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EXTREMITY JOINT RANGE OF MOTION EXERCISE ON INTRADIALYTIC BLOOD PRESSURE CONTROL IN HEMODIALYSIS PATIENTS

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ABSTRACT

Changes in blood pressure during hemodialysis is an important point that must be a concern. The occurrence of hypotension and intradialytic hypertension can have an impact on reducing the adequacy of dialysis, decreasing kidney function, and can even affect the patient's quality of life. Among the non-pharmacological interventions that are considered safe and effective in the management of intradialytic blood pressure control are intradialytic exercises, one of which is range of motion exercises for the extremities. To determine the effect of extremity joint range of motion exercises on intradialytic blood pressure control in hemodialysis patients. This research used a quasi-experimental pre-test and post-test control group design using cluster sampling with a purposive sampling technique with a sample size of 46 respondents (23 intervention and 23 control group respondents) with Wilcoxon test data analysis. in the intervention group the average systolic blood pressure before and after intradialytic exercise was -6.42mmHg, the diastolic blood pressure difference was -2.38mmHg with p value of systolic and diastolic blood pressure p=<0.05, In the control group systolic blood pressure p= 0.024 with a difference of 2.4, independent t test results mean systolic blood pressure 2.88mmHg and diastolic blood pressure mean 1.12mmHg with p value both P>0.05. Extremity joint range of motion exercises can affect blood pressure in the intervention group.

Keywords: blood pressure; hemodialysis; intradialytic exercise; range of motion exercises for extremities

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INTRODUCTION

Apart from being able to save the patient's life, hemodialysis therapy can also cause acute and chronic complications. Conic complications include disorders of the cardiovascular, respiratory, skin, central nervous, musculoskeletal and vascular access systems. Patients undergoing hemodialysis can also experience complications during the hemodialysis session both at the beginning and/or during the hemodialysis session (Rayani, 2019). Changes in blood pressure are very important when performing hemodialysis, the incidence of hypotension as an intradialytic complication is the most common condition followed by hypertension (Ali, 2021). According to 2018 IRR data, cardiovascular disease is the largest comorbidity (15%) and the highest cause of death in hemodialysis patients. Meanwhile, intradialytic hypertension is still the most common complication, namely 38%, followed by hypotension, namely 14%, from 2016 to 2018 (PERNEFRI, 2018). Based on IRR data from Gunung Jati Cirebon Hospital, there were 140 hemodialysis patients, with intradialytic complications caused by cardiovascular causes with 60 cases of hypertension, and 30 patients with intradialytic hypotension, followed by 10 patients with cramps, 6 patients with chills, 3

patients with fever and chest pain and most CKD patients undergoing dialysis tend to become inactive which leads to decreased physical activity and fitness, which ultimately leads to a lower quality of life than the healthy population (Assawasaksakul et al., 2021).

Blood pressure and volume status are signs of dialysis, optimal blood pressure can affect the patient's quality of life and the health condition of hemodialysis patients. Efforts to control blood pressure in hemodialysis patients include limiting salt and fluids, limiting nutritional status, increasing compliance with dietary restrictions, and exercising diligently (Flythe & et al, 2020) . Normal blood pressure is if systole is <120 mmHg and diastole is 80 mmHg. Patients with essential hypertension who receive antihypertensive drug therapy have normal systolic blood pressure <135 mmHg and diastolic 85 mmHg, whereas in patients with CKD the systolic blood pressure is 125 mmHg and diastolic 75 mmHg and the blood pressure in patients undergoing hemodialysis is 130 mmHg systolic and diastole 85 mmHg (WorkgroupK/DOQI, 2005). Intradialytic exercises are light exercises to prevent the emergence of intradialytic hypotension in patients while undergoing hemodialysis and continue to carry out therapy in the supine position (Sakitri & et al, 2017).

Extremity joint range of motion exercises can provide a beneficial adaptation mechanism in the structure and function of blood vessels in impaired kidneys, renal failure is associated with endothelial damage and reduced biological capabilities as well as increased activity of the sympathetic and renin-angiotensin systems (Thompson et al., 2020) . The main effect of exercise is an increase in cardiac output and MAP in response to an increase in heart rate and left ventricular stroke volume thereby restoring cerebral and myocardial perfusion (Mcguire & et al, 2018). Extremity joint range of motion exercises not only provide increased cardiopulmonary capacity and resistance but also promote decreased fatigue, as well as increased muscle strength. Aerobic exercise provides improved aerobic function and other beneficial effects such as motor improvement, and supports muscle fiber development (Deus et al., 2019).

