Efficacy of Telerehabilitation vs Standard Rehabilitation in Adult Ischemic Stroke Patients during COVID-19 Pandemic

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Abstract

Background and Purpose: The coronavirus disease 2019 (COVID-19) pandemic has been disrupting continuity of intermediate care in ischemic stroke patients. There are growing evidences published about telerehabilitation as a potential alternative to standard rehabilitation, especially during COVID-19 pandemic. We developed and assessed efficacy of an affordable telerehabilitation approach compared to standard rehabilitation.

Methods: In this non-randomized, open-label, controlled trial, we enrolled 67 ischemic stroke patients to receive either telerehabilitation or standard in-clinic rehabilitation. The primary analysis was designed to determine whether telerehabilitation was noninferior to in-clinic rehabilitation for the primary outcome of mean change in Barthel index from baseline to 3 months after rehabilitation.

Results: The primary outcome in the per-protocol population was the mean change of Barthel index from baseline to 3 months after rehabilitation, corresponding to 28.1 points (standard deviation, 21.3) in the telerehabilitation group and 25.3 points (standard deviation, 23.5) in the in-clinic group (between-group difference, 2.8 points; 95% confidence interval, -9.0 to 14.7; P=0.004 for non-inferiority). In the sensitivity analyses, the results were similar to those in the primary analysis. There were no significant differences shown in the analyses of secondary outcomes and safety outcomes.

Conclusion: Telerehabilitation was non-inferior to standard in-clinic rehabilitation in ischemic stroke patients with respect to the mean change in Barthel index after 3 months of rehabilitation.

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Introduction

Stroke is the second leading cause of death and third leading cause of disability-adjusted life years (DALYs)[1] with incidence of ischemic stroke of 142 cases per one hundred thousand person-years globally.[2] In Thailand, stroke is also the first leading cause of death and second leading cause of DALYs[3] with mortality rate of patients with ischemic stroke of 3.4 percent.[4] Thai Department of Medical Service in collaboration with Prasat Neurological Institute had issued Stroke Service Plan[4] and Intermediate Care Model for Elderly people of Thailand[5] in an effort to improve system and continuity of care in stroke patients, reducing its burden on Thai healthcare system.

The coronavirus disease 2019 (COVID-19) pandemic has been causing a diverse global impact. The workload of COVID-19 on healthcare workers and concerns over the highly contagious corona virus had caused inefficiency in the healthcare system, disrupted other patients including ischemic stroke patients from receiving proper rehabilitation care. Recommendations on rehabilitation during COVID-19 pandemic[6] were published encouraging revised triage, decrease in in-clinic rehabilitation, and introduction of telerehabilitation as means to reduce viral transmission. Although growing evidences of telerehabilitation including evidences related to motor power, speech, and language has been published,[7-10] sophisticated equipment might be hardly accessible in resource-limited settings.

This study aims to create a telerehabilitation method readily accessible in the context of developing countries and assess its efficacy relative to standard in-clinic rehabilitation.

Methods

Trial Design

The study was conducted as non-randomized, open-label, controlled trial enrolled patients admitted in Surin hospital from January 1, 2021 to February 27, 2021. The trial was approved by the ethics committee at Surin hospital.

Population

Adult patients aged at least 18 years with clinically stable ischemic stroke were screened according to eligibility criteria. Patients with Barthel index not more than 75 or more than 75 with multiple impairments were included in the study.[5] Patients who could not comply or contacted according to protocol, whose medical conditions or communication problems might interfere with rehabilitation, or who had depression were excluded from the study. The recruited patients were allocated into telerehabilitation group or in-clinic group and followed according to Figure 1. The baseline characteristics were collected as presented in Table 1.

Study Procedure

Patients and caregivers in the telerehabilitation group were given online rehabilitation demonstration videos adapted from Clinical Practice Guidelines for Stroke Rehabilitation[11] and asked to join an interactive Line group, allowing two-way communications and frequent monitoring of telerehabilitation. Patients in the in-clinic group were scheduled for standard rehabilitation in the hospital. After rehabilitation for 3 months, our team contacted patients in both groups and collected outcomes for analyses.

Outcomes

The primary outcome of the study was the mean change in Barthel index from baseline to 3 months after rehabilitation. Secondary outcomes were change in modified Rankin scale from baseline to 3 months after rehabilitation, proportion of patients with Barthel index less than 75 who might be dependent and equal or less than 50 who might need long term care,[5,12] and satisfaction score. Safety outcomes including death and major complications of stroke were collected.

Statistical Analysis

The primary outcome analysis was designed to test whether telerehabilitation approach was noninferior to in-clinic rehabilitation. Noninferiority would be shown if the lower limit of the 95% confidence interval for the between-group difference in the mean change of Barthel index was more than -15 (i.e., mean change of Barthel index in telerehabilitation group minus mean change of Barthel index in in-clinic group). A non-inferiority margin of 15 was considered acceptable as the minimal change in Barthel index that was clinically important.[13-15] The sample size of 49 patients was determined with 90% power to detect difference in Barthel index score of 15 with a two-sided alpha level of 0.05. To allow for attrition, we aimed to enroll at least 59 patients.

