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Original Article

Enhancing hospice care with psychological support and a nomogram to predict delirium in patients with advanced solid tumors

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Abstract: To assesses the impact of integrating hospice care with psychological interventions on patient well-being and to introduce a predictive nomogram model for delirium that incorporates clinical and psychosocial variables, thereby improving the accuracy in hospice care environments. Data from 381 patients treated from September 2018 to February 2023 were analyzed. The patients were divided into a control group (n=177, receiving standard care) and an experimental group (n=204, receiving combined hospice care and psychological interventions) according to the treatment modality. The duration of care extended until the patient's discharge from the hospital or death. The experimental group demonstrated significant improvements in emotional well-being and a lower incidence of delirium compared to the control group. Specifically, emotional well-being assessments revealed marked improvements in the experimental group, as evidenced by lower scores on the Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS) post-intervention. The nomogram model, developed using logistic regression based on clinical characteristics, effectively predicted the risk of delirium in patients with advanced cancer. Significant predictors in the model included ECOG score ≥3, Palliative Prognostic Index score ≥6, opioid usage, polypharmacy, infections, sleep disorders, organ failure, brain metastases, electrolyte imbalances, activity limitations, pre-care SAS score ≥60, pre-care SDS score ≥63, and pre-care KPS score ≥60. The model's predictive accuracy was validated, showing AUC values of 0.839 for the training cohort and 0.864 for the validation cohort, with calibration and Decision Curve Analysis (DCA) confirming its clinical utility. Integrating hospice care with psychological interventions not only significantly enhanced the emotional well-being of advanced cancer patients but also reduced the actual incidence of delirium. This approach, offering a valuable Nomogram model for precise care planning and risk management, underscores the importance of integrated, personalized care strategies in advanced cancer management.

Keywords: Hospice care, psychological interventions, advanced cancer, dysphoria, delirium

Introduction

According to the latest data published by the International Agency for Research on Cancer (IARC), the global cancer burden for 2020 includes approximately 19.29 million new cancer cases - 10.06 million in men and 9.23 million in women - along with 9.96 million cancer-related deaths, with 5.53 million men and 4.43 million women affected [1]. This significant impact positions China as a key player in the global cancer landscape. In the United States, the cost for medical care in the last month of life for patients with advanced cancer reaches approximately $21,093 [2]. In Canada, the average cost of hospitalization for patients at the end of life is reported to be $38,820 [3]. In China, the total annual medical expenditure on malignant tumors exceeds $220 billion, with the costs in the last three months of life for patients with advanced cancer accounting for about two-fifths of the total treatment expenditure [4-7].

Delirium, a clinical syndrome characterized by cognitive dysfunction, often presents with acute onset, fluctuating consciousness, attention deficits, and cognitive decline [8-10]. Several factors can precipitate delirium, including drug side effects, metabolic disorders, sys-

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temic infections, and direct effects of the cancer itself [11]. Patients with advanced cancer are particularly vulnerable to delirium due to their inherent physical and psychological vulnerability and multiple contributing factors, such as chemotherapy and radiation therapy, medication side effects, electrolyte imbalances, pain, sleep disturbances, and potential comorbidities [12]. These concurrent factors significantly increase the risk of delirium, adversely affecting patients' quality of life and creating challenges for families and healthcare teams.

Traditional models of cancer care, which focus primarily on physical treatments such as chemotherapy, radiation, and surgery, often neglect the psychological and emotional needs of patients. This neglect is particularly evident in the advanced stages of cancer, where patients may experience significant psychological distress, anxiety, and uncertainty, underscoring the inadequacy of traditional models of care in addressing these non-biological concerns [13]. Hospice care, which adopts a holistic model of care, not only manages physical symptoms but also addresses the psychological, social, and spiritual needs of patients [14]. Beyond physical symptom management, psychological interventions are crucial in the comprehensive care of patients with advanced cancer to provide emotional support, reduce psychological distress, improve quality of life, and promote effective communication between patients and their families [15]. Such interventions can directly improve patients' psychological health and indirectly benefit their physiological condition, for example, by reducing anxiety and depression, which in turn can improve sleep quality and pain management. Integrating psychological interventions into the comprehensive treatment plan for patients with advanced cancer is essential to improving their overall well-being [16].

Compared with conventional cancer care, hospice care places a strong emphasis on personalized attention, focusing on pain and symptom management, psychological support, and spiritual comfort, thereby significantly enhancing the quality of life for patients with advanced cancer [17]. This holistic approach not only alleviates symptoms of delirium and supports family members, ensuring a dignified and peaceful end of life, but also underscores the importance of early recognition and prediction of delirium as critical components in improving care quality for these patients [10]. Previous studies, while focusing on these outcomes, have not developed a predictive model to assess and validate the protective factors against delirium provided by these care strategies. Our study addresses this gap by creating a predictive nomogram model that integrates both clinical and psychosocial variables, enhancing the precision of delirium risk assessment in hospice care settings. Delirium, which severely impairs patients' quality of life and increases healthcare resource utilization and costs, highlights the clinical necessity for developing an effective prediction model. Such a model aims to facilitate the early identification of high-risk patients, allowing for the timely implementation of targeted prevention and intervention strategies. This integrated care strategy underscores the synergistic benefits of combining hospice care with proactive delirium management, demonstrating a comprehensive approach to enhancing patient well-being and optimizing healthcare resources.

In the context of existing literature, the integration of hospice care and psychological interventions in the management of advanced cancer patients has not been thoroughly explored. Previous models have predominantly focused on either aspect in isolation, overlooking the synergistic potential of combining both approaches. This oversight represents a significant gap, as the complex challenges faced by these patients often necessitate a multifaceted care strategy that addresses both physical symptoms and psychological distress. Furthermore, existing delirium prediction models have been limited by their reliance on either clinical or psychosocial variables, neglecting the comprehensive assessment that integrates both dimensions. Our study innovatively bridges these gaps, combining hospice care and psychological interventions to evaluate their collective impact on adverse emotional responses and delirium risk in advanced cancer patients. By adopting this holistic approach, we aim to unveil more personalized and comprehensive care strategies that effectively address the multifaceted needs of advanced cancer patients. Additionally, the developed prediction model for delirium, leveraging a wide range of

both clinical and psychosocial variables, represents a significant advancement over existing models by providing a more accurate and practical tool for guiding clinical nursing practice and patient care.

