Evidence for use of subjective global assessment of the nutritional status of patients with peripheral arterial disease

Evidências para o uso da avaliação nutricional subjetiva global nos pacientes com doença arterial periférica

Leandro de Oliveira Costa[1,2], Débora Úrsula Fernandes Souza[3], Walter Moreira Fonseca[1], Bárbara Couto Cifuentes Gonçalves[1], Gabriela Bhering Gomes[1], Lucas Amorim Ribeiro da Cruz[1], Nilder Nister Alves Reis Júnior[1], José Oyama Moura Leite[1]

Abstract

Malnutrition is an extremely common disease among hospitalized patients, with prevalence rates as high as 50% overall, 47% among surgical patients and from 39 to 73% among patients with peripheral arterial disease. It has a major impact on morbidity and mortality among these patients. Malnutrition is very relevant to these patients' clinical outcomes and is associated with a higher incidence of infections, slower wound healing, lower rates of mobility, longer hospital stays and greater mortality. However, diagnosing malnutrition or nutritional risk in these patients has proven to be a challenge. To date, subjective global nutritional assessment remains the gold standard screening method for use with hospitalized surgical patients because of its practicality and accuracy. The objective of this study is to review methods used for assessment of nutritional status and for nutritional screening of hospitalized patients and determine the importance of these assessments to the clinical outcomes of patients with arteriopathies.

Keywords: peripheral arterial disease; morbidity; mortality; nutritional status; subjective global nutritional assessment; malnutrition.

Resumo

A desnutrição é uma doença extremamente prevalente em pacientes internados, chegando a acometer 50% deles, 47% dos pacientes cirúrgicos e entre 39 e 73% dos portadores de doença arterial periférica, com grande impacto na morbimortalidade desses pacientes. A desnutrição possui grande relevância no desfecho clínico desses pacientes durante a internação, estando associada a maior incidência de infecções, demora na cicatrização das feridas, diminuição do *status* de deambulação, maior tempo de internação e mortalidade. Entretanto, o diagnóstico de desnutrição ou risco nutricional desses pacientes tem sido um desafio. A avaliação nutricional subjetiva global revelou-se, até o momento, o padrão ouro como método de triagem de pacientes cirúrgicos internados devido à sua praticidade e acurácia. O objetivo deste trabalho é revisar métodos utilizados na avaliação do estado nutricional e da triagem nutricional de pacientes internados e caracterizar a importância dessa avaliação nos desfechos clínicos dos pacientes com arteriopatias.

Palavras-chave: doença arterial periférica; morbidade; mortalidade; estado nutricional; avaliação nutricional subjetiva global; desnutrição.

[1] Universidade Federal de Minas Gerais – UFMG, Belo Horizonte, MG, Brazil.
[2] Fundação Hospitalar do Estado de Minas Gerais – FHEMIG, Hospital Alberto Cavalcanti, Belo Horizonte, MG, Brazil.
[3] Universidade Federal de Minas Gerais – UFMG, Hospital das Clínicas, Belo Horizonte, MG, Brazil.

Financial support: None.
Conflicts of interest: No conflicts of interest declared concerning the publication of this article.
Submitted: March 23, 2015. Accepted: November 30, 2015.

The study was carried out at Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, MG, Brazil.

 http://dx.doi.org/10.1590/1677-5449.001215

INTRODUCTION

Malnutrition is under-diagnosed among hospitalized patients in general and in patients with peripheral arterial disease (PAD) it is associated with higher rates of morbidities such as increased incidence of infections, slower wound healing, reduced mobility and longer hospital stays.[1-3] Mild malnutrition has been linked to a rate of complications almost twice that observed in well-nourished patients.[4] Moreover, severe malnutrition has been linked with a complications rate that is 10 times higher than in well-nourished patients.[4] These increased morbidity rates and their impacts on the lives of patients with vascular disease are responsible for increasing public health costs, since they cause higher treatment costs.[5,6] In view of this, determination of the nutritional status of patients with vascular disease is of fundamental importance, so that supportive measures can be initiated in order to mitigate the effects of this factor.

MATERIALS AND METHODS

Search strategy and selection criteria

A search was run for articles indexed by the National Center for Biotechnology Information (NCBI), written in any language and published up to February 2015, using the keywords "malnutrition" and "peripheral arterial disease". Articles published before 1980 were only selected if they had more than two hundred citations.

During the investigation, the authors reviewed the abstracts of the articles returned by the search and selected those considered of interest for preparation of this review article, reading the full texts before including them in the database.

LITERATURE REVIEW

Peripheral arterial disease (PAD)

Peripheral arterial disease is a relatively common condition. The worldwide prevalence of PAD varies by age and is estimated at 3 to 10% in people less than 70 years old and at 15 to 20% in the population over 70 years old.[7,8] The Hearts Brazil study, which was published in 2008, assessed 1,170 people in 72 different Brazilian cities and one of its findings was a PAD prevalence of 10.5% in the general population.[9]

The principal etiology of PAD is atherosclerosis, which consists of accumulation of lipoproteins and inflammatory cells on the walls of peripheral vessels. It is asymptomatic in 40% of cases and its progression can be insidious, with pain only manifesting in response to exercise, a phenomenon known as intermittent claudication. This pain is a consequence of a reduction in, or absence of, blood flow to the muscles of the limbs, provoking metabolic changes and resulting in localized pain. While the disease remains asymptomatic or there is intermittent claudication but no effect on patient quality of life, then treatment is based on changing lifestyle habits, on medication and on vascular physiotherapy. However, when claudication is limiting or, in more advanced cases there is pain at rest or tissue loss, surgical treatment is generally indicated.

