Review Article

Locomotive Syndrome: A New Concept to describe a Long-known Phenomenon: A Review of the Literature

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Abstract

As the population ages, the number of people with disabilities who are unable to live independently is expected to increase. Geriatric exercise programs aiming to maintain or restore mobility and the ability to live independently are most effective if older people at risk of disability are involved in these programs as early as possible. The concept of locomotive syndrome has been developed by the Japanese Orthopedic Association in order to draw the attention lay people and healthcare professionals to early recognition and treatment of structural disorders and functional decline of the musculoskeletal system responsible for mobility in old age. Because these changes begin in people in their 50s, the prevention of the locomotive syndrome in old age should already start in the middle age.

Keywords: Locomotive Syndrome; Older People; Living Independently

1. Introduction

Today, the proportion of those over 65 represents 20% of the total population. This proportion will reach 32% by 2050 [1]. As the population ages, the number of people with disabilities who are unable to live independently is expected to increase [2]. At the same time, studies demonstrate that a physically active lifestyle and proper functioning of the locomotor system have a positive influence on the independent living of the elderly [3]. Nowadays, several geriatric exercise programs have been developed to maintain or restore mobility and the ability to live independently [4-10]. These programs are most effective if older people at risk

of disability are involved in these programs as early as possible. Consequently, it is especially important to have valid testing methods to assess the functional abilities of the elderly with different levels of capabilities, and individuals at risk identified by these measurement tools to participate regularly in physical activity programs aiming to enhance their ability to live independently. This endeavor led to the development of the concept of the locomotive syndrome (LoS), which is a relatively new concept among geriatric health care professionals.

2. Locomotive Syndrome

LoS was formulated In Japan by the Japanese Orthopedic Association in 2007 to describe a condition characterized by unstable equilibrium and mobility difficulties due to structural and functional damage to the organs of the locomotive system responsible for mobility. This condition affects the most basic movements of everyday life, i.e. getting up from a seat and walking [11-15]. In this concept, the musculoskeletal system refers to the bones, joints, intervertebral discs, muscular system, and the nervous system that regulates muscle function. Thus, musculoskeletal disorders and conditions leading to LoS include osteoporosis, osteoporosis-related fractures, osteoarthritis, spondylosis, sarcopenia, and disorders of the regulatory nervous system. These diseases and conditions are responsible for the symptoms of LoS, namely pain, reduced mobility, joint deformity, muscle weakness, and impaired balance. As the condition worsens, these symptoms make it difficult for the person to move, such as getting up from a seat and walking. Finally, the performance of daily living activity declines, leading to deterioration in the quality of life and eventually a long-term institutional care becomes necessary [14]. In terms of the physical aspect of functional decline, there are overlaps between the three frequent syndromes in the elderly (i.e. sarcopenia, frailty, LoS). Disturbance in gait is an essential component of all three syndromes [16]. Degenerative musculoskeletal disorders have already started at the beginning of middle age [17]. According to Iwaya et al., difficulty with physical activity first appears only in sport [18]. Later, it becomes difficult to walk, to change position (e.g. Getting up from the ground or from sitting) and, then to live independently. As the ability for physical activity declines, the condition is considered to be LoS stage 1 and later LoS stage 2 [15-17]. Without effective intervention, physical mobility is affected to such an extent that it counts already as a severe disability, meaning there is an actual overlap between the other two geriatric syndromes, i.e. between sarcopenia and frailty [16]. The aim of the individual, and of those responsible for the health of the individual, is to delay the onset of the decline of physical abilities, to reduce its extent, and to never let physical abilities be led to severe disability.

3. Prevalence of LoS

In Japan, two national surveys examined the prevalence of LoS in the population over 50 years [15, 16]. According to these surveys, the incidence of LoS increases with age both in women and men, and it is more common among women than men in all age groups.

4. Assessment of LoS

Early recognition of mobility difficulties would be important to improve the individual's functional ability through lifestyle changes and targeted treatment when needed. Therefore, early recognition is important to stop the process leading to loss of independence. The severity of disabilities associated with locomotive syndrome is determined based on the performance of the two most basic mobility, namely walking and standing up [14]. Numerous tests are used in gerontology to assess these two mobilities, but in the

age group of 40-80, the same test is not sensitive enough to assess both the people of better abilities and the ones of weaker abilities [19, 21]. Among older people of better abilities the ceiling effect, while among older people of weaker abilities the floor effect influences the sensitivity of these tests [22]. For this reason, the research team developing the concept of LoS has developed and validated two functional tests, the Two-step test and the Stand-up test. The results of these tests, sensitively indicate disturbance in the execution of test movement among elderly with different abilities [22]. The Two-step test measures gait ability. Its result strongly correlates with maximum gait speed [22]. During the test, the elderly person is asked to make two maximum long strides from standing start position. If the elderly is able to maintain the final standing position for at least three seconds without any additional small steps, the test will be considered successfully completed. From two successive tests, the result of the better one is recorded. From this value, the step length standardized for body height is calculated [14-16, 22].

