



Factors related to prognosis after rehabilitation for stroke following cardiac surgery



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Purpose

- This study aimed to investigate the factors related to stroke after cardiac surgery, and to investigate predictive factors for discharge in patients who were referred to the department of rehabilitation medicine.

Methods

Design

- Retrospective study
- From March 2018 to March 2023

Inclusion criteria

- Patients who had cardiac surgery and were transferred to the inpatient department of rehabilitation medicine
- Patients who had pre-existing acute stroke before surgery
- Patients who had not developed neurological disease other than stroke (ex. Spinal cord injury)

Clinical characteristics

- Age, Sex, BMI, past medical history (hypertension, diabetes, dyslipidemia, atrial fibrillation, previous stroke, chronic renal failure), smoking history, alcohol history, pre-operation ejection fracture, pre-operation laboratory findings (hemoglobin, creatinine, white blood cell (WBC), c-reactive protein (CRP)), operation factors (operation time, cardiopulmonary bypass usage), reason of transfer, presence of seizure event
- Discharge destination, length of stay at hospital and death

Functional evaluation

- The modified Barthel index (MBI), Functional ambulatory category (FAC) and manual muscle testing (MMT) at the time of transfer and at the time of discharge
- The MMT was evaluated using medical research council scale. The sum of MMT in bilateral shoulder, elbow, wrist, hip, knee and ankle was used .

Table 1. Clinical characteristics according to stroke

	With stroke	Without stroke	
	N = 55	N = 39	<i>p</i> -value
Age, year	66.9 ± 13.3	70.8 ± 9.4	0.122
Male, n (%)	33 (60.0 %)	23 (59.0%)	0.920
Body mass index	22.8 ± 3.8	22.4 ± 3.2	0.592
Past medical history, n (%)			
Hypertension	22 (40.0%)	20 (51.3%)	0.278
Diabetes	15 (27.3%)	13 (33.3%)	0.527
Dyslipidemia	6 (10.9%)	8 (20.5%)	0.198
Atrial fibrillation	25 (45.5%)	20 (51.3%)	0.577
Previous stroke	5 (9.1%)	4 (10.3%)	0.850
Chronic renal failure	4 (7.3%)	8 (20.5%)	0.058
Smoking, n (%)	19 (35.2%)	15 (38.5%)	0.746
Alcohol, n (%)	20 (37.0%)	14 (35.9%)	0.910
Preoperative ejection fraction (%)	57.2 ± 12.6	52.8 ± 15.6	0.147
Surgery type, n (%)			0.739
CABG	11 (20.0%)	6 (15.4%)	
Heart valve surgery	36 (65.5%)	24 (61.5%)	
Combined surgery	6 (10.9%)	7 (17.9%)	
Heart transplantation	2 (3.6%)	2 (5.1%)	
Operation factors			
Operation time, min	357.2 ± 200.7	372.4 ± 197.2	0.715
Cardiopulmonary bypass use, n (%)	44 (81.5%)	30 (76.9%)	0.591
Laboratory findings			
Hemoglobin, g/dL	12.1 ± 2.2	10.7 ± 2.1	0.004*
Creatinine, mg/dL	1.27 ± 0.95	1.84 ± 1.68	0.054
White blood cell, 10 ³ /uL	7.45 ± 3.29	8.46 ± 5.62	0.280
C-reactive protein, mg/dL	1.45 ± 3.30	3.15 ± 6.22	0.125
Seizure, n (%)	17 (30.9%)	5 (12.8%)	0.041*
Initial functional evaluation			
MBI (0-100)	23.9 ± 26.4	40.1 ± 24.3	0.004*
FAC (0-5)	1.22 ± 1.30	1.85 ± 1.23	0.021*
MMT sum (0-60)	43.1 ± 9.6	43.1 ± 7.23	0.979
Follow up functional evaluation			
MBI (0-100)	43.9 ± 30.1	53.0 ± 25.3	0.123
FAC (0-5)	2.15 ± 1.52	2.44 ± 1.19	0.322
MMT sum (0-60)	44.6 ± 11.3	45.0 ± 7.3	0.857
Home Discharge, n (%)	23 (41.8%)	21 (53.8%)	0.250
Length of hospital stay, days	80.0 ± 68.4	87.4 ± 46.7	0.562
Duration of rehabilitation, days	22.4 ± 6.7	19.4 ± 6.1	0.028*

CABG: carotid artery bypass graft; FAC: Functional Ambulatory Category; MBI: Modified Barthel Index; MMT: manual muscle test.

