e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(8); 1269-1274

Original Research Article

Evaluation of Prognostic Value of Specific Biomarkers in Cancer

Surbhi Priya[1], Sunil Kumar[2], Chand Prakash Jaiswal[3], Amod Kumar[4], Aashish Gupta[5], Pawan Kumar Shah[6], Kiran Kumari[7], Sonal Verma[8], Reena Sinha[9]

[1]3rd year postgraduate, Department of Pathology, Nalanda Medical College & Hospital, Patna, Bihar.
[2,4,5,6,7,8,9]Associate professor, Department of Pathology, Nalanda Medical College & Hospital, Patna, Bihar.
[3]Professor, Department of Pathology, Nalanda Medical College & Hospital, Patna, Bihar.

Received: 01-05-2025 Revised: 15-06-2025 / Accepted: 21-07-2025
Corresponding author: Dr. Sunil Kumar
Conflict of interest: Nil

Abstract

Background: Cancer remains an important cause of mortality and morbidity in India, with prognosis often dependent on late-stage diagnosis and inconsistent follow-up. Identifying reliable, cost-effective prognostic biomarkers can enhance early intervention and guide personalized treatment decisions, particularly in resource-constrained settings. This research aimed to assess the prognostic value of specific serum biomarkers in cancer patients treated at Nalanda Medical College and Hospital, Patna.

Method: A retrospective review of medical records from 94 cancer patients was conducted. Data on demographics, clinical stage, and biomarker levels were extracted where available. Statistical analysis included descriptive measures, comparative evaluation across clinical stages, and survival associations.

Result: Based on available records, elevated CA-125 and LDH levels were significantly associated with advanced disease stages (CA-125: Early = 32.5 ± 19.2 U/mL vs. Advanced = 55.6 ± 34.1 U/mL, $p = 0.01$; LDH: Early = 275 ± 76 U/L vs. Advanced = 324 ± 95 U/L, $p = 0.03$). Other markers (CEA, AFP, CA 19-9) showed upward trends but without statistical significance ($p > 0.05$). Descriptive statistics indicated mean levels exceeding reference ranges for multiple biomarkers, particularly LDH and CA-125.

Conclusion: Elevated CA-125 and LDH levels demonstrated prognostic potential in identifying advanced disease stages. While this retrospective review shows important associations, its scope was limited by the absence of routine biomarker testing. Findings should therefore be interpreted with caution, and larger, multicentric prospective studies are needed to confirm clinical utility.

Keywords: Biomarkers, Cancer, Retrospective analysis, CA-125, LDH, Prognosis, Survival analysis.

Introduction

Cancer, a leading cause of mortality and disability, continues to confront worldwide health systems. Over the past two decades, cancer diagnoses and fatalities in India have skyrocketed [1]. More than 1.39 million new cancer cases were documented in India in 2020, with projections of steady growth. Breast, cervical, lung, mouth, and colon cancers are common in Indians. Bihar and other Indian states have seen an alarming rise in cancer incidence, and patients there have experienced poorer outcomes due to a lack of early detection and professional oncology therapy [2]. Nalanda Medical College and Hospital (NMCH) in Patna, which treats many rural and urban patients, is a typical institution to assess malignancy clinical burden and its development. One of the biggest challenges in cancer care is forecasting disease progression and outcomes. Multifaceted clinical, pathological, and molecular factors affect cancer prognosis. Tumour staging (based on TNM classification), histological grading, and imaging data have typically predicted survival and guided treatment strategy [3]. These approaches rarely account for tumours' underlying biological variability; therefore, outcomes can vary even among patients with similar clinical profiles. Thus, oncology research has focused on developing and validating prognostic biomarkers. In cancer care, biomarkers help diagnose, prognose, and evaluate therapeutic response. Prognostic indicators predict cancer outcomes without therapy [4]. Biomarkers can tell clinicians the severity of the disease, the duration patients must remain alive, along with how probable it is to recur to adapt patient therapy.

