JRSR 7 (2020) 60-65

Journal of Rehabilitation Sciences and Research

Journal Home Page: jrsr.sums.ac.ir

Original Article

Lower Limb Amputee Patients Have Comorbidities and Risk of Complications - Findings from a Hospital Audit

Shyh Poh Teo[1, 2*], MD

[1]Older Persons Rehabilitation Services, Hutt Hospital, Lower Hutt, New Zealand
[2]Department of Internal Medicine, Raja Isteri Pengiran Anak Saleha Hospital, Brunei Darussalam

ARTICLE INFO

Article History:
Received: 11/04/2020
Revised: 01/06/2020
Accepted: 03/06/2020

Keywords:
Amputees
Comorbidity
Postoperative complications
Rehabilitation
Standards of care

Please cite this article as:
Teo SP. Lower Limb Amputee Patients Have Comorbidities and Risk of Complications - Findings from a Hospital Audit. JRSR. 2020;7(2):60-65.

ABSTRACT

Background: Lower limb amputee patients tend to have multiple co-morbidities and are at risk of developing complications during early rehabilitation for lower limb amputees. These complications are associated with worse outcomes and interruption in rehabilitation, requiring a transfer from the rehabilitation ward to acute medical or surgical care. This study aims to describe the circumstances of patients transferred from early lower limb amputee rehabilitation ward to regional hospitals, and identify areas of potential improvement in management.
Methods: The present study is a retrospective study of electronic records for patients admitted or transferred to Hutt Hospital from vascular surgery wards for early lower limb amputee rehabilitation between 1st January 2009 and 31st December 2011. The data collected was identified through a multidisciplinary discussion to determine appropriate standards of care for amputee patients. This included patient demographics, comorbidities, cognitive and physical function, as well as complications during rehabilitation.
Results: There were 42 lower limb amputations with median age of patients 71.5 years. Dysvascularity was the most common cause (57.1%) for amputation. Patient care was inappropriately stepped-down to a rehabilitation ward, including one in six amputees who were not haemodynamically stable, and one-quarter of patients with hypoglycaemia. Handover between allied health staff and comprehensive assessment, particularly of the contralateral limb should be improved. Complications during rehabilitation involved 71.4% patients, the most common non-wound issues were decubitus ulcers, chest infections and delirium. A quarter of the patients, initially living at home were discharged to residential care. The median length of hospital stay was 44.5 days.
Conclusions: Amputee patients have multiple co-morbidities and a high risk of complications. The areas of improvement identified included transfer of care between allied health professionals, appropriateness of step-down transfer to rehabilitation, assessment of the contra-lateral limb and standardisation of care. Education of healthcare professionals and systematic transfer of care should be implemented for patients transferred for early rehabilitation for lower limb amputees.

Introduction

Amputee patients are complex to manage and tend to have multiple co-morbidities [1]. For patients with peripheral vascular disease, an amputation is performed when there is critical ischaemia of a limb and restoring circulation with vascular procedures, such as angioplasty or bypass fails. These patients need to recover from surgery, post-operative complications and overcome prior deconditioning. Amputee rehabilitation has been shown to improve survival and function [2].

*Corresponding author: Shyh Poh Teo, Department of Internal Medicine, Raja Isteri Pengiran Anak Saleha Hospital, Bandar Seri Begawan, BA1710, Brunei Darussalam. **Tel:** +673 2242424;
Email: shyhpoh.teo@moh.gov.bn

For older amputees, there is a lower rate of successful prosthesis fitting [3] and a 1-year mortality rate above 40% [4, 5]. As the number of amputees is also on the increase [1, 6] management of amputees should be systematic. Guidelines for management of amputee patients are available to improve outcomes and reduce complication risk [7-9]. Patient selection for step-down transfer is important as the rehabilitation ward is less equipped to handle acute medical or surgical issues. Delays or interruption in rehabilitation due to complications occur in up to a third of amputee patients, resulting in worse outcomes [10].

It has been shown that older people undergoing amputations mostly failed to return to their functional baseline, particularly those who have a higher amputation level, stroke, end-stage renal disease and poor baseline cognitive scores. As these comorbidities are associated with worse outcomes, they should be assessed and managed to maintain activities of daily living and quality of life [11].

