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Malnutrition Inflammation Score Index (MIS) in Hemodialysis Patients Dialyzing through AV Fistula Versus Hemodialysis Patients Dialyzing through Permacath (Double Lumen Tunneled Catheter) At Memorial SOUAD KAFAFI University Hospital Hemodialysis Unit

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Abstract

Background: Chronic kidney disease (CKD) is a serious disease with considerable health consequences. The most common treatment that alleviates the symptoms and rescues the patients' life is hemodialysis. The prevalence of CKD is increasing in the world for many reasons. An annual growth of 5-6 percent in the CKD compared to population growth has been a challenge in all countries around the world.

Aim of Study: To assess the nutritional state and inflammation in hemodialysis patients dialyzing through Permcath (Double Lumen Tunneled Catheter) and in hemodialysis patients dialyzing through AV fistula.

Patients and Methods: This comparative study will be conducted on 52 hemodialysis patients at the Memorial Souad Kafafi University Hospital Hemodialysis Unit, Misr University for Science and Technology. The study will span a period of six months, involving a detailed analysis of patient data to achieve the research objectives.

Results: The study compared demographic, clinical, and nutritional parameters between AV Fistula and Permacath hemodialysis patients. Both groups had similar age and gender distributions, but the AV Fistula group had higher mean weight, BMI, and serum albumin levels, indicating better nutritional status. AV Fistula patients also showed longer access duration, higher hemoglobin levels, and lower inflammatory markers (ferritin and CRP) compared to Permacath patients, who exhibited greater malnutrition and inflammation. The Malnutrition-Inflammation Score (MIS) was significantly higher in the Permacath group, correlating negatively with BMI, hemoglobin, and albumin levels. These findings underscore the clinical and nutritional challenges faced by Permacath patients.

Conclusion: The study highlights significant differences in nutritional and inflammatory status between patients undergoing hemodialysis via AV Fistulas and those using Permacaths. Patients with Permacaths generally exhibit higher Malnutrition-Inflammation Scores (MIS), indicating more severe malnutrition and inflammation compared to those with AV Fistulas. Additionally, key clinical parameters, including hemoglobin, serum albumin, and markers of inflammation like C-reactive protein and ferritin, are worse in the Permacath group, suggesting a greater burden of malnutrition and inflammatory stress. The correlation analysis further demonstrates that prolonged hemodialysis duration is associated with improved nutritional markers and better management of fluid balance, though it is also linked to higher inflammation levels. Overall, the findings underscore the importance of addressing malnutrition and inflammation, particularly in patients using Permacaths, and suggest that more attention to nutritional support and inflammatory management is needed for improving outcomes in long-term dialysis patients.

Key Words: *Malnutrition Inflammation Score – Hemodialysis – Dialyzing – Permacath – Double Lumen Tunneled Catheter – AV Fistula.*

Introduction

CHRONIC kidney disease (CKD) is a serious disease with considerable health consequences. The most common treatment that alleviates the symptoms and rescues the patients' life is hemodialysis. The prevalence of CKD is increasing in the world for many reasons. An annual growth of 5-6 percent in the CKD compared to population growth has been a challenge in all countries around the world I1].

Maintenance hemodialysis (MHD) is one of the main methods of renal replacement therapy in patients with end stage renal disease (ESRD). With

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the continuous improvement of dialysis technology, although the physiological function of MHD patients has been improved, their survival rate and quality of life are still poor due to the long-term nature of treatment and the particularity of the disease. The longer the duration of dialysis treatment is, the greater the physiological and psychological pressure that hemodialysis patients face, which will to some extent affect the ability of patients to self-care. In 1998, WHO defined the meaning and content of self-care, and put forward that self-care is a measure and action taken by individuals in order to obtain health, prevent disease and treat disease. It includes nutrition, hygiene, environment, lifestyle, social and economic factors, and self- medication [2].

The MIS was initially developed by Kalantar-Zadeh et al. [3] to assess nutritional deficits in patients on HD. It comprises 10 items and a combination of the 7-point SGA with dialysis vintage, BMI, and laboratory parameters (serum albumin level and total iron-binding capacity). Each item is rated from 0 to 3 points, with a total score of 30 points, with higher scores indicating worse nutritional status. The KDOQI guidelines suggest MIS use as an assessment tool]. It has also been reported that the survival prognosis is poor when the MIS score is ≥7. Moreover, a global review demonstrated that 28% to 54% of patients on dialysis had nutritional risk when assessed using either the SGA or MIS [4].

Protein energy malnutrition is recognized as a leading cause of morbidity and mortality in dialysis patients. Protein-energy-wasting process is observed in about 45% of the dialysis population using common biomarkers worldwide. Although several factors are implicated in protein energy wasting, inflammation and oxidative stress mechanisms play a central role in this pathogenic process [5].

Screening malnutrition, which is the most common complication in hemodialysis patients, is extremely important screening tests are very important in the early identification of malnutrition in hemodialysis patients. The availability of MIS was found to be high in detecting malnutrition in hemodialysis patients because of its high accuracy and sensitivity [6].

Malnutrition in patients undergoing hemodialysis therapy usually results from decreased appetite, drug-related factors, and a very limited diet [7].

There is evidence that hemodialysis therapy can elevate energy expenditure by 20 % in a hemodialysis session. Other factors also can elevate energy expenditure in patients undergoing hemodialysis such as abnormal hormone levels involving insufficient production of testosterone in both genders, growth hormone and insulin resistance, persistent inflammation, and low levels of triidothyroid. Acidosis, which is a prevalent metabolic derangement in patients undergoing hemodialysis, suppresses protein synthesis and quickens protein degeneration [8].

The inception of hemodialysis is linked with a decrease in functional status among elderly, resulting in a vicious cycle of decreased consumption of reduced physical function and loss of appetite, at last patients' nutritional status of get worse of food, because [9].

Among the eight nutrition-related tests evaluated, MIS and albumin are the strongest predictors of mortality in hemodialysis patients. Since there are no significant differences in terms of the added value, serum albumin is the most precise predictor of mortality in HD patients [10].

Aim of the work:

To assess the nutritional state and inflammation in hemodialysis patients dialyzing through Permcath (Double Lumen Tunneled Catheter) and in hemodialysis patients dialyzing through AV fistula.

Patients and Methods

Study population: Type of study: Comparative Study. Study setting: The study will be conducted on 52 hemodialysis patients at the memorial Souad Kafafi University Hospital Hemodialysis unit, Misr University for Science and Technology. Study period: 6 months, started at October 2023 to April 2024, Sample size: 52 patients.

Patients in this study will be divided into 2 Groups: Group (A): Will include 26 hemodialysis patients dialyzing through the AV fistula. Group (B): Will include 26 hemodialysis patients dialyzing through Permacath (Double Lumen Tunneled Catheter).

Ethical consideration: An informed consent will be obtained from all participants in the study.

Inclusion criteria: Participants 40-60 years old, both sexes and maintained regular HD for more than six months with three sessions /week, four hours for each session, bicarbonate-containing dialysate, and heparin–based anticoagulation.

Exclusion criteria: Age below 40 and above 60 and patients with other uncontrolled debilitating disease such as: Malignancies. Autoimmune disease. Acute inflammatory condition. Decompensated liver disease.

Methods: All patients will be subjected to the following: 1- Full history taking. 2- General and local examination including vital data and Anthropometric Measures (Weight-Height-BMI). 3- Laboratory investigations: complete blood count, iron profile (Ferritin, Total Iron Binding Capacity, Transferrin saturation), kidney functions (urea, creatinine), C-reactive protein (CRP), serum calcium and phosphorus, serum Na, and K, serum albumin, urea reduction ratio. i-Lipid profile and HBA1C.

