REVIEW ARTICLE

Comparison Between Hemodialysis and Peritoneal Dialysis in the Risks for Disease Activity in LN-ESRD Patients: A Systematic Review and Meta-analysis

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ABSTRACT

Context • End-stage renal disease (ESRD) is the advanced stage of a progressive loss of kidney function. About 10% of all patients with lupus nephritis (LN) eventually progress to ESRD, which may necessitate renal replacement therapy (RRT), such as hemodialysis (HD), peritoneal dialysis (PD), and/or kidney transplant. Research hasn't confirmed which dialysis options, prior to kidney transplantation, are beneficial to patients' prognoses.

Objective • The study intended to compare the risks—related to disease activity, exercise, all-cause infection, all-cause cardiovascular events, and mortality—of the use of HD and PD for LN-ESRD adults, as the initial alternative treatment before renal transplantation.

Design • The research team performed a narrative review and analyzed the data obtained about clinical outcomes for HD and peritoneal dialysis. For the review, the research team searched the PubMed, EMBASE, and SCOPUS databases. The search used the keywords: end-stage renal disease, renal replacement therapy, hemodialysis and peritoneal dialysis.

Setting • The study made in Affiliated Hospital of Hebei University, China.

Participants • The studies included 15 636 patients who had been diagnosed with LN-ESRD prior to renal transplantation.

Outcome Measures • For the data analysis, the research team divided the data into two groups, one of which included the data on the clinical outcomes for HD patients and one of which included the data on the clinical outcomes for PD patients. The study evaluated four types of risks: lupus-flare risks, all-cause infection risks, all-cause cardiovascular events risk, and risk of mortality.

Results • The 16 studies found in the review reported one or more outcomes of interest for the two dialysis modalities, HD and PD. The analysis of the data from the 16 studies showed that HD was associated with a higher risk than PD: (1) of lupus flares, with RR = 1.23 (confidence interval: 0.82, 1.85), but the difference didn't reach statistical significance ($P = .31$); (2) of all-cause infection risk, with RR = 1.02 (confidence interval: 0.66, 1.59), but the difference didn't reach statistical significance ($P = .92$); (3) of all-cause cardiovascular events, with RR = 1.44 (confidence interval: 1.02, 2.04), and the difference reached statistical significance ($P = .04$); and (4) of mortality risk, with RR = 1.29 (confidence interval: 0.95, 1.75), but the difference didn't reach statistical significance ($P = .10$).

Conclusions • The current study may have reference significance for clinical treatment of ESRD. Except for all-cause cardiovascular events in which PD was superior to HD, offering better outcomes, both treatment modalities provide more or less similar clinical outcomes as effective initial choices for RRT in LN-ESRD patients prior to renal transplant. The current research team, however, encourages further research on the question, addressing better the possible sources of biases encountered in the current study. (*Altern Ther Health Med.* 2022;28(6):144-149)

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Chronic renal failure (CRF) is the most prevalent, worldwide, public-health problem of older adults.[1] CRF's main cause is a damaged kidney, and dialysis is the preferred way to treat end-stage renal disease (ESRD), the last stage of CRF, to remove accumulated toxins from the body. Dialysis patients have high levels of associated cardiovascular-disease (CVD) complications, and the treatment may be responsible for some side effects, including thyroid disorders, oxidative stress, heart problems, and aggravation of hypertension risk.[2]

ESRD is the advanced stage of a progressive loss of kidney function, commonly characterized by an estimated glomerular filtration rate (eGFR) of lower than 15 ml per minute per 1.73 square meters.[3] ESRD results as an ultimate complication from underlying renal-debilitating chronic conditions, including systemic diseases, such as diabetes or hypertension; inflammatory conditions, such as glomerulonephritis or tubulointerstitial nephritis; autoimmune disorders, such as systemic lupus erythematosus (SLE); genetic disorders such as polycystic kidney diseases; and chronic urinary tract infections and obstructive conditions.[4]

