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Original Article

The impact of internet multidisciplinary continuity care on the living quality of home-based patients with malignant tumors undergoing PICC catheterization

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Abstract: Objective: To evaluate the impact of Internet-based multidisciplinary continuity care on the quality of life of home-based patients with PICC catheters for malignant tumors. Method: This study is a retrospective research analysis. A total of 131 patients with malignant tumors who received PICC catheterization at Xijing Hospital from Jan. 2023 to Dec. 2023 were enrolled in this study. Patients were divided into two groups: 61 in the control group who received conventional nursing care, and 70 in the observation group who received multidisciplinary continuous nursing care via an Internet platform in addition to conventional nursing. The Strategies Used by Patients to Promote Health (C-SUPPH), the Quality-of-Life Core Questionnaire (QLQ-C30), the Exercise of Self-care Agency Scale (ESCA), Self-Rating Depression Scale (SDS) and Self-Rating Anxiety Scale (SAS) were adopted for investigation and analysis. Six months after intervention, the two groups' ego-efficacy, living quality, self-care ability and psychological status, as well as treatment compliance and satisfaction with care were compared. Results: Post-intervention, both groups showed significant improvements in ego-efficacy and self-care ability scores (all $P<0.05$). The observation group scored higher in all dimensions of ego-efficacy and self-care ability compared to the control group (all $P<0.05$). Furthermore, the observation group demonstrated significant improvements across all dimensions of quality of life ($P<0.05$), whereas the control group only showed improvement in social function ($P<0.05$). The observation group also exhibited lower scores for anxiety and depression post-intervention compared to the control group (all $P<0.05$). Additionally, the observation group had a significantly lower incidence of complications and higher post-intervention treatment compliance and satisfaction with nursing ($P<0.05$). Conclusion: Multidisciplinary continuing nursing care delivered via an Internet platform significantly enhances self-management efficiency, quality of life, and self-care ability of home-based patients with PICC catheters for malignant tumors. This care model also effectively improves patients' mental health and increases their compliance with treatment and satisfaction with nursing.

Keywords: Internet platform, multidisciplinary continuity of care, malignant tumor, PICC catheterization, quality of life

Introduction

A peripherally Inserted Central Catheter (PICC), also called a PICC line, is a long, thin tube that's inserted through a vein (including the cephalic vein, median cubital vein, and noble vein) to the superior vena cava [1]. Widely used in oncology, a PICC line can effectively reduce pain and vascular damage caused by repeated puncture during chemotherapy. It can also reduce drug stimulation of vascular intima, effectively protect blood vessels, and enhance transfusion safety, providing a long-term treatment for patients. In addition, it also reduces the workload of nursing staff [2, 3].

Patients with malignant tumors are discharged with the catheter retained during treatment interruptions. However, if not properly managed, PICC can lead to complications like catheter slippage and infection, impacting the quality of catheter placement and the progression of chemotherapy [4, 5]. Routine follow-up interventions often simply address issues associated with catheterization and maintenance, which falls short in reducing complications from PICC

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catheterization. In addition, patients' inadequate understanding of catheter care and limited self-management skills further increase the risk of complications, which may severely affect their living quality [6, 7].

This study investigated the impact of multi-disciplinary continuity nursing on the quality of life of cancer patients with PICC retention at home, aiming to reduce the incidence of PICC-related complications.

Data and methods

Clinical data

This research is a retrospective analysis, and the patients were grouped according to the admission time. This study involved 131 patients with malignant tumor who underwent PICC catheterization and were hospitalized at Xijing Hospital from Jan. 2023 to Dec. 2023. Among them, 61 patients were taken as the control group, while the other 70 patients were placed in the observation group. This research was approved by Xijing Hospital ethics Committee.

Inclusion and exclusion criteria

Inclusion criteria: Patients with clinicopathologically confirmed malignant tumors; Patients aged >18 years old; Patient with stable condition and a life expectancy of >6 months; Patients and their relatives who gave informed consent.

Exclusion criteria: Those unable to use WeChat for communication; Those with a history of mental illness or cognitive impairment; Patients undergoing palliative care; Patients with PICC placement less than 6 months; Patients who died within 6 months after the intervention.

Methods

The control group received regular discharge guidance and telephone follow-up. Experienced nursing staff provided education on PICC catheter maintenance at discharge and distributed health education manuals detailing nursing precautions. Patients were required to visit the hospital weekly for catheter maintenance.

In contrast, the observation group received multidisciplinary continuous nursing via an Internet platform. We established a WeChat public account and constructed a multidisciplinary continuous nursing team consisting of 1 specialist physician, 1 nutritionist, 1 psychologist, and 4 specialist nurses. Patients and their families were encouraged to follow the WeChat account and join the group during their hospital stay. This group received routine updates and educational content through the WeChat account, including information on PICC care, dietary and nutritional advice, medication guidelines, management of common complications, pain care, exercise, and follow-up schedules. Questions from patients were answered daily in the WeChat group, and the nursing content related quizzes were posted with incentives such as red envelopes for correct answers to encourage participation. In addition, Weekly reminders for hospital visits for catheter maintenance were sent, and monthly individual assessments were conducted. Personalized nursing guidance was formulated according to their own conditions. Nutritionists assessed each patient' nutritional status and advised on dietary guidance; psychologists provided targeted psychological interventions and counseling, and nurses recorded patient feedback. For those not actively participating or failing to respond, nursing staff followed up with the patients and their family members to ensure compliance and understanding of the patient's condition.

