Acta Biomed 2017; Vol. 88, N. 2: 167-171 DOI: 10.23750/abm.v88i2.5035 © Mattioli 1885

Original article

# Early rehabilitative treatment after infrainguinal lower limb bypass surgery

*Ettore Carlisi[1], Patrick Caspani[2], Paola Morlino[2], Maria T. Bardoni[1] Claudio Lisi[1], Maurizio Bejor[2], Elena Dalla Toffola[1]*

[1] Physical Medicine and Rehabilitation Unit, I.R.C.C.S. Policlinico San Matteo Foundation & University of Pavia, Pavia, Italy;
[2] Department of Clinical, Surgical, Diagnostic and Pediatric Sciences, University of Pavia, Pavia, Italy

**Summary.** *Background and aim of the work:* Functional activity may remain limited in patients affected by critical limb ischemia, despite successful infrainguinal lower limb bypass surgery (ILLBS). The aim of the work was to evaluate the impact of a rehabilitative intervention on postoperative ambulatory status and pain. *Methods:* In an observational study, data were collected on 34 patients undergoing ILLBS for critical limb ischemia or end-stage peripheral arterial disease. All patients underwent a postoperative rehabilitation program aimed at recovering gait autonomy. Information was collected on pre-operative comorbidities, ambulatory status (on admission to and discharge from hospital) and pain in the affected lower limb (on the first physiotherapy session and at discharge). *Results:* Before ILLBS, 61.8% of the patients walked independently without aids or assistance. The rehabilitative program started on average 5.7 (SD: 2.1) days after surgery. At discharge, 50% of the patients walked independently, 41.2% walked with aids and/or assistance and 8.8% were not able to walk. Overall, 76.5% of the sample recovered their pre-operative ambulatory status. Although pain tended to decrease, the difference at the first (1.5; SD: 2.6) and at the last treatment session (0.8; SD= 1.3) was not statistically significant. *Conclusion:* Our exercise protocol resulted to be easy to perform during hospital stay, with an overall favourable outcome for ambulatory status. Our results are in line with those reported in literature about the rates of postoperative dependence in walking, but appear to be slightly better in regards to the percentage of patients who recovered pre-operative ambulatory status. (www.actabiomedica.it)

**Key words:** rehabilitation, Infrainguinal lower limb bypass surgery, critical limb ischaemia

## Introduction

Peripheral arterial disease (PAD) is a common manifestation of systemic atherosclerotic disease. Exercise is part of the lifestyle modification needed in PAD and a supervised treadmill-training regime is considered effective in improving symptoms and increasing walking distance (1). However, where no improvement is seen with conservative management, a surgical approach is usually considered for disabling PAD. An increasing number of surgeons favour endovascular treatment as the initial therapy, but infrainguinal lower limb bypass surgery (ILLBS) is still the most common choice for diffuse occlusive disease of the infrainguinal segment or critical limb ischemia (CLI) (2). Patient's expectations are that postoperatively they will be pain free and walk well, but functional activity may remain limited as a consequence of multiple factors, including hospitalization, despite successful surgical treatment (3). Delay in the recovery of complete autonomy in daily life activities implies an additional burden on health care resources. Traditional outcome measures, focusing only on technical "success", are usually considered poor predictors of functional outcome (3),

whereas from a rehabilitative point of view, general mobility and ambulatory status, reflecting functional performances, are considered basic measures of outcome after surgery. The role of rehabilitation following ILLBS has yet to be properly delineated.

We report a supervised early rehabilitative intervention for the post-acute phase of ILLBS and evaluate its impact on ambulatory status and pain in a short-term assessment.

## Methods

*Population and study design*

In an observational study, data were collected on 34 patients undergoing infrainguinal lower limb bypass surgery followed by a rehabilitation program aimed at recovering preoperative ambulatory status. Patients were affected by critical limb ischemia (or severe disabling end-stage PAD). All were treated at the Vascular Surgery Unit of our hospital from February 2011 to March 2014 and evaluated by a physiatrist as soon after ILLBS as they were considered clinically stable by the surgeon. We considered ineligible for early post-acute rehabilitation patients who were still clinically unstable one week after surgery. Information was collected from medical charts on basic demographics and pre-operative comorbidities. The impact of pre-operative comorbidities was calculated using the Charlson Comorbidity Index (4,5).

*Outcome*

For the aim of the present study, ambulatory status was categorized into three groups: independent patients walking without aids or assistance; aided patients who were ambulant with walking aids and/or assistance and dependent patients (bed-bound or wheelchair-bound). We recorded information about the walking performance on admission to and discharge from hospital and we calculated, as outcome of the study, the percentage of patients who recovered pre-operative ambulatory status. Pain in the affected lower limb was recorded on the first and on the last physiotherapy session, using the Numeric Rating Scale (6).

