Rehabilitation of Transtibial Vascular Amputation with Type 2 Diabetes Mellitus and Peripheral Artery Disease: A Case Report

Juwita Arum Mayangsari[1], Nur Sulastri[2]

juwita.arum.mayangsari-2017@fk.unair.ac.id
[1] Physical Medicine and Rehabilitation Resident, Faculty of Medicine Universitas Airlangga, Surabaya, Indonesia
[2]Departemnt of Physical Medicine and Rehabilitation, Faculty of Medicine Universitas Airlangga, Surabaya, Indonesia
Dr. Soetomo Academic Medical Center Hospital, Surabaya, Indonesia

Abstract

Introduction: Most lower extremity amputations are currently caused by vascular disorders. Diabetes contributes to two-thirds of all lower extremity amputations, while 6-10% of amputations are due to traumatic injury, and the remainder is due to a tumor. The role of physical medicine and rehabilitation experts is very important in providing an overview of the functional level based on the level of amputation.
Case: 66 years old, female, referred from Orthopedic department with diagnosing right below-knee amputation 1 year ago, to be made a prosthesis. She underwent amputation because has an ulcer on the back of her foot that worsens and is always wet. She has diabetes mellitus type 2, diabetic nephropathy, hypertension, and peripheral artery disease that altered her condition. She already could do most of the daily activities and walk independently using a walker in a couple of months after surgery. From the physical examination, we found postural low back pain, limitation of right hip joint range of motion, peripheral polyneuropathy, decreased cardiorespiratory endurance, and less confident MFES that indicate fear of fall in geriatric. A complete geriatric assessment was done. Following the rehabilitation program for 6 months, the patient felt a more fit, full right hip range of motion was obtained. She walked more easily with her prosthesis and experienced improvements in physical function parameters
Conclusion: The prosthesis was needed to decrease energy consumption during ambulation. Recommended amputation rehabilitation involves interaction between the health care team and the patient to achieve rehabilitation goals.

Keywords: amputee; transtibial amputation; geriatric; diabetic foot; rehabilitation

1. Introduction

Most lower extremity amputations are currently caused by vascular disorders (diabetic vascular disorders, atherosclerosis, immunologic, and idiopathic), which ranges from 75-93% of amputations. Diabetes contributes to two thirds of all lower extremity amputations, while 6-10% of amputations are due to traumatic injury, and the remainder are due to tumors (Walsh et al. 2010). International diabetes federation (IDF) estimated the total number of people with diabetes worldwide is to rise from about 536 million in 2021 to 642 million in 2030. In Indonesia, people with diabetes mellitus number around 19 million in 2021 (IDF, 2022).

Peripheral arterial disease (PAD) one of macrovascular complication of diabetes mellitus. It is the third leading cause of atherosclerotic vascular morbidity after coronary artery disease (CAD) and stroke,

increasing the risk of cardiovascular disease-related disability and death (Fowkes, 2013). The prevalence of PAP in developed countries is around 5% at the age of 40-44 years and becomes 12% at the age of 70-74 years. Between 2000 and 2010, the number of people living with PAD increased by 13.1% in high-income countries and 28.7% in middle- and low-income countries (Criqui et al., 2021). Another recent systematic review estimated that 238 million people lived with PAD in 2015, of whom 64 million lived in high-income countries and 172 million lived in low- and middle-income countries (Song et al., 2020).

The role of physical medicine and rehabilitation experts is very important in providing an overview of the functional level based on the level of amputation. In addition to pharmacological treatment, a supervised exercise program has been recommended as a therapy for PAP. Recent evidence demonstrates the benefits of exercise even among patients with PAP who do not have claudication. An exercise program combined with risk factor modification offers the possibility of slowing the clinical course of PAP (Hamburg and Balady, 2011). Supervised treadmill exercise and home walking exercise each improve walking ability in patients with PAP (Mcdermott, 2019).