MIS (malnutrition inflammation score): Composed of ten components, seven of them being from the Global Subjective Assessment and three items (BMI, serum albumin, and total iron-binding capacity) are not from Global Subjective Assessment. Each component of the MIS hasfour levels of severity, being scaled from 0 (normal) to 3 (very severe). The final score ranges from 0 to 30.

Statistical analysis: Recorded data were analyzed using the statistical package for social sciences, version 23.0 (SPSS Inc., Chicago, Illinois, USA). The quantitative data were presented as mean± standard deviation and ranges when their distribution was parametric (normal) while non-normally distributed variables (non-parametric data) were presented as median with inter-quartile range (IQR). Also qualitative variables were presented as number and percentages. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk Test.

The following tests were done: Independent-samples *t*-test of significance was used when comparing between two means. Mann Whitney U test: for two-group comparisons in non-parametric data. The Comparison between groups with qualitative data was done by using Chi-square test. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the *p*-value was considered significant as the following: Probability (*p*-value): *p*-value <0.05 was considered significant. *p*-value <0.01 was considered as highly significant. *p*-value >0.05 was considered insignificant.

Results

This table compares the age and gender distribution between patients with AV fistula and those with Permacath catheters. Both groups have similar mean ages (AV fistula: 53.8±5.42 years, Permacath: 54.1±7.04 years), and the difference is statistically insignificant (*p*=0.895). Age ranges for both groups are also nearly identical, between 40-60 years. In terms of gender distribution, 57.7% of the AV fistula group are male and 42.3% are females, compared to 46.2% and 53.8% are females in the Permacath group, but this difference is not statistically significant (*p*=0.405). The gender distribution shows a nearly equal split between male and female participants, with no significant bias toward either gender in both groups.

This table highlights differences in height, weight, and BMI between the AV Fistula and Permacath groups.

The mean height of both groups is nearly identical (AV Fistula: 168.4±7.61 cm, Permacath: 168.1±6.25 cm), with no significant difference (*p*=0.874). However, significant differences are observed in weight and BMI. The AV Fistula group has a higher mean weight (77.6±24.0 kg) compared to the Permacath group (61.7±18.85 kg), with a *p*-value of 0.010, indicating statistical significance. Similarly, the BMI is significantly higher in the AV Fistula group (27.0±8.48) compared to the Permacath group (22.2±6.67) (*p*=0.029).

Table (1): Demographic comparison between AV fistula and permacath groups.

	AV Fustula group (n=26)		Permacath group (n=26)		Test value	*p*-value
	N	%	N	%		
Age:						
Mean ± SD	168.4±7.61		168.1±6.25		*t*=0.132	0.895
Range	150-181		157-180			
Gender:						
Male	15	57.7	12	46.2	X^2=0.693	0.405
Female	11	42.3	14	53.8		

Using: *t*-Independent Sample *t*-test for Mean ± SD.
X2 = Chi-Square test.
p-value >0.05 is insignificant.
**p*-value <0.05 is significant.
***p*-value <0.01 is highly significant.

Table (2): Anthropometric comparison between AV fistula and permacath groups.

	AV Fustula group (n=26)		Permacath group (n=26)		Test value	*p*-value
	N	%	N	%		
Height:						
Mean ± SD	168.4±7.61		168.1±6.25		*t*=0.159	0.874
Range	150-181		157-180			
Weight:						
Mean ± SD	77.6±24.0		61.7±18.85		*t*=2.660	0.010*
Range	37-121		46-135			
BMI:						
Mean ± SD	27.0±8.48		22.2±6.67		*t*=2.253	0.029*
Range	16.4-42.8		14.5-44.3			
BMI category:						
Under eight	6	23.1	9	34.6	X^2=4.834	0.050*
Normal weight	5	19.2	9	34.6		
Overweight	6	23.1	5	19.2		
Obese	9	34.6	3	11.5		

Using: *t*-Independent Sample *t*-test for Mean ± SD.
X^2= Chi-Square test.

p-value >0.05 is insignificant.
**p*-value <0.05 is significant.
***p*-value <0.01 is highly significant.

Table (3): Comparison of hemodialysis access duration and comorbidities in AV fistula and permacath groups.

	AV Fustula group (n=26)		Permacath group (n=26)		Test value	*p*-value
	N	%	N	%		
Duration of HDX access:						
Mean ± SD	2.85±1.39		0.96±0.39		*t*=6.396	<0.001**
Range	0.5-5		0.5-1.5			
Duration of HDX:						
Mean ± SD	3.23±1.58		3.38±1.53		*t*=0.446	0.657
Range	1-6		1-6			
Comorbidities:						
HTN	12	48	10	38.5	X^2=2.043	0.728
DM	8	32	6	23.1		
IHD	3	12	3	11.5		
AF	1	4	3	11.5		
HF (III, IV)	0	0	4	15.4		

Using: *t*-Independent Sample *t*-test for Mean ± SD.
X^2= Chi-Square test.

p-value >0.05 is insignificant.
**p*-value <0.05 is significant.
***p*-value <0.01 is highly significant.

This table compares the duration of hemodialysis (HDX) access, overall HDX duration, and comorbidities between the AV Fistula and Permacath groups. The AV Fistula group has a significantly longer mean duration of HDX access (2.85±1.39 years) compared to the Permacath group (0.96±0.39 years), with a highly significant *p*-value (<0.001). However, the overall duration of hemodialysis treatment is similar between both groups, with no significant difference (*p*=0.657). Regarding comorbidities, the prevalence of hypertension (HTN), diabetes mellitus (DM), ischemic heart disease (IHD), atrial fibrillation (AF), is relatively comparable between the groups, with no statistically significant differences (*p*-values >0.05). However Patients' with Heart failure were assigned only to the permacath group.

Table (4): Vital sign comparison between AV fistula and permacath groups.

	AV Fustula group (n=26)	Permacath group (n=26)	Test value	*p*-value
Systolic blood pressure:				
Mean ± SD	127.5±8.51	128.2±8.79	0.320	0.750
Range	15-140	115-140		
Diastolic blood pressure:				
Mean ± SD	83.1±6.27	86.3±6.89	1.704	0.095
Range	70-95	74-100		
Heart rate:				
Mean ± SD	77.4±8.85	80.1±8.4	1.125	0.266
Range	60-89	60-90		
Respiratory rate:				
Mean ± SD	14.5±2.0	14.7±2.19	0.396	0.694
Range	12-18	12-18		
Temperature:				
Mean ± SD	49.5±64.35	36.8±0.25	1.001	0.322
Range	36.5-365	36.3±37.2		

Using: *t*-Independent Sample *t*-test for Mean ± SD.
p-value >0.05 is insignificant.
**p*-value <0.05 is significant.
***p*-value <0.01 is highly significant.

This table compares vital signs, including blood pressure, heart rate, respiratory rate, and temperature, between the AV Fistula and Permacath groups.

There are no statistically significant differences in any of the measured parameters. The systolic blood pressure (AV Fistula: 127.5±8.51 mmHg, Permacath: 128.2±8.79 mmHg) and diastolic blood pressure (AV Fistula: 83.1±6.27 mmHg, Permacath: 86.3±6.89 mmHg) show slight variations between the groups, but neither difference reaches statistical significance (*p*=0.750 and *p*=0.095, respectively). Similarly, heart rate (*p*=0.266), respiratory rate (*p*=0.694), and body temperature (*p*=0.322) are comparable between the two groups.