The Stand-up test assesses the function of the lower limb. Its result strongly correlates with the muscle strength of the knee extensor muscles [24]. The elderly person is asked to stand up from chairs of different heights first using both legs and then using only one leg. During the test the arms are folded in front of his chest. The height of the sitting surface is changing as follows: 40, 30, 20, and 10 cm, sequentially. If the older person is able to maintain the standing position for at least three seconds without additional steps, the test will be considered successfully completed [24]. These tests prove to be sensitive when assess the execution in both middle-aged and elderly population. Moreover, they are simple, easy to apply in a small space, take less time, and are suitable for self-assessment [15]. Because both tests measure two movements that are common in everyday life, the relevance of the result can be clearly interpreted by the people, and thus they are easily motivated to get involved in physical activity [15]. Another benefit of the tests is that clear cutoff values refer to LoS. If the value of the Two-step test is less than 1.3 or 1.1, the subject is regarded as having LoS stage 1 or LoS stage 2, respectively. If the Stand-up test is failed to be completed from the stool of 40 height using single leg, the subject is regarded as having LoS stage 1 and in case the person failed to perform the test from the stool of 20 cm height using both legs than it is regarded as having LoS stage 2 [15]. Besides these two functional tests, a self-administered questionnaire, called the “25-question Geriatric Locomotive Function Scale (GLFS-25)” have also been developed to evaluate motor dysfunction of older people aged 65 years and over [25]. However, the linguistic validation of this questionnaire remains to be done.

5. Conclusion

The concept of LoS has been developed by the Japanese Orthopedic Association in order to draw the attention lay people and healthcare professionals to early recognition and treatment of structural disorders and functional decline of the musculoskeletal system responsible for mobility in old age. As these changes begin in people in their 50s, the prevention of LoS in old age should already start in the middle age, in the age of 50+. Therefore, this preventive task is not only the responsibility of the health professionals working with older people, but of all health professionals.

References

1. United Nations Population Division. Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2008 Revision (2008).
2. Chen BK, Jalal H, Hashimoto H, et al. Forecasting Trends in Disability in a Super-

Aging Society: Adapting the Future Elderly Model to Japan. J Econ Ageing 8 (2016): 42-51.

3. Manini TM, Pahor M. Physical activity and maintaining physical function in older adults. Br J Sports Med 43 (2009): 28-31.
4. Rydwik E, Frändin K, Akner G. Effects of physical training on physical performance in institutionalized elderly patients (70+) with multiple diagnoses. Age Ageing 33 (2004): 13-23.
5. Liu CJ, Latham N. Can progressive resistance strength training reduce physical disability in older adults? A meta-analysis study. Disabil Rehabil 33 (2011): 87-97.
6. Steib S, Schoene D, Pfeifer K. Dose-response relationship of resistance training in older adults: a meta-analysis. Med Sci Sports Exerc 42 (2010): 902-914.
7. Keuerleber J, Henschke N. Progressive resistance strength training can reduce physical disability in older adults. Br J Sports Med 46 (2012): 323-324.
8. Pahor M, Guralnik JM, Ambrosius WT, et al. Effect of structured physical activity on prevention of major mobility disability in older adults: the LIFE study randomized clinical trial. JAMA 31 (2014): 2387-2396.
9. Borde R, Hortobágyi T, Granacher U. Dose-Response Relationships of Resistance Training in Healthy Old Adults: A Systematic Review and Meta-Analysis. Sports Med 45 (2015): 1693-1720.
10. Lacroix A, Hortobágyi T, Beurskens R, et al. Effects of Supervised vs. Unsupervised Training Programs on Balance and Muscle Strength in Older Adults: A Systematic Review and Meta-Analysis. Sports Med 47 (2017): 2341-2361.
11. Nakamura K. A “super-aged” society and the “locomotive syndrome”. J Orthop Sci 13 (2008): 1-2.
12. Nakamura K. Locomotive syndrome: disability-free life expectancy and locomotive organ health in a "super-aged" society. J Orthop Sci 14 (2009): 1-2.
13. Nakamura K. The concept and treatment of locomotive syndrome: its acceptance and spread in Japan. J Orthop Sci 16 (2011): 489-491.
14. Nakamura K, Ogata T. Locomotive syndrome: definition and management. Clin Rev Bone Miner Metab 14 (2016): 56-67.
15. Ikemoto T, Arai YC. Locomotive syndrome: clinical perspectives. Clinical Interventions in Aging 13 (2018): 819-827.
16. Yoshimura N, Muraki S, Oka H, et al. Association between new indices in the locomotive syndrome risk test and decline in mobility: third survey of the ROAD study. J Orthop Sci 20 (2015): 896-905.
17. Kadono Y, Yasunaga H, Horiguchi H, et al. Statistics for orthopedic surgery 2006–2007: data from the Japanese Diagnosis Procedure Combination database. J Orthop Sci 15 (2010): 162-170.
18. Iwaya T, Doi T, Seichi A, et al. Characteristics of disability in activity of daily living in elderly people associated with locomotive disorders. BMC Geriatr 17 (2017): 165.
19. Podsiadlo D, Richardson S. "The timed "Up & Go": a test of basic functional mobility for frail elderly persons." J Am Geriatr Soc 39 (1991): 142-148.
20. Bohannon RW. Sit-to-stand test for measuring performance of lower extremity muscles. Percept Mot Skills 80 (1995): 163-166.

21. Peel NM, Kuys SS, Klein K. Gait speed as a measure in geriatric assessment in clinical settings: a systematic review. J Gerontol A Biol Sci Med Sci 68 (2013): 39-46.
22. Ogata T, Muranaga S, Ishibashi H, et al. Development of a screening program to assess motor function in the adult population: a cross-sectional observational study. J Orthop Sci 20 (2015): 888-895.
23. Muranaga S, Hirano K. Development of a convenient way to predict ability to walk, using a two-step test. J Showa Med Assoc 63 (2003): 301-303.
24. Muranaga S. Evaluation of the muscular strength of the lower extremities using the standing movement and clinical application. J Showa Med Assoc 61 (2001): 362-367.
25. Seichi A, Hoshino Y, Doi T, et al. Development of a screening tool for risk of locomotive syndrome in the elderly: the 25-question geriatric locomotive function scale. J Orthop Sci 17 (2012): 163-172.