

CHAPTER 2

LITERATURE REVIEW

DEFINITION

Stroke is defined as rapidly developed clinical signs of focal or global disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin.

Stroke is the most common serious neurological problem in the world, and in the United States it is second only to head trauma as the leading cause of neurological disability.

EPIDEMIOLOGY

The prevalence rate is 66 per 100,000 below the age of 45, 1,998 per 100,000 for these age 45 to 64, and 5,063 per 100,000 for these age 65 or over. The incidence rate is 100-250 per 100,000 and rises with increasing age. There is a doubling of incidence rate in each successive decade above the age of 55.⁽¹⁾ In Thailand, in the Siriraj Hospital study, the prevalence rate is 690 cases per 100,000 but the incidence rate has never been studied.^(2,3) About 936 stroke patients per year come to Siriraj Hospital. For Srinagarind Hospital, there are approximately 300 stroke patients per year, (70% due to thrombosis, 20% due to emboli, 10% due to hemorrhage).

DIAGNOSIS

The diagnosis of a stroke is based on history, physical examination, laboratory examination, lumbar puncture, CT scan, and MRI. A well-trained physician can usually differentiate a stroke from other processes on the basis of clinical features alone at least 80% of the time.

In 1984-1985, the Siriraj Stroke Score⁽⁴⁾ was developed to differentiate between cerebral infarction and cerebral hemorrhage. The Siriraj Stroke Score was based on 5 variables: consciousness, vomiting, headache, diastolic blood pressure, atheroma marker (History of diabetic mellitus, coronary heart disease, intermittent claudication)

Siriraj Stroke Score (SSS)

$$= (2.5 \times \text{score for consciousness}) + (2 \times \text{score for vomiting}) + (2 \times \text{score for headache}) + (0.1 \times \text{score for diastolic blood pressure}) - (3 \times \text{score for atheroma}) - 12$$

Consciousness : 0 = alert, 1 = drowsy or stupor,
2 = semicomatose or coma

Vomiting : 0 = no, 1 = yes

headache within two hours : 0 = no, 1 = yes

Atheroma marker : 0 = none, 1 = one or more

SSS > 1 : Cerebral hemorrhage

SSS < -1 : Cerebral infarction

-1 < SSS < 1 : CT scan for diagnosis

sensitivity for detection of cerebral hemorrhage = 89.3%

sensitivity for detection of cerebral infarction = 93.2%

overall accuracy = 90.3%

RISK FACTORS

1. Age

Age is one of the main risk factors for stroke. In most age groups, a stroke is as common in women as in men. A stroke is the major complication of atherosclerosis.

2. Hypertension

Hypertension is the greatest treatable risk factor for ischemic as well as hemorrhagic strokes. The risk is related to the level of blood pressure throughout its range: the incidence of stroke risk as blood pressure rises.

3. Cardiac disease

The ischemic coronary artery heart disease is the major risk factor however nonatherosclerotic heart disease is also an important cause. Coronary artery disease is the major cause of death among stroke survivors. The coexisting coronary artery disease is also a factor that may influence stroke rehabilitation by limiting the patient's level of participation.

The heart can serve as a source of emboli that subsequently travel to the brain. Most important thrombogenic heart disease is atrial fibrillation. The rheumatic heart disease or other valvular disease is also a frequent precursor.

4. Diabetic mellitus

The complication of diabetic mellitus is atherosclerosis. The diabetics develop stroke at an increased rate.

5. Previous stroke or transient ischemic attack (TIA.)

The stroke is itself a risk factor for another stroke.

The patients with prior stroke, TIA. are more likely to suffer further cerebrovascular disease.

The etiology of a stroke is based on 2 vascular systems that supply the brain; the carotid system and the vertebrobasilar system.

80% of strokes happen in the carotid distribution, with a hemiparesis ranging from mild weakness to complete paralysis of the limb on one side of the body, typically involving the face, arm or leg in any combination. There is often some degree of numbness or sensory loss in a similar distribution as the weakness. Aphasia, dysarthria, headache and visual field cut may also occur.

20% of strokes happen in the vertebrobasilar system. In a brain stem stroke, bilateral signs are frequently present and cranial nerve and cerebellar abnormalities are usually prominent. Brain stem strokes are often small and patients have an excellent prognosis for recovery. The large stroke is often fatal but most people who survive from brain stem strokes recover well, with little functional impairment. The prognosis for recovery from carotid strokes is highly variable and depends on many factors but, in general, is less complete than in brain stem stroke.

PATHOLOGY

Vascular disease of the brain takes four major forms; thrombotic, embolic, lacunar, and hemorrhagic.

