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A PILOT STUDY TO ASSESS THE GLYCEMIC PATTERN OF PATIENTS UNDERGOING HEMODIALYSIS IN END STAGE RENAL DISEASE

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Abstract:

Objective*: The objective of the study is to assess the glycemic pattern of patients undergoing haemodialysis in end stage renal disease.*

Methods*: Ten patients were included in the study. The glucose profile of the patients during the dialysis day was monitored using a glucometer. The duration of dialysis was 4 hours. The glucose levels before, during and within 1 hour after dialysis was monitored. All data regarding study was collected from a suitably designed proforma.*

Results: *The mean value of glucose levels on blood before the start of dialysis was higher (274±123.6) in comparison to glucose levels during intra dialysis and post dialysis. The values of glucose levels during dialysis were slightly higher (176.7±56.5) than post dialysis.*

Conclusion*: Diabetic patients were more prone to hyperglycaemia than non-diabetic patients. Patients with diabetes may experience hypoglycemia after dialysis and can be prevented by giving a mid-dialysis snack and through continuous monitoring of glucose levels on dialysis days.*

Keywords*: Dialysis, Hyperglycemia, Hypoglycemia, End stage renal disease*

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INTRODUCTION:

Chronic Kidney Disease (CKD) is characterized by a progressive deterioration in kidney function ultimately leading to irreversible structural damage to existing nephrons. Kidney Disease Outcome Quality Initiative defines CKD as kidney damage or a reduced glomerular filtration rate (GFR)<60ml/min/1.73m² for three months or more irrespective of the cause [1,2]. Dialysis makes it possible to continue living with chronic kidney disease for many years or even decades. There are two main types of dialysis known as haemodialysis and peritoneal dialysis. Haemodialysis is the most used type of dialysis. In this method blood is transported out of the body through tubes and cleaned in a machine using dialysis fluid [3,4].

Major initiation factors for CKD include diabetes mellitus, hypertension and glomerular nephritis and progression factors include hypertension, diabetes mellitus, proteinuria, smoking, hyperlipidaemia [5]. Strict glycaemic control is clearly indicated to improve diabetic management, reduce proteinuria and slow the rate of decline in eGFR. High protein consumption accelerates the progression of diabetic nephropathy presumably because of increased glomerular hyper filtration and intraglomerular pressure. Maintaining consistent glycemic control is difficult in patients with End Stage Renal Disease (ESRD) because the disease causes many changes in glucose metabolism, insulin resistance, secretion and degradation, whereas haemodialysis treatment results in changes to drug metabolism [6,7].

Factors that are associated with an increased risk of haemodialysis-induced hypoglycaemia include use of glucose-free dialysate, glucose loss during dialysis, decreased renal gluconeogenesis and alterations in metabolic pathways. Factors that are associated with haemodialysis-associated hyperglycaemia and other glucose disarrays in patients with ESRD include insulin resistance, removal of insulin by haemodialysis and secretion of counter-regulatory hormones [8]. The uraemic toxin pseudouridine, which accumulates in the circulation of patients with renal failure, has been reported to impair insulin-mediated glucose utilization in muscle. Patients with ESRD show increased serum levels of the gluconeogenic hormones glucagon and parathyroid hormone as well as resistance to the anabolic hormone's insulin, growth hormone and insulin-like growth factor-1. Vitamin D deficiency, obesity, metabolic acidaemia and inflammation also contribute to insulin resistance in advanced CKD[9].

Glucose readily cross the dialysis filter and lead to negative and positive balances depending on concentration gradient across the membrane. Dialysis solutions do not contain glucose and thereby cause loss of blood glucose in the dialysis effluent. [10,11]. Other factors include poor food intake, reduced insulin excretion and reduced gluconeogenesis. Insulin is said to be removed from blood and filtered during dialysis, especially when high flux dialysers are used which can effect on post hyperglycemia[12]. Using glucose-based dialysate fluid, giving snacks during dialysis as per diet instructed by physician, reducing predialysis anti-diabetic medications in patients experiencing hypoglycemia may help to prevent glycemic fluctuations [13].

