IMPACT OF EARLY POST STROKE REHABILITATION PROGRAM ON NEUROLOGICAL AND FUNCTIONAL OUTCOME

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Abstract:

Stroke is a common cause of death and long-term disability with varied and unpredictable outcome if not managed rapidly and in correct manner, so it requires acute phase treatments with intensive rehabilitation therapy. Stroke rehabilitation is a complex process that aims to facilitation of adaptive learning to maximize the functional independence, effective rehabilitation interventions initiated early after stroke can enhance the recovery process and minimize functional disability which leads to higher quality of life and social productivity. Therefore, the **aim of the study** was to examine the impact of early post stroke rehabilitation program on neurological and functional outcome. **Patients and Methods:** Quasi-experimental research design was conducted in both neurology department (stroke unit) and outpatient department (neurology clinic) at Mansoura University Hospital. A purposive sample of 100 adult patients of both sexes with cerebrovascular stroke, who corresponded to inclusion criteria were assigned into two equal groups, early rehab (study) group and late rehab (control) group. **Results**: the results indicates, early post stroke rehabilitation program (after one week) enhances neurological and functional recovery, among early rehab group comparing to late rehab group. Close correlation between neurological and functional recovery. **Conclusion:** Early post stroke rehabilitation program have a significant positive impact on patient's neurological and functional recovery. In addition, neurological recovery significantly correlates to functional recovery.

Key words*:* Stroke, Early rehabilitation, Functional, Neurological outcome.

Introduction:

Stroke is a rapidly clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer, or leading to death, with no apparent cause other than of vascular origin [1], it considered to be one of the important global health problems as 15 million people worldwide suffer a stroke annually, of these, 5 million are left permanently disabled, placing a burden on family and community [2]. In Egypt, prevalence of stroke has been estimated to be 10.2/1000; with annual incidence was 2.1/1000/year [3].

The prognosis of stroke mainly depends on the incidence of complications; such patients are

often weak and susceptible to deterioration of existing disease or development of new illness, with resulting functional decline, high rates of rehospitalization, increased morbidity, and death. After stabilization of the patient's condition, secondary prevention measures to prevent long-term complications are begun, in addition to measures to provide rehabilitation [4, 5].

Rehabilitation is a process of re-education, to acquire a new skill or improve an existing skill, it involves a combined and coordinated use of medical, social, educational, and vocational measures for retraining individuals to reach their maximal physical, psychological, social, vocational, and a vocational potentials[6]. Previously it was thought that damage to the central nervous system was irreversible. Now, relearning can take place as soon as possible after injury when patients are medically stable [7].

Neural plasticity is believed to be the basis for both motor learning in the intact brain and relearning in the damaged brain that occurs through physical rehabilitation. Rehabilitation must be progressed at the same time with neural adaptation to promote motor control and skill improvement, taking into considerations sufficient training intensity, in which dose, frequency, and duration of training are important parameters [6], to help stroke patients to achieve better function before being referred to out-patient rehabilitation services for further independence [8].

Once a patient is medically stable, the focus of their recovery shifts to rehabilitation, to prevent secondary health complications, minimizing impairments, and achieving functional goals [9]. There is a growing literature on the benefits of early admission to rehabilitation, it also demonstrated a time dependent rehabilitation induced map reorganization following stroke, and noted that the brain appears to be "primed" to recover early following stroke and at this point rehabilitation therapies will be the most effective [10].

Aim of study:
The aim of the study was to examine the impact of early versus late post stroke rehabilitation program on neurological and functional outcome.

Research hypothesis:

The study hypotheses that, stroke patients attending stroke rehabilitation program early after one week exhibit better neurological and functional outcome, than those non attending

Operational definition

Neurological outcome

▪ Neurological improvement with favorable prognosis.

Functional outcome

▪ Mobilization and resumption of self care activities as early as possible.

▪ Recover patient's ability to perform ADLs.

▪ Learn compensatory strategies for residual deficits.

▪ Increasing dependence and return to the community.

Early rehabilitation

▪ Rehabilitation program applied after one week.

