93			
C-reactive protein (mg)	1.49	0.63–3.55			

Odds ratios for continuous variables (i.e. all except sex, type and dialysis day) are for a one standard deviation increase.

Phosphorus intake was excluded in the multivariable analysis as it was closely correlated with protein intake.
[1]The reference category is well-nourished (PG-SGA score of A; malnutrition defined as score of B or C)
Abbreviations: BMI, body mass index; PG-SGA, patient-generated–subjective global assessment; MWF, Monday, Wednesday & Friday; TTS, Tuesday, Thursday & Saturday; Kt/V, dialysis adequacy; OCM, online clearance measurement; OR, odds ratio (un-standardised coefficient); CI, confidence interval

Table 4: Participants daily dietary intakes of energy, protein, potassium and phosphorus compared with standard daily recommendations (Ash et al., 2006; National Kidney Foundation, 2000) by nutrition status (as assessed by the PG-SGA). Values shown as n (%) or mean (standard deviation)

	All	Nutritional status		
Daily intake	**(n=35)**	**Well-nourished (n=19)**	**Malnourished (n=16)**	**P-value**
Energy (kJ/kg)	99.4 (27.3)	103.1 (29.1)	95.0 (25.1)	0.392
% within 125–146	3 (8.6)	0 (0)	3 (18.75)	
% ≥ 125	5 (14.3)	2 (10.5)	3 (18.75)	
Protein (g/kg)	0.96 (0.32)	1.05 (0.33)	0.86 (0.28)	0.080
% within 1.2–1.4	2 (5.7)	1 (5.3)	1 (6.25)	
% ≥1.2	5 (14.3)	3 (15.8)	2 (12.5)	
% ≥1.1	11 (31.4)	9 (47.4)	2 (12.5)	
% ≥1.0	16 (45.7)	12 (63.2)	4 (25.0)	
Potassium (mmol/kg)	1.20 (1.66)	0.91 (0.32)	1.53 (2.43)	0.323
% < 1	23 (65.7)	13 (68.4)	10 (62.5)	
Phosphorus (mg)	1275 (456)	1466 (432)	1048 (383)	0.005
% < 1000	12 (34.3)	3 (15.8)	9 (56.3)	

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Conflict of interest

The authors declare no conflict of interest.

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Salt, protein, phosphate and sugar: nutrition trends in kidney disease

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Campbell, K. L., & Rossi, M. (2014). Salt, protein, phosphate and sugar: nutrition trends in kidney disease *Renal Society of Australasia Journal, 10*(3), 141-145.

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Abstract

Dietary modification has long been considered a modifiable risk factor for the progression of chronic kidney disease (CKD) and a key management strategy in end-stage kidney disease. This review will focus on the history of the reoccurring focus on dietary components of salt and protein, as well as the impact of consumer behaviour moving towards convenience foods, on intake of phosphate and sugar in the form of fructose.

The latest evidence in CKD supports diets low in sodium, discourages strict diets low in protein and presents a strong case to turn the cycle of eating habits back to basics, in a bid to lower processed food intake and improve the health outcomes of our CKD patients.

Keywords

Nutrition, kidney disease, diet, sodium, phosphate.

Background

In this anniversary year of the *RSAJ*, it is timely to reflect on trends in research and practice for the nutritional management of kidney disease. In modern history, there is no better example that reflects history repeating itself than diet trends or 'fads' coming in and out of vogue in a cyclic nature.

When we consider patterns of research informing practice in the nutritional management of kidney disease, there is a long history of reoccurring focus on salt and protein intake, and a new focus on the role of processed and convenience foods in dietary management of chronic kidney disease (CKD).

Dietary salt restriction

Public health recommendations for restricting salt intake has been rather controversial over the last 40 years since it was first promoted in the *Dietary Goals for the United States* as a health promotion strategy (US Senate Select Committee, 1977). Its time course for recommendation in kidney disease management follows a similar, yet less controversial path. The initial impetus for this recommendation came from observational studies. Since this time, large scale observational studies such as INTERSALT (Intersalt Cooperative Research Group, 1988), followed by intervention studies TOHP I and II (Cook *et al.*, 2007) and the DASH study (Appel *et al.*, 1997), have highlighted benefits for lowering sodium intake on blood pressure (BP) management in the general population. However, there has been ongoing criticism of this approach, with suggestions that the science of salt is not scientific but political (Graudal & Jürgens, 2013), and as such, the cyclic nature of a 'low-salt diet' in CKD has followed. An overview of the current evidence for sodium restriction in CKD, which up until recently was drawn primarily from data from non-CKD populations, is provided below.