In the primary analysis, the primary outcome was analyzed using per-protocol analysis. The primary outcome was tested for normal distribution and the between-group difference was calculated using t-test without adjustment for covariates. Sensitivity analyses were also performed including multiple imputation of outcomes, worst case substitution of missing outcomes, and modified intention-to-treat analysis. Results for secondary outcomes and safety outcomes were reported with P values. All statistical analyses were performed with IBM SPSS software, version 22.

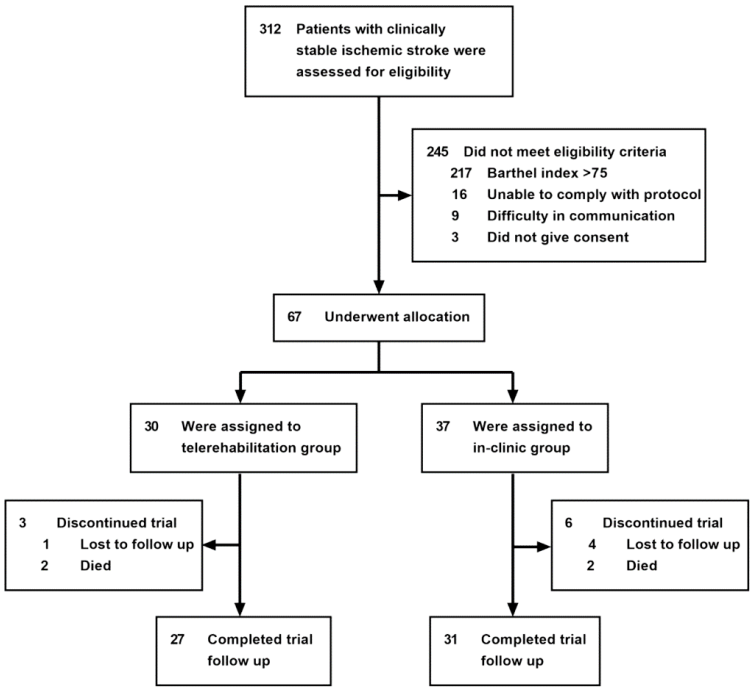


Figure 1. Flow diagram of study enrollment

Results

Patients

Of the 312 ischemic stroke patients screened, 245 (79%) were excluded. The most common reasons for exclusion were Barthel index >75, and unable to comply with protocol. Of the 67 patients enrolled, 30 were allocated to the telerehabilitation group and 37 to the in-clinic group. The mean (±SD) age was 69±11 years, and 34 patients (51%) were male. Hypertension was the most common risk factor (48%), followed by diabetes mellitus (19%), and dyslipidemia (16%). Small vessel occlusion was the most common stroke subtype (42%), followed by large-artery atherosclerosis (33%). The baseline median (IQR) NIHSS was 6 (4-11), median (IQR) Barthel index was 50 (25-70), and median (IQR) modified Rankin scale was 4 (4-5).

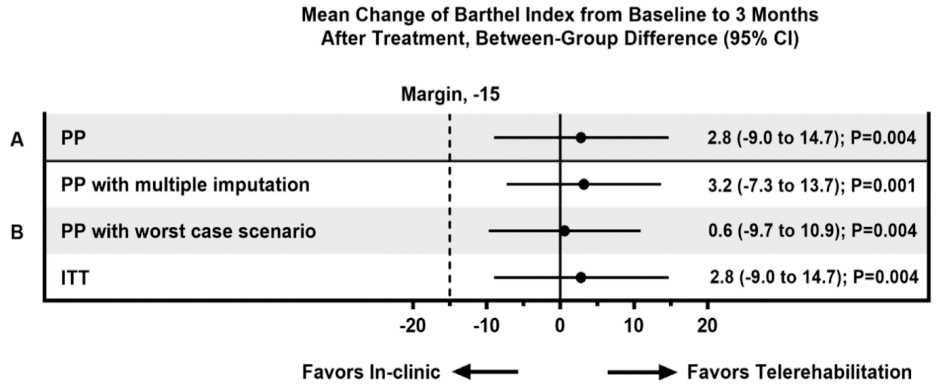
Table 1 Characteristics of patients

Characteristic	TR Group (n=30)	IC Group (n=37)	P Value
Male sex - No. (%)	12 (40%)	22 (59%)	0.113
Age - mean (SD), y	67.9 (12.3)	70.3 (9.6)	0.407
Risk factors - No. (%)			
Diabetes mellitus	5 (16%)	8 (22%)	0.610
Hypertension	15 (50%)	17 (46%)	0.741
Dyslipidemia	5 (17%)	6 (16%)	0.961
Atrial fibrillation	3 (10%)	7 (19%)	0.308
Smoking	2 (7%)	3 (8%)	0.823
NIHSS - median (IQR)	5 (4-8)	8 (4-12)	0.088
Stroke subtype - No. (%)			
Large-artery atherosclerosis	9 (30%)	13 (35%)	0.420
Cardioembolism	5 (17%)	11 (30%)	0.212
Small vessel occlusion	15 (50%)	13 (35%)	0.220
Other determined or undetermined	1 (3%)	0	0.263
Barthel index - median (IQR)	60 (45-70)	45 (20-70)	0.095
Modified Rankin scale - median (IQR)	4 (4-5)	4 (4-5)	0.911
Depression - No. (%)	0	0	

Abbreviations: TR, telerehabilitation; IC, in-clinic; NIHSS, national institutes of health stroke scale; IQR, interquartile range.

