Invited Review

Pharmaceutical Care for Dialysis Patients

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ABSTRACT

The incidence of end stage renal disease (ESRD) is increasing worldwide. Dialysis centers are overwhelmed by the increased number of patients. When a patient becomes aware that his/her kidneys are nonfunctional, he/she is likely to be confused and depressed. The counseling of the patient in the matter of drugs, disease, and lifestyle forms an important necessity, which can help the patient's confidence and motivate the patient for self-care of his/her condition. The counseling of the patient and dispelling the myths regarding ESRD and dialysis is vital for all patients on a continuous basis. This can be achieved by practicing the pharmaceutical care in ESRD patients on dialysis. In this article, the knowhow and the significance of self-management of ESRD patients on dialysis is discussed.

Introduction

End stage renal disease (ESRD) is an irreversible deterioration of kidney normal function (glomerular filtration rate <15 mL/min/1.73 m^2) and requires renal replacement therapy. The options for renal replacement therapy for ESRD patients are hemodialysis, peritoneal dialysis and kidney transplantation.[1] Patients with ESRD who are on dialysis (hemodialysis or peritoneal dialysis) have typically multiple comorbidities and have a huge burden of prescription medicines and polypharmacy.[2,3] Several publications have focused on medication related problems (MRPs), which are highly prevalent in patients on dialysis with estimates of one MRP for every 15.2 drug exposures.[4] Due to MRPs induced morbidity, nonadherence and noncompliance to the prescribed oral medication is a common trait with a high rate of 67%.[5] The poor compliance and nonadherence is a social issue where patient's belief and myths play a role in shaping the attitude and practice. There is a need to engage with all patients to get the health education, which assists them in self-care of the condition. In addition to this, motivation plays a crucial role and acts to motivate for the self-care among patients. The patient who becomes involved in self-care is open to patient education and can be updated very easily in matters of medicines, the disease and lifestyle modifications suitable for the failed kidney function. The ESRD comorbidities such as diabetes, hypertension, cardiovascular disease, and anemia can cause serious consequences to a patient. The American Pharmacists Association defines pharmaceutical care (PC) as a patient-centered, outcomes oriented pharmacy practice that requires the pharmacist to work in concert with the patient and the patient's other healthcare providers to promote health, to prevent disease, and to assess, monitor, initiate, and modify medication use to assure that drug therapy regimens are safe and effective.[6] PC is very much required for ESRD patients on dialysis because the patient condition is sensitive to even mild alterations in diet and medications. Dialysis patients are depressed and are low in morale due to frequent sessions of dialysis at least 2-3 times/week in hemodialysis and every day in peritoneal dialysis. The changed kidney conditions and functional ability mandates for contingency evaluations of pharmacokinetic and pharmacodynamic parameters for prescribed medicines. Identification of MRPs with an objective of resolution is one of the prime objectives of PC. The PC provision has benefited ESRD patients on dialysis in the arena of clinical, economical and humanistic outcomes.[4,7] The challenges for the pharmacists are to identify the MRPs and search for comparable therapy and convince the physician and nurse regarding the preference of the idea, which can resolve the MRPs. In therapeutics, there will be decisions which involve a change in the prescribed medicines or dosage. In such situations, patients are likely to become worried and confused. It becomes necessary

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to reassure the confidence of the patient by providing clarification as to why the medicines or dosage was changed by the prescriber. The pharmacist's application of skills and knowledge are the guiding principles in developing a customized PC plan for a patient. The PC cycle essentially involves assessment of the needs of drug therapy, lifestyle changes, and disease conditions. The patient's explicit PC plan focuses on recognition of actual and potential outcomes of MRPs. The rational subsequent step is to develop and implement a customized care plan for the patient. The PC cycle is complete with periodic evaluation and review of the identified objectives of the care plan. The outcomes of the PC cycle should be able to identify and classify the issues in the treatments and patient's compliance which are discussed or shared with physician, pharmacist or nurse providing healthcare for that patient. The referrals to doctors or nurses are important outcomes of PC cycle.[8] The findings of clinical pharmacists are appreciated for early and timely identification and resolution of MRPs, improvement in patient compliance, provision of drug information to healthcare professionals and patients. They are also well-known for their intellectual insights for improving biochemical and therapeutic responses of drug therapy, which have a direct impact on improving outcome of therapy and the quality of life. The summary of impact of clinical pharmacist interventions on hemodialysis patients is specified in Table 1.[4,7,9-14]

