Impact of Falls in Palliative Care Units in Japan: A Multicenter Prospective Cohort Study

St. Luke's International University Graduate School of Public Health

Capstone Project

Impact of Falls in Palliative Care Units in Japan: A Multicenter Prospective Cohort Study

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Abstract

Background: Falls in patients with advanced cancer present serious problems, but there is no established way to predict them.

Objectives: This study was a multicenter prospective cohort study performed in palliative care units to develop a falls prediction model.

Method: Patients who experienced a fall within one month of death will be included in the study, and variables associated with the fall will be analyzed among the background variables. Based on the result of univariate analysis, we performed a multivariate analysis using logistic regression analysis and the classification tree. Finally, through these analyses, we propose a prediction model for falls.

Result: Among 1896 patients, 1633 patients were eligible for this analysis and 150 of the eligible patients had experienced a fall. Twenty-two variables were found to be associated with falls ($p < 0.05$) in the univariate analysis. Using the variables having the p-value that is less than 0.20 as explanatory variables, we performed a multivariate logistic regression analysis. The receiver operating characteristic curve analysis indicated that the value of the area under the curve was 0.80 (95%CI: 0.754 - 0.846). In addition, the sensitivity was 71.6% and the specificity was 74.3%. From these results, we found that the performance of the developed prediction model was relatively high. In addition, to confirm the order of the magnitude of importance of explanatory variables on the multivariate logistic regression model, the classification tree analysis was performed using variables that were associated with falls. The most influential variable in predicting falls was the Palliative Performance Scale.

Conclusion: Factors associated with falls in patients with advanced cancer admitted to a palliative care unit have been identified through this study.

Keywords: cancer, CART, fall, palliative care units, prediction

Introduction

It is important to prevent falls in hospitalized patients because a fall is the leading cause of injury for elderly patients and cause serious complications (Bergen et al., 2016). 3.2% of falls occurred and 1.2% of falls caused injury in acute care hospitals. The total number of the injury were as follows: open wounds (rubbing, laceration, skin laceration) 54.9%; closed wounds (damage, hematoma) 34.7%; sprains 2.1%; dislocations 0.7%; vertebral fracture 0.7%; fractures other than vertebral fracture 5.6%; and subdural hematoma 4.0% (Barker et al., 2016). On the other hand, the frequency of falls in patients admitted to the palliative care setting with advanced cancer is high (18 - 50%), and factors such as delirium, age, length of stay, brain tumor, depression, and psychotropic medications have been cited as contributing factors (Stone et al., 2012). Previous studies have evaluated the background factors of falls (Zhang et al., 2018; Goodridge & Marr, 2002), but there are no reports of a multicenter evaluation in a large number of patients with advanced cancer.

The purpose of this study was to identify factors associated with falls as the primary endpoint in palliative care wards in Japan and to propose a method of fall prediction that could be used in clinical practice.

Methods

This was a multicenter post hoc exploratory analysis of, prospective cohort studies of advanced cancer patients who were receiving palliative care in palliative care units in Japan. We compared background variables with the presence of falls within one month of death as the primary endpoint. The study was conducted in accordance with the ethical guidelines for research on human subjects based on the Declaration of Helsinki.

Participants

This study was a part of a multicenter prospective observational study, named East-Asian Collaborative Study to Elucidate the Dying Process (EASED) . This study examined the process of death and end-of-life care in terminally ill cancer patients who admitted to palliative care units in Japan. In this study, we consecutively enrolled patients who were newly admitted to the palliative care units during the research period. All interventions, including all tests and treatment, were performed as usual clinical practice. The inclusion criteria of this study were (a) 18 years old or older, (b) locally advanced or metastatic cancer (including hematological neoplasms), and (c) patients admitted to palliative care units. We excluded patients who were scheduled to be discharged from hospital within a week or who did not wish to participate.

Data Collection

We collected data from the EASED. The data we analyzed were: patient characteristics, symptoms, general condition, and blood test data . We focused on the following factors as possible background factors for falls.

Data on Admission

For the patient background we used: age, gender, metastatic site, systemic complications (Charlson Comorbidity Index (CCI)), and treatment history for cancer. Neurological data included consciousness, delirium, and cognitive function. The presence, cause, and severity of delirium and the history of delirium were recorded. The diagnosis of delirium was based on the American Psychiatric Association DSM-V, the severity of delirium was based on item nine of the Memorial Delirium Assessment Scale (MDAS), and perceptual disturbances and hallucinations were based on the item "perceptual disturbances and hallucinations" of the Delirium Rating Scale R-98.

