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Evaluation of the impact of deranged lipid and glucose profile among stroke patients: An observational study

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Abstract

Aims: The aim of the study to evaluate the impact of dyslipidemia and hyperglycemia among stroke patients.

Material and Methods: This was a cross-sectional study conducted in the Department of Medicine, Metro Hospital and Cancer Research Centre, Jabalpur, MP, India from October 2018 to January 2020. During the study period, a total of 140 stroke patients were admitted out of them, 120 patients were participated in this cross-sectional study. Age, gender, and social status, past medical history (hypertension, diabetes, atrial fibrillation, ischemic heart disease, transient ischemic attack, and previous history of stroke), other risk factors (smoking, alcohol use, and obesity/BMI) and family history were obtained from all the patients.

Results: The mean age of 65.9 years with 76.67% of them aged above 50 years, and 66.67% of them were males. The co-morbidity, 94 (78.33%) patients had hypertension, 65(54.17%) patients had diabetes mellitus, and 12(10%) patients had transient ischemic attack. 59 patients (49.17%) were smokers, the majority of the smokers were males, and 13(10.83%) patients were obese with a BMI above 30 kg/m² with a mean of 32.3 kg/m². 96 (80%) patients had a family history of hypertension, 63 (52.5%) patients had a family history of stroke and 73(60.83%) patients had a family history of diabetes mellitus. Regarding the lipid profile and hyperglycemia, it was found that, 35 patients (29.17%) had LDL greater than 130 mg/ dl, 23 patients (19.17%) had cholesterol equal or greater than 200 mg/dl, 20(16.67%) patients had TAG equal or greater than 200 mg/dl, 73 (60.83%) patients had low HDL. 63 patients (52.5%) had HbA1C levels equal or greater than 6.5% and 66 patients (55%) had FBG equal or greater than 126 mg/dl. The mean level of cholesterol, LDL, HDL and TAG were 162.7, 115.4, 41.7, and 134.1mg/dl respectively. The mean of the HbA1c was 7.1%, while the mean of FBG was 156mg/dl.

Conclusion: Most of the patients with stroke had low HDL levels, high levels of FBG and HbA1c. Hypertension, DM, smoking and family history of HTN and DM are significant risk factors for the incidence of stroke.

Keywords: Hyperglycemia, lipid profile, HTN, stroke

Introduction

Stroke is defined as abrupt onset of symptoms and/or sign of focal and global loss of cerebral function lasting for at least 24 hrs with no apparent cause other than of vascular origin ^[1]. Stroke is diagnosed based on history, clinical findings and the brain imaging. Stroke is classified on the basis of its etiology as either ischemic or hemorrhagic ^[2]. In India, the prevalence of stroke is estimated as 203 per 100,000 above 20 years. In India, stroke incidence is 105 to 152/100,000 persons per year ^[3]. Ischemic stroke accounts for about 85% of cases, primary intracerebral hemorrhage (ICH) for 10% and subarachnoid hemorrhage (SAH) for the remaining 5% ^[4]. The role of lipid and lipoprotein biomarkers, such as of total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG), in risk prediction of ischemic heart disease is well established 1,2,4 but their value as independent predictors for ischemic stroke is less certain ^[5]. In most epidemiological cohorts, the relationship between lipids and stroke is complex and varies by stroke subtype, with associations strongest for atherosclerotic subtypes. Conversely, there is an increased risk of ICH at low cholesterol levels, and there is evidence that small vessel disease may share a similar profile of inverse association with lipid levels. The associations also depend on the specific lipid component considered, with the data strongest for TC and LDL-C ^[6].