In New Zealand, at least 40% of amputees are aged 60 years and over; with a third of patients requiring amputations due to vascular complications [12]. Hutt Hospital is a regional hospital with 270 beds, located 30 minutes from Wellington, which is the main tertiary hospital. Rehabilitation of amputee patients is done by the multidisciplinary Older Persons and Rehabilitation Service (OPRS). Vascular surgeons performing amputations for the greater Wellington area (including Hutt) are based in Wellington Hospital. Once deemed stable, post-acute surgery, patients living in Hutt are transferred to Hutt Hospital for rehabilitation.

The aims of this study were to describe the type of lower limb amputee patients for early rehabilitation, including complications, in Hutt Hospital, and identify areas of potential improvement in care and management of amputee patients.

Methods

This was a retrospective audit of patients admitted or transferred to Hutt Hospital for lower limb amputee rehabilitation between 1st January 2009 and 31st December 2011, as concerns were raised regarding an increase in the number of amputees with complications in the ward, requiring transfer back to acute care.

Identifying patients discharged after amputee rehabilitation was difficult due to variability in discharge diagnosis. A list of patients who underwent vascular surgery (including amputation) in Wellington Hospital was obtained from the departmental database. Electronic records were reviewed to determine whether they had amputations and were appropriate for inclusion in the study. This was a census of all amputee patients identified. Patients discharged directly from vascular surgery or transferred to other hospitals were excluded.

Gathered information was determined by a multidisciplinary discussion regarding what was deemed appropriate standards of care for amputees. This discussion involved a consultant physician, geriatrician, physiotherapist, clinical nurse manager, registered nurse and occupational therapist. A pro forma sheet was designed and completed after a manual review of clinical and electronic records. Data was analysed with Excel.

Baseline patient information includes age, gender, level and side of amputation, reason for amputation and whether further procedures were required. Elixhauser co-morbidities, which is a list of medical conditions easily obtained from administrative databases and is predictive of 1-year mortality, was used as a reference list to identify patients' medical conditions [13].

The admissions ward in Hutt Hospital was identified. Adequacy of transfer of care from physiotherapy, occupational therapy and nurses including wound chart was assessed. Due to inconsistency of documentation in clinical notes, it was not possible to determine the type of stump bandaging used.

Medical stability and appropriateness of transfer post amputation was assessed based on the following criteria provided in amputee guidelines [7]: haemodynamic stability, lack of systemic infection or appropriate treatment provided, stable surgical site, acceptable bowel and bladder management and co-morbidities addressed.

Cognition and psychological and nutritional assessments post-amputation were reviewed. The Abbreviated Mental Test (AMT) is routinely completed on admission to the Hutt rehabilitation ward, which is a cognitive screening tool scored between 0 to 10 points. Documentation of the contralateral limb assessment including sensory or motor deficits, arterial perfusion, deformity, pressure loading and footwear, as well as pain type, adequacy and type of analgesia were reviewed.

Complications during rehabilitation including wound related problems were identified. Wound status was categorised based on healing, which is described in amputee guidelines [7]. Rehabilitation outcomes include Functional Ambulation Level [7], Functional Independence Measure (FIM) [14], functional goals of prosthesis fitting [7] and whether a prosthesis was provided on discharge.

Functional ambulation level classifies a person's ability to mobilise into several categories; independent community ambulatory, limited community ambulatory, limited household ambulatory, supervised household ambulatory, transfers only or bedridden [7]. The FIM scores 18 items related to self-care, bowel and bladder control, transfers, mobility, communication and cognition, rated on a 7-point scale from complete dependence (1-point) to complete independence (7-points). This is measured on admission and discharge to quantify progress in rehabilitation, with total scores ranging from 18 to 126 [14]. Functional goals of prosthesis fitting are indicated through K-levels, ranging from 0 to 4, and determines the expected outcomes from a prosthesis and rehabilitation. Level 0 indicates the person is unable to ambulate and transfer, thus a prosthesis would not be helpful; while level 4 exceeds basic ambulation including high impact, stress and energy levels; for example in an active adult or athlete [7].

