

Incidence and Risk Factors of Medical Complications during Inpatient Stroke Rehabilitation

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Background: Knowing the types and frequency of medical complications of stroke patients during inpatient rehabilitation, together with the ability to identify high-risk patients, would be extremely helpful for providing the best possible physiologic environment for their recovery.

Methods: A retrospective study was conducted. Charts of 346 stroke patients who were consecutively admitted or transferred for inpatient rehabilitation in a tertiary care hospital from October 1997 to September 1998 were reviewed. Demographic and stroke characteristics, preexisting neuromedical conditions, neurological deficits, disability level, medical complications occurring during inpatient rehabilitation, and complications that required transfer off the rehabilitation ward were recorded for each patient. Univariate and stepwise multiple logistic regression analyses were performed to determine the factors that were significantly associated with the occurrence of any medical complication.

Results: Forty-four percent of patients experienced 1 or more complications. The most common complications were musculoskeletal pain (15.0%), urinary tract infection (13.6%), depression (9.3%), upper gastrointestinal tract bleeding (4.9%), and pneumonia (4.9%). Ten patients were transferred to the acute care ward during admission because of severe medical complications. Among them, 5 had a recurrent stroke, 3 had pneumonia, 1 had ventriculoperitoneal shunt obstruction, and 1 had organic psychosis. The occurrence of any of the medical complications was significantly associated with the following factors which were presented at admission or transfer to the rehabilitation ward: being female, having no voluntary movement of the affected hand, being more functionally dependent, and having to undergo Foley catheter insertion.

Conclusions: Medical complications were common among stroke patients undergoing inpatient rehabilitation. Prevention and proper management are also very important in the rehabilitation ward.

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Key words: medical complications, stroke, inpatient rehabilitation.

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Data from the Framingham study indicate that many comorbid medical diseases occur significantly more frequently among survivors of stroke than among matched controls.^(1,2) Medical complications are believed to be an important problem after acute stroke, and these complications present potential barriers to an optimal recovery.^(2,3) In addition, some patients need to be transferred back to an acute care setting, which interrupts the inpatient rehabilitation therapy and further increases the overall cost of stroke management.⁽⁴⁻¹¹⁾ The risk of mortality and institutionalization are significantly increased in patients suffering complications during rehabilitation.^(4,6,8)

The management of medical complications constitutes a prominent part of stroke inpatient rehabilitation. Knowing which complications often occur and identifying the clinical factors that are associated with an increased risk of experiencing these complications would be valuable in facilitating implementation of appropriate prevention and management interventions.⁽¹²⁻¹⁷⁾ The vast majority of current findings concerning medical complications during stroke inpatient rehabilitation are based on data collected in Western countries.^(6,8-14,16,17) Many aspects of Taiwan's health care system and clinical practice differ from those of Western countries. These differences might cause different presentations of complications among stroke patients in Taiwan compared with those in Western countries.

Our goal in this study was to examine the frequency and types of medical complications that occur during stroke inpatient rehabilitation. We also wanted to determine which complications result in transfer to an acute care facility and to identify which concurrent factors place stroke patients at increased risks for the occurrence of complications.

METHODS

Patients with a primary diagnosis of stroke, who were consecutively admitted or transferred to the rehabilitation ward of a tertiary care hospital for comprehensive inpatient stroke rehabilitation from October 1997 to September 1998, were enrolled. Their medical charts were reviewed. Stroke, defined as an acute event of cerebrovascular origin causing focal or global neurological dysfunction lasting > 24 h, was confirmed by both clinical and radiographic

evidence. Included were patients who were ≥ 18 years of age, whose stroke had occurred within the prior 3 months, and whose primary reason for admission or transfer to the rehabilitation ward was disability resulting from the stroke. Patients who had other neurological disease, such as parkinsonism, poliomyelitis, and cancer, were excluded.

The medical complications that occurred during the inpatient rehabilitation period for each patient were recorded. Medical complications were defined as medical or neurological management problems that generated a physician's order for evaluation or management. Recurrent events, such as adjustments of antihypertensive medication or insulin dosages, were not counted as medical management problems. We also recorded the patients' demographic data, preexisting neuromedical conditions, the characteristics of their stroke, the severity of the neurologic deficits, and disability level at the time of admission or transfer to the rehabilitation ward. The type of stroke was defined as either hemorrhagic or ischemic. The location of lesions was defined as either supratentorial or infratentorial. The side the lesion was on was defined as either right, left, or bilateral. The motor neurologic deficits of each patient were measured using Brunnstrom's stages of motor recovery.⁽¹⁸⁾ We reclassified our patients into 2 groups as Brunnstrom's stages ≤ 2 and stages >2 . Patients' level of disability in activities of daily living (ADLs) was assessed using the Barthel index.⁽¹⁹⁾ The duration between stroke onset and rehabilitation admission and length of stay in the rehabilitation ward were both documented.

