# Changes in Antihypertensive Therapy After Renal Transplantation

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## ABSTRACT

**Introduction.** Post-transplant hypertension is extremely frequent, occurring in 60% to 90% of cases. It is involved in the pathogenesis of chronic graft dysfunction and patient survival.

**Objectives.** We sought to describe changes in antihypertensive therapy after renal transplantation (RT) depending on the type of pretransplant renal replacement therapy (RRT), hemodialysis (HD) or peritoneal dialysis (PD).

**Methods.** We performed a retrospective cohort study of RT patients who were divided into 2 groups according to the type of pretransplant RRT (HD group: 69 patients; PD group: 38 patients). Patients with a diagnosis of nonessential hypertension etiology, diagnosis of renal artery stenosis of the graft, active urologic complications, and history of acute graft rejection were excluded. Variables related to chronic kidney disease and RT as well as antihypertensive therapy were studied.

**Results.** PD patients had reduced number of antihypertensive drugs at 1 month after RT ($1.39 \pm 1.03$) compared with pre-RT ($2.16 \pm 1.30$; $P = .001$), a trend that was maintained at 6 months ($1.70 \pm 1.18$; $P = .06$). In HD group, the number of antihypertensive drugs increased at 6 months after RT ($1.59 \pm 1.17$) compared with pretransplant ($1.15 \pm 1.13$; $P = .027$). The use of calcium channel blockers increased by 10.2% by 1 month ($P = .071$) and 9.2% ($P = .036$) by 6 months after RT.

**Conclusion.** By 1 month after RT, antihypertensive therapy was reduced. Calcium channel blockers were the most common drug group, although it is usually necessary to use more than 1 drug.

AFTER renal transplantation (RT), surgical or medical complications may occur, some early and others later. Post-transplant hypertension is extremely prevalent, occurring in 60% to 90% of the cases. It is a significant factor in the pathogenesis of chronic graft dysfunction and patient survival [1]. In the absence of conclusive data provided by randomized clinical trials in patients with RT, antihypertensive treatment should be chosen according to the clinical characteristics of the patient and the presence of other comorbidities [1,2].

## MATERIALS AND METHODS

We performed a retrospective study of patients who underwent RT from hemodialysis (HD) and peritoneal dialysis (PD) from January 1, 2014, to December 31, 2015, at Puerta del Mar Hospital, Cadiz.

### Study Population

All adult (≥18 years) RT patients with more than 6 months of pre- and post-RT follow-up were enrolled. Patients with a diagnosis of nonessential hypertension etiology, diagnosis of renal artery stenosis of the graft, active urologic complications, or history of acute graft rejection were not included.

Hypertension was defined as the use of 1 or more drugs to control blood pressure (BP). BP was measured in each clinic visit and its therapeutic goal was established according to guidelines [2]. Immunosuppressive therapy included steroids, tacrolimus (Tac),

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and mycophenolic acid in most patients. BP control and immunosuppressive therapy were not statistically different between groups (data not shown).

### Statistical Analysis

Variables are presented as mean and standard deviation, median and interquartile range, or frequency, and these were compared using *t* test, Mann-Whitney *U* test, $\chi^2$ test or Fisher exact test, as appropriate. McNemar test was used to compare the antihypertensive therapy before and after RT. A 2-sided *P* value <.05 was considered statistically significant. Statistical analyses were performed using SPSS version 22.0.

## RESULTS

In the study period, 126 patients were transplanted and a total of 107 were included. Clinical and demographic characteristics at baseline are shown in Table 1.

There were 69 patients in the HD group and 38 in the PD group. Before RT, patients in the PD group showed a higher prevalence of hypertension ($P < .001$), had a shorter time on pre-RT renal replacement therapy (RRT; $P = .014$), and received more antihypertensive drugs than patients in the HD group ($P < .001$).

### Antihypertensive Therapy After Renal Transplantation

The prevalence of hypertension after RT was similar in both groups: at 1 month, HD vs PD, 57 (82.6%) vs 25 (65.8%; $P = .512$); at 6 months, HD vs PD, 58 (84%) vs 25 (65.8%; $P = .460$). On the other hand, a 5.7% increase in hypertensive patients was observed in the HD group at 6 months ($P = .055$). Some patients in the PD group could suspend antihypertensive therapy after RT, although no statistically significant differences were found (Table 2). No statistically significant differences were found between hypertensive and nonhypertensive patients in dose and serum trough Tac levels at 1 or 6 months post-transplantation: Tac dose at 1 month, hypertensive vs nonhypertensive: 0.11 ± 0.03 mg/kg vs 0.11 ± 0.04 mg/kg ($P = .962$), and at 6 months: 0.07 ± 0.03 mg/kg vs 0.08 ± 0.03 mg/kg ($P = .428$); serum trough Tac levels at 1 month, hypertensive vs nonhypertensive: 7.62 ± 1.40 ng/mL vs 8.03 ± 2.34 ng/mL ($P = .291$), and at 6 months: 6.91 ± 1.71 ng/mL vs 6.62 ± 1.25 ng/mL ($P = .260$).