Extremity joint range of motion training can increase blood flow to the muscles, increase the area and surface of the capillaries, thereby increasing the transfer of urea and toxins from the tissue to the vasculature which is then transferred to the dialyzer (Sakitri & et al, 2017) . Fulfilling the oxygen needs of the tissues will relax so that the workload that affects the heart in hypertensive sufferers will be reduced causing blood pressure and pulse to decrease and be activated to meet the oxygen needs of the tissues. In addition, a relaxed condition will cause activity in the reticular activating system (RAS) to decrease so that the mechanism for releasing serum serotonin from cells is determined in the pons and central brain stem to last longer, so that sleep duration can be longer (Nursalam et al., 2020). Intradialytic exercise during the first or third hour did not worsen hemodynamic instability during treatment regardless of the patient's hydration status. During intradialytic exercise there is an increase in stroke volume, cardiac output, and heart rate, intradialytic changes in brachial and aortic blood pressure, cardiac hemodynamics, and autonomic function are similar on days with and without intradialytic exercise (J. Jeong et al., 2018) . Extremity joint range of motion exercises are carried out in the first 2 hours of hemodialysis to prevent cardiac decompensation during the 2 hours of the hemodialysis process and are carried out for 30-45 minutes after installation of vascular access (Jung & Park, 2011) . The aim of this study was to determine the effect of extremity joint range of motion training on controlling intradialytic blood pressure in hemodialysis patients.

METHOD

This research uses a quantitative research method with a quasi-experimental design, namely an equivalent pre-test and post-test with control group design by comparing the results of the intervention of two groups, namely the control group and the intervention group. Inclusion criteria in this study include: adult age (more than 18 years), patients with routine hemodialysis therapy twice a week. patient on similar anti-hypertensive drug therapy, patient underwent hemodialysis 8 times in a row, no femoral access was installed. The study exclusion criteria were as follows: patients at risk of complications: hypertension with blood pressure >180/105 mmHg, pulse 120/minute, heart failure grade 3 or 4, angina grade 24, history of myocardial ischemia in the last 6 months, uncontrolled diabetes mellitus with hypertension , autoimmune, have infection or inflammation, risk with musculoskeletal: renal bone, bone loss, and tendon rupture, experience drastic changes in hemodynamics, experience intradialytic complications during treatment. This research was carried out in the Hemodialysis room at Juanda Kuningan Hospital for 4 weeks from 30 August – 25 September, 8 times the extremity joint range of motion exercise intervention with a duration of 15 minutes in the first two hours during hemodialysis. The total number of respondents was 46 people, namely 23 respondents in the control group and 23 respondents in the intervention group from a population of 60 using a non-probability purposive sampling technique. The data collection tools used were stethoscopes, spignomanometers, questionnaires, blood pressure observation sheets, and SOPs for range of motion exercises for extremities. Data analysis used univariate and bivariate analysis with dependent t tests and independent tests.

RESULTS

Table 1.
Distribution of Respondents Based on Gender in the Intervention Group and Control Group (n=46)

Variable	Intervention		Control Group		Total	%
	f	%	f	%		
Gender						
Man	11	47.8	14	60.9	25	54.3
Woman	12	52.2	9	39.1	21	45.7
Consuming Hypertension Medication						
Yes	11	47.8	13	56.5	24	52.2
No	12	52.2	10	43.5	22	47.8

Table 2.
Frequency Distribution of Respondents Based on Length of Hemodialysis and Age in the Treatment Group and Control Group (n=46)

		Intervention Group	Group Control
Duration of HD (Months)	Mean	26	24
	Median	24	25
	Minimum	7	7
	Maximum	60	60
Age	Mean	44.69	46.04
	Median	47	48
	Minimum	18	16
	Maximum	62	63
IDWG	Mean	4.6	4.1
	Median	3.9	3,4
	Minimum	1.80	1.50
	Maximum	8.80	6.80

Table 3.
Differences in Blood Pressure Before and After Intervention Performing Extremity Joint Range of Motion Exercise Intervention in the Intervention Group (n=46)

	f	Mean	elementary school	Difference	P
Systole					
before intervention is carried out	23	145.02	10.82	-6.42	0,000
After intervention	23	151.44	9.70		
Diastole					
before intervention is carried out	23	85.14	4.69	-2.38	0.006
after intervention	23	87.52	2.92		

