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SARCOPENIA AND DURATION OF POSTOPERATIVE HOSPITAL STAY IN PATIENTS OF CARCINOMA ESOPHAGUS WHO UNDERWENT ESOPHAGECTOMY: A HOSPITAL BASED PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Esophagectomy is the most effective treatment for locally advanced esophageal cancer, but it has a high mortality rate. Sarcopenia is a common comorbidity in cancer patients, and the exact impact of sarcopenia on esophagectomy outcomes is unclear. The aim of this study was to determine the duration of postoperative hospital stay in resectable esophageal cancer patients that underwent esophagetomy, comparing those with sarcopenia to those without sarcopenia. There is very limited data available from sub-Himalayan belt of northern India, hence the present study was planned to know the association of sarcopenia with duration of postoperative hospital stay in resectable esophageal cancer patients that underwent esophagetomy. **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 esophageal cancer were considered for the study. **Results:** Eighteen patients were included in the study. Patients had a mean age of 60.43± 14.16 years. Sarcopenia was detected in 8(44.44%) patients based on EWGSOP2 (The European Working Group on Sarcopenia in Older People 2) recommendations and 10 patients were non sarcopenic. The mean age was 65.37 years in the sarcopenic group (SG) and 55.5 years in the non-sarcopenic group(NSG).The mean SMI(Skeletal Muscle Index) was 42.23±7.10 cm^2/m^2 and 47.14±6.24 cm^2/m^2 in the SG and NSG, respectively. The 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). Postoperative duration of hospital stay was significantly higher in the sarcopenic group than in the non-sarcopenic group (17 days vs. 11.5 days; p = 0.03). **Conclusions:** Postoperative duration of hospital stay was significantly higher in the sarcopenic group than in the non-sarcopenic group in resectable esophageal cancer patients who underwent esophagectomy.

KEYWORDS: Sarcopenia _ Postoperative Duration _ Hospital Stay _ esophageal malignancy _Sub Himalayan Region.

INTRODUCTION

According to the latest data from the Global Cancer Observatory (GLOBOCAN), esophageal cancer (EC) is the eighth most common cancer diagnosis and the sixth leading cause of cancer-related deaths worldwide as of 2020.[1] Furthermore, the incidence of esophageal cancer has been steadily increasing in recent years. The standard treatments for esophageal cancer are chemotherapy, radiation therapy, and surgical resection.[2] Histologically, esophageal cancer can be classified as either adenocarcinoma or squamous cell carcinoma (SCC), which have distinct prognoses, treatment options, tumor locations, etiologies, and pathologies.[3,4] Globally, esophageal squamous cell carcinoma (ESCC) accounts for more than 85% of all esophageal cancer cases.[5] The primary risk factors for ESCC are alcohol consumption and smoking, while the main risk factors for esophageal adenocarcinoma are smoking, abdominal obesity, and gastroesophageal reflux disease (GERD).[4,5] In contrast to esophageal adenocarcinoma, which is more common in North America and Western Europe, ESCC is typically found in the upper part of the esophagus, near the tracheal bifurcation, and is the predominant histologic type in Eastern Europe, Asia, and Africa.[4,6] ESCC generally has a poorer prognosis and a tendency for early lymphatic spread.[7] Surgery may be an option for managing certain types of cancer, while others may require a combination of treatments like induction therapy and surgical removal. The optimal approach for adenocarcinoma remains a subject of ongoing discussion,

