의학석사 학위논문

외과중환자의 중환자조기재활 후 지속적인 재활프로그램 적용 후 임상효과 전후비교

Impact of the implementation of continuous rehabilitation program in surgical intensive care unit patients after early rehabilitation

울산대학교 대학원

의학과

우다희

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이 논문을 의학석사학위 논문으로 제출함

2022년 2월

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Abstract

Objective: Early rehabilitation is an essential part of critical care nowadays. In order to maximize its effectiveness, we have implemented a continuous rehabilitation program since April 2020 at our tertiary referral center in which patients continue rehabilitation after ICU discharge. We aim to compare clinical outcomes after implementation of this continuous rehabilitation program in this study.

Methods: We retrospectively searched electronic medical records and analyzed the demographic data, rehabilitation records and clinical outcomes of patients admitted to ICU between April 2019 and March 2021 in Division of Trauma and Surgical Critical Care our center. Patients admitted to SICU between April 2019 and March 2020 were allocated as the pre-program group (n=127) and those admitted between April 2020 and March 2021 as the post-program group (n=143). Primary outcomes were defined as post ICU hospital stay, ICU readmission, and discharge route.

Results: In the per-protocol analysis, post ICU hospital stay was longer in pre-program (6 (3-21) vs. 3 (4-11), p=0.046) with higher ICU readmission rates (20.5% vs. 11.2%, p=0.036) but no difference in discharge route.

Conclusion: Implementation of continuous rehabilitation program in surgical intensive care unit patients led to shorter sub-ICU stay and lower ICU readmission rate.

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Introduction

Patients in intensive care unit (ICU) are at high risk of post-intensive care syndrome (PICS) and ICU acquired weakness which reduces quality of life and poses a challenge to returning to previous daily life. ICU acquired weakness (ICUAW) led to short-term functional disability and longer hospital stay[1]. Even after the critical illness has resolved and the patient was discharged from hospital, patients face decreased quality of life, reduced physical function, neurocognitive impairments, psychologic effects such as depression, anxiety and posttraumatic stress disorder[2-6]. As high as 80% of patients in ICU are reported to acquire neuromuscular dysfunction[7] and only one week of bed rest can result in up to 20% loss of muscle strength [8]. Many research papers have provided evidence that early rehabilitation is feasible and safe to be carried out in critically ill patients and there is also compiling evidence that early rehabilitation shortens ICU stay and ventilation usage and improves quality of life and muscle power in ICU patients[9-15]. Our goal is not merely keeping patients alive in the ICU; helping them return to daily life is an essential part of critical care nowadays and accordingly, Asan Medical Center provides a rehabilitation program for surgical intensive care unit (SICU) patients.

Our SICU is in charge of resuscitating unstable patients perioperatively, close monitoring of patients under surgical observation and timely decision making of surgical intervention. It follows the closed ICU model in which the patient is under full time care of the intensivist and ICU team perioperatively. Once the patient becomes stable enough to be discharged from ICU, patients either transfer to general ward or sub-ICU depending on their medical conditions. Sub-ICU at our hospital is a specialized hospital room in which close monitoring is possible for up to four patients. The patients are under continuous monitoring of a residing nurse and an on-duty doctor is available when attendance is needed any time of the day. It acts as a bridge for patients who need additional close monitoring after ICU discharge and before going to general ward.

At our SICU there are physical therapists responsible for carrying out rehabilitation programs. However, the program and physical therapist care was limited to SICU stay only and was discontinued after patients are transferred to sub-ICU or general ward. If patient needed additional rehabilitation after ICU discharge for reasons such as prolonged hospital stay and muscle wasting, the primary physician consulted the department of rehabilitation medicine. If the rehabilitation medicine doctors agreed that rehabilitation was necessary, then the patient could receive rehabilitation at the hospital rehabilitation center. However, there are limited resources in the center and the patient must wait for days or even weeks for available schedule. Zanni and colleagues have reported that a median of 56% [IQR, 25%-68%] of ICU patients were not able to receive rehabilitation due to lack of rehabilitation staff[11]. Rehabilitation was also limited to two or three days per week for most patients while the SICU early rehabilitation program was carried out at a daily basis. Moreover, the patient was also restricted from

using the rehabilitation center if contact, droplet or airborne precautions were required. According to a study on antibiotics resistant organism transmission in ICU, 21% of patients admitted to ICU were placed on contact precautions, leaving out many patients that could benefit from rehabilitation[16]. Especially with the breakout of Covid virus, our center is taking active measures to prevent its spread, including contact and airborne precaution of patients with possible symptoms of the virus or asymptomatic potential carriers. Such patients had rehabilitation schedules put on hold for a couple of weeks. Furthermore, although many studies have shown the safety of rehabilitation in patient on ventilator, such patients or those who have an oxygen demand higher than 5L/min are not eligible for our rehabilitation center due to lack of resources and safety protocols.

