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PREVALENCE OF COMPUTED TOMOGRAPHY DETERMINED SARCOPENIA IN PATIENTS WITH GASTROINTESTINAL MALIGNANCY: A HOSPITAL BASED PROSPECTIVE OBSERVATIONAL STUDY IN SUB HIMALAYAN REGION

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ABSTRACT

Background: Gastrointestinal malignancy remains a disease with poor survival and many complications. Sarcopenia or muscle wasting is a component of cachexia associated with poor postoperative performance status. The skeletal muscle index (SMI) calculated by computed tomography scans at the level of the third lumbar vertebra. The aim of this study was to determine the prevalence of sarcopenia in gastrointestinal malignancy patients using computed tomography. **Methods:** A hospital based prospective observational study was conducted in the Department of General Surgery of a tertiary care hospital in Shimla, Himachal Pradesh. All patients who reported to Department of Surgery during the study period of 1st September 2021 to 30th September 2022 with diagnosis of gastrointestinal malignancy (esophagus, stomach, colorectal) were considered for the study. **Results:** Ninety Eight patients with the diagnosis of gastrointestinal malignancy (esophagus, stomach, colorectal) were included in the study. Prevalence of sarcopenia was 41.84%   (41 patients) based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations. Patients had a mean age of 59.56± 14.16 years. Sarcopenia was detected in 41(41.84%) patients based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations. The mean age was 63.63 years in the sarcopenic group (SG) and 55.49 years in the non-sarcopenic group (NSG). The mean serum albumin levels in sarcopenic group was 3.20±.55(g/dl) and in patients without sarcopenia was 3.30±.54(g/dl).The mean SMI(Skeletal Muscle Index) was 46.27±8.13 cm²/m² and 4.29±8.05 cm²/m² in the SG and NSG, respectively. The mean body mass index (BMI) in all patients was (20.19 ± 2.85 kg/m²). **Conclusions:** Prevalence of sarcopenia was 41.84% (41 patients) based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations in patients with gastrointestinal malignancy (esophagus, stomach, colorectal).

KEYWORDS: Sarcopenia_Prevalence_ gastrointestinal malignancy _Sub Himalayan Region.

INTRODUCTION

The incidence of gastrointestinal (GI) malignancy is a significant global health concern, with nearly 30% of the worldwide population affected by these types of cancers. Alarmingly, GI malignancies are associated with high cancer-related mortality rates.[1,2] One of the most prominent risk factors for the development and increased mortality of these malignancies is aging. As individuals grow older, there is often an exponential rise in the incidence and severity of GI cancers.[2,3] Despite advancements in oncological treatment modalities, surgical resection remains the primary curative approach for many GI malignancies.[4] However, for elderly oncologic patients, the risk of postoperative complications is a significant concern due to factors such as compromised nutritional status and the presence of potential comorbidities.[5] Sarcopenia, a condition characterized by the progressive loss of skeletal muscle mass and strength, was first described by Rosenberg in 1989 and is often referred to as age-related sarcopenia.[6,7] Sarcopenia is a progressive and generalised skeletal muscle disorder involving the accelerated loss of muscle mass and function that is associated with increased adverse outcomes including falls, functional decline, frailty, and mortality. It occurs commonly as an age-related process in older people, influenced not only by contemporaneous risk factors, but also by genetic and lifestyle factors operating across the

life course. It can also occur in mid-life in association with a range of conditions. Sarcopenia has become the focus of intense research aiming to translate current knowledge about its pathophysiology into improved diagnosis and treatment, with particular interest in the development of biomarkers, nutritional interventions, and drugs to augment the beneficial effects of resistance exercise. The prevalence of sarcopenia is quite substantial, affecting approximately 20% of healthy individuals under the age of 70, and more than 50% of those over the age of 80.[8] Epidemiological studies have further elucidated the extent of this problem, with one study finding that the incidence of muscle reduction in healthy elderly Chinese individuals ranged from 4.1% to 11.5%. Similarly, a Japanese epidemiological investigation revealed that 14.2% of elderly men and 22.1% of elderly women experienced muscle loss.[9] The underlying causes of sarcopenia are multifactorial and may include skeletal muscle disuse, endocrine imbalances, chronic wasting diseases, systemic inflammatory responses, insulin resistance, and malnutrition.[10,11] The profound impact of sarcopenia on the health and well-being of the aging population, particularly in the context of GI malignancies, underscores the critical need for a comprehensive understanding of this condition and the development of effective prevention and management strategies.