General Condition and Physician's Prediction of Prognosis

The ECOG PS, the Karnofsky Performance Scale (KPS), the Global Health, and the Palliative Performance Scale (PPS) were used to assess general health. Clinician Prediction of Survival (CPS) based on the physician's experience was recorded.

Medical Treatment

We documented opioid use, opioid dose (converted to oral morphine), antipsychotic use, type of antipsychotic used (haloperidol, risperidone, quetiapine, olanzapine, chlorpromazine, other), and antipsychotic dose (haloperidol 5 mg/day, risperidone 2.5 mg/day, quetiapine 166 mg/day, olanzapine 6.3 mg/day, and chlorpromazine 250 mg/day or higher were considered high doses.). The presence or absence of psychotropic medication use, the type of psychotropic medication used (benzodiazepines, non-benzodiazepines sleeping pills, antidepressants, anticonvulsants, anti-dementia drugs, drugs with Anticholinergic Risk Scale ≥2), and the presence or absence of indwelling urinary catheters were all recorded.

Data at Time of Death

Discharge status included discharge from hospital with death and discharge from hospital with survival. Quality of life at the end of life was noted using the Good Death Scale (GDS), which is a five-item scale developed in Taiwan to assess quality of life at the end of life. The items are as follows based on the original material of GDS (Chang, et al., 2016):

1. Has the patient known the fact that he/she is dying?

0 = *Complete ignorance*, 1 = *Ignorance*, 2 = *Partial awareness*, 3 = *Complete awareness*

2. Could the patient accept his/her illness well?

0 = *Complete unacceptance*, 1 = *Unacceptance*, 2 = *Acceptance*, 3 = *Complete acceptance*

3. Has the patient arranged everything according to his/her own will?

0 = *No reference to the patient's will*, 1 = *Following the family's will alone*, 2 = *Following the patient's will alone*, 3 = *Following both the patient and the family's will*

4. Was the timing appropriate for the patient to pass away?

0 = *No preparation*, 1 = *The family alone had prepared*, 2 = *The patient alone had prepared*, ,

3 = *Both the patient and family had well prepared*

5. How about the physical condition of the patient at that time?

0 = *A lot of suffering*, 1 = *Suffering*, 2 = *A little suffering*, 3 = *No suffering*

Death consideration during hospitalization included expressions of wanting to die quickly and wanting death to be actively hastened and the reasons for these expressions were recorded. The reasons for the desire to die quickly were categorized as follows: 0 = No expression, 1 = Pain, 2 = Dyspnea, 3 = Fatigue, 4 = Other physical symptoms, 5 = Burden on others, 6 = Loss of control over the future, 7 = Inability to take care of oneself, 8 = Nothing to look forward to or play a role in, 9 = Lack of hope, 10 = Fear of death or dying process, 11 = Loneliness, and 12 = Lack of self-worth/meaninglessness of one's existence.

Delirium details were recorded as presence or absence of delirium during the hospitalization, the severity of hyperactive delirium (using MDAS), and the final treatment for delirium. The treatment for delirium was categorized as follows: 0: none, 1 = antipsychotics, 2 = antipsychotics plus intermittent sedation (or benzodiazepins for sleep), 3 = shallow continuous sedation with

sedatives (*), and 4 = deep continuous sedation with sedatives (*sedatives: midazolam, barbiturates, propofol). Falls during hospitalization within one month before death, complications of falls, purpose of the patient's behavior before the fall, and death within 48 hours of the fall were recorded.

The physician recorded all data on a structured data-collecting sheet. Patients were observed from the time of admission until the time of discharge. The observer checked for symptoms while providing usual medical care. Patients whom had difficulty communicating verbally had their symptoms identified based on their proxy's opinion.

Data Analysis and Statistics

For the first step, we calculated descriptive statistics; we calculated the summary statistics for each variable. Next, to investigate the relationship between each continuous variable and the main outcome (fall), we performed the univariate analysis based on the Mann–Whitney U test. Also, based on the Fisher's exact test, we carried out the univariate analysis for the relationship between each categorical variable and fall. Finally, we performed the multivariate analysis for the investigation of the relation between the significant variables on univariate analyses and the outcome (fall) through multivariate logistic regression analysis and classification and regression trees. Significance was accepted at $p < .05$ and statistical analysis was performed with R version 3. 6. 3.