In general, in the early period of ESRD, no specific symptoms of the disease occur, and the symptoms may not be easily perceived by patients. However, as the condition deteriorates, and the accumulation of toxins in the body continues, patients can develop various symptoms of uremia poisoning, including gastrointestinal symptoms causing nausea and vomiting, cardiovascular symptoms indicating heart failure, shortness of breath, nervous-system symptoms such as delirium and confusion, anemia, and other complications.[5,6] Meanwhile, in laboratory examination, patients may present with elevated serum creatinine, decreased hemoglobin, electrolyte turbulence, calcium and phosphorus disturbance, and increased parathyroid hormone (PTH).[7]

One study found that diabetes and hypertension are the leading causes of ESRD in adults and that lupus nephritis (LN) accounted for 1.60% of patients with ESRD in the USA as of 2012.[5] However, between 2009 and 2013, cystic and congenital diseases were found to be the main cause of ESRD in children, at 33%, higher than for glomerular diseases, at 24.60%; other secondary causes of glomerulonephritis accounted for about 13% of ESRD.[8] About 10% of all LN patients eventually progress to ESRD, which may necessitate renal replacement therapy (RRT), such as hemodialysis (HD), peritoneal dialysis (PD, and/or kidney transplant.[9]

Dialysis prolongs the life of an individual but can't cure the underlying problem. Renal rehabilitation has been defined as "coordinated, multifaceted interventions designed to optimize a renal patient's physical, psychological, and social functioning, in addition to stabilizing, slowing, or even reversing the progression of renal deterioration, thereby reducing morbidity and mortality."[10]

Many factors affect dialysis, not only related to the methods of dialysis but also to other major factors, such as diet, fluid management, medications and medical surveillance, education, and psychological and vocational counseling.[11] Some studies have indicated that regular exercise can also improve renal function and lower the risks of overall mortality.[12] RRT for chronic kidney disease (CKD) patients who don't receive dialysis.[13]

Research hasn't confirmed which dialysis options, prior to kidney transplantation, are beneficial to patients' prognoses. Some literature has shown that the prognosis of uremia patients depends on such factors as their treatment plans, races, employment statuses, medical insurance types, and family burdens (Financial stress and family care).[14-15] Physical rehabilitation after dialysis has consistently resulted in improvements to patients' life quality, efficacy in dialysis, functional outcomes, and reduction depression in dialysis patients.[16]

Whether dialysis patients exercise has also been found to be very important.[17] Some studies have shown that appropriate exercise can improve dialysis patients' physiological function, increase their ability to perform daily activities, improve their cardiopulmonary endurance, reduce their postoperative dysfunction, decrease their cardiovascular risks, and improve their life quality.[18] Some studies with a limited number of participants have shown that a combination of aerobic and progressive resistance exercises performed two or three times a week for 6-8 weeks, no matter which types of dialysis participants received, can improve participants' quality of life.[19]

HD and PD serve as initial RRT modalities prior to kidney transplantation, which is considered a modality superior to other therapies in terms of patients' survival rate and quality of life.[20] Some studies have shown that dialysis, in conjunction with adequate immunosuppressive drugs, can provide 10% to 28% of LN-ESRD patients with enough improvement that they don't require any further dialysis.[21-22]

However, one study has shown that CKD patients receiving HD have a high rate of mortality with CVD, such as chronic heart failure, and a higher mortality risk has been shown for sedentary HD patients.[23] Although the practice may be debatable, providing a patient with dialysis for a short period of time after he or she develops LN-ESRD, not to exceed 24 months, is advised before transplantation is chosen.[24,25]

Therefore, the present study intended to compare the risks—related to disease activity, exercise, all-cause infection, all-cause cardiovascular events, and mortality—of the use of HD and PD for LN-ESRD adults, as the initial alternative RRTs before renal transplantation.

METHODS

The study took place in Affiliated Hospital of Hebei University, Hebei,China.

Procedures: Literature Review

The research team performed a narrative review by searching the PubMed, EMBASE (Elsevier B.V., Amsterdam, The Netherlands), and SCOPUS databases. The search used the keywords included: all combinations of "end-stage renal disease or LN-ESRD" AND "renal replacement" OR "hemodialysis" OR" peritoneal dialysis"; all searches were performed in June and July 2021.

