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Comparative analysis of clinical findings of hospitalized Chronic Kidney Disease (CKD) patients

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Abstract
The Human kidneys are major organs of the body for waste removal & maintaining homeostatic balance, fluid & electrolyte balance by filtering blood. There are many disorders of kidney. One the major one is Chronic Kidney Disease (CKD). In the present study an effort was made to do a comparison of nutritional status of CKD patients on dialysis who underwent renal transplantation. Comparative analysis was done in pre & post transplant in terms of anthropometry, biochemical parameters, clinical examination & diet compliance. In total 30 samples were selected on the basis of inclusion criteria and comparative study in combination with statistical analysis was done. From the above study it can be concluded that nutritional status both pre and post renal transplant can be improved in terms of anthropometric, biochemical, electrolytes, clinical sign and symptoms and diet intake when a proper medical nutrition therapy is provided to the patients.

Introduction
Kidneys are major organs of body which maintains homeostatic balance by filtering blood. These are bean-shaped situated behind belly below the ribs, at either side of spine. They remove wastes; maintain body fluid and the level of electrolytes. Approximately 180 L of fluid is produced after filtration and re-absorption, it remains to 1.5 L that is excreted in the form of urine. Each kidney is attached to a ureter which carries urine to the bladder (Kathleen & Janice, 2017).
The kidney are associated with other functions also e.g., rennin - angiotensin mechanism that is responsible for maintaining blood pressure (Sparks *et al*., 2011).

Prevalence
Hill *et al*., 2016 conducted a research through literature searches in 8 databases to estimate CKD prevalence and concluded that global mean of 5 stages is 13·4 % and stages 3–5 was 10·6 %.

Kidney Diseases
There are some common kidney problems like kidney stones, acute kidney disease, nephrotic syndrome, chronic kidney disease etc. Chronic Kidney Disease (CKD) is found most common all over the world. CKD at all stages is associated with high mortality and morbidity (Hill *et al*., 2016). It causes slow decline in kidney function that precipitate into renal failure.

Estimating GFR or Creatinine Clearance by Cockcroft – Gault Formula
GFR (ml/min) for males = (140-age) X Weight (in kg)/ 72 X Serum Creatinine
GFR (ml/min) for females = (140-age) X Weight (in kg)/ 72 X Serum Creatinine X 0.85 (Botev *et al*., 2009). As per KDOQI, NKF, 2002 following cutoffs of GFR are calculated to estimate kidney function & protein requirements of individuals-

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Table 1: Stages of CKD

Stage	Description	GFR (ml/min/1.73m^2)
1	Kidney damage with normal or increased GFR-slight kidney change	≥90
2	Kidney damage with mildly decreased GFR and function	60-89
3	Moderately decreased GFR and function	30-59
4	Severely decreased GFR and function	15-29
5	End-Stage renal disease/failure	<15 (or dialysis)

Proteinurea, heamaturea or anatomic issues are seen in Stage 1 and 2 where as stage 5 results in death in the absence of dialysis or transplantation (Kathleen & Janice, 2017).

Role of Electrolytes

Sodium plays a major role in maintaining fluid balance, muscle & nerve function. When there is overloading of sodium in the body it causes oedema (retention of water). Therefore, dietary sodium intake should be restricted to control or prevent oedema (Whelton *et al.,* 2012). Potassium is necessary for normal functioning of nerves, cells and muscles. It is obtained in the body by drinks or foods and lost in the form of urine. Phosphorus is combined with oxygen in body to provide energy. It is a building block for substances such as cell membranes, DNA, etc. Imbalances in phosphate level may cause either hyperphosphatemia (too high phosphorus) or hypophosphatemia (too low phosphorus). Serum phosphorous levels increases with decrease in rate of glomerular filtration. Phosphorus level monitoring should be done and accordingly use of phosphate binders should be recommended (Kathleen & Janice, 2017).

When glomerular filtration rate is < 15 ml/min/1.73m^{2,} it is considered as end-stage renal disease (ESRD). In this condition, waste products are not excreted out of body that causes uremia - a condition characterized by symptoms of malaise, nausea, weakness, vomiting, muscle cramps, itching, metallic taste in the mouth and neuro dysfunction. ESRD can be medically managed through dialysis, kidney transplantation, psychologic support, immuno-suppressant therapy, erythropoietin and active vitamin D (Kathleen & Janice, 2017).