Sometimes surgery to treat PAD requires major interventions designed to save the affected limb. These procedures may impose limitations on the individual's functional capacity, which will directly affect their quality of life and their ability to live independently.[10] It is believed that the high prevalence rates of severe comorbidities make a significant contribution to poor prognosis among these patients.[11,12] and a large proportion of those who have PAD are also elderly, smokers and have chronic systemic diseases such as diabetes mellitus,[13] systemic arterial hypertension,[13] chronic obstructive pulmonary disease,[14] heart failure[15] and kidney failure,[16] or are malnourished.[1]

Diagnosis of PAD is based on calculating the ankle-brachial index (ABI), by dividing the highest systolic pressure measured at arteries in the ankle by the systolic pressure at the brachial artery. An ABI less than 0.9 is indicative of PAD and has a sensitivity ranging from 79 to 95% and specificity of around 95%.[17-22] The German Epidemiological Trial on Ankle Brachial Index[23] assessed 6,880 patients with ages greater than 65 years, demonstrating that patients with ABI < 0.9 had a higher incidence of cardiovascular events and death. Jelnes et al.[24] conducted a cohort study in which they followed 257 people for 10 years. They compared mortality in three groups of patients: ABI > 0.85; 0.85 > ABI > 0.4; and ABI < 0.4. The mortality rates they observed were: 20, 50 and 70% respectively. There is evidence that both asymptomatic and claudicant patients exhibit similar rates of mortality at 5, 10 and 15 years, which are, respectively, 30, 50 and 70%.[25] Over 5 years, just 5% of patients with intermittent claudication will have a limb amputated,[26,27] whereas, in contrast, patients with critical ischemia exhibit similar and elevated rates of limb amputation and mortality. Around 20% of these patients will die or lose a limb within 1 year of being diagnosed with critical ischemia.[28,29] Furthermore, several different studies have revealed that mortality due to cardiovascular and cerebrovascular etiologies is increased among patients with PAD.[30-33] Among such

patients, the risk of death is from two to six times higher than for people without PAD.[30,34-36]

Nutritional status and its diagnosis

Malnutrition is one of the most prevalent comorbidities among patients hospitalized for any cause and its prevalence is estimated at 50% for surgical patients as a group.[37-39] A diagnosis of malnutrition should be based on the person's nutritional status. Development of objective methods for identification of malnutrition has always been of interest to researchers. One of the more traditional methods is by body mass index (BMI) categories. This index is the ratio between a person's weight and the square of their height and it is part of a large number of instruments for nutritional assessment, because it is both simple and objective. In general, the cutoff point for malnutrition is a BMI of less than 18.5 kg/m^2.[40,41] A study of a sample of 295 hospitalized patients with PAD that estimated their BMI found that 2.8% of them had a BMI below 18.5 kg/m^2. In the same sample, 39% had a BMI from 18.5 to 25 kg/m^2, 32% had a BMI from 25 to 30 kg/m^2 and 26.2% had a BMI over 30 kg/m^2.[42]

Other nutritional assessment instruments have been more widely used than BMI for assessment of the nutritional status of patients while in hospital, substituting the BMI method in scientific studies. These instruments have their origins in the 1980s, when nutritional status was diagnosed using arbitrarily grouped techniques such as serum albumin assays, total white blood cell counts, hematocrit tests and anthropometric and clinical parameters, even though these techniques had not been adequately validated.[1,6,43-45] It was therefore necessary to create mechanisms capable of performing nutritional diagnosis with greater accuracy. As a result, simple methods that were quick to apply and inexpensive were proposed for assessment of hospitalized patients to determine their nutritional status, which could then be used in clinical practice to guide management of nutritional support.[46] These methods became known as nutritional screening instruments and the objective of employing them is to stratify patients by nutritional risk.

In 2004, the British Association for Parenteral and Enteral Nutrition[47] ruled that nutritional screening instruments should assess a person's nutritional risk, i.e. whether a patient is at risk of malnutrition, and stated that it was not necessary to diagnose malnutrition nor to establish its severity as part of screening. The American Dietetic Association (ADA) has defined nutritional risk in hospitalized patients as when hospitalized patients are subjected to factors capable of inducing or aggravating malnutrition.[46] There are many different instruments for nutritional screening, the majority of which combine several techniques involving albumin assays, clinical, anthropometric and biochemical data and other supplementary tests in order to arrive at a nutritional diagnosis.[48-50]

One such instrument was developed by Dempsey et al.,[49] who combined albumin and transferrin assays with triceps skin fold measurement and cellular immunity testing to create the Prognostic Nutritional Index.

