

HYPERLIPIDEMIA IS AN IMPORTANT PROBLEM IN PEDIATRIC RENAL TRANSPLANT RECIPIENTS

İpek Kaplan Bulut¹, *Kadriye Özdemir¹, Mustafa Orhan Bulut², Nida Dinçel¹, Ebru Yılmaz¹, Cüneyt Hoşoşkun³ and Sevgi Mir¹

¹Department of Pediatric Nephrology, Ege University School of Medicine, Bornova, Turkey

²Department of Pediatric Cardiology, Ege University School of Medicine, Bornova, Turkey

³Department of Surgery, Ege University School of Medicine, Bornova, Turkey

Author for Correspondence

ABSTRACT

Background: Hyperlipidemia is common after solid organ transplantation and a risk factor for atherosclerosis. The aim of the present study was to detect prevalence of dyslipidemia and reveal lipid profile in pediatric renal transplantation. *Material and Methods:* This study was performed in children renal transplant recipients between the ages of 1 year to 18 years at Ege University. The follow-up time was at least 1 year after renal transplantation. After a 12-hour overnight fasting serum lipid profile were studied. *Results:* There were 53 (50.5%) male patients and 52 (49.5%) female patients. Fifty-six (53.3%) patients received a cadaveric kidney and 49 (46.7%) patients received living related kidney. The prevalence high total cholesterol level at 1, 2 and 5 years were found 39.4%, 33.2%, and 36.4% respectively. The prevalence high LDL level at 1, 2 and 5 years were determined 39.1 %, 35.2 % and 36.2%, and 30.4%, respectively. But it was not statistically significant. The comparison of pretransplantation, first, second and fifth year's group's triglyceride levels for the presence of chronic allograft nephropathy (CAN) revealed no statistically significant difference. *Conclusion:* In conclusion, prevalence of hyperlipidemia is significantly high in pediatric renal transplant recipients. Lipid levels should be closely followed-up after renal transplantation.

Key Words: Renal Transplantation, Hyperlipidemia, Children and Prevalence

INTRODUCTION

Cardiovascular disease is leading cause of death among renal transplant recipients (Chavers et al., 2003; Cooper, 2001; Lindholm et al., 1995 and Raees-Jalali et al., 2012). Hyperlipidemia is a significant metabolic disorder that is common after solid organ transplantation and a risk factor for atherosclerosis (Siirtola et al., 2005; Razeghi et al., 2011 and Kasiske et al., 1996). Although the underlying reasons have not been understood today, some studies reported that correlations have been detected between immunosuppressive regimens such as cyclosporine and steroids and hyperlipidemia in renal transplant recipients (Raees-Jalali et al., 2012; Bastani et al., 1995 and Hricik et al., 1991).

After transplantation unstable serum lipid levels represent a complicated problem, which may affect graft and patient survival (Razeghi et al., 2011; Bumgardner et al., 1995 and Markell et al., 1989). Several studies have shown an association between high serum concentrations of low density lipoprotein cholesterol (LDL-C) and triglyceride (TG), and declining renal functions after renal transplantation (Isoniemi et al., 1994; De Vries et al., 2004; Katznelson et al., 1996; Massy et al., 1996 and Guijarro et al., 1995).

Studies associated with dyslipidemia were done commonly in adults, and involved short-term follow-up results. Rarely studies were performed about dyslipidemia on long-term follow-up in renal transplant recipients. The aim of the present study was to detect prevalence of dyslipidemia and reveal lipid profile in pediatric renal transplantation.

MATERIALS AND METHODS

This study was performed retrospectively in children who underwent renal transplantation on Ege University. The inclusion criteria were: age from 1 year to 18 years, follow-up time at least 1 year after renal transplantation and having the latest measured glomerular filtration rate more than 60 ml/min per 1.73 m² body surface area. Re-transplanted children, patients with multiple organ transplantation (liver-kidney transplants) and patients with less than one year follow up were excluded from the study.

The data about age, sex, donor type, cold ischemia time and primary cause of renal failure, graft function, immunosuppressive regimen, current clinical, demographical, and laboratory data for the patients were recorded. The lipid profile of the cases including total cholesterol, low-density lipoproteins, very low density lipoprotein, high-density lipoproteins, and triglyceride levels were before and after transplantation were measured after a 12-hour overnight fasting.

Research Article

Immunosuppressive therapies were included steroids, cyclosporine, tacrolimus, mycophenolate mofetil (MMF), azathioprine or sirolimus in our center.