Results

- A total of 94 patients were enrolled, with 55 patients in stroke group and 39 patients in non-stroke group (Figure 1)
- Stroke patients exhibited lower initial MBI and FAC and underwent longer sessions of rehabilitation before discharge (Table 1)
- Analysis in terms of discharge location revealed that patients who discharged home had higher preoperative ejection fraction and higher MBI, FAC and the sum of MMT sum at the time of transfer and discharge (Table 2)
- Logistic regression analysis showed that initial MBI significantly predicted home discharge (Table 3)

Table 2. Clinical characteristics according to discharge destination

	Home discharge	Others	
	N = 44	N = 50	<i>p</i> -value
Age, year	69.3 ± 10.5	67.9 ± 13.1	0.563
Male, n (%)	22 (50.0%)	34 (68.0%)	0.076
Body mass index	23.2 ± 3.6	22.1 ± 3.5	0.120
Past medical history, n (%)			
Hypertension	19 (43.2%)	23 (46.0%)	0.784
Diabetes	12 (27.3%)	16 (32.0%)	0.617
Dyslipidemia	7 (15.9%)	7 (14.0%)	0.795
Atrial fibrillation	23 (52.3%)	22 (44.0%)	0.423
Previous stroke	3 (6.8%)	6 (12.0%)	0.394
Chronic renal failure	6 (13.6%)	6 (12.0%)	0.812
Smoking, n (%)	15 (34.1%)	19 (38.8%)	0.640
Alcohol, n (%)	14 (31.8%)	20 (40.8%)	0.368
Preoperative ejection fraction (%)	58.6 ± 10.9	52.4 ± 16.0	0.035*
Surgery type, n (%)			0.199
CABG	8 (18.2%)	9 (18.0%)	
Heart valve surgery	28 (63.6%)	32 (64.0%)	
Combined surgery	8 (18.2%)	5 (10.0%)	
Heart transplantation	0	4 (8.0%)	
Operation factors			
Operation time, min	350.3 ± 205.3	376.0 ± 192.9	0.535
Cardiopulmonary bypass use, n (%)	32 (72.7%)	42 (84.0%)	0.192
Laboratory findings			
Hemoglobin, g/dL	11.5 ± 2.1	11.5 ± 2.4	0.988
Creatinine, mg/dL	1.46 ± 1.53	1.55 ± 1.07	0.731
White blood cell, 10 ³ /uL	7.65 ± 3.82	8.06 ± 4.90	0.655
C-reactive protein, mg/dL	1.64 ± 3.62	2.61 ±5.60	0.328
Seizure, n (%)	7 (15.9%)	15 (30.0%)	0.107
Initial functional evaluation			
MBI (0-100)	44.0 ± 24.7	18.8 ± 22.5	< 0.001*
FAC (0-5)	1.98 ± 1.17	1.06 ± 1.27	0.001*
MMT sum (0-60)	45.6 ± 7.6	40.8 ± 9.0	0.007*
Follow up functional evaluation			
MBI (0-100)	63.1 ± 22.6	33.9 ± 26.1	< 0.001*
FAC (0-5)	2.86 ± 1.25	1.74 ± 1.31	< 0.001*
MMT sum (0-60)	48.2 ± 7.1	41.7 ± 10.8	0.001*
Stroke, n (%)	23 (52.3%)	32 (64.0%)	0.250
Length of hospital stay, days	60.8 ± 32.5	102.6 ± 71.5	< 0.001*
Duration of rehabilitation, days	19.6 ± 5.9	22.5 ± 6.9	0.030*

Table 3. Multivariate logistic regression analysis for home discharge

	B (SE)	Odds ratio	95% CI	p-value
<i>Patients (N = 94)</i>				
Initial MBI	0.04 (0.01)	1.04	1.01 – 1.06	0.001*
Length of hospital stay, days	-0.02 (0.01)	0.98	0.97 – 0.99	0.007*
<i>Patients with stroke (N = 55)</i>				
Initial MBI	0.06 (0.02)	1.06	1.02 – 1.11	0.004*
Preoperative ejection fraction	0.08 (0.05)	1.08	0.99 – 1.19	0.093

