The Gulf Journal of Oncology

Indexed By PubMed and Medline Database

Issue 52, Sep 2026
ISSN No. 2078-2101







Under the Patronage and Honoring of HRH Prince Saud bin Nayef bin Abdulaziz, Governor of the Eastern Province: Saudi Cancer Foundation Successfully Launches "AlSharqia Wardiyah 18"

The Official Journal of the Gulf Federation For Cancer Control

Table of Contents

Original Articles:

Clinico–Demographic Variables Affecting Survival in Esophageal Cancer: Real–World Evidence from a Tertiary Cancer Centre in Western India **07**
Samiran Chavan, Atul Kumar Gupta, Bharti Devnani, Puneet Pareek

Characteristics of hospital readmissions within 30 days among adult patients with cancer in Jordan **14**
Nour M. Mustafa, Pharm D, BCOP, Dima Attili, Pharm D, Nour Faqeer, Pharm D, BCOP

Efficacy of Volumetric Modulated Arc Therapy (VMAT) in Nasopharyngeal Carcinoma: A Retrospective Analysis. **20**
Venkada Manickam Gurusamy, Palmira Caparrotti, Hissa Hussain Al–Abdulla, Saju Raveendran Divakar, Ghazia Shaik, Patsey Conway–Murray, Amna Rafi Vora, Muhammad Usman, Rabih Wafiq Hammoud, Noora Al–Hammadi.

Prevalence, Correlates, and Predictors of Depression and Anxiety Among Cancer Patients in the UAE: A Comprehensive Cross–Sectional Study Using the Hospital Anxiety and Depression Scale (HADS) **29**
Manal Ali Buabeid, Ayesha Alqasem, Maitha Salem Althehli, Shamma Ali Alhefeiti, Faryal Iqbal, Amin Abyad, Hassan Jaafar and Humaid O. Al–Shamsi

Induction spatially fractionated GRID radiotherapy (SFGRT) radiotherapy for locally advanced extremity soft tissue sarcoma: Report of 10 years follow up. **44**
Abdullah Alsuhaibani, Mohammed Almahmoud, Mohammed Mohiuddin, Muhammad Memon, Ahmed Nobah, Medhat Elsebaie, Ayman Elshenenawy, Rajive Pant, Mahmoud Shaheen, Majid Alyamani, Hatim Khoja, Tariq Alzaid, Fouad Al Dayal. Ahmed Elashwah

Modeling Cancer Incidence and Mortality in Yemen Using GLOBOCAN 2020 Estimates: An Empirical and Rank–Based Analysis **52**
Gamal Abdul Hamid, Amen Bawazir, Safa A. Shukry, Taher Bin Sumiat, Noureddine Ouerfelli

Establishing the First Four–Dimensional Multipurpose Central Nervous System Tumors Biobank in Saudi Arabia: Project Design, Perspectives, and Preliminary Results **65**
Deema Hussein, Saleh Baeesa, Alazouf Alhowity, Ishaq Khan, Mona Alomari, Hanadi Qashqari, Nawal Madkhali, Reem Alserihi, Mohammed Bangash, Fahad Alghamdi, Awatif Jamal, Mohamad Saka, Torki AlZughaibi, Ghazi Damanhouri, Adeel Chaudhary, Adel Abuzenadah

Review Articles:

Craniospinal Irradiation (CSI) Techniques: A Systematic Review of Comparative Dosimetric Outcomes, Organ–at–Risk Sparing, and Treatment Efficiency **79**
Kesava Ramgopal Adavikolanu, Chandramouli Ramalingam, Soorej Balan Kaliyath, Abhishek Raghava KS, Thirumal M, Nagasai Divya Kari, Pragnahitha Neerudu, Ambedkar Yadala, Ajay Kumar Kondeti

Case Reports:

Tubular Ileal Duplication Associated with Diffuse Polyposis and Metastatic Adenocarcinoma Presenting as Acute Small Bowel Obstruction in an Adult: First Reported Case and Review of the Literature **92**
Aliasgar I Kachwala, Obaid M Alharbi, Rajan Arora.