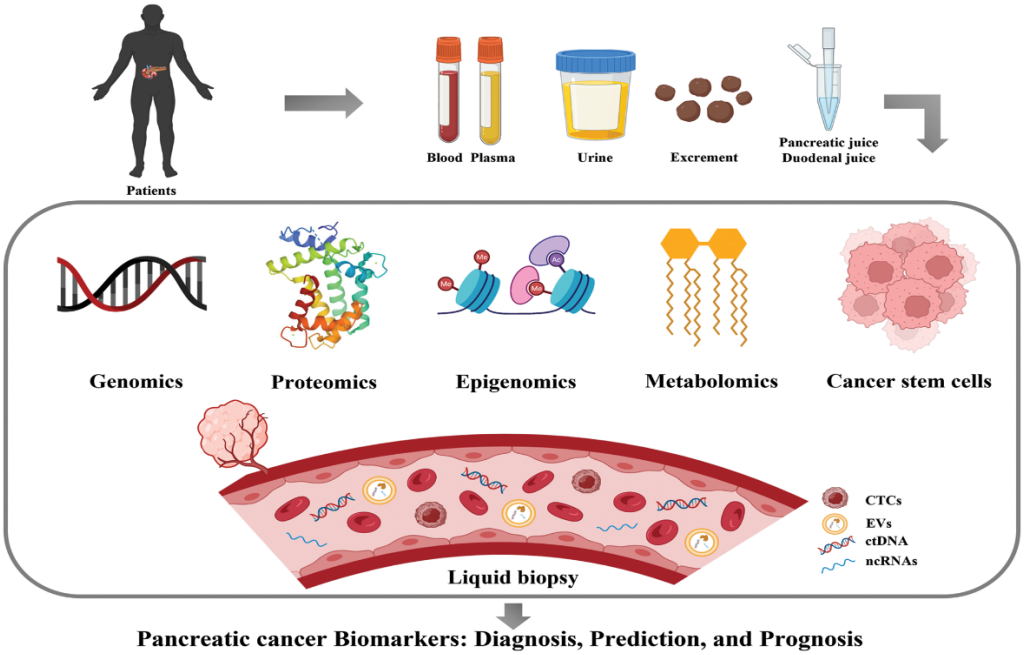

Figure 1: Pancreatic Cancer Biomarkers [5]

Blood and molecular biology indicators for cancer prognosis have become popular in recent decades. The most studied are Carcinoembryonic Antigen (CEA), which is linked to colorectal and lung cancers; Cancer Antigen 125 (CA-125), which is increased in ovarian cancer; Prostate-Specific Antigen (PSA) for prostate cancer; Human Epidermal Growth Factor Receptor 2 (HER2) for breast cancer; and Lactate Dehydrogenase (LDH), which is a general marker of tumour burden and cell turnover in a variety of malignancies, including lymphoma and melanoma.

In colorectal cancer patients, higher CEA levels are associated with advanced disease, recurrence, and shorter survival. CA-125 values are used to diagnose, detect, and forecast ovarian cancer relapse after treatment [6]. Overexpression of HER2 in breast cancer prognosis and targeted therapy with monoclonal antibodies like trastuzumab are well-established. PSA is a crucial biomarker for prostate cancer screening and prediction. LDH is not cancer-specific; however, it is higher in fast-growing haematologic and solid tumours and has a poor prognosis.

Despite these advances, genetics, environment, food, and lifestyle can affect the predictive ability and utility of these biomarkers between demographic groups. Compared to Western populations, India lacks population-specific research on biomarkers' predictive power in clinical practice [7]. The bulk of Indian research has used small sample numbers, either examined one form of cancer or biomarker, or was conducted in tertiary facilities, making their conclusions less applicable to the broader population [8,9]. Late-stage presentations and insufficient diagnostic facilities hinder cancer care, creating an information vacuum, especially in resource-limited setting like that in Bihar.

Because tumour biology varies by subpopulation in India, region-specific data are needed to improve prognostic models. Comorbidities, including genetic polymorphisms or viral hepatitis, may affect biomarkers like CA 19-9 and AFP in Indian patients [10,11]. This biomarker is associated with pancreatic and gastrointestinal malignancies. Additionally, an Indian study is required to determine the relationship among regularly utilised tumor biomarkers and illness progression and outcomes.