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Hypertension, diabetes, and dyslipidemia are major modifiable risk factors for CVD. The prevalence of these risk factors has increased sustainably in China, and even worse, many middle-aged people have at least two chronic diseases [7-9]. The reason for disease clustering is probably mutual risk factors, such as aging, obesity, and smoking. Nevertheless, few analyses focused on common risk factors for hypertension, diabetes, and dyslipidemia. In addition, previous studies have shown that the clustering of two risk factors increases the risk of CVDs [10, 11]. However, limited evidence is available with regard to the relationship between multiple chronic diseases and CVDs. The severity of acute stroke is associated with the incidence and degree of hyperglycemia and the mortality was significantly increased in hyperglycemic patients [12]. Undoubtedly, dyslipidemia and diabetes are two of the common disorders all over the world, and they are considered as risk factors for many diseases, while stroke is a clinical condition that directly and badly affects life and may result in death. Therefore, the aim of this study was to determine the impact of dyslipidemia and hyperglycemia in stroke patients and to assess the risk factors associated with stroke among these patients and this would influence the treatment course and prognosis of stroke per se.

Material and Methods

This was a cross-sectional study conducted in the Department of Medicine, India from October 2018 to January 2020, after taking the approval of the protocol review committee and institutional ethics committee. After taking informed consent detailed history was taken from the patient or the relatives. The technique, risks, benefits, results and associated complications of the procedure were discussed with all patients.

Methodology

Total 140 stroke patients with a confirmed diagnosis on CT scan were admitted to the hospital, out of them, 120 patients were participated in this study.

Patients without a confirmed CT scan, those suspected of having a transient ischemic attack or patients, who refused to undergo the interview or give blood sample, were excluded. Age, gender, and social status, past medical history (hypertension, diabetes, atrial fibrillation, ischemic heart disease, transient ischemic attack, and previous history of stroke), other risk factors (smoking, alcohol use, and obesity/BMI) and family history were obtained from all the patients.

Fasting venous blood samples were collected from stroke patients to measure cholesterol, TAG, LDL, HDL, FBG, and HbA1c. Hyperlipidemia was defined as cholesterol equal or more than 200 mg/dl, TAG of equal or more than 200 mg/dl, LDL of equal or more than 130 mg/dl, and HDL of less than 40 mg/dl in men and less than 50 mg/dl in women [13]. Patients were diagnosed as diabetic if FBG level is equal or more than 126 mg/dl on more than one occasion or random blood glucose level more than 200 mg/dl on one occasion with symptoms of hyperglycemia or HbA1c equal or more than 6.5% [14]. Patients who were normoglycemic at the time of presentation, but with a history of diabetes, taking insulin or oral hypoglycemic were also labelled as diabetics. A smoker was defined as a person who smoked at least one cigarette per day for the preceding 3 months or more, or use

tobacco in any form [15]. Obesity was defined as a person with a BMI of 30 kg/m2 or more.

Results

Out of them, 120 patients were participated in this cross-sectional study, giving a response rate of 85.71%. The patients had a mean age of 65.9 years with 76.67% of them aged above 50 years, and 66.67% of them were males. The demographic distribution of age and gender in the study is shown in Table 1. Studying the co-morbidity, 94 (78.33%) patients had hypertension, 65 (54.17%) patients had diabetes mellitus, and 12 (10%) patients had transient ischemic attack. 59 patients (49.17%) were smokers, the majority of the smokers were males, and 13(10.83%) patients were obese with a BMI above 30 kg/m2 with a mean of 32.3 kg/m2. The co-morbidities incidence rates are demonstrated in Table 2.

Table 1: Demographic distribution of age and gender

| Gender | 120 | % |
|--------------|-----|-------|
| Male | 80 | 66.67 |
| Female | 40 | 33.33 |
| Age in years | | |
| Below 50 | 28 | 23.33 |
| Above 50 | 92 | 76.67 |

Table 2: Co-morbidities associated with stroke

| Co-morbidities | Number of cases | % |
|----------------|-----------------|----------|
| HTN | 94 | 78.33; 1 |
| DM | 65 | 54.17 |
| TIA | 12 | 10 |
| Smoker | 59 | 49.17 |
| BMI > 30 | 13 | 10.83 |

BMI: body mass index, TIA: transient ischemic attack, DM: diabetes mellitus, HTN: hypertension

Table 3: Distribution Of family history

| Familial history | Number of cases | % |
|------------------|-----------------|-------|
| HTN | 96 | 80 |
| Stroke | 63 | 52.5 |
| DM | 73 | 60.83 |

DM: diabetes mellitus, HTN: hypertension.