Poor physical fitness might also contribute to insulin resistance in patients with ESRD. Improvements in tissue oxygen supply and exercise tolerance have been shown to normalize hyperglycaemia and glucose intolerance in patients with erythropoietin-corrected anaemia [14]. There is continuous need for glucose monitoring in patients receiving maintenance hemodialysis.

METHODS:

An observational study was conducted in patients undergoing maintenance hemodialysis in end stage renal disease. The study period was three months. The study was conducted in Dialysis unit of Cosmopolitan Hospital, PG Institute of Health Science and Research in Thiruvananthapuram, Kerala after getting approval from Ethical committee.

Inclusion criteria

- Patients above the age of 18 years.
- End stage renal disease patients on hemodialysis among which both diabetic and nondiabetic patients were included

Exclusion criteria

- Patients who are not willing
- Pregnant women

Sample size of 10 patients was recruited for studies as per inclusion and exclusion criteria. Informed consent was obtained. All data regarding study was collected from a suitably designed proforma [15,16]. A questionnaire was also prepared and provided to the patients to get more information based on their diet, insulin dose and difficulties during dialysis [17,18].

The glucose profile of the patients during the dialysis day was monitored using a glucometer. The duration of dialysis was 4 hours. The glucose levels before, during and within 1 hour after dialysis was monitored. All the patients had their snacks during dialysis as per the protocols by the doctor. During the dialysis, symptomatic hypoglycemic and hyperglycemic effects were also observed.

Statistical analysis of data

Data were fed to the computer and analyzed using SPSS software package version 22.0. Qualitative data were described using number and percent. Quantitative data were described using mean, standard deviation, and median. A calculated P value <0.05 is considered to be statistically significant. The association between qualitative study variables was assessed by Chi-square test and unpaired t-test was used for comparison of two independent groups.

RESULTS:

Table 1: Age group distribution

Age	Frequency	Percent
<50	3	30.0
51-60	2	20.0
61-70	3	30.0
>70	2	20.0
Total	10	100.0

Table 1 shows frequency distribution of patients undergoing hemodialysis in end stage renal disease.30% of the patients were in the age group below 50, 20% of the patients were in the age group of 51-60, 30% of the patients were in the age group of 61-70 and 20% of the patients were in age group above 70. Average age of study population was 60.8±13.32 years.

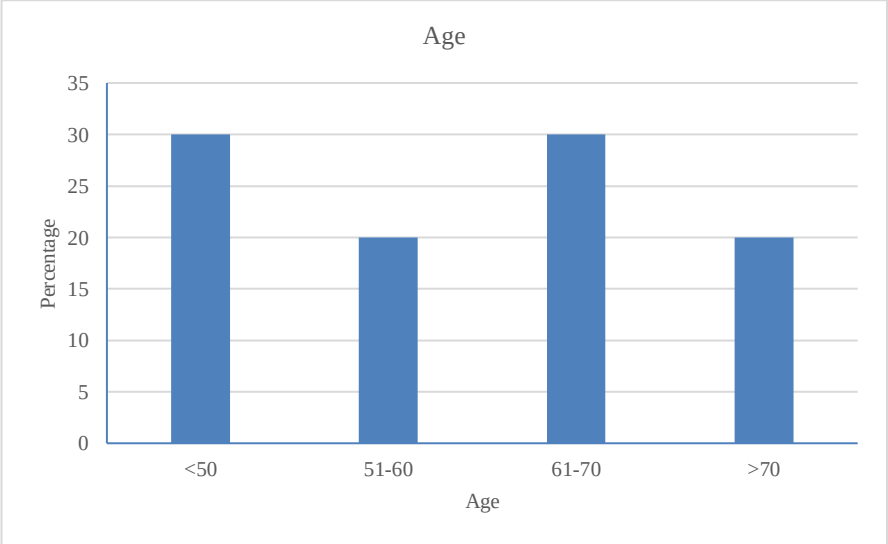

Figure 1: Age group distribution

Table 2: Gender distribution

Gender	Frequency	Percent
Male	6	60
Female	4	40
Total	10	100

Table 2 represents the frequency distribution of patients according to gender. Out of 10 patients, 6 were males and remaining were females.