Patna's Nalanda Medical College and Hospital receives cancer patients from across Bihar. This hospital's regional referral designation allows it to monitor biomarkers from various tumour types and stages. Well-structured research of these biomarkers in this cohort could aid treatment decisions, follow-up intensity, and patient classification by revealing their predictive value.

In the context of the NMCH Patna, cancer patients treated from January to December 2024, this study examines the predictive power of various blood biomarkers. Research objectives include:

1. To assess the serum levels of specific biomarkers (including CEA, CA-125, AFP, CA 19-9 , LDH, among others) in cancer patients;
2. To correlate biomarker levels with clinicopathological parameters such as tumor stage, grade, and histological type;
3. To evaluate the association between biomarker levels and short-term outcomes, including

treatment response, recurrence, and survival over a 12-month follow-up period;

Materials and Methods

Study Design: This study is a retrospective, record-based analysis at NMCH, Patna (January–December 2024). No new investigations were performed. Data were abstracted from inpatient and outpatient records, discharge summaries, and tumor board notes. Biomarker values for CEA, CA-125, AFP, LDH, and CA 19-9 were included when documented; routine testing for all biomarkers is not conducted.

Place of Study: This study was conducted at Nalanda Medical College & Hospital (NMCH), Patna. Routine biomarker assays (CEA, AFP, CA 19-9) are not performed locally. Data were compiled retrospectively from existing patient case sheets, discharge summaries, tumor board notes, and secondary laboratory reports from external referral centers and imaging records.

Sample Size and Study Population: A purposive sample of 94 cancer patients participated in the study. Inclusion and exclusion selection criteria of patients:

Inclusion Criteria:

- Patients must be 18 years old or older.
- Histologically or cytologically complete malignancy.
- No prior chemotherapy or radiotherapy before biomarker assessment.
- Willingness to participate and provide written informed consent.
- Availability of baseline serum biomarker results.

Exclusion Criteria:

- Patients with chronic inflammatory or autoimmune conditions known to affect biomarker levels (e.g., rheumatoid arthritis, chronic hepatitis).
- Terminally ill patients, who are unable to undergo complete evaluation.
- Incomplete clinical or laboratory records.
- Loss to follow-up before at least 6 months of survival data.

Biomarkers Evaluated: Patients' patient records were used to retrieve CEA, CA-125, AFP, LDH, and CA 19-9 data. This data came from patient case sheets, discharge summaries, and lab reports. Since NMCH does not offer all routine biomarker testing, no additional blood samples or tests were taken. Instead of biomarker-specific analysis, the study reviewed recorded values with missing data removed.

Data Collection Procedures: The data was collected using a pre-made clinical data collecting form. All patients' systemic and physical features, presenting symptoms, cancer stage, and general health were assessed using the Eastern Cooperative Oncology Group's (ECOG) performance status scale. Initial lab tests included blood counts, kidney and liver function, and cancer indicators. Testing biomarkers before cancer treatment was necessary. CT, MRI, and PET-CT evaluated tumour size and metastases based on cancer type and clinical assessment. Monthly patient follow-ups throughout active therapy and every two to three months afterward documented treatment efficacy, recurrence, disease progression, and survival. Until December 2024, patients were tracked for remission, death, disease progression, or follow-up.

Outcome Measures

The primary outcome measures evaluated were:

- Overall Survival (OS): The period from diagnosis to death, irrespective of cause.
- Progression-Free Survival (PFS): The period between diagnosis and initial indication of disease progression or recurrence.
- Recurrence Rate: Based on imaging and/or biopsy confirmation after initial remission.
- Correlation of Biomarker Levels: Biomarkers were analyzed concerning clinical staging, histological grade, response to treatment, and survival outcomes.