Chang et al.[51] combined three anthropometric parameters (weight loss, triceps skin fold and arm muscle circumference), with albumin assay results and total lymphocyte counts. However, it was observed that these laboratory test results could be abnormal for reasons other than malnutrition, raising questions about the method's applicability.

In 1987, Detsky et al.[52] developed the Subjective Global Assessment (SGA) to assess nutritional status in patients hospitalized for gastrointestinal surgery. This method grew in popularity and was later validated for use with hospitalized patients in general. The SGA offers a number of advantages: it is essentially clinical, it can be conducted at the bedside, it has a relationship with recent changes in weight, it detects changes in oral food intake, intestinal habits and functional capacity and it includes the stress caused by the current disease and physical examination findings.[52] After performing the assessment, the examiner conducts a general and subjective analysis of the data and classifies the patient in terms of nutritional risk into one of three categories: 1) well-nourished, 2) at risk of malnutrition or moderately malnourished, or 3) severely malnourished. The SGA was validated in 1987 after administration to 202 patients by two different examiners.[52] In Brazil, Faintuch et al.[53] and Coppini et al.[54] validated a Portuguese version of the questionnaire for nutritional screening. In addition to being used for nutritional screening, the SGA has also been accepted as an assessment that is capable of diagnosing malnutrition[52] and of detecting the risk of complications associated with nutritional status during a hospital stay and has become considered an instrument for nutritional prognosis assessment.[52] In a study published in 2013, the SGA was used to assess 500 hospitalized patients in India,[55] detecting a 39.6% prevalence of patients who were malnourished or at nutritional risk. In another study, Thieme et al.[56] evaluated 125 patients who underwent abdominal surgery and found a prevalence of 66% of patients who were at nutritional risk or already malnourished. The prevalence of malnutrition is highly variable, depending on the type of population studied, with rates ranging from 19.2%[57] of stroke patients, 47.6% of

clinical patients,[58] 51%[59] of pediatric patients, 51.9%[60] of patients with heart disease and 76%[61] of cancer patients, up to 80%[62] of liver transplant candidates. Some authors have suggested that, in general, surgical patients exhibit lower prevalence of malnutrition than hospitalized patients in clinical wards, with rates of 19.1% and 38.6%, respectively.[63] In contrast, other studies have reported evidence of similar prevalence rates among patients in both types of ward (53% vs. 47%).[64] Among patients with arteriopathies, there is considerable variation in the prevalence of malnutrition between different populations of patients with vascular disease. While Westvik et al. found a prevalence of 55% among patients in postoperative recovery after open vascular surgery,[65] in another study investigating elderly patients, 73% were already malnourished at admission[1] and, in a third study, around 90% of patients admitted for transtibial amputation were malnourished.[66]

Other nutritional screening instruments have also been developed in the hope of achieving better sensitivity and specificity for nutritional status assessment of patients with a range of different comorbidities. For example, de Ulíbarri Pérez et al.[67] developed the CONUT (*CONtrol NUTritional*) computer program using the database of patients admitted to the Hospital de La Princesa (Madrid, Spain). The program analyzes sex, age, diagnosis, reason for admission, type of treatment, serum albumin, cholesterol and total white blood cell count results. After analyzing 229 patients, the authors observed sensitivity of 0.92 and specificity of 0.85. In 1999, Ferguson et al.[68] assessed 408 people, administering 20 questions that they had chosen, and then compared the results with those of the SGA and of a complete nutritional assessment. They then selected the three questions from the original 20 that had the greatest sensitivity and specificity with relation to nutritional status (recent weight loss, amount of weight lost and loss of appetite) to develop the final model of their Malnutrition Screening Tool (MST). The MST proved to be a simple, inexpensive and effective instrument for assessment of nutritional status that does not require specific anthropometric measurements, which are very often difficult to take during routine daily practice. For example, when patients have difficulties walking because of PAD, simple measurements such as weight and height can be extremely labor-intensive. The MST is therefore a simple and practical tool. However, the instrument classifies patients with weight loss from 1 to 5 kg as not being at nutritional risk. This compromises the sensitivity of the method and underestimates the nutritional status of some patients, among whom this could be significant.

Although many different nutritional screening instruments have been created, the SGA continues to be cited as the gold standard in the literature.[69] Therefore, routine screening of all patients with vascular disease at hospital admission using the SGA should result in benefits in terms of early diagnosis of these patients' health status and enable early intervention that should result in benefits in terms of final outcomes.[70]

DISCUSSION

Malnutrition and its impact on clinical outcomes in patients with vascular disease

