ORIGINAL RESEARCH ARTICLE

Association Of Sarcopenia With Postoperative Outcomes In Patients Undergoing Robotic Assisted Esophagectomy

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ABSTRACT

INTRODUCTION

Sarcopenia is a syndrome characterized by progressive and generalized loss of skeletal muscle mass and strength and it is strictly correlated with physical disability, poor quality of life and death. Esophageal cancer is widely accepted as major health issue, being the 8th most commonly encountered malignancy worldwide and the sixth most common cause of death due to malignancy. Esophagectomy is the surgical procedure to treat the esophageal cancer but it carries a considerable risk of complications after the procedure.

OBJECTIVES

To determine the association of sarcopenia with postoperative complications like surgical site infection, respiratory complications (graded by Clavien Dindo classification), length of postoperative hospital stay, and mortality.

METHODOLOGY
This retrospective observational study conducted in the Department of Surgical Oncology, Krishna Institute of Medical Sciences, Secunderabad. The study included 68 patients receiving robotic-assisted esophagectomy for esopahgeal and esophageal junction cancer. Sarcopenic status was determined by CT scans and Psoas Muscle Index [**Psoas Muscle Index (PMI)**-calculated by dividing the product of multiplication of antero-posterior and transverse diameters of psoas muscle at the level of L3 vertebra by the Height of the patient squared (mm2 /m2)]. Complications were graded using the Clavien-Dindo classification.

RESULTS
The mean age in our study cohort was 60.20 years (± 9.44SD) ranging from 37 to 70 years. Females (56%) had a higher incidence of sarcopenia than males (47%) in the current study. ECOG performance status ≥2 was strongly associated with sarcopenia with a significant p-value of <0.005. The incidence of significant morbidity ie. Clavien Dindo Grade ≥ III complications was much more common in sarcopenic than in nonsarcopenic patients which was statistically significant ($p<0.001$).

CONCLUSION
Now with the advent of multimodal strategy for the treatment of esophageal cancer, which should not only include surgery and oncological treatment, but also a more comprehensive approach that includes patient education, physical activity, and nutritional support focussing on reducing cachexia, anticipation of post-operative events and improving overall quality of health.

KEYWORDS
Sarcopenia, Esopahageal Cancer, Esophagectomy.

INTRODUCTION
Sarcopenia is a syndrome characterized by progressive and generalized loss of skeletal muscle mass and strength and it is strictly correlated with physical disability, poor quality of life and death. Esophageal cancer is widely accepted as major health issue, being the 8th most commonly encountered malignancy worldwide and the sixth most common cause of death due to malignancy.[1] Esophagectomy is the surgical procedure to treat the esophageal cancer but it carries a considerable risk of complications after the procedure. The primary complications include pulmonary, anastomotic leak, infection, vocal cord paralysis, and others.[2] There is a 5% chance of postoperative mortality. To improve surgical outcomes, a thorough preoperative risk assessment is therefore required. In this scenario, the patient's overall health, including their caloric-protein nutritional status, determines their eligibility for the procedure.[3] Loss of skeletal muscle mass and strength are the hallmarks of the illness known as sarcopenia. Patients with esophageal cancer have preoperative sarcopenia with a frequency of 14.4% to 80%. The gold standard test for diagnosing sarcopenia is the calculation of skeletal muscle mass (SMM), which is based on the skeletal muscle index (SMI) from computed tomography of the transverse muscle mass at the level of the lumbar vertebras. SMM is an easily accessible and affordable test to look at sarcopenia because computed tomography is frequently used as a preoperative staging for

patients with esophageal cancer.[4] In 1992, Clavien et al. proposed a complication scoring system categorizing complications depending on the treatment they require. After revision in 2004, it is known as the Clavien-Dindo Classification (CDC) ever since. It has widely been used and was proven to correctly measure outcome after complications in surgery. Only the highest rated complication is then being used to describe the surgical outcome in terms of complications.[5] In our study the patients were assessed by CDC. The most common functional scores used for treatment planning are the ECOG performance score and the Karnofsky performance index. They are simple to use and have shown to correlate independently with outcomes in patients with gastrointestinal malignancy. Though commonly in use, they are subjective, prone to inter observer fluctuation, and do not always identify all patients at the highest risk of complications.[6]

The study aimed to provide insights into the relationship between preoperative sarcopenia and postoperative outcomes in this patient population.