Various updates have been made regarding the definition of sarcopenia, and published consensus definitions by a range of expert groups from around the world. But the most widely used method and gold standard for assessing muscle mass is computed tomography (CT), specifically by evaluating the skeletal muscle index at the third lumbar vertebra, with specific cut-off points for each sex.[12,13] In our study, we used the cut-off points from EWGSOP2 (The European Working Group on Sarcopenia in Older People 2), which defines sarcopenia as a lumbar skeletal muscle index by CT imaging (at the 3rd lumbar vertebra) of <55 cm²/m² in men and <39 cm²/m² in women.[14,15] There is very limited data available from sub-Himalayan belt of northern India, hence the present study was planned to determine the prevalence of sarcopenia in gastrointestinal malignancy patients using computed tomography.

MATERIAL AND METHODS
A hospital based prospective observational study was conducted in the department of surgery of a tertiary care hospital in Shimla, Himachal Pradesh between September 2021 to September 2022., ninety eight patients with the diagnosis of gastrointestinal malignancy (esophagus, stomach, colorectal) reported to Department of General Surgery IGMC SHIMLA. We excluded patients who did not gave consent and patients with spinal deformity, quadriplegia, spinal muscular atrophy. We investigated the prevalence of sarcopenia in the patients of gastrointestinal malignancy.

Sarcopenia was assessed by calculating the Skeletal Muscle Index (SMI) using CT scans at the L3 vertebra. In this study, the contrast-enhanced CT abdomen (CECT) used for diagnosing gastrointestinal malignancy was used to calculate the SMI, with no additional CECT performed solely for this purpose. Patients underwent CT scans using a 64-slice MDCT (Light Speed VLT – XTE, GE Medical System), with cross-sectional images taken at the L3 vertebral level where both transverse processes were visible. The areas of the psoas, quadratus lumborum, erector spinae, transversus abdominis, internal and external obliques, and rectus abdominis muscles were manually measured using the area measurement tool in RadiAnt DICOM viewer. The threshold range for identifying skeletal muscle was set between -30 to +150 Hounsfield units. The skeletal muscle area was then normalized for height to calculate the SMI.
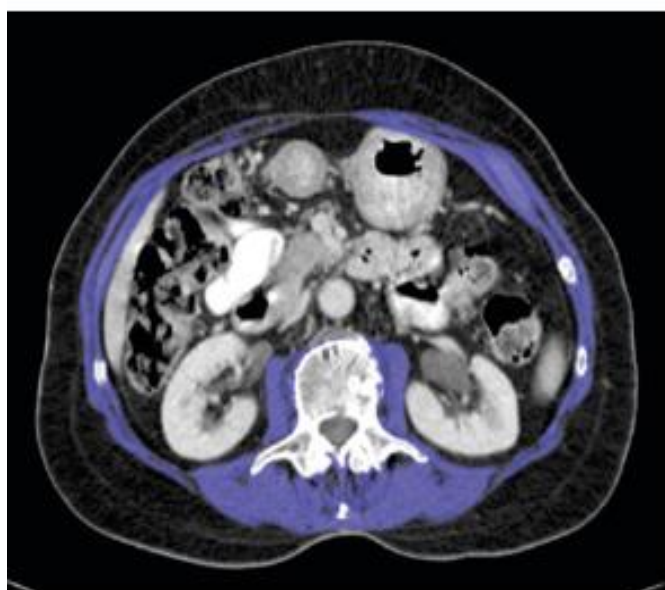
The skeletal muscle index is calculated as follows.

Cross-sectional area of the total skeletal muscles at L3 (psoas, quadratus lumborum, erector spinae, transversus abdominis, internal and external obliques and rectus abdominis muscles) in [cm]^2
Height [m]^2

Patients were categorized into sarcopenic and non-sarcopenic groups based on CT measurement of total skeletal muscle mass in cross sectional area at the level of L3. Based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations, SMI < 55 cm^2/m^2 was considered the cutoff for men, compared to < 39 cm^2/m^2 for women.