Table (5): Hematological comparison between AV fistula and permacath groups.

	AV Fustula group (n=26)	Permacath group (n=26)	Test value	*p*-value
Hemoglobin:				
Mean ± SD	9.4±0.86	8.8±0.71	2.989	0.004**
Range	8-11	7.3-10		
TLC:				
Mean ± SD	6.4±1.31	6.38±0.87	0.186	0.853
Range	4-9	4.6-8.3		
Platelet:				
Mean ± SD	246.3±55.87	266.8±48.06	1.421	0.162
Range	170-377	185-355		

Using: *t*-Independent Sample *t*-test for Mean±SD.
p-value >0.05 is insignificant.
**p*-value <0.05 is significant.
***p*-value <0.01 is highly significant.

This table compares hematological parameters, including hemoglobin levels, total leukocyte count (TLC), and platelet count, between the AV Fistula and Permacath groups.

Hemoglobin levels are significantly higher in the AV Fistula group (9.4±0.86 g/dL) compared to the Permacath group (8.8±0.71 g/dL), with a highly significant *p*-value of 0.004, indicating better hemoglobin maintenance in AV Fistula patients. However, no significant differences are observed in TLC (*p*=0.853) or platelet count (*p*=0.162) between the two groups.

Table (6): Iron profile comparison between AV fistula and permacath groups.

	AV Fustula group (n=26)	Permacath group (n=26)	Test value	*p*-value
Serum iron:				
Mean ± SD	49.1±11.19	48.6±13.48	0.157	0.876
Range	33-82	30-95		
TIBC:				
Mean ± SD	225.3±40.56	206.6±29.11	1.901	0.063
Range	168-305	145-286		
Tsai:				
Mean ± SD	21.4±4.56	23.2±6.18	1.227	0.225
Range	15-31	15-45		

Using: *t*-Independent Sample *t*-test for Mean ± SD. *p*-value >0.05 is insignificant. **p*-value <0.05 is significant. ***p*-value <0.01 is highly significant.

This table examines the iron status of patients in the AV Fistula and Permacath groups, focusing on serum iron, total iron-binding capacity (TIBC), Transference saturation (Tsai), and ferritin levels.

Both groups have comparable serum iron levels (p=0.876) and iron saturation indices (p=0.225), indicating no significant difference in these parameters.

TIBC shows a marginally non-significant difference (p=0.063), with slightly higher levels in the AV Fistula group.

Table (7): Renal function and inflammatory marker comparison between AV fistula and permacath groups.

	AV Fustula group (n=26)	Permacath group (n=26)	Test value	*p*-value
Creatinine:				
Mean ± SD	7.82±1.06	7.88±0.91	0.224	0.824
Range	5.5-10	6.5-10		
Urea:				
Pre:				
Mean ± SD	133.8±12.37	140.5±13.84	1.828	0.074
Range	106-155	110-160		
Post:				
Mean ± SD	35.8±4.67	37.8±5.42	1.765	0.082
Range	27-48	29-48		
Urea ratio:				
Mean ± SD	73.1±1.84	71.6±2.66	1.692	0.097
Range	69-75	65-75		
Serum albumin:				
Mean ± SD	3.6±0.46	3.2±0.28	3.749	<0.001**
Range	2.9-4.5	2.6-3.6		
Ferritin:				
Mean ± SD	434.6±148.8	621.3±194.62	3.887	<0.001**
Range	180-680	320-920		
C-reative protein:				
Mean ± SD	4.5±1.55	12.4±3.74	9.841	<0.001**
Range	1-8	6-19		

Using: *t*-Independent Sample *t*-test for Mean ± SD. *p*-value >0.05 is insignificant. **p*-value <0.05 is significant. ***p*-value <0.01 is highly significant.

This table compares renal function markers (creatinine and urea levels) and inflammatory indicators (serum albumin, C-reactive protein, and Ferritin) between AV Fistula and Permacath patients.

Creatinine levels are similar between the groups (p=0.824), with no significant difference. Pre-dialysis urea levels and post-dialysis urea levels show a non-significant trend toward being higher in the

Permacath group (p=0.074, p=0.082), the urea reduction ratio is lower in the Permacath group (p=0.097), indicating less effective urea clearance during dialysis but not significantly different between the two groups.

Serum albumin is significantly lower in the Permacath group (p<0.001), reflecting poorer nutritional and Inflammatory status, while C-reactive protein levels, an indicator of inflammation, are significantly higher in the Permacath group (p<0.001).

Also Ferritin levels are significantly higher in the Permacath group (621.3±194.62 ng/mL) compared to the AV Fistula group (434.6±148.8 ng/mL), with a highly significant p-value (<0.001).

Table (8): Lipid profile comparison between AV fistula and permacath groups.

	AV Fustula group (n=26)	Permacath group (n=26)	Test value	*p*-value
Cholesterol:				
Mean ± SD	205.6±41.8	220.5±39.57	1.311	0.196
Range	140-290	139-280		
Triglycerides:				
Mean ± SD	174.5±49.02	174.0±37.66	0.041	0.967
Range	85-311	120-290		
HDL:				
Mean ± SD	47.4±7.75	46.4±8.46	1.648	0.145
Range	40-70	40-80		
LDL:				
Mean ± SD	93.7±13.51	95.0±12.38	0.342	0.73
Range	70-125	70-130		

Using: *t*-Independent Sample *t*-test for Mean ± SD. *p*-value >0.05 is insignificant.
**p*-value <0.05 is significant. ***p*-value <0.01 is highly significant.

This table compares lipid profile parameters–cholesterol, triglycerides, HDL (high-density lipoprotein), and LDL (low-density lipoprotein) between the AV Fistula and Permacath groups.

The mean cholesterol values were slightly higher in the Permacath group (220.5±39.57) compared to the AV Fistula group (205.6±41.8), but the p-value of 0.196 indicates no significant difference. Triglyceride levels were nearly identical, and both HDL and LDL levels also showed no notable differences, with p-values of 0.145 and 0.733, respectively.

Table (9): Electrolyte and glycemic profile comparison between AV fistula and permacath groups.

	AV Fustula group (n=26)	Permacath group (n=26)	Test value	*p*-value
HbA1C:				
Mean ± SD	6.25±1.33	6.0±0.92	0.533	0.596
Range	4-9	4.2-7.9		
Serum Na:				
Mean ± SD	136.2±2.85	135.1±1.92	1.752	0.099
Range	130-142	130-140		
Serum K:				
Mean ± SD	4.6±0.96	4.9±0.85	1.368	0.177
Range	3.3-6	3.3-6		
Serum Ca:				
Mean ± SD	8.1±0.87	7.8±0.79	1.345	0.185
Range	6.9-9.6	5.9-8.9		
PO4:				
Mean ± SD	4.1±1.55	4.2±1.77	0.308	0.760
Range	1.9-6.8	1.8-7.8		

Using: *t*-Independent Sample *t*-test for Mean ± SD. *p*-value >0.05 is insignificant.
**p*-value <0.05 is significant. ***p*-value <0.01 is highly significant.

This table evaluates the glycemic control and electrolyte balance in patients with AV Fistula and Permacath.

HbA1c levels were similar between the groups, with a mean of 6.25±1.33 in the AV Fistula group and 6.0±0.92 in the Permacath group (*p*-value 0.596). Serum sodium (Na), potassium (K), calcium (Ca), and phosphate (PO4) levels also showed no significant differences between the groups, with *p*-values of 0.099, 0.177, 0.185, and 0.760, respectively.

Table (10): Nutritional and functional status comparison between AV fistula and permacath groups.