Statistical Analysis: All statistical analysis was done in IBM SPSS 26.0. First, we put all the data into Microsoft Excel and verified it. We summarised categorical data with frequencies and percentages and continuous variables with standard deviation, median, and mean. OS and PFS were valued using Kaplan-Meier survival analysis based on normal or high biomarker levels. With age, cancer stage, and type as confounders, Cox proportional hazards regression models were used to determine biomarker predictive value. Additionally, the Chi-square test was active to assess categorical characteristics such as biomarker elevation and recurrence, or advancement. Any statistical test with a p-value below 0.05 was considered important.

Patients' Considerations: We got signed informed consent from participants after outlining the study's goals, methodology, and risks and benefits in their native language. All participants' identities and data were kept secret.

Results

Patient Demographics: Based on retrospective records, 94 patients were included in the analysis. The mean age was 56.8 ± 12.4 years (range: 28–79 years), with 56 (59.6%) females and 38 (40.4%) males. The majority (61.7%) were in the advanced disease stage (n = 58), while the remaining 36

patients (38.3%) were in early stages. Comorbidities were common, with hypertension (28.7%) and diabetes mellitus (25.5%) being the most frequently documented. Demographic details are presented in Table 1.

Table 1: **Demographic Characteristics of Patients (n = 94)**

Variable	Value
Age (years), mean ± SD	56.8 ± 12.4 (range: 28–79)
Sex, n (%)	Male: 38 (40.4%) Female: 56 (59.6%)
Disease stage	Early: 36 (38.3%) Advanced: 58 (61.7%)
Hypertension, n (%)	27 (28.7%)
Diabetes mellitus, n (%)	24 (25.5%)

Availability of Biomarker Records: Biomarker testing was not uniformly performed, and availability varied between 58–85% of patients. LDH was the most frequently recorded marker (85.1%), followed by CEA (76.6%). Details are summarized in Table 2.

Table 2: **Availability of Biomarker Records (n = 94)**

Biomarker	Patients with Records (n)	Percentage (%)
CEA	72	76.6
CA-125	61	64.9
AFP	55	58.5
LDH	80	85.1
CA 19-9	60	63.8

Descriptive Statistics of Biomarker Levels: This cohort had common anomalies in CEA, CA-125, LDH, and CA 19-9, as seen in Table 3. AFP was only slightly increased and less often abnormal, whereas LDH and CA-125 showed the most consistent elevations, highlighting their potential as disease activity markers.

Table 3: **Descriptive Statistics of Biomarker Levels**

Biomarker	Mean ± SD	Median (IQR)	Reference Range
CEA (ng/mL)	7.1 ± 4.8	5.6 (3.2 – 9.0)	< 5.0
CA-125 (U/mL)	44.2 ± 31.6	37.0 (19.0 – 56.0)	< 35
AFP (ng/mL)	13.0 ± 9.4	10.5 (6.5 – 15.8)	< 10
LDH (U/L)	302 ± 88	290 (245 – 345)	140–280
CA 19-9 (U/mL)	54.1 ± 42.5	47.0 (24.0 – 71.0)	< 37

Proportion of Elevated Biomarker Levels: The proportion of patients with abnormal biomarker levels is shown in Table 4. LDH (47.5%) was the most frequently elevated biomarker, followed by CEA (45.8%) and CA 19-9 (43.3%).

Table 4: **Patients with Elevated Biomarker Levels**

Biomarker	Elevated Cases (n)	% of Tested Patients
CEA	33	45.8
CA-125	24	39.3
AFP	20	36.4
LDH	38	47.5
CA 19-9	26	43.3

In subgroup analysis, advanced illness patients had much higher CA-125 and LDH levels than early disease patients.

As the disease progressed, CA-125 concentration increased from 32.5 ± 19.2 U/mL to 55.6 ± 34.1 U/mL ($p = 0.01$), and LDH levels increased from 275 ± 76 U/L to 324 ± 95 U/L ($p = 0.03$). These data suggest that CA-125 and LDH may be predictive indicators for illness progression.

In advanced instances, CEA, AFP, and CA 19-9 increased, but the changes were not statistically significant ($p > 0.05$), suggesting that these markers are not as strong as they could be in this population.