As mentioned above, there were many obstacles to receiving a continuous rehabilitation at Asan Medical Center. Needham and colleagues have recommended continued early rehabilitation and mobilization to inpatient outside ICU and outpatient settings to improve physical, cognitive, and mental health outcomes[17]. But because the numerous limitations kept many patients from continuing rehabilitation outside of SICU at out center, we have implemented a continuous rehabilitation program in which SICU patients continue rehabilitation in sub-ICU and general ward since April 2020. We allocated more rehabilitation staff in the sub-ICU and extended the SICU rehabilitation protocol to sub-ICU in order to start this pilot program. Data on rehabilitation after ICU care is sparse, and in this paper, we aim to share our experience with implementing a continuous rehabilitation in our center's sub-ICU. We have compared the clinical outcomes before and after the implementation but further research in this area is needed and we believe that our study can be a start point.

Methods

Study population

We retrospectively searched electronic medical records (EMR) and analyzed the demographic data, rehabilitation records and clinical outcomes of patients admitted to ICU between April 2019 and March 2021 in Division of Trauma and Surgical Critical Care at our tertiary referral center (figure 1). Patients admitted to SICU between April 2019 and March 2020 were allocated as the pre-program group (n=127) and those admitted between April 2020 and March 2021 as the post-program group (n=143). A total of 270 patients were included in the per protocol analysis. We compared the two groups to analyze the effects of implementing a continuous rehabilitation program in sub-ICU.

Outcome measures

Primary outcome was defined as post ICU hospital stay and secondary outcomes were ICU readmission and discharge route.

ICU and Sub-ICU rehabilitation program

Any patient whose SICU stay is longer than 3 days are candidates for early rehabilitation program which is divided into 6 steps and carried out according to each patient's physical ability (Figure 3). In step 1, passive joint movement and continuous passive movement machine was applied. If patient's mental was clear, step 2 which consisted of active joint movement, stretching and in-bed cycling was prescribed. If the patient was capable of head elevation greater than 60 degrees and an upper extremity Medical Research Council (MRC) motor grade equal to or greater than 3 (movement against gravity), the patient was prescribed step 3 rehabilitation in which the patient practiced sitting at edge of bed. Patients with lower extremity MRC equal to or greater than 3 moved on to stage 4 where standing and weight shift exercise was added. For patients who were capable of 1 minute standing and could be switched to portable oxygen device if there was need for any, the patient underwent stage 5 with walking in place or stage 6 with walking a distance greater than 10 meters. The rehabilitation lasted about 30 minutes every day from Monday through Friday except in cases of patient refusal or patient absence due to work up and treatment.

If any of the following adverse events occurred during rehabilitation, the patient took a rest and was re-evaluated 2 minutes later: respiratory rate greater than 35 per minute, cyanosis or oxygen saturation less than 90%, abnormal symptoms (dizziness, shakiness, cold sweats), heart rate increase of more than 30 beats per minute than baseline, removal of lines, catheters, cannulas, etc., and fall down or fractures. Rehabilitation was also discontinued if there was patient refusal or physician's decision to stop rehabilitation for any other reason. In such situations, rehabilitation was discontinued and the event was recorded in electronic medical record.

Prior to continuous rehabilitation program implementation, this one-on-one rehabilitation was carried out by SICU physical therapists in patients who stayed in the SICU longer than 3 days. We have adapted this same protocol to sub-ICU patients since April 2020 by a newly hired physical therapist in sub-ICU.

Statistical Analysis

Statistical analyses were done using SPSS version 18.0 (IBM Corp., Armonk, NY, USA). Chi squared tests or Fisher's exact tests were conducted for univariate analysis for categorical variables and results presented as number (%) with p-value. T-tests were done for continuous variables with an even distribution and results presented as mean ± standard deviation with p-value, and a Mann-Whitney test was done for continuous variables with an uneven distribution and results presented as median (IQR) with p-value. A p-value of <0.05 was considered significant. A multivariate analysis was done with Mann-whitney U test, Chi-square test or Fisher's exact test. Wilcoxon signed rank test was done to

compare the rehabilitation stage change before and after sub-ICU rehabilitation.

