

## Diabetic Patients with Carotid Plaques

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### Abstract

**Introduction:** Carotid plaques are often reported in association with carotid intima-media thickness studies, both considered as a marker of atherosclerosis. But its detailed description is most often neglected.

**Methodology:** In a follow-up review of a carotid intima-media thickness study. Results were used to compare clinical characteristics, laboratory characteristics and 2D echocardiographic characteristics of patients with and without carotid plaque.

**Results:** Systolic blood pressure, fasting blood sugar, high HDL and carotid intima-media thickness were significantly higher in patient with plaque.

**Conclusions:** Carotid plaque formation a marker of atherosclerosis is probably more likely to occur in the presence of local vascular factors.

**Keywords:** Carotid plaque; Carotid intima-media thickness

### Introduction

The Mannheim CIMT Consensus Report suggested that plaque should be defined as “a focal structure that encroaches into the arterial lumen of at least 0.5 mm or 50% of the surrounding intima-media thickness or demonstrated a thickness of greater than or equal to 1.5 mm” [1].

Imagings of arteries to identify and quantify the presence of subclinical vascular disease have been suggested to further refine CVD risk assessment [2]. Plaque morphology in the carotid artery is less well defined, unlike that seen in the coronary artery. Carotid plaque is often reported along with CIMT as marker of subclinical atherosclerosis. It can also be classified as stable and unstable plaque. It can also be described as pedunculate or non-pedunculate. Salonen and Salonen in a study have found that internal-media thickness in the common carotid artery, as well as extracranial carotid plaque and stenoses, to be predictive of incident acute myocardial infarction [3]. In the Augsburg MONICA population study, greater than 75% stenosis was observed in only 0.6% of the participants aged 25 to 65 years, although plaques were identified in 24% of participants [4]. Other community based study like the ARIC study shows prevalence of 10% in normal population [5]. Most studies of carotid arteries in general populations have used stenosis as the measure of atherosclerosis, which is a relatively late manifestation of the disease. Early phases of atherosclerotic plaque formation may result in thickened arterial walls with simultaneous dilatation, thereby preserving the lumen [5]. Thus, there is growing interest in measuring intima-medial thickness (IMT) to study the natural history of earlier changes. In diabetes mellitus several other factors have been shown to be associated with atherosclerosis; Serum 25-Hydroxyvitamin D3 levels, C-reactive protein level and inflammatory states [6-10]. Genetic makeup like the SOX6 gene polymorphism and the enrichment of 2-arachidonoyl-

lysophosphatidylcholine in carotid atheroma are other that promote plaque formation [11,12].

This study was to compare parameters seen between subjects with plaques and those without plaques.

### Methodology

This was an observation made while analyzing a carotid IMT study done on newly diagnosed patients with diabetes mellitus carried out at the Jos University Teaching Hospital. It compares clinical features (height, weight, hip circumference, waist circumference, and blood pressures), chemical laboratory (electrolytes, urea, uric acid and lipids), 2D echocardiography and carotid IMT between individuals seen with carotid plaques and those without.

### Design

The study was a follow up of descriptive cross-sectional hospital based study. Subjects recruited in this study were patient diagnosed as diabetics who volunteered from the medical out-patient adult clinic at the Jos University Teaching Hospital. They were stable patients, not with any diabetic emergencies. The method of selection was by non-random sampling, patients while waiting to have routine fasting blood glucose before seeing a doctor were given consent form and those that consented were recruited. Ethical clearance from management of Jos University Teaching Hospital was obtained before the commencement of the study. Adults above the age of 18 years were recruited.

A questionnaire was filled while clerking the subject to obtain data which included; a short relevant clinical history, followed by general clinical examination. Height and weight were measured in duplicate and averaged. Waist circumference was measured midway between the rib cage and superior border of the iliac crest. Blood pressures (BP)

were measured in the right arm in a seated, relaxed position using a mercury sphygmomanometer.

Seven (7) milliters of fasting venous blood sample was taken for analysis in the laboratory urea electrolyte, creatinin and lipids.

Finally, the subjects were taken to the echo-room where their average carotid intima-media thickness were determined using the 8.0 MHz probe of real time B mode ultrasound imager (ALOKA SSD 4000 ultrasound system Japan). The average values of the far wall of the proximal 1.0 cm of both right and left common carotid arteries (two from each side) is used for the study. Proximal 1 cm of Common carotid was used in this study. A plaque is noted when there is a localized widening greater than 0.5 mm than the surrounding CIMT.