Pharmaceutical care cycle in dosage adjustment for end stage renal disease patients

The clinical pharmacist plays a pivotal role in connecting the doctors and nurse with patients. The well-trained clinical pharmacist's approach to the patient is to assess the level of morbidity and other socioeconomic issues in the therapy. He corresponds with the fellow healthcare providers in matters of drugs thus saving their effort and time. The clinical pharmacist having a sound background of pharmacokinetics and pharmacodynamics is expert in customized dosage adjustment in ESRD patients, which is the prime aspect of pharmacotherapy. The dose adjustment of drugs is based on the creatinine clearance of the patients. The creatinine clearance in adult patients can be calculated by the Cockcroft-Gault Equation, which is commonly used for estimation of creatinine clearance [Equations 1 and 2].[15]

$$GFR_{Male} = ([140 - Age] \times Body\ weight\ [kg])/(72 \times Serum\ creatinine\ [mg/dL]) \quad \text{(Equation 1)}$$

$$GFR_{Female} = 0.85 \times GFR_{Male} \quad \text{(Equation 2)}$$

Creatinine clearance is an index for initiating drug therapy in ESRD patients who have compromised renal function. Creatinine clearance is usually calculated for empirical adjustment of dose and its frequency. The estimation of the drugs in the dialysate acts as a guide for deciding the schedule and the amount of the drug to be administered. In ESRD patients whether a drug can be taken before or after dialysis is an aspect for which patients look to pharmacist's guidance. Based on the dialyzability of the drug in question the pharmacists can advise when to take the drug.

Fluid management in dialysis patients

Patients on hemodialysis have a fluid intake restriction of 500-700 ml, plus the preceding day urine output. The recommended weight gain for hemodialysis patient should not be more than 1.5-2 kg between dialysis sessions.[16] For example: If the volume of the urine is 250 ml in 24 h, the fluid intake can be 750-1000 ml in 24 h. However, in peritoneal dialysis patients fluid intake of 3 L/day

Table 1: Impact of clinical pharmacist interventions on hemodialysis patients

Name of the author	Targeted population	Intervention	Sample size	Study site	Study duration	Outcome
Sathvik *et al*.[9] 2007	Hemodialysis patients	Patient medication knowledge	90	Mysore, India	16 weeks	Medication knowledge of HD patients was improved through medication education session
Abraham *et al*.[10] 2012	Hemodialysis patients	Patient counseling	50	Kochi, India	6 months	The increase in score in all four domains (physical, psychological, environmental and social) among the test group compared to control group
Abraham and Ramachandran[11] 2012	Hemodialysis patients	Patient counseling	81	Kochi, India	12 months	The increase in score in all four domains (physical, psychological, environmental and social) among the test group compared to control group
Thomas *et al*.[12] 2009	Hemodialysis patients	Patient counseling	56	Ernakulam, India	6 months	The mean HRQoL in the test group showed a consistent improvement of 2% in 6 months compared to control group
Dashti-Khavidaki *et al*.[13] 2013	Hemodialysis patients	Pharmaceutical care	92	Tehran, Iran	6 months	PC significantly improved HRQoL of HD patients especially in the role-emotional, mental health, social functioning, and general health dimensions
Pai *et al*.[14] 2009	Hemodialysis patients	Pharmaceutical care	107	New York, USA	2-year	Patients who have clinical care provided by pharmacists do not have worsened HRQoL after 1 year and are able to maintain HRQoL for an additional year
Pai *et al*.[4] 2009	Hemodialysis patients	Pharmaceutical care	104	New York, USA	2-year	Identification and resolution of MRPs through PC resulted in decreased drug use and costs for patients undergoing hemodialysis. Hospitalization rates were significantly lower in the PC group, with a trend toward shorter duration
Dashti-Khavidaki *et al*.[7] 2012	Hemodialysis patients	Clinical pharmacy services	86	Tehran, Iran	6 months	Serum Ca concentration was increased in hypocalcaemia patients and decreased in hypercalcemia patients until it reached the optimal range in both groups. Hb concentration increased in anemic patients and serum ferritin reached target values in all patients. Total cholesterol, low-density lipoprotein cholesterol and triglycerides decreased to near-optimal values in dyslipidemia patients

HD = Hemodialysis, PC = Pharmaceutical care, HRQoL = Health related quality of life, Ca = Calcium, MRPs = Medication related problems, Hb = Hemoglobin

may be allowed due to daily dialysis in which the fluid overload is taken care of.[17] Fluid overload can lead to breathlessness, swelling, high blood pressure and eventually leading to enlargement of the heart and its failure.