Dialysis

It is a treatment which helps patients to filter and purify blood using a machine. It balances fluids and electrolytes in body. It is of two types – hemodialysis (HD) and peritoneal dialysis (PD).

Table 2: Normal Biochemical Parameters in context to normal renal function

Lab Parameters	Adult Normal Range
Renal values	
Blood urea	15-40 mg/dl
Uric acid	3-7.2 mg/dl
Electrolytes	
Potassium	3.5-5 mEq/L
Chloride	95-106 mEq/L
Sodium	135-145mEq/L
Magnesium	1.6-2.6mEq/L
Phosphorus	
Child	4.5-6.5 mg/dl

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Adult	2.5-4.5 mg/dl
Protein factors	
Total Protein	6-8 g/dl
Serum Albumin	3.5-5 g/dl
Globulin	2-4 g/dl
Pre albumin	16-35 mg/dl
Nitrogen balance	Goal of 1-24 g/24hours urinary urea nitrogen
Serum creatinine	0.5-1.2 mg/dl
C-reactive protein	0 (Elevated in inflammation)
Transferrin	>200 mg/dl
Calcium	8.4-10.2 mg/dl
Bicarbonate	22-29 mEq/L

Source: The Best of Basics in Clinical Nutrition-Dietician's Essential Pocket book Fourth Edition – 2016

Table 3: Guidelines for CKD patients

Nutrient	Recommendation
Energy	30 – 35 Kcal/ kg/ day
Protein	For patients with CKD, not on dialysis, are given 0.6 - 0.8 g/ kg/day For critically ill CKD patients with dialysis, 1.2 – 1.4 g/kg/day protein is given
Potassium	Depends on potassium levels of blood
Sodium	Depends on edema & high BP, recommended 4 g salt /day
Fluid	1000 ml + urine output if patient is on dialysis (Depends on extent of edema, BP & sodium level in blood)
Phosphorus	800 – 1000 mg/day

Source: Clinical Dietetics Manual (Indian Dietetics Association)

Aim

The present study was planned with a view to do Comparative study of Chronic Kidney Disease (CKD) patients on dialysis who underwent renal transplantation.

Objective

- To compare nutritional status of patients at the time of admission before renal transplant
- To compare nutritional status of patients post renal transplant

Methodology

Present study was done for comparison of CKD patients on dialysis who underwent renal transplantation in terms of nutritional status i.e. comparative analysis was done in pre & post transplant patients in terms of anthropometry, biochemical parameters, clinical examination & diet compliance.

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Locale of the Study

The study area selected for the present study was Mahatma Gandhi Hospital, Jaipur (Rajasthan). Mahatma Gandhi Hospital is a multispecialty hospital located in the Sitapura area of Jaipur city.

Sample Size

The total numbers of 30 CKD on haemodialysis patients who underwent renal transplant were selected.

Inclusion Criteria

- Only males were considered for the study having age between 18-50 years
- Patients who have CKD on MHD & underwent renal transplant
- Patients who are non-diabetic

Exclusion Criteria

- Patients having age below 18 years, above 50 years and female gender
- Patient who are not diagnosed with CKD
- Patients who are not on hemodialysis
- Patients who did not undergo renal transplantation
- Patients who are diabetic

Sample Selection

All patients were taken from Kidney Transplant Unit who fulfilled inclusion criteria until desired number (i.e. 30) of sample was completed.
General information was collected from patient, attendant & patient's file.

Anthropometric Data

Patient's height was measured by heightometer & weight was taken by digital weighing balance. BMI was calculated by the formula: Weight (Kg)/ Height (M^2).

Biochemical Data Collection

The biochemical data of patients was collected from patient's files from the time of admission till discharge. Biochemical data included results related to WBC, platelets, haemoglobin, electrolytes, calcium and creatinine level.

Clinical examination

It was done of all patients pre & post transplant as loss of fat & muscle mass, dehydration/ loose motion/ constipation/ pallor nails & conjunctiva/ difficulty in chewing/ swallowing/ nausea/ vomiting/ intake Vs output etc

Diet history & diet Compliance

Data related to diet was collected by 24 hrs dietary recall at the time of admission & diet intake over prescribed diet during hospitalization.

