

Comparative Study Of Diaphragmatic Breathing Exercise And Butekyo Breathing Exercise In Hemodialysis Patients

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Abstract

Introduction: Hemodialysis patients also develop complications beyond renal impairment, such as compromised respiratory function. Elevated blood pressure, decreased lung volumes, impaired pulmonary function, and dyspnea are common findings but not addressed adequately. Diaphragmatic breathing exercises are a non-invasive method for maintaining respiratory health and general well-being. Diaphragmatic breathing promotes deeper ventilation by stimulating the diaphragm effectively. **Methodology:** Hemodialysis patients who fulfilled the inclusion criteria were selected. A total of 48 participants were chosen, & were randomly divided into 2 groups (24 into each group). Group A included Diaphragmatic breathing & group B included Butekyo breathing. Modified borg scale was used to evaluate Dyspnea score; FEV₁/FVC ratio was used to check the lung capacity & Blood pressure was measured using sphygmomanometer and KDQOL was used to check the quality of life in hemodialysis patient. A 4 weeks' treatment protocol was given for each group. **Results:** Hemodialysis patients receiving the treatment programs showed improvement in dyspnea, pulmonary function, and quality of life for both diaphragmatic and Butekyo breathing methods. Butekyo patients were able to reduce dyspnea scores more and improve their FEV₁/FVC ratio more than in Group A. Blood pressure decreased in both groups, with a small advantage for the Butekyo group. Lastly, KDQOL scores increased after the intervention, indicating an improved sense of well-being among participants. **Conclusion:** Butekyo and diaphragmatic breathing techniques, affect respiratory function, blood pressure, and quality of life. Both interventions were effective in producing positive outcomes but the improvements in pulmonary function and symptom control were better with Butekyo method practitioners. **Keywords:** Hemodialysis, respiratory dysfunction, Butekyo breathing, diaphragmatic breathing, dyspnea, breathing exercises, blood pressure

INTRODUCTION

Chronic kidney disease (CKD) is an umbrella term for a multitude of disorders that lead to nephron destruction, sustainable and irreversible loss of kidney structure and function for a period of three or more months. ^[1] Millions are afflicted with this ailment globally, exerting a huge burden on healthcare systems. Chronic kidney disease is characterized by progressive loss of kidney function and frequently leads to end-stage renal disease, where survival is dependent on dialysis or kidney transplantation. ^[2] Patients with early CKD (1-2) often remain asymptomatic and are thus only diagnosed when renal function declines rapidly. ^[3] CKD therefore for sakes any serious progress toward discomfort, impairment, or productivity. With a moderately advanced stage and end-stage chronic kidney disease (3-4 sub-stages), quality of life drops significantly, cardiovascular risks increase, and metabolic derangements increase. ^[4] With end-stage renal disease (stage 5) needing renal replacement therapy, either through dialysis or through transplant, the burden on health-care facilities becomes enormous. ^[4]

One of the main goals of CKD management is to alleviate symptoms, slow the disease's progression, and avert complications such as anaemia, cardiovascular disorder, bone disorder, and electrolyte imbalances.^[5] Chronic kidney disease (CKD) must mainly be treated by either dialysis or medication, or, for end-stage CKD, kidney transplantation and lifestyle changes; however, there are some newer options now being discussed and accepted in terms of improving patient outcomes and bettering the quality of life, such as dietary management, exercise rehabilitation, or psychological aid.^[6] A steady rise in the need for hemodialysis treatment is due to the increasing prevalence of chronic kidney disease (CKD), mainly driven by diabetes and hypertension among an aging population.^[7] According to a study done in 2015, which put the total number of patients needing dialysis at least 2.9 million in Asia, there is an enormous backlog, with an estimated 66% of people needing the dialysis care not getting it.^[8] Development in the standard of life and prolonging life in patients suffering from end-stage renal disease is one of the most important benefits of hemodialysis. Without hemodialysis, the total renal failure humans develop would build fluid, electrolytes, and toxins to become very sick and die from having hemodialysis.^[9]