Materials and methods

Sample sources

Clinical data was retrospectively collected from patients with advanced cancer that treated in the People's Hospital of Rugao during September 2018 and February 2023. The study was approved by the medical ethics committee of the People's Hospital of Rugao (2023084 (L)).

Inclusion criteria: 1. Patients clinicopathologically diagnosed with cancer with an expected survival time of ≤3 months (n=464). 2. Patients aged ≥18 years (n=440). 3. Patients and their families who declined antitumor therapy aimed primarily at prolonging survival time (n=427). 4. Patients who received either routine care or hospice care combined with psychological interventions (n=420). 5. Patients with complete clinical data (n=412).

Exclusion criteria: 1. End-stage cancer patients with hospitalization ≤48 h (n=407). 2. People with mental illness (n=392). 3. Patients suffering from severe organ function damage or severe diseases of the blood and immune systems (n=386). 4. Patients with a Karnofsky Performance Scale (KPS) score <30 (n=381).

Delirium was screened using the Nursing Delirium Screening Scale (NU-DESC) [18], which includes four key features: inattention, altered level of consciousness, acute or fluctuating mental status changes, and disorganized thinking. A diagnosis of delirium can be made when a patient exhibits three of these features simultaneously. In addition, the scale assesses eleven items, including perceptual disturbances, psychomotor retardation/excitement, disorganized thinking, acute onset, and disorientation, with a total possible score of 44. A score of less than 9 indicates no delirium, a score between 20 and 22 suggests possible delirium, and a score greater than 22 confirms a diagnosis of delirium. All patients were assessed upon admission.

Sample screening and grouping

Three hundred and eighty-one eligible cases were screened according to the inclusion-exclusion criteria, including 177 patients received conventional care as the control group, and 204 patients received hospice care combined with psychological intervention as the experimental group. According to the occurrence of delirium, the patients were divided into a delirium group and a non-delirium group, and a nomogram prediction model was constructed based on the independent risk factors screened by logistic regression analysis. Finally, to validate the effectiveness of the model, we divided the patients into a training set and a validation set according to a ratio of 7:3. A brief flow chart is shown in **Figure 1**.

Clinical data collection

The content of the questionnaire was designed based on the national and international literature and tailored to the purpose of the study. Data were sourced from the patient's electronic medical records and outpatient review records, including clinical information and functional scores.

The Eastern Cooperative Oncology Group (ECOG) scale was utilized to assess the patient's level of functioning: 0 - fully active; 1 - symptomatic but ambulatory, capable of light work; 2 - capable of self-care, bedridden less than 50% of the day; 3 - limited self-care, bedridden more than 50% of the day; 4 - totally disabled; 5 - deceased [19]. In addition, the Palliative Prognostic Index score [20] ranges from 0 to 15, with higher scores indicating a poorer prognosis. Clinical factors such as infection, sleep disorders, hepatic and renal failure, tumor and brain metastases, benzodiazepine use and multidrug combinations were also taken into account.

Functional scores were assessed using the KPS [21], which assesses the patient's ability to perform activities of daily living and self-care, with scores ranging from 0 (dead) to 100 (normal with no symptoms or signs of disease). The Self-Anxiety Scale (SAS) [22] was used to quantify anxiety level with scores ranging from 20 to 80, where higher scores indicate more severe anxiety. The Self-Depression Scale (SDS) [23] was used to assess depression level