Diet Provided Day-wise

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Table 4: Pre Renal Transplant: High protein Renal Normal Diet

Food Group	Exchange	Calorie (Kcal)	Protein (g)	Carb (g)	Fat (g)	Sodium (mg)	Potassium (mg)
Milk	2	178	9.6	25	4.5	230	448
Paneer	2	92	6.4	10	3	20	-
Starch	1	88	0	2	0	0	0
Cereal	13	1178	37.6	241	6.4	7.6	1053
Pulse	2	172	12	15	0.6	14	464
Vegetable	4	136	5	16	0.4	115.04	415.4
Fat	3	135	0	0	15	-	-
Sugar	4	80	0	20	0	-	-
Salt	3g	-	-	-	-	1200	-
Total		2059	70.6	349	29.9	1586.64	2380.4

Post Renal Transplant

Table 5: Day 1: Liquid Normal diet

Menu	Exchange	Energy (Kcal)	Protein (g)	Carb (g)	Fat (g)	Sodium (mg)	Potassium (mg)
Tea	1	43	1.6	7.5	0.075	42	84
Milk	1	92	6.4	7.5	2.25	146	280
Soup	1	50	2	10	0.1	27.7	103
Khichdi soup	1	56	3.2	10.4	0.36	0.74	26.8
Milk	1	92	6.4	7.5	2.25	146	280
Veg soup	1	50	2	10	0.1	27.7	103
Dalia soup	1	27	0.96	5.6	0.12	1.36	22.72
Milk	1	92	6.4	7.5	2.25	146	280
Sugar	1	40	0	10	0	-	-
Salt	2g	-	-	-	-	800	-
Total		542	28.96	76	7.505	1337.5	1179.52

Table 6: Day 2: Soft Normal Diet with more hygienic precautions

Food Group	Exchange	Calorie (Kcal)	Protein (g)	Carb (g)	Fat (g)	Sodium (mg)	Potassium (mg)
Milk	1.5	178	9.6	22.5	2.4	230	448
Pulse	4	344	24	30	1.2	14	928
Cereal	7	424	16.4	69	3.9	13.98	304.4
Veg	1	50	2	10	0.1	27.7	103
Fat	2	90	0	0	10	0	0
Sugar	3	60	0	15	0	0	0
Salt	2g	-	-	-	-	800	-
Total		1146	52	146.2	17.6	1085.7	1783

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Table 7: Day 3: Full Normal diet with more hygienic precautions

Food Group	Exchange	Calorie (Kcal)	Protein (g)	Carb (g)	Fat (g)	Sodium (mg)	Potassium (mg)
Milk	2.5	230	16	25	7.5	365	700
Cereal	12	1048	34.8	197.4	7.2	7.2	1119.3
Pulse	4	344	24	30	1.2	15.2	928
Vegetable	4	204	8	40	0.4	138.48	514.8
Fat	5	225	0	0	25	-	-
Sugar	5	100	0	25	0	-	-
Salt	2g	-	-	-	-	800	-
Total		2099	76.4	317.4	38.3	1190.9	3010.1

Data Analysis

The data analysis was evaluated statistically. The collected data from the outcome – anthropometric, biochemical, clinical and diet compliance was tabulated and analyzed using statistical tests and techniques. Statistics in terms of mean, standard deviation and ANOVA were used to interpret the collected data and to determine the mean scores obtained for outcomes of different patients are significantly different from each other or not.

Results and discussion

Comparative studies are the studies to compare, demonstrate ability to examine and contrast ideas or subjects. It shows how two subjects are similar or different from each other. With this view, the present study was planned to compare nutritional status of renal-transplant patients in pre & post transplant phase. The data obtained was analyzed and interpreted under the following headings:

1. Anthropometric assessment
    a. Pre transplant
    b. Post transplant
2. Biochemical assessment
    a. Pre transplant (CBC, Electrolytes, Renal Function)
    b. Post transplant (CBC, Electrolytes, Renal Function)
3. Clinical examination
    a. Pre transplant (Intake and Output, difficulty in food intake, dehydration/ nausea/vomiting)
    b. Post transplant (Intake and Output, difficulty in food intake, dehydration/ nausea/vomiting)
4. Diet intake
    a. Pre transplant

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b. Post transplant

1. Anthropometric assessment

The average weight pre renal transplant was 60.6 ± 15.09 kg. The average height of the selected sample was 159 ±6.28 cm. The average BMI of pre renal transplant patients was 30.26 ± 36.12kg/m^2 (Table 8).