Table 4.
Differences in Blood Pressure Before and After in the Control Group (n=46)

	f	Mean	elementary school	Difference	P
Systole					
before intervention is carried out	23	150.9	7.99	2,4	0.024
after intervention	23	148.5	6.70		
Diastole					
before intervention is carried out	23	86.94	2.70	0.54	0.447
after intervention	23	86.40	2.44		

Table 5.
Effect of Extremity Joint Range of Motion Exercises on Blood Pressure Control (n=46)

		Group	f	Mean	elementary school	P
Post Systole	Intervention	Intervention Group	23	151.4	9.7	0.247
		Control Group	23	148.5	6,7	
Post Systole	Intervention	Intervention Group	23	87.5	2.9	0.165
		Control Group	23	86.4	2,4	

DISCUSSION

Gender

This is in accordance with the theory which explains that men lead unhealthy lifestyles such as consuming a lot of fast food, being busy and stressful, sitting all day in the office, often drinking coffee, energy drinks, rarely drinking water and smoking, poor habits. Both of these are risk factors for kidney damage (Dharma, 2015). Meanwhile, women pay more attention to their health by adopting a healthy lifestyle and regularly taking hypertension medication, confirmed by Gonzales' research that there is a relationship between gender and a decrease in GFR values in hypertension sufferers in Spain (Ilma et al., 2017) . This was also found in this study, male patients had a bad lifestyle such as smoking, staying up late, not consuming enough water, often drinking energy drinks when they had a lot of work, and women were more able to control their eating, take medication and sleep regularly. and drink lots of water.

Consuming Hypertension Medication

The use of hypertension medication requires consideration of indications, for example lowering blood pressure or heart protection. Non-pharmacological treatment must be considered first. The underlying volume excess in most cases of increased blood pressure in dialysis, if blood pressure remains above target after non-pharmacological measures directed at volume control, then hypertension medication. it is necessary, if blood pressure is well controlled and hypertension medication interferes with the UFR, to reduce the medication to allow for an increase in the UFR (flyhte, 2020). Blood pressure control has a beneficial effect on LVH in hemodialysis patients, pharmacological measures to treat hypertension with

blockers and nondihydropyridine calcium channel blockers, ACE inhibitors play an important role in treating hypertension by reducing systemic pressure which can cause regression of LVH and gradual improvement of diastolic function, heart disease coroner (Escoli et al., 2019)

Hypertension drugs being considered include angiotensin converting enzyme/angiotensin receptor blockers, and calcium channel blockers, for relatively stable intradialytic blood pressure using longer acting drugs, once a day can increase compliance and reduce burden, administration time is individualized taking into account interdialytic blood pressure and frequency of intradialytic hypotension (Flyhte, 2020). The research assumption of patients undergoing hemodialysis focuses on avoiding blood pressure that is too high or too low by considering blood pressure during intradialytic and interdialytic and post-dialysis with pharmacological management of hypertension medication. Hypertension medication as the first line of angiotensin-converting enzyme inhibitors/angiotensin receptor blockers to lower blood pressure (Flythe & et al, 2020) .

Long time undergoing hemodialysis

Wahyuni et al, (2019) research showed that the average person undergoing hemodialysis was 21 months and the highest was 96 months (8 years) which could be categorized as undergoing long-term hemodialysis. Hemodialysis can help kidney function in maintaining the body's hemostasis, prolonged hemodialysis treatment will result in the emergence of various complications and have a stressful impact on the patient so that the patient will not be productive and the level of patient compliance will decrease, thereby further decreasing the patient's quality of life (Dejvorakul & et al, 2019). Elements of the quality of life of chronic kidney failure patients undergoing hemodialysis therapy are divided into four elements, namely physical health experienced by the patient, mental health elements experienced by kidney failure sufferers, problems or complications in kidney failure sufferers and patient satisfaction in undergoing hemodialysis (Iswara & Muf seenin, 2021) . Complications often occur in respondents who have undergone hemodialysis therapy for more than one year, the endothelial cells experience dysfunction and over a long period of time will cause apoptosis which ultimately disintegrates the structure and function of the endothelium (Noorkhayati & Daryani, 2016) .

Blood pressure variability may be caused by disorders endothelial function, increased inflammation, increased stress on blood vessel walls, impaired baroreceptor function, and increased activity of the sympathetic nervous system, changes in solution dialysis and osmotic pressure can cause pressure fluctuations blood. blood vessel stiffness, decreased cardiac output, and generalized dysautonomia and new hormonal imbalances and can amplifying these fluctuations thereby creating change hemodynamics easier (Yu et al., 2021) .