Statement about Institutional Review Board Approval

This capstone project and the EASED study was approved by the Seirei Mikatahara Hospital Institutional Review Board in July 2016.

Results

Baseline Patients' Characteristics

A total of 1,896 patients participated from 22 PCUs in Japan from January 2017 to June 2018. Of the patients enrolled, 263 were excluded because they were discharged alive. Thus, the total number of patients were evaluated in this study was 1,633. Of the patients included, 150 patients (9.2%) fell within one month of death. Characteristics are summarized in Table 1. Median age was 74.0 years old. The major comorbidities were cerebrovascular disease were 7.0% (n = 115), dementia 8.1% (n = 132), and hemiplegia 1.5% (n = 24). The proportions of ECOG PS 0/1 were 0.6% (n = 10), ECOG PS 2 - 6.2% (n = 102), ECOG PS 3 - 40.5% (n = 661) and ECOG PS 4 - 52.7% (n = 860). The median prognosis predicted by the physician at the time of admission was 21 days.

Univariate and Multivariate Analyses of Factors Associated With Falls

In the univariate analysis, to investigate the relationship between the primary outcome that is “fall or no fall” and the other categorical variable, we performed the Fisher’s exact test. In addition, to assessing the relation between “fall or no fall” and the continuous variable, we carried out the Mann–Whitney U test. As a result, the following variables were statistically significant in the univariate analysis: age (continuous variable), gender (categorical variable), cerebrovascular disease (categorical variable), ECOG PS (categorical variable), KPS (continuous variable), GH (continuous variable), PPS (continuous variable), palliative care phase (categorical variable), urine catheter (categorical variable), psychotropic drug (categorical variable), nonbenzodiazepine hypnotics (categorical variable), antidepressants (categorical variable), Good Death Scale: “Has the patient known the fact that he/she dying?” (categorical variable), output of suicidal ideation (categorical variable), statement of reasons for suicidal ideation (categorical variable), suicidal ideation for pain (categorical variable), suicidal ideation for loss of control for the future (categorical variable), presence of delirium (categorical variable), severe delirium (categorical variable), therapy for

delirium (categorical variable), length of hospital stay (continuous variable), prognosis (continuous variable). These are shown in Table 2.

In general, if the number of explanatory variables on the multivariate logistic regression analysis is large, we often face the problem of multicollinearity. In this situation, it can be considered that there is a possibility that the estimated odds ratios were not stable in the logistic regression analysis. In addition, among the important explanatory variables from the point of view of prediction, it was also possible that multiple occurrences of a variable had similar information. For this situation, when we applied the variable selection method to the obtained multivariate logistic regression model, the explanatory variables that were not appropriate from a clinical point of view were selected. From these backgrounds, we next confirmed whether or not there was multicollinearity on the estimated multivariate logistic regression model. With that in mind, we assessed the multicollinearity based on the values of the variance inflation factor and generalized variance inflation factor, As a result, we excluded the three explanatory variables: (a) KPS, (b) statement of reasons for suicidal ideation, and (c) presence of delirium, from the multivariate logistic regression model. We found that the number of candidate explanatory variables was 22 after the univariate analysis, but, by checking the multicollinearity, we finally used the variables that are age, gender, cerebrovascular disease, ECOG PS, GH, PPS, palliative care phase, urine catheter, psychotropic drug, nonbenzodiazepine hypnotics, antidepressants, Good Death Scale (“Has the patient known the fact that he/she dying?”), output of suicidal ideation, suicidal ideation for pain, suicidal ideation for loss of control for the future, severe delirium, therapy for delirium, length of hospital stay, and prognosis as the explanatory variables on the multivariate logistic regression model. With this prediction model, we performed the ROC curve analysis. In this case, the value of AUC was 0.80 (95%CI: 0.754 - 0.846). In addition, the values of sensitivity and specificity were 71.6% and 74.3%, respectively.

