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Original Article

Assessment of Sensitivity and Specificity of CEA in Primary Diagnosis of patients with Gastrointestinal Malignancy

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Abstract:

Primary Diagnosis of GI (gastrointestinal) malignancy is difficult and most of the diagnostic tools were costly and invasive. The clinical validity of monitoring the serum biomarker carcinoembryonic antigen (CEA) was assessed in 100 patients with gastric, duodenal and colorectal adenocarcinomas in a tertiary-level hospital in Bangladesh. Sensitivity and specificity of the test were evaluated preoperatively. Patients were assessed clinically, radiologically, and biochemically. Our study revealed that in gastrointestinal (GI) malignancy as a whole the CEA test had a preoperative sensitivity and specificity of 54% and 80%, respectively. In stomach cancer, the sensitivity and specificity of CEA were 33.33% and 100%, respectively. In duodenal adenocarcinoma and carcinoma of caecum, the sensitivity and specificity of CEA were 66.67% and 40.0%, respectively. In colonic cancer, the sensitivity and specificity of CEA were 42.86% and 60.0%, respectively. In rectal carcinoma, the sensitivity and specificity of CEA were 42.86% and 63.64%, respectively. All these values are not statistically significant. So for detecting GI malignancies, the use of CEA is not widely recommended due to its low sensitivity and high specificity. An additional finding was that serum CEA levels were significantly elevated in advanced stages of gastrointestinal (GI) malignancy, with the highest levels observed in stage D (100%) followed by stage C (92.3%) and stage B (32.3%).

Key words: IGI malignancy, CEA.

Introduction:

The incidence and mortality rates of gastrointestinal malignancies differ greatly around the world. Colorectal carcinoma, in particular, is the third most frequently diagnosed cancer in males[1] and the second most commonly diagnosed cancer in females[2]. Early diagnosis in primary healthcare is challenging. With regular screening, the disease can be identified at an early stage and the prognosis of the disease would be much better. Upper GIT endoscopy and colonoscopy is the mainstay of confirmatory diagnosis. There are several other methods to suspect/detect GI malignancies including barium X-ray, CT colonography and serum

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biomarker analysis. Barium meal and enema are noninvasive and cheaper, but they are less sensitive than Upper GIT endoscopy or colonoscopy to detect the early stage of the disease [3, 4].

Tumor markers are commonly used in clinical practice in combination rather than in isolation. High diagnostic sensitivity and specificity are the two most desired characteristics of an ideal tumor marker. Carcinoembryonic antigen (CEA) is one of the most frequently expressed serum biomarkers in GI malignancy and has been broadly utilized since it can be utilized to evaluate the disease state simply and inexpensively. CEA is also elevated in several nonmalignant and other malignant diseases, including medullary thyroid cancer, breast cancer and mucinous ovarian cancer and also has a relationship with different stages of the disease[5]. Use of CEA in routine screening or detecting malignancies is not widely recommended due to its low sensitivity and high specificity[6] and also its association with several nonmalignant medical conditions[7]. Despite of these general limitations on the use of tumor markers some of them have proved helpful in diagnosing certain tumors[8]. In this study, we have tried to assess the sensitivity and specificity of CEA as a primary diagnostic tool for patients with GI malignancy in our perspective and also assess whether our observational data correlates with other studies.

Materials and methods:

This study was a prospective cross-sectional study. To evaluate the diagnostic sensitivity and specificity of CEA in GI malignancy this study has been carried out at the department of surgery of Bangabandhu Sheikh Mujib Medical College Hospital, Faridpur. Samples were collected during the period of June 2023 to December 2023. Patients with GI malignancy were enrolled in the study with informed written consent. Data were collected in an approved data collection form. Confidentiality was maintained strictly. Data were analyzed using IBM SPSS version 23 and presented in a textual and graphical manner. CEA of the patients were measured by radio-immune assay. The cut-off value of CEA for our study was 5ng/ml irrespective of sex and smoking. Staging of the malignancy was done precisely according to the clinical, radiological and postoperative histological findings. All the data were recorded and correlated with all these variables and assessments of sensitivity and specificity were done.

Result:

Among the 100 cases of GI Malignancy, 89 patients presented with conventional symptoms such as per rectal bleeding, passing black tarry stool, unexplained anemia, presence of a mass in the abdomen, and alteration of bowel habits. These patients were diagnosed by endoscopic/colonoscopic biopsy. Preoperative staging was done by contrast CT scan of the abdomen and chest, and MRI of pelvis. The remaining 11 patients were presented with features of intestinal obstruction where emergency surgery was performed and postoperative histopathology confirmed final diagnosis and stage. The mean age of the study group was 45.51±13.92 years and range 19-84 years. (Table I)

Table I: Distribution of patients according to Age (n=100)

Age (in years)	Frequency (%)
> 55	22(%)
46-55	24(%)
36-45	28(%)
26-35	20(%)
≤ 25	6(%)
Mean±SD	45.51±13.92
Range	19-84 years

Among 100 patients, 58% of patients were male and 42% patients were female. Out of 100 malignant patients, 50% had rectal carcinoma, 24% patients had colon carcinoma, 12% caecum and 8% patients had stomach carcinoma. (Table II).