Tubulolobular Carcinoma of the Breast: First Case Report from Saudi Arabia **98**
Mehad Ahmed, Wafaey Badawy, Samah O. Mohager

Conference Highlights/Scientific Contributions

- **News Notes** **103**
- **Advertisements** **106**
- **Scientific Activities** **107**

Original Article

Clinico–Demographic Variables Affecting Survival in Esophageal Cancer: Real–World Evidence from a Tertiary Cancer Centre in Western India

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Abstract

Introduction or Background: Esophageal cancer (EC) is a major global health concern, ranking seventh in incidence and sixth in cancer–related mortality. In India, it accounts for approximately 47,000 new cases and 42,000 deaths annually. Squamous cell carcinoma (ESCC) is the predominant histology, particularly among socioeconomically disadvantaged populations. Most patients present with advanced disease and poor performance status, limiting curative treatment options. While trials such as CROSS and RTOG 85–01 have established the benefits of multimodal therapy, real–world outcomes from low–resource settings like Western Rajasthan remain underrepresented. This study aimed to evaluate overall survival and identify prognostic factors in patients with EC treated at a tertiary center in rural India.

Materials and Methods: A retrospective observational study was conducted at the Department of Radiation Oncology, AIIMS Jodhpur, analyzing data from January 2020 to December 2023. Patients with histologically confirmed ESCC or adenocarcinoma who received definitive treatment were included. Data on demographics, ECOG performance status, tumor site, clinical stage, treatment modality, and survival outcomes were extracted. Overall survival (OS) was calculated from the date of diagnosis to death or last follow–up. Kaplan–Meier curves were used for survival analysis, and the log–rank test evaluated subgroup differences. Variables significant in univariate analysis were subjected to multivariate Cox regression.

Results: Out of 61 patients, the median age was 58 years, with 32 females and 29 males. Surgical resection was performed in 24 patients; 40 received concurrent chemoradiotherapy. Median OS was significantly higher in the surgical group (95 vs. 13 months, p=0.001) and in those receiving concurrent chemotherapy (24 vs. 12 months, p=0.021). Performance status was a strong predictor: ECOG 0 and 1 had superior OS compared to ECOG 2 and 3 (p=0.004). Local recurrence was associated with poorer outcomes (p<0.001), while distant metastasis did not significantly impact OS (p=0.639). Clinical stage showed a trend toward significance (p=0.064). On multivariate analysis, surgery (HR 0.30, p=0.001), concurrent chemotherapy (HR 0.46, p=0.019), and absence of local progression (HR 0.31, p=0.020) were independent predictors of improved survival.

Discussion: The study highlights the survival benefit of multimodal treatment, particularly surgery and concurrent chemoradiotherapy, in esophageal cancer. Patients with good performance status were more likely to receive and tolerate intensive treatment, resulting in better outcomes. The findings align with global evidence supporting trimodality therapy for resectable, locally advanced disease. Poor outcomes in patients with ECOG ≥2 or local progression emphasize the need for early detection, nutritional support, and prehabilitation to optimize fitness for curative therapy.

Conclusion: In this real–world study from a rural Indian cancer center, surgery and concurrent chemoradiotherapy significantly improved survival in esophageal cancer. Performance status and local disease control emerged as key prognostic factors. These findings underscore the need for timely diagnosis, patient optimization, and access to multidisciplinary care to improve outcomes in resource–constrained settings. Prospective, multicenter studies are warranted to further refine treatment strategies tailored to low– and middle–income countries.

Keywords: Esophageal cancer, concurrent chemoradiotherapy, overall survival, prognostic factors

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Introduction

Esophageal cancer (EC) is a significant global health concern, ranking seventh in terms of incidence and sixth in cancer–related mortality according to GLOBOCAN 2020 estimates [1] The burden is particularly high in Asia, including India, where EC is the sixth most common cancer and cause of cancer–related death, accounting for approximately 47,000 new cases and 42,000 deaths annually [2]. Despite advances in diagnostics and treatment, the overall prognosis remains poor, with a case fatality rate nearing 90%.

Esophageal cancer primarily occurs in two histological forms—squamous cell carcinoma (ESCC) and adenocarcinoma (EAC)—each associated with distinct risk profiles. While tobacco and alcohol use are risk factors for both, ESCC is additionally linked with poor nutritional status, consumption of extremely hot beverages, and low intake of fruits and vegetables. In contrast, EAC is associated with gastroesophageal reflux disease (GERD), obesity, and sedentary lifestyle, and it has been rising in incidence in the Western world [3]. In India, ESCC continues to be the dominant histology, particularly among rural and socioeconomically weaker populations[4].

