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Assessment of Brain Injury Marker (Carcinoembryonic Antigen) in Preeclamptic Pregnant Women in the Third Trimester of Pregnancy

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Abstract *Carcinoembryonic antigen (CEA) is a glycoprotein normally produced during fetal development, but presence of tissue damage and inflammation, its levels increase and this may be linked to Carcinoembryonic antigen in the pathophysiology of preeclampsia. This study aims to assess the level of Carcinoembryonic antigen (CEA) in preeclamptic pregnant women in the third trimester of pregnancy. Forty (40) consenting pregnant women were recruited from St. Philomina Catholic Hospital, Edo State, Nigeria. After the subjects were identified and recruited into the study, they were taken to the laboratory where their vital signs was taken and 10 milliliters (10 ml) of venous blood was drawn from consenting participants and placed in a lithium heparin sample bottles analyzed for Carcinoembryonic antigen (CEA) levels by fluorescence immunoassay. Data obtained from this study were analysed using Graph Pad Prism 9. Results generated were expressed as mean ± SEM and a P-value of ≤ 0.05 were considered statistically significant. The present study showed that there was statistically significant increase in the level of Brain injury marker (CEA) was observed in preeclamptic women compared to normotensive pregnant women, indicating various underlying pathophysiological processes such as Brain injury in preeclampsia.*

Keywords: *Assessment, Carcinoembryonic Antigen (CEA), Glycoprotein, Preeclampsia, Pregnant Women*

1. INTRODUCTION

Preeclampsia is a complex and multifactorial pregnancy complication characterized by high blood pressure and damage to organs such as the kidneys, liver, and brain. It affects approximately 2-8% of pregnancies worldwide, making it a leading cause of maternal and fetal morbidity and mortality. Early detection and prediction of preeclampsia are crucial to prevent severe complications and ensure timely interventions.

Recent studies have highlighted the potential of brain injury markers in predicting preeclampsia. Carcinoembryonic antigen (CEA) has emerged as a promising biomarker due to its association with brain injury and preeclampsia pathophysiology. CEA is a glycoprotein normally produced during fetal development, but its levels increase in response to tissue damage and inflammation .

This study aims to assess the level of Carcinoembryonic antigen (CEA) in preeclamptic pregnant women in the third trimester of pregnancy. By analyzing CEA levels, this research seeks to identify potential early indicators of preeclampsia, enabling timely interventions and improving

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maternal and fetal outcomes. The use of CEA as a predictor of preeclampsia offers a promising approach, as it is a widely available and cost-effective biomarker. This study's focus on CEA provides a nuanced understanding of its predictive role, enabling healthcare providers to make informed decisions and improve patient care. Furthermore, the study's findings will have implications for the development of personalized medicine approaches to preeclampsia diagnosis and management.

2. RELATED WORKS

Carcinoembryonic Antigen (CEA) is a glycoprotein first discovered in 1965 by, initially found in human fetal colon tissue and later recognized for its presence in the serum of patients with colorectal cancer. CEA belongs to the immunoglobulin superfamily and plays a role in cell adhesion, influencing various physiological processes such as embryonic development, tissue differentiation, and wound healing. While its expression is low in healthy adults, elevated levels of CEA are often associated with various malignancies, including colorectal, pancreatic, gastric, lung, breast, and ovarian cancers. Additionally, non-cancerous conditions like inflammatory bowel disease, liver disease, and smoking can also cause increased CEA levels, which limits its specificity as a diagnostic marker.

CEA's clinical utility is significant for diagnosing, prognosticating, and monitoring cancer progression. Its primary use is in colorectal cancer detection, where elevated serum levels are a marker for disease recurrence, but CEA can also be useful in assessing other cancers. However, due to its lack of sensitivity and specificity, CEA is often used in conjunction with other diagnostic tools like imaging and histopathology. Despite limitations, research continues into enhancing CEA’s diagnostic and therapeutic roles.

CEA was discovered during a period of intense research in the 1960s, when isolated it from human colon cancer tissue. They named it "Carcinoembryonic Antigen" due to its presence in both cancerous and embryonic tissues. Subsequent studies revealed CEA’s role as a glycoprotein in cell adhesion, differentiation, and signaling pathways, which are important in cancer progression, including immune modulation and tumor metastasis.

CEA's expression is primarily seen in the gastrointestinal tract during embryonic development and remains low in healthy adults, with minor expression in gastrointestinal epithelial cells. Its dysregulated expression in cancer leads to elevated serum levels, detectable in conditions like colorectal cancer, but also in other malignancies and certain non-cancerous conditions.

Clinically, CEA measurement serves as a valuable tool for early cancer detection, prognosis, and monitoring treatment response, with higher baseline CEA levels indicating more advanced disease and poorer prognosis.