The lifespan and long-term survival of renal failure patients have enhanced by the application of hemodialysis. Patients suffering from end-stage renal disease (ESRD) have a very short life expectancy; this could either be without hemodialysis or kidney transplant. However, hemodialysis was found to lengthen this lifespan by a couple of years, thus enabling patients to resume their normal social lives as well as work and everyday activities.^[10] Chronic kidney disease (CKD) and kidney replacement therapy like hemodialysis and peritoneal dialysis have far-reaching effects on the respiratory system. These effects are acute, resulting in pleural effusions, infections, and ARDS, or chronic, leading to developmental lung-parenchyma calcification that eventually causes respiratory disability. Dyspnea is a common respiratory symptom of End stage kidney disease that is normally evaluated by lung function tests.^[11] In hemodialysis population, dyspnea is highly common. Patients on hemodialysis may have diaphragmatic dysfunction, giving rise to symptoms such as fatigue and dyspnea.^[12] Both the disease and hemodialysis treatment can affect the respiratory system, adding to the decline in physical activity and conditioning. Hemodialysis patients with CKD experience diminished strength in respiratory muscles and lung function.^[13]

The diaphragm is one of the key respiratory muscles, and for good breathing function, it is essential. The first serious analyses of the interaction between diaphragm and chest movement in respiration were made by Sewall and Pollard at the end of the nineteenth century. Apart from its role in respiration, the diaphragm also plays a role in swallowing and phonation. Its impairment is associated with myriad conditions, ranging from respiratory failure to inability to carry out even minimal exercise, sleep disturbance, and even possible death.^[14-16] The impact of diaphragmatic breathing on blood pressure in pre-hypertensive patients was examined by Wang et al. Compared with the group practicing only diaphragmatic breathing, those receiving biofeedback training in addition to diaphragmatic breathing showed greater reductions in blood pressure.^[17] The benefits of biofeedback training, which likely enhanced the effects of diaphragmatic breathing, have mainly to do with reduced sympathetic activity and enhanced vagal tone, while alterations in blood pressure and heart rate variability were achieved through diaphragmatic breathing alone.^[17] Buteyko, one of the several Russian breathing systems for health, was introduced to Australia, Europe, and the USA since the 1990s. Dr. Konstantin Pavlovich Buteyko stated that his breathing retraining method could treat a significant proportion of the long-term illnesses affecting modern society.^[18] Reduced-volume breathing is the principal breathing technique used in the Buteyko Method.^[18,19] Low-volume breathing frequently lessens respiratory effort, causes the respiratory muscles to relax, and enhances diaphragm function. It may decrease the amount of lung air trapping or hyperinflation.^[18] The core idea behind BBT is the deliberate decrease in respiratory volume and rate to return to ideal CO₂ levels, which enhances oxygen delivery to tissues via the Bohr effect.^[20] The control of arterial CO₂ levels, which is essential for respiratory drive, blood pH management, and autonomic nervous system balance, is the main mechanism behind Buteyko breathing.^[21] These patients could utilize respiratory exercises as an adjunct, low-cost, nonmedicinal form of anxiety control while reserving potentially hazardous pharmacologic interventions.^[19]

Breathing exercises such as diaphragmatic breathing and Buteyko breathing appear to empower the respiratory function through improved lung capacity and oxygenation. Diaphragmatic breathing encourages the inhalation of deep, slow breaths engaging the diaphragm, while Buteyko breathing teaches to consciously lengthen the exhalation by reducing the breathing rate in order to maintain carbon dioxide concentration in the body. However, limited evidence exists comparing their efficacy in the context of hemodialysis. The above study aims to evaluate and compare the impact of diaphragmatic and Buteyko breathing exercises on pulmonary function (FEV_1/FVC ratio), dyspnea perception (Modified Borg Scale), blood pressure regulation, and quality of life (KDQOL scale), aiming to identify effective, low-cost adjunct therapies to enhance the functional and clinical outcomes in this patient group.

MATERIALS AND METHODOLOGY

The study was conducted after receiving approval from the Institutional Research Committee. Once the ethical approval was approved reference no (DYPMCK/IEC.164/2025) participant were screened on basis of inclusion and exclusion criteria.

Inclusion criteria

Patients with chronic renal disease on maintenance dialysis, belonging to the age group 45 and above and both the genders.

Exclusion criteria

Patients with known lung disease, such as asthma or chronic obstructive pulmonary disease, Neuromuscular disorders, Severe Cardiovascular disease, Uncooperative patient.