Most patients present with locally advanced or metastatic disease, having symptoms such as progressive dysphagia and significant weight loss. Early–stage disease may be amenable to endoscopic resection, but a large proportion require multimodal therapy.

Curative treatment approaches include surgical resection, often preceded by neoadjuvant chemoradiotherapy as supported by landmark trials like CROSS [5], or perioperative chemotherapy as per the MAGIC trial [6]. Minimally invasive esophagectomy with standardized lymphadenectomy has become the surgical standard in resectable cases. In unresectable or inoperable scenarios, definitive chemoradiotherapy remains the cornerstone, with concurrent chemotherapy offering significant survival benefit as per trials like RTOG 85–01 [7]. In advanced–stage disease, systemic chemotherapy, targeted therapy, immunotherapy and palliative radiation contribute to symptom relief and modest survival gains.

However, real–world outcomes in low– and middle–income countries often diverge from trial settings seen in the west. Factors such as delayed presentation, limited access to comprehensive cancer care, and poor nutritional or performance status prevent optimal treatment. In Western Rajasthan, with its rural geography, limited health infrastructure, and high prevalence of EC risk factors—the burden of esophageal cancer poses a significant challenge [8].

This retrospective study was conducted at a tertiary cancer center in Western Rajasthan to evaluate real–world survival outcomes and identify key clinico–demographic and treatment–related factors influencing prognosis in esophageal cancer. By analyzing variables such as age, sex, clinical stage, ECOG performance status, tumor progression, and therapeutic approaches including surgery and concurrent chemoradiotherapy, the study aims to generate evidence from a rural Indian setting. The insights are expected to inform practical & affordable treatment strategies, support timely diagnosis and patient optimization, and promote multidisciplinary oncologic care—ultimately contributing to improved outcomes in esophageal cancer, particularly in low–resource settings.

Materials and Methods

This retrospective observational study was conducted at the Department of Radiation Oncology, AIIMS Jodhpur, a tertiary cancer care center located in Western Rajasthan, India. The data was collected and analyzed for patients treated between January 2020 and December 2023. Ethical clearance was obtained from the Institutional Ethics Committee, and patient confidentiality was maintained in accordance with the ethical standards of the Declaration of Helsinki.

Inclusion and Exclusion Criteria

All patients with a histologically confirmed diagnosis of esophageal carcinoma (either squamous cell carcinoma or adenocarcinoma) who underwent initial staging work–up with upper gastrointestinal endoscopy and contrast–enhanced computed tomography (CECT) and received any form of anticancer treatment (surgery and/or radical radiotherapy with or without concurrent chemotherapy) were included in the study. Patients with inconclusive biopsy reports, other histologic subtypes, or incomplete clinical records were excluded.

Data Collection

Demographic and clinical data were retrieved from the hospital's electronic medical records and patient charts. Information collected included:

- Age
- Sex
- ECOG performance status
- Clinical stage (as per the AJCC 8th Edition TNM classification)
- Tumor location (categorized as cervical, upper thoracic, middle thoracic, and lower thoracic esophagus)

- Presence of local recurrence or distant metastasis
- Treatment modality (surgery, radiotherapy, concurrent chemoradiotherapy)

Tumors involving more than one region of the esophagus were classified according to the region with the maximum extent of involvement.

Treatment Modalities

Patients were managed based on performance status, disease stage, and tumor resectability. Treatment modalities included:

- Surgical resection, with or without neoadjuvant/adjuvant therapy
- Radical radiotherapy, with or without concurrent chemotherapy

Outcome and Follow–Up

The primary outcome was overall survival (OS), defined as the time from diagnosis to death or last follow–up. Patients were followed up regularly, and survival status was obtained from hospital records or telephonic communication when necessary.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Windows, Version 26.0. Quantitative data were presented as means, medians, and standard deviations, while categorical data were summarized using frequencies and percentages.

Survival analysis was conducted using the Kaplan–Meier method, and differences between subgroups were evaluated using the log–rank test. Variables significant in univariate analysis were entered into a Cox proportional hazards regression model for multivariate survival analysis. A p–value of <0.05 was considered statistically significant.