Total cholesterol, triglyceride, and high-density lipoprotein levels were determined using enzymatic methods. Low-density lipoprotein cholesterol was calculated based on the Friedewald formula (Friedewald et al., 1972). Hyperlipidemia was accepted as total cholesterol, LDL cholesterol, and triglyceride levels >95th percentile (Hickman et al., 1998). Values for less than 40 mg/dL for male and 50 mg/dL for female were defined low HDL cholesterol. Patients diagnosed for hyperlipidemia were treated with statins.

The study was approved by local ethic committee. Statistical analyses were performed using the statistical software SPSS version 13.0 (SPSS, Chicago Ill USA). Results are based on two-tailed, t-tests. Due to missing data many comparisons were based on less than 30 observations per group. This lack of sufficient number of observations could be responsible for non-significant tests. Therefore statistics that do not reach conventional 0.1 or 0.05 levels are still reported.

RESULTS

This study included 105 pediatric renal transplant recipients. There were 53 (50.5%) male patients and 52 (49.5%) female patients. Fifty-six (53.3%) patients received a kidney from cadaveric donor and 49 (46.7%) received a kidney from a living donor. The mean recipient age was 95.96±78.7 month (5-218 month), and the mean age of all donors was 34.5±13.2 years (1.5-64 years). Patients were followed more than 12 months [median 69 months (range 12–181)]. The etiology of end stage renal diseases were glomerular diseases in 49.5% (n=52) patients, urological abnormalities in 41% (n=43) patients, and unknown etiology in 9.5% (n=10) patients in our study (Table 1).

Multivariate analysis demonstrated that age, gender, nutritional status, prednisone, CsA, anti-hypertensive drugs, and pretransplant lipid (cholesterol, triglyceride, VDL, HDL) levels were correlated independently with posttransplant lipid (cholesterol, triglyceride, VDL, HDL) levels. Mean lipid values of pre-transplant period were as follow: TC: 179.8 mg/dL, LDL-C: 140 mg/dL, TG: 161 mg/dL, HDL-C: 55 mg/dL. The mean values in the first post-transplant period were TC: 192 mg/dL, LDL-C: 165 mg/dL, TG: 170 mg/dL, HDL-C: 50 mg/dL (Fig. 1). The prevalence high total cholesterol level at 1, 2 and 5 years were found 39.4%, 33.2%, and 36.4% respectively. The prevalence high LDL level at 1, 2 and 5 years were determined 39.1 %, 35.2 % and 36.2%, and 30.4%, respectively. But it was not statistically significant.

Table 1: Demographic features of patients

	Mean (95% CI) or Count (Frequency)
Gender	
<i>Male</i>	53 (50.5%)
<i>Female</i>	52 (49.5%)
Cadaveric donor	56 (53.3%)
Living donor	49 (46.7%)
Cause of ESRD	
<i>Nephrologic</i>	52 (49.5%)
<i>Urologic</i>	43 (41%)
<i>Unknown</i>	10 (9.5%)