1. Thrombotic stroke

Thrombotic stroke is the most common kind of stroke, accounting for about 40%. Thrombotic strokes are usually due to the atherosclerotic stenosis or occlusion of a large blood vessel. Thrombosis commonly occurs at night, therefore, the

patient who awakens in the morning with a new deficit has probably had a thrombotic stroke. Warning signs may precede the stroke, and as many as half of patients with thrombotic strokes report previous signs.

2. Embolic stroke

Emboli cause perhaps 30% of all strokes. Embolic strokes have a very abrupt onset. Most strokes occurring in the setting of myocardial infarction are the result of cardiac emboli.

3. Lacunar stroke

Lacunar strokes comprise approximately 20% of all stroke. These are very small infarctions, by most definitions less than one cubic centimeter in size. Infarctions are small and the prognosis is generally excellent, with about 85% of patients experiencing a very good recovery.

4. Hemorrhagic stroke

Intracerebral hemorrhage accounts for only 10% of all stroke. The onset is very sudden. The prognosis of a hemorrhagic stroke is very poor, with an initial mortality of 50% to 70% . If the patient does recover, the blood may be reabsorbed, leaving only mild deficits.

The most significant recovery occurs within three months following a thrombosis or embolus. The recovery of a hemorrhagic stroke patient may occur between 6 and 12 months.

CLINICAL FINDING

Paralysis and weakness

Paralysis and weakness is the most outstanding characteristic of stroke. Hemiplegia is the most common symptom. Paralysis and weakness may not be the most disabling factor to the stroke patients. The disability may depend on a wide variety of factors such as spasticity, incoordination, uninhibited reflex.

Spasticity

During the recovery phase, the limbs affected by the stroke progress from a state of flaccidity to spasticity as exhibited by increased deep tendon reflexes, clonus, and clasp-knife reaction to flexor and extensor synergies. Some spasticity may be useful to the patient, particularly for standing and walking. The spasticity will be treated if it produces an increase in disabling effects. Factors that enhance spasticity include the presence of contracture, anxiety, extremes of heat or cold, or any ordinarily painful condition, such as an ingrown toenail, an infection, or an decubitus ulcer. An attempt should be made to eliminate or diminish these factors before any pharmacological or surgical approach to treating the spasticity is tried.

Sensory deficit

The sensory deficit in stroke patients such as proprioception, tactile sensation, vibration, pain, and temperature. Some patients have good return of voluntary motor

functioning but that is not utilized by the patient because of the persistent sensory deficit.

In cortical sensory lesions impairing proprioception from the knee down, the lower extremity can function adequately with a gross motor pattern for walking. Useful distal function in the upper extremity require not only fine motor coordination for prehension but also sensory sophistication of a high order of complexity. Hence, when cortical proprioception is involved, there is a poorer prognosis for regaining useful function in the upper extremity than in the lower extremity.

Communication disorders

Communication may be affected by a language disorder, an impairment of speech production, or both. Language problem involves a set of symbols (words, letters, number, pictures, and gestures) and the rules for combining these symbols to express ideas. Speech problem involves the motor process necessary for saying words: respiration, phonation (voice production), resonance, articulation (formation of the vowels and consonants), and prosody (rate, rhythm, stress). The impairment communication is very frustrating to the stroke patient. The speech disorders evaluation and training help the patients and family better understand how to communicate.

Aphasia

Aphasia can be defined as an acquired impairment of verbal language behavior at the linguistic level caused by brain damage to the dominant cerebral hemisphere. It ordinarily affect all language area to some degree, such as understanding the speech of others, speaking, reading, writing

and arithmetic, but may involve principally verbal expression or principally comprehension. Aphasia is classified into : expressive aphasia (motor aphasia), receptive aphasia (sensory aphasia), mixed aphasia (global aphasia).

Dysarthria

Dysarthria is disorder of speech production that is associated with muscular weakness. Facial, pharyngeal, laryngeal muscle weakness can be a cause of slurred speech referred to as dysarthria.

Emotional response and psychological impairment

The patient with recent onset of stroke react to the newly acquired disability in a manner similar to those with other types of new disability. These reactions can usually be categorized in order of occurrence and frequency as denial, depression, anxiety, and hostility.

The hemiplegic patient must learn new way of doing many old, habitual activities, such as dressing. The patient's ability to achieve functional recovery depends on ability to learn new information and new behavior routines. The intellectual regression and behavioral changing effect to newly learning.

Left hemiplegia and right hemiplegia.

The right hemiplegic patient is unable to communicate effectively. Both vocabulary and auditory retention span are reduced. However, intact right hemisphere function such as visuomotor perception and visuomotor memory provide ways in which learning may proceed.