Results

Total 61 patients with appropriate records were taken into consideration. Median age of presentation was 58 years, 29 were male while 32 were females. Out of these patients, 24 underwent surgical intervention while 37 underwent treatment with radical radiotherapy. Various clinic–demographic variables were taken into consideration for survival analysis as age, sex, surgical intervention, concurrent chemotherapy, performance status. After a median follow–up of 35 months, univariate survival analysis was done using Kaplan Meier Curve with above mentioned variables. The variables which were found statistically significant, were considered for multi–variate analysis using Cox Regression analysis.

Baseline Characteristics – (Table 1)

Baseline Characteristics		Number
Sex	Male	29
	Female	32
Age	<58 years	31
	>58 years	30
Surgery	Yes	24
	No	37
Concurrent Chemotherapy	Yes	40
	No	21
Location of primary	Cervical	13
	Upper Thoracic	19
	Middle Thoracic	21
	Lower Thoracic	8
Final Outcome	Live	22
	Dead	39

Table 1 – Table representing baseline characteristics of patients

Survival Analysis (using Kaplan Meier curves)

1. Age vs Overall Survival – (Fig. 1)

Median age of presentation was 58 years. Overall Survival was compared between age <58 years and >58 years.

Median OS was found to be 18 months (<58 years) and 19 months (>58 years) with p value of 0.66

2. Sex vs Overall Survival – (Fig 2)

Among 61 patients, 29 were male while 32 were female patients.

Median OS was found to be 20 months (Male) vs 15.5 months (Female) with p value of 0.513.

3. Surgical Intervention vs Overall Survival – (Fig 3)

Out of 61 patients,24 underwent surgical intervention while 37 underwent treatment with radical radiotherapy.

Median OS was found to be 13 months (Nonsurgical arm) vs 95 months (Surgical arm) with p value of 0.001.

4.Concurrent Chemotherapy vs Overall Survival – (Fig 4)

Out of 61 patients, 40 patients received concurrent chemotherapy.

Median OS was found to be 24 months (Concurrent Chemotherapy arm) while 12 months (No concurrent chemotherapy) with statistically significant p value of 0.021.

5.Local Progression vs Overall Survival– (Fig 5)

Out of 61 patients, 22 patients developed local recurrence/progression.

Median OS was found to be 13 months (local progression/recurrence arm) while not reached in no local recurrence arm with statistically significant p value of <0.001.

6. Distant Metastasis vs Overall Survival– (Fig 6)

Out of 61 patients, 13 patients developed distant recurrence.

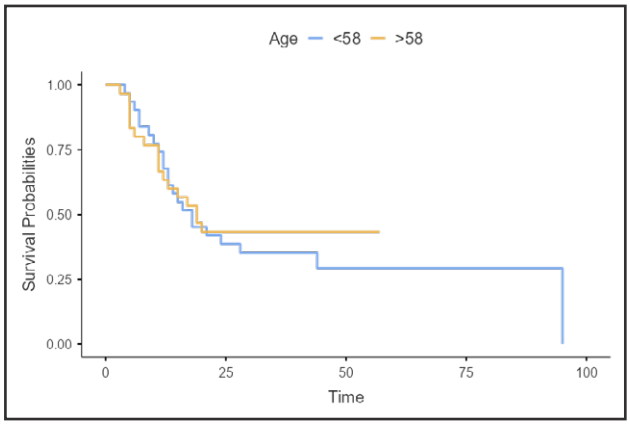


Fig 1 – Kaplan Meier Curve representing survival analysis of survival outcome vs Age

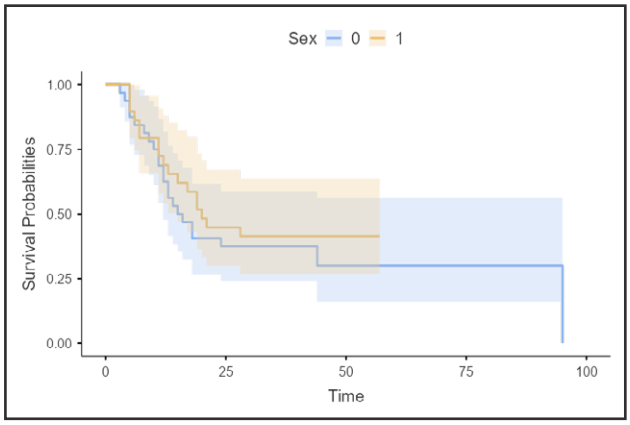


Fig 2 – Kaplan Meier Curve representing survival analysis of survival outcome vs Sex