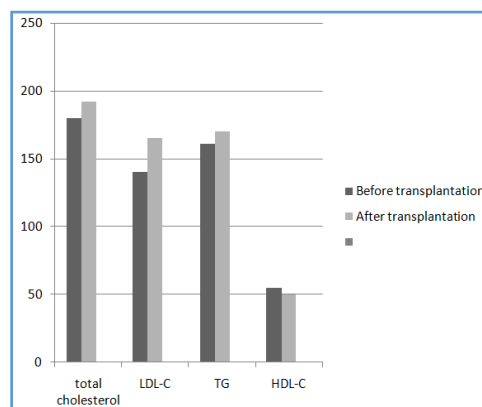


Figure 1: The mean serum lipids values of before and after transplantation

Research Article

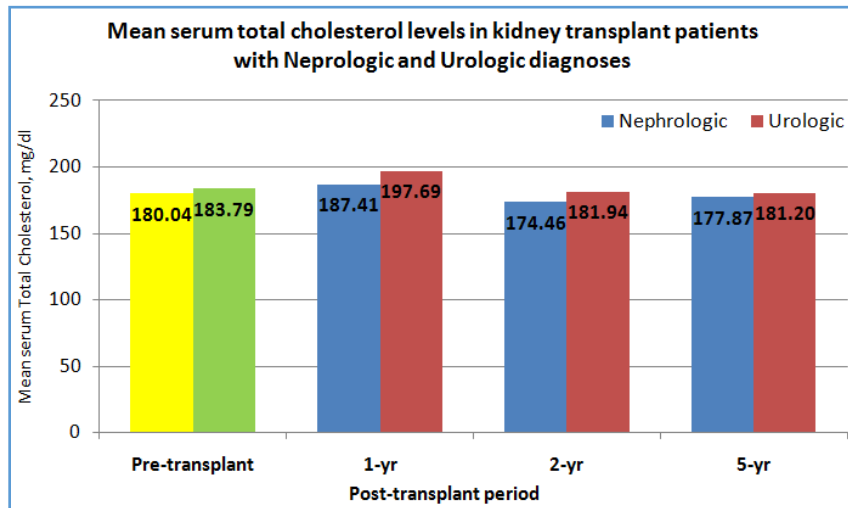


Figure 2: Mean serum total cholesterol levels in kidney transplant patients with nephrologic and urologic diagnoses

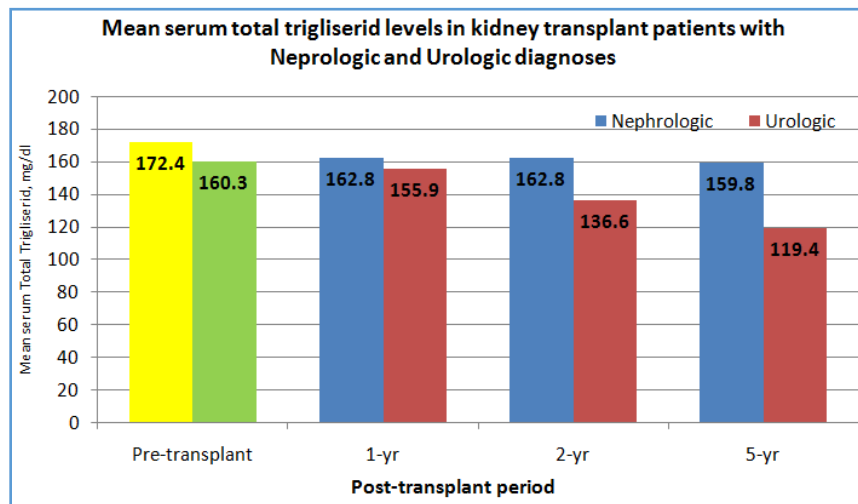


Figure 3: Mean serum total triglyceride levels in kidney transplant patients with nephrologic and urologic diagnoses

Table 2: Post-transplant and pretransplant first, second, fifth years, total cholesterol and triglyceride levels according to etiology of end stage renal failure

	Diagnosis				p
	Nephrologic		Urologic		
	n=49		n=42		
	Mean	SD	Mean	SD	
Pre-transplant total cholesterol	180.0	76.2	183.8	60.2	NS
Pre-transplant triglycerid	172.4	118.1	160.3	70.0	NS
Post-transplant total cholesterol, 1-year	187.4	63.0	197.7	46.1	NS
Post-transplant total cholesterol, 2-year	174.5	58.2	181.9	45.1	NS
Post-transplant total cholesterol, 5-year	177.9	56.0	181.2	43.9	NS
Post-transplant total triglycerid, 1-year	162.8	74.4	155.9	74.3	NS
Post-transplant total triglycerid, 2-year	162.8	108.2	136.6	65.6	0.22
Post-transplant total triglycerid, 5-year	159.8	63.0	119.4	63.0	<0.05

Notes: Results are based on two-tailed, t-tests. Due to missing data many comparisons were based on less than 30 observations per group. This lack of sufficient number of observations could be responsible for non-significant tests.

Research Article

Table 3: Post-transplant and pretransplant first, second, fifth years, total cholesterol and trigliseride levels according to chronic allograft nephropathy (CAN)

	KAN				p
	Present		None		
	n=13		n=92		
	Mean	SD	Mean	SD	
Pre-transplant total cholesterol	153.70	59.19	186.42	68.94	0.17
Pre-transplant trigliserid	161.09	73.59	162.05	105.24	NS
Post-transplant total cholesterol, 1-year	221.11	69.10	191.21	55.74	0.14
Post-transplant total cholesterol, 2-year	173.17	42.45	178.67	52.89	NS
Post-transplant total cholesterol, 5-year	185.50	33.19	179.07	51.05	NS
Post-transplant total trigliserid, 1-year	191.89	100.74	156.27	69.68	0.17
Post-transplant total trigliserid, 2-year	129.67	77.10	151.59	91.17	NS
Post-transplant total trigliserid, 5-year	131.75	71.07	139.36	65.92	NS

Notes: Results are based on two-tailed, t-tests. Due to missing data many comparisons were based on less than 30 observations per group. This lack of sufficient number of observations could be responsible for non-significant tests. Therefore statistics that do not reach conventional 0.1 or 0.05 levels are still reported.