This study was approved by the Asan Medical Center Institutional Review Board. (IRB number: 2021-1230)

Results

Demographic and clinical profile of the study patients (Table 1)

There were no statistical differences in age (66.34±14.41 vs. 66.47±13.88, p=0.940) and sex (63.0% vs. 62.9%, p= 0.993) between the conventional and continuous rehabilitation group. There was however, difference in the route of ICU admission. There was a higher percentage of patients admitted to ICU from the emergency room (23.6% vs. 14.7%) or general ward / sub-ICU (29.8% vs. 17.5%) in the pre-program group while there was a higher percentage of patients admitted from the operation room (44.9% vs. 66.4%) in the post-program group. The two groups also differed in the cause of ICU admission. The pre-program group had a higher percentage of patients admitted for intensive care (47.2% vs. 29.4%) while the post-program group had higher percentage of patients admitted for emergency (35.4% vs. 46.2%) and elective (17.3% vs. 24.5%) operations. There were no statistically significant differences in APACHE IV (Acute Physiology And Chronic Health Evaluation IV) score (70.44 ± 20.12 vs. 65.81±19.14, p=0.054). There were also no differences in the percentage of patients who received an operation prior to or directly after ICU admission, continuous renal replacement therapy (CRRT) rates and extracorporeal membrane oxygenation (ECMO) rates.

O2 Delivery (Table 2)

Among our study population, 69.3% of the pre-program group and 60.1% of the post-program group required mechanical ventilation (MV) during ICU care. There were no statistical differences in the MV days of the two groups during their initial ICU stay (5 days [IQR, 0-21 days] vs. 3 days [IQR, 0-9 days], p=0.l44) as well as total MV days (6 days [IQR, 0-27 days] vs. 4 days [IQR, 0-15 days], p=0.102), which included MV days during subICU stay and ICU readmission. There were also no significant difference in reintubation rate (7.9% vs. 11.9%, p=0.272), high flow nasal cannula (HFNC) usage rate (35.4% vs. 36.4%, p=0.874), HFNC days during initial ICU stay (0 day [IQR 0-1 day] vs. 0 day [IQR 0-1 day], p=0.136) and total HFNC days (0 day [IQR 0-3 days] vs. 0 day [IQR 0-2 days], p=0.799). However, the pre-program group showed higher tracheostomy rate (34.6% vs. 21.0%, p=0.012). A subgroup analysis of the patients with tracheostomy was done to compare total tracheostomy days during initial ICU stay and post ICU stay (Table 3). There were no statistical differences in tracheostomy

cannula (T-can) days during initial ICU stay (34 days, [IQR, 19-70 days] vs. 32 days, [IQR, 18-57 days], p=0.178) and post ICU T-can days (8 days, [IQR, 3-32 days] vs. 8 days, [IQR, 1-20 days], p=0.090). T-cannula removal rates showed a similar rate of 70.5% vs. 70.0% (p=0.966) and those who were not able to remove their T-cannula were discharged with the cannula in place and planned for weaning after discharge.

Rehabilitation (Table 3)

The pre-program group had longer rehabilitation sessions both during the initial ICU stay (3 days [IQR, 0-8 days] vs. 1 day [IQR, 0-5 days], p=0.029) and total ICU stay (3 days [IQR, 0-9 days] vs. 2 days [IQR, 0-5 days], p=0.011). The pre-program did not receive continuous rehabilitation in sub-ICU and post program group receive sub-ICU rehabilitation for a mean of 2.39 days [IQR, 0-4 days] when the whole post-program group was included and a mean of 4.89 days [IQR, 2-6 days] from post-program group who actually received rehabilitation in sub-ICU.

Hospital stay and discharge route (Table 4 and 5)

We compared hospital stay of the two groups. First of all, both the initial ICU stay (6 days [IQR, 3-21 days] vs. 3 days [IQR 4-11], p=0.046) and total ICU stay (8 days [IQR, 3-26 days] vs. 5 days [IQR 3-15], p=0.021) was longer in the pre-program group. Pre-program group showed longer sub-ICU stay (4 days [IQR, 3-26 days] vs. 5 days [IQR 3-15], p=0.021). The hospital stay after first ICU discharge (18 days [IQR, 10-34 days] vs. 14 days [IQR 9-25], p=0.011) and sub-ICU discharge (4 days [IQR, 3-6 days] vs. 3 days [IQR 2-5], p=0.021) were also significantly different.