Managing thirst in dialysis patients

Thirst is a subjective feeling, which becomes irresistible due to dryness of mouth and throat. This can be addressed by keeping the mouth and throat in wet condition. Reusable ice cubes are used to overcome the discomfort caused by thirst. One of the important objectives of management of hemodialysis patients is to prevent fluid overload. They can keep their mouth and throat moist with saliva without drinking cool drinks or fluid intake. False bottomed mug can also help the patients to achieve psychological contentment. The containers for drinking water should always be <200 ml and never be bigger than 500 ml bottle, which helps the patient to resist the temptation of compulsive drinking.[16] The patient should be educated about the dangers of consuming salty and spicy foods as they increase thirst and tendency to drink more water. The patient should be knowledgeable regarding the hidden fluids present in food items, fruits, vegetables, which add to the fluid overload - for example, water enriched fruits and vegetables such as water melons, grapes, apples, oranges, tomatoes, lettuce, and celery. The objective of education is to create awareness, motivate and practice the fluid restriction voluntarily. The alertness regarding the relationship between hot and humid conditions and thirst can be beneficial in controlling fluid intake. For example, avoiding hot environment can be an important practical tip. Patients can save on fluid intake, while using oral medication along with meals. Candies and condiments such as hard sweets, gum, mints, or a wedge of lime or lemon to combat dry mouth, which stimulate secretions of saliva and keep the mouth wet. This can also be achieved by rinsing the mouth with mouthwash. However, one should be cautioned about risk of swallowing.[16,18]

Salt management in dialysis patients

Sodium chloride is a natural ingredient present in most of the foodstuffs. Processed foods such as canned, packaged and fast foods have added sodium, which may go unnoticed. The high sodium levels in ESRD patients on dialysis induce them to consume more water due to irresistible thirst with the burden of high blood pressure with edema. Salt management is an important strategy for supervision of ESRD patients on dialysis. Sodium intake is instrumental in the fluid related weight gain between the dialysis sessions. If the patient has consumed excess salt it is usually indicated by episodes of hypertension, which is missing in the case of consumption of water alone. The prescribed intake of sodium for patients on hemodialysis is between 1.6 and 2 g/day (depending on urine output). In peritoneal dialysis patients a more liberal salt intake of 6-8 g/day is allowed because it can be easily removed by daily dialysis.[16,17] Common salt is a combination of sodium and chloride ions one tablespoon of salt has approximately 2.4 g of sodium. The concealed salts present in fruits and vegetables can be minimized by rinsing the slices in plain water before consumption. The salt being soluble in water gets easy separated. One can use grated fruits and vegetables in cooking as it removes the salt present in the peelings. Substitution of lemon and raw mango to impart salty taste to the food can reduce the requirement for common salt. Similarly, using fresh herbal spices like green chilies, coriander and mint can be beneficial. The caution to rinse in water all the canned foodstuffs (vegetables, beans, meat, and fish) before consumption can reduce the salt burden. Calculating the total salt intake from packaged and canned foodstuffs by computing the label mentioned sodium content can be helpful in salt management.[18]