A 3.5 MHz probe was then use to determine left ventricular measurements through the left para-sternal long axis view window for all subjects, in M-mode cutting across the left ventricle, taking measurement from leading edges.

Discrete dates were presented as means and standard deviation, Analysis was done with both Epi-info 3.5.1 and SPSS 16. T-test was used to compare the means of the two groups. P-value of <0.05 was considered a statistical significant value using an application made by Erico.

### Results

A total of 18 (eighteen) patients had plaque seen at the carotid artery, there sex, ages and duration of illness with diabetes mellitus were tabulated (Tables 1 and 2). Basically all patients did not get beyond secondary level of education, six (33%) had no formal education, eleven 11 (61%) had some form of primary education and only one (6%) had some secondary level of education. Majority of plaques site seen were within the right carotid artery eight out of eleven documented.

| S. No. | Age | Sex | Duration of DM (years.) | Level of education | Side of plaque |
|--------|-----|-----|-------------------------|--------------------|----------------|
| 1      | 45  | F   | 7                       | P                  | R              |
| 2      | 70  | F   | 8                       | N                  | R              |
| 3      | 75  | M   | 16                      | P                  | L              |
| 4      | 64  | M   | 14                      | P                  | R              |
| 5      | 56  | F   | 2                       | N                  | -              |
| 6.     | 75  | F   | 7                       | P                  | -              |
| 7      | 60  | F   | 20                      | N                  | -              |
| 8      | 52  | M   | 2                       | P                  | L              |
| 9      | 55  | F   | -                       | N                  | -              |
| 10     | 56  | F   | 3                       | P                  | R              |
| 11     | 70  | F   | 9                       | S                  | R              |
| 12     | 75  | M   | 17                      | P                  | L              |
| 13     | 65  | F   | 20                      | P                  | R              |
| 14     | 54  | F   | 8                       | N                  | R              |
| 15     | 60  | m   | 21                      | P                  | -              |
| 16     | 65  | F   | 6                       | N                  | -              |
| 17     | -   | M   | 3                       | P                  | R              |
| 18     | 52  | F   | 7                       | P                  | -              |

Abbreviations: P: Primary; N: None; S: Secondary; R: Right; L: Left; DM: Diabetes Mellitus

**Table 1:** Characteristics of patients with plaque.

| Characters |              | Plaque n=18 | Non-plaque n=170 | t-Value | P-Value |
|------------|--------------|-------------|------------------|---------|---------|
|            | Age (years)  | 62+8.8      | 55.1+14.3        | 1.21    | >0.05   |
|            | Sex (male %) | 30,0        | 38.9             |         |         |
|            | Height (cm)  | 160.33+7.8  | 159.44+18.78     | 0.22    | >0.05   |