Median length of stay was also calculated. Follow-up at an artificial limb centre, with vascular surgery and allied health staff was collated.

The admission and discharge destination of patients were compared. In New Zealand, the levels of residential care are as follows: Rest homes for residents who are mild to moderately dependent needing some assistance with activities of daily living and night care, but not nursing care; dementia rest home for residents with challenging behaviour assessed by psych-geriatricians as requiring special care and close monitoring with restricted access outside the facility; and hospital level care for residents requiring long-term nursing care, where the facility is always staffed by at least two people, with a registered nurse present at all times.

Results

Patient Characteristics

There were 42 amputations in total. The median age was 71.5 years (ranging from 48 to 89 years), 29 (69%) were male. Two-thirds of amputations (28 patients) were transtibial or below-knee, while a fifth (8 patients) were transfemoral or above-knee. The baseline patient characteristics, including comorbidities and reasons for amputation, are summarised in Table 1. No other concomitant musculoskeletal abnormalities were identified. Dysvascularity was the most common cause for amputation (57.1%). One third of patients required further amputation or vascular procedures. None of the patients had amputations performed due to trauma.

Transfer from Acute Vascular Surgical Care

Patients who underwent amputation were in Wellington Hospital for a median of 9 days (Ranging from 3 to 84 days). One patient had their lower limb amputation performed in Hutt Hospital by plastic surgeons.

The wards patients were transferred to at Hutt Hospital were as follows: 26 patients (61.9%) to the medical ward, 14 (33.3%) to the rehabilitation ward and two to the surgical wards; of which one was for plastic surgery for wound complications.

The 25 patients transferred from acute vascular surgical care remained in Hutt Hospital acute medical or surgical ward for a median of 7 days (Ranging from 1 to 61 days).

3 patients were not transferred to rehabilitation; one was transferred back to vascular surgery, a patient requested discharge home with hospice follow-up due to pain, and one was directly discharged from the medical ward.

Handover between allied health staff of both hospitals was limited, with formal transfer of care by physiotherapists for10 patients (23.8%), by occupational therapists for 3 patients (7.2%) and by nurses for 7 patients (16.7%). This was determined by identifying formal handover documents in the clinical notes of patients when transferred to the rehabilitation wards.

Criteria for appropriateness of transfer (as per amputee guidelines) are summarised in Table 2 [7].

Assessment of Amputee Patients

Abbreviated Mental Test (AMT) was completed for 31 patients. Median AMT was 8 (Ranging from 3 to 10). Although all patients had psychological concerns, psychology assessment was provided for only 7 patients (16.7%). 35 patients (83.3%) had a nutritional screen done, with subsequent dietician review if warranted.

Table 1: Baseline Patient Characteristics (N=42)

Gender, n (%)	
Male	29 (69%)
Female	13 (31%)
Median age (years)	71.5 years (Range: 48 to 89 years)
Amputation type, n (%)	
Hip disarticulation	1 (2.4%)
Transfemoral	8 (19%)
Transtibial	28 (66.7%)
Lower digits	4 (9.5%)
Other (Index and middle finger)	1 (2.4%)
Amputation side, n (%)	
Left	25 (59.5%)
Right	17 (40.5%)
Median time: admission to amputation	3 days (Range 0 to 49)
Median no. of comorbid medical conditions	5 (Range 1-11)
Comorbid medical conditions, n (%)	
Peripheral vascular disease	24 (57.1%)
Hypertension	24 (57.1%)
Congestive cardiac failure	20 (47.6%)
Diabetes	18 (42.9%)
Renal failure	17 (40.5%)
Cardiac arrhythmias	16 (38.1%)
Chronic Pulmonary disease	12 (28.6%)
Other neurological disorders	11 (26.2%)
Deficiency anaemia	10 (23.8%)
Coagulopathy	4 (9.5%)
Peptic ulcer disease	4 (9.5%)
Valvular heart disease	4 (9.5%)
Reason for amputation, n (%)	
Dysvascularity	24 (57.1%)
Diabetes	13 (31.0%)
Non-diabetic arteriosclerosis	9 (21.4%)
Venous Disease	2 (4.8%)
Infection	17 (40.5%)
Acute	13 (31.0%)
Chronic	4 (9.5%)
Neoplasia (High grade pleomorphic sarcoma)	1 (2.4%)

Documentation of findings regarding the contralateral limb assessment was analysed for 39 patients only, as 3 were bilateral amputees. Findings are summarised in Table 3.