*Procedures–Post acute rehabilitation*

The early post-acute rehabilitation project had two objectives: maintenance (or recovery) of the range of motion and of the strength in the affected limb; and recovery of standing position and gait. The program involved daily 30 minute sessions, each consisting of 15 minutes of exercise in bed and 15 minutes of gait training assisted by a physiotherapist, until the discharge from hospital.

Table 1 reports the stages of the rehabilitation program we carried out.

The program usually started with cautious passive mobilization of the joints in the limb that had undergone ILLBS, with the patient lying supine. Once the ankle joint had been mobilized, the physiotherapist focused on the knee and hip, often kept in a flexed attitude because of the pain. The physiotherapist then assisted active flexion and extension of the limb (including hip, knee and ankle) and stretched the hamstrings to gain complete knee extension. This was followed by easy isometric reinforcement of the gluteus muscles. From the supine position, the patient was brought into lateral decubitus and then into a sitting position. From the 2$^{nd}$ session of treatment, the program focused on recovery of the upright position and gait. Exercises included bilateral hip abduction and marching on the spot. Upright position and gait training were usually aided (cane or walker), but only transitorily if the patient had not required them previously. At the beginning of gait training, the therapist asked the patient to walk for a 10 meter distance. The patient performed progressively longer distances and the physiotherapist corrected the gait pattern if necessary.

**Table 1.** Early postoperative Rehabilitation Program

| |
|---|
| **From the 1st session of physiotherapy** |
| • Passive mobilization of hip, knee and ankle |
| • Active-assisted exercise in flexion & extension of hip, knee and ankle |
| • Sitting & standing position recovery |
| **From the 2nd session of physiotherapy** |
| • Standing position recovery |
| • Assisted exercises in upright position |
| • Gait training |
| • Gait pattern control |

In addition to anamnestic data, we collected the following: length of treatment (expressed as number of sessions of physiotherapy); the start dates of the program, of upright positioning and of assisted gait training (expressed as number of days after surgery). Patients signed their consent in accordance with the indications of the local ethical committee.

*Statistical Elaboration*

Categorical variables are expressed in numbers and percentages; quantitative variables are shown with mean and standard deviation. The Paired T-test was used to analyze pre-post therapy differences. A significance level of $P<0.05$ was adopted. MedCalc for Windows Version 9 software was used to analyze the data.

## Results

34 infrainguinal lower limb bypass procedures, 18 (52.9%) on the right lower limb, were performed on 34 patients (79% males), aged 71.1 years (SD: 13.9). A high preoperative comorbidity burden (Charlson Comorbidity Index >5) was recorded in 12 (35.3%) of the patients. All patients started the early rehabilitative program an average of 5.7 (SD: 2.1) days after surgery. Three patients were not able to start gait training: the first because of a previous leg amputation, the second because of a haematoma at the surgical site and the third because affected by dizziness. None of the patients died before hospital discharge, on average 12.74 (SD: 5.96) days after ILLBS. The mean number of treatment sessions before discharge was 5,6 (SD:3.9). On average, patients needed 2 sessions of physiotherapy (SD: 2.1) to recover standing and walking function.

*Outcome*

Data on ambulatory status are reported in Figure 1.

Despite claudication, 32 (94.1%) of the patients were still able to walk at least short distances on admission to the hospital. Before ILLBS, 21 (61.8%) of the patients walked independently, 11 (32.4%) walked with aids and/or assistance and 2 (5.9%) were wheelchair or bed-bound. At discharge, 17 (50%) of the patients walked independently, 14 (41.2%) walked with aids and/or assistance and 3 (8.8%) were not able to walk. On the whole, 26 (76.5%) of the sample recovered their pre-operative ambulatory status after the early rehabilitation program, the other 8 (23.5%) presenting a worse ambulatory status than before hospitalization. Although pain tended to decrease, the difference between pain in the affected limb at the first (1.5; SD: 2.6) and at the last treatment session (0.8; SD=1.3) was not statistically significant.