Table 8: Average anthropometry of pre and post renal transplant patients

	Average Height (cm)	Average Weight (Kg)	Average BMI (Kg/M^2)
Pre renal transplant	159 ±6.28	60.6 ± 15.09	24.04 ± 36.12
Post renal transplant	159 ±6.28	59.6 ± 15.21	23.65 ± 4.4

Forte *et al*., 2020 studied factors responsible for weight gain after kidney transplantation and inferred that lower body weight before transplant and female gender were related to increase in weight by > 5% in first twelve months after transplant. In present study, statistical analysis revealed that variation in weight as well as BMI was not significantly different (p≤0.05) among CKD patients pre and post renal transplant.

2. Biochemical Assessment

Table 9 is presenting the average biochemical profile of pre & post transplant renal patients. The biochemical estimation was performed for CBC (White Blood Cells, Platelet count, haemoglobin), electrolytes, calcium and creatinine level. The average pre renal transplant WBC, platelet and haemoglobin count were 11.1 ± 4.2 10^3/µL, 191 ± 78.5 10^3/µL and 8.11 ± 1.48 g/dL respectively that were observed 7.81 ± 2.4 10^3/µL, 199 ± 88.4 10^3/µL and 8.19 ± 1.45 g/dL respectively after transplant. Post transplant decrease in WBC was also noticed by Luan *et al.*, 2011 also who stated that around 20–63% of kidney transplant patients face at least one bout of leukopenia/ neutropenia. It particularly happens about 100 days beyond transplantation and can persist from 1 to 4 weeks. There are multiple causes of leukopenia / neutropenia (Yang, Yu & Chen, 2015). A slight increase in platelet & almost similar values for haemoglobin were noticed that were statistically not significant (p≤0.05). Choukroun *et al*., 2012 studied the effect of correction of post kidney transplant anaemia and found its role in prevention or delay of allograft nephropathy.

Electrolytes

It was performed for sodium and potassium levels. The average pre renal transplant sodium level was 136.9 ± 2.88 mmol/L, while after transplant; it was recorded as 135.2 ± 3.33 mmol/L. The average potassium level was found 4.56 ± 0.62 mmol/L in pre renal transplant and 3.98 ± 0.50 mmol/L in post transplant patients. Statistical analysis further revealed that there was significant difference in values of potassium among CKD patients pre and post renal-transplant.

The average pre and post renal transplant calcium content was 8.14 ± 0.5 mg/dl and 8.69 ± 0.5 mg/dl. It was significantly different (p≤0.05). The renal function test estimation was performed for creatinine level. The average pre and post transplant creatinine level was 2.63 ± 1.06 mg/dL and 1.01 ± 0.35 mg/dL, respectively which was found statistically significant. Hariharan *et al*., 2002 in their study on post renal transplant patients concluded that creatinine levels after one year of transplant are indicator of long-term renal graft sustainability.

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Table 9: Average biochemical reports in pre & post renal transplant patients

Parameter	Reports	Pre-transplant	Post-transplant
CBC	WBC	11.1 ± 4.2 10^3/µL	7.81 ± 2.4 10^3/µL
	Platlet Count	191 ± 78.5 10^3/µL	199 ± 88.4 10^3/µL
	Haemoglobin	8.11 ± 1.48 g/dL	8.19 ± 1.45 g/dL
Electrolytes	Sodium	136.9 ± 2.88 mmol/L	135.2 ± 3.33 mmol/L
	Potassium	4.56 ± 0.62 mmol/L	3.98 ± 0.50 mmol/L
Mineral	Calcium	8.14 ± 0.5 mg/dl	8.69 ± 0.5 mg/dl
RFT	Creatinine level	2.63 ± 1.06 mg/dL	1.01 ± 0.35 mg/dL

3. Clinical examination

a. Pre transplant (Intake and Output, difficulty in food intake, dehydration / nausea / vomiting