Data analysis

The number of medical complications during rehabilitation was counted for each patient. The frequency of each of the medical complication and the incidence of those medical complications that resulted in transfer to an acute care ward were determined.

Many patients had more than 1 complication. Because of the diverse nature and incidence of those medical complications, the presence or absence of any medical complication was used in the subsequent analyses. Chi-square test was used to determine the relationship of each of the demographic and stroke characteristics, neurological deficits, and pre-existing medical conditions, with the occurrence of any medical complications. Continuous variables

between patients with and without complications were compared using the t-test. Stepwise multiple logistic regression analysis was conducted using the significant factors ($p < 0.05$) predicting the occurrence of medical complications during a stroke inpatient's rehabilitation. All analyses were performed using SAS (SAS, 2002).

RESULTS

In all, 346 patients were recruited for the study. A description of the demographic and stroke characteristics of the patients is provided in Table 1. The 346 patients ranged in age from 27 to 86 years (mean = 65 years); 186 (53.8%) were male. The strokes were predominantly ischemic in origin (76.3%), and they more commonly involved the supratentorial region (87.8%). Left (48.0%) and right (45.7%) hemisphere pathology was equally represented. The mean onset-to-rehabilitation ward admission interval was 17.4 ± 14.9 days. The mean length of the rehabilitation stay was 28.0 ± 13.8 days. The frequencies of preexisting medical conditions among the patients are displayed in Table 2, which shows that hypertension (78.9%), diabetes mellitus (37.9%), prior stroke (25.4%), a history of hyperlipidemia (24.9%), and a history of smoking (18.8%) were the most common preexisting conditions.

Of the 346 patients, 151 (44%) experienced at least 1 medical complication, among them 110 had 1 complication, 29 had 2 complications, 9 had 3 com-

plications, and 3 had 4 complications. Table 3 lists the types and frequencies of medical complications. It shows that musculoskeletal pain (15.0%), urinary tract infection (13.6%), depression (9.3%), upper gastrointestinal tract bleeding (4.9%), and pneumonia (4.9%) were identified most frequently. One patient experienced sudden death due to cardiac arrest of unknown cause. Of the patients with complications, most were managed in the rehabilitation ward, and only 10 patients required transfer back to an acute-care setting, among them, 5 had recurrent stroke, 3 had pneumonia, 1 had ventriculoperitoneal shunt obstruction, and 1 had organic psychosis. Two patients died after transfer due to respiratory failure.

Table 4 presents the results of the univariate analysis. The occurrence of complications was sig-

Table 1. Demographic and Stroke Characteristics of Stroke Patients Admitted or Transferred for Inpatient Rehabilitation (N = 346)

Age (years, mean \pm SD)	65.2 \pm 11.4
Gender, no. (%)	
Female	160 (46.2%)
Male	186 (53.8%)
Type of stroke, no. (%)	
Ischemic	264 (76.3%)
Hemorrhagic	82 (23.7%)
Location of lesion, no. (%)	
Supratentorial	304 (87.8%)
Infratentorial	42 (12.2%)
Side of stroke, no. (%)	
Right hemisphere	158 (45.7%)
Left hemisphere	166 (48.0%)
Bilateral hemispheres	22 (6.4%)

Table 2. Preexisting Medical Conditions of the Study Patients

Medical condition	No. (%)
Hypertension	273 (78.9%)
Diabetes mellitus	131 (37.9%)
Prior stroke	88 (25.4%)
Hyperlipidemia	86 (24.9%)
Smoking	65 (18.8%)
Alcoholism	30 (8.7%)
UGI bleeding	24 (6.9%)
Arrhythmia	20 (5.8%)
COPD	14 (4.1%)
Renal failure	13 (3.8%)
Seizures	8 (2.3%)
Myocardial infarction	5 (1.5%)
Angina	4 (1.2%)

Abbreviations: UGI: upper gastrointestinal tract; COPD: chronic obstructive pulmonary disease.

