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Assessment of the Implementation of Critical Pathway in Stroke Patients: A 10-years follow up study

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Objective
To evaluate the effects of the implementation of Critical Pathway (CP) in stroke patients for 10 years.

Methods
Data were collected from 960 patients who were diagnosed with stroke at the university hospital emergency room, who were transferred to the rehabilitation center after the acute phase and discharged after undergoing comprehensive rehabilitation. Based on data collected over a period of 10 years, changes in demographic and stroke characteristics, medical complications and functional status, and length of stay (LOS) were observed before and after CP implementation. As evaluation tools of functional status, the Modified Rankin Scale (mRS), the Korean Version of the Modified Barthel Index (K-MBI), and the Korean Mini-Mental State Examination (K-MMSE) were included.

Results
There was no significant difference in demographic and stroke characteristics between before and after CP implementation. For those with pre-existing medical conditions, there was no significant difference between before and after CP implementation, except for a significant decrease in cardiac arrhythmia (p=0.008) and dyslipidemia (p=0.001). The majority of complications was significantly decreased after implementation of CP (Table 1). Except for hemorrhagic stroke patients, Brunnstrom stage of ischemic and total stroke patients after CP implementation was statistically significantly increased in the upper proximal, upper distal and lower extremity and significantly higher scores for K-MMSE at transfer to rehabilitation center (Table 2). The LOS of total hospitalization and rehabilitation center hospitalizations was statistically significantly reduced in ischemic and total stroke patients (Table 3).

Conclusion
The implementation of CP allows better application of evidence and guideline-based key interventions and help to provide early, comprehensive, organized and more specialized

care to stroke patients. Despite limited evidence, CP is still recommended as a means of promoting best practice in hospital care for stroke patients. Future research on the effects of the implementation of CP in multiple institutions is needed.

Abstract Objective To evaluate the effects of the implementation of Critical Pathway (CP) in stroke patients for 10 years. Methods Data were collected from 960 patients who were diagnosed with stroke at the university hospital emergency room, who were transferred to the rehabilitation center after the acute phase and discharged after undergoing comprehensive rehabilitation. Based on data collected over a period of 10 years, changes in demographic and stroke characteristics, medical complications and functional status, and length of stay (LOS) were observed before and after CP implementation. As evaluation tools of functional status, the Modified Rankin Scale (mRS), the Korean Version of the Modified Barthel Index (K-MBI), and the Korean Mini-Mental State Examination (K-MMSE) were included. Results There was no significant difference in demographic and stroke characteristics between before and after CP implementation. For those with pre-existing medical conditions, there was no significant difference between before and after CP implementation, except for a significant decrease in cardiac arrhythmia (p=0.008) and dyslipidemia (p=0.001). The majority of complications was significantly decreased after implementation of CP (Table 1). Except for hemorrhagic stroke patients, Brunnstrom stage of ischemic and total stroke patients after CP implementation was statistically significantly increased in the upper proximal, upper distal and lower extremity and significantly higher scores for K-MMSE at transfer to rehabilitation center (Table 2). The LOS of total hospitalization and rehabilitation center hospitalizations was statistically significantly reduced in ischemic and total stroke patients (Table 3). Conclusion The implementation of CP allows better application of evidence and guideline-based key interventions and help to provide early, comprehensive, organized and more specialized care to stroke patients. Despite limited evidence, CP is still recommended as a means of promoting best practice in hospital care for stroke patients. Future research on the effects of the implementation of CP in multiple institutions is needed.

Table 1. Comparison of the number of stroke patients with medical complications before and after CP implementation

	Before (N=100)	After (N=860)	p-value
Post-stroke shoulder pain	78 (78.0%)	389 (45.2%)	0.000***
Dysphagia	66 (66.0%)	461 (53.6%)	0.024*
Post-stroke depression	46 (46.0%)	169 (19.7%)	0.000***
Foley catheter insertion	38 (38.0%)	192 (22.3%)	0.001**
Pneumonia	32 (32.0%)	82 (9.5%)	0.000***
Urinary tract infection	23 (23.0%)	80 (9.3%)	0.000***
Hydrocephalus	21 (21.0%)	51 (5.9%)	0.000***
Drug reaction	20 (20.0%)	74 (8.6%)	0.001**
Tracheostomy	20 (20.0%)	77 (9.0%)	0.001**
Stroke progression	19 (19.0%)	33 (3.8%)	0.000***
GI symptoms	17 (17.0%)	122 (14.2%)	0.544
Electrolyte abnormality	12 (12.0%)	17 (2.0%)	0.000***
Deep vein thrombosis	8 (8.0%)	27 (3.1%)	0.030*
Fall	8 (8.0%)	12 (1.4%)	0.000***
Post-stroke seizure	7 (7.0%)	13 (1.5%)	0.001**
PEG	5 (5.0%)	16 (1.9%)	0.095
Decubitus ulcer	3 (3.0%)	34 (4.0%)	0.846
Heterotopic ossification	2 (2.0%)	3 (0.3%)	0.151

