The Factors Affecting Blood Pressure in Pediatric Renal Transplant Recipients

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ABSTRACT
To investigate the parameters affecting systemic blood pressure in pediatric renal transplant recipients, we retrospectively examined the data from 19 adolescent renal transplant recipients including 6 girls overall, mean age of 15.47 ± 3.56 years. Serum creatinine (Scr), fractional extraction of sodium (FENa), whole blood trough cyclosporine (C0), plasma total cholesterol (TC) and triglyceride levels, and systolic and diastolic blood pressure (SBP and DBP) were monitored during a total of 677 visits. SBP and DBP, classified as <95p (groups 1s and 1d) and >95p (groups 2s and 2d), were correlated with differences between groups 1 and 2.

Group 2s Scr and FENa levels were higher than group 1s (P = .002 and P = .048, respectively), whereas C0 and FENa levels were higher in Group 2d than Group 1d (P = 0.028 and P = 0.036, respectively). Among the entire group, SBP and DBP positively correlated with C0; Scr and SBP, with FENa. While there was a positive correlation between SBP and C0 in groups 1s and 2s (r = 0.188, P < .000; and r = 0.145, P = .040), DBP was only associated with C0 in group 1d (P = .03, r = 0.156). In contrast, DBP showed a positive correlation with Scr in group 2d (P = .023, r = 0.132), and SBP with Scr in Group 1s. C0 and Scr levels were correlated in Groups 1s, 1d and 2d. At high BP levels (>95p), SBP is mostly affected by C0; DBP, with Scr. However, in both groups these two parameters positively correlate with each other. Thus, in adolescent renal transplant recipients the cause of high blood pressure does not appear to be solely related to cyclosporine related to induced allograft dysfunction.

HYPERTENSION is a frequent complication in children and adolescents with renal transplantation with a prevalence between 70% and 80%. The cause is multifactorial, including immunosuppressive therapy, chronic graft rejection, and prior hypertension. Factors such as age, gender, and race play only minor roles in posttransplant hypertension. As in adults, high BP in children with renal transplants is associated with allograft dysfunction or failure and LVH. The aim of the study was to determine biochemical parameters affecting blood pressure levels among pediatric renal transplant recipients.

MATERIALS AND METHODS
The data from 19 pediatric recipients 13 boys, 6 girls of renal transplants between April 1993 and March 2003 were analyzed retrospectively with a mean follow-up of 55.21 ± 27.85 (8–104) months. All patients received cyclosporine (CsA), prednisolone and azathioprine. No patient had undergone native nephrectomy. Serum creatinine (S_cr), fractional extraction of sodium (FE_Na), glomerular filtration rates (GFR) calculated according to the Schwartz formula, whole blood trough CsA (C0), plasma total cholesterol (TC) and triglyceride (TG) levels, and blood pressures were monitored at regular visits. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) measurements were classified as <95p [Gr1s (n = 463), Gr1d (n = 365)] or ≥95p [Gr2s (n = 214), Gr2d (n = 305)]. Correlation of SBP and DBP with demographic and clinical parameters was sought by a Pearson analysis.

RESULTS
Among the entire group, SBP and DBP levels positively correlated with C0 and S_c, SBP also correlated with FeNa.
whereas DBP did not show any significant correlation (Table 1). In addition to SBP and DBP, Cr was positively correlated with FENa, TC, and TG levels \((r = 0.136, P = .04; r = 0.156, P < .00; r = 0.091, P = .029\), respectively). When blood pressure measurements were classified according to the 95p level, Sa and FENa levels were significantly higher among Gr2 compared to Gr1 \((P = .002, P = .048\); whereas C0 and FENa levels were higher among Gr2 than Gr1 \((P = .028, P = .036\). For both Gr1 and Gr2, positive correlation was observed between SBP and C0 \((P = .000, r = 0.188; P = .040, r = 0.145, respectively). Gr1 patients showed a positive correlation between DBP and C0 \((P = .003, r = 0.156); but in Gr2, DBP showed a positive correlation only with Sa \((P = .023, r = 0.132\).

### DISCUSSION

The major cause of hypertension (HT) among renal graft recipients is impaired renal function, secondary to chronic allograft nephropathy or, less frequently, to recurrence of the primary disease, the use of immunosuppressive calcineurin inhibitors, uncontrolled renin secretion by the shrunken kidneys of the recipient, stenosing lesions of the transplant artery, polycythemia, or genetic predisposition of the graft donor to hypertension. Long-term follow-up revealed transient or persistent HT for several visits in our patients, all of whom were searched for factors that may be responsible for HT. Additionally, we sought to correlate biochemical parameters with blood pressure levels.


cSA has been one of the most important medications used after renal transplantation. Besides its immunosuppressive effects, the drug has a severe potential of nephrotoxicity, trough concentration monitoring is essential. C0 showed a positive correlation with SBP, DBP, TG, TC, and FENa, a result that is similar to data showing increased cardiovascular risk factors, such as hypertension and hyperlipidemia, among patients treated with high drug doses.6,6 Csa nephrotoxicity occurs late after renal transplantation, often accompanied by an increase in SBP and in Doppler resistive index. Csa dose reduction may improve renal function, reduce graft resistive index, and lower SBP.7 It has been previously shown that FENa is significantly higher among hypertensive patients than normotensive subjects.8 In our experience, Scr and FENa levels were higher among patients with higher levels than those with normal SBP levels. There was a positive correlation between C0 and SBP both at high and normal blood pressure levels; however, the correlation with DBP disappeared at high levels, which may indicate that CsA nephrotoxicity was responsible for high SBP levels in transplant recipients.

Posttransplantation hypertension and graft dysfunction are closely related. C0 and FENa levels were higher among patients with elevated DBP levels than among those with normal DBP, but high DBP levels only correlated with Scr levels. This finding implies that diastolic HT is the result of deteriorating renal function rather than CsA nephrotoxicity.

In conclusion, the parameters most prominently affecting SBP and DBP are Scr, FENa, and C0, which reflect the vasoconstrictive effects of CsA. At high BP levels (≥95p), the most important factor affecting SBP is C0, while DBP mostly is affected by Scr.

### REFERENCES


### Table 1. Correlation of Systolic Blood Pressure and Diastolic Blood Pressure With Other Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>C0</th>
<th>Triglyceride</th>
<th>Cholesterol</th>
<th>FENa</th>
<th>Creatinine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic blood pressure</td>
<td>r: 0.127</td>
<td>r: -0.034</td>
<td>r: 0.014</td>
<td>r: 0.116</td>
<td>r: 0.120</td>
</tr>
<tr>
<td>Diastolic blood pressure</td>
<td>r: 0.105</td>
<td>r: -0.058</td>
<td>r: 0.060</td>
<td>r: 0.070</td>
<td>r: 0.104</td>
</tr>
</tbody>
</table>

C0: Trough cyclosporine A level; FENa: Fractional sodium excretion.