The pre-program group showed a higher rate of ICU readmission during the same hospital stay (20.5% vs. 11.2%, p=0.036). There were 51.2% of patients from pre-program group who were discharge to their homes and 62.2% from post-program group (p=0.67). The rest expired during the hospital stay or were transferred to another hospital either to continue treatment or on hopeless discharge. There was no meaningful difference in the in-hospital mortality of the two groups (5.5% vs. 2.1%, p=0.198).

Additionally, a multivariate analysis was done to eliminate the confounding effects of APACHE score and cause of ICU admission. First ICU stay and sub-ICU stay duration turned out to be shorter and ICU readmission rates lower in the post-program group. However, post ICU hospital stay and post sub-ICU hospital were statistically insignificant.

Rehabilitation in Sub-ICU

In our study population, there were 70 patients that received rehabilitation at sub-ICU. Among them, 27 patients were on ventilation or high flow nasal cannula and 8 were on contact precaution due to multidrug resistant antibiotics or Clostridium difficile.

We collected rehabilitation stage data of patients. Figure 2 shows the percentage of rehabilitation stages of the 70 patients. At the beginning of rehabilitation, patients at stages 1 from 6 were 4%, 10%, 20%, 46%, 17% and 3% respectively. At the end of rehabilitation, patients at stages 1 from 6 were 1%, 4%, 10%, 43%, 23% and 19% respectively. When we did a Wilcoxon signed rank test to compare the rehabilitation stage at start and at end, the p-value was 0.000.

Discussion

In our study, we have shown that a continuing rehabilitation after ICU discharge is feasible and leads to shorter sub-ICU stay and lower ICU readmission rates. There been a conceptual change in critical care to include not only resuscitation from critical state but also transforming ICU culture to encourage early mobility and restoring neuromuscular function and improving functional outcomes after recovery from critical illness. [18, 19] Our center is equipped with proper equipment, rehabilitation program and rehabilitation team which allows early rehabilitation in SICU patient. However, after discharge from ICU, the patient no longer receives rehabilitation due to lack of continuous rehabilitation program and rehabilitation team outside of SICU. A study revealed that in 55% of patients transferred out to general ward from ICU, activity level decreased on the first full ward day compared to their last full ICU day [20]. Another study showed that after transfer from ICU to general ward, it took on average 2.5 hours for patients to regain bed activity, 16 to regain chair activity, and 7 hours for to regain ambulation activity for patients whose highest level of activity in ICU was bed activity, chair activity and ambulation activity respectively[21]. We decided to experimentally implement a continuous rehabilitation system so that the same ICU rehabilitation program can be applied to patients directly after their discharge from ICU and admission to sub-ICU to bridge this gap.

Regarding demographic and clinical profiles of pre and post-program groups, there seemed to be a difference in baseline characteristics. There was a higher percentage of patients admitted for intensive care and thus admitted from the emergency room or general ward sub-ICU in the pre-program group while there was a higher percentage of patients admitted for emergency or elective surgery and thus admitted from the operation room in the post-program group. Second, when comparing the initial ICU stay of the two groups, pre-program group showed longer ICU stay (6 days [IQR, 3-21 days] vs. 3 days [IQR 4-11], p=0.046). These differences point to the heterogeneity of study groups and higher severity in the pre-program group. We tried to reduce the effects of the confounding factors by doing a multivariate analysis with clinical outcomes.

After the implementation of the program, more patients were given the chance to receive daily rehabilitation directly after ICU discharge. In the former rehabilitation system, consultation with rehabilitation medicine department could be sought after and it was possible to use the rehabilitation center but there existed many limitations due to limited slots and tighter exclusion criteria for eligible patients. In our study after implementation a pilot continuous rehabilitation program, 70 received sub-ICU rehabilitation and among them, a total of 31 patients who could not have received rehabilitation in the prior system received rehabilitation due the new system. This is especially important when considering that a large percentage of our patient population in sub-ICU are on ventilation or tracheostomy and/or require high oxygen flow as shown in table 2. There have been many post resuscitation patients that have been neglected and deprived of optimal rehabilitation to lack of resources in the past. But we have shown that our new program can be safely extended to patients with oxygen delivery devices and patients on contact, droplet or air precautions.