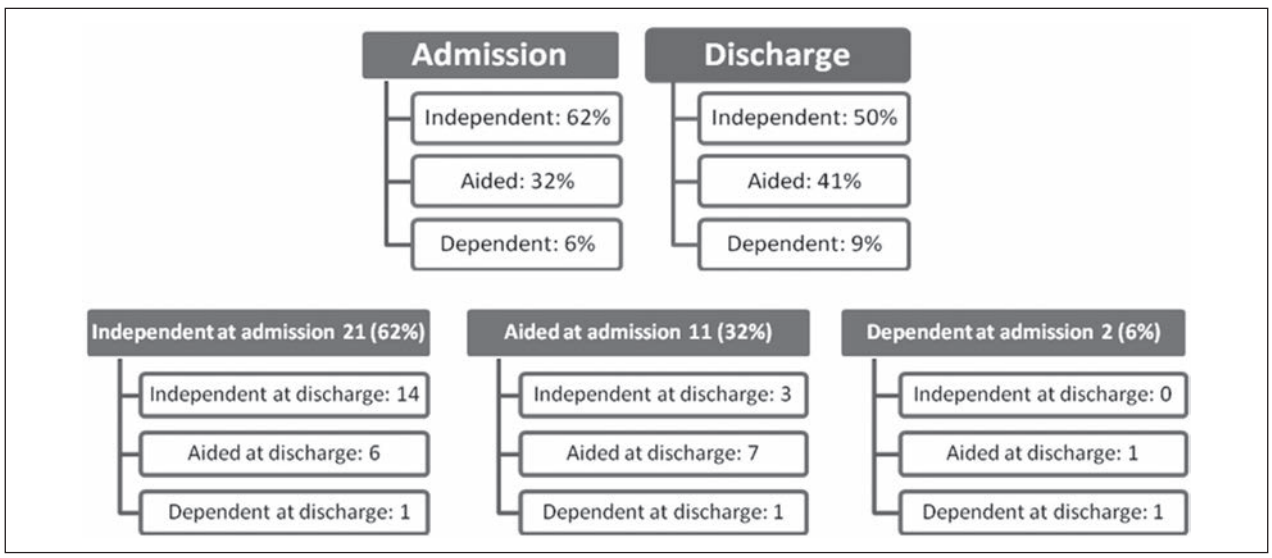


**Figure 1.** Ambulatory status at admission and at discharge

## Discussion

Intermittent claudication, the symptomatic expression of the inability of the blood flow to supply the oxygen required by lower limbs, is typical of PAD (1). Consequently, the primary goal after ILLBS should be rapid recovery of the walking function. Preoperative non-ambulatory status as well as postoperative non-ambulation have been found to significantly predict mortality (3). In spite of this, the small number of studies detailing the ambulatory status of patients prior to and after ILLBS, report a generally slow recovery of walking, with a significant number of patients failing to achieve independent mobility in the postoperative period (3,7-18). Recent studies have also shown that patients are often discharged from hospital with a worse post- than pre-operative functional status, despite successful surgical treatments (3,19). Ambler (2013) reported significantly impaired postoperative mobility, in association with prolonged hospital stay, with rates of dependence in walking of 7% at discharge and of 21% at 12 month follow-up (17). In 2012, Rollins et al. reviewed 10 previous studies assessing mobility status of patients who had undergone ILLBS; only three reported an improvement in ambulatory status at follow-up. The authors estimated that ILLBS maintains ambulation in 75% of patients at a follow-up period ranging from 30 days to 1 year, with the rate of independence in walking prior to ILLBS being 91% on average. In the present study, the majority of our patients (94%) were still able to walk preoperatively (62% independent walking, 32% aided walking). At discharge from hospital, the overall percentage of ambulant patients remained stable(91%) with 50% of patients completely independent and 41% aided in walking. Most of our patients (76.5%) recovered preoperative ambulatory status, the other 23.5% presenting a worse post than pre-hospital ambulatory status. Our results at post operative discharge are comparable and in line with those reported by Ambler and Ballotta (16,17) about the rates of dependence in walking (< 10%), but appears to be slightly better in regards to the percentage of patients who recovered pre-operative ambulatory status (76.5% versus 59%) (17).

The lack of longer follow-up prevents further comparisons with the previously published literature and evaluation of the impact of our exercise program in the medium and long-term period. This study presents other formal limitations, especially a small sample size and the absence of comparison with a control group (not performing rehabilitation). Our exclusively functional evaluation also does not take into account the technical features of the bypass procedures. None of the previously cited studies takes into account the potential of postoperative rehabilitation in improving the functional outcome of ILLBS. However, in our opinion, a supervised exercise program, performed in the first and second postoperative weeks, could play a precious role in functional recovery.

In terms of the type of exercise, choosing the best rehabilitation treatment after ILLBS can be challenging because the field has not been exhaustively investigated so far. Lungren et al addressed the issue in 1989 and found that performing exercise improves the benefit conferred by surgery (19). In 2007, Badger reported significant advantages (increase in maximum walking distance) for a supervised treadmill exercise program started 4 weeks after ILLBS, but 70% of patients did not take part in the training because of their high comorbidity burden or refused to (1). Our early rehabilitation program is not intended to substitute supervised treadmill exercise, which improves exercise tolerance and walking distance. Nevertheless it is easy to perform during the hospital stay, without any additional time burden for the patients.

## Conclusions

The past years have witnessed a growing interest in the role of early mobilization of surgical patients, in keeping with the hypothesis that this might reduce further physical and psychological sequelae. In this paper, we present a patient-oriented supervised exercise protocol, reflecting our real everyday practice. Our aim was to focus the reader's attention on the role of exercise in the immediate postoperative period of ILLBS. Further studied are needed to understand the efficacy of rehabilitation in this context.