Initially, a brief demographic data including name, age, gender, etc. As per data collection sheet were recorded. Written as well as informed consent is taken from all the participants willingly. 48 subjects were randomly allocated into two groups by using a computer randomization pattern and outcome measures were being taken before the interventions i.e 24 in each group. Participants were educated about the condition and procedure of the exercise were explained in detail. Group A were received diaphragmatic breathing exercise for 3 days for 4 weeks and Group B were received Buteyko breathing exercise for 3 days for 4 weeks with diaphragmatic breathing exercise. Pre and post assessment of FEV_1 and FEV_1/FVC was done for each participant of each group through digital spirometry. Modified Borg scale is used for rating the exertion level, to take blood pressure, a sphygmomanometer was used, after which the patient rates the level of exertion according to the modified borg scale. Pre and post exertion level of the same activity and the parameters was assessed for the patient.

Group a:

Diaphragmatic breathing exercise – Instruct patient to be in sitting position with slight trunk flexed, Instruct the participants to place one hand over his/her upper abdomen and other hand over the upper chest for the tactile feedback. Instruct the patient to inhale deep slow breath through nose without usage of accessory muscle and then slowly exhale through the Mouth. Instruct the patient to feel feedback of the upper abdomen and chest through his/her hand as when patient takes deep inhalation the upper abdomen and chest rises in upward direction.



Fig 2: Diaphragmatic breathing exercise

Group b:

Buteyko breathing exercise- Buteyko breathing exercise consists of nasal breathing, patient was instructed to inhale keeping the mouth closed through and exhaled Through nose to remove air from lungs. Then the patients were instructed to hold the breath until the feel urge for the breath. This cycle of nasal breathing was repeated with rest period of 30 seconds to 2 minutes between each cycle.

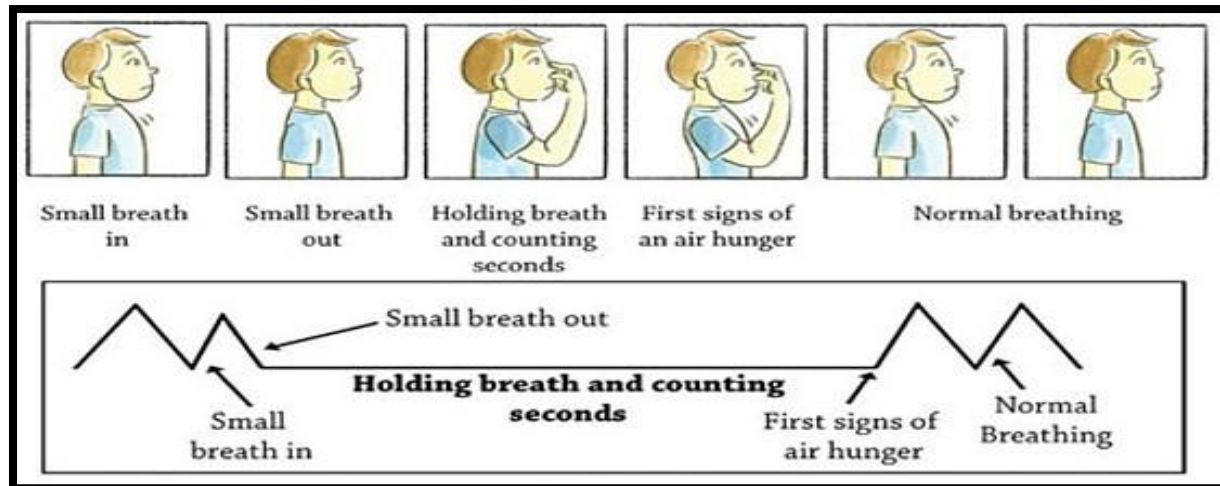


Fig 3: Butekyo breathing technique

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Group A- Diaphragmatic Breathing Exercise	Group B-Buteyko Breathing Exercise
No. of patients: 24	No. of patients: 24
Patient position: sitting	Patient position: sitting
Repetitions: 3 days per week	Repetitions:3 days per week
Diaphragmatic breathing exercise	Buteyko breathing exercise

Modified borg scale:

ws

SCALE	SEVERITY
0	No Breathlessness* At All
0.5	Very Very Slight (Just Noticeable)
1	Very Slight
2	Slight Breathlessness
3	Moderate
4	Some What Severe
5	Severe Breathlessness
6	
7	Very Severe Breathlessness
8	
9	Very Very Severe (Almost Maximum)
10	Maximum

