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Original Research Article

Nutrition Therapy in Kidney Transplantation

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Abstract: Kidney transplantation is a major operation, where patients after undergoing a transplant are at risk of having metabolic disorders due to weight gain such as Diabetes Mellitus, hypertension, dyslipidemia as well as heart disease and stroke. Knowing the right nutritional therapy in kidney transplant sufferers both immediately after undergoing a transplant and long after undergoing a kidney transplant in order to get optimal health quality**.** References that discuss nutritional therapy in kidney transplantation both for the provision of the amount of energy, the type and amount of carbohydrates, the amount of protein intake and the type of fat given from various sources. There are guidelines in providing nutrition to kidney transplant patients with calories starting from 25-30 kcal / kg BW, protein starting from 0.8 grams / kg BW, limiting fat and cholesterol intake and micronutrient supplementation if according to indications. Appropriate nutritional regulation in patients with renal transplantation is expected to reduce the risk of metabolic disease and improve outcomes.

Keywords: Nutrition, Kidney, Transplantation, Calories, Protein, Fat.

INTRODUCTION

A kidney transplant is the taking of a kidney from a person's body then grafted into the body of another person who is experiencing severe and permanent impaired kidney function. Kidney transplantation is currently the therapy of choice in end-stage chronic renal failure that can provide a normal quality of life again. The kidney transplantation process is described in the figure below(Nuhn Matthew,2011) :

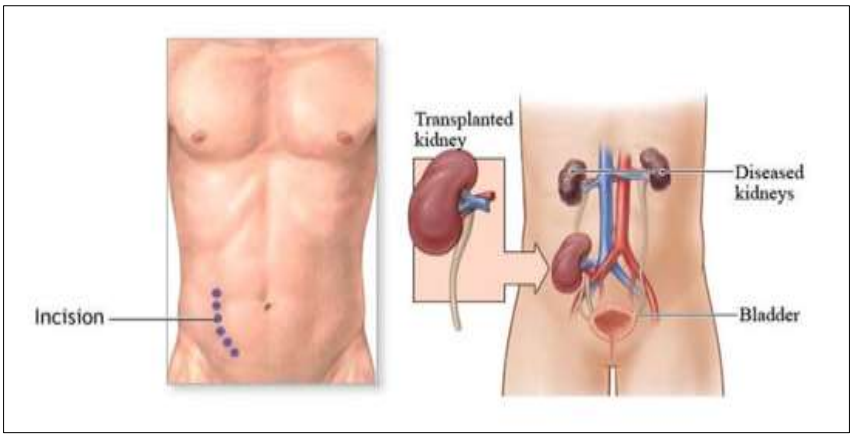

Figure 1: Kidney Transplantation (Nuhn Matthew,2011)

Patients who will undergo a kidney transplant need to be monitored and evaluation both before undergoing a kidney transplant and after undergoing a kidney transplant (PERNEFRI, 2013). Patients with kidney transplants if they do not monitor their nutritional intake after transplantation will be at risk of metabolic diseases caused by weight gain and are

often found in patients after undergoing kidney transplantation. Weight gain can be caused by the administration of steroids, immunosuppressive drugs, and recovering from kidney failure disease so that appetite increases. Deteriorating dietary quality intake over time hurts the nutritional status and function of transplanted kidneys after a 5-year post-transplant period(Lin *et al*., 2024).

Nutritional regulation can lower the risk of pain and death resulting from hypertension, dyslipidemia, diabetes, and cardiovascular disease. In this state nutrition can be an appropriate intervention in preventing the appearance of chronic diseases(Akbulut & Gencer-Bingol, 2021). The purpose of this review is to explain the importance of nutritional regulation in patients after undergoing kidney transplantation so that weight loss can be controlled and reduce the risk of metabolic diseases.

METHODS

We searched references about nutritional therapy in kidney transplantation from database period (2000– 2024), from expert organizations, such as ESPEN, the National Kidney Foundation, for the guideline and other related article, with keywords: (nutrition OR diet OR nutrients) AND (renal OR kidney) AND (transplantation OR replacement). Providing nutrients in kidney transplants such as the number of calories, carbohydrates, proteins and fats as well as the provision of micronutrients such as vitamins and minerals. We excluded duplicate articles and articles with language other than English. Finally we found 21 article to discuss in this article.