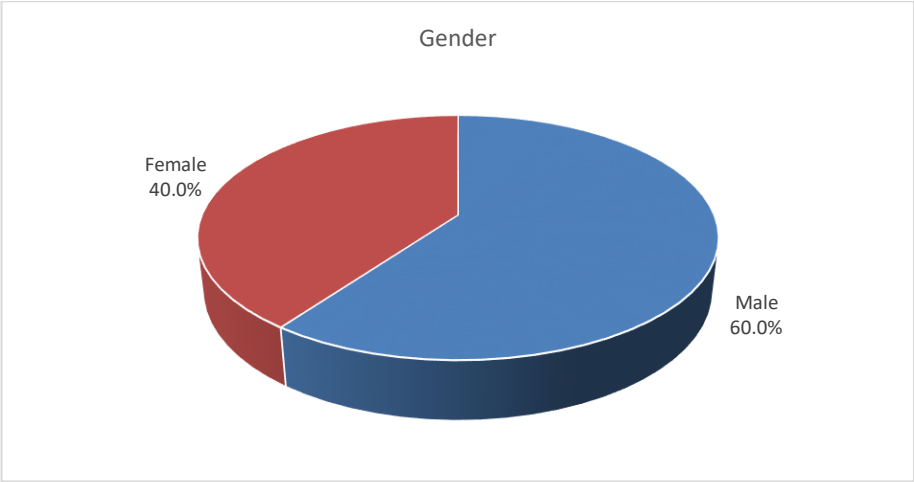

Figure 2: Gender distribution

Table 3: Distribution of patients attending dialysis session at different times of a day

Dialysis session	Frequency	Percent
Morning	4	40
Afternoon	5	50
Evening	1	10

Table 3 shows frequency distribution of subjects attending dialysis in different times of the day. Out of 10 subjects ,4 subjects attended morning session, 5 subjects attended afternoon session and 1 subject attended evening session.

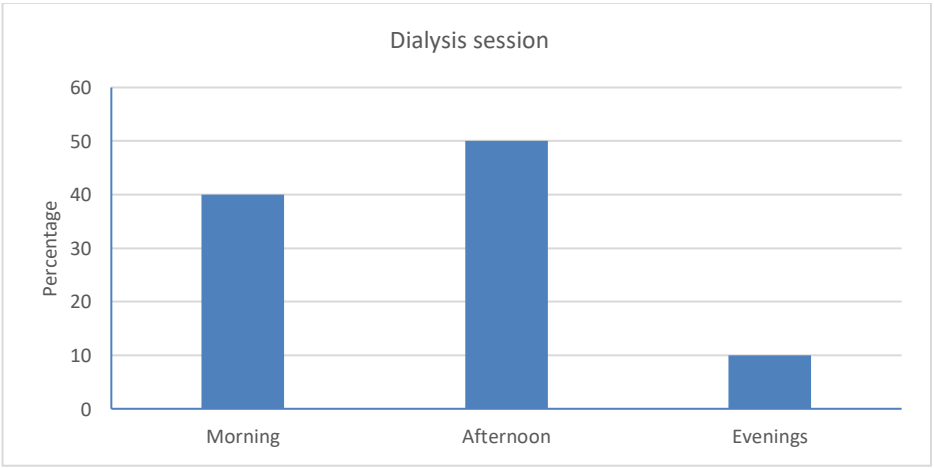

Figure 3: Frequency distribution of subjects attending dialysis session at different times of a day

Table 4: Distribution of patients experiencing difficulties during dialysis

Symptoms	Frequency	Percent
Hypotension	5	50
Muscle cramps	3	30
Shortness of breath	2	20
Total	10	100

Table 4 represents the frequency distribution of patient's difficulties during dialysis session. 50% of patients had hypotension, 30% of patients had muscle cramps and 20% of patients experienced shortness of breath.