Salt is a substance in great abundance in the food supply. There is a clear imbalance between physiological need for sodium, guideline recommendations and actual sodium intakes, particularly in Western and Asian countries (Elliott & Brown, 2007). The physiological need for salt is thought to be in the order of up to 1.0 g/day (Morris, Na, & Johnson, 2008) whereas guidelines state up to 2.3 g/day is acceptable (Chan & Johnson, 2013). Further, current intakes are well above both of these, in the order of 3.5–4.6 g/day (Elliott & Brown, 2007).

Salt plays a key role in homeostasis of fluid and blood volume. This is achieved by action of the renin-angiotensin aldosterone system (RAAS) (Kobori, Nangaku, Navar, & Nishiyama, 2007). In the event of increased blood volume and/or blood pressure, inhibition of RAAS is triggered, resulting in an increased excretion of sodium and fluid via the kidneys (Kobori *et al.*, 2007). In the case of CKD, however, the responsiveness of RAAS is compromised, which results in fluid imbalance and issues of BP regulation, most commonly hypertension. In addition to this physiological disturbance, patients with CKD are thought to be particularly salt-sensitive, which further exacerbates the issue (Doulton & MacGregor, 2004).

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Sodium is recognised as a modifiable risk factor for cardiovascular disease (CVD) and key for the management of BP and albuminuria, which are, in turn, cornerstones of CKD treatment (Ritz & Mehls, 2009). In addition, a variety of metabolic consequences of high sodium intake have been hypothesised, including a direct effect on endothelial function, mediated through increasing oxidative stress and inflammation. These factors further exacerbate the effect of a high-salt diet in CKD (Ritz, Dikow, Morath, & Schwenger, 2006).

Meta-analyses of randomised-controlled trials (RCT) in the general population support reducing dietary sodium intake, thereby reduced BP (Feng J He, Li, & MacGregor, 2013). Variations in the results of these trials are generally due to different amounts of dietary sodium reductions between interventions. This verifies the concept from observational trials, which demonstrate the dose-dependent effect of sodium reduction on BP changes (He & MacGregor, 2008). This has been shown to be the case for normotensive as well as hypertensive individuals, although the latter to a lesser extent. However, the major issue with these trials for nephrology practice is the exclusion of patients with kidney disease. Therefore, from the above investigations, it is unclear how much our patients would benefit from sodium intervention.

Until recently, evidence for the benefit of a low-sodium diet in CKD populations was sparse and had significant methodological limitations. It is only in the past year that we have a Cochrane Review under way and dedicated trials investigating the effect of low sodium intakes on cardiovascular outcomes (McMahon, Campbell, Bauer, & Mudge, 2012). The most robust trial to date is the recent LowSalt CKD study, which represents a tightly controlled, short-term investigation (double-blind, placebo-controlled, cross-over study)(McMahon *et al.*, 2013). Although this trial showed substantial reduction in systolic BP and albuminuria, the short duration of the intervention and the somewhat artificial research environment (for example, the use of sodium tablets to mimic a high-salt diet), doesn't address the question of sustainability. DeBrito *et al.* have overcome some of these limitations in a six-month RCT demonstrating similar BP benefits with a low- versus a high-sodium diet using dietary counselling alone in Bangladeshi patients with CKD (de Brito-Ashurst *et al.*, 2013).

Adherence to dietary change is extremely challenging (McMahon, Campbell, Mudge, & Bauer, 2012), particularly in the modern food environment where sodium is abundant. Research is needed to investigate if dietary change in lowering sodium intake is sustainable, and if so, does it result in measurable changes to CKD patients' CVD risk and associated morbidity. One would suspect so; however, the trials are needed. Until then, based on changes achieved in BP and proteinuria, we can be confident that recommending a reduction in sodium intake in patients with CKD above recommendations (>100 mmol/day) is warranted.