Energy and protein turnover in dialysis patients

Energy is derived in the body by metabolizing carbohydrates, fat, and protein. The metabolic end products are carbon dioxide and water for carbohydrates, aldehydes and ketone bodies for fat and urea and water for proteins. The compromised kidney function mandates the patients to derive more energy from proteins instead of carbohydrates and fats. This explains the requirement of high protein for dialysis patients. The carbohydrate derived energy may cause an increase in water load. The energy derived from proteins is safe as excess urea is extracted twice a week in dialysis. The fat metabolic end products are detrimental due to their influence on pH imparting acidity to the blood. The energy and protein nutritional status in dialysis patients can be measured by estimating the serum albumin, serum pre-albumin, serum creatinine and the creatinine index, dietary interviews and diaries, protein equivalent of total nitrogen appearance, anthropometry, subjective global nutritional assessment, dual energy X-ray absorptiometry and adjusted edema-free body weight. Energy expenditure of patients undergoing maintenance dialysis is similar to that of normal and healthy individuals. Serum albumin level should be monitored each month for fluctuations. If albumin level is below the normal, it means that the patient is progressing toward negative protein balance. Hypoproteinemia can result from a diet low in proteins. If not corrected, chances of getting frequent infections leading to hospitalizations are increased. The daily energy intake for dialysis patients aged <60 years is 35 kcal/kg/day and for patients aged more than 60 years is 30-35 kcal/kg/day.[19] To meet the energy requirements, hemodialysis patients are to take 1.2 g/kg/day of protein and peritoneal dialysis patients are to take 1.2-1.3 g/kg/day of protein.[19] Beans, peas, lentils, soy milk, nuts and nut spreads such as almond butter, peanut butter, soy nut butter, and sunflower seeds are a safe source of natural proteins. Food rich in carbohydrate and low in protein are bread, cereals, pasta, noodles, and rice. Animal derived proteins from foodstuffs such as mutton, chicken, fish, eggs and dairy products such as milk cheese and yogurt need to be consumed with caution.

Potassium management in dialysis patients

Potassium is an important constituent of blood and tissues. It plays an important function in the depolarization and repolarization cycle of neurons and muscles. Potassium level is maintained by the kidneys in order to optimize neuromuscular function. During the resting potential of a cell the intracellular potassium levels are higher than extracellular levels. The ion specific channels of sodium and potassium open up heralding depolarization in which the potassium goes out of the membrane and sodium enters the cells due to the difference in gradient. The cycle is complete with repolarization where in sodium potassium ATPase pumps potassium in and sodium out of the cell. This process is mainly dependent on the concentration gradient. In hyperkalemia due to high concentration of potassium in extracellular fluids the diffusion of potassium will be from outside to

inside hampering the depolarization and repolarization cycle, which effects neuronal and muscular functions. In ESRD patients as the kidneys are nonfunctional the normal potassium balance gets affected leading to hyperkalemia. The potassium derived from diet gets accumulated in the body as it is not excreted out. Some potassium is present abundantly in nature, and foodstuffs invariably contain some potassium in hidden form. One needs to take into account all the potassium consumed in the form of food as it is critical to maintain the potassium levels near to normal values. One of the important objectives of dialysis is to maintain the potassium level in the blood. If not, it can cause weakness in muscle contraction, arrhythmia, and cardiac arrest. Potassium levels should be monitored every month. The dietary potassium is generally restricted to 2-3 g/day for patients on hemodialysis and 3-4 g/day for peritoneal dialysis.[19] Dialysis patients are advised to restrict the potassium intake by choosing the food stuff low in potassium. Fruits and food stuffs rich in potassium are bananas, oranges/orange juice, sweet limes, dates (dried), mangoes, kiwi and prunes/prune juice. Vegetables which are rich in potassium are potatoes, sweet potatoes, tomatoes/tomato juice/tomato sauce, split peas, lentils, beans, spinach (cooked), mushrooms (cooked), chili peppers and pumpkin. Fruits which are low in potassium such as apples/apple juice, papayas, pineapple, grapes/grape juice, cranberry juice and dates (fresh) are recommended. Vegetables which are low in potassium such as cabbage, carrots, cauliflower, cucumber, celery and onions (raw), mushrooms (fresh), summer squash (cooked) and green beans are recommended.