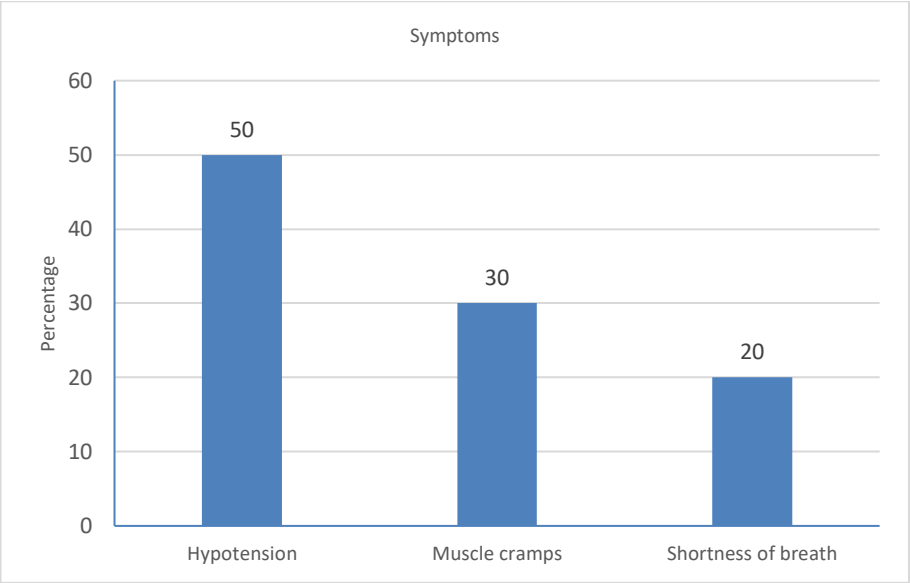

Figure 4: Distribution of patients according to difficulties experienced during dialysis

Table 5: Mean glucose levels on pre-dialysis, intra-dialysis and post dialysis

Duration	N	GRBS1\ (mg/dl)	
		Mean	Sd
Pre dialysis	10	247.4	123.6
Intra dialysis	10	176.7	56.5
Post dialysis	10	148.9	48.3

The mean value of glucose levels on blood before the start of dialysis was higher (274±123.6) in comparison to glucose levels during intra dialysis and post dialysis. The values of glucose levels during dialysis were slightly higher (176.7±56.5) than post dialysis.