The left hemiplegic patient often demonstrates visuomotor perceptual impairment, loss of visual memory, and left-sided neglect. However, this patient may retain verbal influence, so that the deficit may not be readily apparent. Learning is impaired. The patient's performance may not improve despite repeated practice.

Pattern of recovery

In a typical classic stroke, the affected limbs are totally paralyzed. When accompanied by absence of tendon reflexes, the affected extremity is said to be flaccid. The deep tendon reflex, usually returns within 48 hours. Characteristically, there is a gradual continuous progression from flaccidity to spasticity to normal muscle tone, while complete motor paralysis resolves through synergy patterns to voluntary segmental movement; for example, a patient who attempts to flex his or her elbow will have movement at the shoulder, wrist, and possibly the fingers.

TREATMENT

Following a completed stroke, care of the patient should emphasize supportive treatment. Patients are generally admitted to the hospital following the acute event. Supportive treatment of vital functions is necessary if the patient is comatose or unstable. The patients should have bed rest to avoid postural hypotension, a condition that may aggravate their stroke. They should be allowed to ambulate early for active rehabilitation and prevention of complications. An antiplatelet agent will be recommended for patients. Surgical treatment will be carried out in the severe case.

Rehabilitation treatment

From various studies on the natural history of stroke patients, it has been observed that 10% experience an almost complete spontaneous recovery. Another 10% do not benefit from any form of treatment owing to the severity of disability. It is the remaining 80%, with significant neurological deficits who may benefit from rehabilitation.⁵

The stroke outcome is related to the cause of the stroke, its severity, and its location. The age of the patient, his or her motivation, the family and socioeconomic system, and the specific neurological deficits all affect the outcome of rehabilitation. Different aspects of physical therapy of importance include the timing (how soon after the stroke ?) type (activities of daily living, speech therapy, occupational therapy, interdisciplinary team approach versus individual therapy), duration, and intensity.

Selection of patients for rehabilitation

If the patient can comprehend either verbal or non verbal direction, can follow two-step or three-step commands, and can retain learned skills from one day to the next, he/she deserves an attempt at full rehabilitative training.

The patient who can not follow two-step or three-step commands will receive only prevention rehabilitation program (range of motion exercises, bed positioning).

Acute rehabilitative intervention

After the patient sustains a stroke, problems may occur due to immobility. The person who lives alone and, therefore, may not be discovered for several hours or even days following

an event, is particularly prone to development of pressure sores and joint stiffness. Bed positioning should be of concern. Positions of side lying should be changed approximately every 2 hours. Bed side physical therapy, range of motion exercises, should be started if the patient appears medically stable, at approximately 48 hours after stroke.

Full rehabilitation program

The major goal of rehabilitation is promoting ambulation and self care. The patients will compensate for physical deficit through rehabilitation.

The patients will be admitted into the hospital and will be managed by the rehabilitation team; physiatrist, nurse, physical therapist, occupational therapist, psychologist and social worker.

The full rehabilitation program is composed of exercise, ambulation, activities of daily living training, speech therapy, psychosocial and vocational support.

Exercise

The patients will receive exercise from physical therapy such as a range of motion exercises and strengthening exercises. Selection of the type of exercise depends on the muscle power of the patient.

- Muscle power grade 0 : passive range of motion exercise
- grade 1 : isometric exercise
- grade 2 : active assistive exercise
- grade 3 : active exercise
- grade 4 : strengthening exercise
- grade 5 : strengthening exercise

Ambulation

Ambulation often is any useful means of movement from one place to another. Toward independence ambulation the patients will be trained in bed mobility, sitting balance, transfer, standing and walking by a physical therapist.

Bed mobility

The patient can turn from side to side to prevent pressure sore. Independence is likewise enhanced by an activity to move between a recumbent and a sitting position. Sitting balance is required to accomplish many other activities of daily living including transfer.

The patient who has been left in the bed for a long time will develop postural hypotension. The transient hypotension due to the sudden change in posture may cause cerebrovascular insufficiency with transient vertigo.

Transfer

After the patient can getting out of bed, the patient will be taught to move between a wheelchair and bed, toilet or seat independently.

Multiple factors such as postural hypotension, limitation of joint motion, balance in sitting position influence a hemiplegic's ability to successfully complete an independent, safe transfer. Appropriate evaluation of the patient's abilities and correction of remediable deficit should be done prior to beginning or in the course of transfer training.