Subjects & Method

Study Design:

▪ Quasi-experimental research designs were used in this study.

Setting:

▪ The study was conducted in both neurology department (stroke unit) and outpatient department (neurology clinic) at Mansoura University Hospital.

Subjects

A purposive sample of 100 adult patients of both sexes with cerebral stroke admitted to neurology department were included in the study. A representative sample size was calculated using epidemiological information (EPI info.) program version 6.02 after taking into consideration the total number of cerebral stroke patients admitted to neurology department in mansoura university hospital (alpha error 5% (= confidence level=95%) Beta error 20% (=study power= 80%).

Sample Size = Z 2 * (p) * (1-p) C 2

Where: Z = Z value (e.g. 1.96 for 95% confidence level), p = percentage picking a choice, expressed as decimal, (.5 used for sample size needed), C = confidence interval, expressed as decimal (11)

The study subjects were divided randomly and assigned to two equal groups, early rehab group (receive rehabilitation after one week) and late rehab group (receive routine nursing care and late rehabilitation as prescribed by treating physician), 50 each.

Inclusion criteria:

Sample of either sex, aged from 20 to 60 years old, medically stable and fit for a rehabilitation program, have the ability to learn, willing to participate in the study, and newly admitted to stroke unit.

Exclusion criteria:

Patients with traumatic brain injury, chronic disabling pathologies ie, severe Parkinson's disease; polyneuropathy; severe cardiac, liver, or renal failure; and cancer, and unconscious patients were excluded from the study.

Tools:

The following tools were utilized to collect data pertinent to the study

Tool I: "Biosociodemographic data"

To collect date about patient's socio-demographic characteristics, present and past health history

Tool II: National Institute of Health Stroke Scale (NIHSS) [12]

NIHSS is a 15 item physical deficit rating instrument used to monitor neurological improvement or neurological worsening by assessing level of consciousness, gaze, visual fields, motor function of the face, upper extremity, and lower extremity, articulation, limb ataxia, sensory function, language, and the presence of neglect. The rating instrument shows excellent reproducibility and inters rater reliability (0.96).

Scoring system

Ratings for each item are scored with 3 to 5 grades with 0 as normal, 1-4 minor stroke, 5-15 moderate stroke, 16-20 moderate to severe Stroke and 21-42 severe stroke. Patients with a baseline NIHSS score of less than 5 generally have a favorable prognosis while those with scores more than 20 have a low likelihood of favorable outcomes. It strongly predicts outcomes and response to interventions, thus it has face validity (0.977).

Tool III: Barthel Index scale (BI) [13]

Used in scoring improvement during rehabilitation of patients with chronic neuromuscular or musculoskeletal disorders, it measures functional disability by quantifying patient performance in 10 activities of daily life. These activities can be grouped according to self-care (feeding, grooming, bathing, dressing, bowel and bladder care, and toilet use) and mobility (ambulation, transfers, and stair climbing). Validity was found to be between 0.73 and 0.77, and demonstrated high inter-rater reliability (0.95) and test–retest reliability (0.89) as well as high correlations (0.74–0.8)

Scoring system

Maximal score of 100 indicating that a patient is fully independent in physical functioning, and a lowest score of 0 representing a totally dependent bed-ridden state. Middle categories imply that the patient supplies over 50 per cent of the effort.

Methods:

▪ Permission to conduct the study was obtained from responsible authorities of the study area (Neurology Department of

Mansoura University Hospital) after clear explanation to the aim of the study.

- Human rights and ethical consideration, prior to the pilot of this study, and verbal consent approval was obtained from each participating patient and his/her family prior to inclusion into the study.
- Clarification of the nature and purpose of the study was done. The investigator emphasized participation is absolutely voluntary.
- Anonymity, privacy, safety and confidentiality were assured the right to withdraw from the study at any time.
- **Tool I** was developed by the researcher based on recent relevant literature review and reviewed by supervisors.
- **Tool II and Tool III** were adopted by researcher without any change in content based on recent relevant literature review
- Rehabilitation program for cerebral stroke patients was developed by the researcher based on recent relevant literature review and supplied by clear, descriptive pictures.
- Tools were reviewed by eight experts in the field and necessary modifications were done prior to data collection.
- Arabic form of rehabilitation program translated by the researcher using simple and

clear words for better understanding by the patients and their families.

