Fall risk assessment in neurodegenerative diseases

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Abstract

A fall clinical index and fall accident prevention manual were devised. The fall assessment sheet was used subsequently at each hospital. However, fall accidents were not necessarily reduced. This assessment sheet was complicated, and there was the problem that not all the characteristics of the patients were covered. We performed univariate analysis of the risk factors associated with falls according to the patients newly. Also, we performed multivariate analysis of fall risks according to disease properties.

The subjects were 41,984 inpatients. The fall risk according to a fall assessment sheet with 41 items was examined. Seven diseases were classified, and the risk factors that were characteristic of each disease were examined. As fall risk factors of patients with intractable neuromuscular disease, eight items were identified than this study. We added three fall risk factors to the preliminary research. A new assessment item consisting of items appropriate to patients with neurodegenerative disease was completed. The assessment sheet intends to be managed in future. It is planned to connect with effective fall / fall preventive measures for patients with intractable neurologic disease.

Keywords : fall clinical index, fall accident prevention, assessment, univariate analysis multivariate analysis

Introduction

Falls are the leading cause of injurious death among older adults. Risk factors of falling include a history of prior falls, muscle weakness, poor gait or balance, visual impairment, arthritis, functional limitations, depression and use of psychotropic medications [1]. Furthermore, having multiple risk factors increases the risk exponentially [2]. However, risk profiles are not the same for all seniors. Among older adults living in the community, fall risk tends to be mostly related to mobility status [2, 3]. Several reviews have been published that give a cross-section of fall-risk assessment tools [4–7]. For hospital patients, the fall factors are more complicated as compared with healthy subjects. In other words, it is thought that the patients will show a specific fall pattern under the influence of various diseases. In the National Hospital Organization, a committee specializing in fall accident prevention project duties standardization was set up in 2007. A fall

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clinical index and fall accident prevention manual were devised.

In June, 2008, a fall accident prevention project started. At all hospitals which belonged to the National Hospital Organization, a unified fall assessment sheet was utilized (http://www.hosp.go.jp/resources/content/6381/20iryouanzenhakusyo.pdf#search='%E8%BB%A2%E5%80%92%E3%83%BB%E8%BB%A2%E8%90%BD%E4%BA%8B%E6%95%85%E9%98%B2%E6%AD%A2%E3%83%9E%E3%83%8B%E3%83%A5%E3%82%A2%E3%83%AB+%E5%9B%BD%E7%AB%8B%E7%97%85%E9%99%A2%E6%A9%9F%E6%A7%8B'). An effort to decrease the number of fall accidents was made. The on-admission assessment sheet was used in an average of 98.4% of 144 hospitals of the National Hospital Organization. There was no significant decrease in the number of fall accidents. The previous assessment sheet consisted of 10 categories with 41 items including age and anamnesis. Because there were many assessment items, there was a problem that the evaluation of all the items took time. There was also a problem that not all the characteristics of the patients in all the hospitals were covered. Therefore, we examined the risk factors associated with falls according to the patients in 99 National Hospital Organization hospitals with various characteristics of the patient. Also, an assessment sheet suitable for patients with neurodegenerative disease was completed by analyzing fall risks according to disease properties.

Materials and Methods

The study period was from December, 2010 to October, 2011, and the data collection period was from February 1, 2011 to March 31, 2011. The target hospitals were 99 hospitals where study cooperation was obtained in 128 hospitals using the fall assessment sheet of the National Hospital Organization. The classification of the characteristics of the patient. Patient characteristics were classified into the following seven categories, and data were collected; acute phase internal medicine, acute phase surgery, convalescent sub-acute phase, muscular dystrophy, severe mental-physical handicap, neuromuscular intractable diseases, mental disorder. The evaluation times were as follows: 1) less than 24 hours after hospitalization, 2) less than ten days after start of the study for the patients in long-term hospitalization, 3) the most recent observation of a fall, 4) less than three days after surgery, 5) when the situation of the patients changed.

Univariate analysis was conducted on 41 items of the assessment sheet and presence or absence of falls / fall development. The seven classifications of the characteristics of the patients were summarized in three groups. Group A: Acute phase internal medicine / surgery; Group B: convalescent sub-acute phase, muscular dystrophy, severe mental-physical handicap, intractable neuromuscular diseases; Group C: mental disorder. The presence or absence of falls was a purpose variable. Univariate analysis was conducted on the items on the assessment sheet. Multivariate analysis was conducted as an explanation variable on the items where significant differences ($p < 0.05$) were found. SPSS ver.18 was used for statistics processing.

