

Role of Diabetes in Neural plasticity following stroke – Educating A Diabetic Stroke Patient

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Abstract

This expert opinion gives a clear idea about the controversies that exist among literature and professionals regarding the delayed prognosis among stroke patients who are known cases of Type 2 diabetes Mellitus (T2DM). Neuroplasticity is an innate ability of the brain to recover, adapt and modify itself following an insult, however, this can be altered in the case of T2DM. stroke patients with T2DM are a special category and require specific attention in terms of diet, exercise, drug, and lifestyle modification. All these aspects are discussed briefly in this expert communication article.

(Key words – Diabetes mellitus, hyperglycemia, stroke, diabetic educator, neuroplasticity)

It is well documented that diabetes mellitus is a risk factor for cerebrovascular disease (Jarrett & Keen, 1975; Kannel & McGee, 1979) and that previously unrecognized hyperglycemia increases the risk of stroke and transient ischemic attacks (Riddle & Hart, 1982). Despite current preventive therapies, patients with a transient ischemic attack (TIA) and ischemic stroke remain at high risk for recurrent brain disease and cardiovascular events. In an effort to develop new therapies, abnormal glucose tolerance has recently been proposed as an interventional target.

Among persons not otherwise known to be diabetic, impaired glucose tolerance (IGT) and diabetic glucose tolerance (DGT) are each associated with an increased risk for incident vascular

disease, vascular disease mortality, and all-cause mortality. There may be a pre-existing diabetes mellitus or there may be stress-induced hyperglycemia following stroke. Out of these two hyperglycemia due to stress response seems to have a more adverse effect than pre-diabetes.

It is the stress of acute illness that causes hyperglycemia which is perceived to be a temporary process that is most often seen in intra-cerebral hemorrhage than in ischemic lesions of the brain. Feibel et al., 1977 found Evidence of stress response having an association with poor prognosis. Elevated HbA1 was associated with early mortality and poor prognosis in patients with stroke (Oppenheimer et al). The adverse effect of hyperglycaemia on energy metabolism in the ischemic brain is postulated to be the result of severe lactic acidosis.

On the other hand, cerebral blood flow studies indicate that hyperglycemia is not necessarily an Unfavorable condition in acute cerebral ischemia. Moreover, in out-of-hospital cardiac arrests, a high glucose level may simply reflect prolonged cardiopulmonary resuscitation rather than be the primary determinant of poor neurologic outcome. showed that a high admission glucose level predicted mortality but not morbidity for intracerebral hemorrhage which is directly opposite as compared to ischemic hemorrhage.

The mechanisms for the association between IGT and increased risk for vascular disease are not fully understood, but it is known that the prevalence of metabolic risk factors (eg, low high-density lipoprotein cholesterol level and elevated systolic blood pressure) increase linearly according to post-challenge glucose concentration (Meigs JB et al,1998).

Some studies suggest that neither history of diabetes mellitus nor elevated serum glucose concentration at admission to the hospital is very helpful in predicting the outcome of an acute ischemic cerebrovascular event or the size of infarction by CT. The severity of neurologic deficits on admission and the type of cerebral infarction remains the most important prognostic factors. Most patients with mild strokes or lacunar infarctions do well whether they are hyperglycemic or have a history of diabetes or not. These results are similar to those reported by other clinical investigators (Mohr JP 1985, And *HP Adams*1988.).

These studies also add that the best prognostic factors remain the cause of cerebral ischemia and the severity of neurologic deficits. Concern about the potentially adverse impact of hyperglycemia has already prompted recommendations that serum glucose concentrations of patients with acute stroke be kept in a near-normal range. This recommendation is appropriate for

most acutely ill patients, regardless of whether they have had a stroke. A study done by Gray S. Christopher in 1989 showed that hyperglycemia is an important prognostic marker in young stroke than in age. Power et al concluded that the relation between outcome and the fasting, rather than the random, blood sugar concentration pointed toward the hyperglycemia being a function of a stress response and not of pre-existing glucose intolerance.

In a study where the stress hormones were studied following stroke, it was the conclusion that there was a high level of changes in the circulating levels of stress hormones, particularly cortisol, glucagon, and insulin after stroke. This was significantly more in previously nondiabetic compared to diabetic subjects.

From all these studies we can conclude that diabetes is considered a risk factor for stroke without any dispute or controversies. But when it comes to the role of Diabetes in prognosis or recovery from stroke, there are quite a few controversies prevailing. But most of these studies were done in the period between 1983 to 1995. I would like to throw more light into happening in the brain following a stroke, how it recovers after an insult, and how the glycaemic level affects the same.

The brain has some innate ability to reorganize on its own after a stroke. There are a series of events taking place in the brain following an acute stroke. This is called neuronal plasticity. Neuroplasticity is the ability of the brain to recover and remodel on its own. A literature survey concluded that Diabetes influences stroke in several aspects: age, subtype, speed of recovery, and in mortality. Increased glucose levels on admission independently increase mortality from stroke in non-diabetic but not in diabetic patients.

In human diabetes, degenerative and functional disorders of the central nervous system, including depression, are common findings. Defective dentate gyrus (DG) neurogenesis is associated with affective-related disorders and depression

Saravia FE concluded that astrocyte changes present in genetic and pharmacological models of T1D appear to reflect an adaptive process to alterations of glucose homeostasis. From his study, Kissela B in 2006 concluded that diabetes increases post-stroke mortality and adversely affects post-stroke outcomes as compared with stroke patients without diabetes. Hishinuma A, et al in 2009 concluded from their study that insulin resistance in combination with decreased insulin secretion may be associated with ischemic stroke recurrence or IHD.