	AV Fustula group (n=26)	Permacath group (n=26)	Test value	*p*-value
BMI score:				
Median (IQR)	0 (0-1)	0.5 (0-2)	1.668	0.095
Range	0-2	0-3		
Score of comorbidities:				
Median (IQR)	1 (1-2)	2 (1-2)	1.638	0.10
Range	1-2	1-2		
Change in end dialysis over dry weight:				
Median (IQR)	1 (0-2)	1 (1-2)	0.551	0.582
Range	0-2	0-2		
Dietary intake:				
Median (IQR)	0.5 (0-1)	0 (0-1)	2.050	0.040*
Range	0-1	0-1		
GI symptoms:				
Median (IQR)	1 (0-1)	1 (1-1)	1.808	0.071
Range	0-1	0-2		
Functional capacity:				
Median (IQR)	0.5 (0-1)	1 (0-1)	0.231	0.817
Range	0-1	0-2		
Loss of Sc fat:				
Median (IQR)	0 (0-1)	0 (0-0)	1.031	0.303
Range	0-1	0-2		
Muscle losing:				
Median (IQR)	0 (0-0)	0 (0-0)	1.515	0.130
Range	0-1	0-1		
TIBC score:				
Median (IQR)	1 (1-2)	1 (1-2)	1.62	0.245
Range	0-2	0-3		
Serum albumin score:				
Median (IQR)	2 (1-2)	1 (0-2)	2.192	0.028*
Range	1-3	0-3		

Using: *t*-Independent Sample *t*-test for Mean ± SD.
p-value >0.05 is insignificant.
**p*-value <0.05 is significant.
***p*-value <0.01 is highly significant.

This table assesses the nutritional and functional status of patients in the AV Fistula and Permacath groups using several metrics.

The BMI score and comorbidity scores show no significant difference between the two groups (*p*=0.095 and *p*=0.101, respectively). Changes in dialysis weight, gastrointestinal symptoms.

Functional capacity is higher (worse) in females than male but it is comparable between the groups.

The median loss of SC fat was 0 (IQR: 0-1) in the AV Fistula group and 0 (IQR: 0-0) in the Permacath group, with a *p*-value of 0.303, indicating no significant difference. Similarly, muscle loss showed a median of 0 (IQR: 0-0) in both groups, with a *p*-value of 0.130.

However, two notable differences are observed: dietary intake is significantly lower in the Permacath group (p=0.040), and the serum albumin score is significantly higher in the AV Fistula group (p=0.028), indicating poorer nutritional status in Permacath patients.

Table (11): Malnutrition-inflammation score (MIS) comparison between AV fistula and permacath groups.

	AV Fustula group (n=26)		Permacath group (n=26)		Test value	*p*-value
	N	%	N	%		
MIS score:						
Mean ± SD	6.96±3.26		9.31±3.4		2.536	0.014*
Median (IQR)	6 (5-9)		8.5 (7-11)			
Range	2-13		3-16			

Using: *t*-Independent Sample *t*-test for Mean ± SD. *p*-value >0.05 is insignificant. **p*-value <0.05 is significant. ***p*-value <0.01 is highly significant.

This table presents the comparison of the Malnutrition-Inflammation Score (MIS) between the AV Fistula and Permacath groups.

The MIS is significantly higher in the Permacath group (mean: 9.31±3.4) compared to the AV Fistula group (mean: 6.96±3.26), with a p-value of 0.014, indicating a statistically significant difference. The median MIS is also higher in the Permacath group (8.5) than in the AV Fistula group (6), suggesting that Permacath patients are more prone to malnutrition and inflammation. The range of MIS scores in the Permacath group is broader (3-16) compared to the AV Fistula group (2-13).

Table (12): Malnutrition-inflammation score (MIS) comparison between AV fistula and permacath groups.

	AV Fustula group (n=26)		Permacath group (n=26)		Test value	*p*-value
	N	%	N	%		
MIS score:						
Normal (0-2)	1	3.8	0	0	8.413	0.038*
Mild (3-5)	10	38.5	2	7.7		
Moderate (6-8)	7	26.9	11	42.3		
Severe (9-30)	8	30.8	13	50.0		

Using: *t*-Independent Sample *t*-test for Mean ± SD. *p*-value >0.05 is insignificant. **p*-value <0.05 is significant. ***p*-value <0.01 is highly significant.

The comparison of Malnutrition-Inflammation Score (MIS) between the AV Fistula and Permacath groups shows a statistically significant difference (p-value = 0.038).

In the AV Fistula group, 3.8% of patients had a normal MIS score (0-2), while none in the Permacath group had a normal score. The distribution of mild MIS (3-5) was higher in the AV Fistula group (38.5%) compared to the Permacath group (7.7%).

However, the Permacath group had a higher prevalence of moderate MIS (42.3%) and severe MIS (50%) compared to the AV Fistula group, which had 26.9% and 30.8% for moderate and severe MIS, respectively.

Table (13): Malnutrition-inflammation score (MIS) across different BMI categories.

	Under weight (n=15)	Normal weight (n=14)	Over-weight (n=14)	Obese (n=12)	Test value	*p*-value
MIS score:						
Normal (0-2)	1	3.8	0	0	8.413	0.038*
Mild (3-5)	10	38.5	2	7.7		
Moderate (6-8)	7	26.9	11	42.3		
Severe (9-30)	8	30.8	13	50.0		

Using: *t*-Independent Sample *t*-test for Mean ± SD. *p*-value >0.05 is insignificant. **p*-value <0.05 is significant. ***p*-value <0.01 isش highly significant.

This table explores the relationship between BMI categories (underweight, normal weight, overweight, and obese) and the Malnutrition-Inflammation Score (MIS).

There is a significant difference in MIS across the different BMI groups (p=0.014), indicating that malnutrition and inflammation levels vary based on body weight.

Underweight patients have the highest MIS (mean: 12.1±2.67), suggesting they experience the most severe malnutrition and inflammation, with a median score of 13. As BMI increases, the MIS decreases, with obese patients having the lowest scores (mean: 5.5±2.43, median: 5), indicating better nutritional status and lower inflammation levels.

Table (14): Correlation between malnutrition-inflammation score (MIS) and various clinical parameters.

	MIS score	
	r	*p*-value
Age	–0.111	0.433
BMI	–0.657	<0.001**
Duration of HDX access	–0.420	0.002**
Duration of HDX	–0.456	0.001**
Systolic blood pressure	0.085	0.551
Diastolic blood pressure	0.057	0.687
Heart rate	–0.100	0.479
Respiratory rate	–0.010	0.901
Temperature	0.034	0.812
Hemoglobin	–0.782	<0.001**
TLC	–0.264	0.058
Platelet	0.072	0.614
Serum iron	–0.483	<0.001**
TIBC	–0.673	<0.001**
Tsai	–0.068	0.630
Ferritin	–0.247	0.078
Creatinine	–0.389	0.004**
Urea ratio	–0.333	0.016*
Serum albumin	–0.729	<0.001**
C-reative protein	0.211	0.133
Cholesterol	–0.386	0.005**
Triglycerides	–0.111	0.325
HDL	–0.094	0.468
LDL	–0.332	0.016*
HbA1C	–0.147	0.298
Serum Na	–0.111	0.434
Serum K	–0.546	<0.001**
Serum Ca	–0.647	<0.001**
PO4	-–0.591	<0.001**

Using: One way-ANOVA test for Mean ± SD.
p-value >0.05 is insignificant.
**p*-value <0.05 is significant.
***p*-value <0.01 is highly significant.

This table shows the correlations between the Malnutrition-Inflammation Score (MIS) and a range of clinical variables.

