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Research Article

Evaluating The Efficacy of Carcinoembryonic Antigen in Standard Rectal Cancer Patient Surveillance: Does it Provide Benefits?

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Abstract

Introduction:

Carcinoembryonic Antigen (CEA) has been linked to colorectal cancer cell adhesion and innate immunity. According to the National Institute for Health and Care Excellence (NICE), curative surgery is recommended for non-metastatic colorectal cancer, followed by a 3-year follow-up with CEA tests every 6 months and two chest, abdomen, and pelvis CT scans to detect recurrence. This study aimed to explore CEA's role in predicting both local and distant recurrence in comparison with computed tomography (CT) as the gold standard for rectal cancer.

Methods:

A retrospective analysis was conducted on all patients who were treated at the West Suffolk Hospital NHS Trust from 2014 to 2018. Electronic medical records of all eligible patients were reviewed to collect data on patient demographics, clinical characteristics, tumor characteristics, surgical details, adjuvant therapy, and follow-up data.

Results:

Of the 146 patients who underwent curative resection, 100 were male and 46 were female. During the 3-year follow-up period, 27.7% (40/146) of patients developed relapses. CEA was elevated in five patients, which was correlated with CT scans of the chest, abdomen, and pelvis. However, 31 patients were found to have metastasis in the follow-up CT scan, despite normal CEA levels.

Conclusion:

This study at the West Suffolk Hospital NHS Trust (2014-2018) emphasizes CEA's role in predicting rectal cancer recurrence after curative resection. While CEA is correlated with CT scans for some patients, it is not infallible, especially for distant metastases. Combining CEA and regular CT scans enhances surveillance and effectively detects local and distant recurrence. Further research is needed to establish surveillance for rectal cancer.

Keywords: CEA; Colorectal Cancer; CT Scan; Tumour.

Introduction

The incidence of rectal cancer, a common epithelial cell tumour of the rectum, is a significant concern for global health and contributes to substantial morbidity and mortality rates. Globally, it ranks as the third most prevalent cancer in males and the second most common in females, causing 860,000 deaths annually [1]. This makes Colorectal Cancer (CRC), including rectal cancer, a substantial global health challenge [2], and its incidence tends to increase with the improvement of living standards. Various clinical and pathological methods are used to assess the progression of CRC, including TNM staging, Dukes-modified classification, and histopathological grading. Treatment typically involves surgery for healthy patients, whereas those with distal rectal cancer may receive neoadjuvant radiotherapy or chemoradiotherapy. High-risk patients receive adjuvant therapy based on tumour stage and location [3].

Carcinoembryonic antigen (CEA), a 180–200 kDa immunoglobulin superfamily glycoprotein, was first described in 1965. Solid tumours, including 90% of colorectal malignancies, release CEA [4]. Elevated preoperative CEA levels, the most reliable serum prognostic indicator in colorectal cancer, are associated with worse prognoses. CEA has been linked to colorectal cancer cell adhesion and innate immunity. CEA also aids in colorectal cancer cell adhesion to metastatic sites and tumour growth [5]. Given its superiority to other independent prognostic indicators, carcinoembryonic antigen (CEA) has been suggested for the postoperative follow-up of patients with CRC. However, CEA alone has a low prognostic accuracy. Despite the lack of a consensus on CRC prognostic models, computational intelligence models have been proposed. However, multivariate background model trials are required [6].

Rectal cancer pretreatment assessments often involve measuring serum Carcinoembryonic Antigen (CEA) levels. Elevated CEA levels both before and after chemoradiation therapy (CRT) are associated with a poor tumor response and a higher risk of recurrence [7]. The decreasing ratio of pre- to post-CRT serum CEA levels might predict disease-free survival in patients with rectal cancer and a pre-CRT CEA level above 6 ng/ml. However, it is rarely documented whether clinically derived CEA measures, including the decrease ratio, correspond to a pathological complete response after surgery [8].