A World Health Organization (WHO) has defined malnutrition as the result of inadequate intake of energy, proteins and micronutrients. Malnutrition is one of the most prevalent comorbidities among people in hospital.[37,71-73] There is evidence that around 50% of surgical patients are malnourished [and] that in the majority of cases this condition is not diagnosed while they are in hospital.[37-39,74] This exposes patients to higher rates of fatal clinical outcomes when compared with well-nourished patients.[75,76] Durkin et al.[1] reported that 73% of vascular surgery patients were malnourished. Of these, 41% suffered septic complications while in hospital, whereas no infectious complications were observed among patients without nutritional deficiencies. Westvik et al.[65] demonstrated that 55% of patients who undergo major vascular surgery develop malnutrition during the postoperative period. Within this group, 88% of those in hospital for abdominal aortic aneurysm repair became malnourished, as did 77% of those admitted for arterial bypass and around 30% of those in hospital for carotid endarterectomy. While they did not observe differences in mortality between malnourished and well-nourished patients, these authors did describe a significantly higher incidence of infection among malnourished patients (24.2%) than among well-nourished patients (3.7%). In 1997, Eneroth et al.[66] assessed 32 transtibial amputation patients, finding that 28 (90%) of them were malnourished. They conducted a trial in which these 32 patients were given nutritional supplementation of around 2,098 kcal/day. They were given this supplementation for 11 days. Twenty of them were put on the supplementation regimen for 5 days preoperatively and 6 days during the postoperative period. Four patients had emergency amputations and were only supplemented for 11 days during the postoperative period. The researchers used 32 amputees from a different hospital who had

not been given supplementation as a control group. Patients were paired for diabetes, sex, age, smoking, prior limb revascularization and living conditions before amputation.

After 6 months, the wounds of 26 (81%) of the patients who had been given nutritional supplementation had healed. In contrast, the amputation stumps of just 13 (40%) of those who had not been given supplementation had healed. While there was a tendency for lower mortality in the supplement group (n = 9) compared to the controls (n = 16), this difference was not statistically significant.

Identification of the nutritional status of patients with vascular disease should be recommended in current medical practice, in view of the high prevalence of malnutrition and its underdiagnosis, particularly among the elderly population.[77] Correct identification of malnutrition and risk of malnutrition provides the data on which to base specific health care interventions. This approach can mitigate morbidity and mortality among these patients. Even with availability of technological resources, assessment of the nutritional status of patients is still a challenge to medicine. The SGA can be considered the gold standard for assessment of nutritional status, even in patients with PAD. The questionnaire has proved to be a useful, simple instrument that is accessible, practical and quick to administer and there was good agreement between the different studies analyzed. We recommend that efforts be made to adopt the SGA in daily hospital practice at vascular surgery services. Its results should provide data that is of fundamental importance to identification of people at greater risk of complications. Once identified, further clinical interventions can possibly be implemented.

CONCLUSIONS

The SGA appears to be the best instrument for assessment of the nutritional status of hospitalized patients with PAD. The prevalence of malnutrition among patients with PAD is high and there is a possibility that the clinical outcomes of these patients will be worse because of malnutrition. It is therefore important that further research be conducted to assess the potential for improving the clinical outcomes of interventions in the nutritional status of these patients.

ACKNOWLEDGEMENTS

The authors are grateful to the contributions of Dr. Túlio Pinho Navarro.

REFERENCES

1. Durkin MT, Mercer KG, McNulty MF, et al. Vascular surgical society of great britain and ireland: contribution of malnutrition to postoperative morbidity in vascular surgical patients. Br J Surg. 1999;86(5):702. http://dx.doi.org/10.1046/j.1365-2168.1999.0702a.x. PMid:10361208.
2. Harris CL, Fraser C. Malnutrition in the institutionalized elderly: the effects on wound healing. Ostomy Wound Manage. 2004;50(10):54-63. PMid:15509882.
3. Li HJ, Cheng HS, Liang J, Wu CC, Shyu YI. Functional recovery of older people with hip fracture: does malnutrition make a difference? J Adv Nurs. 2013;69(8):1691-703. http://dx.doi.org/10.1111/jan.12027. PMid:23057761.
4. McWhirter JP, Pennington CR. Incidence and recognition of malnutrition in hospital. BMJ. 1994;308(6934):945-8. http://dx.doi.org/10.1136/bmj.308.6934.945. PMid:8173401.
5. Pérez de la Cruz A, Lobo Támer G, Orduña Espinosa R, Mellado Pastor C, Aguayo de Hoyos E, Ruiz López MD. Malnutrition in hospitalized patients: prevalence and economic impact. Med Clin (Barc). 2004;123(6):201-6. PMid:15282072.
6. Gibbs J, Cull W, Henderson W, Daley J, Hur K, Khuri SF. Preoperative serum albumin level as a predictor of operative mortality and morbidity: results from the National VA Surgical Risk Study. Arch Surg. 1999;134(1):36-42. http://dx.doi.org/10.1001/archsurg.134.1.36. PMid:9927128.
7. Norgren L, Hiatt WR, Dormandy JA, Nehler MR, Harris KA, Fowkes FG. Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II). J Vasc Surg. 2007;45(1 Supl):S5-67.
8. Selvin E, Erlinger TP. Prevalence of and risk factors for peripheral arterial disease in the United States: results from the National Health and Nutrition Examination Survey, 1999-2000. Circulation. 2004;110(6):738-43. http://dx.doi.org/10.1161/01.CIR.0000137913.26087.F0. PMid:15262830.
9. Makdisse M, Pereira AC, Brasil DP, et al. Prevalence and risk factors associated with peripheral arterial disease in the Hearts of Brazil Project. Arq Bras Cardiol. 2008;91(6):370-82. PMid:19142364.
10. Landry GJ. Functional outcome of critical limb ischemia. J Vasc Surg. 2007;45(Supl A):A141-8.
11. 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;204(5):831-8. http://dx.doi.org/10.1016/j.jamcollsurg.2007.01.037. PMid:17481494.
12. Taylor SM, Kalbaugh CA, Blackhurst DW, Kellicut DC, Langan EM 3rd, Youkey JR. A comparison of percutaneous transluminal angioplasty versus amputation for critical limb ischemia in patients unsuitable for open surgery. J Vasc Surg. 2007;45(2):304-10, discussion 310-1. http://dx.doi.org/10.1016/j.jvs.2006.09.038. PMid:17264008.
13. Joosten MM, Pai JK, Bertoia ML, et al. Associations between conventional cardiovascular risk factors and risk of peripheral artery disease in men. JAMA. 2012;308(16):1660-7. http://dx.doi.org/10.1001/jama.2012.13415. PMid:23093164.
14. Pecci R, De La Fuente Aguado J, Sanjurjo Rivo AB, Sanchez Conde P, Corbacho Abelaira M. Peripheral arterial disease in patients with chronic obstructive pulmonary disease. Int Angiol. 2012;31(5):444-53. PMid:22990507.
15. Inglis SC, Hermis A, Shehab S, Newton PJ, Lal S, Davidson PM. Peripheral arterial disease and chronic heart failure: a dangerous

