Review / Derleme

# Nutritional Approach and Treatment in Patients with Stroke, An Expert Opinion for Turkey

## İnme Hastalarında Nütrisyonel Yaklaşım ve Tedavi, Türkiye için Uzman Görüşü

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## Abstract

Cerebrovascular diseases comprise the most common category of inpatient cases taken care of by neurologists. Dysphagia and malnutrition are not rare after stroke. It is strongly recommended for neurologists to screen and treat swallowing disturbances and malnutrition in stroke patients. However, present scientific literature lacks clear evidence with regards to nutritional treatment strategies for stroke patients. This review and recommendation paper is written with the aim to standardize nutritional screening and treatment algorithms during acute and chronic phases of cerebrovascular diseases and guide neurologists in Turkey for their daily practice.

**Keywords:** Stroke, nutrition, malnutrition, dysphagia

## Öz

Beyin damar hastalıkları nöroloji uzmanlarının en çok yatırarak izlemek durumunda kaldığı hasta grubunu oluşturmaktadır. İnme sonrası disfaji ve beslenme bozukluğu nadir değildir. Akut dönemde ve taburculuk sonrasında inme hastalarının malnütrisyon ve yutma bozukluğu açısından izlemi ve tedavisi nöroloji uzmanları tarafından gerçekleştirilmelidir. Ancak mevcut literatür ve kaynaklarda inme hastalarının nütrisyonel tedavisi ile ilgili net veriler yoktur. Bu gözden geçirme ve öneri makalesi, Türkiye özelinde beyin damar hastalığının akut ve kronik fazlarında nütrisyonel yaklaşım ve tedavi yöntemlerini standardize hale getirebilmek ve nöroloji uzmanlarına rehberlik etmesi amacıyla hazırlanmıştır.

**Anahtar Kelimeler:** İnme, nütrisyon, malnütrisyon, disfaji

## Introduction

There is no specific evidence revealing how nutritional evaluation should be made in patients with cerebrovascular disease and which nutritional therapy should be preferred. The daily practice applied for these patients basically depends on scientific data obtained from general intensive care units (ICUs) and geriatric patient populations. Some countries and nutrition societies have developed their own national guidelines to compensate for this deficit. Five national specialists in the fields of stroke, neuro-intensive care, nutrition, and swallowing disorders

collaborated to create basic proposals on the clinical significance of nutrition and dysphagia in patients with stroke, the diagnosis and treatment of malnutrition, and swallowing disorders, enteral nutrition products, application principles and complications, with consideration to national conditions.

A scientific search was performed in medical databases (PubMed and Embase) using the keywords "stroke, cerebrovascular disease, malnutrition, malnutrition screening, malnutrition assessment, nutrition, enteral nutrition, parenteral nutrition, oral supplements, dysphagia, dysphagia diagnosis, dysphagia screening, and dysphagia treatment". The resulting articles were evaluated

by each expert and a preliminary assessment was conducted via online communication. Consensus decisions on controversial and unclear issues were made following 3 meetings, each lasting 8 hours. The principles of nutritional assessment and treatment in patients with stroke were summarized in 19 questions and their relevant answers.

### 1. Is malnutrition a common problem after stroke?

Malnutrition is defined as "a state resulting from lack of uptake or intake of nutrition leading to altered body composition (decreased fat free mass) and body cell mass resulting with diminished physical and mental function, and impaired clinical outcome from disease". Malnutrition may also occur as the result of a disease state and ageing (1). Patients with stroke may lose their eating and drinking abilities due to disorders of consciousness, swallowing problems, postural instability, decreased mobilization, limitations in communication, fatigue, depression, and visuo-spatial deficits. Nearly 90% of patients with stroke have a risk of malnutrition (2).

Malnutrition rates reported in patients with stroke differ greatly according to the evaluation methods used and the patient population taken under consideration. The malnutrition rate determined among patients with acute stroke at admission is reported as 3.8-32%; this ratio reaches up to 7.5-35% at the end of the second week of hospitalization. The prevalence of malnutrition within two-weeks after stroke is increased by nearly two-fold (3,4,5,6,7,8,9,10,11,12,13,14,15). Malnutrition is very common in patients in rehabilitation centers, and malnutrition rates may increase up to 30-49% in the chronic phase (16,17,18,19,20,21,22).

*Malnutrition is not a rare event in the acute phase after stroke; its frequency increases gradually in subsequent weeks.*

### 2. What is the frequency of dysphagia after stroke?

The frequency of dysphagia varies greatly according to the evaluation method used. The rate of dysphagia is 30-65% in the acute phase of ischemic and hemorrhagic stroke (23,24,25,26,27,28). When a detailed examination is performed for the diagnosis of dysphagia by videofluoroscopy (VFS) or fiberoptic endoscopy, it increases up to 64-78% (29). Its frequency decreases to 22% in subsequent weeks (11). At the end of the sixth month, 13% of patients have not yet started to eat normally; dysphagia becomes permanent in nearly 3% of patients, and they require continuous enteral feeding (25,26,30).

*Dysphagia is a common problem following stroke, but recovers in the majority of patients with time.*

### 3. How is energy metabolism affected after stroke?

Patients in the acute phase following stroke are not in a high hypermetabolic state, unlike patients with other critical diseases. In the first week after stroke, basal energy requirement is increased only by 7-26% above normal; it is not markedly elevated as in

traumatic brain injury, sepsis or burns. Energy requirement at rest is found to be slightly increased in intracranial hemorrhage compared with ischemic stroke (19,31,32,33).

After stroke, plasma catecholamine, cortisol, glucagon levels, interleukins, and acute phase reactants are found to be increased as a component of the acute stress response. This systemic response causes both a rapid catabolism and degradation of fat-free body mass, namely muscle tissue and fats. However, it is not clear how much this systemic response plays a role in the development of malnutrition.

In the case of fasting, all fat stores are degraded, and fatty acids are released to produce energy. Fatty acids cannot be used as an energy source for the brain because they cannot pass through the blood-brain barrier. Ketone bodies produced from fatty acids in the liver can pass through the blood-brain barrier, but they are not a good and effective energy source for neurons. If blood glucose is not replaced in patients with stroke whose oral intake is reduced, rapid muscle protein degradation starts in order to use amino acids as an energy source. This process, accompanied by other factors such as hormonal deficits, inflammation, and immobility, rapidly leads to a clinical picture with the potential of development of sarcopenia (34,35).

Intestinal wall integrity depends on mesenteric blood flow and presence of nutrient products in the bowel lumen. Restriction of oral intake in a patient with stroke leads to rapid atrophy of intestinal villi and crypts, an increase in intestinal wall permeability, and translocation of pathogenic intestinal bacteria via the bowel wall. All of these processes culminate in an increased risk for sepsis (36,37).