Age

At the age of more than 55 years, the arteries lose their flexibility and become stiff, blood with each heart beat is forced through narrow blood vessels and causes an increase in blood pressure (Cahyo et al., 2021) . In hypertensive patients with chronic renal failure, hypertensive changes in the kidneys occur with a slightly different mechanism, decreased autoregulation of the afferent arterioles which causes hyperfiltration and the response of the afferent arterioles to vascular changes. When hyperfiltration continues, further damage and worsening of hypertension occurs, both at the systemic level and the glomerular level, which in the long term results in glomerulosclerosis and atrophy to necrosis (Charles & Ferris, 2020)

Older aged patients with intradialytic systolic blood pressure variations of 30 mmHg, had higher ultrafiltration rates, greater inter-dialytic weight gain, and less renal function than patients with intradialytic systolic blood pressure variations <15 mmHg (Yu et al. al., 2021) .

IDWG

Research by Abdiansyah et al., (2017) stated that high IDWG > 3% has a 3 times risk of experiencing hypertension predialysis blood pressure so that controlling interdialysis weight gain can be done to control blood pressure in hemodialysis patients.In line with research (Lestari & Saraswati, 2020) hemodialysis patients experience weight gain of 2-<4%. Patient compliance with fluid input determines the achievement of optimal dry body weight, in addition to factors that can increase IDWG such as hemodialysis adequacy, duration of hemodialysis, hemodialysis flow rate and dialysate fluid used (Smeltzer et al, 2012) . The IDWG that can be tolerated by the body is no more than 3% of dry weight (Bayhakki & Hasneli, 2018) Excess predialysis volume is the sum of IDWG and excess post-dialysis residual volume, an increase in the percentage of IDWG is associated with an increase in predialysis blood pressure and a change in blood pressure with hemodialysis, and an increase in IDWG over a long interdialytic period is associated with a small effect on blood pressure control (Yu & et al, 2021) .

High IDWG requires greater fluid removal, and high ultrafiltration can influence hemodynamic instability with compensatory mechanisms in response to fluid accumulation in dialysis patients, dominant extravascular volume expansion, vaso-relaxation due to suppression of the renin-angiotensin system and neurohumoral responses, long-term effects length of volume expansion in the heart, and diastolic dysfunction occurs causing changes in blood pressure. Non-pharmacological strategies for hypertension in hemodialysis patients are sodium restriction and dry body weight management, these are the first strategies. According to research (Sakai et al., 2017) patients controlled blood pressure without the use of antihypertensive drugs by strictly limiting salt and water intake, the subjects' average IDWG increased, and repeated seasonal variations occurred, however, the average IDWG gradually decreased after the intervention by a nutritionist. Excessive IDWG in patients can cause problems including worsening hypertension, pulmonary edema which can increase the occurrence of hemodialysis emergencies, increasing the risk of ventricular hypertrophic dilatation and heart failure (Smeltzer et al, 2012) .

Furthermore, appropriate dialysis prescription has a direct impact on IDWG. These include adequate UFR, sodium profile and dialysis time. The use of oral diuretics may be beneficial in regular hemodialysis patients with residual urine output. High-dose loop diuretics are often required, high UFR levels have been associated with increased mortality, and that limiting UFR levels is a way to improve clinical outcomes and determining UFR level limits may increase the risk of undesirable consequences, including complications associated with long-term volume overload such as increased blood pressure and heart failure (Maimani et al., 2021)

Post-dialysis weight loss slowly and gradually until the patient reaches the ideal dry body weight with minimal signs of either hypervolemia or hypovolemia is the standard volume management tool for hemodialysis hypertensive patients, the average post-dialysis weight loss is 0.9 kg over 4 weeks can reduce interdialytic blood pressure by 6.9/3.1 mmHg (Georgianos & Agarwal, 2018) .

Differences in Blood Pressure Before and After the Extremity Joint Range of Motion Exercise Intervention in the Intervention Group

This study shows that extremity range of motion exercises performed during hemodialysis in the intervention group can significantly control intradialytic blood pressure. The average systolic blood pressure in the intervention group increased from before the intervention, namely 145.02 mmHg and after the intervention it became 151.44 mmHg with a p value = 0.000. Meanwhile, the average diastolic blood pressure in the intervention group increased from before the intervention, namely 85 .14 mmHg and after intervention it became 87.52 mmHg with a p value = 0.006. This is in line with research by Rhee (2019), the group with intradialytic hypertension and the intradialytic hypotension group showed a decrease in blood pressure during exercise compared to blood pressure before exercise. The degree of reduction in blood pressure after dialysis was reduced when exercise was carried out for several months.