CEA detection methods include enzyme-linked immunosorbent assays (ELISA), chemiluminescent immunoassays (CLIA), radioimmunoassays (RIA), and imaging techniques like PET-CT. These tests are employed to measure CEA levels in biological fluids, contributing to the diagnosis, staging, and monitoring of CEA-expressing tumors, particularly in colorectal cancer. Point-of-care tests, such as lateral flow immunoassays and PCR-based methods, offer rapid testing for CEA detection, while next-generation sequencing (NGS) provides insights into genetic alterations related to CEA. The changes in CEA levels over time are critical for assessing treatment efficacy and detecting disease recurrence.

3. MATERIALS AND METHODS

Geographical Description of the Study Area

This research was carried out among Third Trimester Pregnant women in St. Philomina Catholic Hospital, Edo State , Nigeria.

lies longitudinally at 04ºE and 43ºE and Latitude 05º44ºN and 07º34ºN. It geopolitical location is the South South and it has a population of 3.5 million people. Oredo land, Benin City, the State capital, is 100 km long. Edo State, South-South, Nigeria. Oredo is a Local Government Area of Edo State, Nigeria. Its headquarters are in the town, Benin city. It has an area of 502 km² and a population of 500,000 at the 2006 census.

Majority of which are civil servants, traders, businessmen/women, transporter, farmers, teachers/lecturers and students by occupation. Oredo, since after its designation as headquarters and as the host of Oba of Benin Palace, the town has grown into an urban center.

Research Design

Fourty (40) consenting pregnant subjects were recruited from St. Philomina Catholic Hospital, Edo State. These subjects consisted of twenty (20) normotensive pregnant women in their third trimester of pregnancy with blood pressure between 120/80mmHg to 130/90 mm/Hg without presence of proteinuria and twenty (20) preeclamptic women in their third trimester of pregnancy classified as having preeclampsia according to their blood pressure measured was above 130/90 mm/Hg with the presence of proteinuria taken two consecutive times at presentation at the antenatal clinic of the hospital

Sample Size

The Population of study was determined using the formula;

$N= Z^2pq/d^2$

Where N= the desired sample size (when population is greater than 10,000)

Z= is a constant given as 1.96 (or more simply at 2.0) which corresponds to the 95% confidence level.

P= previous survery prevalence of 2.23%

q= 1.0-p

d= acceptable error 5%.

Where N= sample size, Z=1.96, p=0.1% (0.01) and d=5% (0.05)

N= 39.8 subject.

Therefore, the sample for this study is 40 respondents who are normotensive and preeclamptic pregnant women from Oredo town, Benin City.

Ethical Approval and Informed Consent

Ethical clearance (REC Approval No:RECC/10/2023(07)) was obtained from the Research Ethics Committee of St. Philomina Catholic Hospital, Edo State.

Written informed consent was obtained from subjects prior to commencement of the study.

Blood Sampling

10 milliliters (10 ml) of venous blood was drawn from consenting participants and placed in a lithium heparin sample bottles. Blood samples was spun in a bucket centrifuge at 2500 RPM (rounds per minute) for 10 minutes after which plasma was collected and stored frozen in plain sample bottles and was analyzed for Brain injury marker (Carcinoembryonic antigen).

Experimental Protocols

After the subjects were identified and recruited into the study, they were taken to the lab where their vital signs was taken, after which blood samples were collected by venipuncture and taken to the chemistry laboratory for analysis.

Study Area/Population

The study were conducted for three months at St. Philomina Catholic Hospital, Edo State, Nigeria.

Inclusion Criteria

Normotensive and Preeclamptic pregnant women in the third trimester of pregnancy, within the age range of 25 to 35years was used for this study. Pregnant women were recruited for this study and women who had given birth before and were pregnant for the second time.

Exclusion Criteria

Normotensive and Preeclamptic pregnant women who were on drugs and with a known history of hyperlipidemia, gestational Diabetes and other comorbidity.

Biochemical Examination

Measurement of Carcinoembryonic antigen (CEA) by fluorescence immuno assay.

Procedure

Step 1: Preparation: Prior to the testing, the test cassette, detection buffer and specimen was allowed to equilibrate at room temperature. The ID chip was inserted into the chip port of the instrument after the ID chip was confirmed to be consistent with the batch number of test cassette

Step 2: Sampling: Plasma sample of 75 µL was drawn with transfer pipette and added to the buffer tube.

Step 3: Loading: The sample mixture of 75 µL was loaded into the sample well of the test cassette.

Step 4: Testing: The standard test mode was used in which the test device was inserted onto the test cassette holder of FIA Meter right after adding sample mixture to the sample well and "Test botton" was been pressed to start testing. The reaction time was 3 minutes.

Step 5: Reading result: Results were displayed on the main screen of meter and was printed out by pressing "Print".

Step 6: Withdraw: The used test kit was discarded according to local regulations and procedure after released from the meter.

Data Analysis

Data obtained from this study were analysed using Graph Pad Prism 9. Results generated were expressed as mean ± SEM and a P-value of ≤ 0.05 were considered satistically significant. The significance of difference among the groups were used to assess the repeated-measures analysis of variance (ANOVA). Independent students' t-test were used to compare normotensive and preelclamptic pregnant women groups.