*Patients with inadequate food intake after stroke start to lose their muscle tissue rapidly. Additionally, the lack of nutrients in the oral enteral route causes a risk of intestinal epithelial atrophy.*

### 4. Does development of dysphagia and malnutrition after stroke contribute to unfavorable outcomes?

Mortality is higher in patients with malnutrition at admission (38). The Barthel index score on day 30 is lower, mortality is higher at the end of the first week, and complications are more frequent in patients whose nutritional parameters deteriorate after stroke. Duration and costs of hospitalization are higher in patients with malnutrition (10,13,23). Patients who are not fed adequately and develop malnutrition during the period of hospitalization have worse prognosis at the end of the third month during follow-up (11,14). This unfavorable effect of malnutrition continues till the sixth month after stroke (23).

The major complications of dysphagia related with stroke may be listed as aspiration and aspiration pneumonia (29), dehydration (39), prolonged hospitalization (40), longer rehabilitation period, and healthcare requirements (41). These complications cause a decrease in the physical and social well-being of patients with stroke, and the quality of life of the patient and their relatives (26). The presence of dysphagia increases the risk of malnutrition (25,29,40,42,43,44).

*Dysphagia and malnutrition after stroke increase mortality, morbidity, and costs.*

## 5. Is nutritional support beneficial in patients with stroke?

There is limited scientific evidence indicating that the correction of nutritional status and providing adequate energy intake in post-stroke patients has positive effects on clinical recovery (15,45,46,47). This issue cannot be completely tested by a controlled clinical trial because there would evidently be an ethical problem with not feeding a group of post-stroke patients and feeding the other group. In line with studies and scientific evidence indicating that nutritional support in the general patient population has favorable effects on prognosis, *it is generally accepted that the correction of nutritional parameters in post-stroke patients would also contribute positively to clinical prognosis.*

## 6. How is the nutritional state of stroke patients evaluated and followed up?

The nutritional state and fluid intake of stroke patients should be evaluated at admission and at regular intervals thereafter, and the best nutritional plan should be prepared for patients (9). Clinical scales, anthropometric measurements, laboratory tests, and functional tests can be used to evaluate the nutritional state of stroke patients (10,48). Some clinical scales have been developed for screening malnutrition, and others have been developed for both screening and evaluation; in other words, for defining the severity of malnutrition.

The screening tests developed to screen patients with malnutrition or at the risk of malnutrition are listed as Nutritional Risk Screening-2002 (NRS-2002), Mini Nutrition Assessment-Short Form (MNA-SF), Malnutrition Universal Screening Test (MUST), Malnutrition Screening Tool (MST) and Short Nutrition Assessment Questionnaire (SNAQ). Acute stroke patients, especially patients who cannot be fed orally, are under increased risk of malnutrition (49,50). It is recommended that malnutrition should be intermittently screened during the chronic phase of stroke (51,52,53,54). Screening tests can be performed in a short time by nurses or physicians.

There are three validated tests for evaluation of nutrition. These are the Subjective Global Assessment (SGA) (55), MNA (56), and 'informal evaluation' of nutritional state, which is the evaluation of patients by visual observation (49,57). There is no standard screening and evaluation test for stroke patients. The most commonly used tests are MNA and SGA (52). SGA is an evaluation test for nutritional state developed to evaluate complication risks in patients scheduled for surgery (55). MNA is developed as a screening and evaluation tool in geriatric patients (56,58). Both tests contain anthropometric measurements. MNA is a test with two steps; MNA-SF is used in malnutrition or malnutrition risk screening, and the complete test can assess the severity of malnutrition. The MNA and SGA tests show moderately significant correlations with biochemical parameters and anthropometric measurements in chronic stroke patients (for MNA r=0.520, for SGA r=0.449) (50). The power of these tests may be increased by biochemical markers (3).

Anthropometric measurements that may be used in nutritional state assessment are body weight, body mass index (BMI), triceps skin thickness, and the arm and calf circumference measurements. The measurements of body weight and BMI are difficult in immobilized patients. Triceps skin thickness or mid-arm circumference may be measured in immobilized patients, but it should also be considered that these measurements may be misleading because of the presence of edema and atrophy in stroke patients. The hand grip test (with hand dynamometer) may be performed at the bedside as a functional test. However, none of these assessments are validated for the evaluation of nutritional status in patients with stroke.

Other investigations that may be used to evaluate body composition include bioelectrical impedance analysis, dual-energy X-ray absorptiometry, computed tomography, ultrasonography, and magnetic resonance imaging.

There is no ideal biochemical marker to demonstrate the nutritional state of stroke patients. The cut-off values of biochemical parameters are debatable. Malnutrition rates differ greatly according to the methods used and cut-off values (49). Biochemical markers used during follow-up can be listed as albumin, pre-albumin, transferrin, retinol binding protein, serum iron, total cholesterol, leukocyte count, lymphocyte count, hemoglobin, and vitamin B12 and folic acid levels. There are also studies indicating that lower serum albumin levels (<3.5 mg/dL) are related with poor prognosis after stroke (59,60,61), and that albumin level is not related to the amount of protein and calorie intake (62). Blood levels of biochemical markers cannot be routinely used in the quantitative evaluation of malnutrition because their levels can change enormously with several factors such as patient age, acute stress, systemic inflammation and infections, hepatic function, catabolic processes, and accompanying diseases (63).

The diagnostic criteria for malnutrition were re-defined in 2015 by the European Society of Parenteral and Enteral Nutrition (Table 1) (1).

*Stroke patients are generally at risk for malnutrition. Malnutrition that adversely affects prognosis should be evaluated starting from the acute phase, and a nutritional plan should be implemented accordingly.*

*There is no single method recommended to evaluate malnutrition in stroke patients; the MNA and SGA tests, which have been shown to be valid for other patient groups, can be used. Anthropometric measurements and laboratory investigations indicating body composition may be used in the diagnosis and follow-up of patients with malnutrition. There is no standard*

| Table 1. Malnutrition diagnostic criteria according to European Society of Parenteral and Enteral Nutrition | |
|---|---|
| Definition 1 | BMI <18,5 kg/m² |
| Definition 2 (1+ one of the remaining) | 1. >10% involuntary weight loss at any time or >5% weight loss in the last 3 months<br>2. <70 years old; BMI <20 kg/m²<br>≥70 years old; BMI <22 kg/m²<br>3. Fat-free BMI; females <15 kg/m², males <17 kg/m² |
| BMI: Body mass index | |

*biochemical test that can be used in the evaluation of the nutritional state of patients with stroke.*

*Nutrient and fluid intake of all stroke patients, especially those with problems of oral feeding, should be followed up during the acute phase, and their nutritional states should be evaluated weekly. Malnutrition screening and follow-up are also important in stroke patients during the chronic and rehabilitation phases. MUST, MST, NRS-2002, SNAQ or MNA-SF may be used as screening tests.*

## 7. Which tests are used for the screening and evaluation of dysphagia in stroke patients?

The diagnosis of dysphagia can be made in stroke patients by bedside screening and clinical assessment tests. Specific equipment is essential for the advanced evaluation of dysphagia. During clinical examination, potential indicators of dysphagia include impaired consciousness, "National Institutes of Health Stroke Scale" score >12, aphasia, hypophonia, dysarthria, severe neurologic deficit, marked facial paralysis, decreased pharyngeal sensation and wet sound, cough, and change of voice after swallowing. On the other hand, risk factors for aspiration in patients with stroke are reported as presence of brainstem lesion, bihemispheric infarcts, accumulation of intraoral secretion, soft palate dysfunction, delay in swallowing reflex, marked facial paralysis, history of recurrent pulmonary infection, smoking and chronic obstructive pulmonary disorder, weak spontaneous cough, dysphonia, voice change, wet sound and wet coughing after swallowing. It is not always possible to diagnose aspiration by clinical examination. Nearly half of all patients with dysphagia aspirate, and pneumonia is reported to develop in one-third of these cases. Silent aspiration is the passage of swallowed material below the vocal cords without coughing. Under VFS, the incidence of aspiration is 30-51% in acute stroke patients, whereas silent aspiration is reported as 8-27% (64,65,66).