Pain was sub-typed as phantom limb pain in 23 (54.8%) patients, residual limb pain in 13 (31.0%) and lower back pain in 3 (7.1%). Type of pain was not characterised in 13 (31.0%) patients. Analgesia was considered adequate in 30 (71.4%) patients.

The most frequent analgesia prescribed was paracetamol in 37 (88.1%), followed by amitriptyline 17 (40.5%), short acting morphine 16 (38.1%), gabapentin 15 (35.7%), tramadol 13 (31%) and diclofenac 13 (31%). Median number of analgesics per patient was 4 (Range 1-8).

Complications during Rehabilitation

30 patients (71.4%) experienced complications during their stay in hospital. The most common wound complications identified were infections in 13 (30.9%) patients, surgical wound dehiscence in 5 (11.9%), stump necrosis in 2 (4.8%) and haematoma in 2 (4.8%). One patient had osteomyelitis. The three most common non-wound related complications were decubitus ulcers

Table 2: Appropriateness for transfer

Appropriateness For Transfer	Yes	No
Haemodynamic Stability	35 (83.3%)	7 (16.7%)
No infection / Treatment given	32 (76.2%)	10 (23.8%)
Stable Surgical Site	30 (71.4%)	12 (28.6%)
Bowel / Bladder Management	23 (54.8%)	19 (45.2%)
Comorbid Conditions Addressed	19 (45.2%)	23 (54.8%)

Table 3: Assessment of the contralateral limb

Contralateral Limb:	Normal	Abnormal	Not assessed
Sensory Deficit	8 (20.5%)	3 (7.7%)	28 (71.8%)
Motor Deficit	10 (25.6%)	10 (25.6%)	19 (48.7%)
Arterial Perfusion	10 (25.6%)	9 (23.1%)	20 (51.3%)
Deformity	2 (5.1%)	1 (2.6%)	36 (92.3%)
Abnormal Pressure Loading	0	5 (12.8%)	34 (87.2%)
Footwear	0	1 (2.6%)	38 (97.4%)

Table 4: Rehabilitation Outcomes

Rehabilitation Outcomes	Admission	Discharge
Place of Residence:		
Home	35 (83.3%)	24 (57.1%)
Rest Home	4 (9.5%)	5 (11.9%)
Hospital Level Care	3 (7.1%)	9 (21.4%)
Transfer to Tertiary Hospital	0	4 (9.5%)
Functional Ambulation Level:		
Independent Community Ambulator	18 (42.9%)	4 (9.5%)
Limited Community Ambulator	8 (19.0%)	9 (21.4%)
Limited Household Ambulator	8 (19.0%)	5 (11.9%)
Supervised Household Ambulator	3 (7.1%)	5 (11.9%)
Transfers	2 (4.8%)	16 (38.1%)
Bedridden	0	3 (7.1%)
Not Documented	3 (7.1%)	0

(21.4%), chest infections (14.3%) and delirium (14.3%). Other complications such as joint contracture, peripheral nerve injury, oedema of the residual limb, disuse atrophy of the ipsilateral or contralateral limb, as well as psychological complications such as depression were not documented.

No patients were diagnosed with venous thrombo-embolism. DVT prophylaxis was prescribed in 80.9%; 30 (71.4%) on enoxaparin and 4 (9.5%) on warfarin. Eight (19%) did not have prophylactic anticoagulation.

Rehabilitation Outcomes

One quarter of patients initially living at home were discharged to an alternative facility, with an increase in proportion of patients discharged into residential care. Table 4 summarises the place of residence for patients on admission and discharge, and functional ambulation level from admission to discharge.

Four patients were transferred back to Wellington Hospital due to complications; of which two were discharged home. The remaining two had the contra-lateral limb amputated, then returned to Hutt Hospital for rehabilitation; of which one was discharged home, the other to Hospital Level Care.

FIM on admission for 37 patients was 70.5 (Range 28 to 113). Median FIM on discharge for 36 patients was 94.5; the mean change in FIM for 36 patients was 11.5.