## References


1. Badger SA, Soong CV, O'Donnell ME, Boreham CA, McGuigan KE. Benefits of a supervised exercise program after lower limb bypass surgery. Vasc Endovascular Surg 2007 Feb-Mar; 41(1): 27-32.
2. The Task Force on the Diagnosis and Treatment of Peripheral Artery Diseases of the European Society of Cardiology (ESC). ESC Guidelines on the diagnosis and treatment of peripheral artery diseases. Eur Heart J 2011 Nov; 32(22): 2851-2906. doi: 10.1093/eurheartj/ehr211.
3. Rollins KE, Coughlin PA. Functional outcomes following revascularisation for critical limb ischaemia. Eur J Vasc Endovasc Surg 2012 Apr; 43(4): 420-425.
4. Charlson ME, Pompei P, Ales KL, MacKenzie RC. A new method of classifying prognostic Comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987; 40: 373-383.
5. Charlson ME, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. J Clin Epidemiol 1994; 47(11): 1245-1251.
6. Krebs EE, et al. Accuracy of the Pain Numeric Rating Scale as a screening test in primary care. J Gen Intern Med 2007; 22 (10): 1453-1458
7. Nehler MR, Moneta GL, Edwards JM, Yeager RA, Taylor LM Jr., Porter JM. Surgery for chronic lower extremity ischemia in patients eighty or more years of age: operative results and assessment of postoperative independence. J Vasc Surg 1993 Oct; 18 (4): 618-624.
8. Abou-Zamzam AM Jr., Lee RW, Moneta GL, Taylor LM Jr, Porter JM. Functional outcome after infrainguinal bypass for limb salvage. J Vasc Surg 1997 Feb; 25 (2): 287-295.
9. Pomposelli FB Jr, Arora S, Gibbons GW, et al. Lower extremity arterial reconstruction in the very elderly: successful outcome preserves not only the limb but also residential status and ambulatory function. J Vasc Surg 1998 Aug; 28(2): 215-225.
10. Nicoloff AD, Taylor LM Jr, McLafferty RB, Moneta GL, Porter JM. Patient recovery after infrainguinal bypass grafting for limb salvage. J Vasc Surg 1998 Feb; 27(2): 256-263.
11. Luther M. Surgical treatment of chronic critical leg ischaemia. A five-year follow-up of survival, mobility, and treatment level. Eur J Surg 1998 Jan; 164(1): 35-43.
12. Landry GJ, Moneta GL, Taylor LM Jr, Edwards JM, Yeager RA. Comparison of procedural outcomes after lower extremity reversed vein grafting and secondary surgical revision. J Vasc Surg 2003 Jul; 38(1): 22-28.
13. Chung J, Bartelson BB, Hiatt WR, et al. Wound healing and functional outcomes after infrainguinal bypass with reversed saphenous vein for critical limb ischemia. J Vasc Surg 2006 Jun; 43(6): 1183-1190.
14. Taylor SM, Cull DL, Kalbaugh CA, et al. Critical analysis of clinical success after surgical bypass for lower-extremity ischemic tissue loss using a standardized definition combining multiple parameters: a new paradigm of outcomes assessment. J Am Coll Surg 2007 May; 204(5): 831-838.
15. Goodney PP, Likosky DS, Cronenwett JL; Vascular Study Group of Northern New England. Predicting ambulation status one year after lower extremity bypass. J Vasc Surg 2009 Jun; 49(6): 1431-1439.
16. Ballotta E, Gruppo M, Mazzalai F, Martella B, Terranova O, Da Giau G. Infrapopliteal arterial reconstructions for limb salvage in patients aged >=80 years according to preoperative ambulatory function and residential status. Surgery 2010 Jul; 148(1): 119-128.
17. Ambler GK, Dapaah A, Al Zuhir N, et al. Independence and mobility after infrainguinal lower limb bypass surgery for critical limb ischemia. J Vasc Surg 2014 Apr; 59(4): 983-987.
18. Vogel TR, Petroski GF, Kruse RL. Functional status of elderly adults before and after interventions for critical limb ischemia. J Vasc Surg 2014 Feb; 59(2): 350-358.
19. Lundgren F, Dahllof AG, Lundholm K, Schersten T, Volkmann R. Intermittent claudication – surgical reconstruction or physical training? A prospective randomised trial of treatment efficiency. Annals of Surgery 1989; 209(3): 346–355.


Received: 11 December 2015
Accepetd: 13 January 2016
Correspondance:
Ettore Carlisi, MD
I.R.C.C.S. Policlinico San Matteo Foundation
Piazzale Golgi 19, 27100 Pavia, Italy
Tel. 0382.502052
Fax 0382.502075
E-mail: e.carlisi@smatteo.pv.it.