Several studies have shown that tumor cells can acquire metastatic potential early during tumor growth. Wo et al. suggested that a small tumor size in lymph node positivity may indicate aggressive biology. Therefore, early stage rectal cancer with elevated serum CEA levels may indicate early metastatic potential and poor rectal cancer survival. However, few studies have examined how T stage and serum CEA levels (C0 and C1) affect rectal cancer prognosis [9,10]. This study aimed to explore the role of CEA in predicting both local and distant recurrence in comparison to computed tomography (CT) as the gold standard for rectal cancer.

According to the NICE guidelines, individuals who have undergone potentially curative surgical treatment for non-metastatic colorectal cancer are eligible for follow-up care for the first three years post-treatment. This follow-up care aims to detect any local recurrence or distant metastases. The recommended follow-up plan includes serum Carcinoembryonic Antigen (CEA) measurement and computed tomography (CT) scans of the chest, abdomen, and pelvis. Patients should receive two CT scans in the third year and CEA measurements every six months [11].

Patients and Methods: A retrospective analysis was conducted on all patients with rectal cancer treated at the West Suffolk Hospital NHS Trust from 2014 to 2018. The study was approved by the Institutional Review Board. The inclusion criteria were Patients who underwent curative rectal cancer resection without metastasis or those who underwent local resection of cancer were included. Patients who underwent palliative resection or presented with metastasis were excluded. Electronic medical records of all eligible patients were reviewed to collect data on patient demographics, clinical characteristics, tumour characteristics, surgical details, adjuvant therapy, and follow-up data. Serum CEA levels were measured at regular intervals during follow-up. Recurrence and metastasis were defined as the appearance of new lesions on imaging studies or biopsy-proven disease after the initial treatment. This study aimed to assess the sensitivity and specificity of CEA.

Results: We conducted a retrospective analysis of the data obtained from a cohort of 200 patients diagnosed with rectal cancer who received treatment at the West Suffolk Hospital NHS Trust between 2014 and 2017. Each patient underwent comprehensive evaluation through a multidisciplinary team (MDT) assessment to ensure tailored and holistic management. After applying meticulous exclusion criteria, 146 patients were identified as suitable candidates for curative resection, with a rigorous follow-up period of at least 3 years post-surgery. Within this cohort, there was a predominance of male patients, comprising 100 individuals, whereas the remaining 46 patients were female, as depicted in Figure 1.

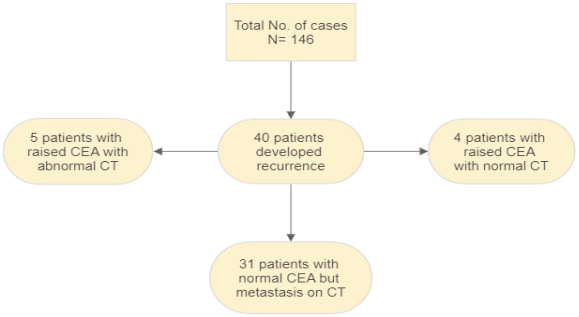

Figure 1: Study Design

The age spectrum of the patients ranged from 40 to 86 years, reflecting the diverse demographic profiles commonly observed in rectal cancer populations. Over the course of the follow-up period, disease recurrence was observed in 40 patients, representing 27.7% of the cohort. Of particular interest is the assessment of carcinoembryonic antigen (CEA) levels as a potential biomarker for disease recurrence. Among the subset of patients experiencing recurrence, five exhibited elevated CEA levels, correlating with abnormal findings detected on chest, abdominal, and pelvic computed tomography (CT) scans. Notably, four patients with elevated CEA levels demonstrated normal CT scan results, underscoring the complexities associated with relying solely on biomarker assessments for disease surveillance.

Our research revealed that a considerable proportion of patients (31 out of 40) with evidence of metastasis on CT scans had normal CEA levels, which underscores the limitations of CEA as a highly sensitive marker for detecting metastatic disease. The sensitivity of CEA, when compared to CT scans, was found to be relatively low (13.89 %), highlighting the need for additional imaging modalities for accurate disease assessment. In contrast, the specificity of CEA was relatively high at 96.36%,(Figure 2) indicating its usefulness as a tool for ruling out disease progression in patients with normal levels.