Statistical Analysis
The presentation of the Categorical variables was done in the form of number and percentage (%). On the other hand, the quantitative data were presented as the means ± SD and as median with 25th and 75th percentiles (interquartile range). The following statistical tests were applied for the results.

The association of the variables which were quantitative in nature were analysed using Independent t test (for two groups) and ANOVA (for more than two groups).

The association of the variables which were qualitative in nature were analysed using Chi-Square test. If any cell had an expected value of less than 5 then Fisher's exact test was used.

The data entry was done in the Microsoft EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver 25.0.For statistical significance, p value of less than 0.05 was considered statistically significant. Ethical approval was obtained from institutional ethical committee.

RESULTS
Ninety Eight patients with the diagnosis of gastrointestinal malignancy (esophagus, stomach, colorectal) were included in the study. Prevalence of sarcopenia was 41.84% (41patients) based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations. Patients had a mean age of 59.56± 14.16 years. Sarcopenia was detected in 41(41.84%) patients based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations. The mean age was 63.63 years in the sarcopenic group (SG) and 55.49 years in the non-sarcopenic group (NSG).The mean serum albumin levels in sarcopenic group was 3.20±.55(g/dl) and in patients without sarcopenia was 3.30±.54(g/dl). The mean SMI(Skeletal Muscle Index) was 46.27±8.13 cm²/m² and 4.29±8.05 cm²/m² in the SG and NSG, respectively. The mean body mass index (BMI) in all patients was (20.19 ± 2.85 kg/m^2).

Esophageal Malignancy
Out of ninety eight patients; eighteen (18) patients were of esophageal malignancy. Prevalence of sarcopenia was 44.44% (8patients) based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations. Patients had a mean age of 60.43± 14.16 years. Among the 18 patients with diagnosis of esophageal cancer; 8 patients (44.44 %) were diagnosed as sarcopenic and the remaining 10 patients non sarcopenic (55.56%) based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations. The mean age of patients with sarcopenia with esophageal malignancy was 63.37 years and the mean age of patients without sarcopenia with esophageal malignancy was 55.5 years. Clinicopathological features of the two groups are shown in Table 1. Regarding gender, the proportion of women was higher in the sarcopenic group than men in the non-sarcopenic group (61.1% vs. 37.5 %). Of body weight and composition, mean body mass index (BMI) was lower in the sarcopenic group than in the nonsarcopenic group (19.11 ± 1.99 vs. 19.83± 2.13 kg/m^2). Nutritional parameters such as mean serum albumin was lower in the sarcopenic group than in the non sarcopenic group (sarcopenic, 3.13±.48 g/dl vs. non-sarcopenic, 3.22±.59 g/dl). Mean skeletal muscle index (cm²/m²) in patients of esophageal carcinoma in sarcopenic patients was 42.23±7.10cm²/m² while skeletal muscle index (cm²/m²) in patients of esophageal carcinoma in non sarcopenic patients was 47.14±6.24cm²/m².

Table 1: Clinicopathological features of sarcopenic and non-sarcopenic patients in esophageal malignancy.

Clinicopathological features	Sarcopenic group(n=8)	Non Sarcopenic group(n=10)
Mean age(years)	63.37	55.5
Gender Men Women	3(37.5%) 5(62.5%)	3(30%) 7(70%)
BMI (kg/m^2)	19.11 ± 1.99	19.83± 2.13
Serum albumin(g/dl)	3.13±.48	3.22±.59
SMI(cm²/m²)	42.23±7.10	47.14±6.24

Gastric malignancy Patients

Out of ninety eight patients; 41 patients were of gastric malignancy. Prevalence of sarcopenia was 43.90% (18patients) based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations. Patients had a mean age of 60.66± 12.93 years.

Among the 41 patients with diagnosis of gastric cancer; 18 patients (43.90 %) were diagnosed as sarcopenic and the remaining 23 patients (56.1%) based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations. The mean age of patients with sarcopenia with gastric malignancy was 65.94 years and the mean age of patients without sarcopenia with gastric malignancy was 55.49 years. The prevalence of sarcopenia was remarkably higher among patients more than 60 years of age. Clinicopathological features of the two groups are shown in Table 2.