The review includes articles published in the english language from January 1993 to July 2019. To assure the validity of the data, the research team assigned two independent researchers reviewed the data and a third reviewer resolved any disagreements.

Inclusion criteria: (1) All patients in this study were LN-ESRD patients; (2) The following information was abstracted: Author, year of publication, country, number of

intervention and control groups, mean age (year), gender, race, participant health conditions, cardiovascular events risk, Hemodialysis duration, Peritoneal Dialysis duration, infection risk; kidney transplantation; lupus flare risk or mortality risk in studies; (3) Compare these factors with corresponding controls.

Procedures: Data Analysis

The research team analyzed the data obtained from the literature seach about clinical outcomes for HD and PD. The 16 studies included 15 636 patients found in the review reported one or more outcomes of interest for the two dialysis modalities, HD and PD. Studies reporting similar outcomes of interest were analyzed together.

Groups. The research team divided the data into two groups, one of which included the data on the clinical outcomes for HD patients and one of which included the data on the clinical outcomes for PD patients.

Outcome measures. The study evaluated four types of risks: lupus-flare risks, all-cause infection risks, all-cause cardiovascular events risk, and risk of mortality.

Statistical Analysis of Risks

For the data analysis, SPSS 25.0 statistical software were used for data analysis and processing. The measurement data was presented as mean ± s, the counting data presented as percentage, and χ^2 was used to verify the data. $P < .05$ was considered to demonstrate statistically significant differences.

RESULTS

Study Selection

A total of 195 records were initially retrieved, of them 147 duplicate publications were removed. After screening, we included 48 articles for further examination of full texts. Furthermore, one additional trial was extracted through hand-searching of reference lists among related reviews. Of these articles, 32 studies were excluded because of the following reasons: Not in English (n = 4), irrelevant outcomes (n = 10), without control group (n = 3) No hemodialysis arm (n = 7), and without sufficient data (n = 8). 16 eligible articles were included in the final quantitative analysis (Figure 1).

Table 1 provides a summary of the characteristics of the 16 studies found in the literature review and included in the current study's analysis of clinical outcomes for HD and PD. The 16 studies included 15 636 patients who had been diagnosed with LN-ESRD prior to renal transplantation.

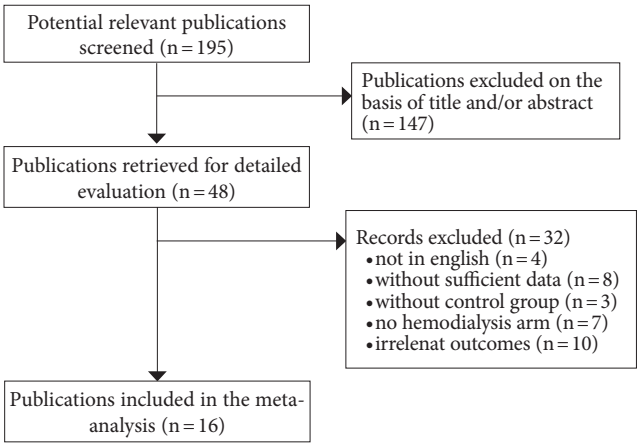
Clinical Outcomes of Reviewed Studies

All 16 studies reported one or more outcomes of interest for the two dialysis modalities, HD and PD. Seven studies compared the lupus-flare risks;[26,28,29,34,35,39,40] five compared all-cause infection risks;[26,28,30,31,35] six compared all-cause cardiovascular events risks;[28,30,31,35,37,39] and twelve compared the risk of mortality.[26-28,30-33,35-38-,40,41]

Two studies compared the clinical outcomes for LN-ESRD patients and those of patients with ESRD due to other causes, such as diabetes and hypertension.[28,32] Many also compared clinical outcomes for different RRTs for patients with ESRD due to various causes.[28-31] Only a few studies compared clinical outcomes for different RRTs for LN-ESRD patients.[28]

Furthermore, the few studies that compared the RRTs used for LN-ESRD patients reported conflicting results in their clinical outcomes. [31,33]

Figure 1. Flow diagram for study inclusion.