It is an outcome measure used to access the exercise intensity without rely on physiological parameter. Introduce the scale to the patient properly, ask the patient to start exercise at light intensity after few minutes ask the patient to rate their perceived exertion, ask the patient to rate its exertion at regular interval, encourage the patient to aim for specific RPE range based on their fitness goals. According to a study there is high reliability for borg scale, the validity of Borg scale ranges from (0.88; 95% CI 0.84-0.91)

Kidney Disease Quality of Life (KDQOL-36): It is patient-reported outcome measure (PROM) evaluating health-related quality of life in patients with kidney disease. 3 kidney disease-specific subscales:

Symptoms and Problems of Kidney Disease (12 items)

Effects of Kidney Disease on Daily Life (8 items)

Burden of Kidney Disease (4 items)

Each scale is rated from 0 to 100, with higher ratings reflecting higher quality of life or fewer perceived issues.

Age	A	B
Mean	55.92	57.00
S.D.	6.88	7.81

Scores are determined by domain and are not summed into a total score. According to a research the Internal consistency (Cronbach's alpha) is 0.83–0.85, Test-retest reliability (ICC) is 0.713–0.999 and the Construct validity is Established across populations and dialysis modalities.

RESULTS

GENDER DISTRIBUTION

Table No.1: Gender distribution of Group A

Gender	Frequency	Percentage
Male	17	70.83%
Female	7	29.17%
Total	24	100%

Males accounted for 70.83% of the total, while females comprised 29.17%

Table No.2: Gender distribution of Group B

Gender	Frequency	Percentage
Male	13	54.16%
Female	11	45.84%
Total	24	100%

Among the 30 participants 26 were male and 4 were female.

Table No. 3: Mean Distribution of Age

The mean age of participants in Group A was 55.92 years, with a standard deviation of 6.88 years, indicating a moderate variation in age distribution within the group. In Group B, the mean age was slightly higher at 57.00 years, with a standard deviation of 7.81 years, suggesting a similar pattern of age variability. These values reflect a relatively comparable age profile across both groups, ensuring demographic homogeneity with respect to age.

Table No.4: Group Wise Comparison of Mean Dyspnea Score

Outcome	Group	Mean	S.D.	P-value
Dyspnea score	A	3.46	1.91	0.305497902
	B	3.19	1.75	

The dyspnea scores for Group A, which underwent diaphragmatic breathing exercises, showed a mean value of 3.46 with a standard deviation of 1.91. Statistical analysis revealed a p-value of 0.305, indicating that the change in dyspnea scores was not statistically significant.

Table No.5 : Group Wise Comparison of Mean Blood Pressure

Outcome	Group	Mean	S.D.	P-value
SBP	A	135.46	13.78	0.014140705
	B	127.50	10.32	
DBP	A	76.54	10.09	0.414564198
	B	77.08	6.90	

In terms of systolic blood pressure (SBP), Group A had a mean value of 135.46 mmHg with a standard deviation of 13.78, while Group B recorded a lower mean SBP of 127.50 mmHg with a standard deviation of 10.32. The comparison between the two groups yielded a p-value of 0.014, indicating a statistically significant difference in systolic blood pressure.

For diastolic blood pressure (DBP), Group A showed a mean of 76.54 mmHg with a standard deviation of 10.09. The p-value for this comparison was 0.414, suggesting that the difference in diastolic blood pressure between the groups was not statistically significant.

Table No.6: Group Wise Comparison of Mean FEV₁/FVC Ratio

Outcome	Group	Mean	S.D.	P-value
FEV ₁ /FVC Ratio %	A	72.40	5.64	0.0009297
	B	76.89	3.55	

The FEV₁/FVC ratio, expressed as a percentage, showed a mean value of 72.40% in Group A with a standard deviation of 5.64. In comparison, Group B demonstrated a higher mean ratio of 76.89% with a standard deviation of 3.55. The statistical analysis revealed a p-value of 0.0009, indicating a highly significant difference between the two groups in terms of pulmonary function.