Phosphorus and calcium balance in dialysis patients

Phosphorous is an important element required for nucleic acids, enzymes and adenosine-5'-triphosphate. It is distributed even in the bone as calcium phosphate. Calcium is mostly present in conjugation with phosphate. The sequestration of calcium into bone is the interplay of parathyroid hormone, vitamin D and phosphorus. Vitamin D is converted to its active form with enzymes released by the kidney. Phosphate excretion is through the gastrointestinal tract (GIT) by active secretions. In ESRD patient's phosphate accumulation poses a challenge as it is difficult to get rid of it by dialysis. Hence, the phosphate binders are given orally with diet. This will help in removing phosphates from the system. In healthy people, the excess phosphate gets secreted by the kidney by an active process. The phosphorus is widely distributed in food items and acts as a source for pooling of phosphate in the body. High levels of phosphorus can cause resorption of the bone causing calcium to move from the bone to blood. This results in weakness, pain with fragile bones and other symptoms including itchy skin and formation of calcium enriched stone in the gallbladder and urinary tract crystals. Hence, it becomes essential to maintain the phosphorus and calcium levels near normal. It is only possible by assessing the levels of phosphorus and calcium once in a month and parathyroid hormone levels should be monitored once in 3 months. Calcium, phosphate and parathyroid hormone levels are utilized in management of phosphorus and calcium balance in dialysis patients. Dietary phosphorus need to be restricted to 0.8-1 g/day and should be implemented if serum phosphorus levels rises to >4.6 mg/dl. Tissue calcification is the deposition of calcium in the tissues. Serum calcium phosphorus product levels are utilized to guide the prevention of depositions. It is usually safe to maintain the levels at <55 mg/dl. Calcium intake should is targeted to below 1.5 g/day, and total calcium intake (supplements and diet) should not exceed 2 g/day.[20] Foodstuff such as milk, cheese, dried beans, peas, colas, nuts, and peanut butter are high in phosphorus.

Anemia in dialysis patients

The kidney has a direct link to bone marrow through erythropoietin (EPO). EPO is a hormone which stimulates the bone marrow to produce red blood cells. Patients suffering from kidney diseases are unable to produce endogenous EPO. Hence, they are supplemented EPO to overcome the anemia on a regular basis that is, once in a week. Optimal hemoglobin levels for dialysis patients should be at least 10 g/dl. In the process of dialysis, the iron loss is about 1-2 g/year this is also overcome by administration of parenteral iron therapy either weekly or monthly as per the requirement of individual patient's needs.[21] Iron loss in dialysis patients is also due to gastrointestinal bleeding, blood sampling for tests, apart from dialysis. Transferrin is a protein required for transport of iron from blood to bone marrow. The assessment of iron deficient anemia should be carried out periodically to decide the administration of supplements of iron. Transferrin saturation is a guiding value, which should be at least 20% and ferritin should be more than 200 ng/mL in hemodialysis and more than 100 ng/mL in peritoneal dialysis patients. The monthly assessment of iron levels is required for the management of anemia related morbidity.

Micronutrient supplements for end stage renal disease patients

In the absence of natural kidney function, dialysis is carried out to maintain the vital parameters such as serum urea, potassium, calcium, sodium, phosphorus, and iron. However, patients on dialysis have altered GIT functions and flora. Hence, they are unable to meet the daily requirement of vitamins and minerals. Deficiencies of vitamin C, folate, vitamin B6, calcium, vitamin D, iron, zinc, and selenium are usually observed. The supplementation of above micronutrients is a strategy to overcome it. The National Kidney Foundation clinical practice guidelines for nutrition in chronic renal failure suggest that patients achieve 100% of the Dietary Reference Intakes (DRI) for vitamins A, C, E, K, thiamin (B1), riboflavin (B2), pyridoxine (B6), vitamin B12, and folic acid, as well as 100% of the DRI for copper and zinc. Due to restricted intake of foodstuff and losses of water-soluble vitamins during dialysis, patients are usually given specially formulated multivitamins.[22,23] Supplementation of L-carnitine has been approved by the U.S. Food and Drug Administration to prevent and treat carnitine deficiency in dialysis patients. L-carnitine has also been found to improve fat metabolism, protein nutrition, antioxidant status, and anemia. Both vitamin C (250 mg a day) and vitamin E (400 international units a day) have improved the condition of the patients absolving them from painful muscle cramps. However, additional clinical trials are required before these can be used as standard therapy. Nutritional value of some common fruits and foods are summarized in Tables 2 and 3.[24,25]

Drugs to be avoided in end stage renal disease patients

End stage renal disease patients should avoid aspirin (should be taken if prescribed by the physician), ibuprofen and ibuprofen containing creams or ointments, decongestants, ispaghula, Oral rehydration salts, magnesium or aluminum containing oral preparations. Because of the universal availability of such over-the-counter antacids, these patients should be advised of this specific contraindication.[26,27]