To our knowledge, this is the first analysis comparing continuous early rehabilitation in surgical patients, especially those who require higher level of monitoring than general ward setting after SICU discharge. In a randomized controlled trial by Wolfgang et al[23], 53 ICU survivors of ICU care received routine standard-care physical therapy during ICU and were allocated to earl-rehabilitation group (n=19) and standard-care group (n=27) after transfer to general ward. Both groups received daily rehabilitation but the early-rehabilitation group received an intensive and a holistic program. The early-rehabilitation group showed shorter hospital stay (median 14 days vs. 21 days) and 25% reduction in hospital costs. Another paper undertook a pilot study with 8 control subjects with standard rehabilitation only and 8 intervention patients receiving enhanced rehabilitation after general ward transfer from ICU but the results were inconclusive due to small sample number [24]. Our study is unique because we focused on perioperative patients or patients under surgical observation. And we also differed from the aforementioned papers in the setting of sub-ICU. We included patients that needed continued intensive care after ICU discharge and might benefit more from continuous, personalized and intensive rehabilitation. The results of our paper are valuable in providing evidence that continuing rehabilitation reduced sub-ICU stay and ICU readmission rate in patients that needed close observation even after ICU discharge. Our program can furthermore be used as a model for a safe and feasible continuous rehabilitation program in other centers.

Our study aimed to compare the clinical outcomes before and after a new program was implemented as a whole, rather than focusing on the individual rehabilitation intervention. Thus, there were both patients that received early rehabilitation in the ICU and those that did not and also those that receive continuous rehabilitation in the sub-ICU in the post-program group and those that did not. This could have masked the effects of continuous rehabilitation on patient groups that benefited from the intervention. More

research is needed to define effects of rehabilitation and select patients that can benefit the most from it.

There were some limitations to this study. First, this was a retrospective and non-randomized design with its inherent limitations. Second, the patient population was heterogenous. It included both postoperative and non-operative patients, those in need of resuscitation and those in need of close observation only, those that received rehabilitation in ICU and those that did not. To eliminate confounding factors, we have done a multivariate analysis but we will also need a larger study group for a reliable propensity score matching or a randomized controlled trial. Lastly, the study group constituted of patients from our single, academic, tertiary hospital. The patient clinical profiles, rehabilitation programs and disease entity may differ significantly from other hospitals. Many multicenter, randomized, prospective studies are needed to define the patient population that will benefit the most from early rehabilitation as well as the optimal time and regimen of rehabilitation before we can systemize an effective continuous rehabilitation program in critically ill patients. Connolly and his colleagues have tried to find out patients that need rehabilitation after recovering from critical illness by reviewing rehabilitation programs analyzing exercise capacity and physical function measurements. However, there were sparse data and lack of complete detail of rehabilitation program and no conclusive results could be drawn[25]. We will also need longer periods of follow up to investigate long term effects of continuous rehabilitation.

