Rehabilitation of Patients with End-Stage Renal Failure after Lower Extremity Amputation

Bertram Greenspun, DO, Robert Leland Harmon, MD


Four patients with end-stage renal failure on maintenance hemodialysis and one patient with near end-stage renal failure received inpatient rehabilitation following lower extremity amputation. All were prosthetically restored. Three of the patients had bilateral below-knee amputations and were ambulatory at the time of discharge, including the patient with near end-stage renal failure who was on maintenance hemodialysis at follow-up. One unilateral below-knee amputee was also ambulatory at discharge. The other unilateral below-knee amputee had an ulcer on the other foot and used a pylon for transfers only. To assess the prevalence of patients on maintenance hemodialysis with lower extremity amputations, a survey of 310 patients at four dialysis units was performed. Of the 310 patients 2.9 percent had at least one amputated lower extremity and 1.0 percent had bilateral lower extremity amputations. Preliminary data and the potential for functional results following prosthetic restoration suggest the need for further research concerning prosthetic restoration in the lower extremity amputee with end-stage renal failure.

KEY WORDS: Amputees; Hemodialysis; Kidney failure, chronic; Rehabilitation

Patients with end-stage renal failure (ESRF) may have a variety of medical problems that interfere with their level of function, including blindness, diabetes mellitus, peripheral neuropathy, amyotrophy, osteodystrophy, amputations, and generalized deconditioning.1 Studies by Gutman and associates4 and by Kutner and Cardenas5,6 examine overall physical activity and vocational rehabilitation in this patient population. However, the literature is scant concerning rehabilitation of these patients following amputation of an extremity. Although Greenspun7 previously presented some of his experience with ESRF patients following lower extremity amputations, to our knowledge the extent of this problem has not been reported.

Case information on five patients with chronic and end-stage renal failure who received inpatient rehabilitation following lower extremity amputation is presented along with data from a survey of hemodialysis units assessing the prevalence of lower extremity amputation in this population.

METHOD

Case Information

The records of an inpatient rehabilitation center were examined covering the period 1980 to 1984. Four patients with end-stage renal failure (ESRF) and one with near ESRF were found who received ambulation training after amputation of one or both lower extremities.

Case 1. A 56-year-old woman with ESRF had been on hemodialysis for five years. Her medical history revealed diabetes mellitus, hypertension, coronary artery diseases and blindness in her right eye.

Case 2. A 44-year-old woman with ESRF had been on hemodialysis two years. Her medical history revealed diabetes mellitus, hypertension, and blindness. She also wore a cardiac pacemaker.

Case 3. A 60-year-old woman had a medical history of chronic renal failure, diabetes mellitus, hypertension and peripheral vascular disease.

Case 4. A 61-year-old man with ESRF had been on hemodialysis for three years. Medical history showed diabetes mellitus, prior myocardial infarction, and peripheral vascular disease. He wore a cardiac pacemaker.

Case 5. A 55-year-old man with ESRF had been on hemodialysis two years. His medical history showed diabetes mellitus and coronary heart disease.

Table 1: Medical Histories for Patients Receiving Rehabilitation after Lower Extremity Amputation

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (yrs)</th>
<th>Sex</th>
<th>Medical History</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>56</td>
<td>F</td>
<td>ESRF, on hemodialysis 5 years Diabetes mellitus Hypertension Bladder in right eye</td>
</tr>
<tr>
<td>2</td>
<td>44</td>
<td>F</td>
<td>ESRF, on hemodialysis 2 years Diabetes mellitus Hypertension Bladder in both eyes</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>F</td>
<td>Chronic renal failure Diabetes mellitus Hypertension Bladder in both eyes Peripheral vascular disease</td>
</tr>
<tr>
<td>4</td>
<td>61</td>
<td>M</td>
<td>ESRF, on hemodialysis 3 years Diabetes mellitus Prior myocardial infarction Cardiac pacemaker Peripheral vascular disease</td>
</tr>
<tr>
<td>5</td>
<td>55</td>
<td>M</td>
<td>ESRF, on hemodialysis 2 years Diabetes mellitus Coronary artery disease</td>
</tr>
</tbody>
</table>