Table 2: Nutritional value of some common fruits

Name of the fruit (nutritional value/100 g)	Protein (g)		Iron (mg)		Potassium (mg)		Phosphorus (mg)		Calcium (mg)		Sodium (mg)		Energy (kcal)	
	India	US	India	US	India	US	India	US	India	US	India	US	India	US
Orange	0.7	0.94	0.32	0.10	9.5	181	20	14	26	40	4.5	0	48	47
Mango, ripe	0.6	0.82	1.3	0.16	205	168	14	14	14	11	26	1	74	60
Banana, ripe	1.2	1.09	0.36	0.26	88	358	36	22	17	5	36.6	1	116	89
Sapota (Chikoo)	0.7	0.44	1.25	0.80	269	193	27	12	81	21	5.9	12	98	83
Pineapple	0.4	0.54	2.42	0.29	37	109	9	8	20	13	34.7	1	46	50
Papaya, ripe	0.6	0.47	0.5	0.25	69	182	13	10	17	20	06	8	32	43
Guava, country	0.9	0.95	0.27	0.26	91	417	28	40	10	18	5.5	2	51	68
Apple	0.2	0.26	0.66	0.12	75	107	14	11	10	6	28	1	59	52
Grapes pale green	0.5	0.72	5.52	0.36	—	191	30	20	20	10	—	2	71	69
Pomegranate	1.6	1.67	1.79	0.30	133	236	70	36	10	10	0.9	3	65	83
Lemon	1	1.10	0.26	0.60	270	138	10		70	26	—	2	57	29
Coconut water	1.4	0.72	0.1	0.29	NA	250	10	20	24	24	NA	105	24	19
Jack fruit, ripe	1.72	1.72	0.23	0.60	-	303	21	36	24	34	—	3	95	95
Water melon	0.2	0.61	7.9	0.24	160	112	12	11	11	7	27.3	1	16	30
Custard-apple	1.6	2	4.31	0.71	NA	382	47	21	17	30	NA	4	104	101
Strawberry	0.7	0.67	1.8	0.41	NA	153	30	24	30	16	NA	1	44	32
Muskmelon (Kharbuja)	0.3	NA	0.21	NA	341	NA	20	NA	32	NA	104.6	NA	17	NA
Amla	0.5	NA	1.2	NA	225	NA	20	NA	50	NA	5	NA	58	NA
Sweet lime (Musambi)	0.8	NA	0.7	NA	490	NA	30	NA	40	NA	—	NA	43	NA
Dates, fresh	1.2	1.81	0.96	0.90	—	696	38	62	22	64	—	1	144	277

NA = Data not available

Table 3: Nutritional value of some common Indian food stuffs

Name of the food stuff (nutritional value/100 g)	Protein (g)	Iron (mg)	Potassium (mg)	Phosphorus (mg)	Calcium (mg)	Sodium (mg)	Energy (kcal)
Egg (hen)	13.3	2.1	73	220	60	78	173
Chicken with bone	16	1.31	189	149	11	20	70
Chicken without bone	25	0.34	332	198	5	25	109
Mutton, muscle	18.5	2.5	270	150	150	33	194
Milk (buffalo's)	4.3	0.2	90	130	210	19	67
Milk (cow's)	3.2	0.2	140	90	120	73	67
Curd (cow's milk)	3.1	0.2	130	83	149	32	60
Prawn	19.1	5.3	262	278	323	66	89

Vaccinations for dialysis patients

All dialysis patients should be recommended vaccinations such as diphtheria tetanus (every 10 years), pneumococcal (every 3-5 years), meningococcal (in case of an epidemic), influenza (once a year), chicken pox (every 10 years), measles mumps/rubella and hepatitis B for all patients who have not been vaccinated and are not immune to the infection.[28,29] All hemodialysis patients should be assessed by annual testing of antibody to hepatitis B surface antigen (anti-HBs) and a booster dose should be administered when anti-HBs levels decline to <10 mIU/mL.[30]

