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A Comprehensive Review on Electrolytes Status in Acute Strokes and Their Outcomes

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I. Introduction

Stroke is a major healthcare issue worldwide with an incidence comparable to coronary events, highlighting the importance of understanding risk factors for stroke and subsequent mortality. Stroke is the third most common cause of death in developed nations after ischemic heart disease and cancer[1]. The prevalence rate of stroke in India is about 1.54 per 1000 and death rate 0.6 per 1000. Advanced age, hypertension, diabetes mellitus, smoking and atrial fibrillation have been found to be risk factors for stroke and relevant mortality in prospective studies .According to World Health Organization (WHO), about 15 million people suffer stroke worldwide every year[2]. Of these 5 million die and 5 million are permanently disabled. Acute ischemic stroke (AIS) is one of the most devastating diseases; it remains a significant health and social issue, with high disability and mortality rates. Stroke is a complex disease that requires the efforts and skills of all members of the multidisciplinary team. A coordinated care of the stroke patient results in improved outcomes, decreased lengths of stay, and decreased costs. Stroke patient die off either due to the primary disease or due to complications.

Medical management focus on the prevention of sub acute complications of stroke, including malnutrition, aspiration, pneumonia, dyselectrolytaemia, UTI, bowel or bladder dysfunction, DVT, pulmonary embolism, contractures, joint abnormalities, and skin breakdown. Electrolyte disturbances such as hypernatraemia or hyponatraemia, resulting from the syndrome of inappropriate antidiuretic hormone (SIADH),increase of brain natriuretic peptides (BNP), inappropriate fluid intake and loss, can lead to complications such as seizures or death. Most haemorrhagic stroke patients are presented with headache and vomiting. Vomiting is an important cause of dyselectrolytaemia.Complications like dyselectrolytaemia are more common in acute phase[3].

The incidence of cerebrovascular diseases increases with age, and the number of strokes is projected to increase as the elderly population grows, with a doubling in stroke deaths. Several population based survey on stroke were conducted from different parts of India[4]. During the last decade the age adjusted prevalence rate of stroke was 250-350 per 100000 population in India. In India, after several population based survey, stroke was ranked as the 6th leading cause of daily loss in 1990 and projected to rank 4th by the year 2020.Recent studies show the age adjusted annual incidence rate is 105 per 100000 population in Kolkata and 262 per 100000 population in the rural community of West Bengal[5].

In almost all neurological disorders, electrolyte disturbances were prominent. Electrolyte disturbance are commonly found in acute stroke setting. Hypernatremia, hyponatermia and hypokalemia was the commonest type of disturbance[6-9]. India will face an enormous socioeconomic burden to meet the costs of rehabilitation of "stroke victims" because the population is now surviving through the peak years (age 55-65) of occurrence of stroke (CVD). Furthermore, published reports suggest that CVD occurs at all ages in both sexes and with increasing frequency with advancing age.

Prospective studies on acute stroke have shown that hypertension,diabetes mellitus, low normal hemoglobin and tobacco use (smoking / chewing) are important risk factors (RFs). The electrolyte imbalance may lead to shift of extracellular fluid to intracellular fluid, ultimately causing brain oedema[10]. These changes in electrolytes and water concentration can result in severe complications.

Disorders of sodium and potassium concentration are the commonest electrolyte abnormalities found in cerebro vascular accident (CVA) and may contribute to mortality unless corrected urgently. Hypokalemia has been confirmed to be a predictor of adverse cardiovascular and renal outcomes[11]. There is a paucity of studies focusing on the potential connection between the serum K+ level and the outcome after acute ischemic stroke (AIS). For the treatment of hypokalemia, potassium supplements (potassium chloride as injection and syrup) are

given at a dose of 1.5gm/5ml, 1.5gm/15ml respectively. Intravenous calcium gluconate at a dose of 1.5-3gm IV infused over 2-5 mins is administered to patients with hyperkalemic electrocardiographic changes[12].

There are studies required to investigate whether hypokalemia in the acute stroke stage contributes to worse functional outcome in AIS patients . Development of hyponatraemia can causes further altered sensorium in stroke patients and when occur abruptly causes convulsions and aggravate cerebral oedema leading to cerebral ischemia causing further brain damage and leads to deaths[13]. Potassium is associated with inhibition of free radicals formation and modulates arterial vessel tone and vascular smooth muscle cell proliferation. Serum calcium plays an important role in the pathogenesis of ischemic cell damage. Intracellular accumulation of calcium can leads to neuronal cell damage by triggering cycle of cytotoxic events and apoptotic cell death. Calcium influx into the cell via NMDA receptors leads to delayed cell death and excitotoxicity associated with ischemia[14]. Magnesium deficiency is associated with vasoconstriction and vascular endothelial cell injury. Thus, acute stroke is a complex pathophysiological state and its management requires the efforts and skills of all the member of the multidisciplinary team. Electrolyte disturbances may have negative influences on the outcome of acute phage of stroke and timely early detection and correction of dyselectrolytemia may improve outcome of acute stroke[15].

GOS (Glasgow Coma Scale) is a 15-point objective clinical scoring system for assessing changes in a patients' conscious level. The GCS tool enables one to effectively monitor the level of consciousness and provides a common language to improve communication in reporting neurological findings among healthcare professionals. Sodium is involved in the transmission of nerve impulses and muscle contraction. Symptoms of hypernatremia include restlessness, seizures and coma which affect GCS. Potassium ions play a major role in regulating fluid balance in cells, the transmission of nerve impulses, and in muscle contractions. A symptom of hypokalemia is confusion or disorientation which in turn is related to the low GCS

People with low GCS have loss of consciousness and this leads to inability to express the feeling of thirst and consequently a low intake of free water. This inability to drink water causes increase in sodium (eg. Diabetes Insipidus). Hypernatremia is associated with increased mortality in hospitalized patients and in medical intensive care units. In a study by Aiyagiri, hypernatremic patients had a lower median admission GCS score and those patients with low GCS admission scores were independently associated with increased mortality. The balance of chloride is closely regulated by the body. Significant increases or decreases in chloride can have deleterious or even fatal consequences: Chloride is also involved in regulating blood pressure. Hyperchloremia, can be caused by kidney failure, kidney dialysis, and an overproduction of parathyroid hormone.

Serum electrolytes can be easily measured in emergency service settings. Studies describing electrolyte status in CVA are rare. If they are estimated and corrected in early phase; patients will have a better prognosis. This study was therefore undertaken to observe the changes in serum electrolyte levels in CVA patients and to find any relation with other biochemical parameters and type of stroke.There are no. of scales available for the assessment of outcome in stroke patients. It includes Barthel Index, Functional Independence Measurement (FIM), Glasgow Outcome Scale (GOS) & Community Integration Questionnaire. Glasgow Outcome Scale (GOS)[16]. This scale allows a prediction of the long-term course of rehabilitation to return to work and everyday life. This scale includes five scores: (i) 1 – Death, (ii) 2 – Persistent vegetative state, (iii) 3 – Severe disability, (iv) 4 - Moderate disability, (v) 5 – Good recovery.

In our country, there are many studies on stroke, its associated conditions and their effect on stroke patient's outcome, but only few studies on electrolytes disturbance in stroke patients has been done in our country, even outside. Thus attempts should be made to find out the common electrolytes status in different type of acute stroke patients and their association with some common clinical presentation.

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