In pre transplant patients, problems such as nausea, vomiting and difficulty in food consumption was common and found to be in 80% of selected samples and only 20% patients were not experiencing such problems. It can also be seen that difficulty in food swallowing due to nausea and vomiting leading to loss in muscle mass. In a study done by Asgari *et al.,* 2017, it was found that hemodialysis caused symptoms of vomiting and nausea in 11.7% and 28.3% cases respectively. On the other hand, Post renal transplant patients experienced comparatively less issues of nausea, vomiting and swallowing of food. It can also be observed by the amount of food consumption by the patient post renal transplant. There was healthy change in BMI (23.16 ± 4.4 kg/m^2) as observed post renal transplant.

The average intake and output on pre renal transplant was 1000.6 ± 279.5 ml and 40.66 ± 6.9 ml respectively, while the average intake and output post renal transplant was 3780 ± 1199.8 ml and 3703.3 ± 1089.6 ml respectively (Table 10). Nolte *et al*., 2018 studied role of diet monitoring and necessity for evidence-based recommendation and concluded that nutrition influences allograft function as well as various cardiovascular risk factors including dyslipidemia, blood pressure, diabetes and weight.

Table 10: Average Intake and Output of the sample Pre renal transplant

	Average values - Pre renal transplant	Average values - Post renal transplant
Input	1000.6 ± 279.5 ml	3780 ± 1199.8 ml
Output	40.66 ± 6.9 ml	3703.3 ± 1089.6 ml

Statistical analysis further revealed that variation in intake and output was significantly different ($p \leq 0.05$) among CKD patient pre and post renal-transplants.

4. Diet intake

Data related to diet was done on the basis of 24 hrs dietary recall at the time of admission & diet intake over prescribed diet during hospitalization.

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a. **Pre renal transplant**

As observed pre renal transplant patients were on high protein renal normal diet containing equal amount of plant and animal protein. But 80% of patients experienced clinical symptoms such as nausea, vomiting and difficulty in swallowing which lead to poor consumption of food hence leading to muscle wasting and low BMI. Diet given to pre transplant patients contains 2059 Kcal and 70.6g of protein out of which the average consumption of energy and protein calculated was 1814 ± 124.29 Kcal and 55.22 ± 5.94 g respectively (Table 11).

b. **Post renal transplant**

A progressive diet was given to patients post transplant – liquid normal diet to soft normal diet to full normal diet with more hygienic precautions. The diet intake was calculated. Diet given on 6^{th} day post renal transplant contains 2099 Kcal and 76.4 g of protein. The average consumption of energy and protein calculated was 2039.9 ± 45.93 Kcal and 73.28 ± 3.87 g respectively (Table 11).
Rho *et al.,* 2013 evaluated nutrient consumption in recent kidney recipients and observed that there is a need to emphasize improved diet quality and revise the guidelines of neutropenic diet.

Table 11: Average nutrient intake Pre and Post renal transplant

	Energy	Protein
Pre renal transplant	1814 ± 124.29 Kcal	55.22 ± 5.94 g
Post renal transplant	2039.9 ± 45.93 Kcal	73.28 ± 3.87 g

Statistical analysis further revealed that variation in energy and protein was significantly different ($p \leq 0.05$) among CKD patients and post renal-transplants.

Conclusion

Comparison of the nutritional status pre and post renal transplant patients was done on the basis of following parameters: anthropometric assessment (weight, height and BMI), biochemical assessment (CBC, Electrolytes, renal function and calcium level), clinical assessment (clinical signs and symptoms and intake and output) and diet intake. Anthropometric measures of pre & post renal transplant patients didn't show any significant change. Biochemical parameters improved post transplant, clinical signs and symptoms such as vomiting, nausea, difficulty in swallowing and intake and output level improved i.e. patients experienced less clinical symptoms and intake-output balance was maintained which further reduces pressure on kidney and diet intake also improved after renal transplant. Hence, from the above observation it can be concluded that proper nutrition intervention results in better condition after transplantation and increases survival of both patient and allograft. In a study done by Zarifi *et al.,* 2020 on nutritional status in kidney transplant patients it was observed that before and 6-month after transplantation the nutritional status improves by increasing dietary intakes to improve medical condition.

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