Factors that change blood pressure are left ventricular stroke volume, blood flow velocity, and arterial resistance. The greater the stroke volume, the greater the volume of blood accommodated in the arteries with each contraction, resulting in increased pulse pressure, but this is inversely proportional to the ability of the blood vessels to stretch. in the arterial system due to aging, a decrease in the stretching ability of the arteries (Dary Gunawan, 2017). The increase in blood vessel volume during physical exercise causes the heart to fill more with blood, the ventricles become more flexible, so that more blood can be ejected with each beat (Syarli, et al, 2018). Blood pressure increases in normal people, but prevention of intradialytic hypotension after exercise is useful in reducing mortality and is associated with a positive effect on blood pressure control. Chronic renal failure patients with intradialytic hypotension have inadequate sympathetic activity of the cardiovascular system and impaired left ventricular systolic function. during treadmill exercise compared with patients without intradialytic hypotension. Although the increase in blood pressure was lower, the blood pressure of intradialytic hypotensive patients increased after starting exercise compared to blood pressure before exercise. During exercise, peripheral vasodilation occurs to meet the metabolic needs of skeletal muscle, at the same time integrated local signals from baroreflex, chemoreflex and skeletal muscle receptors help increase sympathetic outflow in the heart, adrenal glands and help maintain or increase systemic blood pressure levels (JH Jeong et al., 2018) .

Differences in Blood Pressure Before and After in the Control Group

The results of this study in the control group, namely respondents carrying out normal activities during hemodialysis, showed that the average systolic blood pressure in the control group decreased from before the intervention, namely 150.87 mmHg and after the intervention to 148.55 mmHg with a p value = 0.000. Meanwhile, the average diastolic blood pressure in the intervention group did not appear to increase or decrease from before the intervention, namely 86.94 mmHg and after the intervention it became 86.40 mmHg with a p value = 0.447. This is in line with research (Cheng et al., 2020) where there was no significant change in diastole in the control group with a p value = 0.117. Cardiovascular disease is associated with worse short- and long-term survival outcomes in patients with chronic renal failure and lowering blood pressure may reduce cardiovascular risk, but changes in blood pressure were not significant due to low to moderate exercise intensity as assessed using the Borg score and Short duration and low to moderate intensity exercise training is not enough to reduce blood pressure (Cheng et al., 2020). Blood pressure during hemodialysis changes due to high potassium levels and low sodium levels which can reduce blood pressure (Nuari & Widayati, 2017) .The mechanism of changes in blood pressure can be influenced by behavioral, emotional and cardiovascular physiological factors, while arterial stiffness

contributes to short and long term blood pressure, the above risk factors cause patients to experience poor blood volume fluctuations during dialysis, but diastolic blood pressure is not a predictor of cardiovascular death (Zhao et al., 2021) The predialysis blood pressure target is 90 mmHg and post diastolic 80 mmHg (Rocco et al., 2015) . The blood pressure of dialysis patients varies from pre-dialysis to post-dialysis and from day 1 to the next (Georgianos & Agarwal, 2017) . Diastolic blood pressure targets have not been studied more in several studies, diastolic blood pressure measurements are more targeted at home blood pressure which is targeted at <80 mmHg, but there is a link between low diastolic blood pressure and kidney disease, so reducing diastolic blood pressure assisted by medication to <60 mmHg must be avoided due to its association with underlying arterial stiffness and aortic compliance (Turney & Peixoto, 2017) .In the general population, systolic blood pressure continues to increase throughout life, while diastolic blood pressure increases with age as it decreases (Rootjes et al., 2020) .

The Effect of Extremity Joint Range of Motion Exercises on Blood Pressure Control

Independent t test produced a probability value of >0.05 for post-intervention systolic and diastolic blood pressure in the intervention group and control group, so it can be concluded that there was no significant influence between pre-test systolic and post-test systolic blood pressure in the intervention group. The systolic blood pressure value was p. = 0.247 and the diastolic blood pressure value is p = 0.165, meaning that extremity joint range of motion training has no effect on intradialytic blood pressure control in hemodialysis patients. This is in line with research by Lo et al., (2018) where 6 respondents did not experience changes in systolic blood pressure and 10 respondents did not experience changes in diastole. Blood pressure is influenced by various factors such as food consumption or diet, lifestyle, smoking and alcohol consumption habits. As a result, blood pressure in these respondents was in the same range even though the range of motion of the extremity joints was given (Nursalam et al., 2020) . This can also be influenced by the main disease, diet structure, compliance with interventions and use of lipid-lowering drugs (Zhang et al., 2019) .