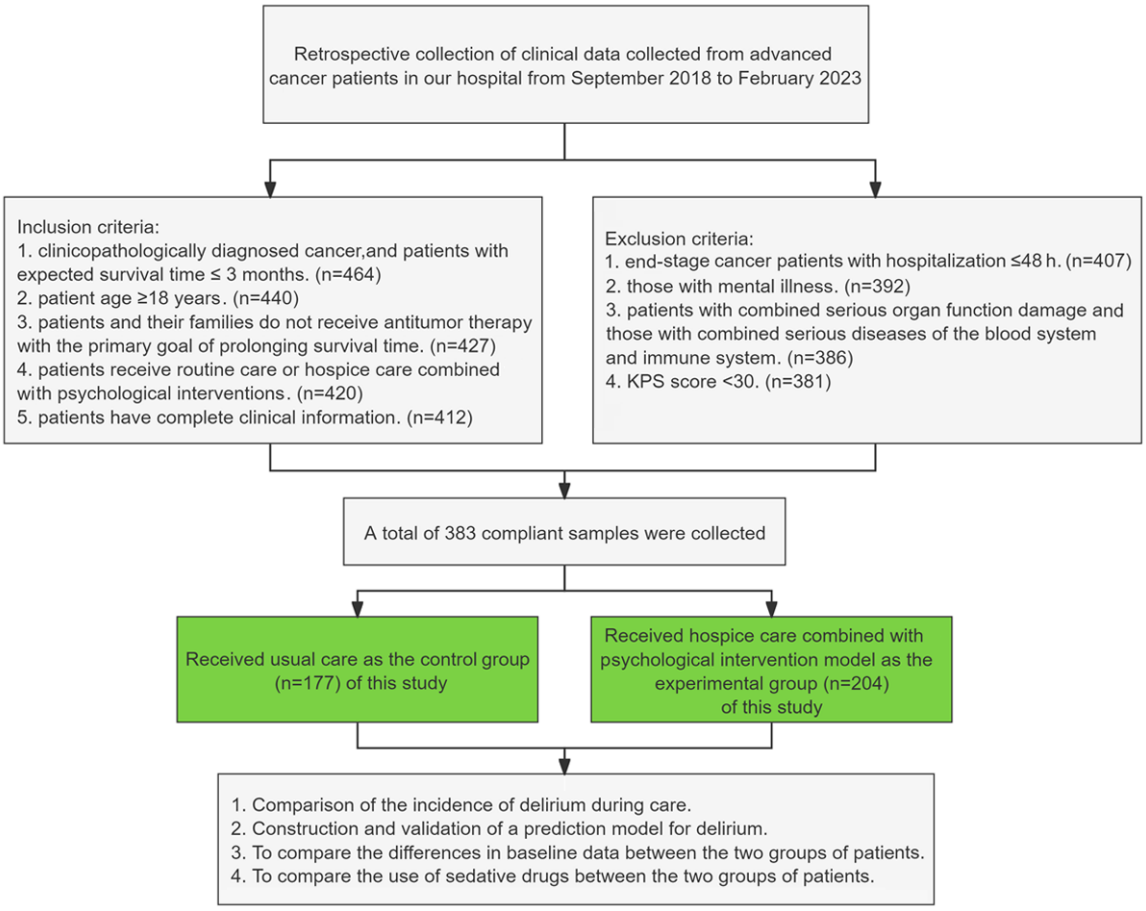

Figure 1. Flowchart of sample screening and result analysis.

with scores ranging from 20 to 80, where higher score indicates more severe depression in the patients. These functional scores were recorded before the nursing intervention and 1 month after the intervention. Delirium was systematically assessed from the beginning of the patient's hospital stay using established criteria, ensuring continuous monitoring throughout their care to reflect the dynamic nature of this condition and its impact on patient care. Note: All data were initially obtained upon admission, except for opioids and benzodiazepines (all of these medications were recorded at discharge or at death), and functional scores which were assessed after each intervention.

Comprehensive nursing intervention program

Patients in the control group received routine care which mainly included condition monitoring, vital signs monitoring, psychological counseling, health education, and primary life care. At the same time, the patients received appropriate immunosuppressive therapy.

The experimental group followed a model that integrated the hospice care and psychological intervention [11]: 1. Systematic training and diagnosis: Nursing staff underwent systematic training to master the latest knowledge of hospice care, which were applied to practical work. Patients admitted to the hospital received a detailed diagnosis to ensure that individualized hospice care and psychological interventions could be provided. 2. Comprehensive life care: Nurses monitored the patient's clinical indicators and vital signs continuously, and provided nutritional support and appropriate treatment. Daily care included psychological comfort measures such as playing music and aromatherapy to improve the patient's psychological state and sleep quality. 3. Death education and grief counseling: The nursing care emphasized psychological communication with patients and

provided death education and grief counseling. Through the establishment of trusting relationships and effective communication, the nursing team helped patients and their families in accepting the natural process of dying managing grief. 4. Intensive psychological intervention: Tailored psychological interventions were provided based on the conditions of terminal patients, using gentle and enlightening communication methods to alleviate patients' psychological burdens and help patients calmly accept their impending death. 5. Multidisciplinary support: Using a comprehensive approach that leveraged multidisciplinary knowledge and comforting methods, the team supported the family to maintain an optimistic attitude in the final stage of the patient's life. Note: The difference between the two care programs stems from an upgrade in the hospital's care programs. From September 2018 to January 2021, all patients with advanced cancer received the routine care. From February 2021 to February 2023, the care program for patients with advanced cancer was upgraded to the psychological intervention combined with hospice care model (Supplementary Materials).

Outcome measurement

Primary outcomes: 1. Comparison of the incidence of delirium during care. 2. Construction and validation of a prediction model for delirium.

Secondary outcomes: 1. Comparison of differences in baseline data between the two groups of patients. 2. Comparison of the use of sedative drugs between the two groups of patients.

Statistical analysis

Data were statistically analyzed using SPSS 26.0. The collected data were all counting data that described as frequencies and percentages. The intergroup analysis was conducted using chi-square analysis. Independent risk factors affecting the occurrence of delirium in patients were analyzed by logistic regression. The effectiveness of the predictive model was analyzed using the receiver operating characteristic (ROC) curve. The nomogram was visualized using the rms package in the R software, and the accuracy and clinical efficacy of the model were verified using calibration and decision curves (DCA) implemented using the rms and DCA packages. Differences between the ROC curves of successive models were analyzed by the Delong test. $P<0.05$ indicated a statistical difference.

Results

Comparison of baseline data between the two groups of patients

The analysis of baseline data revealed no statistical differences in age, gender, tumor type, smoking history, alcohol abuse history, hospitalization duration, ECOG score, or palliative prognostic index score between the control and experimental groups (all $P>0.05$, **Table 1**).

Comparison of the sedative drug dose between the two groups of patients

The usage of sedative drugs was notably higher in the control group compared to the experimental group, showing a significant statistical difference ($P<0.001$, **Table 2**).

Comparison of the incidence of delirium between the two groups of patients

The incidence of delirium in the two groups of patients was counted. It was found that the incidence of delirium in patients of the control group was significantly higher than that in patients of the experimental group ($P<0.001$, **Table 3**).

Analysis of clinical data in patients with delirium

Patients were divided into a delirium group (n=198) and a non-delirium group (n=183). Comparison of clinical data revealed no statistical differences in age, gender, tumor type, history of smoking and alcoholism, benzodiazepine use, or tumor metastasis between the groups (all $P>0.05$, **Table 4**). However, significant differences were observed in ECOG scores (≥3), Palliative Prognostic Index scores (≥6), use of infectious agents, multiple drugs, infections, sleep disorders, hepatic and renal failure, brain metastases, electrolyte disturbances, activity limitation, pre-care SAS scores (≥60), pre-care SDS scores (≥63), and pre-care KPS scores (≥60) (all $P<0.05$, **Table 5**). Logistic regression identified these factors as independent risk factors for delirium development in patients (**Table 6**).

