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Perspective

Utilizing the T12 skeletal muscle index on computed tomography images for sarcopenia diagnosis in lung cancer patients

Introduction

Sarcopenia is a disease characterized by muscle weakness and loss of muscle mass that can be accelerated to deteriorate by cancer. In 2016, sarcopenia was assigned an ICD-10-CM code and a classification code for diseases and health problems (M62.84).[1] The European Working Group on Sarcopenia in Old People 2 classified sarcopenia into primary and secondary forms, with the former being associated with age, and the latter potentially being caused by cancer.[2] This perspective aimed to identify the potential optimal skeletal muscle index at certain levels of the thoracic spine for diagnosing sarcopenia in lung cancer patients.

Previous studies highlighted that the global prevalence of sarcopenia varied from 10% to 27%,[3] while the prevalence of sarcopenia in patients with lung cancer was 44.2%.[4] Sarcopenia was a risk factor for recurrence and mortality in lung cancer, studies have shown that lung cancer patients with sarcopenia have lower 5-year overall survival and 5-year recurrence-free survival rates compared to those without sarcopenia.[5,6] Lung cancer patients with low muscle mass had a nearly 2.5-fold increased risk of chemotherapy-induced hematologic toxicity during follow-up,[7] and the skeletal muscle index showed a difference of 2.72 during chemotherapy.[8] Additionally, sarcopenia played a negative role in falls, fractures,[9] and dysphagia (Fig. 1).[10] Therefore, it is important to recognize and diagnose sarcopenia early in patients with lung cancer, and it also requires widely available and practical clinical diagnostic methods.

CT scan is primarily used for cancer detection, evaluating lesion characteristics, metastasis, and invasion of surrounding muscle tissue. CT is also one of the gold standards for noninvasive muscle mass and quantity assessment and can be used as a diagnostic tool for sarcopenia. Skeletal muscle cross-sectional area (SMA) can be obtained by using software to draw the region of interest (ROI) around the skeletal muscle region on CT images. Typically, skeletal muscle index (SMI) is a standardized indicator calculating by SMA adjusted for height, weight, or body mass index. The SMI is defined by SMA divided by the square of height (cm^2/m^2) as the following this article.

L3 SMI, which measures muscle mass at the third lumbar vertebra, is commonly utilized in diagnosing sarcopenia based on CT imaging. L3 SMI cutoff values are defined by the international consensus for cancer cachexia were 39 cm^2/m^2 for women and 55 cm^2/m^2 for men,[11] and 38.5 cm^2/m^2 for women and 52.4 cm^2/m^2 for men, according to Prado et al.[12] The diagnostic approach for identifying sarcopenia continues to be a topic of debate, often centered around the use of L3 SMI as the standard measurement. Chest CT scans are routinely performed in lung cancer patients to assess muscle mass and visualize lesions at no additional cost. However, routine chest CT scans do not encompass the lumbar spine, resulting in a shortage of standardized diagnostic criteria for identifying lung cancer in individuals with sarcopenia using chest CT scans. Thus, we propose the hypothesis of defining sarcopenia in lung cancer by evaluating the SMI at a specific thoracic spine level in chest CT images.

Recent research has seen a surge in efforts to define sarcopenia by utilizing SMI at specific thoracic spine levels on CT scans. Some studies explored the SMI cutoff values for defining sarcopenia in patients with lung cancer at the T4, T5, T8, T10, and T12 CT.[13–16] In instances where L3 CT scans were unavailable, defining sarcopenia through SMI at the T12 CT slice emerged as the preferred alternative at the thoracic spine level.[17] Ishida et al.[18] developed a formula predicting SMA at L3 using T12 CT, which demonstrated strong concordance and correlation (ICC = 0.849; r = 0.858). Additionally, Dong et al.[19] utilized machine learning to develop a light gradient boosting machine model (lightGBM) classifier based on T12 CT skeletal muscle for identifying sarcopenia in lung cancer, demonstrating the optimal lightGBM model's high performance and reliability, with accuracy and area under curve values of 0.900 and 0.889, respectively (Fig. 2).

Discussion

Prior studies have shown that the cutoff values of T12 SMI for defining sarcopenia in a healthy population, with distinct values observed between genders and across different ethnic groups. In the United States, the established T12 SMI cutoff values are 28.8 cm^2/m^2 for men and 20.8 cm^2/m^2 for women,[17] whereas in China, these values are slightly lower at 25.75 cm^2/m^2 for men and 20.16 cm^2/m^2 for women.[20] The differences in body composition and physical fitness among various ethnic groups can be attributed to a multitude of factors, including dietary patterns, levels of physical activity, socioeconomic status, and other environmental determinants.[21–23] These factors can exert a significant influence on the measurement and interpretation of muscle mass.