as healthcare professionals explore the most effective induction schedules. Less than a fifth of esophageal cancer patients can survive beyond five years, despite medical advancements, primarily because most cases are detected at an advanced stage. In 2016, the International Classification of Diseases-10 officially recognized sarcopenia, a condition first defined through six consensus guidelines in 2010.[8] The European Working Group on Sarcopenia in Older People (EWGSOP) published a useful definition of sarcopenia in 2010[9], which was later adopted by the Asian Working Group on Sarcopenia (AWGS).[10] These definitions describe sarcopenia as characterized by reduced muscle mass and impaired muscle function. According to the AWGS, sarcopenia is defined by diminished muscle mass alongside low muscle strength and/or low physical performance. These definitions also suggest outcome measures for further research and the circumstances in which sarcopenia should be evaluated. According to The European Working Group on Sarcopenia in Older People -2(EWGSOP-2) guidelines, sarcopenia is now defined by considering muscle strength, in addition to muscle quantity and physical performance. The revised criteria suggest specific thresholds for women (grip strength < 16 kg, usual gait speed < 0.8 m/s, and muscle mass < 5.4 kg/m^2) and men (grip strength < 27 kg, usual gait speed < 0.8 m/s, and muscle mass < 7.0 kg/m^2), as measured by dual X-ray absorptiometry or bioimpedance analysis. This updated definition, published in 2018, aims to provide a more comprehensive assessment of sarcopenia, a condition characterized by the progressive loss of muscle mass and function.[11] For diagnosis of sarcopenia as defined by the EWGSOP2 cut off values are.

Assessing muscle strength cut off values are.

Grip strength	<27 kg for men
	<16 kg for women
Chair stand test	>15 s for five rises

Assessing muscle mass/volume cut off values are.

DEXA	<7.0 kg/m^2 for men
	<5.5 kg/m^2 for women
Bio-impedance analysis	8.87 kg/m^2 for men
	6.42 kg/m^2 for women
CT imaging	<55 cm^2/m^2 for men
	<39cm^2/m^{2}for women

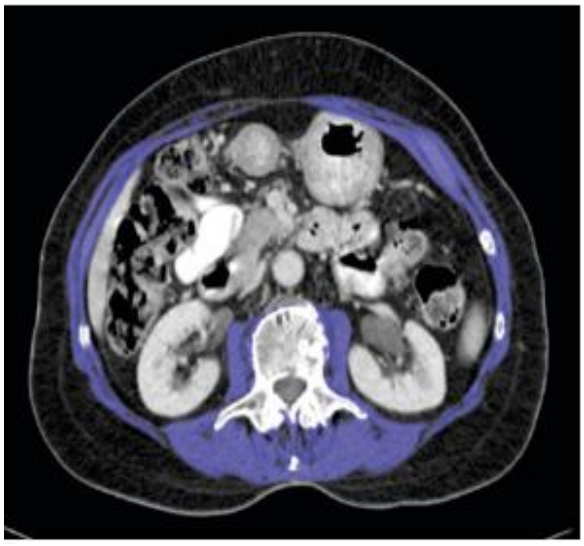
Physical Performance tests

Short physical performance battery test	<8
400 m (Walk 20 m laps)	Non completion or > 6minutes
Gait speed (Over a 4 m course)	<0.8 m/s

Sarcopenia is a condition characterized by a rapid loss of muscle mass and function over time. It is a predictor of poor prognosis for various cancer types, including esophageal cancer, and is linked to increased risk of falls, diminished function, frailty, physical disability, and mortality.[8,11] Sarcopenia is associated with heart disease, respiratory disease, cognitive impairment, and can result in movement disorders and lower quality of life.[12–14] It also increases the risk of falls and fractures, and affects mobility and activities of daily living. Notably, older patients with esophageal cancer are often malnourished, further exacerbating the development of sarcopenia, which can make it more difficult to recover from the cancer.[15-16] As very few Indian studies have evaluated the association of sarcopenia and duration of postoperative hospital stay in patients of carcinoma esophagus who underwent esophagectomy. Therefore, the present study was planned to evaluate the association of sarcopenia with duration of postoperative hospital stay in esophageal cancer patients undergoing esophagectomy.

