

# Comparative Evaluation of $\beta$ -hCG Expression in Benign and Malignant Cystic Breast Lesions: An Observational Study

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## Abstract

**Background:** Cystic breast lesions range from benign conditions to malignant tumors, making accurate differentiation essential for appropriate management.  $\beta$ -hCG has emerged as a potential biomarker due to its role in tumor biology and cellular proliferation.

**Aim:** To evaluate and compare  $\beta$ -hCG expression in benign and malignant cystic breast lesions.

**Materials and Methods:** This hospital-based observational study was conducted at Meenakshi Medical College Hospital, Kanchipuram, over one year. A total of 40 patients with cystic breast lesions were included. Diagnosis was confirmed by histopathological examination.  $\beta$ -hCG expression was assessed using immunohistochemistry and compared between benign and malignant groups. Statistical analysis was performed using SPSS, and a p value less than 0.05 was considered statistically significant.

**Results:** Among 40 cases, 24 were benign and 16 were malignant.  $\beta$ -hCG expression was significantly higher in malignant lesions (75%) compared to benign lesions (16.7%) ( $p = 0.001$ ). Malignant lesions also showed higher intensity of expression ( $p = 0.002$ ). Increased  $\beta$ -hCG expression was more common in patients aged  $\geq 40$  years ( $p = 0.01$ ). The sensitivity, specificity, and accuracy of  $\beta$ -hCG expression were 75%, 83.3%, and 80% respectively.

**Conclusion:**  $\beta$ -hCG expression is significantly associated with malignant cystic breast lesions and may serve as a useful diagnostic marker.

**Keywords:**  $\beta$ -hCG, breast lesions, cystic breast disease, immunohistochemistry, breast cancer, observational study.

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## Introduction

Breast lesions represent a wide spectrum of pathological conditions ranging from benign cystic changes to malignant tumors. Cystic breast lesions are commonly encountered in clinical practice and are often associated with benign conditions such as fibrocystic disease. However, certain cystic lesions may harbor malignancy, making accurate differentiation between benign and malignant conditions essential for appropriate management. Early and precise diagnosis plays a critical role in improving patient outcomes and reducing unnecessary interventions [1].

Histopathological examination remains the gold standard for the diagnosis of breast lesions. However, there has been increasing interest in identifying

molecular and immunohistochemical markers that can aid in distinguishing benign from malignant lesions. Among these, beta-human chorionic gonadotropin ( $\beta$ -hCG) has emerged as a potential biomarker due to its role in cellular proliferation and tumor biology [2].

$\beta$ -hCG is a glycoprotein hormone primarily produced by placental trophoblastic cells during pregnancy. However, its ectopic expression has been reported in various non-trophoblastic malignancies, including breast cancer. Studies have suggested that  $\beta$ -hCG expression may be associated with tumor aggressiveness, increased cellular proliferation, and resistance to apoptosis. The presence of  $\beta$ -hCG in malignant tissues may therefore serve as an indicator of tumor progression and poor prognosis [3].

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The role of  $\beta$ -hCG in benign breast lesions remains less clear. While some studies have reported minimal or absent expression in benign conditions, others have suggested that low-level expression may be present due to proliferative changes in breast tissue. Therefore, evaluating the differential expression of  $\beta$ -hCG in benign and malignant cystic breast lesions may provide valuable diagnostic insights [4].

Several studies have explored the expression of  $\beta$ -hCG in breast tumors and have reported higher expression levels in malignant lesions compared to benign ones. However, the findings are not entirely consistent, and further research is required to establish its diagnostic utility. Understanding the expression pattern of  $\beta$ -hCG in cystic breast lesions may help in improving diagnostic accuracy and guiding treatment decisions [5–6].

In routine clinical practice, observational studies provide important real-world data regarding biomarker expression and disease correlation. Evaluating  $\beta$ -hCG expression in an observational setting allows for better understanding of its clinical relevance in differentiating benign and malignant breast lesions. Therefore, the present study was undertaken to evaluate and compare  $\beta$ -hCG expression in benign and malignant cystic breast lesions in an observational study setting [7].

### Materials and Methods

This hospital-based observational study was conducted in the Department of General Surgery at Meenakshi Medical College Hospital and Research Institute, Kanchipuram, Tamil Nadu, over a period of one year. The study aimed to evaluate and compare  $\beta$ -hCG expression in benign and malignant cystic breast lesions.

A total of 40 patients presenting with cystic breast lesions were included in the study. Patients aged 18 years and above with clinically and radiologically diagnosed cystic breast lesions were considered eligible. Patients with a prior history of breast malignancy, those who had received chemotherapy or radiotherapy, and patients unwilling to participate were excluded from the study.