- All tools were tested for content validity by 10 experts (Jury) in the field from faculty of nursing Alexandria and Mansoura University and medical specialists in neurology department Mansoura university hospital and the necessary modifications were done accordingly.
- A pilot study was conducted on 10 patients (10% of sample size) fulfilling the research criteria in order to assess the feasibility, content related validity, and applicability of the adapted tools. The needed correction, modification, omission, and addition were made.
- Data collection extended over a period of 14 month from 1/11/2012 to 31/12/2013
- The frame work of the study was carried out in **four phases: Assessment phase:**
- Patients who agreed to participate in the study and fulfilled the research criteria were included in the study, and divided into two groups the early rehab group (study) and late rehab group (control) using lots method

Early rehab group (study): they were consisted of 50 adult patients receiving their rehabilitation

program developed by the researcher after one week.

Late rehabilitation group (control): they were consisted of 50 adult patients receiving routine hospital care and late rehabilitation after discharge.

- For both groups necessary data will be collected by using the study tools

Data collection technique

For both groups

- The researcher performs an initial assessment of the baseline data at the first admission day using **Biosociodemographic data sheet (Tool 1).**

- **Neurological status** was assessed using National Institute of Health stroke scale (NIHSS) (Tool II)) at the first admission day, reassessment done after 1st and 3rd month

- **Functional status** was assessed using **Barthel index scale (BI) (Tool III)** at the first admission day and repeated every week (6th day) for the first three months

Planning phase

- Based on the finding of the assessment phase goals, priorities, and expected outcomes were formulated

- In this phase sessions were planned by researcher to provide the patient with:

- Health education regarding nature of disease, its causes,

risk factors, possible complications, recommended medication, importance of medication adherence, early possible complications, prevention, benefits of early stroke rehabilitation, rehabilitation plan, and importance of patient's role using developed booklet. It was distributed to the patients or family members.

a) Stroke patients received, through an individualized treatment plan, a minimum of 30 min per session, 2 to 3 cessions per day, 5 days per week based on individual needs and tolerance

b) The researcher prepared needed equipments and materials to complete work (sphygmomanometer, O2 saturation (pulse oxymetry), glucocheck apparatus, thermometer, tongue blade, penlight, cotton.......etc)

Goals:

The general objective of this program:

At the end of this program, patients receiving early rehabilitation after one week expected to exhibit neurological and functional improvement than those receiving late rehabilitation

Expected outcome

- Neurological improvement with favorable prognosis.
- Mobilization and resumption of self care activities as early as possible.
- Recover patient's ability to perform ADLs.
- Learn compensatory strategies for residual deficits.
- Increasing dependence and return to the community.

Implementation phase:

Early rehab group:

- In this phase through the first week of admission, information about the disease and benefits of early rehabilitation program were provided to patients if able and their families.
- Insure clarity of instruction by testing patient's and family's competency
- Rehabilitation program conducted by the researcher after one week post admission when the patient become stable (Stable vital signs for 24 hours, no chest pain within the previous 24 hours, no significant arrhythmia, no evidence of deep vein thrombosis (DVT)).

Range of motion exercises

- Range of Motion program performed every day 2 - 3 times a day according to patient tolerance, and for short periods of time. Exercises carried out by the researcher slowly and gently, 10 times on each joint.
- Learn patient to support and move the weak limbs with the strong one as far as possible
- Encouraged patients to use limb in functional tasks.

Skin care and positioning

Orientation:

- Explain each part (small parts) in rehabilitation program clearly for patient even with low concentration, and repeat it with each session.
- Orient patient to place, time, and persons frequently.
- Increase brain activity and concentration by participation on different activities
- Start open conversation with patient (one topic each time) and encourage conversation with others.
- Use pictures and ask patient to do as picture.