In the realm of lung cancer, emerging studies have highlighted the variability of T12 SMI thresholds required to diagnose sarcopenia, underscoring the complexity of this condition in such patients. Wakefield et al.[14] demonstrated that 24% of lung cancer patients (53/221) had sarcopenia at T12 with a median lower SMI of 23.9 cm^2/m^2. Takamori et al.[24] reported that the mean preoperative T12 SMI in lung cancer patients was 12.33 cm^2/m^2 in men and 11.22 cm^2/m^2 in women, and decreased, respectively, by 0.99 and 0.54 cm^2/m^2 after lung resection. Furthermore, Watanabe et al.[13] showed the cutoff values of pre-neoadjuvant chemoradiotherapy T12 SMI based on receiver operating characteristic curves for overall survival was 11.6 cm^2/m^2 in men and

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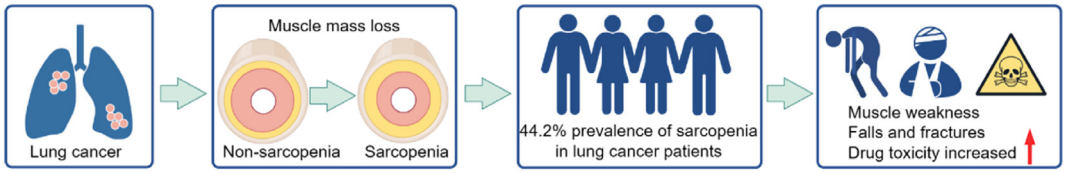

Fig. 1. Sarcopenia in lung cancer.

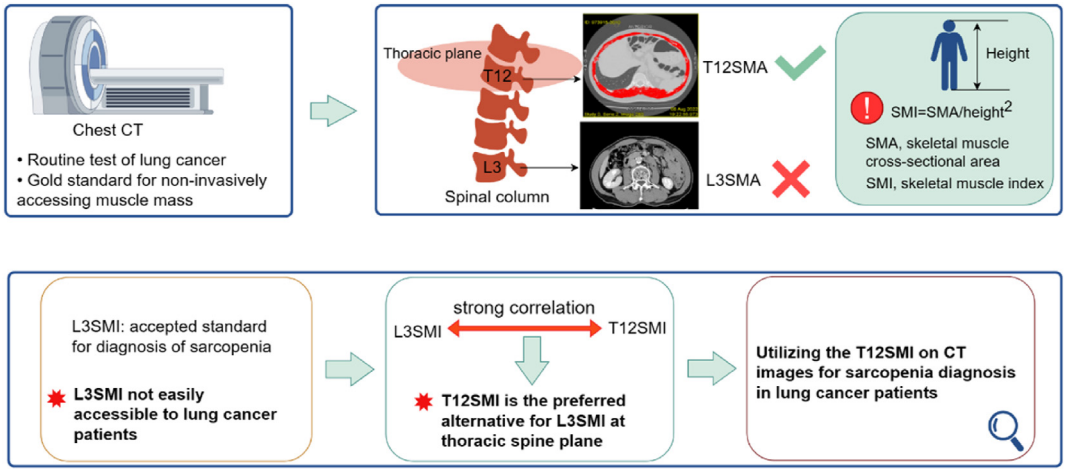

Fig. 2. A potentially easier method for detecting sarcopenia in lung cancer. CT, computed tomography.

10.7 cm^2/m^2 in women; accordingly, 36.8% (39/106) lung cancer patients were classified into a low SMI. These findings collectively highlight the critical need to establish gender-specific and population-specific consensus on T12 SMI cutoff values in the diagnosis and management of sarcopenia among lung cancer patients.

The utilization of T12 SMI for diagnosing sarcopenia in lung cancer patients poses certain challenges. Although research is limited, studies have demonstrated that T12 SMI has a weak correlation with patient survival rates,[15] and its predictive value for other critical sarcopenia indicators, such as grip strength and gait speed, requires further investigation.[25,26] Additionally, most studies on T12 SMI are confined to single-center, small-sample retrospective designs, resulting in findings with limited generalizability. To bridge these gaps, future research should focus on larger-scale, multicenter, prospective studies to validate the efficacy of T12 SMI in diagnosing sarcopenia among lung cancer patients. There is also a need to develop a more comprehensive understanding of T12 SMI's role and its potential integration with other diagnostic indicators to enhance the precision and effectiveness of sarcopenia diagnosis and management.

Implications for nursing

The accurate diagnosis and strategic treatment of sarcopenia are crucial for enhancing survival and improving the quality of life of lung cancer patients.[9,27] This requires a coordinated effort and close collaboration among a multidisciplinary team, emphasizing the critical role of nursing throughout the intervention phases of sarcopenia. Jang et al. highlighted the susceptibility of SMI to decrease during cancer treatment and stressed the importance of monitoring skeletal muscle loss as part of routine oncology nursing practice.[28]

This perspective introduces a novel approach to using T12 SMI in diagnosing sarcopenia among lung cancer patients. This method enables the potential identification of affected individuals and allows for ongoing monitoring of muscle mass changes. In oncology nursing, this approach provides nurses with a useful tool for patient risk screening and offers clear evidence to support more effective management protocols and therapeutic interventions. Moreover, the use of T12 SMI plays a vital role in creating personalized nursing plans, which include customized exercise routines, targeted nutritional support, and necessary psychological counseling. Additionally, the implementation of this diagnostic method holds promise for advancing research in oncology nursing, potentially enhancing clinical nursing quality and patient outcomes in the future.

CRediT authorship contribution statement

All authors have reviewed and approved the manuscript. SH and GZ drafted the manuscript as co-first authors. NH, SL, XL participated in the conceptualization and drawing the figures of the study. LR and YZ conducted the manuscript review and editing as the corresponding author.

Declaration of competing interest

The authors declare no conflict of interest. The corresponding author, Professor Yingchun Zeng, serves as a member of the editorial board of the *Asia-Pacific Journal of Oncology Nursing*. The article has undergone the journal's standard publication procedures.

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Data availability statement

Data availability is not applicable to this article as no new data were created or analyzed in this study.

Declaration of generative AI and AI-assisted technologies in the writing process

No AI tools or services were used during the preparation of this work.

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