2. Case Report

A 66 years old female referred from Orthopedic department with diagnose right below knee amputation 1 year ago, to be made a prosthesis. She came to our hospital to have a leg prosthesis. She underwent amputation because has an ulcer on the back of foot that worseness and always wet. She has hypertension for 10 years, diabetic mellitus type 2, peripheral artery disease and diabetes nephropathy that worsen her condition. She routinely controls at Internal medicine and Cardiology department of Bhayangkara hospital, Surabaya. She had short acting insulin 3 x 10 iu, long-acting insulin 1 x 10 iu, Aspilet 1 x 100 mg, Simvastatin 1 x 20 mg, Amlodipine 1 x 10 mg, Bisoprolol 1 x 5 mg and Furosemid (only if edema appears).

She wasn’t joint social event as much as before she got amputated. She already could do most of daily activity and walking independently using walker in a couple months after surgery. She could walk short distance and doing household activity using walker, for the farer one she using wheelchair, independently. She joined religious gathering if it’s held about 20 m radius, more than that, she couldn’t due to the high effort when walking in one leg using walker. The Barthel index was 80 of 100. There was no pain in the amputee nor the sensation of the amputee segment.

The patient also complained about low back pain which felt in the last 3 months. The back pain come and go with numeric rating scale (NRS) 4. The back pain increased by sitting or standing in a long time and relived with lying (NRS 0). There was no radiating pain. The trauma was denied. She already got LS corset,

which she used often until now and she also got microwave diathermy and transcutaneous electrical stimulation in the low back for 3 months.

The vital sign was as follows: BP 150/90 mmHg; HR 60 x/min (regular); RR 20 x/min; Sat 99%. Kyphotic posture and the joints range of motion were full except for the right hip joint range of was limited in all direction. Sensory deficit felt on the left foot from the ankle to distal and both of hand (stocking glove sensation) 30% indicate peripheral polyneuropathy. She is able to transfer from sitting to standing withhold hand in the grip of the walker, one leg stand were 2 seconds, and hoping by hold of one hand for safety. The stump level at right below knee 54% length, conical shape, no open wound, no pain (Figure 1).

(a)  (b) 

Fig. 1. (a) Stump shape; (b) Patient wearing prosthesis

Cardiorespiratory examination found count test 15, decrease chest expansion (T2 1,5 cm; T4 1 cm; T6 1 cm), the left ankle brachial index (ABI) was 0,94. Electrocardiograph examination found moderate left ventricular hypertrophy. She finished timed up and go test in 50 seconds, walk 55 m in six minutes walking test (6MWT), and modified falls efficacy scale (MFES) was 6,1 that indicate fairly confident fear of fall in geriatric. Blood laboratory result found HbA1C 8,5; creatine serum 2,43 mg/dL; and total cholesterol 233 mg/dL. A complete geriatric assessment including functional capacity, fall risk, cognition, mood, polypharmacy, social support, financial concerns, goals of care, advance care preferences were done.

In pre prosthesis rehabilitation phase, we give her posture correction, diaphragmatic breathing and

chest expansion exercise, active range of motion exercise upper & lower extremities, isotonic strengthening exercise for crutches muscles and both lower extremities, stretching exercise for the right hip joint, drawing in to strengthen the core muscles and post prandial endurance exercise with mild intensity (Borg scale 10-12 or Heart rate rest + 20) 3-5 times a week to help regulate the blood glucose. We also educate the patient to control the diet to avoid high blood glucose fluctuation and low sodium diet. The home visit was scheduled to provide more information for rehabilitation program and caregiver education.

The prosthesis prescription was a below knee prosthesis with total contact surface bearing socket, foam based inner socket, endoskeleton shank and SACH (solid ankle cushion heel) foot. The challenge in this case were the patient's metabolic conditions and stump size which could changing in a couple hours, it's made the prosthesis fitting more complicated. The post prosthesis rehabilitation programs consist of balance exercise, gait training with the prosthesis, and continue post prandial endurance exercise with arm crank and walking.

Following the rehabilitation program for 6 months, the patient felt more fit, full right hip range of motion was obtained. She walked more easily with her prosthesis, and experienced improvements in physical function parameters. The OLS increased from 2 to 6 seconds, MFES from 6,7 to 9,2, decrease TUG from 50 to 18 seconds, could walk 220 m in 6MWT and Barthel index from 80 to 95. Patient also can participate in religious and social events with more confidence. She must control her metabolic condition routinely to maintain her whole condition. Socket evaluation would needed periodically. Patient must care and aware to keep cleanliness her left foot and stump and no less important was support from her family physically and psychologically.

