



Ambulatory Blood Pressure Monitoring (ABPM) in Children After Renal Transplant

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Specific Aim

To measure ambulatory blood pressure in children who have undergone renal transplantation to determine if blood pressure levels are normal and if the normal nocturnal decline in BP is preserved.

Background

Children with end-stage renal disease who have undergone renal transplantation commonly have hypertension. Post-transplant hypertension has multiple potential etiologies including remaining native kidneys, medications such as corticosteroids and calcineurin inhibitors (tacrolimus, cyclosporin), loss of normal allograft function, and pre-existing vascular disease. In addition, we know that these children are at increased risk for future cardiovascular disease.

Methods and procedures

Children currently followed in the nephrology clinical practice were recruited to participate in a 24-hour study. Inclusion criteria included age greater than 6 years, >3 months post-transplant, appropriate developmental level for cooperation, and stable allograft function. After informed consent, clinical data, and anthropometric data were collected, ABPM was performed. The family and child recorded the time of sleep/awakening.

Ambulatory blood pressure monitoring (ABPM)

Space-lab ambulatory monitors were programmed to take the BP every 20 minutes during the 24-hour period. After selection of the appropriate cuff size, the brachial artery of the non-dominant arm at the antecubital fossa was located and the cuff positioned so that the monitor was placed correctly. After 24 hours, the cuff and monitor were removed, and the data downloaded using the Space-lab software. Data from ABPM were analyzed for each individual to determine whether their systolic or diastolic BP was greater than the 95th percentile. HTN was defined as blood pressure index (BPI) >1.0. BPI is the mean BP divided by the 95th percentile for gender and height according to Sord et al. Load represents the percent of readings > 95th percentile for awake or sleeping periods. 24 hour load is the combination of awake and sleeping loads. The nocturnal decline is the percent change from awake to sleeping mean BP and was considered normal if blood pressure decreased $\geq 10\%$.

Measurement of left ventricular mass. Echocardiography was performed according to the standard of the American Society of Echocardiography (ASE).

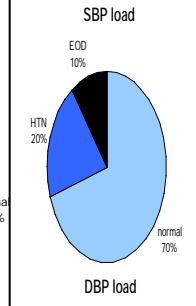
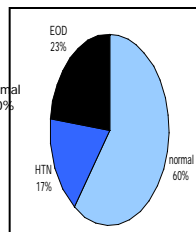
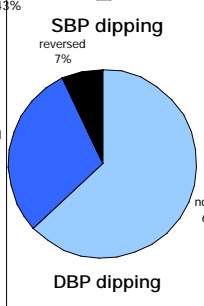
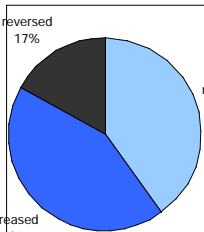
Results

Parameter	Value
SBP dipping	43%
DBP dipping	30%

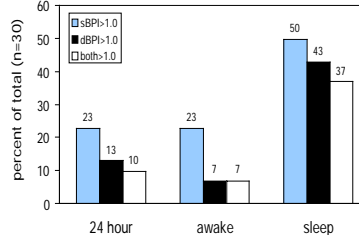
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Subjects were positioned in the partial left decubitus position. Measurements taken in mode of inter-ventricular septal thickness (IVS), posterior wall thickness (PWT), and left ventricular diastolic dimension (LVED) were taken at or just below the mitral valve tips. Left ventricular mass (LVM) was calculated using the formula by Devereux et al according to the ASE guidelines (14):
 $LVM\ mass\ (g) = 0.81(1.04IVS + PWT + LVED)^3 - (LVED)^3 \times 0.06$.



Prevalence of hypertension by BPI



23% and 7% of subjects had both awake and sleeping systolic and diastolic hypertension, respectively.

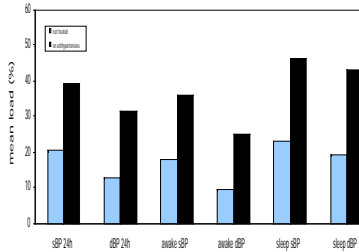
Conclusions

- HTN during sleep was present in 50% of our subjects and was more common than HTN during the awake period.
- If HTN is defined by load (>35% for systolic and >25% for diastolic) rather than BPI, children are more likely to be categorized as having HTN.
- Systolic nocturnal decline was preserved in 40% and diastolic in 63% of subjects, and was reversed in 17% and 7% respectively.
- The BP load was significantly lower in untreated as compared to treated subjects.
- BP correlated with prednisone dosage but was likely influenced by a few individual subjects on higher prednisone dosages.
- Left ventricular hypertrophy was present in 36% of the subset of subjects who had LVM measures performed.

Summary of Previous Studies

Study	Year	Sample Size	HTN Prevalence	SBP Load	DBP Load	SBP Dipping	DBP Dipping
1	2001	15	100%	100%	100%	0%	0%
2	2002	15	100%	100%	100%	0%	0%
3	2003	15	100%	100%	100%	0%	0%
4	2004	15	100%	100%	100%	0%	0%
5	2005	15	100%	100%	100%	0%	0%
6	2006	15	100%	100%	100%	0%	0%
7	2007	15	100%	100%	100%	0%	0%
8	2008	15	100%	100%	100%	0%	0%
9	2009	15	100%	100%	100%	0%	0%
10	2010	15	100%	100%	100%	0%	0%
11	2011	15	100%	100%	100%	0%	0%
12	2012	15	100%	100%	100%	0%	0%
13	2013	15	100%	100%	100%	0%	0%
14	2014	15	100%	100%	100%	0%	0%
15	2015	15	100%	100%	100%	0%	0%
16	2016	15	100%	100%	100%	0%	0%
17	2017	15	100%	100%	100%	0%	0%
18	2018	15	100%	100%	100%	0%	0%
19	2019	15	100%	100%	100%	0%	0%
20	2020	15	100%	100%	100%	0%	0%

Comparison of BP loads between treated and untreated subjects



Correlation between BP parameters, the LVM and estimated creatinine clearance. Estimated creatinine clearance (using the Schwartz formula) correlated with 24 hour diastolic BP index with a correlation coefficient of 0.44, $p = 0.02$. There were no significant correlations between LVM and BP parameters. Prednisone dosage correlated with the following BP parameters (correlation coefficient in parentheses): DBP sleep-0.44, 0.02; SBP 24 h-0.52, 0.003; SBP awake-0.43, 0.01; SBP sleep-0.44, 0.02; systolic load-0.56, 0.001; and diastolic load-0.46, 0.01. There were no significant correlations between calcineurin inhibitor dosage and BP.

Anti-hypertensive medications. Eighteen subjects were prescribed anti-hypertensive medications: 10 were on 1, 6 were taking 2, 1 was on 3, and 1 was on 4 meds. Calcium channel blockers were prescribed in 12 children, ACE inhibitor and/or angiotensin receptor blocker in 8, beta blockers in 6, and clonidine in 3.

Abbreviations:
BP = blood pressure
s = systolic
d = diastolic
LVM = left ventricular mass index
HTN = hypertension
NA = not available
EOD = at risk for end organ damage