Early diagnosis of dysphagia is important in stroke patients to prevent complications, mainly pneumonia. It has been shown that the incidence of pneumonia is higher in stroke patients who are not screened for swallowing than in screened cases (29,67,68).

The level of consciousness and cooperation of the patient, postural control (ability to sit straight with help), oral hygiene and secretion control, and voluntary cough should be evaluated before the screening test.

Screening tests should include water swallowing tests together with a clinical evaluation. Moreover, there are swallowing evaluation tests in which patients are given fluids of different textures and bolus amounts. Different evaluation methods such as the Toronto Bedside Swallowing Screening Test (69), Gugging Swallowing Screen (70), Mann Assessment of Swallowing Ability (MASA) and its MASA Modified Form (71), and the Barnes Jewish Hospital Stroke Dysphagia Screening (72) can be used to screen for dysphagia in stroke patients. The preferred swallowing screening test should be validated, reliable, and have high sensitivity. There is no study indicating the superiority of one of these tests over the other. There is no consensus or recommendation about which is the best test for stroke patients in systematic reviews and guidelines (73,74,75).

The water contents and methodology differ among the most commonly used water swallowing tests. The water content changes

between 5 and 100 mL. Some procedures include re-swallowing boluses with a volume of 3 or 5 mL, others include only sequential water swallowing from a glass, whereas others include both re-swallowing of small amounts and sequential water swallowing. There is no consensus either in the optimal water swallowing test or ideal water amount for the screening of dysphagia (76,77,78). However, the most commonly preferred method in the evaluation of swallowing is to start with small amounts and increase gradually (78).

Dysphagia screening should be performed in every stroke patient before the initiation of oral feeding and drug administration using a simple and valid bedside swallowing test, and the aspiration risk should be defined. This test may be performed by an experienced nurse or healthcare professional. The dysphagia screening test should be performed within the first 24 hours. The screening test may be repeated in the subsequent days if necessary, according to the neurologic condition of the patient. Oral feeding may be initiated carefully in patients who passed the test, but patients should be followed up thereafter for aspiration.

Weak palatal movement, dysarthria, abnormal voice, inadequacy of voluntary coughing, presence of abnormal pharyngeal sensation, observation of cough and voice change (wet voice) after swallowing 5 mL of water three times and 50 mL of water from a glass are high-sensitivity bedside clinical markers in dysphagia screening (Figure 1) (79). Monitorization of oxygen
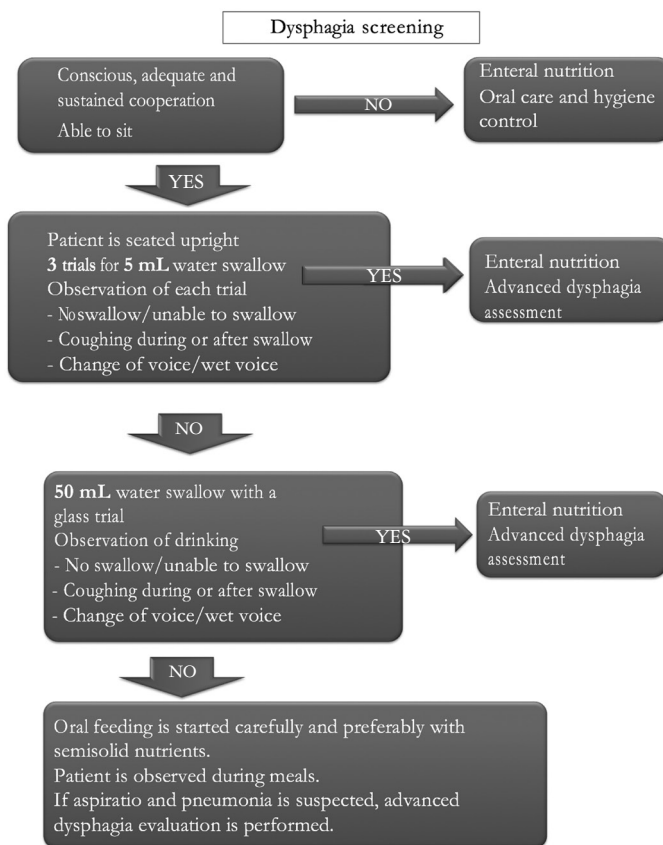


**Figure 1.** Recommended algorithm to determine the presence of dysphagia in stroke patients

saturation from the finger during swallowing evaluation using a peripheral probe may increase the sensitivity of the screening test (80,81,82).

In addition to a screening test, clinical evaluation of swallowing by an experienced physician or speech therapist may determine the presence of aspiration and dysphagia. In clinical assessment, the appropriate method and treatment options and possible risk of aspiration is determined in view of symptoms and signs. The oro-linguo-pharyngeal sensorimotor examination involves food and water swallowing tests with different consistencies. Although there is no generally accepted validated clinical swallowing evaluation method for stroke patients, a standardized protocol or clinical evaluation test developed by Logemann can be used (Annex 1) (83).

Patients who cannot pass the screening test, and those with dysphagia and aspiration risk lasting for longer than one week, may require further instrumental methods according to hospital and patient conditions. Advanced dysphagia evaluation is performed in patients with suspected silent aspiration or in patients who cannot pass screening tests, and is crtical for determining the consistency of foods, the way of swallowing therapy, and rehabilitation method. Therefore, it is recommended that further dysphagia evaluation should be performed by an experienced physician or speech therapist. VFS and fiberoptic endoscopic evaluation (FEES) may be used for this purpose. All phases of swallowing, aspiration, penetration or oropharyngeal residual materials can be shown radiologically using VFS. Its disadvantages include the requirement of complete patient cooperation, need for a sitting position, and a low dose of radiation. FEES is a swallowing evaluation performed using a short flexible endoscope. Patients swallow solutions with different consistencies and a mixture of food dyes. FEES is easy to perform by the bedside and available for follow-up, it is cheap and has no risk of irradiation. However, oral and esophageal phases are not visible during FEES, patients may feel uncomfortable, and it may cause irritation. Also, the requirement for experienced staff is another disadvantage (84,85). Another test is the dysphagia limit, which determines the presence and level of dysphagia during neurologic practice by using EMG (86). Its disadvantages include the fact that patient should be in the sitting position, and should be cooperative (86).