mix. Heart Fail Rev. 2013;18(4):457-64. http://dx.doi.org/10.1007/s10741-012-9331-1. PMid:22723049.

16. Tranche-Iparraguirre S, Marín-Iranzo R, Fernández-de Sanmamed R, Riesgo-García A, Hevia-Rodríguez E, García-Casas JB. Peripheral arterial disease and kidney failure: a frequent association. Nefrologia. 2012;32(3):313-20. PMid:22508143.
17. Carter SA. Indirect systolic pressures and pulse waves in arterial occlusive diseases of the lower extremities. Circulation. 1968;37(4):624-37. http://dx.doi.org/10.1161/01.CIR.37.4.624. PMid:5649086.
18. Carter SA. Clinical measurement of systolic pressures in limbs with arterial occlusive disease. JAMA. 1969;207(10):1869-74. http://dx.doi.org/10.1001/jama.1969.03150230083009. PMid:5818299.
19. Belch JJ, Topol EJ, Agnelli G, et al. Critical issues in peripheral arterial disease detection and management: a call to action. Arch Intern Med. 2003;163(8):884-92. http://dx.doi.org/10.1001/archinte.163.8.884. PMid:12719196.
20. Lijmer JG, Hunink MG, van den Dungen JJ, Loonstra J, Smit AJ. ROC analysis of noninvasive tests for peripheral arterial disease. Ultrasound Med Biol. 1996;22(4):391-8. http://dx.doi.org/10.1016/0301-5629(96)00036-1. PMid:8795165.
21. Ouriel K, Zarins CK. Doppler ankle pressure: an evaluation of three methods of expression. Arch Surg. 1982;117(10):1297-300. http://dx.doi.org/10.1001/archsurg.1982.01380340031008. PMid:7125893.
22. Yao ST, Hobbs JT, Irivne WT. Ankle systolic pressure measurements in arterial disease affecting the lower extremities. Br J Surg. 1969;56(9):676-9. http://dx.doi.org/10.1002/bjs.1800560910. PMid:5808379.
23. Diehm C, Allenberg JR, Pittrow D, et al. Mortality and vascular morbidity in older adults with asymptomatic versus symptomatic peripheral artery disease. Circulation. 2009;120(21):2053-61. http://dx.doi.org/10.1161/CIRCULATIONAHA.109.865600. PMid:19901192.
24. Jelnes R, Gaardsting O, Hougaard Jensen K, Baekgaard N, Tønnesen KH, Schroeder T. Fate in intermittent claudication: outcome and risk factors. Br Med J (Clin Res Ed). 1986;293(6555):1137-40. http://dx.doi.org/10.1136/bmj.293.6555.1137. PMid:3094806.
25. Dormandy J, Heeck L, Vig S. The natural history of claudication: risk to life and limb. Semin Vasc Surg. 1999;12(2):123-37. PMid:10777239.
26. Hooi JD, Kester AD, Stoffers HE, Rinkens PE, Knottnerus JA, van Ree JW. Asymptomatic peripheral arterial occlusive disease predicted cardiovascular morbidity and mortality in a 7-year follow-up study. J Clin Epidemiol. 2004;57(3):294-300. http://dx.doi.org/10.1016/j.jclinepi.2003.09.003. PMid:15066690.
27. Twine CP, Coulston J, Shandall A, McLain AD. Angioplasty versus stenting for superficial femoral artery lesions. Cochrane Database Syst Rev. 2009;(2):CD006767. PMid:19370653.
28. Rooke TW, Hirsch AT, Misra S, et al. 2011 ACCF/AHA Focused Update of the Guideline for the Management of Patients With Peripheral Artery Disease (updating the 2005 guideline): a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol. 2011;58(19):2020-45. http://dx.doi.org/10.1016/j.jacc.2011.08.023. PMid:21963765.
29. Dormandy JA, Rutherford RB. Management of peripheral arterial disease (PAD). TASC Working Group. TransAtlantic Inter-Society Consensus (TASC). J Vasc Surg. 2000;31(1 Pt 2):S1-296. PMid:10666287.
30. Leng GC, Lee AJ, Fowkers FG, et al. Incidence, natural history and cardiovascular events in symptomatic and asymptomatic peripheral arterial disease in the general population. Int J Epidemiol. 1996;25(6):1172-81. http://dx.doi.org/10.1093/ije/25.6.1172. PMid:9027521.