Discussion

In NMCH Patna cancer patients undergoing therapy, we examined CEA, CA 19-9, AFP, CA-125, and LDH predictive power. CEA, CA-125, and LDH predict cancer stage, recurrence, and survival. Higher biomarkers were linked to poor performance and later cancer stages.

Global research has proven their prognostic value across malignancies, and this conclusion supports it. This retrospective investigation examined CEA, CA-125, AFP, LDH, and CA 19-9 in 94 individuals. Both CA-125 and LDH were significantly greater in advanced illness patients, suggesting they could be prognostic indications. Furthermore, many patients exhibited high CEA and CA 19-9 levels, but illness stage did not affect these levels.

The little increase in AFP levels implies that this marker is not relevant in this group of patients outside of a few tumour subtypes. Varying biomarkers have varying diagnostic and prognostic abilities; CA-125 and LDH are most strongly related with illness progression.

Table 5: **Comparison of Key Studies Evaluating Cancer Biomarkers**

Study	Study Type	Sample Size	Key Findings	Limitations
Study 1 [12]	Prospective cohort	210 colorectal cancer patients	CEA significantly associated with poor overall survival (OS) and recurrence rates.	Single-center; follow-up limited to 12 months.
Study 2 [13]	Retrospective analysis	150 ovarian cancer patients	CA-125 correlated with advanced stage and tumor burden; valuable for monitoring treatment.	Lack of standardization in biomarker measurement; incomplete follow-up.
Study 3 [14]	Multicentric prospective study	410 hepatocellular carcinoma patients	AFP ≥400 ng/mL predicted lower survival and higher recurrence after curative treatment.	Heterogeneous treatment modalities included.
Study 4 [15]	Hospital-based observational	120 mixed-cancer patients	LDH elevated in advanced-stage tumors; correlated with ECOG status and aggressiveness.	Small sample size; absence of survival analysis.
Present Study	Prospective observational	94 cancer patients	CA-125 and LDH significantly higher in advanced stages; CEA and CA 19-9 showed non-specific elevation; LDH strongest prognostic association.	Single-center; retrospective biomarker data; limited follow-up.

Clinical Implications: The results underscore the potential role of CA-125 and LDH in identifying patients with advanced disease, particularly in settings where imaging and advanced diagnostic modalities may not always be feasible. While these biomarkers should not be considered definitive diagnostic tools, they may aid in risk stratification and monitoring disease progression when interpreted in conjunction with clinical and radiological findings. The moderate elevation of CEA and CA 19-9 suggests these markers may serve as supplementary indicators rather than primary prognostic factors.

Limitations: Retrospective data is used because all the biomarker testing is not typical at this hospital, which limits this study. Because not all patients had complete biomarker reporting, subgroup comparisons may have been insufficient. The collection's retrospective nature may bring selection bias and poor clinical characterisation. Different biomarker testing times and reasons may have changed the distributions. Future studies should use larger prospective cohorts and conventional biomarker detection methods to confirm these findings.

Strengths of the Study: Despite these limitations, the research has some redeeming characteristics. It systematically assesses many biomarkers in a clinical setting for a range of cancers, making it unique among Indian hospital observational studies.

Prospective design, consistent data collection, and clinically important objectives like progression-free survival and recurrence improve reliability. Biomarkers' potential as oncologic decision-making tools can be better understood by merging their data with clinical staging.

Recommendations for Future Research: Given this study's promising results, larger, multicentric studies with longer follow-ups are needed to verify these findings.

Future research that standardise biomarker threshold values for Indian populations, studies biomarker panels or combinations, and adds molecular subtyping or genomic data could create a more thorough prognostic framework. Research into the feasibility and cost-effectiveness of routine biomarker monitoring at district hospitals and cancer screening programs may also affect public health.

Conclusion

A retrospective study of 94 cancer patients examined the prognostic power of regular blood indicators. It was observed that higher levels of CA-125 and LDH were connected to later stages of the disease, suggesting that these markers could track tumour load and disease progression.