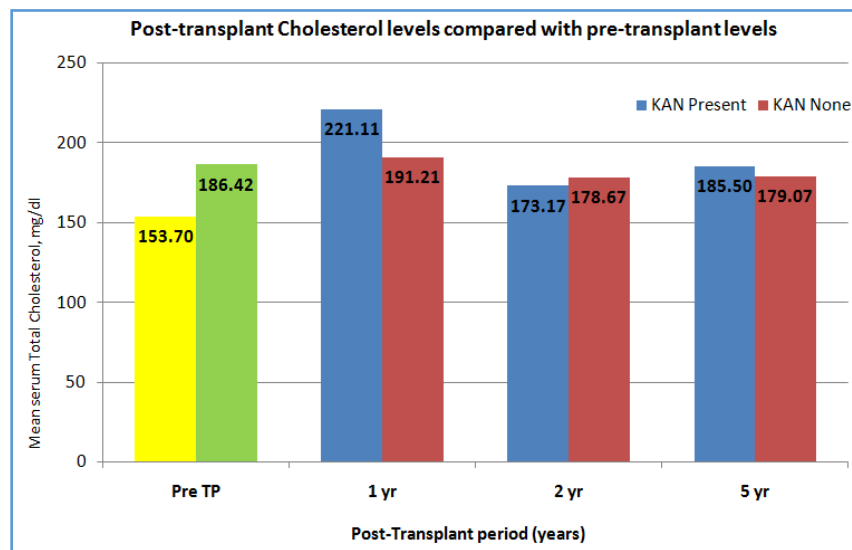


Figure 4: Post-transplant cholesterol levels compared with pre-transplant levels

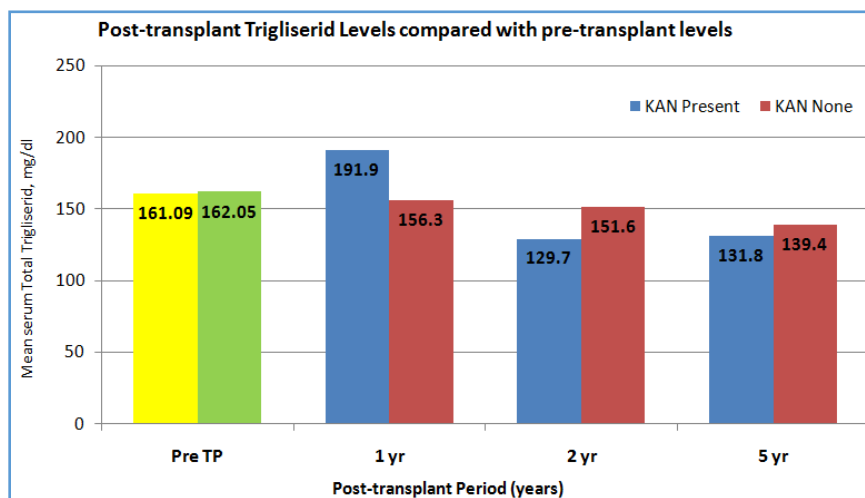


Figure 5: Post-transplant triglyceride levels compared with pre-transplant levels

Research Article

When we compare incidence of hypercholesterolemia and hypertriglyceridemia between etiology of end stage renal failure, type of donor, there were no statistically significant relationship (table 1, 2). Dyslipidemia had a weak correlation with posttransplantation time. The only statistically significant difference was found in triglyceride levels at 5th year between nephrologic and urological causes of end stage renal diseases (Fig. 2, 3). The comparison of pretransplantation, first, second and fifth years groups triglyceride levels for the presence of chronic allograft nephropathy (CAN) revealed no statistically significant difference (table 3). Patients with chronic rejection had higher total-cholesterol levels (221 mg/dL vs 191 mg/dL; $P = 0.14$) as well as higher levels of triglycerides (156 mg/dL vs 191 mg/dL) only on the first posttransplant year (Fig. 4, 5).

DISCUSSION

Coronary artery disease is an important cause of morbidity and mortality after renal transplantation. Lipid disorders, hypertension and obesity contribute to development of atherogenesis and accelerated development of transplant vasculopathy (Razeghi et al., 2011; Bumgardner et al., 1995; Markell et al., 1989; Siirtola et al., 2008 and Berenson et al., 1998).