Vision:

- Facilitation exercise using the vestibulo-ocular reflex
- The researcher gave cues to patient to draw attention to the affected side

Walking:

- Weight bearing exercise including
  A. Modified squat exercise
  B. Step up exercise
  C. Heel lifting exercise
- Sit to stand exercise
- Assist patient for ambulation, taking into

considerations patient's balance in sitting and standing position.
- Help patient to get out from the bed gradually

Falls:
- Advice the patient about the impotence of exercises to enhance mobility, balance training, and increase habitual physical activity levels.
- Educate family members about hazards in the home, use of assistive devices, and good choices about footwear.

Occupational therapy
- Therapy putty
- Peg board
- Ring tree

Dysphagia:
- Dysphagia screening (50 ml water test)
- Shaker's exercise (head lift)
- Jaw press
- Resistance Head Nod
- Masako exercise
- Mendelsohn maneuver
- The researcher advise patient and caregiver about:
- Texture modification of solids and/or liquids (Semi solid food)
- Physical help and verbal encouragement to promote independent.
- Correct position

- Modification of diet consistency
- Regular mouth care

Aphasia:
- Use oral motor exercise
- Advice the patient to keep relaxed and speaking more slowly.
- Check patient understanding, repetition, use facial expression to convey meaning, encourage patient to point, draw or use gestures.
- Appropriate alternative communication strategies or aids.
- Encourage patient to engage in communication
- Ask patient to repeat wards many times.

Oral motor exercises.
The researcher ask patient to:
- Lips retraction
- Lips purse
- Lips puckering
- Lips retraction and protrusion
- Lip hold
- Forward tongue stretch
- Side to side tongue stretch
- Vertical tongue stretch
- Tongue in cheek push
- Jaw exercise (mouth opening)
- Side to side jaw movement
- Cheek cuff

Pain:
- Use of external upper limb support in setting and standing positions, and range of motion exercises.
- Avoid using the arms to pull patient up.

Bowel and Bladder control:

Bladder
- Contract pelvic muscles for 3 second and then relax for 3 seconds. Repeat this exercise 10 to 15 times per session at least 3 times a day
- Regular catheter care and advise patient and family about:
  - Importance of regular catheter care to prevent infection.
  - Correct position
  - Observe for any changes in color, amount and odor of urine.
- Using a catheter valve for a period of time prior to catheter removal

Bowel:
- Advice patient and caregiver about:
- Adequate intake of fluid, bulk, and fiber
- Establish a regular toileting schedule.
- Message abdomen

Deep Vein Thrombosis (DVT)
- Range of motion exercise and early ambulation to improve circulation.

- Anti-embolic stocking (compression stockings)

Breathing and coughing exercise, percussion and vibration.

Late rehab group:
- Patients receiving routine nursing care and late rehabilitation as advised by treating physicians.

Evaluation
Patients of both early rehab (study) and late rehab (control) groups were evaluated and assessed as follows:
1. Follow up through interview (outpatient clinic) and telephone calls were performed
2. Patient's neurological assessment were repeated after first and third month using Tool II to indicate the effect of early rehabilitation program
3. Patient's functional assessment were done every week (6th day) for three months using Tool II: to indicate the effect of early rehabilitation program

To test the effect of implementing early stroke rehabilitation program comparisons were done between studied groups regarding patient's neurological and functional outcome

Statistical analysis
After data were collected it was revised, coded and fed to statistical software SPSS version 16, followed

by tabulation and analysis. All statistical analysis was done using two tailed tests and alpha error of 0.05.

Results:

The findings of the present study will be presented in three parts which are:

- Socio-demographic characteristics of the studied groups
- Comparison between the studied groups according to their neurological status by the end of 1th and 3rd month
- Comparison between the studied groups according to their functional status through the study period
- Correlation between functional and neurological status.

