European Multidisciplinary Journal of Modern Science
*Volume 26, Issue 5 | October-2024*
**ISSN: 2750-6274**

*Article*

# A Revision of Fundamental Issues With Using Dialysis To Treat Chronic Kidney Insufficiency

**Aziz H. Jasim[1*], Dhiya Altememy[2]**

1. Community Health Department, Technical Institute of Karbala, Al-Furat Al-Awsat Technical University, Karbala, Iraq.
2. Department of Pharmaceutics, College of Pharmacy, Al-Zahraa University for Women, Karbala, Iraq

* Correspondence: Azizhussein560@gmail.com

**Abstract:** The current paper reviews chronic renal failure (CRF), a major public health disease that affects the elderly globally. The Chronic Renal Failure (CRF) is primarily caused by compromised kidney function. The glomerular filtration rate (GFR) divides CRF into five stages. Dialysis is the most effective therapy for end-stage renal disease (ESRD), which occurs when a person's GFR is less than 15 ml/min/1.73 m² due to chronic renal failure. Patients undergoing dialysis face a 10–20 times higher cardiovascular risk due to inflamed kidneys and the dialysis technique, which exacerbates hypertension and cardiovascular complications. As a result, both physicians and patients should understand the implications of dialysis, especially for chronic renal failure patients, who need immediate education on the disease, its medications, dietary guidelines, and other essential measures. Accordingly, the current review is an attempt to reveal the processes that may contribute to cardiovascular and other complications in dialysis patients with CRF.

**Keywords:** End-Stage Renal Illness, Glomerular Filtration Rate, Cardiovascular Risk, Dialysis, Hypertension, Chronic Renal Failure

**Citation:** Jasim, A, H. A Revision of Fundamental Issues With Using Dialysis To Treat Chronic Kidney Insufficiency. European Multidisciplinary Journal of Modern Science 2024, 36(5), 138-142.

Received: 24th July 2024
Revised: 11th Aug 2024
Accepted: 28th Sept 2024
Published: 22th Oct 2024



## 1. Introduction

The waste and surplus water can easily be removed by a process called "dialysis" [1]. Dialysis is a man-made way to make the kidneys work again, especially when they stopped working completely. It can facilitate some kidney activities through fast diffusing and filtering of fluid [2]. CRF in patients can be identified when the glomerular filtration rate decreases to 15 ml/min/1.73 m² [3]. Chronic renal failure (CRF), a disorder in which kidney function declines over time, is diagnosed by a reduction in glomerular filtration rate (GFR) due to creatinine increases [4]. The five stages of chronic renal failure are categorised by GFR, with dialysis being the therapy for stage 5 (GFR < 15 ml/min/1.73 m²), commonly known as end-stage renal disease. Chronic renal failure patients need dialysis to remove toxins, which may cause oxidative stress due to an excess of reactive oxygen species [4]. Plasma urate increases CRF, cellular dysfunction, and oxidative stress [5].

Sphygmomanometers monitor blood pressure (BP) during heart contraction. Healthy blood pressure is 120/80 mmHg, whereas hypertension exceeds 140/90 [6]. High blood pressure, fluid buildup, and pollutants may damage blood vessels and renal blood channels. This increases the risk of chronic renal failure and renal disorders when paired with other problems. This research examines the effects of dialysis on nonfunctional

kidneys in CRF to measure cardiovascular risk and metabolic issues and the impact of hypertension on renal illnesses and cardiac risk. In cases of compromised renal function, such as uremic syndrome, hyperkalaemia, extracellular volume overload, acidosis, creatinine clearance, and bleeding diathesis due to coagulation disorders, dialysis is used to remove waste and excess water from the blood. Serum creatinine/BUN or urea and creatinine clearance measure renal function. The main dialysis procedures are haemodialysis and peritoneal dialysis, which use peritoneal membranes for filtration. Thus, younger patients should choose peritoneal dialysis owing to its comfort and simplicity of administration at home, whereas haemodialysis is used for patients with no residual renal function.