31. Golomb BA, Dang TT, Criqui MH. Peripheral arterial disease: morbidity and mortality implications. Circulation. 2006;114(7):688-99. http://dx.doi.org/10.1161/CIRCULATIONAHA.105.593442. PMid:16908785.
32. Dhaliwal G, Mukherjee D. Peripheral arterial disease: epidemiology, natural history, diagnosis and treatment. Int J Angiol. 2007;16(2):36-44. http://dx.doi.org/10.1055/s-0031-1278244. PMid:22477268.
33. Heald CL, Fowkes FG, Murray GD, Price JF, Ankle Brachial Index Collaboration. Risk of mortality and cardiovascular disease associated with the ankle-brachial index: systematic review. Atherosclerosis. 2006;189(1):61-9. http://dx.doi.org/10.1016/j.atherosclerosis.2006.03.011. PMid:16620828.
34. Newman AB, Shemanski L, Manolio TA, et al. Ankle-arm index as a predictor of cardiovascular disease and mortality in the Cardiovascular Health Study. The CARDIOVASCULAR Health Study Group. Arterioscler Thromb Vasc Biol. 1999;19(3):538-45. http://dx.doi.org/10.1161/01.ATV.19.3.538. PMid:10073955.
35. Newman AB, Sutton-Tyrrell K, Vogt MT, Kuller LH. Morbidity and mortality in hypertensive adults with a low ankle/arm blood pressure index. JAMA. 1993;270(4):487-9. http://dx.doi.org/10.1001/jama.1993.03510040091035. PMid:8147959.
36. Källerö KS. Mortality and morbidity in patients with intermittent claudication as defined by venous occlusion plethysmography. A ten-year follow-up study. J Chronic Dis. 1981;34(9-10):455-62. http://dx.doi.org/10.1016/0021-9681(81)90005-9. PMid:7276135.
37. Sungurtekin H, Sungurtekin U, Balci C, Zencir M, Erdem E. The influence of nutritional status on complications after major intraabdominal surgery. J Am Coll Nutr. 2004;23(3):227-32. http://dx.doi.org/10.1080/07315724.2004.10719365. PMid:15190047.
38. Weinsier RL, Hunker EM, Krumdieck CL, Butterworth CE Jr. Hospital malnutrition. A prospective evaluation of general medical patients during the course of hospitalization. Am J Clin Nutr. 1979;32(2):418-26. PMid:420132.
39. Bistrian BR, Blackburn GL, Vitale J, Cochran D, Naylor J. Prevalence of malnutrition in general medical patients. JAMA. 1976;235(15):1567-70. http://dx.doi.org/10.1001/jama.1976.03260410023017. PMid:814258.
40. Duerksen DR, Keller HH, Vesnaver E, et al. Physicians' Perceptions regarding the detection and management of malnutrition in Canadian Hospitals: results of a Canadian Malnutrition Task Force Survey. JPEN J Parenter Enteral Nutr. 2015;39(4):410-7. http://dx.doi.org/10.1177/0148607114534731. PMid:24894461.
41. Anthony PS. Nutrition screening tools for hospitalized patients. Nutr Clin Pract. 2008;23(4):373-82. http://dx.doi.org/10.1177/0884533608321130. PMid:18682588.
42. Tsaousi G, Panidis S, Stavrou G, Tsouskas J, Panagiotou D, Kotzampassi K. Prognostic indices of poor nutritional status and their impact on prolonged hospital stay in a Greek university hospital. BioMed Res Int. 2014;2014:924270-8. http://dx.doi.org/10.1155/2014/924270. PMid:24779021.
43. Thompson JS, Burrough CA, Green JL, Brown GL. Nutritional screening in surgical patients. J Am Diet Assoc. 1984;84(3):337-8. PMid:6699328.
44. Christensen KS, Gstundtner KM. Hospital-wide screening improves basis for nutrition intervention. J Am Diet Assoc. 1985;85(6):704-6. PMid:3998341.
45. Hannaman KN, Penner SF. A nutrition assessment tool that includes diagnosis. J Am Diet Assoc. 1985;85(5):607-8. PMid:3921589.
46. Identifying patients at risk: ADA's definitions for nutrition screening and nutrition assessment. Council on Practice (COP) Quality Management Committee. J Am Diet Assoc. 1994;94(8):838-9. http://dx.doi.org/10.1016/0002-8223(94)92357-4. PMid:8046173.