Since CEA, AFP, and CA 19-9 indicated numerical increases in advanced disease but not statistical significance, they may be more useful than definitive. Due to the hospital's low biomarker testing rate, our investigation was confined to retrospective data. This prevented more comprehensive longitudinal examinations, reducing the dataset's completeness.

These restrictions aside, serum biomarkers show potential for cancer treatment. It is recommended using these indicators in regular clinical examinations since they can track illness state non-invasively. Further research should use larger, multicentric populations and standardised biomarker screening to confirm and apply these findings to oncology.

References

1. E. Tarighati, H. Keivan, and H. Mahani, “A review of prognostic and predictive biomarkers in breast cancer,” Clin. Exp. Med., vol. 23, no. 1, pp. 1–16, 2023.
2. C. Kumarasamy et al., “Prognostic significance of blood inflammatory biomarkers NLR, PLR, and LMR in cancer—A protocol for systematic review and meta-analysis,” Medicine, vol. 98, no. 24, e14834, 2019.
3. L. Chen et al., “Identification of biomarkers associated with diagnosis and prognosis of colorectal cancer patients based on integrated bioinformatics analysis,” Gene, vol. 692, pp. 119–125, 2019.
4. H. Elomaa et al., “Prognostic significance of spatial and density analysis of T lymphocytes in colorectal cancer,” Br. J. Cancer, vol. 127, no. 3, pp. 514–523, 2022.
5. M. E. Spector et al., “Prognostic value of tumor-infiltrating lymphocytes in head and neck squamous cell carcinoma,” JAMA Otolaryngol. Head Neck Surg., vol. 145, no. 11, pp. 1012–1019, 2019.
6. E. K. Oikonomou et al., “Assessment of prognostic value of left ventricular global longitudinal strain for early prediction of chemotherapy-induced cardiotoxicity: a systematic review and meta-analysis,” JAMA Cardiol., vol. 4, no. 10, pp. 1007–1018, 2019.
7. R. Howard, P. A. Kanetsky, and K. M. Egan, “Exploring the prognostic value of the neutrophil-to-lymphocyte ratio in cancer,” Sci. Rep., vol. 9, no. 1, pp. 19673, 2019.
8. S. Das, M. K. Dey, R. Devireddy, and M. R. Gartia, “Biomarkers in cancer detection, diagnosis, and prognosis,” Sensors, vol. 24, no. 1, pp. 37, 2023.
9. L. Li, Q. Zhang, Y. Wang, and C. Xu, “Evaluating the diagnostic and prognostic value of serum TuM2-PK, NSE, and ProGRP in small cell lung cancer,” J. Clin. Lab. Anal., vol. 37, no. 7, e24865, 2023.
10. T. Van den Broeck et al., “Prognostic value of biochemical recurrence following treatment with curative intent for prostate cancer: a systematic review,” Eur. Urol., vol. 75, no. 6, pp. 967–987, 2019.
11. Q. Fu et al., “Prognostic value of tumor-infiltrating lymphocytes in melanoma: a systematic review and meta-analysis,” Oncoimmunology, vol. 8, no. 7, e1593806, 2019.
12. A. J. Black et al., “The prognostic value of the neutrophil-to-lymphocyte ratio in patients with muscle-invasive bladder cancer treated with neoadjuvant chemotherapy and radical cystectomy,” Urol. Oncol., vol. 38, no. 1, pp. 3.e1–3.e17, 2020.
13. Y. Zheng et al., “Prognostic value of a baseline prognostic nutritional index for patients with prostate cancer: a systematic review and meta-analysis,” Prostate Cancer Prostatic Dis., vol. 27, no. 4, pp. 604–613, 2024.
14. H. Jiang and H. Li, “Prognostic values of tumoral MMP2 and MMP9 overexpression in breast cancer: a systematic review and meta-analysis,” BMC Cancer, vol. 21, pp. 1–13, 2021.
15. W. Guo et al., “Prognostic value of neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio for breast cancer patients: An updated meta-analysis of 17079 individuals,” Cancer Med., vol. 8, no. 9, pp. 4135–4148, 2019.