Table 1. Comparison of baseline data

	Control group (n=177)	Experimental group (n=204)	χ^2-value	*P*-value
Age (years)				
≥65	89 (50.28%)	106 (51.96%)	0.107	0.744
<65	88 (49.72%)	98 (48.04%)		
Gender				
Male	118 (66.67%)	132 (64.71%)	0.162	0.688
Female	59 (33.33%)	72 (35.29%)		
Tumor type				
Lung cancer	82 (46.32%)	89 (43.62%)		
Breast cancer	64 (36.15%)	60 (29.41%)	5.226	0.073
Other	31 (17.53%)	55 (26.97%)		
Smoking history				
Yes	55 (31.07%)	55 (26.96%)	0.163	0.686
No	122 (68.93%)	149 (73.04%)		
History of alcohol abuse				
Yes	66 (37.29%)	72 (35.29%)	3.203	0.073
No	111 (62.71%)	132 (64.71%)		
ECOG score				
≥3	101 (57.06%)	104 (50.98%)	0.332	0.565
<3	76 (42.94%)	100 (49.02%)		
Palliative Prognostic Index score				
≥6	92 (51.98%)	100 (49.02%)	0.018	0.892
<6	85 (48.02%)	104 (50.98%)		
Infections				
Yes	58 (32.77%)	59 (28.92%)	0.659	0.417
No	119 (67.23%)	145 (71.08%)		
Sleep disorder				
Yes	79 (44.63%)	87 (42.65%)	0.152	0.697
No	98 (55.37%)	117 (57.35%)		
Liver and kidney failure				
Yes	57 (32.2%)	51 (25%)	2.421	0.120
No	120 (67.8%)	153 (75%)		
Tumor metastasis				
Yes	75 (42.37%)	92 (45.1%)	0.286	0.593
No	102 (57.63%)	112 (54.9%)		
Brain metastasis				
Yes	29 (16.38%)	31 (15.2%)	0.101	0.751
No	148 (83.62%)	173 (84.8%)		

Note: ECOG, Eastern Cooperative Oncology Group Performance Status.

Construction of a nomogram prediction model for delirium

The nomogram model was built upon 11 independent risk factors identified through logistic regression. Each variable in the model was assigned with a specific score. The sum of these scores on the "total score axis" correlates with a predicted delirium risk in advanced cancer patients. For instance, a patient with a specific clinical profile (detailed in the manuscript) scored 404.75 on the model, indicating a 50% delirium risk (**Figure 2A**). Validation of the model's efficacy involved ROC curve, DCA curve, and calibration curve analyses. The ROC curve demonstrated an AUC of 0.847 in deliri-

Table 2. Comparison of usage of sedative drugs between the two groups

Group	Opioids	Benzodiazepines	Multi-drug combinations
Control group (n=177)	115 (64.97%)	69 (38.98%)	68 (38.42%)
Experimental group (n=204)	101 (49.51%)	59 (28.92%)	48 (23.53%)
χ^2-value	9.228	4.301	9.921
P-value	0.002	0.038	0.002

Table 3. Comparison of delirium incidence between two groups

Variable	Control group (n=177)	Experimental group (n=204)	χ^2-value	*P*-value
Delirium group (n=198)	110 (55.56%)	88 (44.44%)	13.72	<0.001
Non-delirium group (n=183)	67 (36.61%)	116 (63.39%)		

Table 4. Analysis of clinical data of patients with and without delirium

Variable	Delirium group (n=198)	Non-delirium group (n=183)	χ^2-value	*P*-value
Age (years)				
≥65	107 (54.04%)	88 (48.09%)	1.349	0.245
<65	91 (45.96%)	95 (51.91%)		
Gender				
Male	131 (66.16%)	119 (65.03%)	0.054	0.815
Female	67 (33.84%)	64 (34.97%)		
Tumor type				
Lung cancer	91 (45.96%)	80 (43.72%)		
Breast cancer	67 (33.84%)	57 (31.15%)	1.344	0.511
Other	40 (20.20%)	46 (25.13%)		
Smoking history				
Yes	59 (29.8%)	51 (27.87%)	0.172	0.678
No	139 (70.2%)	132 (72.13%)		
History of alcohol abuse				
Yes	63 (31.82%)	75 (40.98%)	3.458	0.063
No	135 (68.18%)	108 (59.02%)		
ECOG score				
≥3	119 (60.1%)	86 (46.99%)	6.573	0.010
<3	79 (39.9%)	97 (53.01%)		
Palliative Prognostic Index score				
≥6	115 (58.08%)	77 (42.08%)	9.744	0.002
<6	83 (41.92%)	106 (57.92%)		
Opioids				
Yes	137 (69.19%)	79 (43.17%)	26.23	<0.001
No	61 (30.81%)	104 (56.83%)		
Benzodiazepines				
Yes	75 (37.88%)	53 (28.96%)	3.390	0.066
No	123 (62.12%)	130 (71.04%)		
Multi-drug combinations				
Yes	87 (43.94%)	29 (15.85%)	35.442	<0.001
No	111 (56.06%)	154 (84.15%)		
Infections				
Yes	77 (38.89%)	40 (21.86%)	12.964	<0.001
No	121 (61.11%)	143 (78.14%)		

Sleep disorder				
Yes	107 (54.04%)	59 (32.24%)	18.383	<0.001
No	91 (45.96%)	124 (67.76%)		
Liver and kidney failure				
Yes	69 (34.85%)	38 (20.77%)	9.340	0.002
No	129 (65.15%)	145 (79.23%)		
Tumor metastasis				
Yes	79 (39.9%)	88 (48.09%)	2.590	0.108
No	119 (60.1%)	95 (51.91%)		
Brain metastasis				
Yes	42 (21.21%)	18 (9.84%)	9.276	0.002
No	156 (78.79%)	165 (90.16%)		
Electrolyte disturbance				
Yes	50 (25.13%)	27 (14.75%)	6.372	0.012
No	149 (74.87%)	156 (85.25%)		
Limited mobility				
Yes	111 (56.06%)	73 (39.89%)	9.958	0.002
No	87 (43.94%)	110 (60.11%)		
Pre-care SAS scores				
≥60	63 (31.82%)	27 (14.75%)	15.349	<0.001
<60	135 (68.18%)	156 (85.25%)		
Pre-care SDS scores				
≥63	50 (25.13%)	18 (9.84%)	15.231	<0.001
<63	149 (74.87%)	165 (90.16%)		
Pre-care KPS scores				
≥60	89 (44.95%)	119 (65.03%)	15.466	<0.001
<60	109 (55.05%)	64 (34.97%)		
Nursing program				
Control group	110 (55.56%)	67 (36.61%)	13.72	<0.001
Experimental group	88 (44.44%)	116 (63.39%)		

Note: ECOG, Eastern Cooperative Oncology Group Performance Status; KPS, Karnofsky Performance Scale; SAS, Self-Rating Anxiety Scale; SDS, Self-Rating Depression Scale.

um prediction (**Figure 2B**), while the DCA curve indicated a high net benefit rate (**Figure 2C**). The calibration curve showed a close alignment between predicted and actual probabilities, particularly in lower probability regions (**Figure 2D**).