Table No.7: Group Wise Comparison of Mean Kidney Disease Quality Of Life Scale (KDQOL) Score

Outcome	subgroup	Group	Mean	S.D.	P-value
KDQOL PRE SCORES	Burden Score	A	33.20	17.05	0.003071447
		B	21.26	11.13	
	Symptoms Score	A	61.55	17.83	0.299254587
		B	64.77	23.80	
	Effects Score	A	44.50	16.42	2.98854E-05
		B	64.37	14.69	

Burden Score:

Group A showed a higher burden score with a mean of 33.20 and a standard deviation of 17.05, compared to Group B, which had a lower mean score of 21.26 (SD = 11.13). The p-value of 0.003 indicates a statistically significant difference between the groups, suggesting that Group A experienced a greater perceived burden before the intervention.

Symptoms Score:

The mean symptoms score for Group A was 61.55 with a standard deviation of 17.83, while Group B had a slightly higher mean score of 64.77 (SD = 23.80). However, the p-value of 0.299 suggests that this difference was not statistically significant.

Effects Score:

Group A had a lower effects score with a mean of 44.50 (SD = 16.42) compared to Group B, which scored 64.37 (SD = 14.69). The p-value was extremely low ($p \approx 0.00003$), indicating a highly significant difference between the two groups. This suggests that Group B experienced a significantly more favourable perception of the effects of kidney disease prior to intervention.

DISCUSSION

Dyspnea is the most common symptom reported in hemodialysis ESRD patients and is largely associated with fluid overload, pulmonary congestion, diaphragmatic weakness and anemia^[11,22,12]. In the above study both diaphragmatic and Buteyko breathing exercises have resulted in substantial decreases in dyspnea scores in the groups. Group A has decreased from 5.25 to 3.46, and Group B from 5.13 to 3.19 with highly significant p-values. This enhancement is complementing the previous study and observation by Karacan et al.^[23], which points out that respiratory rehabilitation can successfully alleviate the severity of dyspnea in hemodialysed patients. It is a recognized fact that the technique of diaphragmatic breathing promotes the optimal use of the diaphragm during inspiration and minimizes accessory muscle use; therefore, respiratory effort is decreased and oxygenation is increased^[24,17]. It enhances an efficient breathing pattern that will increase tidal volume, cultivates calmness, and reduces the anxiety that can contribute to dyspnea^[25].

The Buteyko breathing method aims instead to correct chronic hyperventilation by decreasing respiratory rate and increasing CO₂ retention^[18,26]. This method leverages the Bohr effect to improve oxygen unloading at the tissue level. Given that ESRD patients often experience respiratory alkalosis owing to compensatory hyperventilation^[27,28], Buteyko breathing could directly target an underlying pathophysiological contributor to dyspnea in this population. The larger improvement in FEV₁/FVC in group B is consistent with this mechanism. According to Huang HY et al. (2021), the recent research provides further evidence to support the advantages of breathing exercises on mental health. The research showed that there was a significant decrease in depressive symptoms that led to an improvement in mental QOL scores in dialysis patients after the nurse-led breathing intervention.^[29] This improves the current knowledge base and highlights the many benefits of controlled breathing.

Pulmonary Function (FEV₁/FVC)

Pulmonary function, assessed via the FEV₁/FVC ratio, improved significantly in both groups, with a more pronounced effect in Group B (Buteyko breathing), where the ratio increased from 68.51% to 76.89% ($p < 0.001$). The significant improvement in the Buteyko group ($p = 0.00093$ compared to Group A) may reflect enhanced respiratory efficiency through nasal breathing, carbon dioxide retention, and reduced respiratory rate—all key elements of the Buteyko technique. These physiological changes may facilitate bronchial dilation and improved gas exchange, especially in patients with coexisting pulmonary comorbidities.

Although it focusses depth of breathing over breath control, diaphragmatic breathing promotes better ventilation-perfusion matching. Studies such as McKeown & Courtney (2015), who found that asthma patients who practiced Buteyko had better FEV₁ and FEV₁/FVC, confirm Buteyko's superiority in this parameter.^[30] According to Courtney's 2016 research, practicing Buteyko may help enhance long-term pulmonary adaptations and reduce hyperventilation by improving CO₂ tolerance.^[31]

Choudhari, Zagade et al. (2025) have emphasised the relevance of respiratory workouts in holistic treatment by highlighting the advantages of deep breathing in enhancing lung function and sleep quality in CKD patients.^[32]

Blood Pressure Regulation

Both interventions significantly reduced systolic and diastolic blood pressure. However, Buteyko breathing was significantly more effective in reducing systolic blood pressure ($p = 0.014$). The observed improvement in Group B may be attributed to the reduced sympathetic drive associated with slow nasal breathing, which promotes parasympathetic activity, thereby lowering systemic vascular resistance and blood pressure.