Extremity joint range of motion training results in increased blood flow to peripheral tissues, increasing muscle perfusion and opening the capillary surface area, so that toxins move through the dialyzer with greater flow from the tissue to the vascular compartment (Rhee, 2019) In the study of Zhang et al., (2019) this increase in diastolic blood pressure did not depend on the duration of exercise intervention, diastolic blood pressure decreased by 3.23 mmHg in patients who exercised for less than 6 months, and those who exercised for 6-12 months 2 .82 mmHg and this is not related to the administration of hypertension medication. Long-term exercise therapy for 6-12 months is not associated with antihypertensive effects with worsening renal insufficiency and renal dysfunction leading to adaptation to exercise (Zhang et al., 2019) . Exercise is beneficial and has a significant impact on systolic blood pressure if exercise is carried out for 12-16 weeks or 24-26 weeks, but not from exercise for 48-52 weeks (Thompson et al., 2020) According to Heiwe, regular exercise has significant beneficial effects on walking ability, blood pressure and heart rate in adult hemodialysis patients (Zhang et al., 2019) . However, according to Vanden, exercise has no effect on the blood pressure of hemodialysis patients because it is limited to patients with stage 3-4 chronic kidney disease who often have high triglycerides and low high density lipoprotein (HDL) levels which can worsen the development of kidney disease (Thompson et al., 2020) .. Exercise therapy for less than 3 months significantly reduces triglycerides but has no effect on cholesterol, HDL, low density lipoprotein (LDL) (Zhang et al., 2019)

Blood pressure response after exercise range of motion of the extremity joints is recovery from exercise, recovery of the cardiovascular system after exercise is a dynamic period during which many physiological changes occur, although exercise is a critical stress that induces beneficial cardiovascular adaptations associated with routine activity during the recovery period, long-term adaptation length of exercise training is as important as the exercise stimulus with the main result being a reduction in arterial pressure for example cardiac output can be reduced to heart rate and stroke volume and venous return can be considered as a determinant of stroke volume (Romero et al., 2017) Extremity joint range of motion training with a certain intensity is a planned and repetitive activity carried out during dialysis to improve or maintain physical function, and is a supplement to hypertension medication and lifestyle interventions (Zhu et al., 2022)

In the literature, there are several mechanisms that play a role in the process of increasing blood pressure during dialysis, namely excess extracellular volume, vasoconstriction of blood vessels, and dialysate sodium ions. Patients with intradialytic hypertension have been found to have more chronic volume overload compared with other hemodialysis patients, although there is no role for this. causality has been established. patients with intradialytic hypertension have a spike in intradialytic vascular resistance that may explain the increase in blood pressure during dialysis; acute intradialytic changes in endothelial cell function have been proposed as the etiology of increased vascular resistance, although it is unclear whether endothelin-1 or some other vasoconstrictive peptide is responsible. In addition to checking the dry weight of patients with intradialytic hypertension, other management strategies include lowering dialysate sodium and changing antihypertensives to include carvedilol or other poor dialysis antihypertensives (Buren & Inrig, 2016) .

In excess volume increases arterial distension and consequently increases arterial stiffness, but with a decrease in blood volume due to ultrafiltration, the renin angiotensin aldosterone system is activated and angiotensin II levels increase, resulting in vasoconstriction and arterial stiffness, hemodialysis not only creates significant volume fluctuations but also changes the levels of some active vaso molecules such as endothelin, nitric oxide and angiotensin II (JH Jeong et al., 2018) Intradialytic exercise may reduce sympathetic activation of vascular smooth muscle cells and may be a possible mechanism for decreasing arterial shiftness. The carryover effect of exercise on carotid-femoral pulse wave velocity 4 months post-exercise suggests structural improvements exercise may impact collagen concentration, or cross-linking. structural proteins by advanced glycation end products in the arterial wall, both of which are contributors to arterial shiftness (Cooke et al., 2018) .

CONCLUSION

There is an effect of range of motion exercises for extremity joints on controlling intradialytic systolic and diastolic blood pressure in hemodialysis patients.

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