Validation of predictive models

To assess the model's generalizability, the original data were split into training and validation sets in a 7:3 ratio. No significant differences were found in baseline data between these sets (**Table 7**, P>0.05). ROC, DCA, and calibration curve analyses confirmed the model's predictive accuracy, with AUC values of 0.839 and 0.864 in the training and validation sets, respectively (**Figure 3A**, **3D**). The DCA curves showed that the model provided higher net gains compared to the None or All line scenarios across most threshold settings (**Figure 3B**, **3E**). The calibration curves further validated the congruence between the model's predictions and observed probabilities, especially in low probability regions (**Figure 3C**, **3F**). Finally, the two sets of data were tested, and there was no statistical difference between the validation set and the training set (P=0.558, Delong = -0.587).

Discussion

In this study, we retrospectively analyzed the effect of hospice care combined with the psychological intervention model and found that it significantly reduced the use of sedatives and

Table 5. Assignment table

Variable	Assignment content
ECOG score	≥3 points =1, <3 points =0
Palliative Prognostic Index score	≥6 points =1, <6 points =0
Infect	Yes =1, No =0
Multi-drug combination	Yes =1, No =0
Infections	Yes =1, No =0
Sleep disorders	Yes =1, No =0
Hepatic and renal failure	Yes =1, No =0
Brain Metastases	Yes =1, No =0
Electrolyte disorders	Yes =1, No =0
Restricted mobility	Yes =1, No =0
Before care SAS score	≥60 points =1, <60 points =0
Before care SDS score	≥63 points =1, <63 points =0
Before care KPS score	≥60 points =1, <60 points =0
Nursing Programs	Control group =1, experimental group =0
Delirium status	Existence =1, non-existence =0

Note: ECOG, Eastern Cooperative Oncology Group Performance Status; KPS, Karnofsky Performance Scale; SAS, Self-Rating Anxiety Scale; SDS, Self-Rating Depression Scale.

Table 6. Independent risk factors for delirium

	β	Standard error	χ^2	*P*-value	OR value	95% CI	
						Lower limit	Limit
ECOG score	0.394	0.262	2.268	0.132	1.483	0.888	2.477
Palliative Prognostic Index score	0.851	0.265	10.294	0.001	2.341	1.392	3.936
Multi-drug combinations	1.579	0.304	26.914	<0.001	4.848	2.67	8.803
Infections	0.882	0.289	9.308	0.002	2.415	1.371	4.256
Sleep disorder	1.035	0.265	15.219	<0.001	2.814	1.673	4.732
Liver and kidney failure	0.899	0.293	9.393	0.002	2.456	1.383	4.364
Brain metastasis	0.843	0.382	4.876	0.027	2.322	1.099	4.907
Electrolyte disturbance	0.585	0.333	3.089	0.079	1.795	0.935	3.447
Limited mobility	0.627	0.262	5.726	0.017	1.872	1.12	3.128
Pre-care SAS scores	1.150	0.316	13.193	<0.001	3.157	1.698	5.87
Pre-care SDS scores	1.493	0.373	16.037	<0.001	4.448	2.143	9.235
Pre-care KPS scores	-1.002	0.264	14.416	<0.001	0.367	0.219	0.616
Nursing program	0.773	0.266	8.475	0.004	2.167	1.287	3.647

Note: KPS, Karnofsky Performance Scale; SAS, Self-Rating Anxiety Scale; SDS, Self-Rating Depression Scale.

improved patients' quality of life and adverse emotional states. We also found that hospice care combined with the psychological intervention model reduced the incidence of delirium. These findings suggest that a more comprehensive and humanized approach to care is essential in advanced cancer care. This approach focuses not only on the patient's physical health, but also on psychological and emotional support, which is pivotal in improving the patient's overall quality of life. By reducing medication dependency and side effects while alleviating clinical symptoms such as delirium, this integrated care model plays a critical role in improving patient comfort and psychological well-being.

Hospice care embodies a comprehensive and proactive approach to support terminally ill patients, as highlighted in the literature [24]. It is initiated when a clinician conclusively determines the terminal nature of the patient's con-