Table 4: Lipid profile and fasting blood glucose and Glycosylated Hemoglobin levels in stroke patients

| Test | Number of cases | % |
|--------------------------|-----------------|-------|
| LDL ≥ 130 mg/dl | 35 | 29.17 |
| Cholesterol ≥ 200 mg/dl | 23 | 19.17 |
| Triglyceride ≥ 200 mg/dl | 20 | 16.67 |
| Low levels of HDL | 73 | 60.83 |
| HbA1c ≥ 6.5% | 63 | 52.5 |
| FBG ≥ 126 mg/dl | 66 | 55 |

FBG: Fasting blood glucose, HbA1c: glycosylated hemoglobin

Table 3 shows that 96 (80%) patients had a family history of hypertension, 63(52.5%) patients had a family history of stroke and 73 (60.83%) patients had a family history of diabetes mellitus (Table 3).

Regarding the lipid profile and hyperglycemia, it was found that, 35 patients (29.17%) had LDL greater than 130 mg/ dl, 23 patients (19.17%) had cholesterol equal or greater than 200 mg/dl, 20(16.67%) patients had TAG equal or greater than 200 mg/dl, 73 (60.83%) patients had low HDL (Table 4). 63 patients (52.5%) had HbA1c levels equal or greater

than 6.5% and 66 patients (55%) had FBG equal or greater than 126 mg/dl

Table 5: Mean and standard deviation of age, BMI, lipids, glycosylated hemoglobin and fasting blood sugar

| Parameter | Mean (\pm SD) |
|------------------------------------|---------------------|
| Age (years) | 65.9 (\pm 10.5) |
| Obesity (BMI) (kg/m ²) | 32.3 (\pm 2.7) |
| Cholesterol (mg/dl) | 162.7 (\pm 42.4) |
| LDL (mg/dl) | 115.4 (\pm 32.8) |
| HDL (mg/dl) | 41.7 (\pm 16.2) |
| Triglyceride (mg/dl) | 134.1 (\pm 59.4) |
| HbA1c (%) | 7.1 (\pm 1.4) |
| FBG (mg/dl) | 156 (\pm 77.4) |

BMI: body mass index, FBG: fasting blood glucose, HbA1c: glycosylated haemoglobin

The mean and standard deviation of the main variables in this study are shown in Table 5. The mean age of the patients was 65.9 years; the main BMI was 32.3 kg/m². The mean level of cholesterol, LDL, HDL and TAG were 162.7, 115.4, 41.7, and 134.1mg/dl respectively. The mean of the HbA1c was 7.1%, while the mean of FBG was 156mg/dl.

Discussion

Stroke is classically characterized as a neurological deficit attributed to an acute focal injury of the central nervous system by a vascular cause, including cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage, and is a major cause of disability and death worldwide [16]. The presentation of stroke is variable, ranging from subtle to severe, depending on the area of brain involved and the nature of the attack [17]. The role of dyslipidemia in the pathogenesis of stroke is less clear. Studies have shown conflicting findings regarding the association between dyslipidemia and stroke [18]. In this study, the impact of dyslipidemia, hyperglycemia and other stroke risk factors were studied among stroke patients. The male to female ratio was almost 2:1, similar to other studies [19, 20]. Although a study from Oxfordshire, showed that males are more affected than females by genetic factors, the family history are more likely to be found in females than in males.²¹ Regarding the age distribution of stroke patients in the study, the mean age was 65.6 years (\pm 10.5) which is similar to a result of a study in India and a study in Palestine 10 years ago that showed a mean age of 69 years [20, 22]. The majority, 93(76.67%) patients, were above the age of 50 years. Again this result is almost similar to the study conducted in Palestinian that found 82% of patients were above the age of 60 years.²² These results indicate that the incidence of stroke is higher for those who are above 50 years old. On the other hand, the mean BMI of stroke patients was 32.3 kg/m² (\pm 2.7) with 13 (10.83%) patients above 30kg/m² and this is higher than a study carried in Japan [23]. Although obesity and higher BMI is established as a risk factor for coronary artery disease, its role as a risk factor for stroke remains controversial. Although there are many possible causes of human disease, family history is often one of the strongest risk factors for common disease complexes such as stroke, cancer, and diabetes. We found that a family history for HTN, stroke, or DM was associated with the increased incidence of stroke. Family history of

HTN (80%) was found as the main cerebrovascular risk factor in stroke, followed by a family history of DM (60.83%) and stroke (52.5%).