RESULTS AND DISCUSSION

Kidney transplantation is a major surgery that has the potential to have metabolic complications due to surgical conditions and immunosuppression to prevent rejection. To perform a kidney transplant, some conditions must be met by the recipient of the transplant, including having a progressive and irreversible kidney disease, not having active malignancies or infections suffered, not suffering from systemic diseases that will significantly limit rehabilitation, having a life expectancy of more than five years with a successful transplant, and having an adequate family support or social support system and having a willingness to comply with the required care and follow-up requirements after transplantation(Clinical Guideline For Kidney Transplantatiom, 2021),(Kälble *et al*., 2005). The absolute contraindications to a kidney transplant are the presence of active malignancy diseases, severe respiratory conditions, severe ischemic heart disease, severe peripheral vascular disease, transplant candidates with cirrhosis, severe cognitive impairment, having an active drug or alcohol addiction, as well as sufferers of non-compliance with therapy(Clinical Guideline For Kidney Transplantatiom, 2021).

Patients after kidney transplantation are at risk of suffering complications of metabolic diseases, both due to the surgical process and the use of immunosuppressant drugs. Research shows that these complications can be lowered with nutritional interventions, where good dietary status can improve prognosis after transplantation. The purpose of providing nutrients after undergoing transplantation includes providing adequate nutrition to overcome catabolism and accelerate healing, helping to correct electrolyte disorders and achieving optimal blood sugar levels. Data shows that around 20% of transplant sufferers develop into people with Diabetes Mellitus (DM) after a transplant. Blood sugar control worsens as a result of steroid drug use, increased food intake and weight gain (Juliana I, 2007). Immunosuppression drugs administered can aggravate the occurrence of DM, hypertension and dyslipidemia (Juliana I, 2007).

Patients undergoing kidney transplantation also generally experience weight gain, and the presence of appetite stimuli because immunosuppressive therapy can change body composition. Obesity after transplantation needs to be considered because it can stimulate glucose intolerance and hyperlipidemia therefore proper nutrition therapy is required. Nutritional therapy in patients with kidney transplants is to maintain nutritional status and replace nutritional deficits, to minimize catabolic that occur due to organ failure, reduce the risk of infection before and after transplants, as well as optimize the function of transplant organs and minimize rejection. Another goal is to provide optimal protein intake to achieve ideal weight, and reduce the side effects of immune suppression drugs (Strejc J, 2000) .

The initial phase of renal transplantation (4-6 weeks) is characterized by an increase in nutritional needs resulting from a combination of metabolic stress due to surgery and the administration of *immune suppressive* therapy (Chitra & Sunitha Premalatha, 2013). The principle of nutrition management in early post-transplant therapy is to maintain visceral protein stores despite protein catabolism, accelerate wound healing, prevent infections related to surgery and immunosuppressant therapy, prevent electrolyte complications resulting from rapid complications in kidney function (Chitra & Sunitha Premalatha, 2013). The use of high doses of corticosteroids in kidney transplant patients is associated with protein hyper catabolism and results in excessive urea production. High protein intake after kidney transplantation helps prevent muscle mass loss and achieve a positive nitrogen balance (Chitra & Sunitha Premalatha, 2013).

Administration of high doses of corticosteroids can cause *moon face*, truncal obesity and *cushingoid*, this can be prevented by carbohydrate intake 50 % of the total calories and distribute in several meals to avoid hyperglycemia and avoid the cushingoid effects of corticosteroids. Sodium intake is given according to the patient's condition based on blood pressure and fluid retention, usually kidney transplant sufferers are recommended to drink 2 liters per day which is adjusted to the amount of urine produced (Chitra & Sunitha Premalatha, 2013)(Strejc J , 2000).

Protein intake combined with sodium restrictions maintains the function and nutritional status of kidney transplant sufferers, it is also recommended for physical exercise to avoid loss of muscle mass. Approximately 60% of kidney transplant recipients suffer from dyslipidemia after 1 month and 50-70% after 10 years after kidney transplantation which can be caused by the administration of corticosteroids and diuretics produced (Chitra & Sunitha Premalatha, 2013)(Strejc J, 2000) .

One of the long-term complications of kidney transplantation is cardiovascular disease which is the leading cause of death in transplant sufferers in the first year, with immunosuppression being a major contributor and cannot be avoided. Nutritional therapy helps sufferers to control cholesterol, maintain ideal weight and good blood pressure can help lower risk and maintain proper transplant organ function (Strejc J , 2000).