Primary Outcome

The primary outcome in the per-protocol population was the mean change of Barthel index from baseline to 3 months after treatment corresponding to 28.1 points (standard deviation, 21.3) in the telerehabilitation group and 25.3 points (standard deviation, 23.5) in the in-clinic group (between-group difference, 2.8 points; 95% confidence interval, -9.0 to 14.7; P=0.004 for non-inferiority). In the sensitivity analyses with multiple imputation, worst case scenario, and intention-to-treat, the results were similar to those in the primary analysis (Figure 2).



Abbreviations: PP, per-protocol; ITT, intention-to-treat.

Figure 2 Between-group difference in primary outcome of mean change of Barthel index from baseline to 3 months after treatment in the per-protocol population (A) with sensitivity analyses (B)

Secondary Outcomes and Safety Outcomes

The median change of modified Rankin scale from baseline to 3 months after rehabilitation in the telerehabilitation group was not significantly different from those in the in-clinic group (p=0.172). The proportion of patients who were dependent after 3 months of rehabilitation with Barthel index less than 75 and patients who may need long term care with Barthel index equal or less than 50 after 3 months of rehabilitation were not significantly different between group (p=0.176 and p=0.093, respectively). The satisfaction score in the telerehabilitation group was not significantly different from those in the in-clinic group (p=0.591).

The individual safety outcomes in the two groups are presented in Table 3. During the 3 months following, death occurred in 2 of 30 (7%) in the telerehabilitation group and 2 of 37 (5%) in the in-clinic group (p=0.828). The complications that occurred were not significantly different between groups.

Table 2 Secondary outcomes and safety outcomes

Secondary Outcomes	TR Group (n=27)	IC Group (n=31)	P Value
Modified Rankin scale at 3 month - median change (IQR)	-2 (-3 to -1)	-2 (-3 to 0)	0.172
Barthel index at 3 month <75 - No. (%)	6 (22%)	12 (39%)	0.176
Barthel index at 3 month ≤50 - No. (%)	3 (11%)	9 (29%)	0.093
Satisfaction score - median (IQR)	10 (9-10)	10 (8-10)	0.591
Safety Outcomes	**TR Group (n=30)**	**IC Group (n=37)**	**P Value**
Death - No. (%)	2 (7%)	2 (5%)	0.828
Complication - No. (%)			
Pneumonia	2 (7%)	3 (8%)	0.823
Urinary tract infection	1 (3%)	0	0.263
Bedsore	2 (7%)	1 (3%)	0.435
Gastrointestinal hemorrhage	0	0	
Frozen joint	1 (3%)	1 (3%)	0.880
Venous thromboembolism	0	0	
Fall	0	1 (3%)	0.364

Abbreviations: TR, telerehabilitation; IC, in-clinic; IQR, interquartile range.

Discussion

In this trial we created and evaluated the efficacy of a telerehabilitation approach for ischemic stroke patients in resource limited settings. The study met its primary objective of showing noninferiority of telerehabilitation methods, as compared to standard in-clinic rehabilitation, with respect to the between-group difference in mean change in Barthel index after 3 months of rehabilitation. In the analyses of secondary outcomes, there were no significant differences shown in the mean change of modified Rankin scale, the proportions of patients still left with significant disabilities, or patients' satisfaction. The safety outcomes including death and complications also did not show significant differences between groups.

The results of our trial were consistent with the previous studies of telerehabilitation in stroke patients. Although there were restricted timescale and limitations for conducting standard trials during COVID-19 pandemic, this study should appropriately provide moderate evidence for telerehabilitation in stroke patients using affordable methods as an alternative to in-clinic telerehabilitation, especially during COVID-19 pandemic. The study may also facilitate implementation of larger scale standard randomized controlled trials to assess efficacy of telerehabilitation as a potential alternative standard of care, continuing the pace of intermediate care in ischemic stroke patients in the emerging disease time and information age.

There are several limitations of our trial that should be noted. Non-randomized allocation may be subjected to bias. The open-label design may have introduced certain biases. The missing data were addressed using sensitivity analyses of outcome.

In conclusion, in ischemic stroke patients, telerehabilitation was non-inferior to standard in-clinic rehabilitation with respect to the mean change in Barthel index after 3 months of rehabilitation.

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