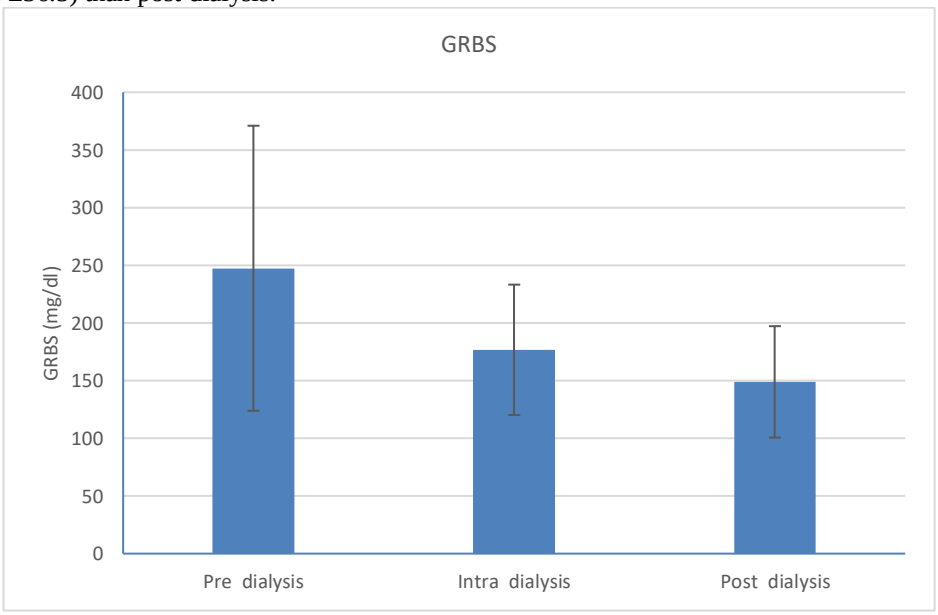

Figure 5: Mean glucose levels on pre-dialysis, intra-dialysis and post dialysis

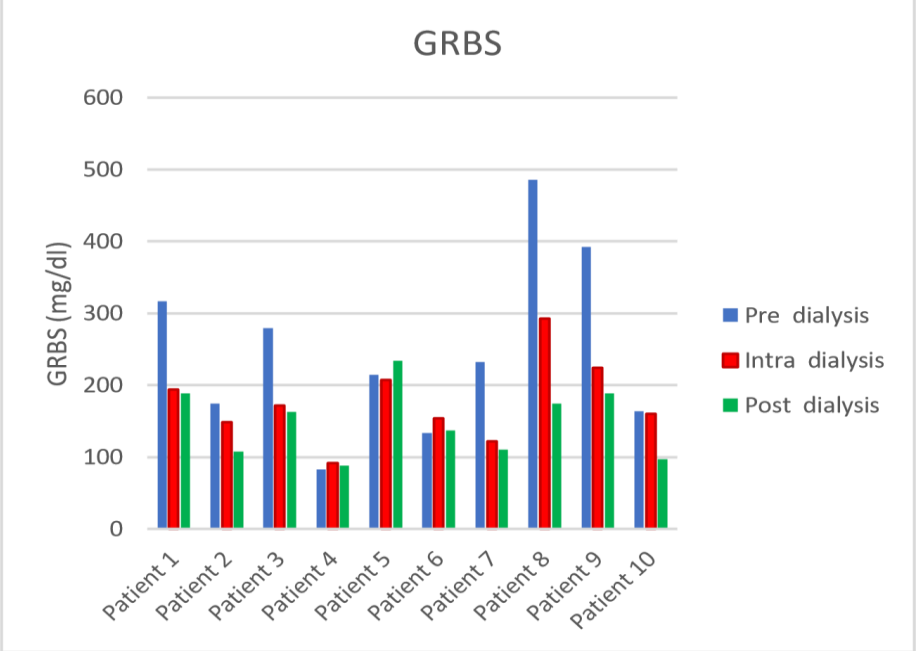

Figure 6: GRBS values in pre dialysis, intra dialysis and post dialysis in 10 patients

Table 6: Age and diabetic and non-diabetic distribution

Age	DM				Total		χ2	df	P
	Yes		No						
	n	%	n	%	n	%			
<50	1	16.7	2	50.0	3	30.0	4.444	3	.217
51-60	2	33.3	0	0.0	2	20.0			
61-70	1	16.7	2	50.0	3	30.0			
>70	2	33.3	0	0.0	2	20.0			
Total	6	100.0	4	100.0	10	100.0			

Table 6 represents percentage distribution of patients according to age and diabetes and non-diabetes. Comparison of diabetes and non-diabetes patients with different age group was statistically insignificant.

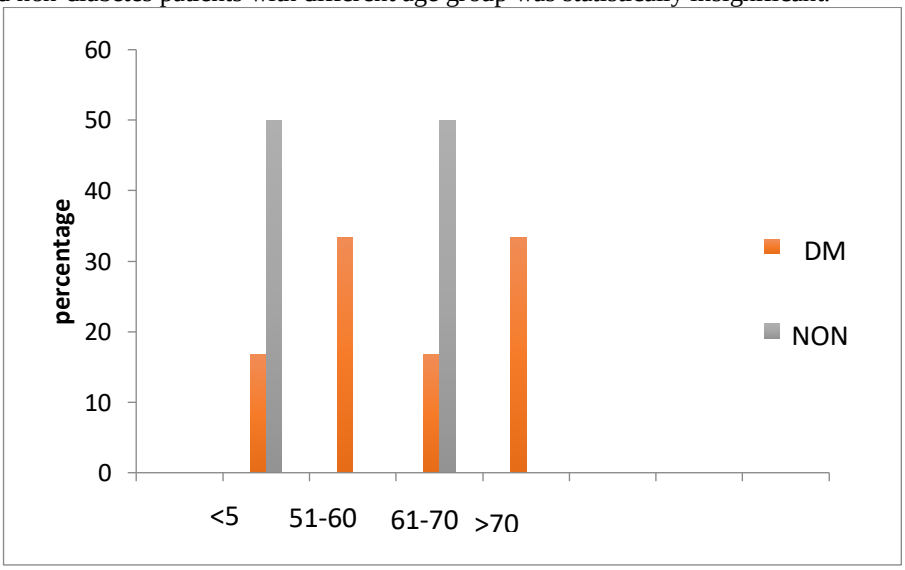

Figure 7: Age and diabetic and non-diabetic distribution

Table 7: Diabetes and non-diabetes and glycemic status distribution

Glycemic status	DM				Total		χ2	Df	P
	Yes		No						
	N	%	N	%	N	%			
No	1	16.7	3	75.0	4	40.0	6.875	2	.032
Hypo glycemia	0	0.0	1	25.0	1	10.0			
Hyper glycemia	5	83.3	0	0.0	5	50.0			
Total	6	100.0	4	100.0	10	100.0			

Table 7 represents the distribution according to diabetes and non-diabetes and glycemic status. Diabetic patients were more prone to hyperglycaemia than non-diabetic patients. The result was found to be statistically significant. Non-diabetic patients had shown no signs of glucose level fluctuation.