Table II: Distribution of the study patients according to tumor location (n=100)

Tumor location	Frequency (%)
Stomach	8(%)
Small intestine	4(%)
Caecum	12(%)
Colon	24(%)
Rectum	50(%)
Anal canal	2(%)

Among 100 patients, 80% of them had their CEA level raised (52% moderately differentiated adenocarcinoma and 28% poorly differentiated adenocarcinoma. (Table III)

Table III: Distribution of the study patients according to histologic grade (n=100)

	CEA Level		
Histologic grade	Normal (< 5 ng/dl) No. (%)	Raised (> 5ng/dl) No. (%)	p value*
Well differentiated	2(2.0%)	0	< 0.002[S]
Moderately differentiated	16(16.0%)	52 (52.0%)	
Poorly differentiated	2(2.0%)	28 (28.0%)	

CEA level was raised in 22(32.35%) patients in stage B, 24(92.30%) patients in stage C, and 4(100%) in stage D malignancy. (Table IV)

Table-IV: Distribution of CEA level according to stage of malignancy (n=100)

Stage	CEA Level		
	Normal (< 5 ng/dl) No. (%)	Raised (> 5ng/dl) No. (%)	p value*
Stage A	2(100%)	0	
Stage B	46(67.64%)	22(32.35%)	
Stage C	2(7.69%)	24(92.30%)	
Stage D	0	4(100%)	

Out of 100 cases true positive was 27, false positive was 10, false negative was 23, and true negative was 40 and sensitivity of CEA in GI malignancy was 54% and specificity was 80%. Out of 24 cases of colon carcinoma true positive CEA level was 6, false positive was 4, false negative was 8, and true negative was 6. Sensitivity of CEA in colon cancer was 42.86% and specificity was 60%. Out of 50 cases of rectal carcinoma CEA level true positive cases was 12, false positive was 8, false negative was 16, and true negative was 14 and Sensitivity of CEA was 42.86% and specificity was 63.64 (Table V)

Table-V: Sensitivity and specificity of CEA in gastrointestinal malignancy (n=100)

Carcinoma site	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)	Positive Predictive Value	Negative Predictive Value
Whole GI	54.00% (39.33-68.18)	80% (66.28-89.95)	72.97% (55.88-86.19)	63.49% (50.40-75.26)
Stomach	33.33% (5.47-88.45)	0.00% (0.00-83.45)	50.00% (8.17-91.83)	0.00% (0.00-80.71)
Small Intestine	66.67% (11.55-94.53)	40.00% (6.49- 84.60)	66.67% (6.49-84.60)	40.00% (11.55-94.53)
Colon	42.86% (17.76-71.08)	60.00% (26.37-87.60)	60.00% (26.37-87.60)	42.86% (17.76-71.08)
Rectum	42.86% (24.48-62.81)	63.64% (40.67-82.76)	60% (36.07-80.83)	46.67% (28.36-65.66)

Discussion:

Gastrointestinal malignancies are prevalent malignant tumors in the body. Early detection, accurate diagnosis, and intensive surveillance are important for improving patient's prognosis. The most familiar serum biomarker for detection of GI malignancy is carcinoembryonic antigen CEA which is a glycoprotein and is normally derived from embryonic endodermal epithelium in the fetus. After birth small quantities of CEA is found in the stomach, colon, tongue, esophagus, cervix, and prostate [9]. The concentration of CEA is modulated by tumor stage, grade and site in the GIT. Some of the antigens enter the circulation and detected by radioimmunoassay of serum. CEA is a non-invasive, non-specific way of detecting and monitoring GI malignancy.

In our study 50% patients had rectal carcinoma, 24% had colon carcinoma, 12% had caecal carcinoma and 8% had stomach carcinoma.

Approximately 70% of colorectal cancer patients have high CEA levels at diagnosis, and previous studies demonstrate that the sensitivity and specificity of CEA in CRC are about 77% and 84%, respectively[10]. In our study, out of 100 patients, it was found that the sensitivity of CEA in GI malignancy as a whole was 54% and the specificity was 80%. In gastric malignancy sensitivity of CEA was 33.33% and specificity was 100.0%. This value is higher compared to the study of Staab et al (21%)[11]. In duodenal and caecal carcinoma sensitivity of CEA was 66.67% and the specificity was 40.0%. In colonic carcinoma sensitivity of CEA in colon was 42.86% and specificity was 60.0%. In rectal carcinoma the sensitivity of CEA was 42.86% and the specificity was 63.64%. These values are comparable to the study of Staab et al (39%)[11].

All of our cases were well, moderate and poorly differentiated adenocarcinomas. CEA level was found raised in 52% of patients with moderately differentiated adenocarcinoma and 28% of patients with poorly differentiated adenocarcinoma (p value < 0.002).

CEA levels were significantly elevated in advanced stages of gastrointestinal (GI) malignancy; with the highest levels observed in stage D (100%) followed by stage C (92.3%) and stage B (32.3%). No case of stage A disease with increased CEA was found in our study.

Conclusions:

This study found that CEA was elevated in patients with GI malignancies with an overall sensitivity and specificity of 54% and 80%, respectively, which was comparable with other studies. In different stages its sensitivity and specificity also varied. The disadvantage of CEA is its low sensitivity and relatively high tumor

specificity. This limits its use in the primary diagnosis of GI malignancy. Therefore, we suggest that CEA can be used in combination with another definitive diagnostic tool.

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