On the other hand, insulin resistance is associated with hyperglycemia and dyslipidemia and promotes atherosclerosis. Although insulin resistance is associated with adipocytokines, little is known about the association in patients with stroke without diabetes mellitus. A study was done by Majima MJ et al which suggested that Insulin-resistant patients with stroke had a large amount of visceral fat and increased levels of tumor necrosis factor-alpha (TNF-alpha). He also recommended that obese patients with stroke should be examined for insulin resistance to reduce the risk of the development of atherosclerosis

From this literature survey, it's quite clear that diabetes influences stroke at onset, manifestation, and outcome stages in a negative manner. So it's an important criterion for the health workers to give diabetic counseling to post-stroke subjects if they can comprehend and cooperate or else counseling should be given to the patient attendees. It is common particularly in Indian society to overfeed and protect stroke patients from activity hoping that they may be deprived and weak. But it's very obvious that this can result in yet another stroke or increased morbidity due to high levels of glucose.

Educating A Diabetic Stroke Patient

Education to stroke patients who are diabetic should emphasize the following points

Diet

A. Questions To the Patients / Attenders

1. What is your mode of feed (oral or tubes)
2. If oral, can you swallow solid food
3. Is there any difficulty in swallowing consistently
4. How often do you have bulk food (usually 3 times a day)
5. How is your taste, is there any particular taste you cannot perceive or are hypersensitive to?
6. What food do you prefer to have more that suits your taste?
7. How much water do you drink per day.
8. Are you allergic to any of the food or fruits
9. Is your diet routine different now compared to premorbid status?
10. Do you have a prescribed diet chart prior to this stroke episode?

11. Apart from these queries the educator should make a note of the glycemetic status, type of diabetes (type 2 or stress-induced or others), did the neuro physicians have some restrictions in food habits (eg- during increased intracranial pressure due to cerebral edema some water containing fruits and vegetables are restricted.)

B. Advises to patients/advisers –

1. Break the food pattern into 5 times a day depending on the glucose levels
2. Plan for a bedtime meal if the fasting glucose values are more.
3. Try to limit carbohydrates and food that have unwanted empty calories
4. Try to include more fibers in the form of serials, green leafy vegetables
5. Try to avoid mutton, pork, fried stuff, and the yellow yoke of an egg.
6. Prefer a boiled egg to a toasted or fried one
7. Use refined oils and do not use reheated oils.
8. Try to chew the food before swallowing
9. Do not skip food after taking an oral hypoglycemic agent or Insulin which can result in hypoglycemia.
10. Have more fluid diets compared to solid stuff.
11. Reduce fat content and increase protein content as its good for the nervous system.
Apart from this advice, the educator should explain the foodstuffs and their calorific values and quantifications. He should clearly give the diet chart and explain twice thrice and make sure that the patient has fully understood the concept as the levels of memory and comprehension will be limited. The educator should keep on modulating the voice and extract some sort of response from the patient as there may be a reduced attention span.

Exercises

A. Questions To the Patients / Attenders

1. How often do you exercise a day?
2. What sort of exercises do you do?
3. Can you sit, stand and walk independently?

4. If yes for how long you can sit, stand, and walk independently?
5. Do you have an exercise prescribed before the episode of stroke?
6. What is your preferred exercise out of that?
7. Is there any discomfort like pain or limited movement or weakness in your limbs or trunk?
8. Do you feel any giddiness on getting up from bed?
9. How is your sleep quality?
10. What is your preferred time of exercise?
11. What is your attitude and perception about the need for exercise being a diabetic as well as a stroke subject?

B. Advices to the patients/attendees

1. Exercises evenly to all parts of the body?
2. Do more workouts on your affected side?
3. Do not use the affected limb for insulin injection as it will aggravate your hand tightness (spasticity)
4. Try bear weight on the affected lower limb and try to use a mirror to see your feet on the ground (it's sensory feedback if there is diabetic sensory neuropathy)
5. Try to do 20 min bouts of exercises at least 5 times a day rather than doing for one hour at a stretch.
6. Try to do more functional training like bed mobility, transfer activities, toileting, feeding, grooming, and other self-care activities.
7. You have to keep a note of your daily glycemic levels as it plays a vital role in the recovery following a stroke.
8. The morning and evenings are preferred times for exercise.
9. YOGA ASANAS and Nadisudhi pranayamas are to be followed as advised in the morning only.

Lifestyle modification

The general inquiry should be made about the habits like smoking, alcoholism, other drugs, etc. patients should be asked about their economic, social and familial background. Advise should

be made to do regular exercises and keep a strict diet and also keep an eye on glucose levels. If there are any bad habits, they are to be strictly prohibited as smoking and alcohol consumption are risk factors for stroke as well as diabetes.

Drugs

A clear chart of the drug timings and meal planning should be made and struck on the wall. The patient should be alarmed about the chances of recurrent stroke, atherosclerosis, and ischemic heart diseases secondary to stroke and dyslipidemia.

To conclude it's doubly difficult to manage a diabetic stroke patient as it's a knife with two sharp edges. But with a good team effort and understanding, it is possible. Education should keep in mind the psychological fragility of a stroke subject and not threaten him too much at the same time should make him realize the importance of diabetic control in stroke management. Thank you.

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