Standing and walking

For successful walking of patient. The patient first learn balance by holding onto a bar or other support while standing. When balance is beginning to be reliable, the patient learn to shift weight from one lower extremity to the other. When this procedure appears to be going well, with the hip, knee, and ankle stabilized actual walking at bar can begin, with the aim of developing an optimal reciprocal pattern of gait. After that the patient progress to use a tripod cane. When the patient doing well, the attempt can be made to use a single cane.

For walking, the patient with stroke should posses the following:

1. The ability to follow instructions, preferably three-step direction.
2. The ability to maintain standing balance, which can be evaluated when the patient is transferring.
3. The absence of contracture in hip and knee flexor and heel cord.
4. Adequate return of voluntary motor function to stabilize the hip, knee, and ankle on the involved side.
5. An intact sense of position in the involved lower extremity. This is not an absolute requisite because patient can learn to walk again by using the lower extremity in which sensory function is still intact.

Activities of daily living (ADL.)

Self care has been summarized by the term "activities of daily living" . Self care tasks are those daily and routine activities necessary for living. Included are those personal care activities appropriate to the age, gender, and

environment of each person, such as eating, grooming, bathing, use of the toilet, dressing. One-handed method is used for stroke patients. This technique will be taught by an occupational therapist.

Eating : The ability to present solid food and liquid to the mouth to chew and swallow are basic skills taken for granted by able-bodied people.

Grooming : The ability to make oneself attractive and presentable to one self and others such as brushing teeth, combing hair, applying make up.

Bathing : The ability to maintain cleanliness also has far-reaching psychosocial implications to prevent skin and systemic infection.

Toilet : The ability to manage bowel and bladder problem.

Dressing : The ability to dress for protection, warmth and self esteem.

Speech therapy

If some patients have speech problems such as aphasia, dysarthria, the speech therapist will evaluate and train them.

The treatment goal is to establish the most effective means of communication to the persons around them. Treatment task and goal depend on the nature and severity of the language or speech disorder and may vary from patient to patient. The following treatment approaches reflect a variety of techniques utilized by speech therapist in dealing with stroke patients at different severity levels.

Psychological support

A psychological problem such as denial, anxiety or depression will be supported by a psychologist. Treatment and support depend on nature and severity of problem. In mild cases respond to favorable rehabilitation process and in severe cases should receive appropriate psychiatric consultation, psychotherapy and drugs are recommended.

Social and vocational support

There has been a tendency in the past for patients who have complete stroke to be fit only for retirement. Recently, at the University of Minnesota⁽⁶⁾, only 53 percent of post rehabilitation stroke patients at all ages were unemployed at the time of follow up. Hence vocational rehabilitation replacement should be considered for all those patients with completed stroke who are under retirement age, if this is feasible.

COMPLICATION

In addition to contracture, spasticity, incoordination, and sensory impairment, the other complication such as shoulder subluxation, shoulder hand syndrome, deep vein thrombosis, heterotopic ossification, etc. is also the important complication.

Shoulder subluxation

Shoulder subluxation is a common problem. The diagnosis is clinical; there is a palpable gap between the acromion and

the humeral head on the affected side more apparent than that on the un affected. The exact cause of subluxation remains unknown; any change in the mechanical maintenance of glenohumeral joint stability may result in shoulder subluxation.

The shoulder sling is used to treated shoulder subluxation. There are many types of slings with no clear advantage to any type. Some patients, over time, will develop enough upper extremity tone that the head of the humerus will be pulled into the glenoid fossa when the patient stands and ambulates.

Shoulder hand syndrome

Shoulder hand syndrome or reflex sympathetic dystrophy of the upper extremity, is well recognized post stroke phenomenon. Clinical symptoms typically include painful active and passive range of motion, particularly abduction, flexion and external rotation at the shoulder with localized tenderness; severe pain on wrist extension accompanied by edema over carpals and tenderness to deep palpation; mild edema over metacarpal without tenderness; and moderate fusiform edema of digits with severe pain on passive flexion of metacarpophalangeal and proximal interphalangeal joints.

Treatment objectives are to decrease pain so that passive stretching may be accomplished. This should result in diminished pain and swelling. In severe case, a short course of oral steroids (prednisolone 30 mg/day) has been shown to be helpful combine with application of superficial heat or cold prior to passive stretching of the affected joints to increase pain tolerance. Sling or resting splints may be necessary. Patients may benefit from oral analgesic drugs such as aspirin or paracetamol. A transcutaneous electrical stimulation unit

may aid in pain management. Sympathetic blocks of the stellate ganglion or upper thoracic ganglion may be required for control of symptoms.