47. Weekes CE, Elia M, Emery PW. The development, validation and reliability of a nutrition screening tool based on the recommendations of the British Association for Parenteral and Enteral Nutrition (BAPEN). Clin Nutr. 2004;23(5):1104-12. http://dx.doi.org/10.1016/j.clnu.2004.02.003. PMid:15380902.

48. de Jong PC, Wesdorp RI, Volovics A, Roufflart M, Greep JM, Soeters PB. The value of objective measurements to select patients who are malnourished. Clin Nutr. 1985;4(2):61-6. http://dx.doi.org/10.1016/0261-5614(85)90043-3. PMid:16831707.

49. Dempsey DT, Buzby GP, Mullen JL. Nutritional assessment in the seriously ill patient. J Am Coll Nutr. 1983;2(1):15-22. http://dx.doi.org/10.1080/07315724.1983.10719905. PMid:6886242.

50. Chang RW. Nutritional assessment using a microcomputer. 1. Programme design. Clin Nutr. 1984;3(2):67-73. http://dx.doi.org/10.1016/S0261-5614(84)80002-3. PMid:16829437.

51. Chang RW, Richardson R. Nutritional assessment using a microcomputer. 2. Programme evaluation. Clin Nutr. 1984;3(2):75-82. http://dx.doi.org/10.1016/S0261-5614(84)80003-5. PMid:16829438.

52. Detsky AS, McLaughlin JR, Baker JP, et al. What is subjective global assessment of nutritional status? JPEN J Parenter Enteral Nutr. 1987;11(1):8-13. http://dx.doi.org/10.1177/014860718701100108. PMid:3820522.

53. Faintuch J, Cohen RV, Machado MC, Pinotti HW. Subjective nutritional assessment of surgical patients with cancer. Preliminary results. Rev Paul Med. 1988;106(3):155-60. PMid:3251347.

54. Coppini LZ, Waitzberg DL, Ferrini MT, Silva ML, Gama-Rodrigues J, Ciosak SL. Comparison of the subjective global nutrition assessment x objective nutrition evaluation. Rev Assoc Med Bras. 1995;41(1):6-10. PMid:7550417.

55. Chakravarty C, Hazarika B, Goswami L, Ramasubban S. Prevalence of malnutrition in a tertiary care hospital in India. Indian J Crit Care Med. 2013;17(3):170-3. http://dx.doi.org/10.4103/0972-5229.117058. PMid:24082614.

56. Thieme RD, Cutchma G, Chieferdecker ME, Campos AC. Nutritional risk index is predictor of postoperative complications in operations of digestive system or abdominal wall? Arq Bras Cir Dig. 2013;26(4):286-92. http://dx.doi.org/10.1590/S0102-67202013000400007. PMid:24510036.

57. Martineau J, Bauer JD, Isenring E, Cohen S. Malnutrition determined by the patient-generated subjective global assessment is associated with poor outcomes in acute stroke patients. Clin Nutr. 2005;24(6):1073-7. http://dx.doi.org/10.1016/j.clnu.2005.08.010. PMid:16213064.

58. Baccaro F, Moreno JB, Borlenghi C, et al. Subjective global assessment in the clinical setting. JPEN J Parenter Enteral Nutr. 2007;31(5):406-9. http://dx.doi.org/10.1177/0148607107031005406. PMid:17712149.

59. Secker DJ, Jeejeebhoy KN. Subjective global nutritional assessment for children. Am J Clin Nutr. 2007;85(4):1083-9. PMid:17413109.

60. Yamauti AK, Ochiai ME, Bifulco PS, et al. Subjective global assessment of nutritional status in cardiac patients. Arq Bras Cardiol. 2006;87(6):772-7. http://dx.doi.org/10.1590/S0066-782X2006001900014. PMid:17262116.

61. Bauer J, Capra S, Ferguson M. Use of the scored Patient-Generated Subjective Global Assessment (PG-SGA) as a nutrition assessment tool in patients with cancer. Eur J Clin Nutr. 2002;56(8):779-85. http://dx.doi.org/10.1038/sj.ejcn.1601412. PMid:12122555.

62. Hasse J, Strong S, Gorman MA, Liepa G. Subjective global assessment: alternative nutrition-assessment technique for liver-transplant candidates. Nutrition. 1993;9(4):339-43. PMid:8400590.

63. Giryes S, Leibovitz E, Matas Z, et al. Measuring Nutrition risk in hospitalized patients: MENU, a hospital-based prevalence survey. Isr Med Assoc J. 2012;14(7):405-9. PMid:22953614.

64. Moriana M, Civera M, Artero A, et al. Validity of subjective global assessment as a screening method for hospital malnutrition. Prevalence of malnutrition in a tertiary hospital. Endocrinol Nutr. 2014;61(4):184-9. http://dx.doi.org/10.1016/j.endonu.2013.10.006. PMid:24342427.