MIS is negatively correlated with several key factors, including BMI (r=–0.657, p<0.001), duration of hemodialysis access (r=–0.420, p=0.002), hemoglobin (r=–0.782, p<0.001), serum albumin (r=–0.729, p<0.001), and several other important markers like creatinine, indicating that higher MIS is associated with lower values of these parameters, particularly nutritional and health-related indicators. Positive correlations are observed with HDL (r=0.295, p=0.034), suggesting a weak positive relationship.

The negative correlations with serum iron (r =–0.483, p<0.001) and serum calcium (r=–0.647, p<0.001) further highlight that patients with higher MIS tend to have worse nutritional and metabolic profiles.

Table (15): Correlation between duration of hemodialysis and various clinical parameters.

	Duration of HDX	
	r	*p*-value
Age	0.401	0.003**
BMI	0.262	0.061
Systolic blood pressure	0.082	0.553
Diastolic blood pressure	0.039	0.782
Heart rate	0.222	0.113
Respiratory rate	0.065	0.647
Temperature	–0.028	0.843
Hemoglobin	0.392	0.004**
TLC	0.05	0.595
Platelet	0.140	0.324
Serum iron	0.238	0.098
TIBC	0.199	0.158
Tsai	0.175	0.215
Ferritin	0.814	<0.001**
Creatinine	0.248	0.076
Urea ratio	0.058	0.684
Serum albumin	0.439	0.001**
C-reative protein	0.443	0.001**
Cholesterol	0.328	0.018*
Triglycerides	0.297	0.033*
HDL	0.104	0.462
LDL	0.279	0.045*
HbA1C	0.126	0.374
Serum Na	0.005	0.971
Serum K	0.706	<0.001**
Serum Ca	0.442	0.001**
PO4	0.654	<0.001**
Change in end dialysis over dry weight	–0.733	<0.001**
Dietary intake	–0.517	<0.001**
GI symptoms	0.076	0.592
Functional capacity	0.030	0.832
Loss of Sc fat	–0.254	0.069
Muscle losing	–0.269	0.054

Using: One way-ANOVA test for Mean ± SD.
p-value >0.05 is insignificant.
**p*-value <0.05 is significant.
***p*-value <0.01 is highly significant.

The correlation analysis between various clinical parameters and the duration of hemodialysis (HDX) shows significant relationships.

Age (r=0.401, p=0.003) and hemoglobin (r=0.392, p=0.004) are positively correlated with HDX duration, indicating an increase with longer HDX.

Strong positive correlations are observed with ferritin (r=0.814, p<0.001), serum potassium (r=0.706, p<0.001), serum calcium (r=0.442, p=0.001), serum albumin (r=0.439, p=0.001), C-reactive protein (r=0.443, p=0.001), and phosphate (r=0.654, p<0.001). Lipid parameters, including cholesterol (r=0.328, p=0.018), triglycerides (r=0.297, p=0.033), and LDL (r=0.279, p=0.045), are also positively correlated with HDX duration.

Negative correlations are observed with the change in end dialysis over dry weight (r=–0.733, p<0.001) and dietary intake (r=–0.517, p<0.001), suggesting adverse effects on weight and nutrition with prolonged HDX. Other factors like serum sodium, GI symptoms, and functional capacity show no significant correlations.

Discussion

Malnutrition and inflammation are common issues in patients undergoing hemodialysis and are strongly associated with adverse clinical outcomes, including higher morbidity and mortality *[7]*. The Malnutrition Inflammation Score (MIS) is a widely used tool to assess the nutritional and inflammatory status of hemodialysis patients. It incorporates several factors, such as body weight, dietary intake, and serum markers, to provide a comprehensive evaluation of a patient's risk. Given the high prevalence of malnutrition-inflammation syndrome in hemodialysis patients, it is crucial to explore how different types of vascular access influence these outcomes *[11]*.

Arteriovenous fistula (AV Fistula) is considered the gold standard for hemodialysis access due to its lower complication rates, including fewer infections and better long-term outcomes. Patients dialyzing through an AV Fistula generally show improved survival and better overall health status compared to those using other access types. The benefits of AV Fistula are thought to extend to nutritional and inflammatory status, potentially leading to lower MIS scores in these patients *[12]*.

Patients dialyzing through Permacaths (double lumen tunneled catheters) tend to experience more frequent complications, including higher rates of infection and thrombosis, which can exacerbate inflammation and malnutrition *[13]*.

This study aimed to assess the nutritional state and inflammation in hemodialysis patients dialyzing through Permacath (Double Lumen Tunneled Catheter) and in hemodialysis patients dialyzing through AV fistula.

The demographic comparison between the AV Fistula and Permacath groups showed that the two groups are generally comparable in terms of age and gender. The mean age for the AV Fistula group is 53.8±5.42 years, and for the Permacath group, it is 54.1±7.04 years, with no statistically significant difference (p=0.895), indicating similar age distributions. In terms of gender, 57.7% of the AV Fistula group are male compared to 46.2% in the Permacath group, while the percentages of females are 42.3% and 53.8%, respectively. However, the difference in gender distribution between the groups is not statistically significant (p=0.405).

This suggests that both groups are demographically comparable, minimizing potential confounding effects of age and gender on the study outcomes.

In the same line a study by Banerjee et al. *[14]* similarly found that demographic characteristics, such as age and gender, did not significantly differ between groups using different types of vascular access for hemodialysis, including AV Fistulas and Permacaths.

The anthropometric comparison between the AV Fistula and Permacath groups revealed significant differences in weight and BMI. While both groups have a similar mean height (168.4±7.61 cm for the AV Fistula group and 168.1±6.25 cm for the Permacath group, p=0.874), the AV Fistula group has a significantly higher mean weight (77.6±24.0 kg) compared to the Permacath group (61.7±18.85 kg, p=0.010). Similarly, the mean BMI is significantly higher in the AV Fistula group (27.0±8.48) than in the Permacath group (22.2±6.67, p=0.029). The BMI category distribution also differs between the groups, with a higher proportion of obese individuals in the AV Fistula group (34.6%) compared to the Permacath group (11.5%), while the Permacath group has more underweight patients (34.6% vs. 23.1%). The chi-square test for BMI categories is statistically significant (p=0.050), indicating that the differences in weight and BMI could have clinical implications for the nutritional status and health outcomes of the patients in each group.

In agreement Karkar et al. *[15]* observed significant differences in anthropometric measures between patients using AV Fistulas and those using Permacaths for hemodialysis also found that patients with AV Fistulas tended to have higher body weight and BMI compared to those using Permacaths, which was attributed to better nutritional status and fewer complications in the AV Fistula group.

The comparison of hemodialysis access duration and comorbidities between the AV Fistula and Permacath groups revealed significant differences in the duration of hemodialysis (HDX) access. The AV

Fistula group has a substantially longer mean duration of HDX access (2.85±1.39 years) compared to the Permacath group (0.96±0.39 years, $p<0.001$), reflecting the more permanent nature of AV fistulas compared to Permacaths. However, the overall duration of hemodialysis treatment is comparable between the two groups, with a mean of 3.23±1.58 years in the AV Fistula group and 3.38±1.53 years in the Permacath group (p=0.657). Regarding comorbidities, the groups exhibit similar rates of hypertension (HTN), diabetes mellitus (DM), ischemic heart disease (IHD), and atrial fibrillation (AF), with no statistically significant differences observed. However, heart failure (HF) is present only in the Permacath group (15.4%), suggesting a potentially more vulnerable patient population in this group, although the overall comorbidity burden does not differ significantly between the groups (p=0.728). These findings highlight the more chronic nature of AV fistulas as an HD access method, while also noting that both groups experience similar comorbid conditions.