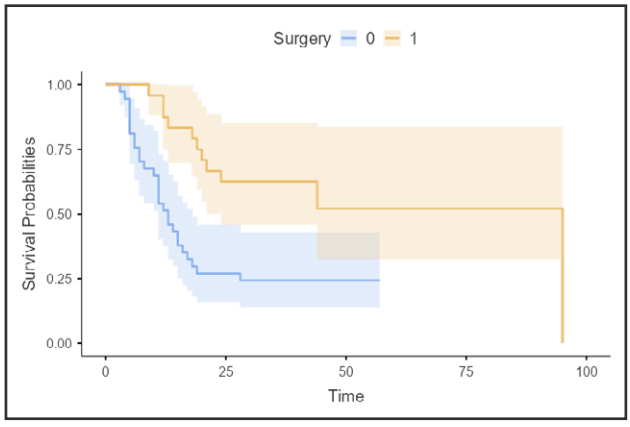


Fig 3 – Kaplan Meier Curve representing survival analysis of survival outcome vs surgical intervention

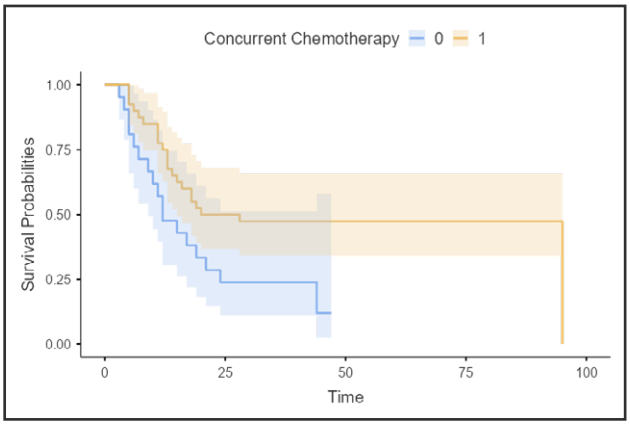


Fig 4 – Kaplan Meier Curve representing survival analysis of survival outcome vs concurrent chemotherapy

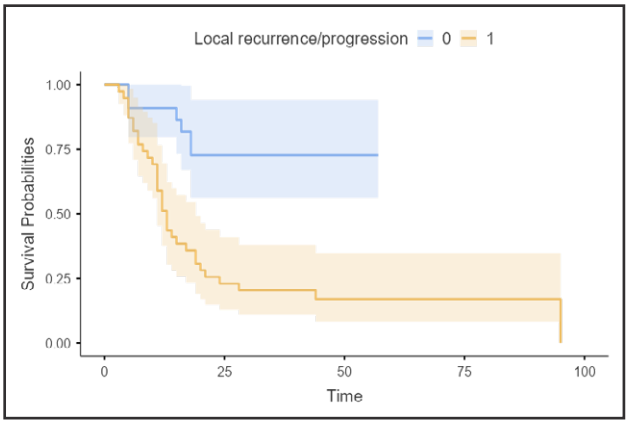


Fig 5 – Kaplan Meier Curve representing survival analysis of survival outcome vs local progression

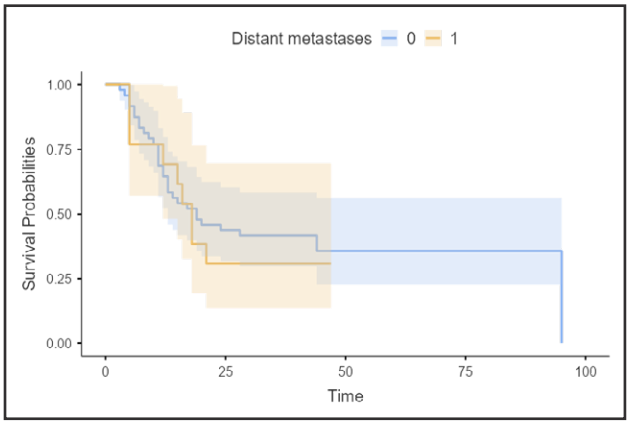


Fig 6 – Kaplan Meier Curve representing survival analysis of survival outcome vs distant metastasis

Median OS was found to be 19 months (No distant recurrence) while 18 months (distant recurrence) with p value of 0.639.