Ethical considerations were as follows. The purpose of this study and the methods were explained to the director of each surveyed hospital in a document. A written agreement to cooperate was obtained. After having been coded, the survey data worked to collect the statistics. The hospital name and individuals were not identified. The data decided to discard with a shredder after the study end / presentation at the meeting / creation of the working papers. This study was approved by the central Ethical Review Board of the National Hospital Organization.

Results

Considering the cases in the 99 hospitals of the National Hospital Organization, 2,944 cases of 41,984 had intractable neurologic disease. The age of all cases was 59.2+-22.3 (mean ± standard deviation as well as the following) age. Age of those with intractable neurologic disease was 62.4+-20.6 years old. The breakdown of all cases was 22,955 men (54.7%), 18,803 women (44.8%), and 226 unknowns (0.5%). The intractable neurologic disease cases numbered 1,578 men (53.6%), and 1,366 females (46.4%). In all 41,758 cases, the number of cases that we fell to was 1,276, and the development situation of the fall was

3.1%. In 2,944 intractable neurologic diseases, 87 patients had fallen (3.0%). The age of patients who had fallen was 69.7+-17.1 years old. The age of patients who had not fallen was 58.9+-22.3 years old. The fall patients had significantly higher average age than the non-fall patients ($p<0.001$). The age of patients in Group B was 69.6+-17.9 years old. The age of the non-fall patients was 60.4+-22.7 years old. The fall patients had significantly higher average age than the non-fall patients ($p<0.001$). An association between assessment item and fall development. A univariate analysis by the chi-square test was conducted according to the characteristics of the patient. The number of items in acknowledgment of significant difference ($p<0.05$) was 20 items in intractable neurologic diseases (Table 1). Multivariate analysis of assessment item and the fall development according to the characteristic of the patient group. There was little fall number of patients with 87 cases for the intractable neurologic disease. Among the items used for the assessment of Group B, 13 showed a significant difference. The things odds ratio 1 of those or more were associated with the following 11 items. 1) Age, 2) time after hospitalization, 3) nurse call is not pushed, 4) muscle weakness, 5) unstable standing and gait, 6) body flexibility, 7) disorientation, 8) excretion at the bedside, 9) use of sleeping medication, 10) narcotic use, 11) diuretic use (Table 2). The five items with the highest rank in odds ratio were as follows. 1) the patients were likely to act without pushing the nurse call 2) narcotic administration. 3) patients performed excretion in bedside. 4) patients were in a bedridden state, but body movement was possible on a bed. 5) patients could walk, but were unstable. The summary of the results of the univariate analysis and the multivariate analysis is shown in Table 3. There were nine significant items in both the univariate and multivariate analysis. Because "narcotic use" showed little frequency of use for the patients with intractable neurologic diseases, we excluded it. A new assessment sheet was made after the following three significantly different items in our previous study were added to the remaining eight items: "Episode of falling in the past", "Disturbance of memory or judgment", "The use of a wheelchair / a stick / a walker / the handrail".

Discussion

Patients with Parkinson's disease (PD) have balance impairments and postural instability. This leads to an increased risk of falling and an increase in both fractures and soft tissue injury [8-12]. Decreased postural stability is also associated with decreased quality of life[13], and individuals with PD tend to limit their activity levels due to a fear of falling, contributing to inactivity and further compromising balance [9,11,14]. It has been reported that over 60% of individuals with PD fall at least once in a 12-month period [15,16]. Up to 70% of individuals with PD fall once annually, while 50% fall twice or more in a one-year period [17,18]. Falls lead to a myriad of complications [19] that can affect not only physical health, but also the psychological health of the individual. Due to the postural instability of patients with PD, it is important to be able to assess who has a balance deficit and is thus at increased risk of falling. Hip fracture and head trauma are two of the most common physical problems incurred by an individual with PD following a fall [20], while the psychological complications include fear of falling [21,22] and reduced quality of life [23].