3. Discussion

The role of physical medicine and rehabilitation experts is very important in providing an overview of the functional level based on the level of amputation. Below knee amputation consists of 3 levels, namely short, medium, and long transtibial amputation. Short transtibial amputation is an amputation with a stump of less than 20% of the tibia length. Medium/standard transtibial amputation is an amputation with a puncture length between 20-50% of the tibia length. Meanwhile, long transtibial amputation is an amputation with a butt length between 51-90% of the tibia length (Walsh et al, 2010).

Rehabilitation in geriatric amputate is always challenging (Silva et al., 2019). Bachmann et al.(2010) have found that comprehensive geriatric assessment (CGA) leads to improved detection and documentation of

geriatric problems. In this case we found so much comorbidities such diabetes mellitus which leads to peripheral neuropathy, peripheral artery disease and nephropathy diabetic. Hypertension, decrease of cardiorespiratory endurance, imbalance and fear off fall also became a challenge in the rehabilitation program. The prosthesis was needed to decrease energy consumption during ambulation. Energy expenditure during ambulation in transtibial vascular amputee would increase about 40% and would walk 44% slower. Crutch walking without prosthesis will increase energy consumption in transtibial amputee (Gonzalez and Edelstain, 2001). A systematic review by Frengopoulos et al. (2021) stated that increased age was negatively associated with prosthesis fitting. Rehabilitation success was not uniform in some participants.

To determine the type of lower limb prosthesis, it is necessary to evaluate the functional status of the amputee patient. The division of functional levels of amputee patients into levels K0-K4 was introduced by Medicare, the United States government insurance company. K0 is the level for those who are not ambulated, at this level there is no need for a prosthesis. Group K1 were those limited to transfer or limited household ambulator, requiring a prosthesis with stance control knee and SACH or single axis foot. Those who unlimited household but limited community ambulator belong to K3 level, need a pneumatic or polycentric knee and multi axis foot. K3 and K4 each are unlimited community ambulator and high energy activities would need an hydraulic knee and energy storing foot (Uustal and Baerga, 2015).

Most lower extremity amputations are currently caused by vascular disorders (diabetic vascular disorders, atherosclerosis, immunologic, and idiopathic), which ranges from 75-93% of amputations. Diabetes contributes to two thirds of all lower extremity amputations, while 6-10% of amputations are due to traumatic injury, and the remainder are due to tumors. The basic principles in determining the level of amputation at surgery are to maintain the limb as long as possible which is best for wound healing, to an acceptable soft-tissue coverage, and to allow for the fitting of a functional prosthesis (Walsh et al, 2010).

Geriatric vascular amputation rehabilitation team should be involved interaction between the health care provider, care giver, and the patient to achieve to achieve mutually agreed goals. The rehabilitation process with prosthesis can be divided into four phases, namely pre-prosthesis management, postoperative care consists of prosthesis fittings and exercises, and long-term follow-up. This division of phases allows physical medicine and rehabilitation specialists to carry out a thorough assessment and ensure that the rehabilitation program is running well. (Walsh et al, 2010).

Major lower-limb amputation would cause a significant socioeconomic burden, decreases functional capacity, autonomy and more importantly quality of life. Elderly people with a lower-limb amputation would

facing a heavy burden on health resources, requiring comprehensive rehabilitation program and long-term care. The special characteristic of geriatric with lower-limb amputation, with multiple physical, psychological, cognitive, and social comorbidities, imposes unique challenges to ongoing rehabilitation care (Silva et al., 2019).

4. Conclusion

The role of physical medicine and rehabilitation experts is very important in providing an overview of the functional level based on the level of amputation. The prosthesis was needed to decrease energy consumption during ambulation. Geriatric vascular amputation rehabilitation team should be involved interaction between the health care provider, care giver, and the patient to achieve to achieve mutually agreed goals.

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