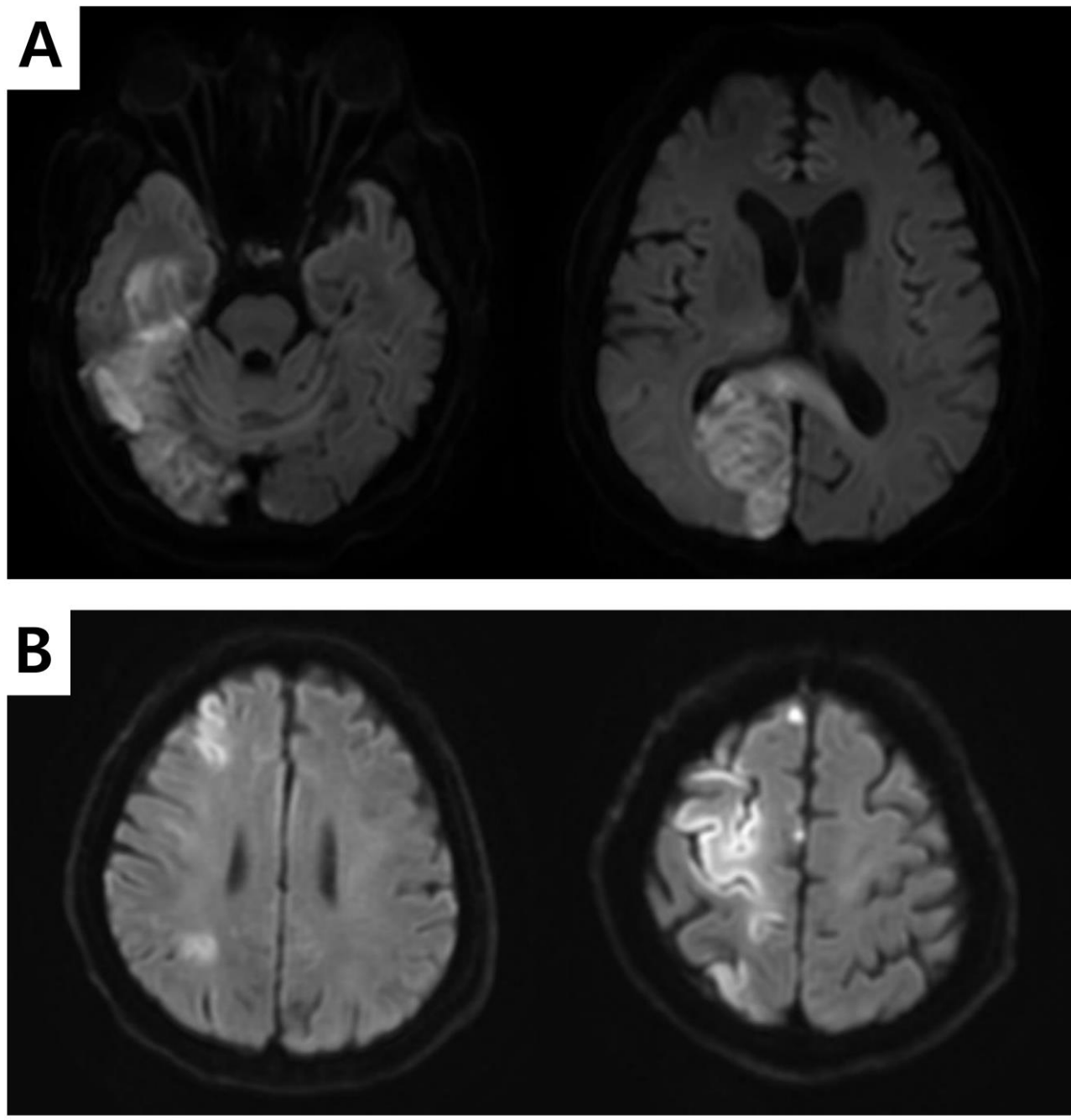


Figure 1. Brain magnetic resonance imaging of acute posterior circulation stroke (A) and acute borderzone stroke (B)

Conclusion

- The study showed that after undergoing cardiac surgery, patients with stroke exhibited pronounced initial functional impairment, but they also showed functional improvement after rehabilitation as those without stroke.
- Moreover, initial MBI at transfer was crucial in predicting home discharge.