Table 5.1: shows the distribution of studied subjects according to their socio-demographic characteristics. A total of 100 patients were enrolled in the study. The age of the studied subjects ranged from 20 to 60 years, the majority of patients in early rehab (study) group (72.0%) were more than 50 years compared to 64.0% of late rehab (control) group. The mean age was 52.8± 8.1 and 52.3 ± 8.1 (t = 0.35 (P=0.731)) for early and late rehab groups respectively.

Males were more in the studied subjects they constituted 58.0% of early rehab (study) and 54.0% of late rehab (control) group. As regards marital status, 60.0% of early rehab and 58.0% of late rehab group were married. Concerning level of education in this study, illiteracy was prevailing among 54.0% of early rehab and 68.0% for late rehab group

Table 5.1: Distribution of studied groups according to Socio-demographic characteristics (N=100)

Socio-demographic Data	Group				Test (P)
	Early rehab (study) (N = 50)		Late rehab (control) (N = 50)		
	No	%	No	%	
Age					$X^2 = 2.2$ (0.327*)
▪ < 40	5	10.0 %	3	6.0%	
▪ 40-50	9	18.0 %	15	30.0%	
▪ > 50	36	72.0 %	32	64.0%	
Mean ± SD	52.8 ± 8.1		52.3 ± 8.1		t = 0.35 (0.731)
Sex					$X^2 = 0.16$ (0.687)
▪ Male	29	58.0%	27	54.0%	
▪ Female	21	42.0%	23	46.0%	
Marital status					$X^2 = 6.0$ (0.049*^)
▪ Single	5	10.0%	0	0.0%	
▪ Married	30	60.0%	29	58.0%	
▪ Widow	15	30.0%	21	42.0%	
Education					$X^2 = 3.4$ (0.338^)
▪ **Illiterate**	27	54.0%	34	68.0%	
▪ **Primary**	4	8.0%	5	10.0%	
▪ **Secondary**	9	18.0%	4	8.0%	
▪ **Highly educated**	10	20.0%	7	14.0%	

X^2: Chi-square test   ^ P value based on Mont Carlo exact probability   * P < 0.05 (significant)

Table 5.2: shows the distribution of studied subjects according to their medical history. Concerning the past medical history, it was noted that about three fourth of early rehab group (76.0%) and late rehab group (74.0%) were not hospitalized. It was observed that 50.0% of the early rehab group and 36.0% of the late rehab group were smokers. The same table reveals that the majority of patients (46.0%) in early rehab group were extremely active, while the majority of late rehab group (48.0%) were moderately active.

The most common drugs consumed by the patients were antidiabetic (46.0% of study group and 76.05 of control group) and antihypertensive drugs (58.0% of study group and 90.0% of control group). For both study and control groups it is clear that the minority of them 28.0% and 40% using cardiac drugs.

Regarding present medical history, it was observed that the majority of early and late rehab groups (92.0% and 88.0% respectively) were ischemic stroke. The table also shows all studied subjects using Rt side as a dominant side, of them more than half in early and late rehab patients (58.0% and 60.0% respectively) are left side hemiplegia.

Table 5.2: Distribution of the studied groups according to their past medical history (N=100)

Past Medical History	Group				Test (P)
	Early rehab (study)		Late rehab (control)		
	No	%	No	%	
Previous Hospitalization					$X^2 = 0.05$ (0.817)
▪ Yes	12	24.0	13	26.0	
▪ No	38	76.0	37	74.0	
Smoking					$X^2 = 1.9$ (0.157)
▪ Yes	25	50.0	18	36.0	
▪ No	25	50.0	32	64.0	
Pre Stroke Activity					$X^2 = 11.1$ (0.011*^)
▪ Sedentary	3	6.0	0	0.0	
▪ Moderately active	13	26.0	24	48.0	
▪ Vigorously Active	11	22.0	15	30.0	
▪ Extremely active	23	46.0	11	22.0	
Medication					$X^2 = 9.5$ (0.002*)
▪ No	18	36.0	5	10.0	
▪ Yes	32	64.0	45	90.0	
Antidiabetic					$X^2 = 9.4$ (0.002*)
▪ No	27	54.0	12	24.0	
▪ Yes	23	46.0	38	76.0	
Antihypertensive					$X^2 = 10.2$ (0.001*)
▪ No	21	42.0	5	10.0	
▪ Yes	29	58.0	45	90.0	
Cardiac Drugs					$X^2 = 1.6$ (0.205)
▪ No	36	72.0	30	60.0	
▪ Yes	14	28.0	20	40.0	
Chronic diseases					$X^2 = 9.5$ (0.002*)
▪ No	18	36.0	5	10.0	
▪ Yes	32	64.0	45	90.0	