*All acute stroke patients should be screened for dysphagia before being given oral medication, food, and fluid. The risk of aspiration pneumonia may be decreased by formal screening test and the evaluation of dysphagia. A valid screening test should be performed by an experienced/trained healthcare professional. Dysphagia screening should be performed within the first 24 hours. Patients who pass the test are allowed oral feeding, but if the patient deteriorates, re-evaluation and follow-up for aspiration should be performed in all patients.*

*Patients who cannot pass the screening test are not allowed to be fed orally. It is suggested that patients should be re-evaluated at least twice per week for passage to oral feeding because it is highly possible for dysphagia to recover during the first weeks.*

*Further instrumental swallowing evaluation may be performed in patients who do not pass the screening test according to hospital and patient conditions. Enteral nutrition is started until VFS or FEES are performed. After VFS and FEES have been performed, a plan is prepared for enteral nutrition process or dysphagia treatment.*

## 8. How is dysphagia managed?

The treatment of dysphagia should be managed by a team including a neurologist, physiotherapist, speech/language therapist, swallowing therapist, dietitian, occupational therapist, and a stroke nurse. Dysphagia treatment includes restorative methods, compensational techniques and adaptive methods (84,87).

The aim of restorative methods is to facilitate improvement in swallowing function. Restorative methods include maneuvers and exercises to strengthen the swallowing muscles and oropharyngeal coordination. Sensorimotor exercises, tongue-chin exercises, chewing exercises, and laryngeal adduction exercises can be given as examples. Biofeedback systems, oral thermal, electrical, and vibratory sensory stimuli may also be used for this reason (43,84). There is insufficient evidence to show whether transcutaneous/neuromuscular electrical stimulation affects the function and safety (aspiration) of swallowing. There is evidence indicating that repetitive transcranial magnetic stimulation, which is one of the non-invasive cranial stimulation techniques, has positive effects on swallowing function, and decreases aspiration. The data for transcranial direct stimulation are inadequate; further studies are required (88). Consistent and adequate benefits have not been obtained in drug studies (nifedipine, cilostazol, cabergoline, angiotensin-converting enzyme inhibitors, amantadine) conducted on swallowing function, so further studies are also required with these as well (87).

The aim of compensation methods is to increase the safety of swallowing without correction of the underlying neuromuscular deficiency, and prevention of aspiration. Examples of postural manipulations are maneuvers such as "chin tuck", head flexion, and turning the head to the weak pharyngeal side (hemiplegic side). Multiple swallowing, forced swallowing, supraglottic swallowing, super supraglottic swallowing, the Mendelsohn maneuver, and laryngeal elevation are some examples of compensatory mechanisms (43,84).

There are no prospective controlled studies demonstrating the efficacy of these methods in patients with swallowing disorders, and favorable effects are reported only from observational and anecdotal reports, and from personal experiences. There are studies reporting that long-term and high-intensity programs are better than short-term and low-intensity studies (89,90).

Attempts have been made to provide patient adaptation to swallowing disorders by using adaptive methods, external support, and dietary regulation. Diet regulation, dietary enrichment, thickeners, enteral tube feeding, and percutaneous endoscopic gastrostomy (PEG) feeding are methods for adaptation (43,84,91). Dietary regulation in dysphagic patients who can be fed orally is directed to adequate nutrient and fluid intake, and to decrease possible aspiration. There are studies indicating that thickened fluids are safer for swallowing and the risk of aspiration is less when compared with thin fluids. However, further studies are required to investigate the benefits of thickeners. Apart from these approaches, it has been shown that approaches for patient's oral hygiene and dental health have positive effects in stroke patients (92,93).

*The most ideal treatment for dysphagia should be performed by a team composed of neurologists, speech therapists,*

*physiotherapists, dietitians, and stroke nurses. While teaching maneuvers and exercises for strengthening oropharyngeal coordination, helpful postures and compensation maneuvers should be shown to prevent aspiration. It is recommended that swallowing rehabilitation should be started in a cooperative stroke patient with dysphagia after one week.*

*Other treatment approaches are thickeners, diet modification (e.g., switching to soft diet and enriched diet), and initiation of enteral feeding without delay if daily calorie and protein requirements cannot be met via the oral route.*

*Applications directed to oral hygiene (oral and tooth care) should be performed in stroke patients to protect against aspiration pneumonia and other infections.*

## 9. Which stroke patients are initiated on enteral feeding?

Enteral feeding should be initiated in every stroke patient who cannot be fed orally due to impaired consciousness, dysphagia or severe neurologic deficit, because they are highly prone to being at a high risk of developing malnutrition and pneumonia. Patients with deterioration in consciousness, lack of cooperation, aphasia, swallowing apraxia, 9th-10th and 12th nerve palsies, and pseudobulbar palsy may require enteral nutrition. Nutritional tube feeding has been shown to reverse malnutrition under conditions where stroke patients cannot be orally fed despite the absence of dysphagia (19,94). Enteral feeding may be initiated just for this time period because dysphagia due to stroke can improve in the first couple of weeks, and it may be switched to oral feeding after improvement of dysphagia (12,95).

*Regardless of the underlying reasons, enteral nutrition should be employed in all stroke patients who cannot be fed orally, unless it is contraindicated.*

## 10. When is enteral nutrition initiated in stroke patients?

The main data about the time to start enteral feeding in stroke patients were obtained from the randomized controlled clinical trial, Feed or Ordinary Diet (FOOD). In this study, which has some limitations, stroke patients who could not be fed orally were randomized into two groups; one with early enteral feeding as soon as possible, and the other with enteral feeding on the seventh day after stroke. Physicians were allowed to decide which type of enteral feeding (NG or PEG) would be administered. No statistically significant difference was found in the modified Rankin Score and mortality rates between early and late-onset enteral feeding groups (46).

Considering the negative effect of malnutrition in the prognosis of stroke patients, it is clear that protein and calorie targets should be reached as soon as possible. If only low-calorie fluids are infused intravenously in comatose stroke patients, the levels of protein and albumin decrease by 1.5 g/dL and 1.2 g/dL, respectively (96). "Early enteral feeding", which means initiation of enteral nutrition within the first 24-48 hours of ICU admission, decreases infective complications and length of hospital stay in patients with traumatic brain injury and in medical ICU patients (97). If there is no severe metabolic disorder such as hemodynamic

instability, diabetic ketoacidosis, or hepatic coma, severe nausea and vomiting or intestinal distention, then early enteral nutrition should be started. Even at lower doses, early enteral feeding has valuable effects on the preservation of intestinal mucosal integrity, and the continuation of barrier function and the immune system of the body. Trophic feeding (10-20 mL/hour) may be sufficient to prevent intestinal mucosal atrophy (98,99,100).