In the total study population, a reduction in the number of antihypertensive drugs was observed at 1 month post-RT ($P = .034$), although no differences were observed at 6 months after transplantation ($P = .453$). In the PD group, a reduction of antihypertensive drugs at 1 month post-RT was observed ($P = .001$) and was maintained at 6 months ($P = .060$). In contrast, the HD group increased the number of antihypertensive drugs at 6 months after RT compared with pre-RT ($P = .027$; Table 3).

There was a reduction in the use of the angiotensin-converting-enzyme inhibitors (ACEIs) and angiotensin II receptor blockers at 1 month ($P < .001$). There was also lower use of ACEIs at 6 months in the total study population ($P = .002$). On the other hand, we observed a greater use of calcium channel blockers (CCBs) and α-blockers at 6 months ($P = .036$ and $P < .001$). CCBs were the most common drug in the total sample in pre- and post-transplant periods, with an increased use after RT (Table 4).

When changes in each RRT group were studied, there was also a lower use of ACEIs and angiotensin II receptor blockers in both groups. In addition, the use of diuretics was reduced in PD patients, and patients in HD group had an increased use of α-blockers.

Most patients needed more than a single drug to achieve an optimal control of BP after RT: at 1 month, HD vs PD: 21 (30.4%) vs 16 (42.1%) ($P = .512$); and at 6 months, HD

**Table 1. Demographic and Clinical Characteristics of the Patients**

| Variables | Total (n = 107) | HD (n = 69; 64.5%) | PD (n = 38; 35.5%) | *P* Value |
|---|---|---|---|---|
| Female sex, n (%)* | 40 (37.4%) | 28 (40.6%) | 12 (31.6%) | .848 |
| Recipient age, y | 56.32 ± 13.28 | 58.42 ± 3.32 | 52.50 ± 12.87 | .028 |
| CVD, n (%) | 13 (12.1%) | 6 (8.7%) | 7 (18.4%) | .170 |
| CKD etiology | | | | .541 |
| DM | 18 (16.8%) | 11 (15.9%) | 7 (18.4%) | |
| Nephroangiosclerosis | 10 (9.3%) | 8 (11.6%) | 2 (5.3%) | |
| GN | 32 (29.9%) | 20 (29.0%) | 12 (31.6%) | |
| Others | 27 (25.2%) | 15 (21.7%) | 12 (31.6%) | |
| Unknown | 20 (18.7%) | 15 (21.7%) | 5 (13.2%) | |
| BMI, kg/m$^2$* | 26.69 ± 5.06 | 26.51 ± 4.96 | 27.10 ± 5.33 | .590 |
| Recipient CMV (IgG+), n (%) | 86 (80.4%) | 56 (81.1%) | 30 (78.9%) | .366 |
| Deceased donor, n (%) | 91 (85%) | 62 (89.9%) | 29 (76.3%) | .057 |
| Donor age, y* | 59.02 ± 1.28 | 59.75 ± 12.017 | 57.57 ± 9.566 | .353 |
| Time on RRT pre-RT, mo† | 16 (9.28) | 19 (13.33) | 11 (1.22) | .014 |
| Donor CMV (IgG+), n (%) | 80 (74.8%) | 59 (85.5%) | 27 (71.1%) | .446 |
| Pre-RT hypertensive patients, n (%) | 83 (77.6%) | 47 (68.1%) | 36 (94.7%) | .031 |
| Pre-RT number of antihypertension drugs* | 1.51 ± 1.29 | 1.15 ± 1.13 | 2.16 ± 1.32 | <.001 |

Abbreviations: BMI, body mass index; CKD, chronic kidney disease; CMV, cytomegalovirus; CVD, cardiovascular disease; DM, diabetes mellitus; GN, glomerulonephritis; HD, hemodialysis; PD, peritoneal dialysis; RRT, renal replacement therapy; RT, renal transplantation.
*Mean ± standard deviation.
†Median ± interquartile range.