Dietary protein restriction

The concept of protein restriction to support the management of CKD was first suggested by Addis in the 1940s (Addis, 1948), more than a century following Prevost and Dumas' discovery of the kidney's role in elimination of protein metabolic waste products, such as urea (Maher, 1989). Addis' hypothesis was based on decreasing the "workload" of the kidneys, and despite this seemingly valid concept, it wasn't until the 1980s when low and very low protein diets were given serious consideration for limiting the progression of CKD. This low protein concept was scrutinised by the landmark study, Modification of Diet in Renal Disease (MDRD), which demonstrated modest results at best, together with the increased risk of malnutrition, questioning the diet's efficacy (Kopple *et al.*, 1997).

Decades on, the focus of dietary protein's role in CKD progression has re-ignited. This time, the scientific rationale behind the diet is more robust, with our evolving understanding of protein as a precursor for key nephrovascular uremic toxins (Mafra, Barros, & Fouque, 2013). This deleterious manifestation of dietary protein has further added to its notorious role in not only the conventional "uremic" state, defined by high concentrations of urea, but also kidney stone formation, gout and hyperphosphataemia. The current Australian guidelines have maintained a conservative view of dietary protein management, with a recommendation of moderate intake in the CKD population, reflective of what is recommended for the general population (0.75–1.0 g/kg/day) (Johnson *et al.*, 2013). However, the rationale behind low and very low protein diets (defined as 0.6 and 0.3 g/kg/day, respectively) has resurfaced, particularly considering knowledge of protein's role in the generation of key uremic toxins.

Two uremic toxins in particular, indoxyl sulphate and p-cresyl sulphate, have received significant attention over the past decade for their nephrovascular properties (Meijers & Evenepoel, 2011). Both uremic toxins originate from the colonic bacterial fermentation of dietary protein-derived amino acids, where they enter the systemic circulation and are thought to target both the kidney and cardiovascular system. Both *in vitro* and animal studies have demonstrated the toxins' inflammatory and oxidative properties, promoting further kidney disease progression and heightened cardiovascular risk (Rossi, Campbell, & Johnson, 2013). Importantly, intervention studies have demonstrated the toxins' amenability to dietary protein restriction (Marzocco *et al.*, 2013).

In addition, diets high in protein, particularly meat, are associated with elevated uric acid levels resulting from their significant purine content (Choi, Atkinson, Karlson, Willett, & Curhan, 2004), as well as enhanced risk of kidney stone formation through promotion of calcium excretion and reducing urinary citrate levels (Bataille, Presne, & Fournier, 2002). Further, the primary waste product of protein catabolism, urea, once deemed inert, is now thought to play an active role in the distinctive systemic inflammation observed in CKD, through weakening of the gastro-intestinal barrier (Vaziri, Yuan, & Norris, 2013). Beyond these symptomatic conditions, low and very low protein diets have been associated with modest improvement in outcomes in the CKD population, including reduced mortality (Fouque & Laville, 2009).

Despite these attractive benefits of low and very low protein diets, it's important to reflect on why low and very low protein diets fell off trend originally. Firstly, there is the risk of malnutrition, given declines in nutritional status and energy intake coincide with low protein diets (Joel D. Kopple *et al.*, 1997). Next, when compared to the benefit of agents such as angiotensin converting enzyme inhibitors or statins on reducing the rate of decline in the estimated glomerular filtration rate (1.9 ml/min per year) to that achieved with dietary protein restriction (0.5 ml/min per year), the impact of a low protein diet appears negligible (Fried, Orchard, & Kasiske, 2001). Finally, protein restricted diets are often plagued by poor dietary compliance, with few studies achieving greater than 50% of targeted restriction (Aparicio, Chauveau, & Combe, 2001). These figures suggest the risks of malnutrition, coupled with poor compliance, may challenge any theoretical benefit association with low and very low protein diets.

Looking to the future, perhaps the resurrection of another trend could hold the answers to this unresolved issue?

Intestinal manipulation has been utilised as a treatment for kidney disease since the late 1950s (Marr, Burnell, & Scribner, 1960). Falling in and out of trend over the past half century, intestinal manipulation techniques began from primitive purgation methods, and invasive gastro-dialysis to the modern day, innocuous pre- and probiotics supplements (Di Cerbo, Pezzuto, Palmieri, & Palmieri, 2012).

Whilst still early days for this revamped trend, the concept of intestinal manipulation holds much promise, with pre- and probiotic therapy demonstrating their ability to decrease hyperuremia, kidney stone formation, uric acid levels and importantly inhibit the generation of those key nephrovascular toxins(Di Cerbo *et al.*, 2012). Simply put, alternative treatments such as pre- and probiotics may very well offer similar benefits in reducing damaging toxin load of a low protein diet without the risks of malnutrition or burden on patients' quality of life, often associated with restrictive diets (Durose, Holdsworth, Watson, & Przygrodzka, 2004).

