

Study on the Effect of Infrared Ray on Pruritus and Sleep Quality of Hemodialysis Patients

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Abstract

Objective: Chronic complications are the most important problem for patients with maintenance hemodialysis. In this paper, infrared ray is used as a treatment method to analyze its effect in the treatment of skin pruritus and sleep improvement.

Methods: 80 patients with hemodialysis admitted in our hospital from May 2017 to October 2019 are randomly divided into observation group and reference group. The observation group is treated by external infrared ray irradiation through dialysis channel. The skin pruritus score, SCRP and sleep quality score of the two groups were compared.

Results: The results showed that the skin Pruritus score of the Observation group was (3.08 ± 1.42), the PSQI Score was (2.29 ± 1.98), the results showed that the skin Pruritus score of the Observation group was (3.08 ± 1.42), and the effective rate of sleep therapy was 95%. All indexes were significantly better than those of the reference group. The difference between the two groups was statistically significant ($P < 0.05$).

Conclusion: The results showed that infrared could be effectively improved the skin hemodialys is quality of patients, and the clinical effect was obvious.

Keywords: Infrared ray; Maintenance hemodialysis patients; pruritus; sleep quality

1. INTRODUCTION

After blood purification treatment, end-stage renal disease (ESRD) would be effectively controlled and the mortality would be reduced. But at the same time, it is often accompanied by itchy skin symptoms, which will cause patients to feel upset and manic, especially the itchiness at night will easily affect the sleep quality of patients. In the long term, this will cause patients to have great psychological fluctuations, pain and even suicidal thoughts. At the same time, DOPPS study suggested that pruritus in ESRD patients was positively correlated with the risk of death [1]. Infrared ray can activate, warm and resonate the cells, effectively regulate blood function, stabilize brain self-discipline, and relieve skin itching and insomnia symptoms to a certain extent. To this end, the purpose of this study was to study the effect of infrared ray on skin itching and sleep quality in hemodialysis patients. The specific analysis is as follows.

2. MATERIALS AND METHODS

2.1. Sample Data

A total of 80 hemodialysis patients admitted to our hospital from May 2017 to October 2019 were selected as the research objects, among which the primary diseases included: 36 cases of chronic glomerulonephritis (45%), 17 cases of hypertensive nephropathy (21.25%), 22 cases of diabetic nephropathy (27.5%) and 5 cases of polycystic kidney disease (6.25%). The research objects is divided into observation group and control group using the random number table method, 40 cases in each group. The observation group has 18 female cases (45%), 22 male cases (55%). The average age was (58.57 ± 13.48). The hemodialysis time was between 12-86 months. The reference group has 21 female cases (52.5%), 19 male cases (47.5%). The average age was (57.67 ± 12.79), the hemodialysis time was between 14-92 months. The comparison of general data between the two groups showed no statistically significant difference ($P > 0.05$), indicating that the study was feasible.

Inclusion criteria: For patients receiving regular maintenance blood dialysis in our hospital, the duration of dialysis treatment was more than 6 months, and the dialysis frequency was 3 times a week, lasting for 4 hours each time. Symptoms of itchy skin and severe sleep disorders were observed before the survey. PSQI Pittsburgh sleep score was above 7. All patients were informed of the study and signed informed consent.

Exclusion criteria: Patients who did not receive regular dialysis treatment and had dialysis time less than 12 hours per week; Itching caused by other skin diseases, including atopic dermatitis and eczema; Patients in critical condition or with blood or other infectious diseases; Patients with severe heart and liver diseases and severe infections; Patients suffering from mental disorder.

2.2. Treatment Methods

According to the application advantage of infrared therapeutic apparatus, the observation group was treated by dialysis access in vitro infrared radiation, the control group without the dialysis pathways in vitro infrared irradiation treatment. Choose MRX-1 type of far infrared transmitter for irradiation treatment. The infrared peak wavelength and the power density are set to light ($648 + 19$) nm, 2-7 mw/cm². While the patient is undergoing blood dialysis, dialysis pathways

vein end around 50 cm loop was locked in infrared therapeutic apparatus in the tunnel. Light source points [2-3] were set at the position of 10mm-12mm dialysis access. Open the infrared therapy apparatus, infrared radiation was performed on the blood flowing in the pipeline for 1 hours each time. After completion of radiation therapy, the venous end of the circuit was removed from the infrared therapeutic apparatus. The treatment effect was observed after 8 weeks of continuous treatment. During the infrared treatment, the patient continued the original drug therapy without changing the type and dose of phosphorus binder.