7. Performance Status vs Overall Survival– (Fig 7)

Out of 61 patients, 7 were in ECOG–0, 23 in ECOG–1, 27 in ECOG–2 while 4 in ECOG–3.

Median OS was found to be not reached (ECOG–0), 44 months (ECOG–1). 13 months (ECOG–2) while 5.5 months (ECOG–3) with statistically significant p value of 0.004.

8. Clinical Stage Group vs Overall Survival – (Fig 8)

Clinical stage information was available for 38 of the 61 patients; staging information was not available for the remaining 23 patients. Among the 38 patients with available staging information, 1 was in clinical stage I, 13 in clinical stage II, 9 in clinical stage III, and 15 in stage IV.

Median OS was found to be not reached (Stage–I), 95 months (Stage–II), 13 months (Stage–III), 11 months (Stage IV) with p value of 0.064.

9. Multivariate Survival Analysis – (Table 2)

Discussion

The current single–center study examined a variety of clinicopathological parameters to determine their impact on overall survival (OS) in esophageal cancer and discovered many significant predictors. Notably, multimodal treatment, particularly the combination of surgery and concomitant chemoradiotherapy, was associated with significantly improved survival.

Patients who received surgical resection had better results than those who were treated non– surgically, which is consistent with the global literature that emphasises curative resection as a cornerstone of therapy [11].

Surgical treatment in our sample likely reflects patients who achieved tumor downstaging or had resectable cancer, leading to better overall survival. This finding is consistent with the landmark CROSS study, which showed that neoadjuvant chemoradiotherapy followed by surgery improves survival over surgery alone[5]. Tri–modality therapy has thus become the standard of care for locally advanced esophageal cancer in fit patients [5].

Our findings support the use of combined modality treatment, which can increase 5–year survival to 35–50% in resectable cases. Previously, single–modality therapy

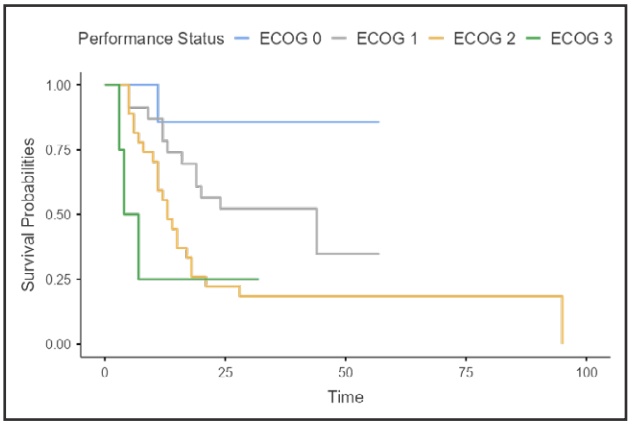


Fig 7 – Kaplan Meier Curve representing survival analysis of survival outcome vs performance status

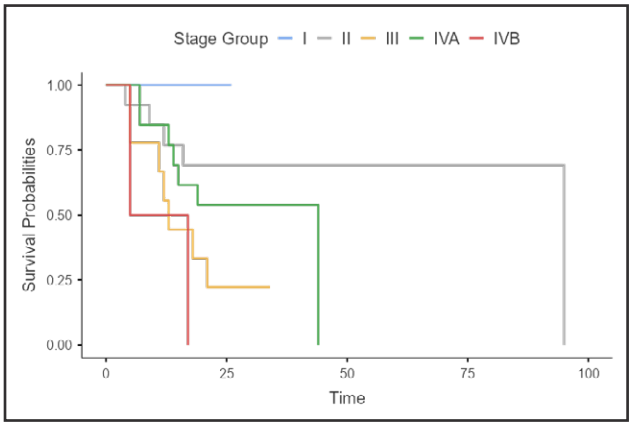


Fig 8 – Kaplan Meier Curve representing survival analysis of survival outcome vs Stage Group

Dependent: Survival		**all**	**HR (univariable)**	**HR (multivariable)**
Surgery	0	37 (60.7)	–	–
	1	24 (39.3)	0.31 (0.15–0.65, p=0.002)	0.30 (0.15–0.63, p=**0.001**)
Concurrent Chemotherapy	0	21 (34.4)	–	–
	1	40 (65.6)	0.48 (0.25–0.91, p=0.026)	0.46 (0.24–0.88, p=**0.019**)
Dependent: Survival		**all**	**HR (univariable)**	**HR (multivariable)**
Local recurrence/progression	1	22 (36.1)	–	–
	0	39 (63.9)	0.31 (0.11–0.83, p=0.020)	0.31 (0.11–0.83, p=**0.020**)

Table 2 – Multivariate analysis of survival outcome vs Surgery/Concurrent chemotherapy, local recurrence

(surgery or radiation alone) had significantly lower 5–year survival rates, sometimes below 10% [10,11].