X^2: Chi-square test

^ P value based on Mont Carlo exact probability   t: independent samples t-test

Table 5.2: Distribution of the studied groups according to their present medical history (N=100) "cont"

Present medical history	Group				Test (P)
	Early rehab (study)		Late rehab (control)		
	No	%	No	%	
Diagnosis					X^2 =
▪ Ischemic	46	92.0	44	88.0	0.44
▪ Hemorrhagic	4	8.0	6	12.0	(0.505)
Affected Side					X^2 =
▪ Rt	21	42.0	20	40.0	0.04
▪ Lt	29	58.0	30	60.0	(0.839)
Dominant Side					
▪ Rt	50	100.0	50	100.0	NA

X^2: Chi-square test

^ P value based on Mont Carlo exact probability   t: independent samples t-test

Figure (5.1) and **(5.2):** Reflects a comparison between the studied groups according to their neurological status by the end of 1th and 3rd month. As regards neurological status among studied groups after one month, it can be observed from **figure (5.1)** that there was a high statistical significance difference between studied groups (P=0.000). Concerning neurological status among studied groups after three months, it can be observed from **figure (5.2)** that there was a high statistical significance difference regarding progress in patient's neurological condition (P=0.000)
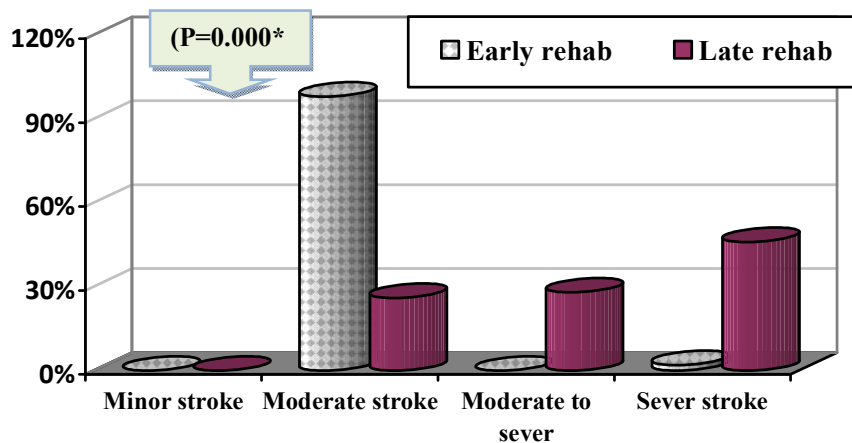

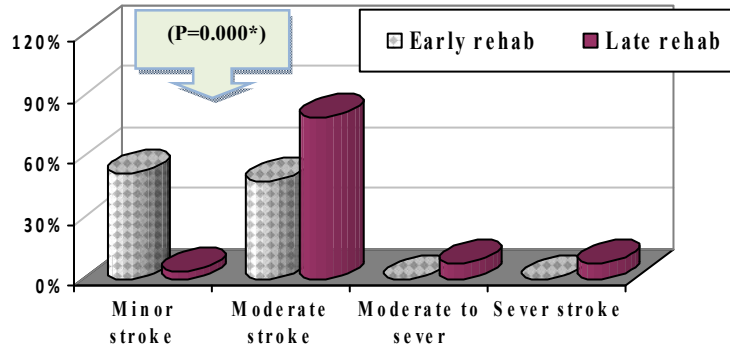**Figure (5.1):** Neurological Status among studied groups after one month

Figure (5.2): Neurological Status Among Studied Groups After Three Months

^ P value based on Mont Carlo exact probability (MCP)