Progressive supranuclear palsy (PSP) and corticobasal degeneration (CBD) are neurodegenerative disorders. PSP is almost nonexistent before the age of 50 years, and its occurrence increases with age and is higher in men [24]. These neurodegenerative disorders are characterized by tau-positive inclusions in neurons and glia [25]. Axial and limb rigidity, supranuclear gaze palsy, balance and gait impairment, and frequent falls are the clinical hallmarks of PSP [26,27]. All of the "tauopathies" involve an abnormal accumulation of intracellular tau protein that results in the development and accumulation of inclusions in neurons or glia that render the cells dysfunctional and ultimately cause cell death.

Patients with PD/PSP/CBD are frequently associated with the presence of postural instability and falls [28,29]. In these and other bradykinetic rigid syndromes, falls occur frequently and are associated with a poorer quality of life [30,31]. The risk of bone fracture increases with a history of falls,

impairment of mobility, low body mass index, and low bone mineral density [32,33]. In patients with disturbances of gait due to Parkinsonism, fractures are more common than in patients with gait disturbances due to other neurological conditions such as peripheral neuropathies [34].

Fall-related complications are associated with substantial economic costs [35,36] and there is an urgent need to identify and protect those individuals at the greatest risk. Risk reduction is a primary focus of numerous health care agendas. Clinical research has provided clinicians with a variety of screening tools to quantify risk factors for falls. Many different fall risk assessments are being used in PD [37-41]. Although physical therapy and exercise might improve balance [42], many of these measures have limitations, including low sensitivity and/or specificity [37,43], ceiling effects [44,45], and inclusion of items that physical therapy intervention cannot address [40,46,47]. Some research has shown that a battery of tests is necessary to fully assess balance; however, a consensus on which tests to include and how to interpret results from multiple tests has not been reached [38,43,48].

It is necessary for the fall risk factor of the inpatient to include three factors as compared with at-home healthy subjects: 1) Having illness, 2) Environmental changes. (Living environment having turned into a hospital instead of home), 3) The characteristics of the disease. Therefore, we conducted univariate analysis on 1) 2), and multivariate analysis was conducted on 3). As a result, nine items were identified. However, we have a problem with 3). We should have originally parsed what kind of difference existed between intractable neurologic disease and other diseases. However, we divided diseases into three broad groups and analyzed because the target number of patients was too small for official approval. Therefore, the intractable neurologic disease was analyzed as Group B, which included the convalescent sub-acute phase, muscular dystrophy and severe mental-physical handicap. Therefore, this analysis cannot adequately elucidate the fall risk specific to a given neurodegenerative disease. Also, end-point 41 was chosen in the diseases of all domains. From these findings, all of the specific events were not included in patients with intractable neurologic disease. We will utilize the new assessment sheet in future. Moreover, we want to reduce the number of falls during the hospitalization of patients with neurodegenerative disease by revising the sheet in the future.

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Table 1. The relationship between assessment items and falls of patients with intractable neurologic disease. Univariate analysis.

Category		Items	*p*
A	Age	over 70y or less 9 y	0.03 *
B	Past history	Episode of fall	0 **
C	Environmental change	①Surgery less than three days	1
		②Condition rapidly recovers or worsens	0.23
		③less than seven days after a hospitalization / change rc	0.02 **
		④Doing rehabilitation	0.95
		⑤The first experience of the Bet life	1
D	Character	①strong shame/hesitation	0.91
		②not depend on another person	0.07
		③act by oneself without using the nurse call	0 *
E	Body condition	①paralysis or sensory loss	0.14
		②arthropathy/contracture	0.86
		③muscle weakness	0 *
		④unstable gait	0 *
		⑤unstable standing	0.1
		⑧Bet life cannot become independent	0.47
		⑦cannot sat on Bet	1
		⑧bedridden, but the body movement is possible	0.08
F	Sensation	①balance disorder	1
		②visual disorder	0.23
		③hearing loss	0.51
G	Cognitive function	①disturbance of memory or orientation	0.01 *
		②consciousness disturbance	0.099
		③Restless behavior	0.145
H	Dailiy activity	①using wheelchair / stick / walker / handrail	0 **
		②assistance of movement and excretion	0 **
		③excretion at the bedside	0 **
		④Intravenous feeding, gullet, drain, urethral catheters	0.613
		⑤Assistance of putting on / taking off of clothes	0.026 *
I	Drug use	①using sleeping drugs	0 **
		②using antipsychotics	0.161
		③using anti-parkinsonian drugs	0.037 *
		④narcotic administration	0.001 **
		⑤using laxatives	0.003 **
		⑥using antihypertensive medications	0.002 **
		⑦using antitumor agents	0.419
J	Excretion	①urine / faecal incontinence	0.002 **
		②constipation/diarrhea	0.033 *
		③pollakisuria	0.002 **
		④urine / defecation desire cannot be said	0.896
		⑤Excretion takes time	0 **