*Enteral feeding should be accepted as part of stroke management. Although there are no supportive data in randomized studies about stroke, in light of data obtained from other fields, enteral feeding should be initiated in acute stroke treatment as early as possible after hemodynamic stabilization is preserved. This time period should not be longer than 48-72 hours.*

## 11. Which route is preferred for enteral feeding?

Feeding tubes are used for enteral nutrition in stroke patients. The route of feeding tube may be nasogastric (NG), nasoduodenal (ND) or nasojejunal (NJ). If nasal tube insertion is impossible, then the oral route (orogastric/oroenteral) can be used. No studies have tested the superiority of these routes over each other during the acute phase in stroke patients. Although the use of postpyloric feeding has been shown to decrease aspiration risk in critical patients in some studies, this has not been corroborated in other studies (101,102,103). As a result, postpyloric feeding is the primary objective; however, enteral feeding should not be delayed if the tube stays in the gastric area.

The location of the feeding tube may be confirmed using chest X-ray or by checking the pH of aspiration material via the tube. If the pH of the aspirated liquid is below 5 (shown by using litmus paper), the tube is supposed to be inserted in the stomach. However, pH measurement alone may cause faulty results if the tube is in the esophagus or when drugs affecting gastric acidity are used. The diameter of commonly used feeding tubes is 6-10 French (Fr); if the diameter of the inserted tube is 8 Fr (1 Fr=0.33 mm), then it is suitable. Feeding should not be performed using a NG drainage catheter. Radiopaque tubes should be preferred because they are easily detected in chest and abdominal X-rays. Displacement of nasoenteral tubes is the most common issue mentioned in studies. It is recommended that a nasal loop should be used to prevent this (104).

It has not been shown that early PEG insertion after stroke is superior to nasoenteric approach in survival and neurologic recovery. It is reported that PEG insertion within the first week after stroke was only helpful to reach nutritional targets, and it decreased ventilator-associated pneumonia risk in one study (105). Long-term NG nutrition has risks such as displacement of tube, traumatic insertion, pressure ulcers, gastric and duodenal ulcers, aspiration and pneumonia, and inadequate feeding or dehydration. It is believed that such problems are less frequently encountered in feeding with PEG (98,99,106).

*As a standard, enteral feeding is initiated by using tubes reaching the enteral system via the nasal route. Initially, NG or ND accesses are targeted. A NJ tube may be used in patients with a high risk of aspiration and recurrent aspirations. If enteral feeding requirement is longer than four weeks, then opening PEG is recommended. No definite benefit has been shown in the opening of PEG during the early phase. However, if it is considered from*

*the beginning that dysphagia and enteral feeding will last for a long period, early PEG insertion may be reasonable.*

## 12. How are calorie, protein, and fluid requirements of stroke patients calculated, and what is the dose of nutritional product?

Indirect calorimetry is the best way to calculate the daily calorie need of a stroke patient. Indirect calorimetry depends on the hypothesis that all oxygen taken into the body is used to oxidize energy sources in the body, and all carbon dioxide produced during this time interval is released through expiration. The energy content that an individual needs at rest is calculated using a closed spirometry system, which captures the oxygen used and carbon dioxide produced in a defined time interval. Measured volumes are converted to the daily calorie requirement by using the Weir formula. It is a non-invasive and cheap method. It calculates the metabolic rate with an error rate of 1%. There are different indirect calorimetric devices with different designs (107,108). However, formulas obtained from test results of hospitalized patients (Penn State, Ireton-Jones, Swinamer) or healthy volunteers (Harris-Benedict, Mifflin-St Jeor) are preferred because there are difficulties with its practical use in ICUs and hospitalized patients. All these equations may be affected by various confounders such as obesity, asthenia, treatments given, body temperature, and comorbid conditions (109). The superiority of energy calculation considering ideal body weight by using height and sex (20-30 kcal/kg/day) to the above-mentioned formulas is its simplicity. It can be used in stroke patients.

There is no specific study investigating the initiation dose of enteral feeding, or the duration to reach the calorie target. It is recommended that enteral feeding is started at an infusion rate of 20 mL/hour, and if there are no complications the infusion rate can be increased by 10-20 mL/hour every 8-12 hours to reach the targeted calories. To provide efficient enteral feeding, 80% of the targeted calorie and protein contents should be given within the first 48-72 hours.

The daily protein requirement is calculated as 1-1.5 g/kg/day. Protein requirement, especially in patients who require ICU hospitalization, may reach up to 2 g/kg/day. Protein is an important macronutrient for wound healing, supporting immune functions, and preservation of BMI. However, it has not been shown that protein-supplemented enteral solutions provide superior nutritional conditions in comparison to that in stroke patients who received standard enteral solutions (102). There are no data proving the efficacy of serum albumin, pre-albumin, transferrin, and C-reactive protein measurements to follow up the adequacy of protein support (103,110).

Daily fluid requirement is calculated as 30 mL/kg/day. To reach this target, and prevent dehydration, it should be remembered that there is 69-86% free water in nutritional products.

*Indirect calorimetry is the most reliable method to calculate calorie requirement, but calorie calculations considering ideal body weight is a frequently used practical method. Daily calorie requirements in stroke patients may be calculated as 20-30 kcal/ kg. It is aimed to start nutrition at 20 mL/hour, and to reach the target dose at least within 48-72 hours.*

## 13. Which enteral product to choose?

Enteral nutritional products are divided into four groups as polymeric, oligomeric, elemental, and disease-specific modified products. Standard polymeric products are preferred in all stroke patients. Osmolarities vary between 265 and 320 mOsm. Energy content is provided by 15-20% of protein, 30-35% of fat, and 49-54% of carbohydrate. A standard 500 mL product contains 20 g protein, 16-20 g fat, and 60-70 g carbohydrate. One mL of a standard polymeric product provides 1 kcal of energy, and its pH value is between 6.5 and 7.0.

The protein content is increased to 29-31 g, the fat content is increased to 20-31 g, and the carbohydrate content is increased to 93-100 g in high-energy products, so that 1 mL of the formulation can provide 1.5-2.0 kcal energy. High-energy products have a high osmolarity and low fluid content. They can be used in patients who should have fluid restriction. Physicians should be cautious about the dehydration of patients while administering these products. These products may cause osmotic diarrhea due to the high osmolarity.

The protein content in every 500 mL of high protein products is increased to 32-34 g, such that 20-22% of energy is provided from proteins. The high protein ratio causes the high osmolarity value to reach 290-474 mOsm. It helps to meet the protein requirement with a lower calorie content.

In high-fiber products, non-digested and non-absorbed fiber ratios are increased without changing the ratios of protein, fat, and carbohydrate. The osmolarity of these products varies between 210-360 mOsm.

Disease-specific products are used for special conditions by changing their contents. Products high in branched chained amino acid (valine, leucine, isoleucine), low in aromatic acids (tyrosine, phenylalanine, methionine, tryptophan) are manufactured for hepatic failure, whereas protein-restricted and essential amino acid and histidine only-containing products are developed for renal failure. Use of these products may not be convenient for patients undergoing dialysis. For diabetic patients, there are products with a low carbohydrate ratio, increased protein and fat ratios, and those containing monounsaturated fatty acids. Their osmolarities are high. These products are more commonly recommended in diabetic patients without blood glucose regulation rather than for routine use. There are no consistent or adequate data about the clinical benefits of disease-specific products.