Lastly, a focus on the type of protein, moving away from animal protein and towards vegetable sources is a new emerging trend in CKD. In fact, turning to vegetables as the main source of dietary protein holds promise for not only managing acidosis (Goraya, Simoni, Jo, & Wesson, 2013) but decreasing phosphorous absorption (due to the lower bioavailability of vegetable forms of phosphorous known as phytate) (Calvo & Uribarri, 2013). Nonetheless, this approach requires increased dietetic monitoring to ensure patients are meeting their essential amino acid requirement (as vegetable proteins tend to be lower in one or more essential amino acids) along with not exceeding their potassium restrictions (with vegetables a major source of potassium). Despite these cautions, studies have that following a vegetarian diet can be appropriate for CKD patients (Chauveau, Combe, Fouque, & Aparicio, 2013).

Eating patterns: back to basics

A modern-day challenge to dietary intervention in CKD is the layering of commercial food production with additives, which is driven by the demand for longer shelf-life and convenient meals. The predominance for convenience foods which are typically 'ultra-processed' has resulted in an increase in not only calorie intake but in food additives (Monteiro, Moubarac, Cannon, Ng, & Popkin, 2013), presenting new issues in the dietary management of CKD.

'Cardiorenal disease' was a term coined to describe the high CVD burden and synergistic relationship between kidney disease progression and CVD severity (McCullough, 2002). Novel risk factors have been the focus of much research over the past decade, with dietary intake of key food additives identified as modifiable risk factors of interest (Stenvinkel *et al.*, 2008). In particular, added sodium, phosphorus and fructose, as well as the increased production of advanced glycation end-products (or AGEs) through processing methods, has generated significant interest in the scientific literature.

The role of dietary phosphorus in metabolic bone disease (CKD-MBD), which is highly prevalent in the dialysis population and of increasing interest in CKD and the general ageing population, is of growing concern (Ketteler, Wolf, Hahn, & Ritz, 2012). The use of phosphorus as a food additive is increasing and the high degree of bioavailability of this form of phosphorus presents a real challenge for the management of serum phosphate and risk of CKD-MBD (Kalantar-Zadeh *et al.*, 2010). Diet interventions focused on educating dialysis patients about the presence of phosphorus additives, through strategies including how to read ingredient labels and the provision of individualised advice regarding convenience food options, resulted in a significant decrease in serum phosphate (Sullivan, Sayre, Leon *et al.*, 2009). This demonstrates the potential impact of dietetic intervention strategies on clinical outcomes. Nonetheless, this level of dietetic intervention is not only time-intensive but is limited by the patients' cognitive capacity.

Advanced glycation end-products (AGEs) are derivatives of glucose-protein or glucose-lipid interactions during food preparation and are implicated in complications associated with ageing, diabetes and CKD (Neade & Uribarri, 2008). This warrants important consideration in later stages of CKD, given serum AGE levels are associated with not only dietary consumption but also impaired renal clearance (Uribarri *et al.*, 2003). AGEs are created by the Maillard (or browning) reaction on food by reducing sugars and free amino groups from proteins and lipids (O'Brien & Morrissey, 1989). Diets rich in highly processed foods, fats and grilled or roasted meats carry a particularly high AGE-load compared with diets rich in plant foods and 'wet' cooking methods (such as casseroles and soups) (Uribarri *et al.*, 2010). Intervention studies demonstrate a 'low AGE' diet can reduce serum AGE levels (Uribarri *et al.*, 2003). Further, providing a low-AGE diet has attenuated the progression of renal disease in experimental mice studies, compared with AGE-containing diets (Thallas-Bonke *et al.*, 2013).