## 2. Materials and Methods

**Study Design:**

The study is a comprehensive review of the fundamental issues related to the use of dialysis for treating chronic kidney insufficiency (CKI). The authors synthesized existing literature to analyze dialysis techniques, associated complications, and the interplay between renal and cardiovascular health.

**Scope of Review:**

The review focuses on:

1. Chronic renal failure (CRF) and its progression to end-stage renal disease (ESRD).
2. Key factors influencing dialysis outcomes, such as glomerular filtration rate (GFR), cardiovascular risks, and oxidative stress.
3. Comparative analysis of dialysis techniques, specifically hemodialysis and peritoneal dialysis.
4. The impact of dialysis on thyroid disorders and inflammation.
5. The biochemical and physiological mechanisms linking dialysis to systemic complications like hypertension, anemia, and vascular calcification.

**Materials and Analysis:**

*The study involved:*

- Collecting data from peer-reviewed articles, clinical guidelines, and authoritative resources on CKI and dialysis, including references to established markers (e.g., serum creatinine/BUN, inflammatory markers like interleukins, and ADMA).
- Analysis of metabolic processes, including oxidative stress and the role of dialysate composition.
- Examination of the interplay between kidney function and systemic conditions, with a focus on cardiovascular and thyroid health.

*Statistical Considerations:*

Where applicable, prior studies were referenced for statistical outcomes, such as correlations between dialysis and cardiovascular events. The review also incorporated findings on significant predictors like GFR thresholds and inflammatory markers.

*Ethical Compliance:*

The study adhered to ethical standards in referencing and synthesizing clinical data, with no experimental procedures requiring direct ethical approval.

*Tools and Instruments:*

The study discussed the mechanics of dialysis equipment, such as dialyzers with semipermeable membranes and the composition of dialysates (e.g., sodium bicarbonate solutions), as part of the technical evaluation.

## 3. Results and Discussion

### Dialysis Technique

Dialyzers are external filters with semipermeable membranes that are used in haemodialysis to remove waste products and surplus water. To separate waste, a counter-current flow gradient is created, with blood flowing in one direction and dialyser fluid flowing in the other. The peritoneum acts as a semipermeable membrane in peritoneal dialysis, allowing waste and excess water to be removed from the fluid. The basic idea behind dialysis is the movement of solute particles over a semipermeable membrane. In addition, the dialysate—a mixture of sodium bicarbonate, sodium chloride, acid concentration, and deionised water—is absorbed from the circulation together with metabolic waste products such as urea and creatinine. Particle size affects the dialysate's diffusion rate across the membrane; a slower diffusion rate is seen for bigger particles. Consequently, the arteriovenous shunt connects arteries to veins, fortifying them with muscular layers similar to arteries. This allows veins to endure multiple punctures and regulate pressure during dialysis.

### Thyroid disorders and Kidney Dialysis

Several previous investigations showed that thyroid hormones effect protein synthesis and cellular growth through the increase of thyroid activity when kidney developes in neonatal rats [16]. Therefore, thyroid and renal diseases have similar etiological origin [17]. Dialysis may affect thyroid function, characterized by reduced triiodothyronine levels (T3), potentially due to an underlying inflammatory cause. Interleukin signalling downregulates the 5'-deiodinase enzyme, preventing peripheral conversion of tetraiodothyronine/thyroxine (T4) to triiodothyronine (T3), a cardiovascular indicator, and is linked to left ventricular hypertrophy [18-20].