Conclusion

The knowhow and practice should go hand in hand to attain good quality of life in all chronic conditions including ESRD. In the arena of health care, gaps in the basic and applied knowledge are prevalent and have their own impact on patient's attitude and practice, which are usually ignored or taken as granted irrespective of their economic status or educational background. There is an utmost need for all patients to get information in the area of disease, drugs and lifestyle. This forms the premises for the provision of PC in all chronic conditions including ESRD. Kidney failure pushes the patients into an inflexible situation where in massive adjustments for pH, calcium, potassium, and sodium serum levels turn out to be critical. Although dialysis supplements some of the vital functions of the kidney it cannot be a replacement for the kidney itself. Dialysis is a cumbersome and risky process requiring the patients and their attendants to be on high alert. Even minor variations in diet, lifestyle and ignorance about the disease can lead to severe consequences leading to admissions to Intensive Care Unit or death. For effective management and sustainable quality of life there is a need for sustained support for patients. Doctors and nurses are found to be busy in routine management of dialysis, hence are not available for elaborate patient education. The clinical pharmacists who are experts in pharmacokinetic and pharmacodynamic aspects of drugs and with background of pharmacotherapy and health sciences are best suited for patient education and counseling of ESRD patients on dialysis. There are many examples of successful models where in the pharmacists are established as a vital link between doctor, nurse and the patients. The PC is a holistic approach for improving the quality of life of the patient taking into account the different aspects of treatment monitoring, documentation and updating the doctor, nurses, and patients.