Fructose has been identified as a potential mediator of increased cardiovascular risk and CKD (Johnson *et al.*, 2007). Fructose is a common food additive in the United States in the form of 'high fructose corn syrup'. This is added to increase the palatability of food and is used in commonly sweetened foods such as soft drinks, and even foods not commonly sweetened such as crackers, thereby becoming rather ubiquitous in the food supply (Johnson *et al.*, 2007). High fructose intake has been associated with increased risk of metabolic syndrome, hypertension and elevated triglycerides. However, the potential impact of fructose on the stimulation of uric acid production has attracted the most attention, and is hypothesised to have a key role for inducing cardiorenal disease (Johnson *et al.*, 2007). Experimental studies have identified a causal effect of fructose consumption on the development of features of the metabolic syndrome (Nakagawa *et al.*, 2006), in addition to the deterioration of renal function, increased glomerulosclerosis and proteinuria in rats fed a high fructose diet (Teff *et al.*, 2004). However, intervention studies in human populations are still needed to identify if the experimental findings are likely to translate to clinical practice.

Given the above, there is an important impetus to promoting the cycle turns back to less processed food in not only the CKD population but also those at high risk of CKD. Fortunately, worldwide there has been a trend in the demand for local, sustainable and organic food production (Kearney, 2010). In fact, Australian food trend predictions for 2014 (Weber Shandwick, 2014) suggest a 'back to basics' approach in line with global, Western trends as a result of rising food costs. Further, consumers are looking to market gardens and buying fresh and local produce, to not only curb costs but increase their feeling of control over where their food comes from. Unlike many other diet trends, this trend, moving away from packaged and processed food consumption patterns, aligns with emerging recommendations for CKD diet management.

Summary

As highlighted in this review, dietary management of CKD patients evolves over time, often following cyclic trends. Enabling dietary change is associated with a range of considerations, including the requirement for cooking skills, the ability to read and comprehend food labels and, importantly, food security, including cost and availability of fresh food to all parts of Australia. Therefore, utilising a multidisciplinary approach, including the expertise of an appropriately qualified dietitian (Accredited Practising Dietitian in Australia or Registered Dietitian in other countries), in addition to public health advocacy is key to supporting patients through the challenge of dietary management in CKD, recognising fact from fad or fiction.

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Typical and atypical haemolytic uraemic syndrome: a brief case comparison report for nurses

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Abstract

Background: Haemolytic uraemic syndrome (HUS) is one of the main causes of acute kidney injury in children. It is a multifaceted disease, characterised by microangiopathic haemolytic anaemia and thrombocytopaenia. It can often affect multiple organ systems, including the central nervous and renal systems.

Objectives: Two case studies are presented that highlight the differences between typical and atypical HUS. Treatment and prognosis differ, depending on the type of HUS. These complex case studies will demonstrate the strategic medical and nursing management required.

Key messages: Typical HUS starts with severe symptoms but it is the atypical form that has long-term consequences. It is important to ascertain the correct diagnosis early and initiate appropriate therapy accordingly. Multidisciplinary care, including nurses, is involved in the management of care for these children and can support and educate their families to assist them through this debilitating disease. New treatments such as Eculizimab hold new promise in the treatment of atypical HUS.

Keywords

Haemolytic uraemic syndrome, plasma exchange, peritoneal dialysis, nursing.

Introduction

Haemolytic uraemic syndrome (HUS) is a clinical syndrome defined by the simultaneous occurrence of microangiopathic haemolytic anaemia, thrombocytopenia and acute kidney injury (Ariceta *et al.*, 2009). HUS is the most common cause of acute kidney injury (AKI) in children resulting from an abnormal, premature destruction of red blood cells (Andreoli, 2002). The care of children with HUS is complex, requiring a multidisciplinary approach. The purpose of this paper is to use two case studies to demonstrate the strategic medical and nursing management required.

In HUS, damaged red blood cells infiltrate the kidney's filtering system, resulting in life-threatening renal failure (Besbas *et al.*, 2006). The initiating factor is often due to an injury to the glomerular endothelium or an imbalance of platelet aggregation factors, resulting in fibrin deposits and clumping of platelets within the capillaries. As this process continues, the capillaries occlude, causing a reduction of glomerular filtration rate leading to AKI. Red blood cells travelling through the plugged capillaries are damaged, causing haemolytic anaemia. Platelets are consumed in this clumping process and are damaged in the blood vessels, causing a reduction in platelets. (Mayer, Leibowitz, & Kurosawa, 2012).

