**Parathyroidectomy Increases Heart Rate Variability and Leptin Levels in Patients with Stage 5 Kidney Disease**

**Authors**

Yao Jiang1,6, Zhixiang Shen2,6, Changying Xing1, Jingjing Zhang1, Xiaoming Zha3, Chong Shen4, Ming Zeng1, Guang Yang1, Huijuan Mao1, Bo Zhang1, Xiangbao Yu1, Bin Sun­­1, Chun Ouyang1, Yifei Ge1, Lina Zhang1, Chen Cheng1, Jing Zhang1, Caixia Yin1, Huimin Chen1, and Ningning Wang1,5.

1Department of Nephrology, The First Affiliated Hospital with Nanjing Medical University, Nanjing, Jiangsu Province, 210029, China.

2Department of Nephrology, Jiangsu Province Geriatric Hospital, Nanjing, Jiangsu Province, 210029, China.

3Department of General Surgery, The First Affiliated Hospital with Nanjing Medical University, Nanjing, Jiangsu Province, 210029, China.

4Department of Epidemiology and Biostatistics, School of Public Health, Nanjing Medical University, Nanjing, Jiangsu Province, 211166, China.

5Corresponding author

6These authors contributed equally to this work .

**Supporting Information**

**Table S1.** Clinical characteristics and laboratory results in CKD group.

|  |  |  |  |
| --- | --- | --- | --- |
|  | CKD patients  (n=141) | | |
| With Severe SHPT  (n=57) | Without severe SHPT  (n=84) | *P* |
| Demographics |  |  |  |
| Age(years) | 45.5±10.3 | 52.4±12.9 | 0.001 |
| Male/Female | 33/24 | 44/40 | 0.519 |
| BMI(kg/m2) | 21.2±3.2 | 22.2±3.0 | 0.055 |
| Dialysis mode, n(%) |  |  |  |
| Predialysis | 0(0.0%) | 28(33.3%) | <0.001 |
| Haemodialysis | 55(96.5%) | 37(44.0%) | <0.001 |
| Peritoneal dialysis | 2(3.5%) | 19(22.6%) | 0.002 |
| Dialysis vintage(months) | 84.0(60.0-120.0) | 10.0(6.0-48.0) | <0.001 |
| Comorbidities, n(%) |  |  |  |
| Diabetic mellitus | 2(3.5%) | 20(23.8%) | 0.001 |
| Hypertension | 41(71.9%) | 72(85.7%) | 0.044 |
| Cause of ESRD, n(%) |  |  |  |
| Glomerulonephritis | 53(93.0%) | 50(59.5%) | <0.001 |
| Diabetic nephropathy | 0(0.0%) | 11(13.1%) | 0.012 |
| Hypertensive nephropathy | 0(0.0%) | 4(4.8%) | 0.248 |
| Polycystic kidney disease | 2(3.5%) | 7(8.3%) | 0.424 |
| Other | 2(3.5%) | 12(14.3%) | 0.036 |
| Anti-hypertension Medication, n(%) | |  |  |
| Calcium channel blocker | 28(49.1%) | 53(63.1%) | 0.100 |
| ACEI/ARB | 12(21.1%) | 13(15.5%) | 0.395 |
| β-Receptor blocker | 22(38.6%) | 27(32.1%) | 0.430 |
| Laboratory values |  |  |  |
| Hemoglobin(g/l) | 99.5±23.6 | 89.5±22.9 | 0.013 |
| Hematocrit(%) | 31.0±7.4 | 27.5±7.0 | 0.005 |
| Glucose(mmol/l) | 4.3±1.1 | 5.2±2.1 | 0.002 |
| Creatinine(μmol/l) | 858.3±231.5 | 883.1±399.2 | 0.643 |
| Urea(mmol/l) | 22.5±7.0 | 26.4±10.6 | 0.009 |
| HDL cholesterol(mmol/l) | 1.1±0.3 | 1.1±0.3 | 0.909 |
| LDL cholesterol(mmol/l) | 2.5±0.6 | 3.0±1.0 | <0.001 |
| Total cholesterol (mmol/l) | 4.0±0.9 | 4.7±1.3 | <0.001 |
| Triglyceride(mmol/l) | 1.5±0.9 | 1.6±1.1 | 0.522 |
| Albumin(g/l) | 37.7±4.1 | 36.4±5.2 | 0.079 |
| Bone metabolism panel |  |  |  |
| Calcium(mg/dl) | 10.1±1.1 | 8.8±1.1 | <0.001 |
| Phosphorus(mg/dl) | 6.8±1.9 | 6.3±2.0 | 0.109 |
| ALP(u/l) | 506.3(286.1-951.6) | 80.1(66.3-104.3) | <0.001 |
| lnALP | 6.1±0.9 | 4.5±0.5 | <0.001 |
| iPTH(pg/ml) | 1980.4(1343.4-2967.4) | 267.9(139.5-507.1) | <0.001 |
| lniPTH | 7.6±0.5 | 5.5±1.0 | <0.001 |
| Leptin(pg/ml) | 5524.4(1673.2-13712.3) | 6454.6(1908.1-17227.1) | 0.384 |
| Leptin/BMI | 259.4(86.3-572.0) | 296.2(83.3-789.6) | 0.480 |
| ln Leptin/BMI | 5.4±1.3 | 5.6±1.4 | 0.441 |