Figure (5.3): reflect a comparison between the studied groups according to their functional status through the study period. As regards the difference of BI score, there was a high significant difference between them through the study period (P=0.000) with apparent increase in mean BI score in early rehab (study) (33.7±18.3) than late rehab (control) group (17.4±15.0) by the end

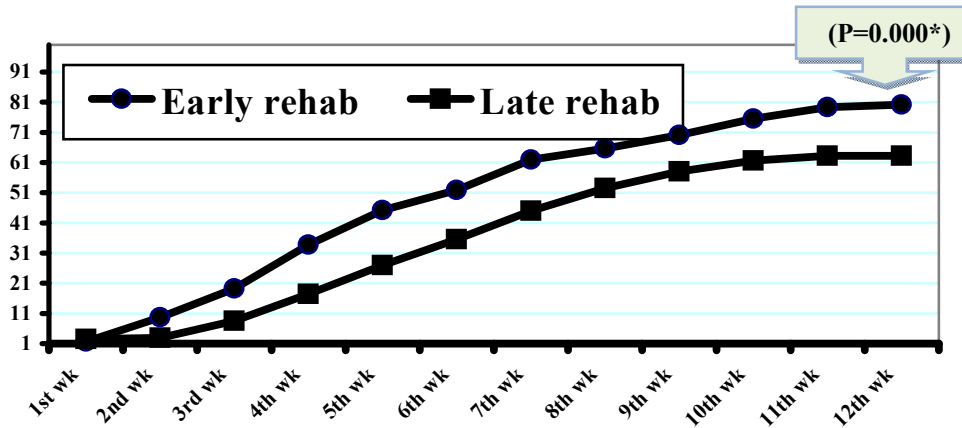**Figure (5.3):** the mean difference of BI score among the studied groups
X^2: Friedman test for related samples   P: p value based on Mann-Whitney test BI: Barthel Index Scale

Table 5.6: Demonstrates the Correlation between Neurological status (NIHSS) and Functional status (BI) from baseline to 3rd month. Concerning early rehab (study) group, the findings of the

present study revealed that there was a significant negative correlation between NIHSS and BI score by the end of the study (P=0.000). In relation to late rehab

(control), it is clear that there was a significant negative correlation between NIHSS and BI score by the end of the study (P=0.000)

Table 5.11: Correlation between Neurological assessment (NIHSS) and Functional assessment (BI) from baseline to 3rd month.

Group	NIHSS		BI. baseline	BI.Wk12
Early rehab (study)	NIHSS baseline	rho	-0.07	-0.47
		P	0.646	0.001*
	NIHSS 3rd month	rho		-0.49
		P		0.000*
Late rehab (control)	NIHSS baseline	rho	-0.54	-0.48
		P	0.000*	0.0000*
	NIHSS 3rd month	rho		-0.52
		P		0.0000*

rho: Spearman correlation coefficient   * P < 0.05 (significant)
NIHSS: Ntional Institute of Health Stroke Scale   BI: Barthel Index Scale

Interpretation of r:

Weak (0.1-0.24)   Intermediate (0.25-0.74)   Strong (0.75-0.99)

Discussion:

Stroke is considered to be a family illness as both patients and their families need information and support in physical and emotional terms. After stroke many patients will be left with persistent neurological deficits and various physical disabilities [14].

The term stroke rehabilitation refers to recovery efforts for any deficits resulting from a stroke, either caused by stroke, or its complications [15,] Fundamentally it is concerned with practicing activities, as this aids positive neuromuscular plasticity and recovery [15]. Initiation of appropriate interventions in appropriate time can make the difference between dependency and independency [16].

Therefore, the current study concentrated on the rehabilitation care for stroke patients, applied early after one week or delayed. Potential differences between studied groups were examined in terms of neurologicaland functional outcome.