### Inflammation and Renal Replacement Therapy

Potentially, kidney inflammation may exacerbate endothelial dysfunction, resulting in a reduction in the availability of nitric oxide (NO). ADMA activity, typically cleaved in the kidney, can predict endothelial dysfunction by inhibiting the enzyme "NO synthase" [21]. Proteinuria is a condition resulting from endothelial dysfunction, which is characterized by increased vascular permeability [22]. Hyperlipidaemia, a condition characterised by an excess of triglycerides in the blood, may develop when the kidneys are unable to properly process certain lipoproteins, such as apo A1. Because it impacts methionine synthase, an enzyme that converts homocysteine to vitamin B12, hyperhomocysteinemia and vitamin B12 deficient anaemia result from inadequate clearance of homocysteine [24]. The atherogenicity and narrowing of blood artery lumens are caused by kidney failure, which inhibits collagen cross-linking [25]. Principal artery calcification, such as that which occurs in the coronaries, may be the consequence of impaired phosphorus and calcium clearance [26]. Osteoprotegerin (OPG) measurement has been utilised to assess main artery calcification [27,28].Additionally, patients undergoing dialysis are at a higher risk of accelerated renal inflammation, which can lead to additional complications, as the membrane significantly impacts inflammation causes. Dialysis can lead to biocompatibility issues, oxidative imbalance, and inflammatory marker retention, potentially affecting the complement system and purity of the dialysate [29-30]. Chronic renal failure in hemodialysis patients increases the risk of developing various diseases like anemia, clotting disorders, infections, electrolyte imbalances, and cardiovascular dysfunction [31-32].

## 4. Conclusion

The researcher concludes that dialysis is the best therapy for enhancing the quality of life and eradicating accumulated toxins from the body for those who have CRF, although the disease may be further exacerbated by the method's various impacts. Patients with chronic renal failure who undergo dialysis may encounter increased

cardiovascular and metabolic risks, requiring physicians and patients to be well-informed about the potential consequences of this commonly used treatment for minor kidney conditions. The patients with CRF should know everything about the disease, its drugs, dietary practices, and the important processes for effective management and a productive existence.

**REFERENCES**


1. Sabitha V, Venkataramana K: Dialysis: A Review of the Mechanisms Underlying Complications in the Management of Chronic Renal Failure. Cureus.2017, 9(8): 1603.
2. Lee KY: A unified pathogenesis for kidney diseases, including genetic diseases and cancers, by the protein-homeostasis-system hypothesis. Kidney Res Clin Pract. 2017, 36:132-144.
3. Tattersall J, Dekker F, Heimburger O, et al.: When to start dialysis: updated guidance following the publication of the Initiating Dialysis Early and Late (IDEAL) study. Nephrol Dial Transplant. 2011, 26:2082-2086.
4. Aziz HJ, Narjis HA: Biochemical Markers of Bone Turnover in Pre-dialysis, Chronic Renal Failure Patients. Researh J Pharm and Tech. 2019, 12 (10):1-4.
5. Inker LA, Astor BC, Fox CH, et al.: KDOQI US commentary on the 2012 KDIGO clinical practice guideline for the evaluation and management of CKD. Am J Kidney Dis. 2014, 63:713-735.
6. Description of High Blood Pressure . (2015). Accessed: March 25, 2017: https://www.nhlbi.nih.gov/health/health-topics/topics/hbp.
7. Foley RN, Collins AJ: End-stage renal disease in the United States: an update from the United States Renal Data System. J Am Soc Nephrol. 2007, 18:2644-2648.
8. Lackland DT, Weber MA: Global burden of cardiovascular disease and stroke: hypertension at the core. Can J Cardiol. 2015, 31:569-571.
9. Stegmayr B: Dialysis procedures alter metabolic conditions. Nutrients. 2017, 9:548.
10. Ifudu O: Care of patients undergoing hemodialysis. N Engl J Med. 1998, 339:1054-1062.
11. Schiffl H, Lang SM, Fischer R: Daily hemodialysis and the outcome of acute renal failure . N Engl J Med. 2002, 346:305-310.
12. Nagane NS, Ganu JV, Jagtap PE: Study of oxidative stress in pre- and post-hemodialysis in chronic renal failure patients. strength physical exercise on oxidative stress and inflammatory responses in hemodialysis patients. Biomedical Research. 2013, 24:498-502.
13. Macunluoglu B, Gumrukcuoglu HA, Atakan A, et al.: Lowering dialysate sodium improves systemic oxidative stress in maintenance hemodialysis patients. Int Urol Nephrol. 2016,48:1699-1704.
14. Harnett JD, Foley RN, Kent GM, Barre PE, Murray D, Parfrey PS: Congestive heart failure in dialysis patients: prevalence, incidence, prognosis and risk factors. Kidney Int. 1995, 47:884-890.
15. Volodarskiy A, Kumar S, Amin S, Bangalore S: Optimal treatment strategies in patients with chronic kidney disease and coronary artery disease. Am J Med. 2016, 129:1288-1298.
16. Braunlich H: Postnatal development of kidney function in rats receiving thyroid hormones .Exp Clin Endocrinol. 1984, 83:243-250.
17. Dubczak I, Niemczyk L, Bartoszewicz Z, Szamotulska K, Saracyn M, Niemczyk S: The influence of hypothyroidism on the conversion and binding of thyroid hormones in patients with end-stage renal disease (Article in Polish). Pol Merkur Lekarski. 2017, 42:101-105.
18. Dunne A, O'Neill LA: The interleukin-1 receptor/Toll-like receptor superfamily: signal transduction during inflammation and host defense. Sci STKE. 2003, 2003:re3.
19. Chen WY, Li LC, Yang JL: Emerging roles of IL-33/ST2 axis in renal diseases . Int J Mol Sci. 2017, 18:783.
20. Zoccali C, Tripepi G, Cutrupi S, Pizzini P, Mallamaci F: Low triiodothyronine: a new facet of inflammation in end-stage renal disease. J Am Soc Nephrol. 2005, 16:2789-2795.
21. Yilmaz MI, Sonmez A, Saglam M, et al.: ADMA levels correlate with proteinuria, secondary amyloidosis, and endothelial dysfunction. J Am Soc Nephrol. 2008, 19:388-395.
22. Matsuguma K, Ueda S, Yamagishi S, et al.: Molecular mechanism for elevation of asymmetric dimethylarginine and its role for hypertension in chronic kidney disease. J Am Soc Nephrol. 2006, 17:2176-2183.
23. Vaziri ND: Dyslipidemia of chronic renal failure: the nature, mechanisms, and potential consequences. Am J Physiol Renal Physiol. 2006, 290:262-272.