All patients underwent detailed clinical evaluation including history taking and physical examination. Radiological assessment was performed using ultrasonography and/or mammography to identify cystic characteristics of the breast lesions. Subsequently, all patients underwent histopathological examination through procedures such as fine needle aspiration cytology, core needle biopsy, or excisional biopsy, which served as the gold standard for diagnosis.

Based on histopathological findings, patients were categorized into benign and malignant groups.  $\beta$ -hCG expression was evaluated in tissue samples using immunohistochemical staining techniques. The presence or absence of  $\beta$ -hCG expression and the intensity of staining were recorded and compared between the two groups.

Data collected included demographic details, clinical presentation, histopathological diagnosis, and  $\beta$ -hCG expression status. The expression levels were analyzed to determine their association with benign and malignant lesions.

All data collected during the study were systematically entered into Microsoft Excel and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics including mean, standard deviation, frequencies, and percentages were used to summarize the variables. Comparative analysis between groups was performed using the independent t test for continuous variables and the Chi square test for categorical variables. A p value of less than 0.05 was considered statistically significant.

### Results

A total of 40 patients with cystic breast lesions were included in the study, of which 24 were diagnosed as benign and 16 as malignant based on histopathological examination.

**Table 1: Demographic Characteristics of Study Participants (n = 40)**

Variable	Benign (n = 24)	Malignant (n = 16)	p value
Mean age (years)	36.4 ± 9.2	48.7 ± 10.5	0.001
< 40 years	15 (62.5%)	3 (18.8%)	
≥ 40 years	9 (37.5%)	13 (81.2%)	

The mean age of patients in the malignant group was higher (48.7 ± 10.5 years) compared to the benign group (36.4 ± 9.2 years). A greater proportion of malignant cases were observed in patients aged ≥40 years (81.2%), whereas benign lesions were more common in younger patients. This difference was statistically significant (p = 0.001), indicating age as an important factor associated with malignancy.

**Table 2:  $\beta$ -hCG Expression in Benign and Malignant Lesions**

$\beta$ -hCG Expression	Benign (n = 24)	Malignant (n = 16)	p value
Positive	4 (16.7%)	12 (75%)	0.001
Negative	20 (83.3%)	4 (25%)	

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$\beta$ -hCG expression was significantly higher in malignant lesions (75%) compared to benign lesions (16.7%). This difference was statistically significant ( $p = 0.001$ ), suggesting a strong association between  $\beta$ -hCG expression and malignancy.

**Table 3: Intensity of  $\beta$ -hCG Expression**

Intensity	Benign (n = 24)	Malignant (n = 16)	p value
Mild	4 (16.7%)	3 (18.8%)	0.002
Moderate	0	5 (31.2%)	
Strong	0	4 (25%)	

Among  $\beta$ -hCG positive cases, benign lesions showed only mild expression, whereas malignant lesions demonstrated moderate to strong expression in a significant proportion of cases. This difference in intensity was statistically significant ( $p = 0.002$ ), indicating higher expression levels in malignant lesions.

**Table 4: Histopathological Types of Lesions**

Diagnosis	Frequency (%)
Fibrocystic disease	14 (35%)
Simple cyst	10 (25%)
Invasive ductal carcinoma	12 (30%)
Other malignancies	4 (10%)

Benign lesions were predominantly fibrocystic disease and simple cysts, while malignant lesions were mainly invasive ductal carcinoma. This distribution reflects the common pathological spectrum of cystic breast lesions.

**Table 5: Association Between Age and  $\beta$ -hCG Expression**

Age Group	$\beta$ -hCG Positive	$\beta$ -hCG Negative	p value
< 40 years	3 (16.7%)	15 (83.3%)	0.01
$\geq$ 40 years	13 (59.1%)	9 (40.9%)	

$\beta$ -hCG expression was more frequently observed in patients aged  $\geq$ 40 years compared to younger patients. This association was statistically significant ( $p = 0.01$ ), suggesting that  $\beta$ -hCG expression increases with age and may be linked to malignant transformation.

**Table 6: Diagnostic Performance of  $\beta$ -hCG Expression**

Parameter	Value (%)
Sensitivity	75%
Specificity	83.3%
Positive Predictive Value	75%
Negative Predictive Value	83.3%

Parameter	Value (%)
Accuracy	80%

$\beta$ -hCG expression demonstrated good diagnostic performance with sensitivity of 75% and specificity of 83.3%. The overall accuracy of 80% indicates that  $\beta$ -hCG may serve as a useful marker in differentiating benign and malignant cystic breast lesions.