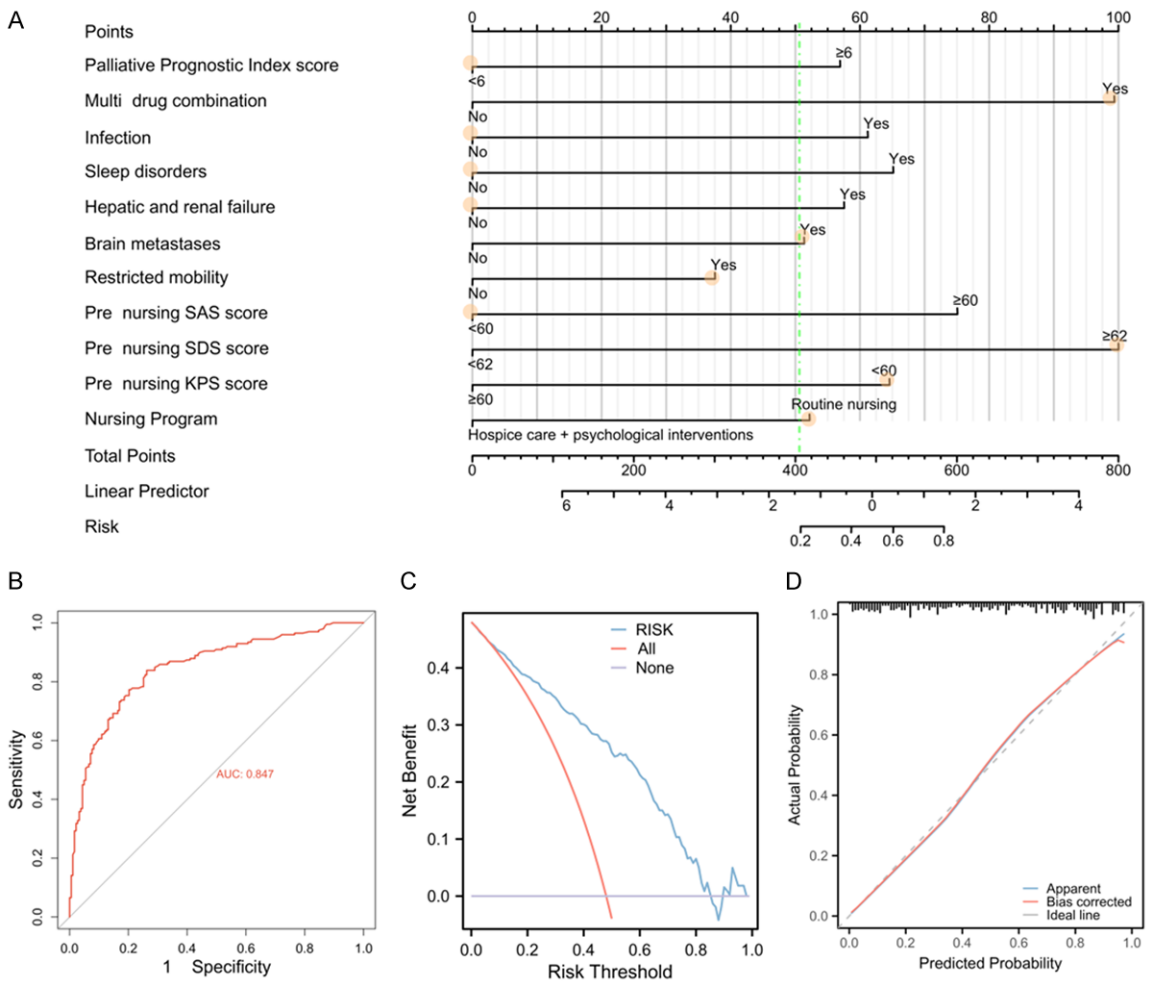

Figure 2. Nomogram Model construction and internal validation. A: Impact of nominal variables on the predictive model; green line segments indicate scores and incidence rates for randomly selected patients. B: ROC curve analysis. C: Decision curve analysis. D: Calibration curve. Note: KPS, Karnofsky Performance Scale; SAS, Self-Rating Anxiety Scale; SDS, Self-Rating Depression Scale.

dition, recognizing that further medical intervention is unlikely to alter the prognosis. This acknowledgment facilitates a process whereby patients and their families come to terms with the inevitability of the situation and accept that prolonging life may not be feasible. For example, Mah et al. [25] found that early palliative care provided in an outpatient setting significantly improved the quality of life of patients with advanced cancer, although its impact on quality of dying, death, and end-of-life quality varied. Similarly, Seow et al. [26] observed a reduced absolute risk difference in hospital death among cancer patients who received palliative care six months before death compared with those who did not. Conversely, the likelihood of receiving supportive home care in the last month was significantly increased. Furthermore, in a systematic review, Riahi et al. [27] highlighted the importance of addressing spiritual needs alongside psychological interventions to improve quality of life and alleviate negative emotions in patients. These findings are consistent with our observations and underscore the importance of a holistic approach that integrates the physical, psychological, social, and spiritual needs of patients in hospice and palliative care. By focusing on symptom relief and providing comprehensive support, hospice care aims to ensure that patients and their families can approach the end of life with dignity and peace, which is paramount.

Delirium, characterized by cerebral dysfunction due to generalized brain hypofunction and

Table 7. Analysis of clinical data of patients in the training and validation sets

	Training group (n=266)	Validation group (n=115)	χ^2-value	*P*-value
Palliative Prognostic Index score				
≥6	132	60	0.209	0.648
<6	134	55		
Multi-drug combinations				
Yes	77	39	0.935	0.334
No	189	76		
Infections				
Yes	77	40	1.285	0.257
No	189	75		
Sleep disorder				
Yes	118	48	0.224	0.636
No	148	67		
Liver and kidney failure				
Yes	75	33	0.010	0.921
No	191	82		
Brain metastasis				
Yes	40	20	0.335	0.563
No	226	95		
Limited mobility				
Yes	133	51	1.027	0.311
No	133	64		
Pre-care SAS scores				
≥60	58	32	1.614	0.204
<60	208	83		
Pre-care SDS scores				
≥63	44	24	1.026	0.311
<63	222	91		
Pre-care KPS scores				
≥60	142	66	0.520	0.471
<60	124	49		
Nursing program				
Control group	119	58	1.048	0.306
Experimental group	147	57		

Note: ECOG, Eastern Cooperative Oncology Group Performance Status; KPS, Karnofsky Performance Scale; SAS, Self-Rating Anxiety Scale; SDS, Self-Rating Depression Scale.

heightened excitability of higher nerve centers, is a significant clinical challenge that manifests as acute activity disturbance [28]. Its prevalence in clinical settings varies widely, reported from 3% to 42% [29], and may exceed 50% in advanced cancer patients. Dezube et al. [30] found a 16.93% incidence rate of postoperative delirium in a retrospective study of 378 esophageal cancer cases. Similarly, a Japanese study [31] found a 57% incidence of delirium in 87 postoperative esophageal cancer patients and associated excessive alcohol consumption and severe postoperative respiratory complications with a higher risk of delirium in men. Hosie et al. [32] reported delirium incidence rates ranging from 56.8% to 90.0% in advanced cancer patients. Our results with a delirium incidence of 51.9% in 381 patients confirm these observations.