Hyperlipidemia is common finding among renal transplant recipients (Kasiske et al., 2004 and Valavi et al., 2008). Alterations in lipid profiles lead to higher total serum cholesterol and triglyceride levels, higher LDL-C, as well as lower HDL-C levels (Raees-Jalali et al., 2012 and Kimak et al., 2010). Elevated lipid levels may be increase the risk of both acute graft rejection and chronic allograft nephropathy (Razeghi et al., 2011; Cohen et al., 2001 and Stephan et al., 2002). But, there are an insufficient number of papers about the prevalence and type of hyperlipidemia in pediatric renal transplant recipients (Razeghi et al., 2011). Our aim was to contribute to the literature about prevalence and type of lipid disorders.

Many risk factors have been identified for post-transplantation dyslipidemia, are primary disease process, medications used such as corticosteroids, proteinuria, and anti-hypertensive drugs, malnutrition, obesity, and patient's diet (Butani et al., 2003 and Saland et al., 2002). Immunosuppressive drugs used to prevent rejection such as cyclosporine and steroids are important causes of post-transplant hyperlipidemia in adult renal transplant recipients (Silverstein et al., 2003 and Bittar et al., 1990). On the other hand, the role of treatments used to prevent rejection in the development of hyperlipidemia is controversial in pediatric renal transplant recipients (Silverstein et al., 2003 and Sharma et al., 1994).

Nutrition with low polyunsaturated fat, excessive saturated fat and cholesterol may contribute to dyslipidemia and cardiovascular disease (Siirtola et al., 2008; Berenson et al., 1998 and Lichtenstein, 2006). Some studies evaluating nutritional aspects and lipid profiles after pediatric renal transplantation suggested that serum cholesterol concentration, plasma TC, and LDL-C concentrations were associated with nutritional factors (Aldamiz-Echevarria et al., 2004 and Delucchi et al., 2001). On the other hand, Siirtola et al examined the association between daily intake of nutrients and serum lipids after pediatric renal transplantation were reported high prevalence of dyslipidemia in recipients could not be explained by the diet (Siirtola et al., 2008). However, the mechanisms have not been completely elucidated (Razeghi et al., 2011; Stephan et al., 2002 and Pannu et al., 2003). Hyperlipidemia is a frequent finding among renal transplant recipients. The most common findings are increased total cholesterol and LDL levels. Also, sometimes elevated TG levels may be accompanied (Kasiske et al., 2004 and Valavi et al., 2008). In our study, prevalence of hypercholesterolemia at pre-transplant, 1, 3, and 5 years were 34%, 46%, 58%, 41%, respectively (Chavers et al., 2003). Silverstein et al., (2000) reported that prevalence of elevated serum cholesterol levels were found in 51.6% adult patients with renal transplantation. In our study, the prevalence of hypercholesterolemia at 1, 3, 5, and 10 years were 36.4%, 38.4%, 43%, and 21.7%, respectively.

The incidence of hyperlipidemia is generally 30–75% in pediatric renal transplant recipients (Silverstein, 2003; Delucchi et al., 2001; Silverstein et al., 2000; Goldstein et al., 1984 and Pennisi et al., 1975). Even in some studies, the incidence of hyperlipidemia was reported as 90–97% at the first year after transplantation (Valavi et al., 2008; Gonyea & Anderson, 1992 and Moore et al., 1993). Razeghi et al., (2011) reported that prevalence of elevated low-density lipoprotein levels was found 29.1% at sixth month. In this study, the prevalence higher low-density lipoprotein cholesterol level at 1, 3, 5, and 10 years were 33%, 37.4%, 40.2%, and 30.4%, respectively. Nowadays investigations concerning an association between hyperlipidemia and the development of chronic rejection are increasing and that lipid-lowering interventions get importance for prevention of chronic rejection.

Hypertriglyceridemia was found to be associated with a greater probability of doubling serum creatinine often recognized as a major contributor to renal allograft dysfunction in various studies (Kasiske et al., 2000; Wissing et al., 2000 and Shivaswamy et al., 2008). Siirtola et al., (2008) reported prevalence of elevated serum TG as 37.9% in pediatric renal transplant recipients. Higher serum TG levels were also found in 51.6% patients in an adult renal transplant recipient (Silverstein et al., 2000). Similarly to these our study revealed hypertriglyceridemia in about

Research Article

50% of pediatric kidney transplant recipients [5]. Another pediatric study showed the prevalence of increased TG levels at pre-transplantation, 1, 3, and 5 years as 54%, 36%, 29%, 14%, respectively (Chavers et al., 2003). In our study, the prevalence higher TG level at 1, 3, 5, and 10 years were 31.3%, 34%, 37.5%, and 34.7%, respectively.