Table 3. Number of Patients with Neuromedical Complications during Acute Inpatient Rehabilitation

Medical complication	No. (%)
Musculoskeletal pain	52 (15.0%)
Urinary tract infection	47 (13.6%)
Depression	32 (9.3%)
Pneumonia	17 (4.9%)
Upper gastrointestinal tract bleeding	17 (4.9%)
Gouty arthritis	6 (1.7%)
Stroke progression	5 (1.5%)
Pressure sores	5 (1.5%)
Seizures	4 (1.2%)
Sudden death	1 (0.3%)
Others	23 (6.7%)

nificantly associated with patients of female gender ($p = 0.004$), those with greater neurological deficits ($p < 0.0001$), those with severe disability ($p < 0.0001$), those who had a Foley catheter inserted ($p < 0.0001$), and those who required longer rehabilitation hospitalization ($p < 0.0001$).

Results of the stepwise multiple logistic regression analysis are shown in Table 5. Four factors recorded at admission or upon transfer to the rehabilitation ward were independently related to the occurrence of any complication. These were being female ($p = 0.0008$), having a severe disability ($p = 0.0001$), having no voluntary movement in the affected hand ($p = 0.015$), and having undergone insertion of an indwelling urethral catheter ($p = 0.024$).

DISCUSSION

To say that "a patient is medically stable and ready for stroke rehabilitation" is inaccurate and misleading. Our data show that inpatient stroke rehabilitation is a medically active service; 44% of patients developed medical complications, and 3% required transfer back to an acute care setting. Several studies^(8-10,13-17) have shown that 44%~95% of stroke patients undergoing rehabilitation develop medical complications during their inpatient stay. In comparison, the complication rate in our study (44%) was lower. The variation could probably be due to several factors. First, this was a 1-hospital study, and referral bias cannot be excluded. Second, the definition of what constitutes a complication varies among these studies. Some included vascular risk factors, such as

Table 4. Factors Related to Medical Complications during Inpatient Stroke Rehabilitation through Univariate Analysis

Factor	Patients with medical complications N = 151	Patients without medical complications N = 195	Odds ratio (95% CI)	<i>p</i>
Age (years)	64.2 ± 11.5	66.2 ± 10.8		0.209
Male gender	68 (45.0%)	118 (60.5%)	0.54 (0.35~0.82)	0.004
Infarct	111 (74.0%)	153 (78.5%)	0.78 (0.47~1.29)	0.333
Side: Left	68 (45.3%)	98 (50.3%)	0.76* (0.31~1.90)	0.652
Right	72 (48.0%)	86 (44.1%)	0.92* (0.37~2.29)	
Bilateral	10 (6.7%)	11 (5.6%)		
Supratentorial	131 (87.3%)	173 (88.7%)	1.14 (0.59~2.19)	0.69
DM history	60 (39.7%)	71 (36.4%)	1.15 (0.74~1.78)	0.527
Hypertension history	120 (79.5%)	153 (78.5%)	1.06 (0.63~1.79)	0.820
Heart disease history	12 (8.0%)	17 (8.7%)	0.90 (0.42~1.96)	0.798
COPD history	9 (6.0%)	5 (2.6%)	2.41 (0.79~7.34)	0.112
Previous stroke	40 (26.5%)	48 (24.6%)	1.10 (0.68~1.80)	0.691
Smoking	23 (15.2%)	42 (21.5%)	0.65 (0.37~1.15)	0.136
Alcoholism	9 (6.0%)	21 (10.8%)	0.53 (0.23~1.18)	0.115
Hyperlipidemia	34 (22.5%)	52 (26.7%)	0.80 (0.49~1.31)	0.376
Brunnstrom stage of affected arm ≤ 2	102 (67.6%)	88 (45.1%)	2.53 (1.63~3.94)	< 0.0001
Brunnstrom stage of affected hand ≤ 2	106 (70.2%)	88 (45.1%)	2.86 (1.83~4.48)	< 0.0001
Brunnstrom stage of affected LE ≤ 2	89 (58.9%)	74 (38.0%)	2.35 (1.52~3.62)	< 0.0001
Barthel index	36.8 ± 19.4	51.3 ± 20.6		< 0.0001
Aphasia	18 (11.9%)	17 (8.7%)	1.42 (0.70~2.85)	0.327
NG tubes	38 (25.2%)	35 (18.0%)	1.54 (0.92~2.58)	0.103
Foley catheter	31 (20.5%)	12 (6.2%)	3.94 (1.95~7.97)	< 0.0001
Tracheostomy	1 (0.7%)	1 (0.5%)	1.29 (0.08~20.85)	1.00
Time from stroke onset to rehab (days)	19.1 ± 38.0	12.8 ± 14.6		0.057
Length of stay (days)	33.9 ± 23.3	18.6 ± 16.2		< 0.0001

Abbreviations: DM: diabetes mellitus; COPD: chronic obstructive pulmonary disease; LE: lower extremity; NG: nasogastric; rehab: rehabilitation.