Classification Tree Analysis

Breiman et al. (1984) proposed the classification and Regression Tress (CART) and its method has been used in various fields. In the CART model, there are two advantages relative to the multivariate logistic regression model. The first advantage is that it is possible to visually confirm the relations among explanatory variables and to understand the order of the magnitude of the importance of explanatory variables for the target outcome. The second advantage is that it is possible to obtain the cut-off point in terms of the important explanatory variable to predict the outcome. Therefore, based on the value of the cut-off point, we can develop a guideline to provide appropriate treatment or to give appropriate diagnostic results. In this study, to verify the prediction model obtained from the multivariate logistic regression, we also developed the CART model. The name of "CART" implies the two methods that are the approaches of the classification and regression. In this study, the outcome is "fall or no fall" that is categorical variable. Therefore, by using the classification tree, we were able to verify the developed multivariate logistic regression model. We applied the CART method to the target data in this study with the 19 variables that were statistically significant ($p < 0.05$) in the univariate analysis: age, gender, cerebrovascular disease, ECOG PS, GH, PPS, palliative care phase, urine catheter, psychotropic drug, nonbenzodiazepine hypnotics, antidepressants, Good Death Scale ("Has the patient known the fact that he/she dying?"), output of suicidal ideation, suicidal ideation for pain, suicidal ideation for loss of control for the future, severe delirium, therapy for delirium, length of hospital stay, and prognosis,. In general, we drew a tree figure called a decision tree using the CART method. The node of the top level of decision tree represents the most important variable in terms of classification for the outcome. Likewise, the nodes at the second level of decision tree indicate the second most important variables to classify the outcome. Figure 4 depicts the decision tree and shows that the most important variable in predicting falls was PPS. The second important variables to predict falls were ECOG PS and GH.

The third important variable was from the Good Death Scale: “Has the patient known the fact that he/she dying?” and finally the presence of severe delirium.

An example of how this might be used in a clinical setting: if a patient spends some time sitting through the day, he or she may have a score of 50 or higher on the PPS (The cut-off point of 45 represents the midpoint value between 40 and 50.). If this is the case, falls should be a concern. In addition, if the patient has a PPS score of less than 40, but has comorbid severe delirium, there is still a possibility of a fall. The patient's awareness of his or her own mortality may also be a predictor of falls. In this study, we were able to suggest some clinically noteworthy variables for predicting falls, as described above.

Discussion

What is clinically important about this study is that it shows the prediction of falls with existing assessment measures. In general, whether a patient with advanced disease will fall or not is usually based on the experience of medical personnel. This has led to different judgments depending on the experience of the healthcare provider. This is why it has been so difficult to educate people to anticipate falls. In this study, we showed which items medical professionals should focus on in their clinical evaluation of fall risk. It is hoped that this perspective can be applied to measures and education to prevent falls. “Which patient falls should we pay attention to?” is a question of great clinical importance. It is difficult to pay attention to all patients. It would be unacceptable from the standpoint of cost-effectiveness of medical resources to invest a lot of human resources to prevent all patients from falling. The medical field is faced with the dilemma of patient safety and distribution of medical resources. In addition, there is a concern that prioritizing patient safety over human dignity in the final stages of life may degrade QOL. For example, a patient who wishes to be independent in defecation may be forced to defecate in an unwanted way in order to prioritize safety.

The findings from this study may provide a solution to this important dilemma for both patients and providers. It may be possible to prevent falls, with fewer burdens on providers, by identifying patients at higher risk for targeted attention.

In addition, the CART analysis revealed a quantitative assessment of items that are effective in predicting falls. Of course, patients who are bedridden with reduced physical function do not fall. In order to predict falls, it is necessary to identify the decline in physical function that is likely to lead to falls. Also, other studies provide suggestions for this clinical concern. As an example, a score of 40 and 50 on the PPS may be a valid cutoff for predicting falls. Therefore, health care providers could consider a specific assessment of whether the patient spends time in a sitting position. By comparing the results of multivariate logistic regression with those of classification tree, both methods revealed that PPS, GH, ECOG PS, and severe delirium were important variables. Moreover, we found that the multivariate logistic regression analysis result was almost similar to the analysis result of the classification tree.

The analysis of the Good Death Scale as an explanatory variable is an interesting aspect of this study. The possibility of the influence of the presence of spiritual pain on the prediction of falls is a new finding in the study of falls. It is known that spiritual pain is more likely to manifest in the final stages of life. Especially in situations where bodily functions are declining, the suffering of being unable to take care of oneself tends to be stronger. Patients with high levels of such suffering may have a tendency to behave in ways that are not commensurate with their physical functions. For example, it has been clinically experienced that a patient may attempt to walk to the bathroom alone, even though it is objectively difficult to walk. From this perspective, support for physical functions and consideration of the environment alone may not be sufficient to prevent falls in cancer patients at the end of life. The essential approach of palliative care to alleviate the patient's spiritual anguish

may occupy a very important role in preventing falls. The discussion on spirituality is very important in palliative care. Further research is needed on the relationship between spiritual pain and falls. An example would be an intervention study that compared the frequency of falls in groups with and without spiritual care intervention.