Elemental and semi-elemental products are low-molecular-weight compounds necessitating minimal digestion and providing almost complete absorption. Fats constitute only 1-12% of the energy content. They decrease pancreatic, biliary, and intestinal secretions, and the amount of feces. They may be used in diseases that deteriorate digestion or absorption capacity.

Modular products are used in addition to nutrients to change the general energy and nutritional composition, and they are comprised of only glucose polymers, protein, or lipids. They are preferred in patients who require fluid restriction, with electrolyte imbalance, or in need of specific nutrients (106,111,112,113).

*Although scientific evidence is inadequate, depending on practical long-term experience, the most commonly employed nutritional products in stroke patients are polymeric standard*

*formulas. Diabetic products may be administered if blood glucose levels are uncontrolled; fiber-rich products can be given in patients with diarrhea and constipation. High-calorie products can be administered in patients with fluid restriction or whose energy requirements cannot be provided. Products high in protein can be given to patients with protein deficiency.*

## 14. How should enteral feeding be administered?

Enteral tube feeding may be performed by either continuous infusion through special pumps or by intermittent bolus administration. There are data obtained from studies conducted on patients in general ICUs about intermittent feeding or continuous infusion. These data indicate that continuous infusion decreases the risk of aspiration, pneumonia, and diarrhea, decrease contamination risk of products, and prevent spending for unnecessary assistant healthcare professional workforce. Therefore, continuous infusion is preferred in hospitalized stroke patients. Intermittent enteral feeding may be preferred in patients who are mobilized, at the stage of discharge, and in those who are planned to receive enteral feeding at home. However, before switching to intermittent feeding, the patient should have reached targeted calorie levels with continuous infusion (106,114,115,116).

The head of the bed should be raised to 30-45 degrees to decrease the risk of aspiration during infusion of nutritional product. Routine use of prokinetic agents is not recommended. There are no data indicating that they decrease the risk or increase tolerance of the risk of aspiration pneumonia. Prokinetic agents (metoclopramide, domperidone) can be used under conditions such as gastric distention, nausea, vomiting, regurgitation, and constipation. Prokinetic agents can also be used to facilitate passage of a feeding tube through the postpyloric region (106,112,113).

Oral hygiene performed at least twice daily using oral antiseptics such as chlorhexidine decreases the risk of pneumonia in stroke patients with an enteral feeding requirement. Bacterial contamination of aspirated saliva is important in respiratory tract infections associated with aspiration. Therefore, oral hygiene should be provided carefully in stroke patients (117,118).

Although no studies have been conducted on stroke patients investigating gastric residual volume (GRV), it has been shown in studies conducted in the ICU that there is no correlation between GRV and the incidence of pneumonia and aspiration. In addition, it is not recommended to perform GRV follow-up during routine practice because it causes interruption of enteral feeding, it prevents reaching protein and calorie goals, and it may lead to contamination of enteral products. GRV measurement is not valid in the presence of post-pylorically located enteral feeding tubes (119,120,121,122,123).

GRV follow-up is only performed in patients who cannot tolerate enteral nutrition, and have nausea, vomiting, distention, and decreased intestinal sounds.

*Continuous enteral nutrition is preferred in acute stroke patients who are followed up in the hospital. It is not recommended to routinely check GRV or initiate prokinetic agents. Oral hygiene decreases the risk of pneumonia and it should be performed twice daily.*

## 15. What are the complications of enteral nutrition in stroke patients, and how are they treated?

**Diarrhea:** This is defined as a daily number of defecations of more than three times with more than 250 mL volume. During enteral nutrition, it may arise due to bolus administration, rapid or high-dose infusion, the use of products with high osmolarities, cold solutions, bacterial contamination, gastrointestinal infection, and malabsorption. The first thing to do in the presence of diarrhea is to check the enteral nutrition scheme of the patient. Decreasing infusion rate, switching to products with lower osmolarity or products high in fiber are the first-step treatment options. Drugs that may cause diarrhea such as antibiotics, prokinetic agents, and antacids should be reviewed.

The presence of fecal incontinence should also be considered. Causes of infectious diarrhea should be ruled out by performing a fecal culture and direct microscopic examination. If there is a suspicion of malabsorption, the patient should be referred to the appropriate departments. If the problem persists despite these precautions, they should be switched to parenteral feeding.

**Nausea-vomiting:** If nausea and vomiting develop during enteral nutrition, first the infusion rate is decreased. Sedative drugs should be discontinued. Prokinetic agents may be used.

**Constipation:** Immobilization, pain and stress, previous abdominal surgery, accompanying systemic diseases such as diabetes and pancreatitis, drugs such as opioids, anticholinergics, erythromycin, and benzodiazepine may decrease gastrointestinal motility. It should be ensured that adequate hydration is preserved in constipated patients with nausea and vomiting. Products high in insoluble fiber content may be started. Discontinuation of drugs causing hypomotility, and dealing with problems of immobilization may solve the problem. If the condition continues, stool softeners or intestinal stimulants may be required. In resistant cases, mechanical and paralytic ileus should be ruled out. If intestinal passage cannot be provided enteral nutrition should be discontinued, and it should be switched to parenteral feeding.

**Refeeding syndrome:** This is observed when high-calorie nutrients are administered rapidly in patients who have been malnourished for a long-time. Refeeding syndrome presents with impaired consciousness, deteriorated medical status, or seizures. Signs of cardiac failure may develop. Hypophosphatemia, hypomagnesemia, hypokalemia, and fluid retention may develop. When refeeding syndrome develops, electrolyte deficiencies and circulation volume should be carefully corrected. Thiamin (50-250 mg) should be administered, especially during glucose infusion. Thiamin support may be required until the patient is stabilized. Intravenous replacement is performed with 40-80 mmol/day of phosphate, 8-16 mmol/day of magnesium, and 80-120 mmol/day of potassium. Diuretics should be used carefully because they may increase the intensity of hypokalemia. At most, 50-75% of the targeted calorie should be administered to patients who have developed refeeding syndrome. It is important to prevent this fatal complication in patients at risk of developing refeeding syndrome by starting enteral nutrition at very small amounts, and gradually increasing the volume (118,124,125,126).

Metabolic complications of feeding with NG tube, PEG, and enteral nutrition are given in Tables 2, 3, and 4.

### 16. How are oral drugs administered in patients fed by enteral route?

There may be problems in enterally fed patients who should receive oral drugs. Parenteral forms of drugs should be used in these patients, especially when they are hospitalized. Tablets are suspended in 30 mL of water after crushing. They are given through tubes using 50-cc syringes. If required, contents of capsulated drugs may be emptied in hot water and the granules should be given through PEG tubes. Oral drugs should never be added into the feeding bag. Crushed tablets or opened capsule contents may have physical and chemical interaction with the feeding tube wall and decrease the administered dose, so drug absorption may change. When slow-release forms are crushed, this characteristic is lost, and drug bolus is administered at high dose. Different drugs should not be mixed in the same syringe. Before and after drug administration with a syringe, the feeding tube should be washed with 15-50 cc of warm water. Thirty minutes before drug administration through a feeding tube, enteral feeding should be discontinued, and it should be re-started 30 minutes after drug administration (127,128,129,130,131,132,133).