HUS is classified into two main categories: those occurring after a diarrhoeal illness (typical) and the other in the absence of a diarrhoeal illness (atypical) (Boyer & Niaudet, 2011). Typical HUS is more common and accounts for approximately 75% of presentations (Besbas *et al.*, 2006). The most common causative strain is *Escherichia coli* (*E. Coli*) that produces a Shiga toxin with bloody diarrhoea (Paton & Paton, 1998). Sources of contamination include under-cooked meat, unpasteurised milk, juice or contaminated water (Proulx, Seidman, & Karpman, 2001). Other bacterial diarrhoeal agents that can cause HUS include Shigella and Salmonella (DuPont, 2009). Typical HUS is also referred to as diarrhoea-associated HUS, typical HUS or Shiga toxin-associated HUS and has a more favourable prognosis (Geerdink *et al.*, 2012).

Atypical HUS is a rare disorder distinguished by the absence of diarrhoea, with an estimated prevalence of 7 per one million children in Europe (Boyer & Niaudet, 2011). Atypical HUS is also known as non-diarrhoeal associated HUS, D–ve HUS, sporadic or familial HUS and can occur without an initial gastrointestinal symptom (Rahman *et al.*, 2012). Outcomes are poorer in atypical HUS as 50% of presentations can progress to chronic kidney disease (CKD) stage 5 (Loirat, Noris, & Fremeaux-Bacchi, 2008). This familial form is associated with

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genetic abnormalities of the complement regulatory proteins and is frequently dormant and becomes activated with a viral flu episode. Children with typical HUS have a history of diarrhoea with malaena with or without vomiting, followed by sudden onset of symptoms of irritability and pallor. Other symptoms include restlessness, oliguria leading to oedema and macroscopic haematuria. Children presenting with this form of HUS have a good outcome of complete recovery (Lowe & Werner, 2005). For children with atypical HUS, the onset is sudden and prodromal features often include an upper respiratory tract infection (URTI), fever, vomiting, hypertension, haematuria and proteinuria (Mehrazma, Hooman, & Otukesh, 2011). The following two cases illustrate the cases of an atypical and typical presentation.

Case report 1 — Atypical haemolytic uraemic syndrome

J, a five-year-old boy who was previously well, with no family history of renal disease, presented with microangiopathic haemolytic anaemia, thrombocytopenia and AKI (non-dialysis requiring) and was diagnosed with atypical HUS. One week prior to this admission to hospital, J had a viral URTI, with a moist cough and sore throat, for which he was treated with amoxycillin by his general practitioner. Following his episode of URTI, he had a five-day history of vomiting, transient rash and two days of brown urine. At presentation, his initial pathology revealed anaemia, thrombocytopenia, impaired renal function and complement dysregulation. Lactate Dehydrogenase (LDH) and haptoglobin, which are markers of haemolysis, were performed to assess the disease process. Both the LDH and haptoglobin were in the abnormal range, suggesting haemolysis. The low C3 levels indicated systemic complement alternative pathway activation 5 (Loirat, Noris, & Fremeaux-Bacchi, 2008).

J was treated with plasma exchange within 48 hours of presentation, initially daily for five days, followed by five treatments per week for two weeks and then three sessions per week for two weeks, according to the 2009 adult guidelines (Ariceta *et al.*, 2009). After five weeks of the treatment, serum creatinine had reduced, platelet count increased and there was no evidence of haemolysis.

Our unit arranged testing for the whole family through a Paris-based laboratory at the Hospital European Georges-Pompidou (Fremeaux-Bacchi *et al.*, 2013), who have significant expertise in researching atypical HUS and the various genetic manifestations that can cause it. This revealed that J was the only member of his family to have Factor H antibodies, which has been shown to be an association with improved outcomes and mortality

The frequency of plasma exchange was reduced once the Factor H antibodies were identified. Immunosuppression with prednisolone and azathioprine was introduced, with a plan for J to remain on immunosuppressive therapy for a minimum of 12 months. After six months, his parameters had normalised, his HB was 127 g/l with normal platelets, LDH, haptoglobin and no red cell fragmentation. His kidney function, urine and blood pressure all normalised. He remained Cushingoid for 12 months as a result of his prednisolone use.

Case report 2 — Typical haemolytic uraemic syndrome

K, a four-year-old girl, presented to our hospital with a four-day history of bloody diarrhoea, decreased urine output, increasing oedema and hypertension. She had been progressively reviewed at a regional hospital, where her pathology results from day one through to day four had deteriorated. Her creatinine had increased from 37 to 315 mmol/l, haemoglobin (Hb) decreased from 144 to 107 g/l and platelets had decreased from 440 mg/l to 86 mg/l.