Evaluation of Analytical Results Stability

Kashiwagi, Hayashi, Mori, & Otani (2020) proposed an evaluation method for the analysis of results of the CART model. Here, we induced a perturbation at the point of a variable on the classification tree model and quantitatively evaluated the stability of the developed classification tree model. If we use our proposed evaluation approach, we can assess the stability of the magnitude order of importance of the explanatory variables on the target CART model. Also, we can evaluate the ease of coupling between important explanatory variables to predict an outcome. For example, we can use our evaluation approach for classifying the risks to a target outcome. In Kashiwagi, et al., (2020), used a set of explanatory variables different from the subset of 19 explanatory variables in this study and we performed the CART analysis on the same dataset. After that, we applied our proposed assessment method in terms of stability to the obtained the CART model. As a result, we carried out the classification of risks in the context of predicting “fall or no fall”. In addition, we confirmed that the findings acquired by applying our assessment approach were very interesting from the clinical viewpoint. In the future, we are willing to apply its assessment method to the developed CART model based on the subset of explanatory variables used in this study and to get more findings that are important from the point of view of clinical application.

Ⅴ. Limitation

This study was conducted as an ancillary study to the EASED study with the primary outcome of prognosis of cancer patients admitted to a palliative care unit. Therefore, the analysis may not have included all factors associated with falls. The same palliative physician completed all observations on the participants. Therefore, while consistency in ratings might be an advantage, observer bias also needs to be considered. Inter-rater reliability should be developed.

Ⅵ. Conclusion

We analyzed the background factors associated with the frequency and prediction of falls in cancer patients admitted to a palliative care ward. The accuracy of predicting falls in the palliative care ward can be improved by focusing on the decline in physical function to the extent that the frequency of falls increases.

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References

Barker, A. L., Morello, R. T., Wolfe, R., Brand, C. A., Haines, T. P., Hill, K. D., Brauer, S. G., Botti, M., Cumming, R. G., Livingston, P. M., Sherrington, C., Zavarsek, S., Lindley, R. I., & Kamar, J. (2016). 6-PACK programme to decrease fall injuries in acute hospitals: Cluster randomised controlled trial. *BMJ (Online)*, *352*, 1–9. https://doi.org/10.1136/bmj.h6781

Bergen, G., Stevens, M. R., & Burns, E. R. (2016). Falls and fall injuries among adults ages over 65 years. *Morbidity and Mortality Weekly Report*, *65*(37), 993–998.

Breiman, L., Friedman J. H., Olshen, R. A., & Stone, C. J. (1984). *Classification and regression trees*. Montery CA: Brooks/Cole.

Cheng, S. Y., Lin, W. Y., Cheng, Y. H., Huang, C. H., Chen, C. Y., Hwang, S. J., Tsai, S. T., & Chiu, T. Y. (2016). Cancer patient autonomy and quality of dying-a prospective nationwide survey in Taiwan. *Psycho-oncology*, *25*(2), 179-186. https://doi.org/10.1002/pon.3901

Goodridge, D., & Marr, H. (2002). Factors associated with falls in an inpatient palliative care unit: An exploratory study. *International Journal of Palliative Nursing*, *8*(11), 548–556. https://doi.org/10.12968/ijpn.2002.8.11.10897

Kashiwagi, H. Hayashi, K., Mori, M. & Otani H. (2020). Classification of fall risk in pallative care wards [Proceedings]. 39th Japanese Classification Society, 67 - 70 .

Stone, C. A., Lawlor, P. G., Savva, G. M., Bennett, K., & Kenny, R. A. (2012). Prospective study of falls and risk factors for falls in adults with advanced cancer. *Journal of Clinical Oncology*, *30*(17), 2128–2133. https://doi.org/10.1200/JCO.2011.40.7791

Zhang, X., Sun, M., Liu, S., Leung, C. H., Pang, L., Popat, U. R., Champlin, R., Holmes, H. M., Valero, V., Dinney, C. P., Tripathy, D., & Edwards, B. J. (2018). Risk factors for falls in older patients with cancer. *BMJ Supportive and Palliative Care*, *8*(1), 34–37. https://doi.org/10.1136/bmjspcare-2017-001388