In our study, we identified various independent risk factors for delirium, including physical health status, mental and emotional well-being, and functional status, in addition to nursing

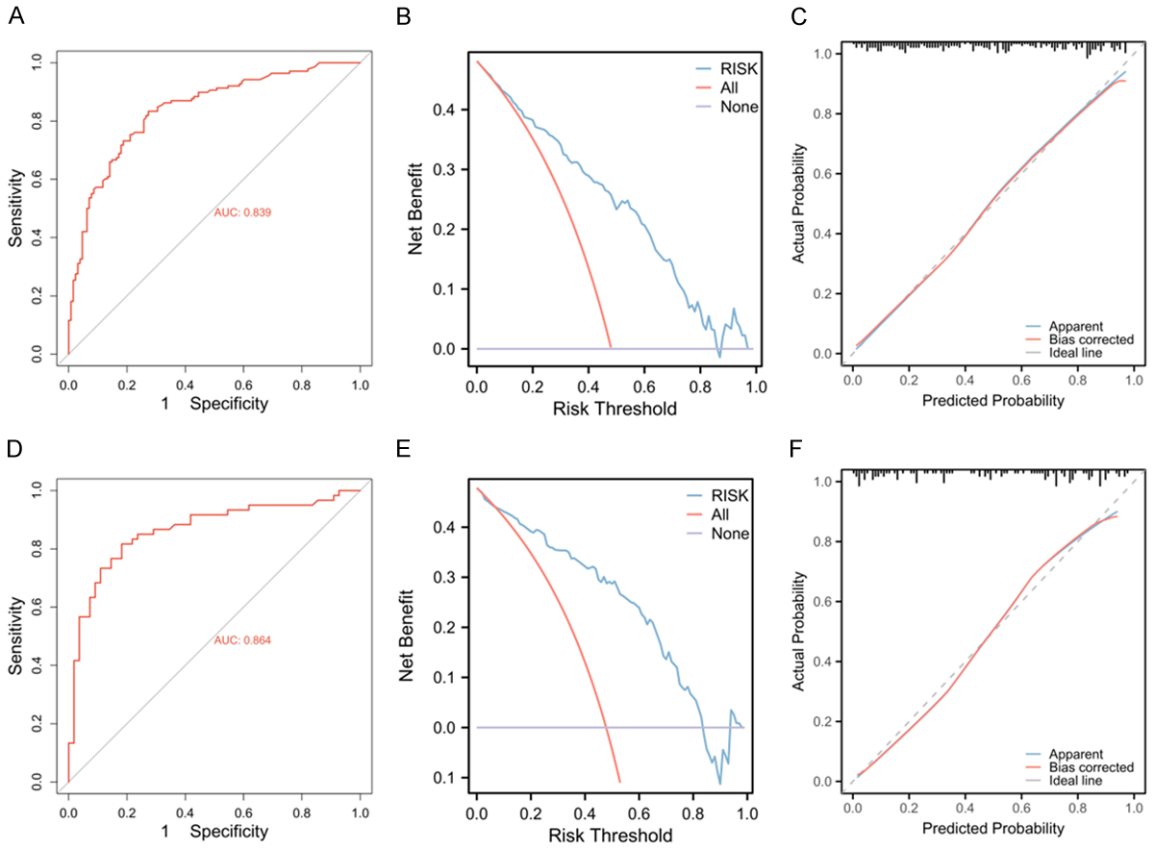

Figure 3. Validation of the model with training and validation sets. A-C: Accuracy and clinical efficacy assessment of predictive models with training set data. D-F: Validation set data for accuracy and clinical efficacy assessment of predictive model.

care. Factors associated with physical health include the severity of cancer progression and the Palliative Prognostic Index score, which reflects the patient's overall health and life expectancy and indicates the degree of physiologic frailty [33]. The risk is compounded by polypharmacy, which can lead to increased drug-drug interactions and physical burden. Complications such as infections exacerbate the patient's condition and disease progression [34], while liver and kidney failure impair drug metabolism and excretion, increasing the risk of toxicity [35]. Brain metastases, signifying invasion of the central nervous system, directly affect brain function, increasing the likelihood of delirium [36]. Mental and emotional state factors highlight the psychological health of patients, with anxiety and depression assessed by SAS and SDS scores, respectively, marking critical concerns for advanced cancer patients facing end-of-life distress [37]. These psychological aspects not only affect mental health but can also impair cognitive function and increase the risk of delirium [38]. Functional status and care needs, as indicated by activity limitations and the pre-care KPS score, suggest a need for more care and support due to reduced self-care abilities, reflecting poorer overall health [39]. This study emphasizes the "program of care" that integrates hospice care with psychological interventions to provide a holistic approach that includes traditional medical care, symptom management, and psychological support. This model ensures that patients receive comprehensive care that addresses both their physical symptoms and the psychological and emotional challenges of their illness.

The Nomogram model serves as an important quantitative tool for clinicians to improve the accuracy of assessing a patient's delirium risk, thereby facilitating more informed decision-making in care planning and management [40].

In this study, we developed a nomogram model using existing data to identify delirium risk in patients with advanced cancer. This model provides clinicians with a reliable quantitative method of assessing delirium risk that is designed to encompass a wide range of potential risk factors, thereby enhancing the predictive accuracy and reliability of the model. By adhering to the "one-tenth rule" and utilizing the entire data set without segregation into training and validation sets, our approach ensures a comprehensive assessment of the multiple elements that influence the onset of delirium. Through this model, we have identified critical factors that are significantly correlated with the risk of delirium, laying the groundwork for tailored care and interventions for patients with advanced cancer.

This study examined the impact of a combined hospice care and psychological intervention model on patients with advanced cancer. However, it was limited by a sample from a single healthcare organization, a retrospective study, and the need for long-term follow-up data. Future studies should increase the sample size, use a prospective design and conduct long-term follow-up to improve the generalizability of the study and provide insight into the long-term effects of such interventions to improve the quality of care for patients with advanced cancer.

Conclusion

Integrating of hospice care with psychological interventions significantly improves the quality of life and reduces delirium in advanced cancer patients, by providing a holistic approach that integrates physical, psychological, and emotional care. Our nomogram model provides clinicians with an accurate tool for assessing delirium risk, and supports informed decisions in care decisions.