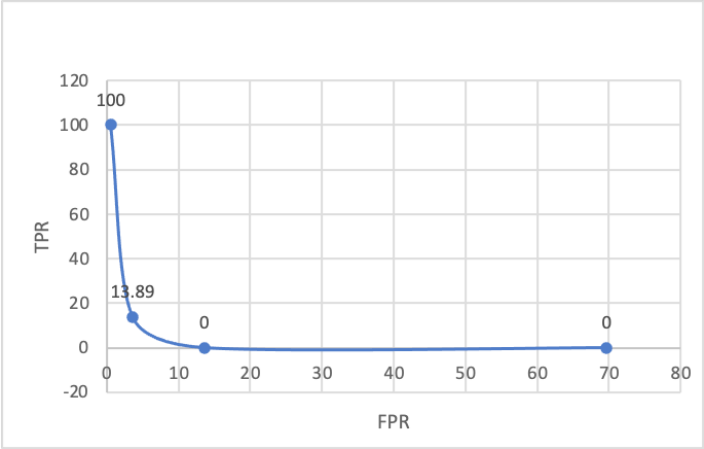

Figure 2: ROC curve of sensitivity and specificity

Discussion

Rectal cancer is a significant global health concern that demands rigorous surveillance and innovative prognostic markers to improve patient outcomes [12]. This study aimed to evaluate the usefulness of Carcinoembryonic Antigen (CEA) in predicting local and distant recurrence in rectal cancer patients after curative resection, comparing its performance to that of the gold standard, Computed Tomography (CT) scans. Our findings shed light on the utility of CEA in this context, and emphasize the need for comprehensive surveillance strategies. CEA, a well-established biomarker of Colorectal Cancer (CRC), has been extensively studied for its prognostic value [13].

In this study, we observed that elevated CEA levels were correlated with CT scans in some patients who later experienced recurrence, suggesting that CEA can be a useful tool for early detection. However, it is crucial to acknowledge the limitations of CEA, especially concerning distant metastases, where it demonstrated lower sensitivity (13.89%) than CT scans. This highlights the complementary nature of the two surveillance methods. The NICE guidelines recommend a follow-up regimen that combines CEA testing every six months with CT scans of the chest, abdomen, and pelvis every two years for the first three years

after post-curative surgery for non-metastatic colorectal cancer. Our study supports the rationale behind these guidelines and emphasizes the importance of integrating multiple surveillance modalities to maximize the detection of both local and distant recurrence.

In a study published in 2016, researchers evaluated the diagnostic accuracy of carcinoembryonic antigen (CEA) for detecting colorectal cancer recurrence. The sensitivity of CEA ranged from 17.4% to 100%, while the specificity ranged from 66.1% to 98.4%. Unfortunately, CEA was ineffective in detecting treatable recurrences at an early stage and failed to exhibit a clinically relevant effect on patient mortality. In line with these findings, our study suggests low sensitivity and a lack of notable differences in detecting early recurrence [14]. The use of CEA to predict rectal cancer recurrence after surgery is an ongoing area of research [15]. Although our results indicate that CEA can aid in identifying recurrence, its limitations in sensitivity warrant further investigation. This study underscores the need for further research to refine and enhance postoperative rectal cancer management. A distinct aspect of our study is the inclusion of patients who underwent local cancer resection. This is particularly pertinent, as rectal cancer treatment options continue to advance, and local resection may become a more prevalent approach in certain cases. By incorporating these patients into our analysis, we aimed to provide a more comprehensive assessment of CEA applicability across various treatment modalities.

Conclusion: Our study at West Suffolk Hospital NHS Trust (2014-2018) highlights the significance of CEA in predicting recurrence of rectal cancer after curative resection. While CEA has shown value in specific situations, it should not be utilized as a substitute for CT scans, especially for detecting distant metastases. By combining CEA with regular CT scans, we can enhance surveillance and more effectively identify both local and distant recurrences. However, further exploration and refinement of post-surgery rectal cancer management strategies is necessary to improve patient outcomes in this complex medical condition.

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