### Discussion

The present observational study evaluated the expression of  $\beta$ -hCG in benign and malignant cystic breast lesions and its potential role as a diagnostic marker. The findings demonstrated a significantly higher expression of  $\beta$ -hCG in malignant lesions compared to benign lesions, suggesting its possible role in tumor biology and diagnostic differentiation.

In the present study, the mean age of patients with malignant lesions was significantly higher than those with benign lesions ( $48.7 \pm 10.5$  vs  $36.4 \pm 9.2$  years), and this difference was statistically significant ( $p = 0.001$ ). A higher proportion of malignancy was observed in patients aged  $\geq$ 40 years (81.2%). Similar findings were reported by Rosen PP et al [9], who noted that the incidence of breast malignancy increases with age, particularly after the fourth decade.

The present study showed that  $\beta$ -hCG expression was significantly higher in malignant lesions (75%) compared to benign lesions (16.7%), with a statistically significant difference ( $p = 0.001$ ). This finding is consistent with Butler SA et al [10], who reported that  $\beta$ -hCG is frequently expressed in malignant breast tissues and may be associated with tumor progression.

The intensity of  $\beta$ -hCG expression was also significantly higher in malignant lesions, with moderate to strong expression observed in a substantial proportion of cases, whereas benign lesions showed only mild expression. This difference was statistically significant ( $p = 0.002$ ). Similar observations were made by Iles RK et al [11], who demonstrated that increased  $\beta$ -hCG expression correlates with tumor aggressiveness and poor prognosis.

The diagnostic performance of  $\beta$ -hCG expression in the present study showed a sensitivity of 75% and specificity of 83.3%, with an overall accuracy of 80%. These findings suggest that  $\beta$ -hCG can serve as a useful adjunct marker in distinguishing benign from malignant cystic breast lesions. Comparable findings were reported by Cole LA et al [12], who highlighted the role of  $\beta$ -hCG as a tumor marker in various malignancies, including breast cancer.

The association between age and  $\beta$ -hCG expression observed in the present study ( $p = 0.01$ ) suggests that increased expression may be linked to malignant

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transformation and disease progression. Similar findings were reported by Hotakainen K et al [13], who observed higher levels of  $\beta$ -hCG in older patients with malignancies.

The exact mechanism of  $\beta$ -hCG expression in breast cancer remains unclear. However, it has been proposed that  $\beta$ -hCG may promote tumor growth by inhibiting apoptosis and enhancing cellular proliferation. Acevedo HF et al [14] suggested that ectopic production of  $\beta$ -hCG in malignant tissues may contribute to tumor progression and immune evasion. The presence of  $\beta$ -hCG in malignant breast lesions may also have prognostic implications. Marcillac I et al [15] reported that  $\beta$ -hCG expression is associated with aggressive tumor behavior and poorer clinical outcomes. This supports the findings of the present study, where higher expression levels were observed in malignant cases.

Although  $\beta$ -hCG expression was detected in a small proportion of benign lesions, the levels were low and not comparable to malignant cases. This finding is in agreement with Stenman UH et al [16], who reported minimal expression of  $\beta$ -hCG in benign conditions.

Recent studies have emphasized the importance of identifying reliable biomarkers for early detection and differentiation of breast lesions. Arrieta O et al [17] highlighted that tumor markers such as  $\beta$ -hCG can improve diagnostic accuracy when used in conjunction with histopathology.

Overall, the findings of the present study suggest that  $\beta$ -hCG expression is significantly associated with malignant cystic breast lesions and may serve as a useful diagnostic and prognostic marker. However, further large-scale studies are required to validate its clinical utility.

### Conclusion

The present observational study demonstrated that  $\beta$ -hCG expression is significantly higher in malignant cystic breast lesions compared to benign lesions, with a strong statistical association ( $p = 0.001$ ). Malignant lesions not only showed higher positivity rates but also exhibited greater intensity of expression ( $p = 0.002$ ), indicating its potential role in tumor progression. Additionally,  $\beta$ -hCG expression was more common in patients aged  $\geq 40$  years ( $p = 0.01$ ), further supporting its association with malignancy. The diagnostic performance of  $\beta$ -hCG, with sensitivity of 75%, specificity of 83.3%, and overall accuracy of 80%, suggests that it can serve as a useful adjunct marker in differentiating benign from malignant cystic breast lesions. However, as this is an observational study,

further large-scale studies are required to establish its definitive diagnostic and prognostic value.

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