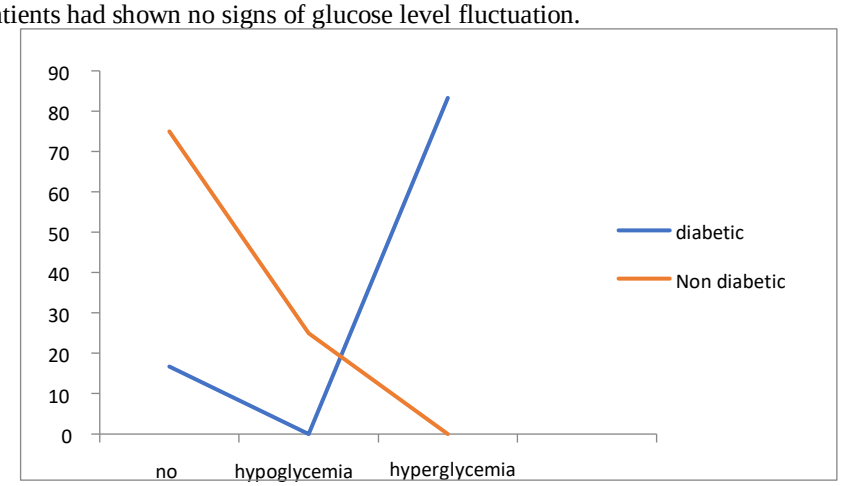

Figure 8: Diabetes and non-diabetes and glycemic status distribution

DISCUSSION:

The main objective of the study was to compare the GRBS values in pre dialysis, intradialytic and post dialysis. A general observation of higher pre dialysis glucose levels was observed in these patients. Out of 10 patients ,5 patients had higher post dialysis glucose levels. Age and diabetic and non-diabetic distribution were also observed and was found to be statistically insignificant (*P=0.317). The age group distribution in the study was compared in order to know the frequency of patients and understand the study population. 30% of the patients were in the age group below 50, 20% of the patients were in the age group of 51-60, 30% of the patients were in the age group of 61-70 and 20% of the patients were in age group above 70.

The frequency distribution of patient's difficulties during dialysis session was studied in order to understand the approach of patients towards dialysis session. 50% of patients had hypotension, 30% of patients had muscle cramps and 20% of patients experienced shortness of breath. Intra dialysis and post dialysis glucose levels are observed, and mean glucose levels were taken. The values of glucose levels are generally higher before start of the dialysis compared to post dialysis.

A study by Rajesh S. Javherani *et al* demonstrated that the mean glucose level on the day of dialysis was significantly lower compared to the day without dialysis. As compared to the dialysis period, the mean blood glucose levels in the post dialysis period were higher but did not reach statistical significance[19].While another study by Rajesh Khyalppa *et al* concluded that the difference in distribution of diabetes and non-diabetes according to the presence or absence of symptoms was statistically significant and suggesting that patients undergoing dialysis should be given a mid-dialysis snack to avoid hypoglycemia and its complications. Insulin dose should be adjusted as per dialysis schedule [20].

Diabetic patients were more prone to post dialysis hyperglycemia than non-diabetic patients and was found to be statistically significant (*P=0.03). Signs of glucose fluctuations are not observed in non-diabetic patients. This study has few limitations. The limitation includes small sample size and the data collected from the patients varies with their diet at the sampling time. This study emphasis that it is important to continuously monitor the blood glucose levels during the dialysis days.

CONCLUSION:

People with diabetes undergoing dialysis should continue to have regular check-ups and continuous glucose monitoring on dialysis days. These glycemic fluctuations should be considered in the management of patients with diabetes related end stage renal disease.

AUTHOR'S CONTRIBUTIONS

All authors have equal contribution.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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