Rules for administering some drugs that are commonly used in neurologic practice through enteral tubes are given in Annex 2.

### 17. How are enterally fed patients followed up?

Follow-up in the first week is especially important in patients who are fed enterally. Urine volume should always be surveyed. Close blood glucose follow-up is performed. Urea, creatinine, electrolytes and liver enzymes should be surveyed every day whereas, calcium, magnesium and phosphorus are monitored twice a week. Body weight should be checked at reasonable time intervals (106,114,115,116).

Dysphagia should be evaluated twice in the first week, once a week in weeks 1-4, in the first month after discharge, and 3-6 months after the first follow-up to test whether patients still require enteral nutrition because it may improve. Enteral tubes are withdrawn in patients with safe swallowing.

### 18. In which stroke patients should oral nutritional support products be used?

Oral nutritional support products are sterile compounds formulized as liquid, semisolid or powder forms, which are prepared to be given orally and include different amounts of micro and macronutrients. Studies have been conducted about their use in different clinical settings to support daily calorie and nutrient intake, and these studies highlighted positive effects in terms of functional (e.g., increased grasp strength), nutritional (e.g., weight gain, achieving daily protein and calorie targets), and clinical (e.g.,

| Table 2. Complications of nasogastric enteral feeding | |
|---|---|
| **Gastrointestinal (30-38%)** | **Mechanical (2-10%)** |
| Nausea-vomiting | Agitation, irritability |
| Esophageal reflux | Rhinitis, otitis, parotitis |
| Diarrhea | Epistaxis |
| Gastrointestinal bleeding | Nasopharyngitis, esophagitis |
| Abdominal cramps | Nasopharyngeal edema, ulcer |
| Abdominal distention and constipation | Malposition or displacement of tube |
| Perforation | Aspiration and edema |
| Malabsorption | Esophageal erosion and stricture |
| Elevated hepatic enzymes | Obstruction of tube |

| Table 3. Complications of percutaneous endoscopic gastrostomy | |
|---|---|
| **During the procedure** | **After the procedure** |
| During the procedure | Peristomal infection |
| Aspiration | Stomal leakage |
| Hemorrhage | Bumper embedding syndrome |
| Abdominal organ damage | Fistula tracts |
| Delayed ileus | Malposition or displacement of PEG |
| Cardiopulmonary complications associated with sedation | Gastric ulcer |
| PEG: Percutaneous endoscopic gastrostomy | |

| Table 4. The most common metabolic complications and their solution methods for enteral feeding | | |
|---|---|---|
| **Complication** | **Cause** | **Solution** |
| Hyponatremia | Excessive hydration | Change the product Restrict fluids |
| Hypernatremia | Inadequate fluid intake | Increase amount of free fluid |
| Dehydration | Diarrhea Inadequate fluid intake | Investigate causes of diarrhea Increase free fluid intake |
| Hyperglycemia | Excessive energy intake Inadequate insulin | Evaluate energy intake Adjust insulin dose |
| Hypokalemia | Refeeding syndrome Diarrhea | Potassium replacement Investigate causes of diarrhea |
| Hyperkalemia | Excessive potassium intake Renal failure | Change the product |
| Hypophosphatemia | Refeeding syndrome | Phosphate replacement Decrease administered calorie amount |
| Hyperphosphatemia | Renal failure | Change the product |

decrease in pressure ulcer incidence and mortality, shortening of hospitalization duration) endpoints, especially in geriatric individuals with malnutrition through the use of oral nutrition support products (134,135,136,137,138).

A limited number of studies have been conducted to investigate whether there are similar effects in stroke patients. The most important of these was a multicenter, randomized-controlled study named FOOD, which was performed on a total of 4023 patients (46). In this study, oral nutritional support was not shown to be significantly effective on mortality and functional outcome in stroke patients. This study had certain methodologic drawbacks in design, such as the evaluation of nutritional state only by clinical observation in 63% of patients, and underrepresentation of malnourished patients, constituting only 8% of the overall cohort. In this subset of patients with malnutrition, there was evidence for a non-significant decrease in mortality and functional dependency. Overall, taking into consideration other additional studies, which are very heterogeneous in terms of the products used and study design, various nutritional goals were attained by using oral nutritional support products, but no consistent clinical benefit was shown in stroke patients (15,16,46,139).

*Use of oral nutritional support products on a routine basis is not recommended in stroke patients. In stroke patients with malnutrition or risk of malnutrition where adequate protein and calorie requirements cannot be provided by normal nutritional schemes, oral nutritional support products can be initiated, if oral intake is safe. Oral nutritional support treatment may contribute to the improvement of nutritional parameters in this patient group. However, there is no consistent evidence indicating their positive effects on clinical endpoints.*

## 19. In which stroke patients should total parenteral nutrition (TPN) be administered?

There are no studies regarding the effects of TPN specifically in stroke patients; therefore, the use of TPN in these patients can be deduced in view of data obtained from other clinical settings. Parenteral nutritional is not clearly superior to enteral nutrition in terms of mortality, functional outcome, and length of hospitalization in patients with functional gastrointestinal tracts. It is not considered as the first-line nutritional treatment because of its possible complications and cost. Parenteral treatment is an option when enteral nutrition is contraindicated or treatment targets are not reached by enteral nutrition (140,141,142).

*Parenteral nutrition is not recommended routinely in stroke patients.*

*Parenteral nutrition should be considered only when oral or enteral nutritional treatments are contraindicated or these treatments cannot provide the required treatment targets.*

*If TPN has to be initiated, every measure should be taken to prevent treatment related complications, mainly hyperglycemia and infection, and nutritional support should be switched to oral or enteral regimens with the shortest time interval possible.*

A nutritional approach algorithm for stroke patients is given in Annex 3 together with three prescription examples regarding basic nutritional requirements (Annex 4).

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| Annex 1. Clinical swallowing assessment (Logemann) which can be used in stroke patients | | |
|---|---|---|
| **Clinical swallowing assessment** | | |
| | Safe | Not safe |
| **Medical history** | | |
|    1. Recurrent pneumonia | | |
|    2. Frequent high fever | | |
|    3. Aspiration pneumonia | | |
|    4. Long-term intubation (>1 week) or tracheotomy (>6 weeks) | | |
| **Cognitive condition** | | |
|    5. Alertness/awareness | | |
|    6. Cooperation/agitation | | |
|    7. Attention/communication level | | |
|    8. Awareness of swallowing problem | | |
|    9. Awareness of secretions | | |
|    10. Ability to manage secretions | | |
| **Major motor function** | | |
|    11. Postural control | | |
|    12. Fatigue | | |
| **Oral motor tests** | | |
|    13. Oral, pharyngeal, laryngeal anatomy and function | | |
|    14. Level of obeying orders | | |
|    15. Dysarthria | | |
|    16. Facial weakness | | |
|    17. Oral apraxia | | |
|    18. Oral sensation | | |
|    19. Pharyngeal wall contraction during gag reflex | | |
|    20. Ability to swallow saliva | | |
|    21. Voluntary coughing and throat cleaning | | |
| **Observations during swallowing trials (with 1 cc thin fluid, 1 cc pudding, a quarter biscuit)** | | |
|    22. Swallowing apraxia | | |
|    23. Oral residue | | |
|    24. Coughing and throat cleaning | | |
|    25. Delayed pharyngeal swallowing | | |
|    26. Decreased laryngeal elevation | | |
|    27. Wheezing voice | | |
|    28. More than one swallowing trial for one bolus | | |