Regarding gender, the proportion of men was higher in the sarcopenic group than women in the non-sarcopenic group (61.1% vs. 38.8 %). Of body weight and composition, mean body mass index (BMI) was lower in the sarcopenic group than in the nonsarcopenic group (19.64 ± 3.36 vs. 20.18± 3.38 kg/m^2). Nutritional parameters such as mean serum albumin was lower in the sarcopenic group than in the non sarcopenic group (sarcopenic, 3.05±.42g/dl vs. non-sarcopenic, 3.24±.42 g/dl). Mean skeletal muscle index (cm²/m²) in patients of gastric carcinoma in sarcopenic patients was 44.08±8.93cm²/m² while skeletal muscle index (cm²/m²) in patients of gastric carcinoma in non sarcopenic patients was 46.19±9.13cm²/m².

Table 2: Clinicopathological features of sarcopenic and non-sarcopenic patients in gastric malignancy.

Clinicopathological features	Sarcopenic group(n=18)	Non Sarcopenic group(n=23)
Mean age(years)	65.94	55.49
Gender Men Women	11(61.1%) 7(31.8%)	12(52.17%) 11(47.82%)
BMI (kg/m ^{2})	19.64 ± 3.36	20.18± 3.38
Serum albumin(g/dl)	3.05±.42	3.24±.42
SMI(cm²/m²)	46.19±9.13	46.19±9.13

Colorectal malignancy Patients

Out of ninety eight patients; 39 patients were of colorectal malignancy. Prevalence of sarcopenia was 38.46% (15 patients) based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations. Patients had a mean age of 57.59± 16.51 years. Among the 39 patients with diagnosis of colorectal cancer; 15 patients (38.46 %) were diagnosed as sarcopenic and the remaining 24 patients (61.54%) were non sarcopenic based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations. The mean age of patients with sarcopenia with colorectal malignancy was 59.58 years and the mean age of patients without sarcopenia with colorectal malignancy was 55.6 years. Clinicopathological features of the two groups are shown in Table 3.

Regarding gender, the proportion of men was higher in the sarcopenic group than women in the non-sarcopenic group (61.1% vs. 38.8 %). Of body weight and composition, mean body mass index (BMI) was lower in the sarcopenic group than in the nonsarcopenic group (20.86 ± 2.34vs. 21.90± 2.8 kg/m^2). Nutritional parameters such as mean serum albumin was lower in the sarcopenic group than in the non sarcopenic group (sarcopenic, 3.22±.64g/dl vs. non-sarcopenic, 3.40±.63 g/dl). Mean skeletal muscle index (cm²/m²) in patients of colorectal carcinoma in sarcopenic patients was 47.54±7.65cm²/m² while skeletal muscle index (cm²/m²) in patients of colorectal carcinoma in non sarcopenic patients was 49.24±8.44cm²/m².

Table 3: Clinicopathological features of sarcopenic and non-sarcopenic patients in colorectal malignancy.

Clinicopathological features	Sarcopenic group(n=15)	Non Sarcopenic group(n=24)
Mean age(years)	59.58	55.6
Gender Men Women	8(61.1%) 7(31.8%)	14(52.17%) 10(47.82%)
BMI (kg/m ^{2})	20.86 ± 2.34	21.90± 2.8
Serum albumin(g/dl)	3.22±.64	3.40±.63
SMI(cm²/m²)	47.54±7.65	49.24±8.44

DISCUSSION

Elderly individuals with gastrointestinal cancers have been experiencing a significant surge in incidence as the global population continues to age and life expectancy increases. This alarming trend is compounded by the rising prevalence of sarcopenia, a condition characterized by the progressive loss of skeletal muscle mass and strength, which also tends to increase with age in patients