Functional goals of prosthesis fitting was categorised as follows: K0 in 2 (4.8%), K1 in 17 (40.5%), K2 in 3(7.1%), K3 in 4 (9.5%). Functional goals were not documented in 16 (38.1%) of patients.

Median length of stay in Hutt Hospital was 35 days (Ranging from 5 to 197 days); while total length of stay in hospital was 44.5 days (Ranging from18 to 203 days).

None of the patients had their prosthesis supplied prior to discharge. The reasons were as follows: 20 (47.6%) prostheses were not ready, 8 (19%) could not be fitted due to wound complications, and four (9.5%) did not have fittings completed for manufacturing of their prosthesis.

Follow-Up

35 (83.3%) were referred to the artificial limb centre. Almost all patients (39 or 92.9%) had vascular follow-up organised while only two-thirds had follow-up community rehabilitation.

Discussion

When an increased incidence of complications affecting rehabilitation was suspected, an audit of amputee patients was warranted. This study describes a three-year sample of amputee patients transferred to Hutt Hospital, a regional hospital with rehabilitation facilities. This study confirmed the suboptimal management of comorbidities and high incidence (71%) of complications, resulting in potentially inappropriate transfer of care to a rehabilitation service.

The large variation in baseline patient characteristics

and outcome for amputee patients in studies limits comparison between different patient groups [14]. There is a wide range in patient ages. While the proportion of men in this group was greater and should be targeted for vascular risk reduction, women with vascular pathology have inequity in outcome, including worse function and quality of life [15]. Standardised care for vascular patients may improve this.

There were multiple co-morbidities per patient; the most common in at least 40% of patients were peripheral vascular disease, hypertension, cardiac failure, diabetes and renal failure. This may be an underestimate, as these comorbidities had to be diagnosed and recorded in clinical notes for inclusion into our data.

Dysvascularity was the most prevalent reason for amputation, followed by 40.5% amputations due to infections. Aggressive management of vascular risk factors and distal infections for these vasculopaths should be prioritised for reducing amputation rate.

Intensive rehabilitation is important, resulting in improved outcomes for functional ambulation and community reintegration [14]. Formal arrangements such as establishing sub-regional specialist rehabilitation units for amputees, preferably in partnership with vascular surgical units may be helpful [15, 16].

Coordinating allied health staff to provide comprehensive rehabilitation is challenging for patients transferred between hospitals. The limited formal handover between therapists in Wellington and Hutt Hospital was identified, which affects continuity of care. An inter-disciplinary care guideline for amputee management is available [9], as coordination of care, including multidisciplinary interim prosthetic programmes have been shown to improve outcome [17]. Education of the rehabilitation team, including physicians, allied health professionals, healthcare providers, caregivers and patients is necessary to achieve quality care for amputee patients.

Guideline recommendations were used to assess appropriateness of transfer from acute vascular surgical care [7]. Multiple unresolved issues include haemodynamic stability, infections and management of co-morbidities. This assessment is important as being in a rehabilitation ward not equipped to handle medical emergencies could result in inadequate care, putting these patients at risk. As one-sixth of the amputees were not haemodynamically stable, with a quarter experiencing hypoglycaemia, there is now a preference in Hutt Hospital for post-acute amputee patients to be re-assessed in a medical ward or Medical Assessment and Planning Unit (MAPU) prior to transfer for rehabilitation.

Complications during rehabilitation were frequent in (71.4%) patients. 30.9% of patients have wound infections, higher than other studies with approximately 20% [18, 19]. As one in five patients have decubitus ulcers, pressure injury prevention strategies should be a priority for these patients.

A comprehensive review of amputees includes assessment of cognition, nutrition, psychological health and examination of the contralateral limb [7]. Cognitive deficits are associated with poor outcome despite rehabilitation [20]. As amputations are associated with negative psychosocial sequelae, psychological assessment and counselling should be offered routinely [21]. As most amputations were due to peripheral vascular disease, assessment of arterial perfusion in the contralateral limb is important to avoid bilateral amputation [22], which was only performed in half of the amputees.