On admission, her presentation was clinically and biochemically consistent with typical HUS. Serology from stool was not available. She was dehydrated, hypertensive, anaemic and suffering AKI. Her initial pathology revealed anaemia, thrombocytopaenia and impaired renal function. Her Hb continued to decrease to 64 g/l, for which she received a blood transfusion. Her urea rose to 23.3 mmol/l and creatinine peaked at 572 mmol/l. Her LDH increased to 3016 units/l (normal range is 100–200) and her haptoglobin decreased to 0.19 mg/dL (normal range 0.36–1.95 mg/dL).

A Tenckhoff catheter was inserted and peritoneal dialysis (PD) was commenced one day after admission, following lengthy conversations with her parents. PD was commenced using small volumes of 10 ml/kg and gradually increased to 30 ml/kg. The day after she commenced PD she remained hypertensive and anuric. She then suffered a seizure on the ward, a chest x-ray (CXR) revealed left lower lobe pneumonia and she was then transferred from the nephrology ward to the intensive care unit, where she was intubated and received haemofiltration for two days. She required a jugular central venous dialysis catheter (CVDC) which occluded after just one day. The following day, another internal jugular CVDC was surgically inserted and she was ordered three daily treatments of plasma exchange at 35 ml/kg per exchange with fresh frozen plasma (FFP). Due to access problems with the CVDC, she only received two treatments of plasma exchanges.

Fifteen days following admission, her urine output improved and she was extubated and transferred back to the nephrology ward. Her hypertension was initially treated with one stat dose of intravenous (IV) hydralazine and then regular oral propranolol three times a day and a weekly dose of nifedipine. K was treated with phenytoin three times a day for her seizures and this was ceased after two weeks. She had a magnetic resonance image (MRI) of her brain, which was normal. Anaemia was diagnosed on admission for which 200 ml of packed red blood cells was transfused. Nutritional support was managed by the paediatric renal dietician according to the patient's requirements. Pediasure 700 ml/day was given via a nasogastric tube for four weeks. K made a slow but full recovery. Fortunately, her renal function improved and she did not require ongoing renal replacement therapy (RRT).

Discussion

Although typical HUS starts with severe symptoms, it is the atypical form that has long-term consequences. These symptoms are of particular concern as they cause immediate and severe deterioration. Early and correct treatment, as described in the two cases above, is pivotal to the child's outcome, so it is important to identify the differences in presentation and manage typical HUS and atypical HUS appropriately as treatment and prognosis is always dependent on the type of HUS (Besbas *et al.*, 2006).

HUS is a syndrome that has seen several important advances in relation to therapeutic approaches. Case reports have suggested that Eculizimab (SOLIRIS), a humanised monoclonal antibody that blocks complement activity targeted against C5, is effective in the treatment of atypical HUS (Mache *et al.*, 2009; Nürnberger *et al.*, 2009). Data from these case reports have demonstrated the effectiveness of Eculizimab in inhibiting complement activation in atypical HUS. Current clinical trials investigating the role of Eculizimab therapy in the treatment of patients with atypical HUS due to complement dysregulation will provide more insight into the effectiveness of this treatment (Lapeyraque, Frémeaux-Bacchi, & Robitaille, 2011). Results of trials may provide a potential future treatment for atypical HUS in children, which may alleviate the need for ongoing plasma exchange.

Implications for practice

The multidisciplinary team caring for these children typically includes paediatric nephrologists, paediatric nephrology nurses, paediatric surgeons, a paediatric dietician, a paediatric social worker and a general paediatrician. Every member of the multidisciplinary team has a major role in caring for these children. It certainly is a challenging experience for everyone in the team. These complex case studies have demonstrated the strategic medical, nursing, pharmacy, dietetic and psychosocial management of the children and their families.

In particular, nephrology and general nurses are pivotal in the management of care for these children. Nurses provide 24-hour health care and can support and educate families to assist them through this debilitating disease. A greater understanding of the disease trajectory, vascular access requirements, subtle differences between types of HUS and the potential outcomes for each child can assist the family to better understand the challenges faced.

Conclusion

Health professionals are required to quickly ascertain the correct HUS diagnosis early and initiate appropriate therapy accordingly. As there are no internationally agreed paediatric guidelines, further research is required to assist paediatric health care professionals to provide the best evidence-based care for children with HUS.

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