A study by Ethier et al. [16] supports the findings that AV Fistulas tend to be used for a longer duration compared to Permacaths due to their more permanent nature, while the overall duration of hemodialysis treatment remains similar between the two groups. The researchers found that AV Fistulas are associated with better long-term outcomes and fewer complications, leading to their longer use. In terms of comorbidities, their study observed no significant differences between patients using AV Fistulas and those using Permacaths in terms of hypertension, diabetes mellitus, and ischemic heart disease, which aligns with the comparable comorbidity rates observed in both groups in the current analysis. However, patients using Permacaths were noted to have a higher prevalence of heart failure, indicating a more vulnerable clinical profile, as seen in the present study.

The comparison of vital signs between the AV Fistula and Permacath groups showed no significant differences across the measured parameters. Systolic blood pressure is similar between the groups, with a mean of 127.5±8.51 mmHg in the AV Fistula group and 128.2±8.79 mmHg in the Permacath group (p=0.750). Diastolic blood pressure tends to be slightly higher in the Permacath group (86.3±6.89 mmHg) compared to the AV Fistula group (83.1±6.27 mmHg), but this difference is not statistically significant (p=0.095). Both groups exhibit comparable heart rates, with means of 77.4 ± 8.85 beats per minute in the AV Fistula group and 80.1±8.4 beats per minute in the Permacath group (p=0.266). Similarly, respiratory rates and body temperatures are consistent between the groups, with no significant variations (p=0.694 for respiratory rate and p=0.322 for temperature). Overall, the findings suggest that vital signs are stable and comparable between the two groups, indicating no significant hemodynamic or respiratory differences based on the type of hemodialysis access.

In alignment Lee et al. [17] and Hicks et al. [18] reported no significant differences in blood pressure, heart rate, respiratory rate, or temperature between patients with different types of hemodialysis access. In the study by Lee et al. [17] patients using AV Fistulas and those using other vascular access methods, including Permacaths, exhibited comparable systolic and diastolic blood pressures, and supporting the current observation that both groups have stable blood pressure readings without significant differences. Similarly, Hicks et al. [18] found that heart rates and respiratory rates were comparable between patients using AV Fistulas and Permacaths, with no significant hemodynamic or respiratory variations attributed to the type of access used. Both studies reinforce the current findings, indicating that vital signs are generally unaffected by the type of hemodialysis access.

The hematological comparison between the AV Fistula and Permacath groups revealed a significant difference in hemoglobin levels. The AV Fistula group has a higher mean hemoglobin level (9.4±0.86 g/dL) compared to the Permacath group (8.8±0.71 g/dL), and this difference is statistically significant (p=0.004). This may suggest better anemia management or improved overall hematologic status in the AV Fistula group. However, total leukocyte count (TLC) and platelet count are similar between the two groups, with no significant differences. The mean TLC is 6.4±1.31 (×10^3/μL) in the AV Fistula group and 6.38±0.87 (×10^3/μL) in the Permacath group (p=0.853), while the mean platelet count is 246.3 ± 55.87 (×10^3/μL) in the AV Fistula group and 266.8±48.06 (×10^3/μL) in the Permacath group (p=0.162). These findings suggest that apart from hemoglobin levels, other hematological parameters are comparable between the two groups.

In a study by Abdelmobdy et al. [10] found that patients with AV Fistulas generally have better anemia management, resulting in higher hemoglobin levels compared to those using Permacaths. This is likely due to the long-term stability of AV Fistulas, which reduces complications like infections that affect erythropoiesis. However, the study, similar to the current findings, reported no significant differences in total leukocyte count (TLC) and platelet count between the groups, indicating that hemoglobin is the primary hematological difference.

The comparison of iron profile parameters between the AV Fistula and Permacath groups showed no statistically significant differences. Serum iron levels are almost identical in both groups, with the AV Fistula group having a mean of 49.1±11.19 μg/dL and the Permacath group a mean of 48.6±13.48 μg/dL (p=0.876). Total iron-binding capacity (TIBC) is slightly higher in the AV Fistula group

(225.3±40.56 μg/dL) compared to the Permacath group (206.6±29.11 μg/dL), though this difference approaches but does not reach statistical significance (p=0.063). Transferrin saturation index (Tsai) is also comparable between the groups, with the AV Fistula group showing a mean of 21.4±4.56% and the Permacath group 23.2±6.18% (p=0.225). Overall, these results suggest that both groups have similar iron profiles, indicating that iron metabolism is not significantly different between patients using AV Fistulas and those using Permacaths.

In a study by Kukavica et al. *[19]* revealed no statistically significant differences in serum iron levels or transferrin saturation between patients using AV Fistulas and those with Permacaths. Like the current study, Kukavica et al. *[19]* reported that although Total Iron Binding Capacity (TIBC) showed a slight variation between groups, it did not reach statistical significance.

The comparison of renal function and inflammatory markers between the AV Fistula and Permacath groups highlighted notable differences, particularly in serum albumin, ferritin, and C-reactive protein (CRP) levels. Both groups have similar creatinine levels (p=0.824) and comparable pre- and post-hemodialysis urea levels (p=0.074 and p=0.082, respectively), indicating no significant differences in renal function. However, serum albumin is significantly higher in the AV Fistula group (3.6±0.46 g/dL) compared to the Permacath group (3.2±0.28 g/dL, p<0.001), suggesting better nutritional status in the AV Fistula group. Ferritin levels, a marker of iron stores and inflammation, are significantly higher in the Permacath group (621.3±194.62 ng/mL) compared to the AV Fistula group (434.6±148.8 ng/mL, p<0.001), indicating higher inflammation or iron overload in the Permacath group. Similarly, CRP, a key marker of inflammation, is substantially elevated in the Permacath group (12.4±3.74 mg/L) compared to the AV Fistula group (4.5±1.55 mg/L, p<0.001). These findings suggest that patients in the Permacath group may be experiencing higher levels of inflammation and poorer nutritional status, which could be related to their dialysis access type or other underlying factors.

In accordance Goldstein et al. *[20]* found that patients with non-infected hemodialysis catheters, like Permacaths, exhibited significantly higher levels of inflammation compared to those with AV Fistulas. This was reflected in elevated CRP levels, indicating a chronic inflammatory state. Additionally, Abdelmobdy et al. *[10]* reported that patients with AV Fistulas had higher serum albumin levels, suggesting better nutritional status, which aligns with the current analysis. Elevated ferritin levels in Permacath patients, as seen in the study, are also indicative of inflammation and potential iron overload, as noted by Aggarwal et al. *[21]*, who observed similar trends in patients with catheter-based access.

The lipid profile comparison between the AV Fistula and Permacath groups showed no statistically significant differences across all parameters. Both groups have similar cholesterol levels, with the AV Fistula group showing a mean of 205.6±41.8mg/dL and the Permacath group a slightly higher mean of 220.5±39.57mg/dL, but this difference is not significant (p=0.196). Triglyceride levels are almost identical between the two groups, with a mean of 174.5±49.02mg/dL in the AV Fistula group and 174.0±37.66mg/dL in the Permacath group (p=0.967). High-density lipoprotein (HDL) and low-density lipoprotein (LDL) levels are also comparable between the groups, with no significant differences observed in HDL (p=0.145) or LDL (p=0.733). These findings suggest that the type of hemodialysis access, whether AV Fistula or Permacath, does not significantly affect the lipid profile in these patients. Both groups appear to have similar cardiovascular risk profiles based on their lipid levels.