Evaluation of Outcomes

Three studies compared the clinical outcomes of LN-ESRD patients' undergoing HD and those undergoing PD prior to a kidney transplant.[27,32,33]

The analysis of the data from the 16 studies showed that HD was associated with a higher risk than PD: (1) of lupus flares, with RR = 1.23 (confidence interval: 0.82, 1.85), but the difference didn't reach statistical significance ($P = 0.31$); (2) of all-cause infection risk, with RR = 1.02 (confidence interval: 0.66, 1.59), but the difference didn't reach statistical significance ($P = .92$); (3) of all-cause cardiovascular events, with RR = 1.44 (confidence interval: 1.02, 2.04), and the difference reached statistical significance ($P = .04$); and (4) of mortality risk, with RR = 1.29 (confidence interval: 0.95, 1.75), but the difference didn't reach statistical significance ($P = .10$).

PD for LN-ESRD patients was superior to HD as an initial RRT prior to renal transplant in terms of better cardiovascular outcomes. The higher risk of all-cause cardiovascular events for the HD group aligns with the findings of contemporary literature describing adverse outcomes for HD, including thrombotic events, vein injury, and fibrosis and stenosis associated with central vein access devices such as dialysis catheters.

The statistically insignificant differences between the two groups in the risk of all-cause infections might be accounted for by the fact that both modalities are associated with infections induced by the dialysis device[34-37] and with peritonitis[38,39] and HD is associated with infections from central-vein access devices.[30]

Table 1. A Summary of Characteristics of 16 Studies Included in the Current Study

Study	N	Dialysis Modality HD, PD	Median Age HD, PD	Ethnicity/ Race	Follow-up Time HD, PD	Primary Study Aim	Country of Study	Outcome Measure
Kang et al (2011)[26]	59	28, 14	35, 41	Not reported	5 ± 3, 5 ± 3 years	Determining long-term outcomes of patients with ESRD secondary to SLE who are managed with different types of RRTs	South Korea	LFR, IR, MR, PS
Tsai et al (2019)[28]	94	42, 12	36.40, 33.20	Not reported	6.30 ± 5.10, 6.00 ± 5.20 years	Determining long-term outcomes and survival rates of patients with ESRD caused by LN, who received three modalities of renal replacement therapy	Taiwan	LFR, IR, MR, CVR, PS
Krane et al (1999)[29]	19	7, 5	32, 36	10 black, 2 white	3, 3 years	Determining lupus activity among patients with ESRD due to SLE, who were either undergoing dialysis or had undergone transplantation	USA	LFR
Chang et al (2013)[30]	1073	813, 260	42.60, 34.10	Not reported	≥3 months on RRT, ≥3 months on RRT	Determining mortality and impact of dialysis modalities on survival with SLE therapies in ESRD	Taiwan	IR, MR, CVR, PS
Weng et al (2009)[31]	36	14, 22	48.70, 37.59	Not reported	126.83, 37 months	Comparing PD and HD outcomes between female SLE patients with ESRD due to lupus nephropathy	Taiwan	IR, CVR, MR, PS
Wu et al (2014)[32]	1998	1640, 196	39.30, 36.20	Not reported	3.31 ± 3.87, 4.34 ± 3.05 years	Determining outcomes of LN patients after progression to ESRD and attempt to elucidate whether deferral of KT is necessary in the Chinese population	Taiwan	MR, PS
Contreras et al (2014)[33]	11 023	1352, 1352	39, 39	Caucasian American; African American; Asian American, other Americans	3, 3 years, median	Comparing the mortality risk of ESRD patients with SLE imitating with PD versus HD	USA	MR
Stock et al (1993)[34]	6	6, 6	Not accessed	Not accessed	Not Accessed	Determining differences in disease activity between treatment modalities, using patients as self-controls	USA	LFR
Zhu et al (2009)[35]	29	10, 19	34.50, 41.79	Not reported	2, 2 years	Comparing two-year outcome of ESRD in LN patients for different dialysis modalities	China	LFR, IR, MR, CVR, PS
Nitatsaki et al (2018)[27]	361	17, 9	Not accessed	Caucasian Afro-Caribbean; south Asian	43 (Confidence interval 13-49) months	Investigating the time spent on dialysis before RT and survival following RT in a cohort of SLE patients	UK	MR
Zhang et al (2016)[36]	425	314, 111	Not accessed	European; Maori and Pacific Islanders; Asian; others	3.80, 3.80 years, median	Comparing dialysis and transplant outcomes for ESRD patients due to lupus nephrites with all other cases	Australia	MR
Levy et al (2105)[37]	368	308, 60	34.50, 43.90	Not reported	5, 5 years	Describing the outcomes of SLE on chronic dialysis	France	MR, CVR
Mustapic et al (2013)[38]	7	6, 1	Not accessed	Not reported	Up to 10 years	Evaluating outcomes of pediatric patients with ESRD due to LN and determining whether an intensive specific treatment in SLE decreased incidence of ESRD and need for RRT, dialysis and kidney transplantation, in pediatric patients in the last four decades in Croatia	Croatia	MR
Kang et al (2010)[39]	59	28, 14	Not accessed		5 ± 3, 5 ± 3 years	Demonstrating the long-term outcomes for lupus patients that underwent different RRTs, including kidney transplantation	South Korea	LFR, CVR
Oliveria et al (2012)[40]	50	11, 2	Not accessed	Non-Caucasians	11, 30 months	Determining the epidemiological profiles and outcomes of LN patients undergoing renal transplantation	Brazil	LFR, MR
Lee et al (2003)[41]	26	20, 6	Not accessed	Not recorded	57.50 ± 4.20 months	Investigating the long-term progress of 26 SLE patients who started regular dialysis at Chinese hospitals and whose stay exceeded a three-month duration	Taiwan	MR