with gastrointestinal malignancies.[16] The precise frequency of sarcopenia in this population can vary widely, depending on the specific definitions, diagnostic techniques, classifications, and cut-off points employed in the assessment. This lack of standardization poses a challenge in accurately quantifying the scale of the problem, which is crucial for developing targeted interventions and optimizing patient management. This study aimed to estimate the prevalence of sarcopenia in gastrointestinal malignancy. The researchers utilized the well-established method of computed tomography (CT) imaging to assess skeletal muscle mass, specifically focusing on the cross-sectional area of the muscle at the level of the third lumbar vertebra. This approach, recommended by the European Working Group on Sarcopenia in Older People (EWGSOP2), employs sex-specific cut-off points to define the presence of sarcopenia, with values below 55 cm²/m² in men and 39 cm²/m² in women indicating the condition.[14,15] The findings of this comprehensive study revealed prevalence of sarcopenia, of 41.84% among the participants with gastrointestinal malignancies meeting the diagnostic criteria. This alarmingly high percentage underscores the significant burden of sarcopenia in this vulnerable patient population and highlights the urgent need for proactive screening, early intervention, and the development of tailored management strategies.[17] It is important to note that the reported prevalence rates can vary substantially depending on the specific definitions, diagnostic methods, and cut-off points employed in the assessment. This variability underscores the importance of standardizing the evaluation of sarcopenia, a critical step in ensuring accurate data collection, meaningful comparisons across studies, and the development of evidence-based guidelines for clinical practice. By providing a robust estimate of the prevalence of sarcopenia in gastrointestinal malignancy patients, this study serves as a crucial call to action for healthcare professionals, researchers, and policymakers to prioritize the identification and management of this debilitating condition. Addressing the challenge of sarcopenia in this population will not only improve patient outcomes but also contribute to the overall optimization of care and quality of life for the growing number of elderly individuals facing the dual burden of cancer and age-related muscle wasting. Sarcopenia, the age-related loss of skeletal muscle mass and function, is a prevalent condition that affects individuals across different regions and age groups.[18] Specifically, studies have shown that sarcopenia affects 5–13% of people aged 60 to 70 and up to 50% of people over 80.[19] This significant decline in muscle mass and strength can have profound implications on an individual's overall health and quality of life. Furthermore, it has been observed that sarcopenia is a prevalent condition within the field of oncology, affecting approximately 35.3% of patients.[20] This is a concerning statistic, as sarcopenia can significantly impact the treatment outcomes and prognosis of cancer patients. In a study conducted by Haiducu et al.[21], it was demonstrated that sarcopenia is highly prevalent

(43.68%) among individuals with gastrointestinal tumours, with esophageal cancer exhibiting the highest prevalence (70.4%) due to the frequently associated symptom of dysphagia, which can further exacerbate the loss of muscle mass and function. Additionally, a meta-analysis conducted by Jogiat et al.[22], which encompassed 21 studies and 3966 patients, identified sarcopenia in 1940 individuals, reflecting a prevalence rate of 48.1% in esophageal tumours. This alarmingly high prevalence underscores the importance of early detection and management of sarcopenia in patients with esophageal cancer. In a separate study, Tan et al.[23] employed computed tomography (CT) data to retrospectively diagnose sarcopenia in esophageal cancer patients, revealing a sarcopenia prevalence of 75.9%. Conversely, Yoshida et al.[24] conducted a prospective study involving 71 patients with esophageal cancer, utilizing the bioelectrical impedance analysis (BIA) method to diagnose sarcopenia, and reported a sarcopenia prevalence of 40.8% in this cohort. Beyond esophageal cancer, research has also shed light on the prevalence of sarcopenia in other types of cancer. According to a study by Mourtzakis et al., the prevalence of sarcopenia in patients with colorectal cancer is 38.6%. This finding underscores the importance of incorporating routine screening and assessment of sarcopenia in the management of various cancer types, as the condition can significantly impact treatment outcomes, quality of life, and overall prognosis for these patients. Another study by Park, H., et al. (2018) in Korea reported a sarcopenia prevalence of 32.4%[25] in gastric malignancy. Studies by Hopkins, J., et al. (2019) in Canada[26] and van Vugt, J., et al. (2018) in the Netherlands[27] reported prevalence of 27.5% and 50.5%, respectively in colorectal cancers. Despite discrepancies in diagnostic criteria and methods, sarcopenia was frequently diagnosed during preoperative examinations in patients with gastrointestinal cancer. In conclusion, prevalence of sarcopenia was 41.84% (41patients) based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations in our study. The current study has several limitations. This was a single-centre prospective observational study and the sample size was small. A validation study with large sample size will be necessary to confirm the prevalence of sarcopenia in gastrointestinal malignancy patients.

Compliance with ethical standards

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