Chi-square test, Revision of Yates, *p<0.05, **p<0.01, n=2.944, 87 falls

Table 2. Multivariate analysis of fall risk according to disease properties. Group B vs Group A and Group C. Logistic regression analysis

Items	Partial regression coefficient	p value	Odds ratio	Confidence interval	
				Lower Limit	Upper Limit
A : over 70y or less 9 y	0.256	0.0746	1.291	0.975	1.710
C3 : less than seven days after a hospitalization / change room	0.346	0.0320	1.414	1.030	1.940
D3 : act by oneself without using the nurse call	0.917	0.0000	2.502	1.791	3.495
E3 : muscle weakness	0.359	0.0236	1.431	1.049	1.952
E4 : unstable gait	0.465	0.0046	1.592	1.154	2.196
E6 : Bet life cannot become independent	−0.441	0.0332	0.644	0.429	0.966
E8 : bedridden, but the body movement is possible	0.521	0.0148	1.684	1.107	2.560
G2 : consciousness disturbance	0.335	0.0897	1.398	0.949	2.058
H3 : excretion at the bedside	0.637	0.0001	1.890	1.377	2.596
I1 : using sleeping drugs	0.458	0.0015	1.580	1.192	2.094
I4 : narcotic administration	0.718	0.0266	2.051	1.087	3.868
I6 : using antihypertensive medications	0.287	0.0722	1.332	0.975	1.820
J4 : urine / defecation desire cannot be said	−0.710	0.0070	0.491	0.293	0.823
constant term	−4.802	0.0000	0.008		

Table 3. Summary of results of univariate analysis and multivariate analysis

Category		Items	Univariate analysis	Multivariate analysis	New assessment item
A	Age	over 70y or less 9 y	○	○	★
B	Past history	Episode	○	×	★#1
C	Environmental change	①Surgery less than three days	×	×	
		②Condition rapidly recovers or worsens	×	×	
		③less than seven days after a hospitalization / change roo	○	○	★
		④Doing rehabilitation	×	×	
		⑥The first experience of the Bet life	×	×	
D	Character	①strong shame/hesitation	×	×	
		②not depend on another person	×	×	
		③act by oneself without using the nurse call	○	○	★
E	Body condition	①paralysis or sensory loss	×	×	
		②arthropathy/contracture	×	×	
		③muscle weakness	○	○	★
		④unstable gait	○	○	★
		⑤unstable standing	×	×	
		⑥Bet life cannot become independent	×	×	
		⑦cannot sat on Bet	×	×	
		⑧bedridden, but the body movement is possible	×	○	
F	Sensation	①balance disorder	×	×	
		②visual disorder	×	×	
		③hearing loss	×	×	
G	Cognitive function	①disturbance of memory or orientation	○	×	★#1
		②consciousness disturbance	×	○	
		③Restless behavior	×	×	
H	Dailiy activity	①using wheelchair / stick / walker / handrail	○	×	★#1
		②assistance of movement and excretion	○	×	
		③excretion at the bedside	○	○	★
		④Intravenous feeding, gullet, drain, urethral catheters	×	×	
		⑥Assistance of putting on / taking off of clothes	○	×	
I	Drug use	①using sleeping drugs	○	○	★
		②using antipsychotics	×	×	
		③using anti-parkinsonian drugs	○	×	
		④narcotic administration	○	○	
		⑤using laxatives	○	×	
		⑥using antihypertensive medications	○	○	★
		⑦using antitumor agents	×	×	
J	Excretion	①urine / faecal incontinence	○	×	
		②constipation/diarrhea	○	×	
		③pollakisuria	○	×	
		④urine / defecation desire cannot be said	×	×	
		⑥Excretion takes time	○	×	

○ signifinant × not significant ★ accepted items #1 item which was supported in preliminary research