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FIGURE LEGENDS

FIGURE 1. Study population

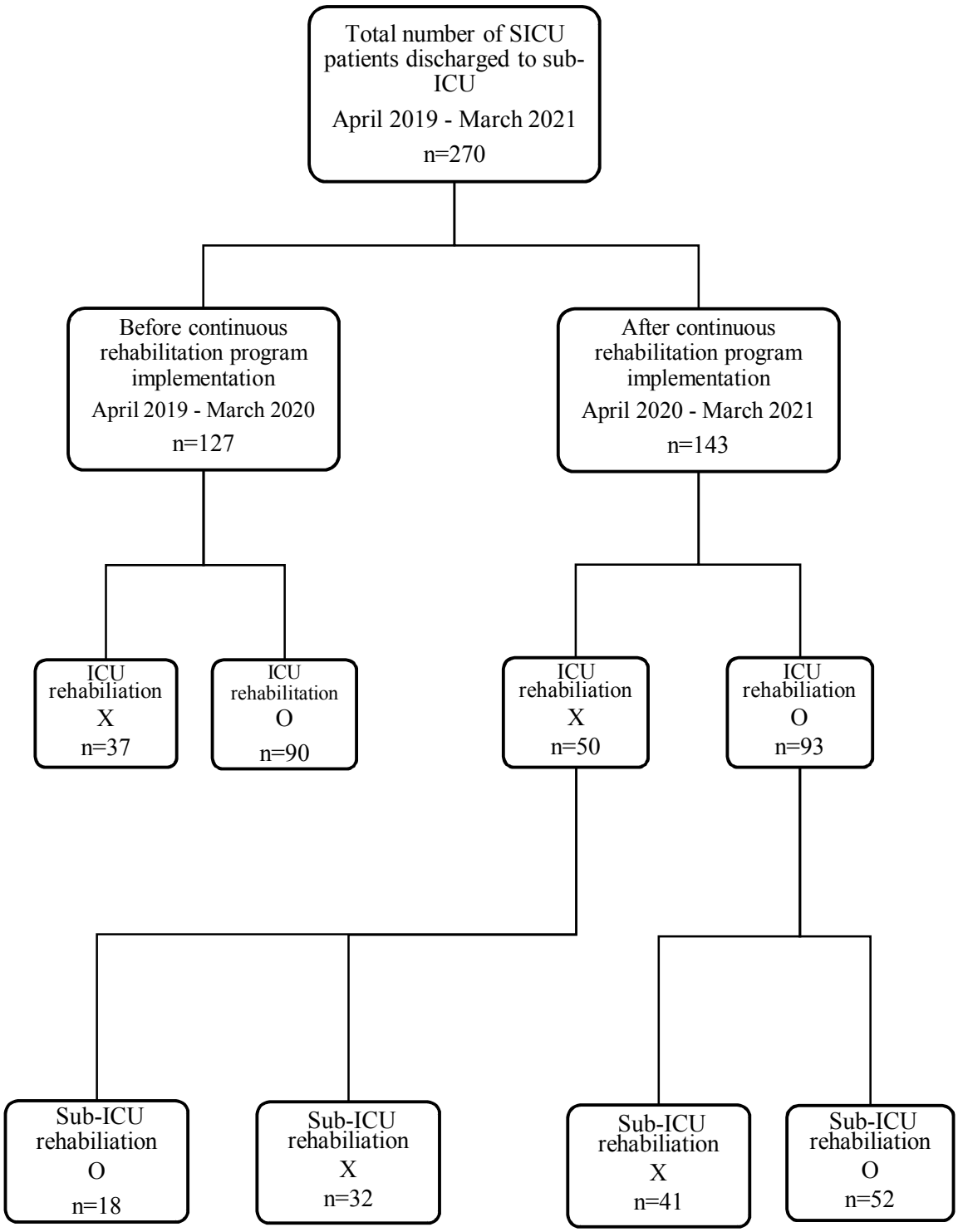

FIGURE 2. Rehabilitation stages in Sub-ICU

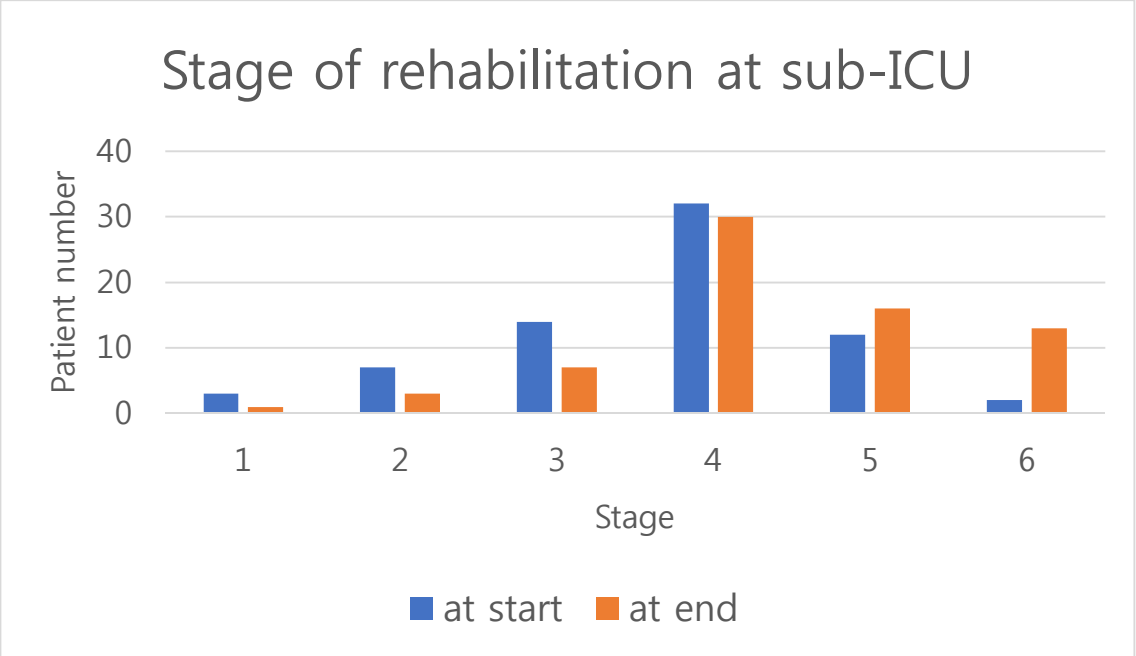

FIGURE 3. Rehabilitation Program

*sub-ICU; sub intensive care unit

*UE; upper extremity

*LE; lower extremity

*MRC; Medical Research Council

Early rehabiliation program in subICU

Rehabiliation						
Stage	**Stage 1:** **Passive joint movement**	**Stage 2:** **Active joint movement**	**Stage 3:** **Sitting at edge of bed**	**Stage 4:** **Standing**	**Stage 5:** **Walking in place (<10 meters)**	**Stage 6:** **Walking (>10 meters)**
Indication	SubICU stay > 1 day	SubICU stay > 1 day Mental clear Safety checklist pass	SubICU stay > 1 day Mental clear Safety checklist pass Head elevation > 60° UE MRC grade ≥ 3	SubICU stay > 1 day Mental clear Safety checklist pass Head elevation > 60° UE MRC grade ≥ 3 LE MRC grade ≥ 3	SubICU stay > 1 day Mental clear Safety checklist pass Head elevation > 60° UE MRC grade ≥ 3 LE MRC grade ≥ 3 1 minute standing Portable O2 device use is possible	SubICU stay > 1 day Mental clear Safety checklist pass Head elevation > 60° UE MRC grade ≥ 3 LE MRC grade ≥ 3 1 minute standing Portable O2 device use is possible
Program	• Passive joint movement • Position change • Continuous passive exercise machine (if mental is clear)	• Active joint movement • Chest expansion exercise • Muscle strengthening exercise • Torso stretching • Rubber ball squeezing • In-bed cycling	• Sitting at edge of bed • Head control, back straightening • Balancing with arms spread open • Thigh exercise • Rubber band pulling	• Muscle strengthening exercise (leg raise, hip riase, knee bending and standing) • Sitting to standing • Moving from bed to chair • Standing • Weight shift (left/right)	• Muscle strengthening exercise (leg raise, hip riase, knee bending and standing) • Squat (5 times/session) • Walk in place (<10 times)	• Muscle strengthening exercise (leg raise, hip riase, knee bending and standing) • Squat (5 times*3 cycles/session) • Walk in place (≥10 times) • Ward ambulation (≥10 meters)