Below are some guidelines in providing nutrition to people with kidney transplants:

Table 1: Kidney transplant nutrition therapy(Mlinšek, 2016)

	Chronic phase	Acute Phase	
	30–35 kcal/kgBW		Energy
low glycemic index; high dietary fiber. Limited Simple sugars	50% of total energy.		Carbohydrates
	0.75–1.0 g/kgBW	–1.4 g/kgBW	Protein
8–10% from omega 6 fatty acids; should be omega 3 fatty acids from plant and marine sources; 20% MUFA, and <10% saturated and trans fatty acids	< 30 % total energy		Fat
	1000 - 1300 mg/d		Calcium
	1000 - 1300 mg/d		Phosphorus
	80 - 100 mmol/d		sodium
	10 - 15 mg/d,		iron
	5 - 15 µg/d		vitamin D
	25 - 30 g/d.		fiber
	2.0-2.5 l/d		Fluid

Based on ESPEN (*European Society for Clinical Nutrition and Metabolism*) guidelines the administration of protein is greater at the beginning of kidney transplantation and decreases in the chronic phase of kidney transplantation. Other guidelines for providing nutrition in kidney transplantation according to Chitra (Chitra & Sunitha Premalatha, 2013) are explained in the table below:

Table 2: Nutrition Administration In Early Kidney Transplants (Chitra & Sunitha Premalatha, 2013)

30-35 Kcal/ kg	Calorie
1.3-2 g/ kg	Protein
30-35% total calories	Fat
Supplementation may be indicated to support wound healing	Zink
Fluid restrictions are indicated only in renal graft which is dysfunctional	Liquid

Table 3: Nutrition Administration At Kidney Transplantation end (Chitra & Sunitha Premalatha, 2013)

25-30 kcal/ Kg BW or enough to keep the ideal BW	Calorie
0.8 g/ kg BW	Protein
< 30% of total calories (< 10% saturated, 10-15% monounsaturated, ~10% polyunsaturated)	Fat
< 300mg	Cholesterol

According to Chitra (Chitra & Sunitha Premalatha, 2013) , zinc administration can be given to support wound healing, and there are restrictions on the administration of fats, especially saturated fats and cholesterol; As for the administration of sodium and micronutrients, it is explained in the table below:

Table 4: Nutrition Administration in Early and Late Phase Kidney Transplantation (Chitra & Sunitha Premalatha, 2013)

50% total calories	Carbohydrates
25-30 g	Fiber
3-4 g (restriction of 1-3 g when hypertension, fluid restrictions, oliguria	Sodium
Restriction 1-3 g only if hypercalcemia and/ or oliguria	Potassium
1200-1500 mg, 800 mg if there is chronic rejection	Phosphor
800-1500 mg	Calcium
Depends on the body's reserves	Iron
Supplementation is indicated, if using cyclosporine	Magnesium
Supplementation is usually not needed, unless the diet is low in protein	Water-soluble vitamins
1-2 µg if there are indications	Vitamin D3

According to Chitra (Chitra & Sunitha Premalatha, 2013) The administration of sodium in the initial and final phases is 3-4 grams a day, and restrictions are carried out up to 1 gram if hypertension, fluid restrictions or oliguria conditions are found. Other guidelines for providing nutrition to kidney transplant sufferers according to Akbulut (Akbulut & Gencer-Bingol, 2021) are described in the table below:

Table 5: Nutrition Administration In Kidney Transplantation(Akbulut & Gencer-Bingol, 2021).

Initial Phase : 30-35 Kal/Kg BW/day Final phase : 23-35 Kcal/Kg BW/day	Energy
Risk of Hyperglycemia High Intake of Fiber and KH Complex	KH
Early Phase : 1.2-2 gr/Kg BW/day Late Stage without DM: 0.6-0.8 grams/Kg BW/Day Late Stage with DM : 0.8-0.9 grams/Kg BW/Day	Protein
Risk of Cardiovascular disease ↑ < 30% total energy Saturated Fats and Trans Fats ↓	Fat
Vitamin and Mineral Supplements (In case of deficiency) Fresh fruits and vegetables (Adjusts to blood potassium levels)	Vitamins and Minerals

According to Akbulut(Akbulut & Gencer-Bingol, 2021) in the case of vitamin and mineral deficiency can be given supplementation, and it is also considered to provide other sources of vitamins and minerals from fresh fruits and vegetables by adjusting to blood potassium levels. Adequate intake of energy and protein for people with kidney transplantation and restrictions from the consumption of saturated fats, sugars and simple carbohydrates so as not to lower the body's resistance and not cause the appearance of chronic diseases(Akbulut & Gencer-Bingol, 2021).