* relative to bilateral side.

Table 5. Factors Significantly Related to Complications through Stepwise Multiple Logistic Regression Analysis

Factor	Odds ratio (95%CI)	<i>p</i>
Male gender	0.45 (0.28~0.72)	0.0008
Barthel index	0.97 (0.96~0.99)	0.0001
Brunnstrom stage of affected hand \leq 2	1.90 (1.13~3.19)	0.015
Foley catheter	2.43 (1.12~5.26)	0.024

hypertension or diabetes mellitus, as complications,^(8-10,14) while others concentrated on problems that were clearly secondary to the stroke incident.⁽¹³⁾ In our study, only those evaluations performed by a physician that resulted in a physician's order intervention were included. Moreover, recurrent events such as insulin or antihypertensive medication adjustments were not counted as a single management problem in our study. Third, this was a retrospective study, we identified the complications from case notes. The results could have been influenced by the quality of note-keeping. Fourth, complication rates might also be expected to vary depending on the characteristics of individual rehabilitation units. At our ward, 3/4 of the beds are for stroke patients. Our clinical pathway for caring for stroke patients includes some risk-management protocols. We believe that organized stroke care may be another factor contributing to the low incidence of complications.

By further analyzing the frequency of each complication, we found that neurological complications were much less frequent (19%) than medical complications (81%). This is consistent with previous findings.⁽¹⁰⁾ We also found that most of the observed frequencies of these complication were lower compared with other results of other studies,^(8-10,13-16) except that we reported a higher frequency of upper gastrointestinal tract bleeding. A number of medical complications, such as pulmonary embolization, myocardial infarction, and deep venous thrombosis, that are thought to plague debilitated stroke patients, were absent from our study.

Considering the type of complications, Kalra et al.⁽¹³⁾ found that there appeared to be significant differences in different stroke care settings. The types of complications recorded in the stroke unit (e.g., aspiration, musculoskeletal pain, and depression) suggested the staff's greater awareness of stroke-related problems, whereas more-severe and potentially life-threatening complications (e.g., urinary

problems and chest infection) were more frequently reported for stroke patients managed in general medical wards. The 3 most common complications in our study were musculoskeletal pain, urinary tract infection, and depression, types similar to those in the stroke unit discussed above.

When medical complications occur during rehabilitation, most patients are managed in our ward, except for those with complications which are serious enough may require transfer to an acute-care ward for treatment. Various studies have shown that approximately 7%~19% of stroke patients undergoing rehabilitation need to be transferred back to an acute-care setting.⁽⁴⁻¹¹⁾ Only 3% of patients in this study had complications that required a transfer. That rate is much lower than those of other studies.^(11,21) The decision to transfer a patient to an acute-care facility depends on the type and severity of the complication, the ability of the rehabilitation medical and nursing staff to manage the complication, and the patient's ability to continue to participate in the rehabilitation program while undergoing treatment for the complication.⁽¹¹⁾ Our rehabilitation ward is connected to an acute medical care unit in the same hospital, so it is convenient to consult with the medical doctors there and seek suggestions for medical care. This arrangement might have contributed to the lower transfer rate. In some studies,^(11,21) venous thromboembolism was a leading complication requiring transfer. In our study, no such complication occurred, and this also might have had an effect on the transfer rate.

Knowing which patients are at high risk of complications is useful in medical management. Risk factors for medical complications in stroke rehabilitation have been studied, and the limited and somewhat-contradictory evidence suggests that advancing age, the severity of neurological deficits and disabilities caused by the stroke,^(3,9,10,13,14) certain preexisting medical conditions,^(9,12) the length of the rehabilitation stay,^(9,10,14) a stroke located in the anterior cerebral circulation region,⁽¹⁵⁾ and urinary incontinence⁽¹⁵⁾ may increase the risk of a complication occurring. Factors that were found to be unrelated to complications during stroke rehabilitation included the interval between stroke onset and rehabilitation admission, and the type of stroke (ischemic vs. hemorrhagic).⁽¹⁰⁾