HDL-C has an anti-atherogenic potential and functional property. Both HDL size and HDL particle concentration were independently associated with other cardiovascular risk factors and the risk for coronary artery disease (Kimak et al., 2010 and EL-Harchaoui et al., 2009). Early use of lipid lowering drugs such as pravastatin (Bastani et al., 1995) and simvastatin (Berenson et al., 1998) after heart transplantation decrease the incidence of clinically severe acute rejection episodes and the incidence and progression of transplant vasculopathy (chronic rejection) in prospective randomized trials, thus improving long-term patient and allograft survival.

However there is no clear correlation demonstrated between lipid reductions and decreased acute rejection or chronic rejection or increased graft survival simvastatin and pravastatin were reported to be effective in controlling lipids and preventing the incidence and severity of acute rejection episodes after kidney transplantation (Delucchi et al., 2001). Our prospective randomized study of early use of pravastatin after kidney transplantation showed pravastatin reduces the incidence of acute rejection (Sharma et al., 1994). Recently, we reported 5-year follow-up data revealing long-term improvement in allograft function and patient survival with pravastatin treatment (Aldamiz-Echevarria et al., 2004).

Although the posttransplant hyperlipidemia is multifactorial disorder, but an immunosuppressive regimens used play a significant role in this problem. Posttransplant hyperlipidemia has been associated with cardiovascular morbidity and mortality and the development of chronic rejection. Statins may be the best choice with respect to antihyperlipidemic agents because they effectively lower lipid levels and are relatively safe to use. The treatment of posttransplant hyperlipidemia should be considered crucial to routine patient care. All patients should be counseled regarding exercise programs and low-fat, low-cholesterol diets. There are some limitations in our study such as simultaneous cardiovascular risk factors and dietary compliance couldn't be evaluated because of the retrospective nature of study.

CONCLUSION

We observed a high prevalence of hyperlipidemia in pediatric renal transplant recipients. Lipid levels should be monitored closely on follow-up. Large longitudinal prospective studies are needed to highlight the association between prevalence of hyperlipidemia, treatment and its relationship to CVD morbidity and mortality in pediatric renal transplant recipients.

ACKNOWLEDGEMENT

Ege University Organ Transplantation Center and Biochemistry Lab.

REFERENCES

- Chavers BM, Hardstedt M & Gillingham KJ (2003).** Hyperlipidemia in pediatric kidney transplant recipients treated with cyclosporine. *Pediatric Nephrology*, **18**(6) 565-569.
- Cooper L (2001).** USRDS. 2001 Annual Data Report. *Nephrology News & Issues*, **15**(10) 31 & 34-35, 38 passim.
- Lindholm A, Albrechtsen D, Frodin L, Tufveson G, Persson NH & Lundgren G (1995).** Ischemic heart disease-major cause of death and graft loss after renal transplantation in Scandinavia. *Transplantation*, **60**(5) 451-457.
- Raees-Jalali G, Eshraghian A, Faghihi A, Roozbeh J, Sagheb MM, Eshraghian H & Behzadi S (2012).** Hyperlipidemia after kidney transplantation: long-term graft outcome. *Iranian Journal of Kidney Diseases*, **6**(1) 49-55.
- Siirtola A, Antikainen M, Ala-Houhala M, Koivisto AM, Solakivi T, Virtanen SM, Jokela H, Lehtimäki T, Holmberg C & Salo MK (2005).** Insulin resistance, LDL particle size, and LDL susceptibility to oxidation in pediatric kidney and liver recipients. *Kidney International*, **67**(5) 2046-2055.
- Razeghi E, Shafipour M, Ashraf H & Pourmand G (2011).** Lipid disturbances before and after renal transplant. *Experimental and Clinical Transplantation: Official Journal of the Middle East Society for Organ Transplantation*, **9**(4) 230-235.
- Kasiske BL, Guijarro C, Massy ZA, Wiederkehr MR & Ma JZ (1996):** Cardiovascular disease after renal transplantation. *Journal of the American Society of Nephrology*, **7**(1) 158-165.
- Bastani B, Robinson S, Heisler T, Puntney G, Aridge D, Lindsey L, Solomon H & Garvin PJ (1995).** Post-transplant hyperlipidemia: risk factors and response to dietary modification and gemfibrozil therapy. *Clinical Transplantation*, **9**(4) 340-348.