In consistence Aggarwal et al. *[21]* found no significant differences in lipid parameters between patients with different types of dialysis access. In their study, cholesterol, triglyceride, HDL, and LDL levels were comparable across groups using AV Fistulas and catheters, with no statistically significant variations.

The comparison of electrolyte and glycemic profiles between the AV Fistula and Permacath groups revealed no statistically significant differences. The mean HbA1C, which measures long-term glycemic control, is similar between the groups, with the AV Fistula group showing a mean of 6.25±1.33% and the Permacath group a mean of 6.0±0.92% (p=0.596), indicating comparable glucose regulation in both groups. Serum sodium (Na) levels are slightly higher in the AV Fistula group (136.2±2.85 mmol/L) than in the Permacath group (135.1±1.92 mmol/L), but this difference is not statistically significant (p=0.099). Serum potassium (K), calcium (Ca), and phosphate (PO4) levels are also similar across both groups, with no significant differences observed. These findings suggest that the type of hemodialysis access does not significantly influence the electrolyte balance or glycemic control in these patients, indicating stable biochemical profiles for both the AV Fistula and Permacath groups.

Abdelmobdy et al. *[10]* reported no significant differences in key biochemical parameters, including glycemic control and electrolyte levels, between hemodialysis patients with different access types. In their study, both HbA1C levels and serum electrolyte concentrations, such as sodium, potassium, calcium, and phosphate, were comparable across the groups, suggesting that the type of dialysis access whether AV Fistula or Permacath does not significantly affect these biochemical markers.

The comparison of nutritional and functional status between the AV Fistula and Permacath groups revealed some notable differences, particularly in dietary intake and serum albumin scores. While most parameters, such as BMI score, comorbidities score, changes in end dialysis over dry weight, and functional capacity, are comparable between the two groups, dietary intake shows a significant difference (p=0.040), with the AV Fistula group having a slightly higher median intake. This suggests that patients in the AV Fistula group may have better nutritional intake compared to those in the Permacath group. Additionally, the serum albumin score is significantly higher in the AV Fistula group (p=0.028), further indicating better nutritional status in this group, as serum albumin is a key marker of nutritional health. Other measures, such as gastrointestinal (GI) symptoms, loss of subcutaneous fat, muscle loss, and total iron-binding capacity (TIBC) score, do not show significant differences, suggesting similar overall functional and nutritional health across both groups, except for the few noted variations. This highlights that the AV Fistula group may have slightly better nutritional outcomes compared to the Permacath group.

Aggarwal et al. [21] highlighted that patients with AV Fistulas tend to have better nutritional outcomes, including higher dietary intake and serum albumin levels, compared to those with Permacaths. Serum albumin, a critical marker of nutritional health, was significantly higher in the AV Fistula group, indicating better overall nutritional status, similar to the current analysis. Abdelmobdy et al. [10] found that AV Fistula patients had improved nutritional intake and better serum albumin scores compared to catheter-based groups, further supporting the notion that AV Fistulas are associated with superior nutritional status. Both studies did not observe significant differences in functional health markers such as BMI, gastrointestinal symptoms, or muscle loss between the groups, corroborating the current findings that most nutritional and functional parameters are comparable except for the noted variations in dietary intake and serum albumin.

The Malnutrition-Inflammation Score (MIS) comparison between AV Fistula and Permacath groups revealed worse nutritional and inflammatory outcomes in the Permacath group. The mean MIS score is significantly higher in Permacath patients (9.31±3.4) than in AV Fistula patients (6.96±3.26, p=0.014), with 50% of Permacath patients classified in the severe category (9-30) compared to 30.8% in the AV Fistula group. Only 3.8% of AV Fistula patients have a normal MIS score (0-2), with none in the Permacath group. These findings suggest that Permacath patients are more prone to moderate to severe malnutrition and inflammation, likely due to the temporary nature of Permacaths and related complications.

Aggarwal et al. [21] and Abdelmobdy et al. [10] both found that patients with Permacaths had higher MIS scores, reflecting more severe malnutrition and inflammation compared to those with AV Fistulas, which showed better nutritional profiles and lower inflammation. Aggarwal et al. [21] attributed this to the increased complications and infections in catheter patients, while Abdelmobdy et al. [10] highlighted the more permanent nature of AV Fistulas as a factor in maintaining better health outcomes. Goldstein et al. [20] further emphasized the elevated inflammatory burden in catheter users, even without infection. Collectively, these studies support AV Fistulas as beneficial in reducing malnutrition and inflammation compared to Permacaths.

The correlation analysis between the Malnutrition-Inflammation Score (MIS) and various clinical parameters revealed significant negative associations with several key indicators, suggesting that higher MIS scores (worse malnutrition and inflammation) are linked to poorer clinical status. Notably, BMI shows a strong negative correlation with MIS (r=–0.657, p<0.001), indicating that lower BMI is associated with higher MIS scores. Duration of hemodialysis access and hemodialysis treatment also show significant negative correlations (r=–0.420 and r=–0.456, respectively), suggesting that longer dialysis durations are linked to better nutritional and inflammatory status. Hemoglobin (r=–0.782, p<0.001) and serum albumin (r=–0.729, p<0.001) are strongly negatively correlated with MIS, highlighting that lower levels of these markers are indicative of higher malnutrition and inflammation. Similarly, serum iron (r=–0.483, p<0.001), TIBC (r=–0.673, p<0.001), creatinine (r=–0.389, p=0.004), cholesterol (r=–0.386, p=0.005), serum potassium (r=–0.546, p<0.001), serum calcium (r=–0.647, p<0.001), and phosphate (r=–0.591, p<0.001) all exhibit significant negative correlations with MIS. These correlations suggest that worse nutritional and inflammatory status is associated with lower levels of these clinical parameters, reinforcing the importance of maintaining proper nutritional health in hemodialysis patients to mitigate the effects of malnutrition and inflammation.

Aggarwal et al. [21] found that higher MIS scores, indicating worse malnutrition and inflammation, were strongly linked to lower BMI and serum albumin levels in hemodialysis patients, reinforcing the current findings. Abdelmobdy et al. [10] similarly observed significant correlations between higher MIS scores and decreased hemoglobin, albumin, and BMI, emphasizing the impact of malnutrition on clinical status. A study by Kalantar-Zadeh et al. [3] further confirmed the negative association between MIS and serum albumin and hemoglobin levels, showing that higher inflammation and malnutrition are linked to poor clinical outcomes in dialysis patients. Lastly, Rambod et al. [22] demonstrated that lower serum potassium, calcium, and phosphate levels were correlated with higher MIS scores, supporting the current observation that worse nutritional and inflammatory status is associated with decreased electrolyte levels and overall poorer health.

The correlation between the duration of hemodialysis and various clinical parameters revealed several significant relationships, indicating how longer dialysis duration impacts patients' clinical and nutritional status. Age shows a moderate positive correlation with dialysis duration (r=0.401, p=0.003), suggesting that older patients tend to be on dialysis for longer periods. Hemoglobin (r=0.392, p=0.004), serum albumin (r=0.439, p=0.001), ferritin (r= 0.814, p<0.001), cholesterol (r=0.328, p=0.018), triglycerides (r=0.297, p=0.033), LDL (r=0.279, p=0.045), serum potassium (r=0.706, p<0.001), calcium (r=0.442, p=0.001), and phosphate (r=0.654, p<0.001) all show significant positive correlations with the duration of hemodialysis. This suggests that longer dialysis duration is associated with better nutritional markers, though elevated ferritin and C-reactive protein (r=0.443, p=0.001) levels indicate higher inflammation in patients with prolonged dialysis.