Participants	Physical therapist, family	Physical therapist, subICU nurse, family	Physical therapist, subICU nurse, rehabilitation nurse specialist, family	Physical therapist, subICU nurse, rehabilitation nurse specialist, family	Physical therapist, subICU nurse, rehabilitation nurse specialist, family	Physical therapist, subICU nurse, rehabilitation nurse specialist, family

TABLE 1. Demographic and clinical profile of the study patients

Parameter	Pre-program group (n=127)	Post-program group (n=143)	p-value
Age	66.34±14.41	66.47±13.88	0.940
Sex			
Male	80 (63.0%)	90 (62.9%)	0.993
Route of ICU admission			
Emergency room	30 (23.6%)	21 (14.7%)	0.002
General ward/ sub-ICU	40 (31.5%)	27 (18.9%)	
Operation room	57 (44.9%)	95 (66.4%)	
Cause of ICU admission			
Emergency operation	45 (35.4%)	66 (46.2%)	0.012
Elective operation	22 (17.3%)	35 (24.5%)	
Intensive care	60 (47.2%)	42 (29.4%)	
APACHE IV	70.44 ± 20.12	65.81±19.14	0.054
Operation at ICU admission			
Yes	95 (74.8%)	118 (82.5%)	0.121
CRRT	16 (12.6%)	11 (7.7%)	0.180
ECMO	1 (0.8%)	2 (1.5%)	0.625

*ICU; intensive care unit

*APACHE; Acute Physiology And Chronic Health Evaluation

*CRRT; continuous renal replacement therapy

*ECMO; Extracorporeal membrane oxygenation

Values are presented as mean ± standard deviation or number (%).

TABLE 2. O2 Delivery in Sub ICU

Parameter	All group
MV usage (n=270)	43 (15.9%)
MV days (n=43)	6 (3-13)
Tracheostomy (n=270)	55 (20.4%)
T-cannula removal (n=55)	35 (63.6%)
HFNC usage (n=270)	81 (30%)
HFNC days (n=81)	2 (2-4)

*MV; Mechanical ventilation

*HFNC; High flow nasal cannula

Values are presented as number (%) or median (IQR).