Research Article

- Hricik DE, Mayes JT & Schulak JA (1991).** Independent effects of cyclosporine and prednisone on posttransplant hypercholesterolemia. *American Journal of Kidney Diseases: the Official Journal of the National Kidney Foundation*, **18**(3) 353-358.
- Bumgardner GL, Wilson GA, Tso PL, Henry ML, Elkhammas EA, Davies EA, Qiu W & Ferguson RM (1995).** Impact of serum lipids on long-term graft and patient survival after renal transplantation. *Transplantation*, **60**(12) 1418-1421.
- Markell MS & Friedman EA (1989).** Hyperlipidemia after organ transplantation. *The American Journal of Medicine*, **87**(5N) 61N-67N.
- Isoniemi H, Nurminen M, Tikkanen MJ, von Willebrand E, Krogerus L, Ahonen J, Eklund B, Hockerstedt K, Salmela K & Hayry P (1994).** Risk factors predicting chronic rejection of renal allografts. *Transplantation*, **57**(1) 68-72.
- De Vries AP, Bakker SJ, van Son WJ, van der Heide JJ, Ploeg RJ, The HT, De Jong PE & Gans RO (2004).** Metabolic syndrome is associated with impaired long-term renal allograft function; not all component criteria contribute equally. *American Journal of Transplantation: Official Journal of the American Society of Transplantation and the American Society of Transplant Surgeons*, **4**(10) 1675-1683.
- Katznelson S, Wilkinson AH, Kobashigawa JA, Wang XM, Chia D, Ozawa M, Zhong HP, Hirata M, Cohen AH, Teraski PI et al:** The effect of pravastatin on acute rejection after kidney transplantation--a pilot study. *Transplantation*, **61**(10) 1469-1474.
- Massy ZA, Guijarro C, Wiederkehr MR, Ma JZ & Kasiske BL (1996).** Chronic renal allograft rejection: immunologic and nonimmunologic risk factors. *Kidney International*, **49**(2) 518-524.
- Guijarro C, Massy ZA & Kasiske BL (1995).** Clinical correlation between renal allograft failure and hyperlipidemia. *Kidney International Supplement*, **52** S56-S59.
- Friedewald WT, Levy RI & Fredrickson DS (1972).** Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clinical Chemistry*, **18**(6) 499-502.
- Hickman TB, Briefel RR, Carroll MD, Rifkind BM, Cleeman JI, Maurer KR, Johnson CL:** Distributions and trends of serum lipid levels among United States children and adolescents ages 4-19 years: data from the Third National Health and Nutrition Examination Survey. *Preventive medicine* 1998, **27**(6):879-890.
- Siirtola A, Virtanen SM, Ala-Houhala M, Koivisto AM, Solakivi T, Lehtimäki T, Holmberg C, Antikainen M & Salo MK (2008).** Diet does not explain the high prevalence of dyslipidaemia in paediatric renal transplant recipients. *Pediatric Nephrology*, **23**(2) 297-305.
- Berenson GS, Srinivasan SR & Nicklas TA (1998).** Atherosclerosis: a nutritional disease of childhood. *The American Journal of Cardiology*, **82**(10B) 22T-29T.
- Kasiske B, Cosio FG, Beto J, Bolton K, Chavers BM, Grimm R, Jr., Levin A, Masri B, Parekh R, Wanner C, Wheeler DC & Wilson PWF (2004).** Clinical practice guidelines for managing dyslipidemias in kidney transplant patients: a report from the Managing Dyslipidemias in Chronic Kidney Disease Work Group of the National Kidney Foundation Kidney Disease Outcomes Quality Initiative. *American Journal of Transplantation: Official Journal of the American Society of Transplantation and the American Society of Transplant Surgeons*, **4**(Suppl 7) 13-53.
- Valavi E, Otukesh H, Fereshtehnejad SM & Sharifian M (2008).** Clinical correlation between dyslipidemia and pediatric chronic allograft nephropathy. *Pediatric Transplantation*, **12**(7) 748-754.
- Kimak E, Halabis M & Baranowicz-Gaszczyk I (2010).** Relationships between serum lipid, lipoprotein, triglyceride-rich lipoprotein, and high-density lipoprotein particle concentrations in post-renal transplant patients. *Journal of Zhejiang University Science B*, **11**(4) 249-257.
- Cohen D & Galbraith C (2001).** General health management and long-term care of the renal transplant recipient. *American Journal of Kidney Diseases: the Official Journal of the National Kidney Foundation*, **38**(6 Suppl 6) S10-S24.
- Stephan A, Barbari A, Karam A, Kilani H, Kamel G & Masri A (2002).** Hyperlipidemia and graft loss. *Transplantation Proceedings*, **34**(6) 2423-2425.
- Butani L, Pai MV & Makker SP (2003).** Pilot study describing the use of pravastatin in pediatric renal transplant recipients. *Pediatric Transplantation*, **7**(3) 179-184.
- Saland JM, Ginsberg H & Fisher EA (2002).** Dyslipidemia in pediatric renal disease: epidemiology, pathophysiology, and management. *Current Opinion in Pediatrics*, **14**(2) 197-204.
- Silverstein DM (2003).** Indications and outcome of treatment of hyperlipidemia in pediatric allograft recipients. *Pediatric Transplantation*, **7**(1) 7-10.