2.3. Observation Index

After 2 weeks, 4 weeks, 8 weeks of infrared treatment, questionnaire using Dirk R Kuypers method[4] was given to two groups to score the skin pruritus: (1) Itch degree is divided into five grades, no scratch, scratch, itch persists after scratching, itch persists after scratching and have scars, notes for 1-5;(2) Itching range was divided into 3 grades, single part, multi-parts and whole-body itching respectively, notes for 1-3;(3) The onset frequency was defined as 10min. Four times of short-term itching with less than 10min each was scored as 1 point, one time with more than 10 minutes was scored as 2 points, and the duration of uninterrupted itching was scored as 5 points.(4) The treatment effect of skin pruritus is divided into three grades, no remission in day and night, unable to sleep at night; partial remission, mild itching in day and night, did not affect sleep; remission, no pruritus during the day, occasional pruritus at night, normal sleep. Effective treatment rate = (partial remission + remission)/total number of cases $\times 100\%$. Sleep quality score was used the PSQI Pittsburgh sleep quality evaluation table [5], 0 to 3 grades, scores above 5 points shows sleep quality is poor. The higher the score, the worse the quality of sleep. Sleep quality evaluation is divided into four grades, Recovery: PSQI < 7 points with normal sleep, Improvement: PSQI > 7 points with insomnia symptoms improved, No effect: PSQI > 7 points with insomnia no improved. Effective treatment = (improvement+ recovery)/total number of cases by 100%.

2.4. Statistical Methods

Data were analyzed using IBM SPSS Statistics 22.0 for Windows (IBM, Armonk, NY, USA). Measurement data was expressed as $(\bar{x} \pm s)$. T-test was used for comparison between groups. Enumeration data was expressed as %. χ^2 test was performed between groups, and $P < 0.05$ was considered statistically significant.

3. RESULT ANALYSIS

3.1. Comparison Analysis of Skin Itching between the Two Groups

Through the data analysis, after infrared 8 weeks after

treatment, the observation group for blood dialysis patients skin pruritus score (3.08-1.42), significantly lower than that of control group (11.25 \pm 6.06). Difference between the two groups have statistical significance ($P < 0.05$), indicating that infrared can effectively improve skin itching problem of hemodialysis patients. With the increase of treatment time, the therapeutic effect was obvious. The results are shown in Table 1.

Table1: Skin itch score of blood dialysis patients in the two groups ($\bar{x} \pm s$, points)

group	Itch score			
	Week 0	Week 2	Week 4	Week 8
Observation group	14.78 \pm 5.42	8.56 \pm 3.72	3.11 \pm 1.51	3.08 \pm 1.42
Reference group	13.84 \pm 6.29	14.12 \pm 5.52	10.26 \pm 5.67	11.25 \pm 6.06
T		5.692	11.216	9.281
P		< 0.05	< 0.05	< 0.05

Meanwhile, from the perspective of clinical treatment effect, the effective rate of skin disease treatment in the observation group of hemodialysis patients after infrared treatment reached 95%, significantly better than the reference group 57.28%, and the difference between the two groups was statistically significant ($P < 0.05$), as shown in Table 2.

Table2: Comparison of the curative effects of skin itching between the two groups (N, %)

group	n	Complete relief	Part relief	Does not relieve	Effective treatment rate
Reference group	40	14/35.00	11/27.50	15/37.50	25/62.50
Observation group	40	22/55.00	16/40.00	2/5.00	38/95.00
χ^2		8.926	6.351	5.169	7.186
P		< 0.05	< 0.05	< 0.05	< 0.05

3.2. Comparative Analysis of Sleep Quality between the Two Groups

Statistics shows the sleep quality of PSQI score of observation group of patients through infrared treated received (2.29 \pm 1.98) after 8 weeks treatment, better than the control group (6.98 \pm 2.19). The difference between the two groups have statistical significance ($P < 0.05$), shows that infrared ray can significantly improve the sleep of hemodialysis patients. The results are shown in table 3.