AIM AND OBJECTIVES

To analyse the association of sarcopenia with postoperative complications like surgical site infection, respiratory complications (graded by Clavien Dindo classification), length of postoperative hospital stay, and mortality.

METHODOLOGY

This retrospective observational study conducted in the Department of Surgical Oncology, Krishna Institute of Medical Sciences, Secunderabad. The study included 68 patients receiving robotic-assisted esophagectomy for esopahgeal and esophageal junction cancer. Sarcopenic status was determined by CT scans and Psoas Muscle Index [**Psoas Muscle Index (PMI)**-calculated by dividing the product of multiplication of antero-posterior and transverse diameters of psoas muscle at the level of L3 vertebra by the Height of the patient squared (mm2 /m2)]. Complications were graded using the Clavien-Dindo classification

Inclusion Criteria

- Age >20 and ≤70
- Resectable tumors
- Upfront surgery

Exclusion Criteria

- Emergency or palliative surgery
- Imaging challenges for assessing sarcopenia.
- Multi-visceral resection.
- Contraindications for major surgery.
- Patients receiving neoadjuvant treatment.

The study was conducted from January 2016 to August 2023, assessed preoperative sarcopenia's association with postoperative events. Sarcopenic status was determined by CT scans and Psoas Muscle Index (PMI). Complications were graded using the Clavien-Dindo classification. Psoas Muscle Index (PMI)-calculated by dividing the product of multiplication of

anteroposterior and transverse diameters of psoas at the level of L3 vertebra by the height of the patient squared (mm2/m2) as shown in figure 1.

The present study was approved by Institutional Ethical committee of Krishna Institute of Medical Sciences, Secunderabad.

Statistical Analysis

The data collected was coded and entered in a Microsoft Excel sheet which was re-checked and analysed using SPSS statistical software version 24. For all statistical tests, a p-value less than 0.05 was taken to indicate a significant difference.

Sarcopenia assessment

a) **Psoas Muscle Index (PMI)** - calculated by dividing the product of multiplication of antero-posterior and transverse diameters of psoas at the level of L3 vertebra by the height of the patient squared (mm2 /m2).

Cut off values Psoas Muscle Index in men according to age		**Cut off values of Psoas Muscle in women according to age**	
Age group	**Cut off value mm2 /m2**	**Age group**	**Cut off value mm2 /m2**
< 40 years	592.3	<40 years old	399.9
40s	474	40s	287.7
50s	422.2	50s	242.5
60s	374.4	60s	220.4
70s	331.5	70s	147.6

Table 1: Age and Gender-specific Cut off values of PMI for assessment of muscle mass

Figure 1 : Measurements for calculating psoas index

Measurements for calculating psoas index

b) Clavien Dindo complication grade: Postoperative complications included intra-abdominal collections, paralytic ileus, chylous leak, postoperative pancreatitis. Systemic complications included pulmonary insufficiency, presence of sepsis, cardiac arrest, deep venous thrombosis, renal insufficiency, and multiorgan failure. All complications were graded according to the Clavien-Dindo classification.

Grades	Definition
I	Any deviation from normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, or radiological interventions. Allowed therapeutic regimens are: drugs as anti-emetics, antipyretics, analgesics, diuretics and electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside
II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition were also included
III	Requiring surgical, endoscopic, or radiological interventions
IIIa	Interventions not under general anesthesia
IIIb	Intervention under general anesthesia
IV	Life-threatening complications (Including CNS complications) requiring ICU management
IV a	Single organ dysfunction
IV b	Multiorgan dysfunction
V	Death of patient

Table 2: Clavien Dindo complication grading

Significant morbidity, defined by Clavien Dindo (Grade III/IV) necessitating medical or invasive treatment. Clavien Dindo Grade V included a patient who succumbed during the 30-day hospital stay, regardless of the etiology. Minor complications included (Grade I/II)

RESULTS

Total of 68 patients were included in present study, this includes 38 males (56.0%) and 30 females (44.0%). The mean age of the study population was 60.20 years (± 9.44SD) ranging from 37 to 70years.