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Table 2: Functional Outcome for with Rehabilitation after Lower Extremity Amputation (I = independence, S = supervision, Min A = minimal assistance)

<table>
<thead>
<tr>
<th>Patient</th>
<th>Length of stay (days)</th>
<th>Function at Discharge</th>
<th>Function at Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60</td>
<td>Transfers</td>
<td>Patient ambulating well 2 years and 2 years 5 months after discharge. Still ambulatory 3 years 9 months after discharge when she had left BKA and required a wheelchair for mobility.</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>Transfers using pylons</td>
<td>Patient using intact right leg for transfers 2 years 4 months after discharge, wearing left pylons for cosmetic purposes. Right leg amputated 3 years 9 months after discharge, and died 3 years 10 months after discharge.</td>
</tr>
<tr>
<td>3</td>
<td>45</td>
<td>Transfers</td>
<td>Patient ambulating well 1 year 10 months after discharge.</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>Ambulation with two axillary crutches</td>
<td>Patient ambulating short distances 180 days after discharge.</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>Ambulation with two quad canes</td>
<td>Patient ambulating well 8 months after discharge when a right hand infection prevented him from holding his cane. At 1 year 2 months after discharge he had not been ambulatory about 6 months but could ambulate short distances with axillary crutches and both prostheses in clinic.</td>
</tr>
</tbody>
</table>

RESULTS

Data for age, sex, race, and medical history for the five patients who received rehabilitation following lower extremity amputation are summarized in Table 1. The mean age was 55.2 ± 6.8 years. All five patients had diabetes mellitus, four had cardiac problems, and two had impaired vision. The other leg of the patients presented with new unilateral below-knee amputations (BKA). Of these, two patients (3 and 4) had prior BKA of the other leg, which had been prossthetically restored. The fifth patient presented with new bilateral BKA.

Lengths of stay in the rehabilitation center ranged from 17 to 62 days for the five patients (table 2) with a mean of 44.2 ± 25.2 days. Each patient had their new amputated leg prossthetically restored. At the time of discharge, only patient 2 was nonambulatory due to an ulcer on the remaining heel that prevented weight-bearing. The four other patients were ambulatory, three for at least 60m and one for short distances. Length of follow-up varied for each patient, but the four patients who were ambulatory at discharge remained so at least eight months after discharge. The nonambulatory patient was ultimately able to use her intact right leg for transfers until it was amputated three years, five months after discharge; she died five months later.

The patient with chronic renal failure (2) was noted to have marked deterioration in her renal function during her hospitalization, and she began maintenance hemodialysis approximately two months after discharge. At her last follow-up visit, one year 10 months after discharge, she continued ambulating well and was still on dialysis.

Data for the hemodialysis unit survey are summarized in Table 3. Clinically, the mean age for the subgroup of patients with lower extremity amputations was higher than for the total population. This difference was statistically significant at 90% but not at 95% confidence. There was no statistically significant difference for sex and race between the two groups. Of the 310 patients surveyed on hemodialysis, nine (2.9%) had lower extremity amputations with four (1.3%) having unilateral BKA, two (0.6%) with unilateral above-knee amputation, and three (1%) with bilateral BKA. In all, 1.2 (1.9%) of the 620 available lower extremities, had been amputated.

DISCUSSION

The five renal failure patients received rehabilitation in an inpatient unit following amputation as each had poor activity tolerance prior to the program. Prosthetic fitting was complicated for these patients by the fluctuation in edema of the stump before and after dialysis. This was managed by casting the patient's stump for the socket just before dialysis, using inserts, and varying the number of stump sock ply as needed when the stump edema was less.