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Disclosure of conflict of interest

None.

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Supplementary Materials

Conduct systematic training for nursing staff to strengthen the patient's admission condition inquiry

In order to help nursing staff in the emergency department room to understand and master the latest hospice knowledge, as well as apply the theoretical knowledge to practical work, we plan to conduct systematic training for all practicing nursing staff. This training will be conducted through reviewing relevant information, PowerPoint presentations and practical simulations, and the nurse manager will be responsible for teaching and practical guidance throughout the process. When a patient is admitted to the hospital, the nursing staff will first learn the basic information about the patient's condition, medical history and family situation. For those patients whose conditions are too serious to be treated, nursing staff will explain to their families and obtain their consent, and then arrange the patients to the hospice ward to receive systematic hospice care and psychological intervention.

Give patients attentive life care

In daily nursing care, nursing staff need to pay close attention to the changes of patients' clinical indicators and vital signs around the clock and provide patients with appropriate nutritional support therapy and immunotherapy under the premise of complying with medical advice. They also regularly remind patients to take medication on time and create a comfortable treatment environment for them. In order to help patients adjust their mindset and alleviate their fear of death, the nursing staff regularly play some of the patients' favorite music with soothing rhythms every day. In this study, some patients suffered from advanced malignant tumors and had experienced multiple chemotherapy treatments, which led to constipation problems. For these patients, the nursing staff can use appropriate amount of moisturizer for lubrication according to the specific conditions of the patients, and use essential oils under the guidance of professionals, as well as abdominal massage using the touch method, which can effectively alleviate the problem of constipation. In addition, some patients have difficulty sleeping due to physical pain. For these patients, caregivers can alleviate anxiety and depressive symptoms through careful psychological interventions and use aromatherapy to improve the problem of sleep disorders, thus helping patients fall asleep quickly and improving the quality of sleep and quality of life. In addition, when the patient is close to the end of life, caregivers can place incense at the patient's bedside so that the patient can feel peaceful in the aroma. In general, the patient's peaceful symptoms can also relieve the family's grief to a certain extent.

Targeted death education and grief counseling

During the nursing period, caregivers should pay attention to the patients' psychological state and understand their attitudes toward death. They should inform patients that death is a stage that a person must go through, and it is also the final destination that we have to face. Patients should cherish their limited time to fulfill their unfulfilled wishes and face death with a calm and positive mindset to alleviate their inner pain. In addition, in nursing care, nursing staff should focus on establishing a good relationship with patients and maintaining good communication to win the trust of patients and their families, so that patients will be more cooperative and compliant with nursing care. In a subtle way, nursing staff can instill in patients the concept of "peaceful death". For those patients who have been identified as end-stage diseases, it is usually futile to take more resuscitation measures, not only will not achieve good therapeutic effects, but also may aggravate the physical and mental pain of the patients. Therefore, during the nursing process, medical staff can conduct health education for patients and their families in various ways, such as distributing health pamphlets and carrying out health knowledge lectures, in order to popularize the concept of natural death. In addition, it is also necessary to focus on grief counseling for patients and their families to help them release their sadness within a reasonable period of time to avoid excessive grief leading to more serious mental trauma and psychological disorders. Patients should be guided to learn to channel their minds, and while giving them all-around attentive care, they should listen patiently to their complaints, minimize their physical discomfort, enhance their comfort at the end stage, and ensure that they can comfortably pass the final stage of life.

Strengthen the psychological intervention for terminal patients

It should be implemented according to the specific conditions of the patients to ensure the relevance and effectiveness of psychological care, and ultimately help the patients to correctly accept death and achieve the optimal state of body and mind. Many of the patients encountered in emergency medicine are patients with cardiovascular and cerebrovascular diseases, whose death usually occurs suddenly. In the process of psychological care, caregivers need to communicate with patients in a gentle, cordial tone, telling them that we will do everything we can to help them get through their difficulties, and using inspiring language to evoke their yearning for their past lives. For patients with accidental injuries, who often suffer from limb dysfunction and fear, psychological care should be carried out simultaneously with physical and mental rescue. During the nursing process, use an affirmative tone of voice and a firm look to sensitize the patients, let them understand that the medical staff is doing their best to save them, and help them reduce their stress and pain through observation and touch, and try to let them pass away calmly and peacefully. For patients on the verge of death, their desire for affection and comfort is very strong. Therefore, in the process of nursing, patients who are not accompanied by their relatives should report the situation to the duty room of the hospital in a timely manner and contact the patients' family members through the police station, while the medical staff should always accompany the patients, hold their hands, and sensitize the patients' lonely hearts with loving and sincere hearts. For patients accompanied by their families, they should be given sufficient opportunities to spend time alone, so that they can enjoy the last affection and reduce the patient's sense of loneliness, while meeting the psychological needs of their families to ensure that both parties have no regrets.

Strengthen the pacification education for patients' families

A large number of objective facts show that, compared with terminal patients, family members have more difficulty in accepting the fact that the patient is about to die or has passed away, and they suffer more intense pain. When a loved one passes away, family members will face emotions such as pain, despair and grief, and even people who were strong in the past have difficulty controlling their emotions. Caregivers are the closest people to the family, so they have an obligation to conduct bereavement counseling. On the basis of providing patient care, nursing staff should also carry out early education and later pacification work for the patient's family, so that they can objectively and correctly recognize and accept the patient's departure and educate them to give the patient more affectionate companionship instead of getting too caught up in grief, so that they can positively and optimistically accompany the patient through the last stage of life. When a patient passes away, medical staff should guide family members to the lounge, hand them a cup of warm water, and take timely precautions to care for family members suffering from cardiovascular and cerebrovascular diseases. They need moderate companionship and polite listening, and comprehensively utilize professional knowledge in nursing, ethics and sociology to pacify the family members. They can also use the Buddhist perspective to give them consolation, telling them that death is not a permanent parting, but a new life and moving on in another way. Through such reassurance efforts, families who are caught up in endless grief can find support and hope and can quickly release their grief and shorten the grieving process.