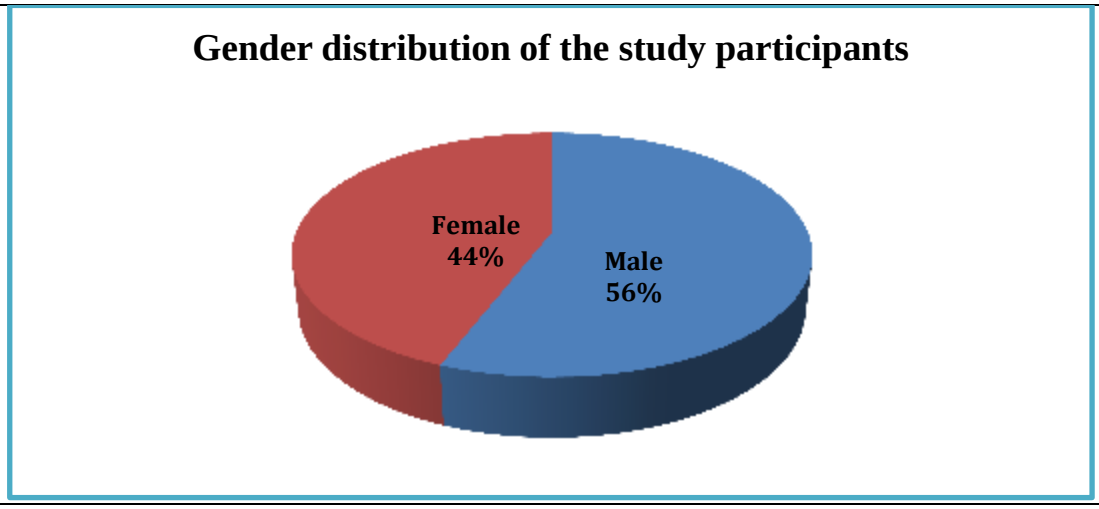

Figure 2 : Characteristic of the study participants

According to the definition for the sarcopenia based on Psoas Index, described in methodology the prevalence of sarcopenia was 41%.

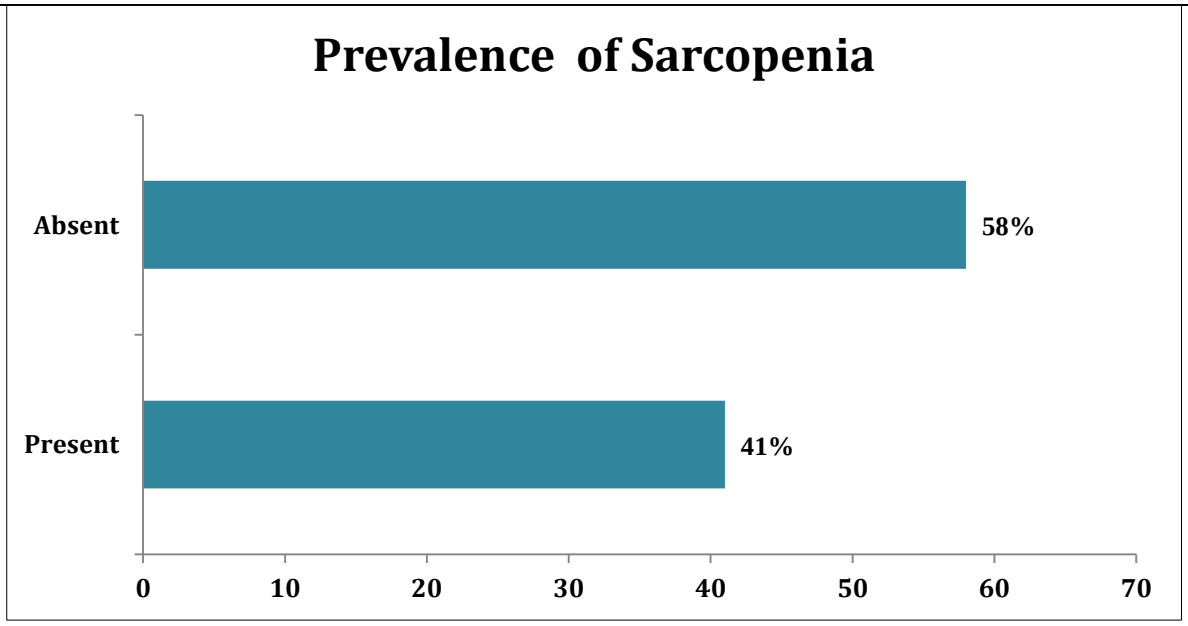

Figure 3: Prevalence of sarcopenia in present study

Parameters	Category	Sarcopenia (f (%))		p-value
		Present	Absent	
Gender	Male	18(47%)	20(52%)	0.8
	Female	17(56%)	13(43%)	0.6
Perfomance status(ECOG)	0-1	9(40%)	14(60%)	< 0.005*
	2-3	41(91%)	4(9%)	< 0.005*
Surgical site Infections(n=10)		7(70%)	3(30%)	0.2
Respiratory Complication(n=28)		22(78%)	6(22%)	<0.001*
Length of Stay**(median)		10(9,14)	9(8,14)	0.005*
Clavien Dindo Grade	I	18(64%)	10(74%)	0.001*