The type of post-amputation pain should be characterised, as this has implications on pain management and function [23]. Pain subtype was only documented in 31% of patients. Currently, input from the acute pain service is provided for amputees post-operatively.

In terms of rehabilitation outcomes, the proportion of patients able to return home reduced by 25%, while those who were able to independently ambulate in the community decreased significantly post amputation from 42.9% to 9.5%, with increased patients functionally limited to transfers only from 4.8% to 38.1%. These outcomes show a decline in function; how this compares to other studies is unclear due to differing baseline characteristics and outcome measures used [24]. Mortality data was not calculated, as this study reviewed patients who managed to be transferred to a secondary hospital only.

Areas of improvement identified include; transfer of care between allied health staff, assessment of appropriateness for transfer to rehabilitation, assessment of contra-lateral limb to reduce risk of further amputations and standardisation of care for these patients.

Recommendations to improve amputee rehabilitation are as follows: Given the complexity of these patients, awareness and education on preventing and treating complications should be emphasized. Guidelines for multidisciplinary team involvement and seamless transfer of care, including steps for implementation are already available, which require review and discussion by the relevant stakeholders [9]. A checklist for assessment of amputee patients, including the multiple facets of care may need to be considered to ensure complications are identified early and managed.

There were several limitations in this study. This was a retrospective study of amputations performed by vascular surgeons in a tertiary hospital, with rehabilitation carried out in a regional hospital, hence there was no influence over which surgical specialty performed the amputations, or the amputation method used. Mortality data was not collected, as we included solely amputees transferred to Hutt Hospital post-surgery. In addition, long term functional outcomes were not evaluated, as the patients had subsequent follow-ups in the artificial limb centre. The sample size is small, preventing multivariate analysis and identifying predictors of outcome. It looked specifically at a subset of amputee patients, who were transferred from post-acute amputation to rehabilitation. As with other studies on amputees, these findings are difficult to generalise due to heterogeneity and variability between amputee patient groups. However, this study adds to the limited evidence of amputee patients and outcomes, particularly regarding management in regional or sub-acute rehabilitation units.

Conclusions

Areas of improvement identified include transfer of care between allied health professionals, appropriateness of step-down transfer to rehabilitation, assessment of the contra-lateral limb and standardisation of care. Education of healthcare professionals and systematic transfer of care should be implemented for lower limb amputee patients transferred for rehabilitation.

Acknowledgements

We would like to thank the following people for all their valuable input and support in this project:
Dr Sisira Jayathissa (Consultant Physician / Geriatrician)
Helen Bryant (Physiotherapist, Community Team Leader)
Joycelyn Go (Clinical Nurse Manager)
Fiona Evans (Registered Nurse)
Anna Harnden-Taylor (Occupational Therapist)

Conflict of Interest: None declared.