TABLE 3. Rehabilitation

Parameter	Pre-program group (n=127)	Post-program group (n=143)	p-value
ICU rehabilitation days	3 (0-8)	1 (0-5)	0.029
Sub-ICU/GW rehabilitation days	N/A	0 (0-4)	

*ICU; intensive care unit

*GW; general ward

Values are presented as median (IQR).

TABLE 4. Clinical outcome

Parameter	Pre-program group (n=127)	Post-program group (n=143)	p-value
First ICU stay	6 (3-21)	3 (4-11)	0.046
Post ICU hospital stay	18 (10-34)	14 (9-25)	0.011
Sub-ICU stay	4 (3-6)	3 (2-5)	0.021
Post sub-ICU hospital stay	14 (6-29)	11 (6-21)	0.020
ICU readmission	26 (20.5%)	16 (11.2%)	0.036
Discharge route			0.127
Home	65 (51.2%)	90 (62.9%)	
Transfer (treatment)	49 (38.6%)	47 (32.9%)	
Transfer (hopeless)	6 (4.7%)	3 (2.1%)	
Death	7(5.5%)	3 (2.1%)	

*ICU; intensive care unit

Values are presented as number (%) or median (IQR).

TABLE 5. Clinical outcome (multivariate analysis)

Parameter	Pre-program group (n=127)	Post-program group (n=143)	p-value
First ICU stay	6 (3-21)	3 (4-11)	0.022
Post ICU hospital stay	18 (10-34)	14 (9-25)	0.055
Sub-ICU stay	4 (3-6)	3 (2-5)	0.011
Post sub-ICU hospital stay	14 (6-29)	11 (6-21)	0.115
ICU readmission	26 (20.5%)	16 (11.2%)	0.036
Discharge route			0.127
Home	65 (51.2%)	90 (62.9%)	
Transfer (treatment)	49 (38.6%)	47 (32.9%)	
Transfer (hopeless)	6 (4.7%)	3 (2.1%)	
Death	7(5.5%)	3 (2.1%)	

*ICU; intensive care unit

Values are presented as number (%) or median (IQR).

TABLE 6. Stages of rehabilitation at subICU

Rehabilitation stage	At start	At end	p-value
			0.000
1	3 (4.3%)	1 (1.4%)	
2	7 (10.0%)	3 (4.3%)	
3	14 (20.0%)	7 (10.0%)	
4	31 (44.3%)	30 (42.9%)	
5	12 (17.1%)	16 (22.9%)	
6	3 (4.3%)	13 (18.6%)	

Values are presented as number (%) or median (IQR).

국문요약

목적

최근에는 조기재활이 중환자치료의 중요한 일부분으로 여겨지고 있다. 조기재활의 효과를 극대화하기 위해 환자들이 외과계중환자실 퇴실 후 지속적인 조기재활을 시행할 수 있도록 서울아산병원에서 2020년 4월에 지속적인 재활 프로그램을 도입하였다. 본 연구에서는 지속적인 재활 프로그램 도입의 임상적인 효과를 알아보고자 하였다.

방법

2019년 4월부터 2021년 3월까지 중환자 외상외과 환자 중 중환자실에 입실한 환자를 대상으로 전자의무기록을 기반으로 인구학적 데이터, 재활기록, 그리고 임상적인 데이터를 후향적으로 수집하고 분석하였다. 2019년 4월부터 2020년 3월 사이에 서울아산병원 외과계 중환자실에 입실한 환자들은 프로그램 전그룹(n=127)에, 2020년 4월부터 2021년 3월 사이에 입실한 환자들은 프로그램 후그룹(n=143)에 배정을 하였다. 일차평가지표는 중환자실 퇴실 이후 재원일수였으며 이차평가지표는 중환자실 재입실률 그리고 퇴원경로로 정하였다.

결과

Per-protocol analysis에서 프로그램 전그룹에서 중환자실 퇴실 이후 재원일수가 유의미하게 길었고 (6 (3-21) vs. 3 (4-11), p=0.046) 재입실률이 낮았으며 (20.5% vs. 11.2%, p=0.036) 퇴실경로에는 차이가 없었다.

결론

외과계 중환자실 환자에게 지속적인 재활 프로그램을 적용하였을 때 집중치료실 재실기간 및 중환자실 재입실률이 유의미하게 낮았다.