	II	4(14%)	3(26%)	
	III	3(11%)	0	
	IV	2(7%)	0	
	V	1(4%)	0	
* Significant p-value				
** Median with IQR and Mann-whutney U test				
Table 3: Association of the factors with Sarcopenia				

DISCUSSION

Nutritional assessment in malignancy can be done with range of techniques. Among them, one may broadly classify anthropometric data, blood indicators, energy expenditure, validated nutritional risk score, and patient-reported food history. However, systemic treatments, underlying disease may have an impact on blood biomarkers of malnutrition, and anthropometric measures may not be able to identify malnutrition in individuals with fluid disturbances, such as hypoalbuminemia, or early indicators of muscle loss. In our study we intended to assess the impact of sarcopenia in immediate post-operative outcomes by calculating Psoas Muscle Index as elaborated in methodology which doesn't need any extra investigation. All our patients for staging assessment undergo Contrast enhanced CT scan from which we calculate our sarcopenia parameters' and analyse those with our post operative outcomes.

This retrospective research study determined the importance of sarcopenia in patients undergoing esophagectomy. The prevalence of sarcopenia in patients undergoing esophagectomy was 41.0 % as seen in this study. Patients with sarcopenia had a significant correlation with postoperative complications such as Clavien Dindo grade ≥III, length of postoperative ICU, and hospital stay. The individual components used for diagnosis of sarcopenia such as the Psoas Index and other severe postoperative complications like Clavien Dindo grade >III. Sarcopenia is a condition characterized by a gradual and widespread loss of skeletal muscle mass and functional capacity, which can lead to physical impairment, poor quality of life, and death.[7,8] Sarcopenia has been studied extensively in various cancers, including colorectal liver metastases, hepatocellular carcinoma (HCC), gastric cancer, and patients with liver cirrhosis, and it has been found to have a negative impact on outcomes and overall survival.[9,10]

Regional and age-related variations were found to influence sarcopenia prevalence in a report by the EWGSOP algorithm.[11] The mean age in our study cohort was 60.20 years (± 9.44SD) ranging from 37 to 70 years. Females (56%) had a higher incidence of sarcopenia than males (47%) in the current study, likely due to the low muscle mass in females as compared to males. Most studies have shown that sarcopenia was prevalent in females.[12]

Numerous studies have reported that the patient's performance status is a significant predictor of postoperative outcomes in oncological patients.[6,13] We used the ECOG grading system to assess performance status before surgery. In our study, ECOG performance status ≥2 was strongly associated with sarcopenia and a significant p-value of <0.005**.**

The incidence of significant morbidity ie. Clavien Dindo Grade ≥ III complications was much more common in sarcopenic than in nonsarcopenic patients which was statistically significant ($p<0.001$). Various studies have determined previously that the presence of sarcopenia increases the risk of postoperative complications. Also, Clavien Dindo grade ≥ III

seemed to increase with the severity of sarcopenia in the current study population. Components of sarcopenia also showed a significant relationship with the Clavien Dindo grade of complications.[5] Length of stay after esophagectomy was significantly longer in sarcopenic patients ($p< 0.005$). The recent consensus statement from ISGPS has stated that patients with sarcopenia have longer recovery time and thus in-hospital stay and screening patients preoperatively may be valuable.[14] Our study showed no statistically significant association was found between surgical site infections and sarcopenia (p-value 0.2).Tatsuto Nishigori et al[15] showed that sarcopenia was associated with respiratory complication and our study showed that a significant association was observed between respiratory complications and sarcopenia (p-value <0.001).

CONCLUSION

Now with the advent of multimodal strategy for the treatment of esophageal cancer, which should not only include surgery and oncological treatment, but also a more comprehensive approach that includes preoperative assessment of sarcopenia, physical activity, and nutritional support focussing on reducing cachexia, anticipation of post-operative events and improving overall quality of health**.**

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