| Annex 2. Important characteristics for some orally administered drugs in stroke patients with tube feeding | | |
|---|---|---|
| **Drug** | **Observation** | **Alternative** |
| **Atenolol** | Inadequate plasma concentration | IV esmolol |
| **Amiodarone** | Very low plasma concentration | IV amiodarone |
| **Carbamazepine** | Effective plasma concentration can be reached very late, or cannot be reached | Frequent serum level measurement |
| **Ciprofloxacin** | Plasma level cannot be estimated<br>Chelation with enteral product (27-67%) | IV ciprofloxacin<br>Twice the dose |
| **Quinapril** | Magnesium carbonate content increases pH, and destroys the drug | |
| **Lansoprazole, Omeprazole** | No stability of gastric acidity<br>Bioavailability decreased by 33-39% | Pantoprazole<br>+bicarbonate |
| IV: Intravenous | | |

| Drug | Observation |
|---|---|
| **Clopidogrel** | 300 mg loading given via NG tube provides more rapid and higher bioavailability than by oral route |
| **Amlodipine** | Since it is rapidly denatured after crushing and diluting, it should be administered rapidly |
| **Aspirin** | Although enteric tablets are crushed, they may not be completely absorbed in the stomach. No need for fear of gastric side effects |
| **Carbidopa +L-dopa** | Case reports indicating it is effective in the perioperative period |
| **Duloxetine** | Tablet dissolves when mixed with apple juice and it provides as much effective blood level as capsules |
| **Warfarin** | It sticks to the feeding tube, so 35% of the dose reaches stomach. Dose should be reduced when feeding is switched to oral route |
| **Dabigatran** | Cannot be placed down an enteral feeding tube |
| **Rivaroxaban** | May also be given to patients via feeding tube if the tube is placed within the stomach |
| **Apixaban** | Crushed forms suspended in distilled water can be administered via a feeding tube |
| **Epdantoin** | 89% is adsorbed. It should be well-diluted. It binds to proteins in nutritional products and calcium salts (±2 hours) |
| **L-dopa** | Its absorption decreases when protein amount increases above 1.4 g/kg/day. It is not administered by continuous infusion |
| NG: Nasogastric | |

Annex 3. Algorithm for the approach to patient with stroke in the acute    and chronic phases

```
┌─────────────────────────┐          ┌─────────────────────────┐
│  Acute stroke patient   │          │  Chronic stroke patient │
└─────────────────────────┘          └─────────────────────────┘
            │                                    │
            ▼                                    ▼
┌─────────────────────────┐          ┌─────────────────────────┐
│ Before oral food, drug  │─────────▶│ Malnutrition screening  │
│   and liquid intake     │          │ (MUST, MST, NRS-2002,   │
└─────────────────────────┘          │    SNAQ, MNA-SF)        │
            │                         └─────────────────────────┘
            │                            │                 │
            ▼                            ▼                 ▼
┌─────────────────────┐      ┌──────────────────┐  ┌──────────────────┐
│ Oral intake is      │      │ Malnutrition     │  │ No malnutrition  │
│ impossible because  │ NO   │ present          │  └──────────────────┘
│ of loss of          │────▶ └──────────────────┘
│ consciousness/      │          ┌─────────────────────────┐
│ cooperation and     │          │ Clinical swallow        │
│ severe aphasia      │          │ evaluation              │
└─────────────────────┘          │ Water swallow test      │
      │                          └─────────────────────────┘
      YES                            │              │
      ▼                              ▼              ▼
┌─────────────────────┐      ┌────────────┐  ┌──────────────┐
│ Oral hygiene        │      │ Dysphagic  │  │ Non-dysphagic│
│ control             │      └────────────┘  └──────────────┘
│ Enteral tube        │
│ feeding             │──▶ Advanced        Careful oral feeding
│ (Start within first │    dysphagia       Enriched diet
│ 48-72 hours)        │    evaluation      Oral supplements
└─────────────────────┘    FEES, VFS
      │
      ▼
┌─────────────────────┐    Dysphagia treatment restorative methods
│ If dysphagia lasts  │    (exercise, neuronal stimulation)
│ more than 4 weeks   │    compensation techniques
│ gastrostomy         │    (posture regulation, swallow maneuvers)
└─────────────────────┘    diet modification (enriched diet,
                           oral supplements, thickeners)
```

Re-evaluate 1-2 times weekly

┌─────────────────────────────────────────────┐
│        Nutritional follow up                 │
│        Anthropometric measures               │
└─────────────────────────────────────────────┘

MUST: Malnutrition Universal Screening Test, MST: Malnutrition Screening Tool, NRS-2002: Nutrition Risk Screen-2002, SNAQ: Short Nutrition Assessment Questionnaire, MNA-SF: Mini Nutrition Assessment-Short Form, VFS: Videofluoroscopy, FEES: Fiberoptic endoscopic evaluation

**Annex 4. Basic requirements in enteral nutrition**

Basic requirements in enteral nutrition

| Water 30 mL/kg | Energy 20-30 kcal/kg | Protein 1.0-1.5 gr/kg |

Initial infusion rate 20 mL/hour
Infusion rate is increased to 10-20 mL/hour at 8-12 hours interims it is expected to reach nutritional goals within 48-72 hours

Example
Male patient with ideal body weight 70 kg

| Requirements | 2100 cc water | 1750 kcal energy | 100 gr protein |

| Time | Infusion rate |
|------|---------------|
| 0-12. hour | 20 mL/hour |
| 12-24. hour | 30 mL/hour |
| 24-36. hour | 40 mL/hour |
| 36-48. hour | 50 mL/hour |
| 48-72. hour | 60 mL/hour |
| After 72 hours | 80 mL/hour |

| Alternative 1 | Content | | |
|---------------|---------|--------|---------|
| Product | Volume | Energy | Protein |
| Standard | 2000 cc | 2000 kcal | 80 gr |
| Total | 2000 cc | 2000 kcal | 80 gr |

| Alternative 2 | Content | | |
|---------------|---------|--------|---------|
| Product | Volume | Energy | Protein |
| High protein | 1000 cc | 1000 kcal | 60 gr |
| High energy | 500 cc | 750 kcal | 20 gr |
| Total | 1500 cc | 1750 kcal | 80 gr |

| Alternative 3 | Content | | |
|---------------|---------|--------|---------|
| Product | Volume | Energy | Protein |
| High protein | 1000 cc | 1000 kcal | 60 gr |
| Standard | 500 cc | 500 kcal | 20 gr |
| Fiber | 500 cc | 500 kcal | 20 gr |
| Total | 2000 cc | 2000 kcal | 100 gr |