Values are presented as number (%)

CP, critical pathway; COPD, chronic obstructive pulmonary disease; GI, gastrointestinal; PEG, percutaneous endoscopic gastrostomy

*p<0.05, **p<0.01, ***p<0.001

Table 2. Comparison of functional states at transfer to rehabilitation center and discharge before and after CP implementation

	Before	After	p-value
Total	(N=100)	(N=860)	
MRS	4.1 ± 1.0	4.0 ± 1.0	0.237
Br-stage UE proximal	3.4 ± 1.2	3.9 ± 1.2	0.000***
Br-stage UE distal	3.4 ± 1.3	3.8 ± 1.3	0.005**
Br-stage LE	3.4 ± 1.1	4.0 ± 1.1	0.000***
K-MBI (at transfer)	35.8 ± 23.3	36.2 ± 23.1	0.863
K-MBI (at discharge)	55.9 ± 28.8	57.6 ± 27.1	0.567
K-MBI gain[a]	20.2 ± 16.3	21.4 ± 17.7	0.510
K-MBI efficiency [b]	0.6 ± 0.7	0.6 ± 0.7	0.475
K-MMSE	15.2 ± 9.7	17.9 ± 9.4	0.009**
Infarction	(N=48)	(N=412)	
MRS	3.7 ± 1.0	3.6 ± 1.1	0.344
Br-stage UE proximal	3.2 ± 1.2	4.1 ± 1.1	0.000***
Br-stage UE distal	3.2 ± 1.3	3.9 ± 1.2	0.000***
Br-stage LE	3.2 ± 1.1	4.3 ± 1.0	0.000***
K-MBI (at transfer)	35.9 ± 23.0	40.8 ± 22.0	0.143
K-MBI (at discharge)	54.8 ± 28.3	61.0 ± 25.4	0.116
K-MBI gain[a]	18.9 ± 15.1	20.1 ± 16.2	0.615
K-MBI efficiency [b]	0.6 ± 0.9	0.8 ± 0.9	0.132
K-MMSE	16.0 ± 9.8	18.8 ± 9.5	0.055
Hemorrhage	(N=52)	(N=448)	
MRS	4.5 ± 0.7	4.4 ± 0.7	0.342
Br-stage UE proximal	3.5 ± 1.2	3.6 ± 1.3	0.467
Br-stage UE distal	3.5 ± 1.3	3.6 ± 1.3	0.769
Br-stage LE	3.6 ± 1.1	3.8 ± 1.2	0.270
K-MBI (at transfer)	35.7 ± 23.7	31.9 ± 23.2	0.142
K-MBI (at discharge)	57.0 ± 29.4	54.5 ± 28.2	0.066
K-MBI gain[a]	21.3 ± 17.4	22.6 ± 19.0	0.661
K-MBI efficiency [b]	0.6 ± 0.6	0.5 ± 0.5	0.320
K-MMSE	14.5 ± 9.5	17.0 ± 9.3	0.066

Values are presented as mean ± standard deviation.

CP, critical pathway; mRS, modified Rankin Scale; Br-stage, Brunnstrom stage; UE, upper extremity; LE, lower extremity; K-MBI, Korean version of Modified Barthel Index; K-MMSE, Korean Mini Mental state exam

[a]Function at discharge - function at rehabilitation start. [b]Gain/rehabilitation stays (days)

*p<0.05, **p<0.01, ***p<0.001

Table 3. Comparison of length of stay (LOS) before and after CP implementation

	Before	After	p-value
Total	(N=100)	(N=860)	
Time from stroke onset to RT start	19.9 ± 20.0	5.5 ± 8.9	0.000***
Time from onset to RH transfer day	42.4 ± 36.0	22.3 ± 15.5	0.000***
RH LOS	64.5 ± 62.6	45.9 ± 32.9	0.004**
Total LOS	84.3 ± 58.6	68.2 ± 42.7	0.009**
Infarction	(N=48)	(N=412)	
Time from stroke onset to RT start	11.2 ± 12.1	1.5 ± 0.9	0.000***
Time from onset to RH transfer day	31.0 ± 22.7	15.7 ± 10.2	0.000***
RH LOS	57.2 ± 43.4	32.3 ± 25.4	0.000***
Total LOS	85.9 ± 54.8	47.9 ± 30.5	0.000***
Hemorrhage	(N=52)	(N=448)	
Time from stroke onset to RT start	27.8 ± 22.5	9.2 ± 11.2	0.000***
Time from onset to RH transfer day	53.0 ± 42.5	28.4 ± 17.0	0.000***
RH LOS	71.2 ± 76.0	58.5 ± 34.1	0.236
Total LOS	82.8 ± 62.5	86.8 ± 43.9	0.652

Values are presented as mean±standard deviation (days).

CP, critical pathway; RT, rehabilitation therapy; RH, rehabilitation; LOS, length of stay

*p<0.05, **p<0.01, ***p<0.001