The Radiation Therapy Oncology Group (RTOG 85–01) trial found that combining chemotherapy with irradiation improved 5–year survival from 0% to approximately 26%[7]. In our study, receipt of concurrent chemotherapy was associated with longer overall survival.

Another major factor in our study was performance status (ECOG). Patients with strong performance status (ECOG 0–1) showed higher survival rates than those with lower functional level. This outcome is expected and confirms prior studies on esophageal cancer [7,12].

Patients with higher performance received vigorous multimodal treatment and managed therapy– related toxicities, while those with ECOG 2–3 may have received only palliative measures.

This highlights the need of enhancing patient fitness before and throughout treatment, including dietary support and managing comorbidities. Treatment intensity should be determined by performance status. Patients with enough functional reserve should get tri–modality therapy, while those with marginal status may benefit from targeted therapy or prehabilitation.

In our analysis, distant recurrence was not significantly associated with overall survival. Median OS was 19 months in patients without distant recurrence and 18 months in those with distant recurrence (p=0.639). Nevertheless, metastatic esophageal cancer remains associated with poor prognosis in published series [9]. Epidemiologic evidence supports this conclusion, as 50% of esophageal cancer patients present with metastases and have a 5–year survival rate of less than 5% [12]. Our findings align with the grim statistics of advanced–stage esophageal cancer, highlighting the challenges of managing the disease once it has metastasized. While modern chemotherapy and immunotherapy have improved median survival by a few months, long–term survival remains a challenge.

Unfortunately, late presentation is typical in Western Rajasthan and India as a whole. Previous Indian studies have shown a high proportion of patients presenting with stage III or IV illness (e.g., 39% stage III and 25% stage IVA in a North–West Indian cohort) [10]. Limited awareness, financial hurdles, and referral delays all contribute to the advanced stage of diagnosis. Our findings highlight the need for public health interventions to promote early diagnosis, such as screening high–risk persons and improving access to care, as advanced cases result in poor outcomes.

Clinical Implications

The findings emphasize the need for a multimodal approach to esophageal cancer treatment and tailored therapy based on patient variables [13]. Our study found that patients who received both surgery and chemotherapy (concurrently with radiation or as preoperative treatment) had a higher survival rate. This validates current treatment protocols that combine modalities for optimal tumor control. When surgery is possible, it should be combined with systemic therapy to address micro–metastases and increase resectability along with interdisciplinary management including nutritional and rehabilitative services, especially in resource– limited areas where patients may exhibit weight loss and fragility [14].

Conclusion

In summary, surgery and chemotherapy are crucial for enhancing survival rates in esophageal cancer, as evidenced by a single–center series. Patients with good performance status and better local disease control had more favourable outcomes, consistent with the findings of this study. Advanced–stage disease remains a significant challenge, with many patients presenting late and experiencing poor results despite treatment (similar to other Indian hospitals).

Early, intensive multimodal treatment provides the highest chance for cure. However, addressing real–world challenges such as patient optimization, therapeutic compliance, and timely diagnosis is crucial to achieve these benefits.

Future studies in India should be multi–center and prospective to validate our findings and explore new medicines and supportive care measures to improve survival in this challenging condition. Our experience, with its successes and limits, contributes to the developing evidence base for managing esophageal cancer in global and Indian settings.

Acknowledgements

The authors would like to thank the Department of Radiation Oncology, AIIMS Jodhpur for providing access to clinical records and institutional support for data collection. We also acknowledge the assistance of the medical records team and technical staff for their contributions during the retrospective data retrieval process.

Funding and Conflict of Interest

Funding: The authors did not receive any external or institutional funding for the preparation of this manuscript.

Conflict of Interest: The authors declare no conflicts of interest related to this study.

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