Data were mean ± standard deviation (SD), or numbers and percentages, or median (25th-75th percentile), as appropriate.

Test of significance by Independent-Samples t test or Wilcoxon’s rank sum test for continuous variables and Chi-square test or Fisher’s exact test for categorical variables.

*P*: CKD patients with severe SHPT versus those without severe SHPT.

CKD, chronic kidney disease; SHPT, secondary hyperparathyroidism; BMI, body mass index; ACEI, angiotensin-converting enzyme inhibitors; ARB, angiotensin receptor blocker; HDL, high density lipoprotein; LDL, low density lipoprotein; ALP, alkaline phosphatase; iPTH, intact parathyroid hormone;

**Table S2.** Baseline HRV parameters in CKD group.

|  |  |  |  |
| --- | --- | --- | --- |
|  | CKD patients  (n=141) | | |
| With Severe SHPT  (n=57) | Without severe SHPT  (n=84) | *P* |
| MHR (beats/min) | 86.1±10.2 | 80.0±11.3 | 0.001 |
| Time domain measures |  |  |  |
| Mean NN(ms) | 709.6±84.4 | 764.8±110.4 | 0.002 |
| SDNN(ms) | 67.9±27.7 | 78.2±28.4 | 0.036 |
| SDANN(ms) | 59.9±25.6 | 69.8±27.1 | 0.031 |
| rMSSD(ms) | 17.8±6.9 | 19.5±10.9 | 0.272 |
| pNN50(%) | 2.3±2.9 | 3.7±6.2 | 0.085 |
| Frequency domain measures |  |  |  |
| ln VLF | 5.5±0.9 | 5.5±1.0 | 0.655 |
| ln LF | 3.9±1.3 | 3.7±1.4 | 0.355 |
| ln HF | 2.6±1.7 | 2.6±2.0 | 0.969 |
| ln LF/HF | 1.2±0.8 | 1.0±1.2 | 0.234 |

Data were mean ± standard deviation (SD).

Test of significance by independent samples *t* test and corresponding *P* values. CKD, chronic kidney disease; SHPT, secondary hyperparathyroidism; MHR, mean 24 hours heart rate; Mean NN, the mean normal-to-normal R–R intervals; SDNN, standard deviation of the normal-to-normal R–R intervals; SDANN, standard deviation of 5-min average of normal R–R intervals; rMSSD, root mean square of differences between adjacent normal R–R intervals; pNN50%, proportion of adjacent R–R intervals differing by >50ms over 24 h; VLF, very-low frequency; HF, high frequency; LF, low frequency.

**Fig S1**.Correlations between lniPTH and HRV parameters in CKD group.

MHR, mean 24 hours heart rate; iPTH, intact parathyroid hormone; Mean NN, the mean normal-to-normal R–R intervals; SDNN, standard deviation of the normal-to-normal R–R intervals; SDANN, standard deviation of 5-min average of normal R–R intervals.