The data on the 310 patients on maintenance hemodialysis were compared to National Center for Health Statistics (2) figures showing the 1977 United States noninstitutionalized civilian population prevalence for patients with least one amputated lower extremity, excluding toes, (0.12%) and for bilateral lower extremity amputees (0.01%). While results of the hemodialysis unit survey should be considered preliminary due to the small sample taken in only one part of the country the data show the prevalence of total lower extremity amputees and bilateral lower extremity amputees on maintenance hemodialysis surveyed to be 24 times and 50 times, respectively, the prevalence in the noninstitutionalized civilian population in 1977.

CONCLUSION

Results for five patients with end-stage and near end-stage renal failure who received rehabilitation following lower extremity amputation suggests these patients deserve a trial pe-
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A period of ambulation training unless they are too medically unstable to participate in the program. A larger study is warranted to compare performance of these patients with performance of patients not on dialysis to determine what other special problems they might have. A larger dialysis unit survey is also needed to assess the number of dialysis patients with lower extremity amputations in this country.

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ABSTRACTS of selected literature


- Eleven consecutive patients with progressive chronic inflammatory demyelinating polyradiculoneuropathy (CIDP) underwent plasma exchange. Eight patients were previously unresponsive to prednisone, two were started on prednisone with plasma exchange, and one did not receive corticosteroids. Electrodiagnostic studies revealed evidence of an acquired demyelinating polyradiculoneuropathy with varying degrees of axonal degeneration. Neurologic impairment was monitored using conventional functional status index. Five patients demonstrated substantial clinical improvement, beginning 3-4 days to 3 weeks after a second course of plasma exchange, and four patients demonstrated minimal or no change. Comparison of responding and nonresponding patients showed no differences related to the presence or absence of antecedent illness, duration of disease, duration of maximum weakness, or severity of impairment prior to plasma exchange. Responders had significantly prolonged F-response and motor distal latencies compared to nonresponders. Results in this unselected, consecutive patient trial suggest a temporal relationship between plasma exchange and clinical improvement in some patients with progressive CIDP.


- Interobserver variation in diagnosis is thought to be an important source of bias in studies of cerebral palsy. Kappa (κ) statistics were used as a measure of interobserver diagnostic agreement for two case series of 20 children attending an institution for the motor handicapped. κ increased threefold after standardization of diagnostic terms. Sources of diagnostic variation are discussed and possibilities and benefits of its further reduction explored.


- The proportions of different fiber types (type 1 and type 2) on the borders of fascicles are shown to differ from the proportions internally. This finding is based on the analysis of a total of 245 fascicles from whole cross-sections of the vastus lateralis muscle from 13 men, aged from 20-80 years. Generally, the difference is more marked in the young than in the old. It is argued that the causes of this difference are likely to be local factors in the muscle.


- A multilumen catheter was modified to allow simultaneous recording of transdiaphragmatic pressure (Pdi) and the electromyographic (EMG) activity of the diaphragm. The catheter was used in 20 healthy males to measure the conduction time of the phrenic nerves and the twitch pressure of each hemidiaphragm during single supramaximal shocks delivered to the phrenic nerve in the neck. Diaphragmatic EMG was also recorded with surface electrodes at various sites on the chest wall. The mean conduction time to the crural fibers was 6.82 ± 0.64 ms on the right and 7.93 ± 0.85 ms on the left, whereas that to the costal fibers adjacent to the midclavicular line was 7.68 ± 0.56 ms on the right and 7.92 ± 0.92 ms on the left. Significant correlations were found between the conduction time of each phrenic nerve and the height and the age of the subjects. Conduction times measured at different EMG recording sites varied by as much as 2 ms. This variability, and that of previously reported values for phrenic conduction time, may be largely accounted for by differences in the conduction distances that were measured to each site in three cadavers. The evoked change in Pdi had a mean rise time of 92 ms and an amplitude of ~10 cm H2O.

References