We used univariate analyses to investigate a number of potential risk factors for developing com-

plications. Complications were more common with female patients, those with severe neurologic deficits or disability presenting at admission or transfer to the rehabilitation ward, and those who had to undergo Foley catheter insertion. After multivariate analysis, 4 of the factors were independently related to the occurrence of a medical complication: being female, having a severe disability, having no voluntary movement the affected hand, and having to undergo Foley catheter insertion. Kalra and colleagues⁽¹³⁾ reported that complications were more frequently recorded in patients with severe stroke deficits. Using the NIHSS scale, Roth⁽¹⁴⁾ also demonstrated that the severity of the neurological deficit on admission to rehabilitation was the strongest predictor of both medical complications and a complication that required a transfer. Dromerick and Reding⁽¹⁰⁾ used a 3-level impairment scale to show that the severity of stroke was related to the likelihood and number of complications in 100 stroke rehabilitation patients. We had similar results: those among our study patients with voluntary movement of the affected limbs, especially the affected hand, had a significantly lower incidence of complications. We also noted that patients with a lower Barthel index score had a significantly higher incidence of complications. It is noteworthy that indwelling urethral catheters and feeding tubes also have the potential to directly contribute to or otherwise be associated with increased complications during stroke rehabilitation.^(14,22) In our study, only indwelling urethral catheters were associated with an increased incidence of complications. We also found that female patients had an increased incidence of complications; this was not found in other studies. Wang et al.⁽²³⁾ found that among stroke patients in Taiwan, women experienced lower survival rates than men, with a difference of 9.7% by the second year of follow-up. According to our clinical observations, male stroke patients receive better care from their families than female stroke patients. This may explain why female stroke patients have higher complication rates and lower survival rates. Advanced age was found to be predictive of complications by Davenport et al.⁽¹⁵⁾ but unrelated to complications by Dromerick and Reding.⁽¹⁰⁾ Age was not a predictor in our study. Some studies^(9,12) have shown that certain preexisting medical conditions increase the risk of complications. We found no preexisting medical condition that was an independent predictor.

There was a significant association between the length of the hospital stay and the occurrence of complications. In some medical records, it was apparent that the occurrence of complications had prevented participation in therapy programs, and resulted in a lengthening of the hospital stay.

The ability to generalize the results of this investigation may be limited by the fact that it was a hospital-based study and thus may have suffered from referral bias. Despite this limitation, the potential clinical implications of the study are clear. These data provide valuable information regarding the occurrence of complications during stroke inpatient rehabilitation in Taiwan. This information not only provides a benchmark of event rates that may help physicians measure the success of their individual care, but may also be helpful in determining necessary preventive therapies. Knowledge of the severity of the stroke and gender, together with the need for Foley catheter insertion can assist clinicians in identifying patients at higher risk for complications that may interrupt inpatient rehabilitation. Many of the complications described in the study are potentially preventable or treatable if recognized. Examples include the early identification of dysphagia to prevent aspiration pneumonia, the judicious use of indwelling catheters to prevent urinary tract infections, and frequent body repositioning to prevent pressure ulcers. Protocols for the prevention, detection, and treatment of the most common complications should be established in each rehabilitation ward. Subsequent research is required to determine whether increased vigilance in the care of patients with these traits can reduce the incidence of complications occurring and improve the outcomes of stroke inpatient rehabilitation.

More than 40% of stroke patients had medical complications during their inpatient rehabilitation. This implies that stroke inpatient rehabilitation is an active medical service and that medical monitoring, prevention, and management are necessary and should be concurrent with inpatient rehabilitation services.

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腦中風病人住院復健期間產生醫療併發症之機率及危險因子探討

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背景：本研究希望了解中風病人於接受住院復健治療期間，發生醫療併發症之型態及發生率，同時希望能藉此找出產生醫療併發症高危險群的病人，進而能提供病人最佳的恢復環境。

方法：這是一個回溯性的研究，我們檢閱了346位在復健病房住院復健之中風病人的病歷。登錄他們的基本資料、中風型態、過去病史、神經缺損的程度、失用的情形及住院復健期間所產生的併發症，以及因此需轉出復健科病房的病因。同時做單變項及多變項的分析，去看什麼因素與併發症的產生有顯著相關。

結果：有44%的病人會有至少一種併發症產生。最常見的併發症是肌肉骨骼的疼痛(15%)，泌尿道感染(13.6%)，憂鬱症(9.3%)，上消化道出血(4.9%)，肺炎(4.9%)。有10位病人需轉回急性病房，其中5人為復發性腦中風，3位為肺炎，1位為腦室腹腔分流阻塞，1位為器質性精神病。而與發生併發症顯著相關的因素為：女性、剛轉入復健病房時其受侵犯的手無主動的動作、當時日常生活較依賴他人及有留置導尿管。

結論：在中風病人住院復健期間產生內科併發症是很普遍的，如何避免及適當的處理併發症是復健科醫師提供的服務中重要的一環。

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