References

1. National Kidney Foundation. Clinical practice guidelines for chronic kidney disease: Evaluation, classification, and stratification. Available from: http://www.kidney.org/professionals/kdoqi/pdf/ckd_evaluation_classification_stratification.pdf. [Last cited on 2013 Aug 10].
2. Manley HJ, Garvin CG, Drayer DK, Reid GM, Bender WL, Neufeld TK, *et al.* Medication prescribing patterns in ambulatory haemodialysis patients: Comparisons of USRDS to a large not-for-profit dialysis provider. Nephrol Dial Transplant 2004;19:1842-8.
3. Manley HJ, McClaran ML, Overbay DK, Wright MA, Reid GM, Bender WL, *et al*. Factors associated with medication-related problems in ambulatory hemodialysis patients. Am J Kidney Dis 2003;41:386-93.
4. Pai AB, Boyd A, Depczynski J, Chavez IM, Khan N, Manley H. Reduced drug use and hospitalization rates in patients undergoing hemodialysis who received pharmaceutical care: A 2-year, randomized, controlled study. Pharmacotherapy 2009;29:1433-40.
5. Schmid H, Hartmann B, Schiffl H. Adherence to prescribed oral medication in adult patients undergoing chronic hemodialysis: A critical review of the literature. Eur J Med Res 2009;14:185-90.
6. American Pharmacists Association. Principles of practice for pharmaceutical care. Available from: http://www.pharmacist.com/principles-practice-pharmaceutical-care. [Last cited on 2013 Oct 14].
7. Dashti-Khavidaki S, Khalili H, Shahverdi S, Abbasi MR, Lessan-Pezeshki M. The role of clinical pharmacy services in achieving treatment targets in Iranian haemodialysis patients. Singapore Med J 2012;53:599-603.
8. Counseling and Advice on Medicines and Appliances in Community Pharmacy Practice. Clinical Resource and Audit Group. Edinburgh: The Scottish Office, NHS in Scotland; 1996.
9. Sathvik BS, Mangasuli S, Narahari MG, Gurudev KC, Parthasarathi G. Medication knowledge of hemodialysis patients and influence of clinical pharmacist provided education on their knowledge. Indian J Pharm Sci 2007;69:232-9.
10. Abraham S, Venu A, Ramachandran A, Chandran PM, Raman S. Assessment of quality of life in patients on hemodialysis and the impact of counseling. Saudi J Kidney Dis Transpl 2012;23:953-7.
11. Abraham S, Ramachandran A. Estimation of quality of life in haemodialysis patients. Indian J Pharm Sci 2012;74:583-7.
12. Thomas D, Joseph J, Francis B, Mohanta GP. Effect of patient counseling on quality of life of hemodialysis patients in India. Pharm Pract 2009;7:181-4.
13. Dashti-Khavidaki S, Sharif Z, Khalili H, Badri S, Alimadadi A, Ahmadi F, *et al.* The use of pharmaceutical care to improve health-related quality of life in hemodialysis patients in Iran. Int J Clin Pharm 2013;35:260-7.
14. Pai AB, Boyd A, Chavez A, Manley HJ. Health-related quality of life is maintained in hemodialysis patients receiving pharmaceutical care: A 2-year randomized, controlled study. Hemodial Int 2009;13:72-9.
15. Cockcroft DW, Gault MH. Prediction of creatinine clearance from serum creatinine. Nephron 1976;16:31-4.
16. McIntyre N, Green D, McIntyre C. Salt and fluid management programme in dialysis patients — Information for healthcare professionals. Available from: http://www.britishrenal.org/getattachment/AboutUs/Time/Salt-and-Fluid-Management/20944_Salt-HCP-Book.pdf.aspx. [Last cited on 2013 Aug 23].
17. Heimburger O, Stenvinkel P, Lindholm B. Nutritional effects and nutritional management of chronic peritoneal dialysis. In: Kopple J, Massry S, editors. Nutritional Management of Renal Disease. 2nd ed. Philadelphia: Lippincott, Williams and Wilkins; 2004. p. 477-512.
18. National Institute of Health (NIH) and National Institute of Diabetes and Digestive and Kidney Disease (NIDDK). Kidney failure eat right to feel right on hemodialysis. National Kidney and Urologic Diseases Information ClearInghouse, USA, 2008. Available from: http://www.kidney.niddk.nih.gov. [Last cited on 2013 Aug 14].
19. National Kidney Foundation. K/DOQI nutrition in chronic renal failure. Am J Kidney Dis 2000;35:S1-193.
20. National Kidney Foundation. K/DOQI clinical practice guidelines for the managing bone metabolism in chronic kidney disease. Am J Kidney Dis 2003;42 Suppl 1:S1-92.
21. Eschbach JW, Cook JD, Scribner BH, Finch CA. Iron balance in hemodialysis patients. Ann Intern Med 1977;87:710-3.
22. Fouque D, Vennegoor M, ter Wee P, Wanner C, Basci A, Canaud B, *et al.* EBPG guideline on nutrition. Nephrol Dial Transplant 2007;22 Suppl 2:ii45-87.
23. Chih-Hung G, Chia-Liang W, Pei-Chung C. Micronutrient metabolism in hemodialysis patients. In: Penido MG, editor. Hemodialysis-Different Aspects. China: InTech; 2011. Available from: http://www.cdn.intechopen.com/pdfs/23800/InTechMicronutrient_metabolism_in_hemodialysis_patients.pdf. [Last cited on 2013 Sep 10].
24. Gopalan C, Ramasastri BV, Balasubramanian SC, Narasingarao BS, Deosthale YG, Pant KC. Nutritive Values of Indian Foods. Hyderabad, India: National Institute of Nutrition; 2007. p. 47-95.
25. National Nutrient Database for Standard Reference, USA. USDA Nutrient Database Available from: http://www.ndb.nal.usda.gov/ndb/search/list. [Last cited on 2013 Aug 18].
26. UNC-kidney center — A patient's guide to chronic kidney disease. Available from: http://www.unckidneycenter.org/kidneyhealthlibrary/CKD/CKD%20Education%20Book.pdf. [Last cited on 2013 Aug 11].
27. Paige NM, Nagami GT. The top 10 things nephrologists wish every primary care physician knew. Mayo Clin Proc 2009;84:180-6.
28. Guidelines for vaccinating kidney dialysis patients and patients with chronic kidney disease. Available from: http://www.cdc.gov/dialysis/PDFs/Vaccinating_Dialysis_Patients_and_patients_dec2012.pdf. [Last cited on 2013 Sep 18].
29. National Kidney Foundation-Vaccinations Recommended for Adult Hemodialysis Patients. Available from: http://www.kidney.org/atoz/content/what_infectdiseases.cfm. [Last cited on 2013 Sep 18].
30. Mast EE, Weinbaum CM, Fiore AE, Alter MJ, Bell BP, Finelli L, *et al.* A comprehensive immunization strategy to eliminate transmission of hepatitis B virus infection in the United States: Recommendations of the Advisory Committee on Immunization Practices (ACIP) Part II: Immunization of adults. MMWR Recomm Rep 2006;55:1-33.

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