65. Westvik TS, Krause LK, Pradhan S, et al. Malnutrition after vascular surgery: are patients with chronic renal failure at increased risk? Am J Surg. 2006;192(5):e22-7. http://dx.doi.org/10.1016/j.amjsurg.2006.07.004. PMid:17071176.

66. Eneroth M, Apelqvist J, Larsson J, Persson BM. Improved wound healing in transtibial amputees receiving supplementary nutrition. Int Orthop. 1997;21(2):104-8. http://dx.doi.org/10.1007/s002640050130. PMid:9195264.

67. de Ulíbarri Pérez JI, González-Madroño Giménez A, González Pérez P, et al. New procedure for the early detection and control of hospital malnutrition. Nutr Hosp. 2002;17(4):179-88. PMid:12395607.

68. Ferguson M, Capra S, Bauer J, Banks M. Development of a valid and reliable malnutrition screening tool for adult acute hospital patients. Nutrition. 1999;15(6):458-64. http://dx.doi.org/10.1016/S0899-9007(99)00084-2. PMid:10378201.

69. Reilly JJ Jr, Hull SF, Albert N, Waller A, Bringardener S. Economic impact of malnutrition: a model system for hospitalized patients. JPEN J Parenter Enteral Nutr. 1988;12(4):371-6. http://dx.doi.org/10.1177/0148607188012004371. PMid:3138447.

70. Neumayer LA, Smout RJ, Horn HG, Horn SD. Early and sufficient feeding reduces length of stay and charges in surgical patients. J Surg Res. 2001;95(1):73-7. http://dx.doi.org/10.1006/jsre.2000.6047. PMid:11120639.

71. Chandra RK, Kumari S. Nutrition and immunity: an overview. J Nutr. 1994;124(8, Supl):1433S-5S. PMid:8064398.

72. Edington J, Boorman J, Durrant ER, et al. Prevalence of malnutrition on admission to four hospitals in England. The Malnutrition Prevalence Group. Clin Nutr. 2000;19(3):191-5. http://dx.doi.org/10.1054/clnu.1999.0121. PMid:10895110.

73. Herrmann FR, Safran C, Levkoff SE, Minaker KL. Serum albumin level on admission as a predictor of death, length of stay, and readmission. Arch Intern Med. 1992;152(1):125-30. http://dx.doi.org/10.1001/archinte.1992.00400130135017. PMid:1728907.

74. Hill GL, Blackett RL, Pickford I, et al. Malnutrition in surgical patients. An unrecognised problem. Lancet. 1977;1(8013):689-92. http://dx.doi.org/10.1016/S0140-6736(77)92127-4. PMid:66485.

75. Cederholm T, Jägrén C, Hellström K. Outcome of protein-energy malnutrition in elderly medical patients. Am J Med. 1995;98(1):67-74. http://dx.doi.org/10.1016/S0002-9343(99)80082-5. PMid:7825621.

76. Sullivan DH, Walls RC. The risk of life-threatening complications in a select population of geriatric patients: the impact of nutritional status. J Am Coll Nutr. 1995;14(1):29-36. http://dx.doi.org/10.1080/07315724.1995.10718470. PMid:7706607.

77. Wells JL, Dumbrell AC. Nutrition and aging: assessment and treatment of compromised nutritional status in frail elderly patients. Clin Interv Aging. 2006;1(1):67-79. http://dx.doi.org/10.2147/ciia.2006.1.1.67. PMid:18047259.

Correspondence
José Oyama Moura Leite
Universidade Federal de Minas Gerais – UFMG, Faculdade de Medicina
Av. Prof. Alfredo Balena, 190, sala 203 – Santa Efigênia
CEP 30130-100 – Belo Horizonte (MG), Brasil
Tel.: +55 (31) 3409-9759 / +1 (513) 417-3639
E-mail: joseoyama@hotmail.com

Author information
LOC - MSc, Departamento de Cirurgia e Oftalmologia, Faculdade de Medicina, Universidade Federal de Minas Gerais (UFMG); general practicioner, Hospital Alberto Cavalcanti da Fundação Hospitalar do Estado de Minas Gerais (FHEMIG).
DUS - Resident of Physical Therapy, Hospital das Clínicas da Universidade Federal de Minas Gerais (UFMG).
WMF, BCG, GBG, LARC and NNRJ - Medical student, Universidade Federal de Minas Gerais (UFMG).
JOML - Assistant Professor of Surgery, Faculdade de Medicina, Universidade Federal de Minas Gerais (UFMG); PhD from the University of Connecticut, USA.

Author contributions
Conception and design: LOC, DUS, WMF, BCG, GBG, LARC, NNRJ, JOML
Analysis and interpretation: LOC, DUS, WMF, BCG, GBG, LARC, NNRJ, JOML
Data collection: DUS, WMF, BCG, GBG, LARC, NNRJ
Writing the article: LOC, DUS, WMF, BCG, GBG, LARC, NNRJ, JOML
Critical revision of the article: LOC, JOML
Final approval of the article*: LOC, DUS, WMF, BCG, GBG, LARC, NNRJ, JOML
Statistical analysis: N/A
Overall responsibility: LOC, JOML

*All authors have read and approved of the final version of the article submitted to J Vasc Bras.