Heterotopic ossification

Heterotopic ossification is seen infrequently but may affect the elbow or the shoulder. It is characterized in early stages by pain, moderate swelling, local warmth, tenderness, and decreasing passive range of motion. Radiological examination in the early stage may reveal no abnormalities, but after several months it may show calcification. Treatment should be directed toward continued efforts at mobilization and modalities for local pain relief. Etidronate disodium may be helpful in preventing further ossification.

Deep venous thrombosis and pulmonary embolism

Deep venous thrombosis in the legs and the accompanying risk of pulmonary embolism is a well recognized complication of immobility. Clinically, the lower extremities must be examined daily for edema, discoloration, or pain on movement. Well fitting antiembolic stockings, early ambulation, and protection of the affected extremity, including proper positioning, should aid in prevention. Mini-dose heparin is advocated by many. Patients in whom deep venous thrombosis is clinically suspected should undergo full heparinization prior to either invasive or noninvasive diagnostic testing. The risk of pulmonary embolism following stroke is approximately 10% with deep venous thrombosis. After diagnosis, the patient should be placed at bed rest with the affected extremity elevated with warm compresses. All therapy to the extremity should be discontinued. After full heparinization, the patient

should be converted to oral anticoagulation prior to a return to full activities.

REVIEW OF THE RELATED LITERATURES

There were three controlled studies to support the hypothesis that rehabilitation programs may be effective for stroke patients. Smith et al. (1981)⁽⁷⁾ in a randomized controlled study of outpatient stroke rehabilitation, divided patients into 3 groups: Group 1 Intensive Program, in which care was provided 4 whole days per week, Group 2 Intermediate Program, in which care was provided 3 half days per week and Group 3, no routine rehabilitation treatment was provided but the patients were regularly visited at home. This study showed that the degree of improvement correlated strongly with the amount and intensity of therapy. This study design was a randomized controlled trial and the outcomes were measured by the activities of daily living (ADL) index. However randomization was not stratified. The prognostic factors of populations of both groups were not mentioned and might not be similar. This study did not mention how to control contamination, cointervention and compliance and there was no blind assessment. This study was not provided enough evidence to conclude that the degree of improvement correlates with the intensity of therapy.

Strand et al. (1985)⁽⁸⁾ study compared the clinical outcomes of patients in special stroke rehabilitation units with patients who received therapy in general medical wards. The results of the comparison confirmed that the ADL outcomes of the patients in a special stroke rehabilitation unit were better than these for the patients who received therapy on general medical ward. At both 3 or 12 months after stroke, the percentage of patients living at home was greater for the

group who were admitted into the stroke unit than for those treated in the general medical ward. However, differences in independence for ambulation were small ($0.10 > p > 0.05$). This study design was a controlled trial and the outcome assessment was mortality rate, need for hospitalization and functional assessment. However, there was no randomization so that there might have been selection bias. There was no blind assessment to eliminate measurement bias, no mention of how to control compliance of staff and patient and the population of both groups was not similar therefore this study was not good to conclude that special stroke rehabilitations unit are better than general medical wards.

Wade et al. (1985)⁽⁹⁾ noted that the functional recovery of stroke patients who received home care service was equal to patients who received hospital care, but statistical analysis, showed that the power of study was only 20%. The suggestion was that outpatient rehabilitation and home care were feasible alternatives to hospital rehabilitation. This study design was a controlled trial and the functional outcomes were assessed by Barthel Index. However the patients were not selected using a randomized method and there was no blind assessment. There might have been both selection bias and measurement bias. It was not concluded that home care service is equal to hospital care.

There are two randomized controlled studies to support the effectiveness of home care program in the myocardial infarction patient. Mather(1971)⁽¹⁰⁾ showed that patient with acute myocardial infarction, selected for the home treatment on the basis of suitable home and the absence of heart failure, showed no disadvantage compare with patients selected for hospital admission. This study design is a randomized control study. There were no significant difference between the two random groups with regard to any of the

characteristics recorded. The outcomes were measured by mortality rate. The difference in mortality between these groups was not significant however the power of study is only 20%.

Hill (1978)⁽¹¹⁾ showed that for patients with uncomplicated suspected myocardial infarction who had suitable home circumstances and continuity of general practitioner care, hospital admission did not confer any significant benefit. This study design was a randomized control study. The two random groups were similar. This study concluded that there was no significant difference in the 6 week mortality rate between the home group and the hospital group of patients with suspected myocardial infarction however the power of study was 1%.

The outcome of a conventional rehabilitation program in the hospital compared to a rehabilitation home program has never been evaluated. This study, a randomized controlled trial will attempt to show evidence for the decision to select proper treatment for each patient according to Thai culture.

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