Screening for sarcopenia

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 esophageal 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 (LightSpeed 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 cut-off 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

Patient characteristics

Eighteen[18] patients were included in the study. 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 were 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 (cm^2/m^2) in patients of esophageal carcinoma in sarcopenic patients was 42.23±7.10cm^2/m^2 while skeletal muscle index (cm^2/m^2) in patients of esophageal carcinoma in non sarcopenic patients was 47.14±6.24cm^2/m^2.

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

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(cm^2/m^2)	42.23±7.10	47.14±6.24

Impact of sarcopenia on post operative duration of hospital stay in resectable esophageal cancer patients who underwent esophagectomy

Of 18 patients who were diagnosed with esophageal cancer 5 patients were operable and they underwent esophagectomy. Out of these 5 patients, 3 patients were sarcopenic and 2 were non sarcopenic. Postoperative duration of hospital stay was significantly higher in the sarcopenic group than in the non-sarcopenic group (17 days vs. 11.5 days; p = 0.03). Table 2 and figure 2 shows the association of sarcopenia and duration of postoperative hospital stay in resectable esophageal cancer patients who underwent esophagectomy. Although there significant difference in the mean duration of hospital stay (sarcopenic, 17 days, vs. non-sarcopenic, 11.5 days; p = 0.03).

Table 2: Mean duration of post operative hospital stay in resectable esophageal cancer patients with and without sarcopenia.

Mean duration of post operative hospital stay in resectable esophageal cancer patients (n=5)			
	Sarcopenic Group (n=3)	Non Sarcopenic Group (n=2)	P value
Post op duration of hospital stay	17 days	11.5days	.03

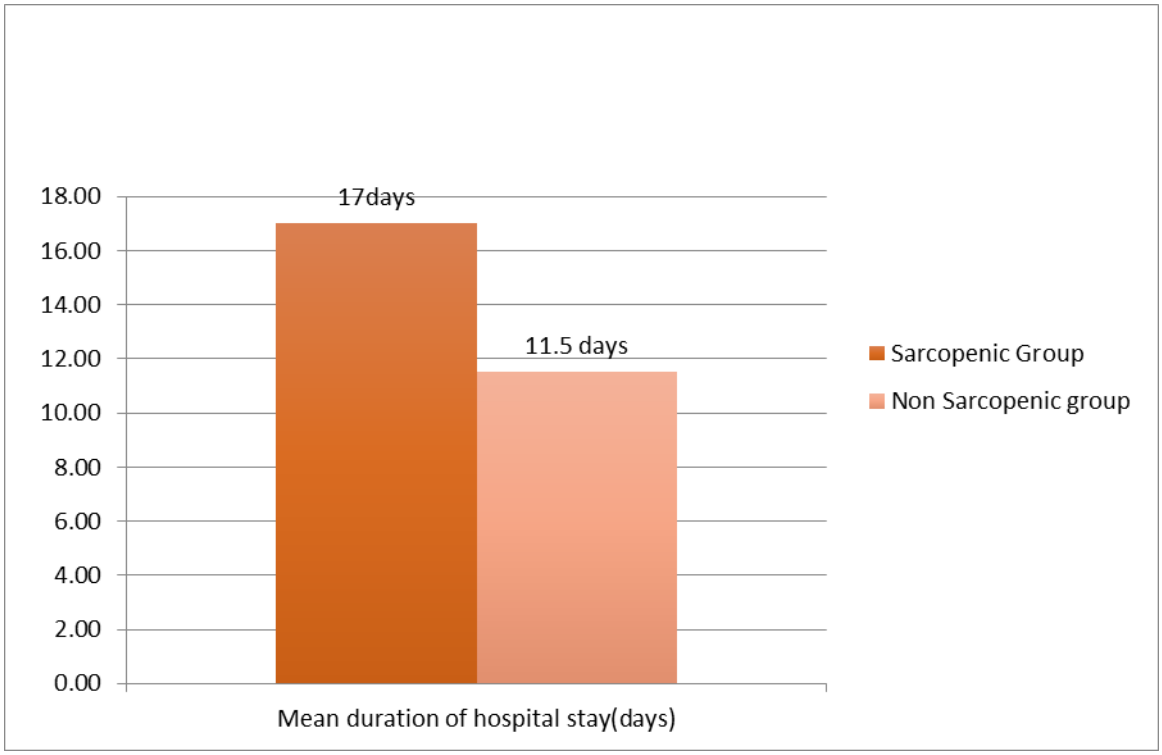


Figure 1: Mean duration of post operative hospital stay in resectable esophageal cancer patients with and without sarcopenia.