24. Weber GJ, Pushpakumar S, Tyagi SC, Sen U: Homocysteine and hydrogen sulfide in epigenetic, metabolic and microbiota related renovascular hypertension. Pharmacol Res. 2016, 113 (Pt A):300-312.
25. Kang AH, Trelstad RL: A collagen defect in homocystinuria . J Clin Invest. 1973, 52:2571-2578.
26. Goodman WG, Goldin J, Kuizon BD, et al.: Coronary-artery calcification in young adults with end-stage renal disease who are undergoing dialysis. N Engl J Med. 2000, 342:1478-1483.
27. Bernardi S, Toffoli B, Bossi F, et al.: Circulating osteoprotegerin is associated with chronic kidney disease in hypertensive patients. BMC Nephrol. 2017, 18:219.
28. Gohda T, Maruyama S, Kamei N, et al.: Circulating TNF receptors 1 and 2 predict mortality in patients with end-stage renal disease undergoing dialysis. Scientific Reports. 2017, 7:43520.
29. Jofre R, Rodriguez-Benitez P, Lopez-Gomez JM, Perez-Garcia R: Inflammatory syndrome in patients on hemodialysis. J Am Soc Nephrol. 2006, 17:274–280.
30. Elliott TL: Electrolytes: potassium disorders . FP Essent. 2017, 459:21-28.
31. Weaver DJ Jr, Somers MJG, Martz K, Mitsnefes MM: Clinical outcomes and survival in pediatric patients initiating chronic dialysis: a report of the NAPRTCS registry. Pediatr Nephrol. 2017,1-12.
32. Han SS, Ryu DR, Joo KW, et al.: Risk of stroke in elderly dialysis patients . J Korean Med Sci. 2017, 32:1460-1467.