References

1. Scott H, Patel R, Hebenton J. A survey of the lower limb amputee population in Scotland 2009. Glasgow: Scottish Physiotherapy Amputee Research Group; 2011. pp. 1-35.
2. Stineman M, Kwong P, Kurichi J, Prvu-Bettger J, Vogel W, Maislin G, et al. The effectiveness of inpatient rehabilitation in the acute postoperative phase of care after transtibial or transfemoral amputation: Study of an integrated health care delivery system. Arch Phys Med Rehabil. 2008;89:1863-72.
3. Fleury AM, Salih SA, Peel NM. Rehabilitation of the older vascular amputee: a review of the literature. Geriatr Gerontol Int. 2013;13(2):264-273.
4. Dillingham T, Pezzin L. Rehabilitation setting and associated mortality and medical stability among persons with amputations. Arch Phys Med Rehabil. 2008;89:1038-45.
5. Hershkovitz A, Dudkiewicz I, Brill S. Rehabilitation outcome of post-acute lower limb geriatric amputees. Disabil Rehabil .2013;35(3):221-7. doi: 10.3109/09638288.2012.690818
6. Fletcher D, Andrews K, Butters M, Jacobsen S, Rowland C, Hallett J. Rehabilitation of the geriatric vascular amputee patient: a population based study. Arch Phys Med Rehabil. 2001;82:776-779.
7. Department of Veterans Affairs, Department of Defense. Rehabilitation of lower limb amputation. [VA/DoD Clinical Practice Guidelines] Washington: Department of Veterans Affairs. [updated 2017 Sep; cited 2020 Apr 5] Available from: https://www.healthquality.va.gov/guidelines/Rehab/amp/VADoDLLACPG092817.pdf
8. BSRM Working Party Report. BSRM Amputee and prosthetic rehabilitation – Standards and guidelines. 3rd Edition. United Kingdom: British Society of Rehabilitation Medicine. 2018. [updated 2018; cited 2020 Apr 5] Available from: https://www.bsrm.org.uk/downloads/prosthetic-amputeerehabilitation-standards-guidelines-3rdedition-webversion.pdf
9. D, Flanagan G. Final report to New Zealand Artificial Limb Board. Design and implementation of interdisciplinary care guidelines for hospital management of amputees in Christchurch. Final report to New Zealand Artificial Limb Board. New Zealand: Artificial Limb Board. [cited 2020 Apr 5] Available from: https://www.nzals.co.nz/assets/Utility-Files/DebbieHockleyCareGuidelinesReport1.pdf
10. Meikle B, Devlin M, Garfinkel S. Interruptions to amputee rehabilitation. Arch Phys Med Rehabil 2002;83(9):1222-8.
11. Vogel TR, Petroski GF, Kurse RL. Impact of amputation level and comorbidities on functional status of nursing home residents after lower extremity amputation. J Vasc Surg. 2014;59(5):2014.
12. New Zealand Artificial Limb Centre. 2013-2014 all current amputees. [Internet]. [cited 2020 Apr 5] Available from: https://www.nzals.co.nz/assets/Utility-Files/NZALS-Statistics-2013-20141.pdf
13. Thompson NR, Fan Y, Dalton JE, Jehi L, Rosenbaum BP, Vadera S, et al. A new Elixhauser-based comorbidity summary measure to predict in-hospital mortality. Med Care. 2015;53(4):374-379.
14. Wong MW-N. Changing dynamics in lower extremity amputation in China. Arch Phys Med Rehabil. 2005;86:1778-81.
15. Lefebvre K, Chevan J. Sex disparities in level of amputation. Arch Phys Med Rehabil. 2011;92:118-24.
16. Fyfe N. An audit of amputation levels in patients referred for prosthetic rehabilitation. Prosthet Orthot Int. 1990;14:67-70.
17. Hordacre B, Birks V, Quinn S, Barr C, Patritti B, Crotty M. Physiotherapy rehabilitation for individuals with lower limb amputation: a 15 year clinical series. Physiother Res Int. 2013;18(2):70-80.
18. Leung H, Wong W, Wu F, Guerin J. Perioperative and rehabilitation outcome after lower limb amputation in elderly Chinese patients in Hong Kong. J Orthop Surg. 2004;12:102-9.
19. Peng C, Tan S. Perioperative and rehabilitative outcomes after amputation for ischaemic leg gangrene. Ann Acad Med Singapore. 2000;29:168-72.
20. O'Neill B, Evans J. Memory and executive function predict mobility rehabilitation outcome after lower limb amputation. Disabil Rehabil. 2009;31:1083-1091.
21. Desmond D, MacLachlan M. Psychological issues in prosthetic and orthotic practice: a 25 year review of psychology in Prosthetics and Orthotics International. Prosthet Orthot Int. 2002;26:182-88.
22. Brett F, Burton C, Duguid M, Brown M, Randell T, Clark K, et al. Risks to the contra-lateral foot of unilateral lower limb amputees: a therapist's guide to identification and management. United Kingdom: BACPAR. [Cited 2020 Apr 5]. Available from: http://bacpar.csp.org.uk/publications/risks-contra-lateral-foot-unilateral-lower-limb-amputees-guideline
23. Ehde D, Czerniecki J, Smith D, Campbell K, Edwards W, Jensen M, Robinson L. Chronic phantom sensations, phantom pain, residual limb pain and other regional pain after lower limb amputation. Arch Phys Med Rehabil. 2000;81:1039-44.
24. Deathe B, Miller W, Speechley M. The status of outcome measurement in amputee rehabilitation in Canada. Arch Phys Med Rehabil. 2002;83:912-8.