Kalantar-Zadeh et al. *[3]* demonstrated that longer dialysis duration is associated with improved nutritional markers, including higher serum albumin and hemoglobin levels, reflecting better management of anemia and nutrition in patients who have been on dialysis for extended periods. Similarly, a study by Rambod et al. *[22]* found that longer dialysis duration correlates with improved serum potassium, calcium, and phosphate levels, indicating better electrolyte balance, though the increase in inflammation markers such as ferritin and C-reactive protein is a well-documented phenomenon in long-term dialysis patients due to ongoing inflammatory stress. Kopple et al. *[23]* also observed that while prolonged dialysis improves nutritional outcomes, it is associated with heightened inflammation, potentially due to the continuous exposure to dialysis-related factors.

Conversely, a significant negative correlation is found with changes in end dialysis over dry weight (r=-0.733, p<0.001), implying that patients on longer dialysis tend to maintain more stable fluid balance. Similarly, dietary intake decreases with longer dialysis duration (r=–0.517, p<0.001), reflecting potential nutritional challenges. Other parameters such as muscle loss and subcutaneous fat loss approach significance, suggesting that prolonged dialysis could be linked to progressive nutritional depletion. These findings indicate that while extended hemodialysis may improve certain clinical parameters, it also highlights potential areas of concern, such as inflammation and nutritional intake.

Aggarwal et al. *[21]* found that longer dialysis duration was associated with better fluid management, consistent with the negative correlation between end dialysis over dry weight and dialysis duration. However, the same study also noted a decline in nutritional markers, such as dietary intake, over prolonged treatment, reflecting potential nutritional challenges similar to those observed in the current analysis. Similarly, Abdelmobdy et al. *[10]* highlighted that longer hemodialysis can lead to nutritional depletion, particularly muscle and subcutaneous fat loss, which approaches significance in their findings. Goldstein et al. *[20]* further emphasized that despite the benefits of extended dialysis on fluid balance, prolonged catheter use in particular was associated with increased inflammation, which can exacerbate nutritional challenges.

Conclusion:

The study highlights significant differences in nutritional and inflammatory status between patients undergoing hemodialysis via AV Fistulas and those using Permacaths. Patients with Permacaths generally exhibit higher Malnutrition-Inflammation Scores (MIS), indicating more severe malnutrition and inflammation compared to those with AV Fistulas. Additionally, key clinical parameters, including hemoglobin, serum albumin, and markers of inflammation like C-reactive protein and ferritin, are worse in the Permacath group, suggesting a greater burden of malnutrition and inflammatory stress. The correlation analysis further demonstrates that prolonged hemodialysis duration is associated with improved nutritional markers and better management of fluid balance, though it is also linked to higher inflammation levels. Overall, the findings underscore the importance of addressing malnutrition and inflammation, particularly in patients using Permacaths, and suggest that more attention to nutritional support and inflammatory management is needed for improving outcomes in long-term dialysis patients.

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مؤشر درجة الالتهاب وسوء التغذية (MIS) لدى مرضى غسيل الكلى الذين يقومون بالغسيل الكلوى من خلال الوصلة الشريانية الوريدية مقابل مرضى غسيل الكلى الذين يقومون بالغسيل الكلوى من خلال بيرماكاث (قسطرة نفقية مزدوجة التجويف) بوحدة الغسيل الكلوى بمستشفى سعاد كفافى التذكارى الجامعى

الخلفيـة: يُعد مـرض الكلـى المزمـن مرضًـا خطيرًا لـه عواقب صحيـة كبيـرة. العـلاج الأكثـر شـيوعًا الـذى يخفـف الأعـراض وينقـذ حيـاة المرضـى هـو الغسـيل الكلـوى. تتزايـد نسـبة انتشـار مـرض الكلـى المزمـن فـى العالـم لأسـباب عديـدة. وقـد شـكلت الزيـادة السـنوية بنسـبة ٥ – ٦٪ فـى حـالات مـرض الكلـى المزمـن مقارنـة بنمـو السـكان تحديًـا فـى جميـع أنحـاء العالـم.

هــدف العمــل: تقييـم الحالـة التغذويـة والالتهابـات لـدى مرضـى الغسـيل الكلـوي باسـتخدام قسـطرة بيرمـاكاث (قسـطرة مزدوجـة التجويـف مزروعـة) ومقارنتهـا بمرضـى الغسـيل الكلـوى باسـتخدام الناسـور الشـريانى الوريـدى (AV Fistula).

المرضــى والأســاليب: تم إجـراء هـذه الدراسـة المقارنـة علـى ٥٢ مريضًـا يخضعـون للغسـيل الكلـوى فـى وحـدة الغسـيل الكلـوى بمستشـفى الجامعـة التـذكارى سـعاد كفافـى، جامعـة مصـر للعلـوم والتكنولوجيـا. اسـتمرت الدراسـة لمـدة سـتة أشـهر وشـملت تحليـلًا مفصـلًا لبيانـات المرضـى لتحقيـق أهـداف البحـث.

النتائـج: قورنـت الخصائـص الديموغرافيـة والسـريرية والتغذويـة بـين مرضـى الغسـيل الكلـوى باسـتخدام الناسـور الشـريانى الوريـدى وقسـطرة بيرمـاكاث. أظهـرت المجموعتـان تشـابهًا فـى التوزيـع العمـرى والجنـس، لكـن مجموعـة الناسـور الشـريانى الوريـدى سـجلت أوزانًـا أعلـى، مؤشـر كتلـة جسـم أعلـى، ومسـتويات ألبومـين أعلـى، ممـا يشـير إلـى حالـة تغذويـة أفضـل. كمـا أظهـرت هـذه المجموعـة مـدة أطـول لاسـتخدام الوسـيلة، مسـتويات هيموجلوبـين أعلـى، وعلامـات التهابيـة أقـل الفيريتـين و(CRP) مقارنـة بمجموعـة قسـطرة بيرمـاكاث، التـى سـجلت سـوء تغذيـة والتهابـات أعلـى. كان متوسـط درجـة سـوء التغذيـة والالتهابـات (MIS) أعلـى بشـكل ملحـوظ فـى مجموعـة قسـطرة بيرمـاكاث، مـع ارتبـاط سـلبى مـع مؤشـر كتلـة الجسـم، الهيموجلوبـين، ومسـتويات الألبومـين. تشـير هـذه النتائـج إلـى التحديـات التغذويـة والالتهابيـة الأكبـر لـدى مرضـى قسـطرة بيرمـاكاث.

الاســتنتاج: تُبـرز الدراسـة وجـود اختلافـات كبيـرة فـى الحالـة التغذويـة والالتهابيـة بـين مرضـى الغسـيل الكلـوى باسـتخدام الناسـور الشـريانى الوريـدى وقسـطرة بيرمـاكاث. يعانـى مرضـى قسـطرة بيرمـاكاث مـن درجـات سـوء تغذيـة والتهابـات أعلـى، مـا يشـير إلـى عـبء أكبـر لسـوء التغذيـة والإجهـاد الالتهابـى. أظهـرت التحليـلات الارتباطيـة أن مـدة الغسـيل الكلـوى الأطـول مرتبطـة بتحسـن المؤشـرات التغذويـة وإدارة أفضـل لتـوازن السـوائل، رغـم ارتباطهـا بمسـتويات التهابـات أعلـى. تدعـو النتائـج إلـى تعزيـز الدعـم التغـذوى وإدارة الالتهابـات لتحسـين النتائـج لـدى مرضـى الغسـيل الكلـوى طويـل الأمـد.