Therefore, family history is thought to be a good predictor of stroke risk because family members most closely represent the unique genomic and environmental interactions that an individual experiences [24]. The involvement of hypertension, diabetes, cigarette smoking, and others in the formation of stroke is widely established [25-27]. Hypertension (78.3%) was found to be the main stroke risk factor, followed by smoking (49.17%) and diabetes (54.17%). Moreover, the high incidence of hypertension increases the risk of stroke. Although our understanding of the benefits of treating high blood pressure, diabetes and smoking for the secondary prevention of strokes is evolving, we have identified a significant need for improvement in overcoming these risk factors. Stroke prevention clinics may need to be more actively involved in the management of these modifiable risk factors if we are to significantly impact the risk of recurrent stroke [28]. The lipid profile of stroke patients was studied and it was found that there were 23 (19.17%) patients with cholesterol level \geq 200mg/dl and the mean total cholesterol was 162.7mg/dl (\pm 42.4), in agreement with other results which showed no significant correlation between cholesterol level and the risk of stroke [29]. Other studies showed an increased risk of stroke in patients with higher levels of cholesterol [30, 31]. This may indicate that the role of high cholesterol levels as a risk factor for stroke is still unclear. High level of TAG ($>$ 200mg/dl) were found in 20 patients (16.67%), and the mean TAG level was 134.1 mg/dl (\pm 59.4). These results are similar to several studies that showed the TAG level ranging from 127 to 154 mg/dl among stroke patients [32]. These observations may indicate that the relationship between elevated TAG levels and the risk of stroke is still lacking, and this is in agreement with previous studies showed that no clear relationship between elevated TAG levels and risk of stroke [33, 32]. The mean LDL level was 115.4 mg/dl (\pm 32.8), 35 patients had LDL above 130 mg/dl (29.17%). Conflicting results are reported in the literature about the relationship between elevated levels of LDL and risk of stroke [34]. Among male patients, 40 (33.33%) of them had HDL level less than 40mg/dl, while, 33(27.5%) female patients had HDL less than 50mg/dl, and the mean HDL level for both males and females was 41.7mg/dl (\pm 16.2). Several studies showed similar findings and suggested that lower levels of HDL are associated with increased risk of stroke, while high levels of HDL are considered as a slight protective indicator against stroke [35]. On the other hand, a study conducted in Hawaii, showed no clear relationship between low levels of HDL and the risk of having stroke [36]. The results of HbA1c showed that 63 patients (52.5%) had HbA1c \geq 6.5% with a mean of 7.1% (\pm 1.4). The FBG \geq 126mg/dl was found in 66(55%) patients with a mean of 156mg/dl (\pm 77.4). The results about HbA1c and FBG were similar to other studies that showed a relationship between hyperglycemia and high HbA1c, and the risk of developing stroke [37-39]. In diabetic patients, several mechanisms suggest that the prolonged hyperglycemia leads to stroke. These include vascular endothelial dysfunction, increased early-age arterial stiffness, systemic inflammation and thickening of the capillary basal membrane [40].

Conclusion

The concept of aggressive management of dyslipidemia is changing dramatically in the past few years, as results of evidences from recent studies, very low lipid levels are also harmful to health. In developing countries like ours where there is very high prevalence of dyslipidemia because of various reasons like improper dietary habits, unhealthy life style etc. there should be a specific cut off level of lipids for treatment. Most of the patients with stroke had low HDL levels, high levels of FBG and HbA1c. Hypertension, DM, smoking and family history of HTN and DM are significant risk factors for the incidence of stroke. Less patients had high LDL, high cholesterol and high TAG, making the effect of these parameters on the incidence of stroke is still controversial.

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