Research Article

- Bittar AE, Ratcliffe PJ, Richardson AJ, Raine AE, Jones L, Yudkin PL, Carter R, Mann JI & Morris PJ (1990).** The prevalence of hyperlipidemia in renal transplant recipients. Associations with immunosuppressive and antihypertensive therapy. *Transplantation*, **50**(6) 987-992.
- Sharma AK, Myers TA, Hunninghake DB, Matas AJ & Kashtan CE (1994).** Hyperlipidemia in long-term survivors of pediatric renal transplantation. *Clinical Transplantation*, **8**(3 Pt 1) 252-257.
- Lichtenstein AH (2006).** Thematic review series: patient-oriented research. Dietary fat, carbohydrate, and protein: effects on plasma lipoprotein patterns. *Journal of Lipid Research*, **47**(8) 1661-1667.
- Aldamiz-Echevarria L, Vallo A, Sanjurjo P, Elorz J, Prieto JA, Ruiz JI & Rodriguez-Soriano J (2004).** Influence of diet on atherogenic risk in children with renal transplants. *Pediatric Nephrology*, **19**(9) 1039-1045.
- Delucchi A, Marin V, Trabucco G, Azocar M, Salas P, Gutierrez E, Guardia S, Cano F & Cumsille MA (2001).** Dyslipidemia and dietary modification in Chilean renal pediatric transplantation. *Transplantation Proceedings*, **33**(1-2) 2008-2013.
- Pannu HS, Singh D & Sandhu JS (2003).** Lipid profile before and after renal transplantation--a longitudinal study. *Renal Failure*, **25**(3) 411-417.
- Silverstein DM, Palmer J, Polinsky MS, Braas C, Conley SB & Baluarte HJ (2000):** Risk factors for hyperlipidemia in long-term pediatric renal transplant recipients. *Pediatric Nephrology*, **14**(2) 105-110.
- Goldstein S, Duhamel G, Laudat MH, Berthelie M, Hervy C, Tete MJ & Broyer M (1984).** Plasma lipids, lipoproteins and apolipoproteins AI, AII, and B in renal transplanted children: what risk for accelerated atherosclerosis? *Nephron*, **38**(2) 87-92.
- Pennisi AJ, Fiedler J, Lipsey A, Mickey R, Malekzadeh MH & Fine NR (1975).** Hyperlipidemia in pediatric renal allograft recipients. *The Journal of Pediatrics*, **87**(2) 249-251.
- Gonyea JE & Anderson CF (1992).** Weight change and serum lipoproteins in recipients of renal allografts. *Mayo Clinic proceedings Mayo Clinic*, **67**(7) 653-657.
- Moore R, Thomas D, Morgan E, Wheeler D, Griffin P, Salaman J & Rees A (1993).** Abnormal lipid and lipoprotein profiles following renal transplantation. *Transplantation Proceedings*, **25**(1 Pt 2) 1060-1061.
- Kasike BL, Chakkeri HA & Roel J (2000).** Explained and unexplained ischemic heart disease risk after renal transplantation. *Journal of the American Society of Nephrology*, **11**(9) 1735-1743.
- Wissing KM, Abramowicz D, Broeders N & Vereerstraeten P (2000).** Hypercholesterolemia is associated with increased kidney graft loss caused by chronic rejection in male patients with previous acute rejection. *Transplantation*, **70**(3) 464-472.
- Shivaswamy V, Stevens RB, Zephier R, Zephier M, Sun J, Groggel G, Erickson J & Larsen J (2008).** Dyslipidemia can be controlled in diabetic as well as nondiabetic recipients after kidney transplant. *Transplantation*, **85**(9) 1270-1276.
- El Harchaoui K, Arsenaault BJ, Franssen R, Despres JP, Hovingh GK, Stroes ES, Otvos JD, Wareham NJ, Kastelein JJ, Khaw KT & Boekholdt SM (2009).** High-density lipoprotein particle size and concentration and coronary risk. *Annals of Internal Medicine*, **150**(2) 84-93.