Table 6: Kidney Transplantation Nutrition Therapy (*Chan M, 2015)*

Chronic Post Transplantation (The dose of immunosuppressant has reached *maintenance*)	Immediately After Transplantation or Acute Phase (first 3 months /when the immunosuppressant drug reaches a stable dose)	After Transplant
0.75-1 gram/ kg BW	~1.4 grams/kg BW	Protein
35-45 kcal/Kg BW (< 60 years old) 30-35kcal/Kg BW (> 60 years old)	30-48 KCal/ kg BW	Calorie
~30% total energy Monounsaturated ~20 % Polyunsaturated ~8-10% (unsaturated Fat) Saturated Fat < 8% total energy Cholesterol < 300 mg / day	~30% total energy Monounsaturated ~20 % Polyunsaturated~ 8-10% (unsaturated Fat) Saturated Fat < 8% total energy Cholesterol < 300 mg / day	Fat
Restrictions in case of hypertension	There are no restrictions, for patients who experience polyuria, sodium administration can be increased	Sodium
No modification if potassium levels are normal	There are no restrictions, for patients who experience polyuria, potassium administration can be increased	Potassium
RDI	1200-1500 mg/day	Calcium
No modification unless the phosphate serum is elevated	1200-1500 mg/day. Supplementation may be required if serum phosphate levels drop	Phosphate
RDI	RDI	Other Vitamins & Minerals
No modifications	Usually given a lot of fluid to maintain fluid balance	Liquid

Protein administration in the early phases after transplantation is recommended greater to rebuild ruptured muscle tissue due to large steroid doses (National Kidney Foundation,2010). A low-sodium diet is still recommended in people

with hypertension. WHO recommends limiting sodium to lower blood pressure in adults by 2 grams a day or 5 grams of salt a day 15(WHO, 2012). A cohort study conducted on animals on the effect of salt on blood pressure stated that only 60% had salt *sensitivity*. *Salt sensivity* to blood pressure is defined as the response of blood pressure both increasing and decreasing salt intake which is influenced by various factors including demographics, environment, genetics and physiology(Choi *et al*., 2019). The provision of vitamins and minerals must be evaluated so that the patient's immune system remains good(Akbulut & Gencer-Bingol, 2021).

The balance of body fluids of kidney transplant patients must be considered, by optimizing hemodynamic adherence before, during and after surgery (perioperative) is expected to improve good outcomes after renal transplantation(Calixto Fernandes *et al*., 2018). Patients who have undergone a transplant usually experience symptoms of pleurisy due to a slowdown in the adaptation of renal tubule function. Polyuria is the first sign of an improvement in kidney function that precedes a decrease in creatinine levels, which can improve on their own within a few days or weeks without specific therapy(Jang *et al*., 2016). Another cause of polyuria is Diabetes Insipidus which can be caused by a central disorder before a kidney transplant, or due to a slow disruption of the secretion of Anti Diuretic Hormone (ADH) due to hydration status before kidney transplantation. Diabetes Insipidus therapy by inhibiting the secretion of ADH , and it is known that changes in the secretion of ADH affected by hemodynamic changes can persist for 3 months or more after kidney transplants (Merani *et al*., 2020),(Nunez *et al*., 2024).

Patients undergoing kidney transplantation may also experience elevated blood sugar levels caused by surgery and exposure to immunosuppression drugs that have metabolic effects and can cause hyperglycemia. Patients who experience hyperglycemia after a kidney transplant who do not previously have Diabetes Mellitus can be given with insulin treatment that *short-acting* insulin to manage hyperglycemia. Patients after transplantation who suffer from hyperglycemia need education in monitoring blood sugar levels and insulin administration before leaving the hospital, the importance of glucose management in inpatients undergoing kidney transplantation is useful for the short and long term. In the short term, blood sugar control in hospitalized patients is important to support the outcome of surgery, where patients with hyperglycemia are at risk for postoperative complications including increased surgical wound infections. Another important thing is the increased awareness to manage food intake and is considered the most effective management in people with hyperglycemia who are hospitalized(Chakkera *et al*., 2006).

Patients after kidney transplantation may also develop thrombocytopenia, which occurs due to bone marrow suppression due to the use of immunosuppressants, infections, microangiopathy, folate deficiency and vitamin B12. Most of the recipients in kidney transplantation showed a reduction in platelet count levels in the initial 3 months(Yang *et al*., 2015); therefore, in patients after undergoing kidney transplantation, it is recommended to be given neutropenia diet(Rho *et al*., 2013). Exercise and physical activity in patients after undergoing a kidney transplant are also important to help control weight; physical activity plays a role in increasing the strength of the heart muscle, increasing endurance, maintaining fitness and bone health(National Kidney Foundation, 2010).

CONCLUSION

Appropriate nutritional arrangements in patients with kidney transplantation are needed in reducing weight gain due to increased appetite and administration of immunosuppression drugs, so it is expected to reduce the risk of metabolic disease after undergoing kidney transplantation.

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