Prediction of Walking Performance Six Months after Kidney Transplantation

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Abstract. This study investigated the ability of 17 variables measured pretransplant to predict gait speed post transplant. Twenty-one renal transplant patients participated. Their age, height, weight, gender, diabetic status, knee extension force, grip force, sit to stand performance, standing balance, and gait speed (comfortable and maximum) were documented before transplant. Gait speed was measured again six months post transplant. Ten of the pretransplant variables were correlated significantly with both comfortable and maximum gait speed six months post transplant. Four additional pretransplant variables were correlated significantly with maximum gait speed six months post transplant. The highest correlations with the six month gait speeds were the same gait speeds pretransplant. Regression analysis showed, however, that pretransplant normalized knee extension strength added significantly to the explanation of both comfortable and maximum gait speed six months post transplant. Diabetic status added significantly to the explanation of comfortable gait speed six months post transplant. The findings of this study support the predictive validity of preoperative knee extension strength measures in kidney transplant patients.

Key words: Transplantation, Gait, Muscle.

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INTRODUCTION

Patients with renal disease, like those with numerous other diseases or disorders often demonstrate compromised walking performance^{1, 2)}. Research has shown this performance to be correlated concurrently with specific patient characteristics and impairments. Among such impairments are muscle weakness and decreased balance^{1, 2)}. What has not been established as often is the ability of various patient characteristics and impairments to predict future walking performance. Given the importance of walking performance to overall well being and independence in the community^{3–6)}, variables predicting such performance merit identification. The primary purpose of this research, therefore, was to determine the extent to which selected characteris-

tics and impairments measured before transplant could predict walking performance six months after transplant. Since early walking performance is known to relate to later walking performance in patients with renal disease and other disorders^{2, 7, 8)}, an additional purpose was to determine if pretransplant characteristics and impairments could offer any explanation of future walking performance beyond that provided by pretransplant walking performance.

METHOD

Subjects

This study involved a sample of 21 renal transplant subjects described in a previous publication²⁾. Twelve subjects received kidneys from cadavers whereas 9 received kidneys from living related do-

nors. Nine subjects were women; 12 subjects were men. Seven were diabetic. Their age was a mean 42 (range=21–58) years.

Instrumentation and Procedures

All measures were obtained before transplantation and six months after transplantation. Muscle strength of the upper extremities was characterized by grip strength which was measured with a Jamar hand-grip dynamometer. Muscle strength of the lower extremities was characterized by the sit to stand test and by knee extension strength measured by an Ametek hand-held dynamometer. Dynamometer measured strengths (forces) were recorded in two forms: actual (in Newtons) and normalized (actual/body weight). Standing balance was quantified using the seven level (0–6) scale described elsewhere by Bohannon, et al.⁸⁾ Walking performance was denoted by gait speed, both comfortable and maximum, over a distance of 6.1 meters.

Statistical analysis was conducted using the Systat statistical program. It involved descriptive statistics, correlations, and multiple regression.

RESULTS

Descriptive statistics for the subjects' pretransplant data are reported elsewhere²⁾ and are not repeated in detail here. Their comfortable gait speed was 110.4 ± 23.7 cm/sec before transplant and 114.8 ± 26.3 cm/sec six months after transplant. Their maximum gait speed was 179.1 ± 48.1 cm/sec before transplant and 169.8 ± 52.7 cm/sec six months after transplant.

Table 1 shows the correlations of independent variables measured pretransplant with gait speed measured six months post transplant. Ten of the pretransplant independent variables correlated significantly with comfortable gait speed at six months. Included among the variables were pretransplant gait speed, all lower extremity strength measures, standing balance, body height, and diabetic status. Fourteen of the pretransplant independent variables correlated significantly with maximum gait speed at six months. The significantly correlated variables were the same as those correlated significantly with comfortable gait speed plus the four upper extremity strength measures.

Regression analysis selected three pretransplant

Table 1. Correlation^a of Independent Variables Measured Pretransplant with Gait Speed Six Months after Transplant

Pretransplant Independent Variables ^b	Comfortable Gait Speed	Maximum Gait Speed
Age	– .021	– .036
Height	<u>.563</u>	<u>.559</u>
Weight	.122	.099
Gender	– .037	– .132
Diabetic status	<u>– .617</u>	<u>– .500</u>
ANKES	<u>.643</u>	<u>.714</u>
ADKES	<u>.584</u>	<u>.729</u>
NNKES	<u>.744</u>	<u>.809</u>
NDKES	<u>.604</u>	<u>.774</u>
ANGS	.399	<u>.522</u>
ADGS	.418	<u>.501</u>
NNGS	.341	<u>.476</u>
NDGS	.355	<u>.445</u>
Sit to stand	<u>.665</u>	<u>.688</u>
Balance	<u>.474</u>	<u>.755</u>
CGS	<u>.783</u>	<u>.670</u>
MGS	<u>.735</u>	<u>.884</u>

^a Critical values for Pearson correlations are .433 (<.05), .549 (<.01), and .665 (<.001). Critical values for Spearman correlations are .435 (<.05), .556 (<.01), and .681 (<.001). Correlations significant at $p < .05$ are underlined. ^b ANKES = actual nondominant knee extension strength, ADKES = actual dominant knee extension strength, NNKES = normalized nondominant knee extension strength, NDKES = normalized dominant knee extension strength, ANGS = actual nondominant grip strength, ADGS = actual dominant grip strengths, NNGS = normalized nondominant grip strength, NDGS = normalized dominant grip strength, CGS = comfortable gait speed, MGS = maximum gait speed.

variables as making a significant simultaneous contribution to the prediction of comfortable walking speed six months post transplant. The three variables were comfortable gait speed (CGS), diabetic status (DS), and normalized knee extension strength of the nondominant side (NNKES). Their multiple correlation with six month comfortable gait speed was .833. The regression equation incorporating the variables was $CGS (6 \text{ months}) = 1.246 + .532 \text{ CGS (pretransplant)} - .421 \text{ (DS)} + 1.979 \text{ NNKES}$. Regression analysis selected two pretransplant variables as making a significant simultaneous contribution to the prediction of maximum walking speed six months post trans-

plant. The two variables were maximum gait speed (MGS) and normalized knee extension strength of the dominant side (NDKES). Their multiple correlation with the six month maximum gait speed was .922. The regression equation incorporating the variables was $MGS (6 \text{ months}) = -.369 + .742 MGS (\text{pretransplant}) + 3.812 NDKES$.

DISCUSSION

This study showed that numerous independent variables measured pretransplant were correlated significantly with walking performance (speed) six months post transplant. All of the significantly correlated independent variables in this study have been found in previous cross sectional research to be related to gait speed^{1, 7, 9-12}. The previous studies verified the concurrent validity of the variables; this study confirmed the predictive validity of the same variables.

That a variable such as gait speed measured at one point in time should correlate with the same variable measured at a later point in time is not surprising. The issue in this study, therefore, became the added value of other variables in predicting an important outcome variable (gait speed). This study showed that other variables did provide added value. Pretransplant normalized knee extension strength added to the prediction of both comfortable and maximum gait speed six months post transplant. Diabetic status also added to the prediction of six month comfortable gait speed. These findings provide support for the measurement of strength and the documentation of diabetic status if the future gait performance kidney transplant patients is of interest.

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