The socio-demographic background of the present study showed that, the mean age of the study group was 52.8 ± 8.1 years, while the mean age of the control group was 52.3 ± 8.1 years. Males were more prevalent in the studied sample. The majority of patient in the early (study) and late rehab (control) groups were married. Illiteracy prevailed among the majority of the early and late rehab group. The majority of early and late rehab groups diagnosed as ischemic stroke. More than one half of the early (study) and late (control) rehab group present with left side hemiplegia. Among studied groups, the right side is a dominant side for all patients.

Regarding to age, stroke was found to be more common among those more than 50 years of age, in this respect *El-shamaa et al. (2011)*, found that the majority of stroke subjects were among the age group

of fifty to sixty years old [17]. The present study revealed that ischemic stroke is the most commonly founded diagnosis. These findings are in agreement with the findings of *Alan et al, (2013) and Khedr et al (2013*) who stated that, of all strokes, 87% are ischemic and 10% are intracerebral hemorrhagic strokes [2, 17].

The findings of the current study demonstrate that, neurological improvement increased significantly in the early rehab group. This may attributed to recovery mechanism of the brain through its neuroplasticity and compensation mechanism initiated early after a stroke.

These findings goes well together with *Roach et al, (2010*) who reported that, spontaneous recovery aiding in neurological recovery early in the post-stroke period, and if accompanied by effective stroke rehabilitation it results in optimal patient recovery [19]. *Gosney et al, 2012* reported that neurological recovery occurs fastest in the first 2 weeks [20]. According to *Murphy and Corbett, (2009*) they stated that stroke induces a process of neurogenesis and migration of immature neurons to areas of damage for a limited period after stroke [21]. *Noggle et al (2013) and Matsui et al (2010*) emphasize that cortical reorganization occurs with experience and training, patients given early rehab (5 to 14 days post-stroke) displayed increased dendritic branching of cortical neurons, whereas patients given delayed rehab (30 days post-stroke) exhibited little improvement [22, 23]. Contrary to the results of the current study *Umphred et al (2013*) expressed caution about training in the early post-stroke period, speculating that abnormal cardiovascular responses to exercise may impede perfusion of ischemic brain tissue during the period when cerebral auto-regulation is most often impaired [24]

This study found that early stroke rehab improving balance, walking ability, and ability to perform ADL. This may

attributed to recruitment of new motor areas and repeated training increase the area of motor cortex that controls the used muscles. **Carey (2012**) proposed that, if rehabilitative intervention is delayed for several weeks after a stroke, activation of mechanisms underlying brain plasticity, brain reorganization, and recovery are severely reduced [25].

These findings in agreement with the findings of *Matsui et al (2010*) who reported that training initiated early between the first week to the first month after onset of injury have been found to induce robust restructuring in the brain, improving motor function and enhancing dendritic growth [23]. Results by **Gosney et al (2012**) who documented that repeated participation in active physical therapeutic programs influences functional reorganization in the brain [20]. Also study by **Roach et al, (2010**) found that Passive daily range of motion exercises are of clinical importance as prolonged immobilization leads to "learned non-use" [19]. **Carey (2012) and Lee et al (2012**), suggests that the majority of functional recovery occurs between first week to first month after onset [25, 26].

Concerning to correlation of neurological recovery to functional recovery the present study revealed that there was a significant negative correlation between neurological and functional recovery. This finding was congruent with **Carey (2012**) who found that functions can be considered in relation to the brain, behavior, performance, and participation of the individual. Neuroplasticity includes greater excitability and recruitment of intact neurons in both hemispheres of the brain as a response to stimulation, participation, training, and experience [25].

Conclusion:

The present study shows strong evidence that early post stroke rehabilitation program (after one week)

enhances neurological and functional outcome in the post-stroke period.

Recommendation

- Strongly recommend that starting rehabilitation program once the patient is medically stable based on comprehensive assessment.
- Post–stroke rehabilitation care should be provided in well organized environment and by interdisciplinary team.
- Using staged approach when caring for stroke patients, and progressively increasing activities according to their abilities.
- In-service educational program should be conducted for nurses regarding importance of rehabilitation for stroke patients at appropriate time, and precautions to be taken.
- Patient and caregiver should be educated about early rehabilitation for patients with stroke.

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