DISCUSSION

As the global population ages and lifespans expand, the number of elderly people with gastrointestinal malignancies has increased considerably. Sarcopenia is also more common in patients with gastrointestinal cancer as they get older. The prevalence of sarcopenia varied significantly depending on the definitions, evaluation methods, classifications, and cut-off points used.[17] This study aimed to know the association of sarcopenia with duration of postoperative hospital stay in resectable esophageal cancer patients that underwent esophagetomy, comparing those with sarcopenia to those without sarcopenia. Sarcopenia cut-off points vary depending on the measuring technique used and the availability of reference studies and demographics. The most common approach for testing muscle mass is computed tomography (CT), which evaluates the skeletal muscle index at the third lumbar vertebra using predefined cut-off points for each gender. In this investigation, we employed the cut-off values 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 third lumbar vertebra) of <55 cm^2/m^2 in males and <39 cm^2/m^2 in women. Sarcopenia, or muscle mass loss, has a substantial impact on the postoperative prognosis of esophageal cancer. Numerous studies have shown that preoperative sarcopenia not only raises the risk of complications including pulmonary difficulties and mortality in older persons, but it also causes longer hospital stays and lower survival rates. Elliott et al.[18] found that preoperative sarcopenia was associated with higher Charlson Comorbidity Index (CCI), longer hospital stays, major postoperative complications, postoperative pulmonary complications (PPC), pneumonia, and longer intubation times. Similarly, a retrospective study conducted by Fehrenbach et al.[19] revealed that esophageal cancer patients with comorbid sarcopenia had a higher risk of major complications and prolonged hospitalization, whereas obese patients with sarcopenia had a significantly higher risk of pneumonia and prolonged hospital stays. Nakashima et al.[20] studied older patients with esophageal cancer and discovered that sarcopenia was associated with an increased risk of anastomotic fistulae and in-hospital death. Makiura et al.[21] found that patients with skeletal sarcopenia had a considerably higher probability of unplanned 90-day readmission, with sarcopenia acting as an independent predictor of this outcome in a multivariate logistic regression model. Preoperative sarcopenia affects surgical complications, but it also has an effect on long-term prognosis. Sarcopenia decreased overall survival

(OS), according to log-rank testing, as reported by Makiura et al.[22] Sarcopenia was found to be an independent predictive factor affecting both OS and disease-free survival (DFS) in another retrospective analysis.[23] In a research comprising 363 patients who had esophagectomy, Sugimura et al.[24] found that a low preoperative skeletal muscle index (SMI) was linked to a poor prognosis. Furthermore, preoperative sarcopenia was found to reduce postoperative OS and recurrence-free survival (RFS) by Takahashi et al.[25] Considering its effects on prognosis and surgical complications in esophageal cancer. Sarcopenia has become an important predictor of outcome. Thus, regular assessment and precise identification of sarcopenia in patients with esophageal cancer can help physicians customize treatment regimens, offer prompt nutritional support, and ultimately enhance both the short- and long-term prognoses of patients with esophageal cancer. In conclusion, postoperative duration of hospital stay was significantly higher in the sarcopenic group than in the non-sarcopenic group (17 days vs. 11.5 days; $p = 0.03$).

The current study has several limitations. This was a single-center 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 esophageal cancer patients.

Compliance with ethical standards

Ethical standards All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1964 and later versions. Informed consent was obtained from all patients for inclusion in the study.

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Conflict of interest We declare that we have no conflicts of interest.

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