In support of these conclusions, Yamaguchi et al. (2015) showed in a randomised controlled experiment that paced breathing decreased systolic blood pressure in hypertension patients by means of autonomic regulation.

^[33]According to Courtney and McKeown (2018), buteyko breathing is thought to enhance arterial CO₂ levels, which play a role in the process of vasodilation and modulation of blood pressure.^[34] The potential benefits of controlled breathing methods in autonomic balancing were further corroborated by Almutary & Al Shammari (2025), who noted remarkable modifications in blood pressure and depression in haemodialysis patients after the implementation of a breathing training program.^[35] Regular breathing exercises were also

determined by Joseph et al. (2005) to improve baroreceptor sensitivity and decrease arterial stiffness, indicating possible long-term benefits for the cardiovascular system.^[36]

Quality of Life Improvements

The therapeutic effects of Buteyko breathing in causing relaxation and reduction of anxiety have been documented in other groups as well. A study in COPD patients revealed significant improvement in depression and anxiety following Buteyko breathing interventions, suggesting it as a good relaxation technique [Journal of Community Health Research, 2021]. Given the extremely high prevalence of stress and psychological burden in hemodialysis patients, it is logical to believe that the relaxation effect of Buteyko breathing would be an important factor in improving their quality of life. Quality of life among hemodialysis patients is often greatly impaired by physical fatigue, emotional distress, dietary restrictions, frequent hospitalization, and the psychological burden of chronic illness ^[37,38]. In this research, both groups experienced improvements in KDQoL subdomains, but Group B experienced greater advantage in the Burden and Effects scores. Group A experienced a rise in Symptoms Score (57.42 to 61.55) and Effects Score (37.30 to 44.50). Group B rose from 60.94 to 64.77 for Symptoms and from 49.33 to 64.37 for Effects Score. Post-intervention Burden Score in Group B (21.26) was considerably less compared with that in Group A (33.20), indicating a considerable reduction in the burden of kidney disease perceived. These findings are in accordance with earlier research that both breathing interventions improve mood, reduce fatigue, and sleep quality ^[19,39]. Hsu et al. (2021) demonstrated that combined breathing exercises and light leg movement increased heart rate variability and reduced fatigue in patients undergoing dialysis ^[29]. Similarly, Sari et al. (2023) found that deep breathing with active range-of-motion exercises significantly improved fatigue and quality of life ^[40]. Mechanistic Comparison

Mechanistic comparison of diaphragmatic breathing and tidal breathing is given below:

Diaphragmatic breathing improves respiratory muscle function by increasing diaphragmatic excursion and decreasing respiratory muscle fatigue ^[24,41]. It is particularly beneficial in patients with evidence of diaphragmatic dysfunction—a frequent finding in hemodialysis patients ^[46,47]. It also decreases hyperinflation and maximizes lung mechanics with tidal breathing. Conversely, the Buteyko breathing emphasizes biochemical and neurologic processes of breathing. It promotes nasal breathing and stimulates control pause technique for the purpose of maximizing oxygenation, stabilizing the autonomic nervous system, and reducing chemoreflex hypersensitivity ^[18,21]. All of these features make it very useful in controlling symptoms of hyperventilation as well as respiratory control in general. The mechanism between the two techniques accounts for the gain seen in the lung function and quality of life of Group B. Diaphragmatic breathing cannot be excluded either because it demonstrated significant change in blood pressure control and symptom relief. Perhaps this technique will prove to be appropriate for other patients with more muscular deconditioning and neuromuscular impairment.

CONCLUSION

Breathing disorders constitute an unrecognized problem among hemodialysis patients. This study investigated whether different breathing techniques, namely the Buteyko and diaphragmatic breathing techniques, would affect respiratory function, blood pressure, and quality of life. Both interventions were effective in producing positive outcomes but the improvements in pulmonary function and symptom control were better with Buteyko method practitioners. This implies that structured breathing interventions will add valuable options to the supportive care in hemodialysis. However, integration of such techniques into routine management may enhance the comfort and betterment of the patients. Continued research will reinforce the evidence in directing clinical practices.

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