Table3: Comparison of sleep quality PSQI scores between the two groups of hemodialysis patients ($\bar{x} \pm s$ points)

group	PSQI score			
	Week 0	Week 2	Week 4	Week 8
Observation group	14.19±4.42	11.25±3.65	6.22±2.11	2.29±1.98
Reference group	14.31±4.75	9.25±3.46	8.28±3.32	6.98±2.19
T		5.192	10.056	8.925
P		< 0.05	< 0.05	< 0.05

From the perspective of clinical treatment effect, the effective rate of sleep quality improvement in the observation group of hemodialysis patients after infrared treatment reached 92.5%, significantly better than the reference group of 55%. The difference between the two groups was statistically significant ($P < 0.05$). The results are shown in Table 4.

Table 4: Comparison of the effects of sleep quality improvement between the two groups of hemodialysis patients (N, %)

Group	n	Recovery	Improve ment	No effect	Effective treatment rate
Reference group	40	12/30.00	10/25.00	18/45.00	22/55.00
Observation group	40	19/47.50	18/45.00	3/7.50	37/92.50
χ^2		5.261	1.321	2.596	11.255
P		< 0.05	< 0.05	< 0.05	< 0.05

4. DISCUSSION

The incidence of itchy skin in ESRD patients is up to 50-90%, which seriously affects the daily life and quality of life of the patients. So it's urgent to improve itchy skin problem. The mechanism of pruritus in ESRD patients has not been definitively concluded yet. Studies have shown that there are many factors involved: (1) Dry skin and lack of moisture are the most common causes in patients; (2) Accumulation of toxins can also lead to itchy skin, and the severity is positively correlated with creatinine urea level; (3) The increased number of mast cells and the increased histamine level lead to an allergic reaction, thus causing itching; (4) The malnutrition caused by the loss of appetite in ESRD patients will also make the skin keratinize and increase susceptibility; (5) Increased parathyroid hormone can promote the release of histamine. [7] At the same time, itchy skin can be extremely severe, affecting the quality of sleep, even unable to fall asleep. Prolonged sleep disorders lead to sleep deprivation, limited daytime activity, and emotional problems such as sleepiness, anxiety, and depression. Therefore, improving the sleep status of ESRD patients can improve their cognitive function and life quality [8].

Infrared ray is a kind of invisible light, which is an electromagnetic wave with the wavelength of 760nm-400 μ m in the spectrum [9]. The instrument using this ray is infrared therapeutic apparatus, which is mainly applicable to the auxiliary treatment of soft tissue injury, nape myofascial inflammation, knee arthritis, herpes zoster, diabetic foot, wound infection, wound healing and other diseases. Infrared therapeutic apparatus can act electromagnetic spectrum directly on human body organization and the effective acupuncture pain points. The depth of the layer based on temperature effect thus raising the temperature of human cortex and joint tissue, expanding capillaries, to regulate blood flow velocity, promote metabolism, enhance the vitality of tissue cells and regeneration [10]. The combined action will have multiple biological effect such as anti-inflammatory analgesic, repairing injured tissues, regulate the circulation of the blood and nerve immune efficacy.

The key to effective treatment is to pinpoint the root cause of the problem. Because of the blood dialysis has not been effectively solved, in the process of long-term hemodialysis, the patients' metabolic ability and immune function were impaired. The body is vulnerable to microbes and germs. Besides, the disinfection dialyser and plasticizer that softens the hemodialysis access used in the process of frequent blood dialysis will cause improper stimulation to the patient's bone marrow, spleen, and skin tissue, which raise the concentration of the blood of the amine, cause allergic reaction, a skin rash and the itching discomfort [11]. At the same time, It could also be that electrolyte dysfunction causes hypercalcemia and skin calcification, which stimulates mast cells to release histamine, causing itchy skin. And infrared treatment method is to use the infrared thermal effect, prompting human local skin tissue temperature increase, and improve blood circulation, promoting the rapid discharge of stranded metabolites, providing support for the skin tissue regeneration cycle. It captures the pathogenesis of itchy skin, improves skin immunity and controls inflammation by the metabolism of skin tissue engineering. It has an important effect on the treatment of skin itching and insomnia. In recent years, with the infrared therapeutic advantage continuously emerging, it is used more and more frequently in clinic. To accurately identify its application effect, through mathematical analysis, this study verified that infrared rays are effective in relieving skin itching and improving sleep quality in hemodialysis patients. It provides a feasible reference for clinical diagnosis and treatment of chronic complications in hemodialysis patients.

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