|   |                          |              |               |       |        |
|---|--------------------------|--------------|---------------|-------|--------|
|   | Weight (kg)              | 70.11+13.16  | 72.64+13.36   | -0.62 | >0.05  |
|   | Hip circumference (cm)   | 99.62+12.9   | 101.29+9.65   | -0.87 | >0.05  |
|   | Waist circumference (cm) | 97.37+13.16  | 97.06+12.86   | 0.00  | >0.05  |
|   | Systolic BP (mmHg)       | 142.0+24.92  | 131.52+20.63  | 2.17  | <0.05* |
|   | Diastolic BP (mmHg)      | 85.1+10.0    | 81.8+12.0     | 1.36  | >0.05  |
| Laboratory results  | Na (Mmol/dL)             | 140.30+4.3   | 138.34+4.4    | 1.83  | >0.05  |
|   | K (Mmol/dL)              | 4.36+0.43    | 4.44+0.66     | -0.50 | >0.05  |
|   | Hco (Mmol/dL)            | 25.37+2.40   | 25.12+3.44    | 0.00  | >0.05  |
|   | Urea (Mmol/dL)           | 6.61+3.63    | 5.33+2.82     | 1.81  | >0.05  |
|   | Cr (Mmol/dL)             | 100.70+26.28 | 98.23+34.77   | 0.24  | >0.05  |
|   | Uric acid (Mmol/dL)      | 357.89+50.60 | 384.08+111.42 | -1.05 | >0.05  |
|   | Total cho (Mmol/dL)      | 5.09+4.63    | 4.99+1.40     | 2.60  | >0.05  |
|   | HDL cho(Mmol/dL)         | 1.50+0.50    | 1.21+0.44     | 2.50  | <0.05* |
|   | Triglyceride (Mmol/dL)   | 1.47+0.56    | 1.63+0.84     | -0.67 | >0.05  |
|   | Fasting blood Sugar      | 17.59+2.8    | 9.60+2.9      | 10.72 | <0.05* |
| Echocardiography  | IVSD (mm)                | 11.37+1.92   | 11.17+3.12    | 0.26  | >0.05  |
|   | IVSS (mm)                | 16.12+2.10   | 16.13+3.36    | 0.01  | >0.05  |
|   | LVIDD (mm)               | 50.50+6.60   | 52.80+7.94    | -1.16 | >0.05  |
|   | LVIDS (mm)               | 33.37+9.72   | 35.25+7.57    | 0.92  | >0.05  |
|   | EDV (mL)                 | 142.20+36.24 | 133.60+43.43  | 0.82  | >0.05  |
|   | ESV (mls)                | 44.25+30.00  | 54.33+29.70   | -1.32 | >0.05  |
|   | EF (%)                   | 65.54+14.7   | 59.52+14.4    | 1.65  | >0.05  |
|   | FS (%)                   | 37.43+9.90   | 32.71+9.90    | 1.92  | >0.05  |
|   | LVM (g)                  | 265.71+77.22 | 253.63+85.32  | 0.55  | >0.05  |
|   | LVPWD (mm)               | 11.25+1.83   | 9.77+1.80     | 3.32  | <0.05* |
|   | LVPWS (mm)               | 15.25+1.48   | 13.63+2.37    | 4.48  | <0.05* |
| CIMT  | (mm)                     | 0.98+0.12    | 0.72+0.16     | 6.59  | <0.05* |
| *Statistical significant difference of P-value <0.05  |                          |              |               |       |        |
| Abbreviations: HDL: High Density Lipoprotein; CIMT: Carotid Intima-Media Thickness; Cho: Cholesterol. |                          |              |               |       |        |

**Table 2:** Comparing of the two groups using clinical, laboratory and echocardiographic features.

## Discussion

The study showed that 18 out of 188 (9.6%) subject had carotid plaque, compared to 24% (Augsburg) study [4]. We probably got this prevalence because it was not our primary objective. However, we think it was appropriate to publish this because no such documentation was done on plaque in our centre. Both the pedunculated and non pedunculated types were seen. The consequence of carotid plaque may not be devastating due to presence of some degree of carotid dilatation [4]. This is unlike the plaque in coronary artery where dilatation is limited impeding on normal flow.

The type and degree of lumen narrowing were not ascertained in the study, colour doppler was done on the vessels with no turbulent flow demonstrated, but again the flow velocity rates were not recorded.

Being one of the main factors in atheroma formation, dyslipidemias was a significant factor expressed as high HDL. "Atherogenic index" assessed as total cholesterol/HDL cholesterol (TC/HDL) and triglyceride/HDL cholesterol (TG/HDL), however, were not significantly raised. Hyperglycemic state has been shown to be associated with carotid plaque formation which manifested in the study as significant fasting blood sugar, although Glycated hemoglobin

(HbA1C) was not assessed [10-13]. Systolic blood pressure elevation was another factor found to be significantly related to plaque formation, perhaps resulting from turbulent flow at this site. This assumption is speculative.

There may appear to be a vascular factor like local inflammation, enrichment of 2-arachidonoyl-lysophosphatidylcholine in the carotid plaques and gene polymorphism. Carotid IMT was significantly higher indicating than atherosclerosis is an important factor in carotid plaque formation.

Heart functions assessed by 2D echocardiogram also show no significant abnormality either. Pulse wave velocity, brachial artery flow-mediated vasodilatation (FMD) and calcium score are a few vascular tests not available that could assess vascular integrity [14-16].

## Conclusions

Carotid plaque is seen in asymptomatic patients and associated with high carotid IMT a marker of sub-clinical atherosclerosis. It may be associated more with local vascular factor rather than systemic cardiovascular risk factors.

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