4. RESULT

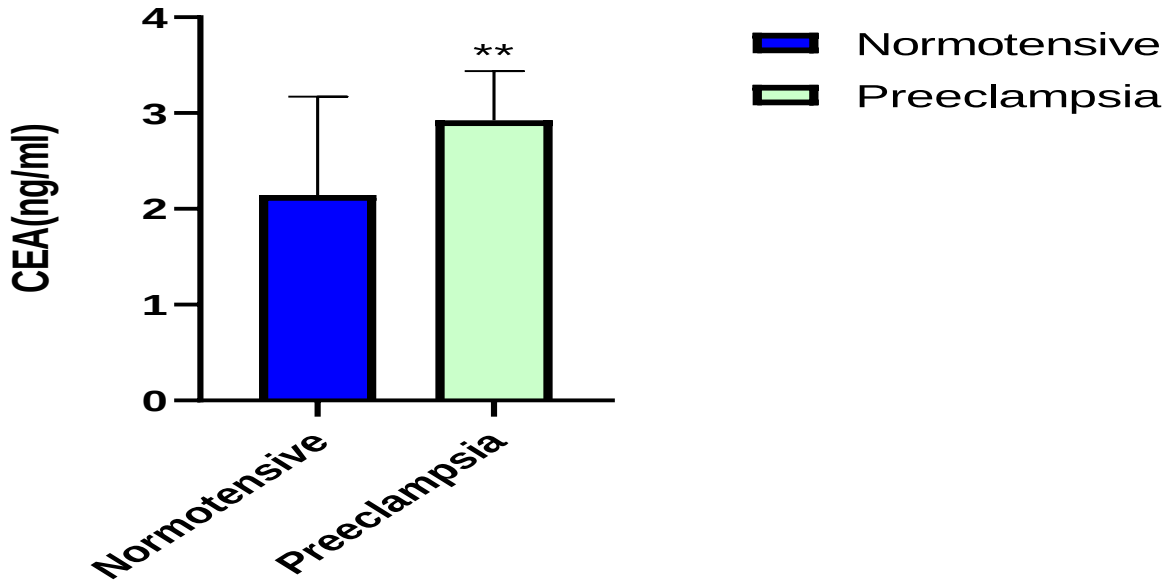

Figure 1: Mean ± SEM of Carcinoembryonic antigen (CEA) level in normotensive (n=20) and preeclampsia (n=20). The t-test was carried out to access any significant difference. ** represents $p<0.01$

Figure 1 shows Carcinoembryonic antigen (CEA) levels in Normotensive and pre-eclamptic women in their third trimester of pregnancy. There was an increase in CEA level from 2.145 ± 0.23 ng/mL in normotensive women to 2.924 ± 0.12 ng/mL in pre-eclamptic women. When both groups where compared, this increase was found to be statistically significant ($p<0.05$; 0.0044)

5. DISCUSSION

Carcinoembryonic antigen (CEA) is a glycoprotein typically associated with certain cancers, particularly colorectal cancer, but it can also be elevated in non-malignant conditions, including inflammation and pregnancy-related disorders [22]. The observed elevation of CEA level in pre-eclamptic women may reflect underlying systemic inflammation and endothelial dysfunction, which are characteristic features of preeclampsia. Figure 4.1, the significant increase in carcinoembryonic antigen (CEA) level observed in pre-eclamptic women compared to normotensive women suggests a potential linked in the pathophysiology of CEA in preeclampsia. This correlate with Several previous studies which reported elevated CEA level in women with preeclampsia compared to normotensive pregnant women [23]. This suggests that CEA may serve

as a biomarker for the inflammatory component of preeclampsia and could potentially aid in its early detection and risk stratification. Furthermore, elevated carcinoembryonic antigen (CEA) level have been associated with adverse maternal and fetal outcomes in preeclampsia, including increased risk of preterm birth [24], intrauterine growth restriction [25], and maternal complications such as eclampsia [26] and HELLP syndrome [27]. Therefore, monitoring CEA level during pregnancy, particularly in the third trimester, may provide valuable information for identifying women at risk of developing preeclampsia and guiding clinical management. Further research is needed to validate the predictive value of CEA in preeclampsia and to elucidate its underlying mechanisms of action in the pathophysiology of this hypertensive disorder of pregnancy.

6. CONCLUSION

The present study showed that there was statistically significant increase in the level of Brain injury marker (CEA) was observed in preeclamptic women compared to normotensive pregnant women, indicating various underlying pathophysiological processes such as Brain injury in preeclampsia. One limitation of this study is the small sample size of 40 pregnant women, which may not accurately reflect the broader population of preeclamptic patients, limiting the generalizability of the results. Additionally, the study was conducted at a single hospital, which could introduce regional biases. Larger, multi-center studies are needed to validate these findings and assess the broader applicability of CEA as a biomarker for preeclampsia in diverse populations.

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