Abbreviations: CVR, cardiovascular-events risk; ERSD, end-stage renal disease; HD, hemodialysis; IR, infection risk; KT, kidney transplantation; LFR, lupus flare risk; LN, lupus nephrites; MR, mortality risk; PS, patient's survival; RT, renal transplant; RRT, renal replacement therapy; SLE, systemic lupus erythematosus; PD, peritoneal dialysis

DISCUSSION

The statistically insignificant differences between the two groups in the risk of lupus flares could be explained by the fact that SLE activity undergoes quiescence, burn-out, when an LN patient progresses to ESRD, and as shown by Gonzalez-Pulido et al,[42] when the patient receives RRT, ideally due to immunosuppressant administration as illustrated by Maroz et al.[43] A small study, by Althaf et al,[44] however, reported that SLE activity could be exacerbated if an LN patient becomes pregnant.

Regarding mortality, a study by Mustapic et al,[38] has reported more deaths associated with HD than PD, specifically due to cardiovascular events such as angina pectoris, myocardial infarction, coronary heart disease, and hyperlipidemia. In the current study, however, the mortality difference didn't reach statistical significance.

On the other hand, the current study showed statistically significant benefits for PD in terms of all-cause cardiovascular outcomes as compared to the MD group. This has been supported by Kang et al,[39] who concluded that PD was superior to HD.

In another study, Chen et al[45] showed that no recovery advantage existed for patients treated by PD as compared with HD, but the same study concluded that PD preserves residual renal function better than HD.

The current study should be interpreted with caution because of possible sources of biases in the reviewed studies as well as in the current review. Some included studies used larger sample sizes than others did, and none of the studies calculated sample sizes and power, thus introducing chances of a type-1 error.[46-47] Participants had different mean age groups, and some studies reported different comorbidities for their participants.

CONCLUSIONS

The current study may have reference significance for clinical treatment of ESRD. Except for all-cause cardiovascular events in which PD was superior to HD, offering better outcomes, both treatment modalities provide more or less similar clinical outcomes as effective initial choices for RRT in LN-ESRD patients prior to renal transplant. The current research team, however, encourages further research on the question, addressing better the possible sources of biases encountered in the current study.

AUTHOR CONTRIBUTIONS

Youlan Gong, BD, and Yamin Zhao, BD, contributed equally to the work.

ACKNOWLEDGMENTS

Internet and Health Education (Grant No.2041ZF311) supported the intervention study on the psychological distress and coping style of ESRD patients receiving HD first. The current study may have reference significance for clinical treatment of ESRD.

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