Observation indicators

① General demographic and clinical data: The demographic data, including patient's gender, age, education degree, marital status, disease type and treatment were collected using a demographic questionnaire designed by our hospital.

② Ego-efficacy: The Strategies Used by Patients to Promote Health (C-SUPPH) [8] (Chinese version) was used to measure patient ego-efficacy before and 3 months after intervention. The scale was comprised of 28 items across dimensions of self-decision making, positive attitude and self-stress reduction. A higher score indicated better ego-efficacy.

③ Self-care ability: The Exercise of Self-care Agency Scale (ESCA) [9] was used to examine patient's self-care ability before and 6 months after intervention. The scale includes 4 aspects of health knowledge, nursing skills, sense of responsibility, and nursing concepts, with a

total of 172 points. A higher score indicates a better self-care ability.

④ Quality of life: The Quality-of-Life Core Questionnaire (QLQ-C30) [10] was utilized to assess patient's quality of life before and 6 months after intervention. The questionnaire covers six dimensions of role function, somatic function, cognitive function, social function, affective function and overall living quality, with a total score of 100 points in each dimension. A higher score indicates a better quality of life for patients.

⑤ Psychological state: Self-Rating Anxiety Scale (SDS) and Self-Rating Depression Scale (SAS) were applied to evaluate the psychological state of patients before and 6 months after intervention. A higher result indicates more severe anxiety/depression state.

⑥ Treatment compliance: Patients' treatment compliance was evaluated after 6 months of intervention using our self-designed questionnaire. The evaluation involves medical treatment, timely medical reviews, functional exercise, and promptness in seeking medical care.

⑦ Incidence of complications: The complications, including catheter-related infection, catheter shedding, and catheter obstruction, were recorded.

⑧ Satisfaction with nursing: After 6 months of intervention, a self-designed nursing satisfaction survey questionnaire was used to assess patient's satisfaction with nursing service. The survey contains 20 items, each scored from 1 to 5, with total scores ranging from 20 to 100 points. A score of 90-100 indicates very satisfied, 80-89 indicates satisfied, and a score <80 represents dissatisfied. Satisfaction = (Number of Very Satisfied Cases + Number of Satisfied Cases)/Total Cases × 100%. The survey has been validated with a Cronbach's α coefficient of 0.893.

⑨ Survival analysis: The overall survival time of patients, with death as the end point of follow-up, was recorded. The follow-up cut-off date was December 31, 2023.

Statistical analysis

SPSS 26.0 was used for data analysis. Data that follows a normal distribution was expressed as ($\overline{x}\pm s$), and count data was expressed as percentages. Comparison of measurement data and count data was performed by t-test and χ^2 test, respectively. Survival analysis was conducted using Kaplan-Meier survival curves, and survival difference between groups was assessed using the Log-rank test. A *P*-value less than 0.05 was considered statistically significant.

Results

Comparison of clinical data between the two groups

A comparative analysis showed no statistical differences in gender, age, course of disease, education, marital status, disease type and treatment modalities between the two groups (all *P>0.05*) (**Table 1**).

Comparison of ego-efficacy between the two groups

After the intervention, the scores of each dimension of self-management efficacy (including self-decision-making, positive attitude, and self-decompression) significantly increased in both groups (all *P<0.05*). Additionally, the observation group demonstrated significantly higher post-intervention scores in these dimensions compared to the control group (all *P<0.05*) (**Figure 1**).

Comparison of self-care ability between the two groups

After the intervention, the scores for self-care ability (encompassing health knowledge, self-concept, self-care skills, and self-care responsibility) significantly increased in both groups (all *P<0.05*). Moreover, the observation group's scores in these dimensions were significantly higher than those in the control group post-intervention (all *P<0.05*) (**Figure 2**).

Comparison of life quality between the two groups

After the intervention, all dimensions of quality of life (role function, somatic function, cognitive function, social function, affective function and overall quality of life) significantly improved in the observation group (all *P<0.05*). In contrast, only the score of social function increased in the control group (*P<0.05*). The post-intervention quality of life scores in the observation

Table 1. Comparison of clinical data between the two groups

	Observation group (n=70)	Control group (n=61)	t/χ^2	*P*
Gender				
Male	43 (61.43)	35 (57.38)	0.222	0.637
Female	27 (38.57)	26 (42.62)		
Age (years, $\bar{x}\pm s$)	56.48±10.21	57.29±9.35	0.471	0.639
Course of disease (months, $\bar{x}\pm s$)	13.12±3.36	13.25±3.41	0.219	0.827
Education				
Junior high school and below	19 (27.14)	16 (26.23)	0.031	0.985
High school/technical secondary school/technical school	38 (54.29)	33 (54.10)		
College degree or above	13 (18.57)	12 (19.67)		
Marital status				
In marriage	55 (78.57)	43 (70.49)	1.129	0.288
Non-marital	15 (21.43)	18 (29.51)		
Disease type				
Lung cancer	19 (27.14)	16 (26.23)	1.168	0.761
Gastric cancer	8 (11.43)	4 (6.56)		
Liver cancer	10 (14.29)	11 (18.03)		
Other types	33 (47.14)	30 (49.18)		
Treatment				
Chemotherapy alone	45 (64.29)	43 (70.49)	2.903	0.234
Combined chemoradiotherapy	8 (11.43)	10 (16.39)		
Targeted therapy combined with chemotherapy	17 (24.29)	8 (13.11)		

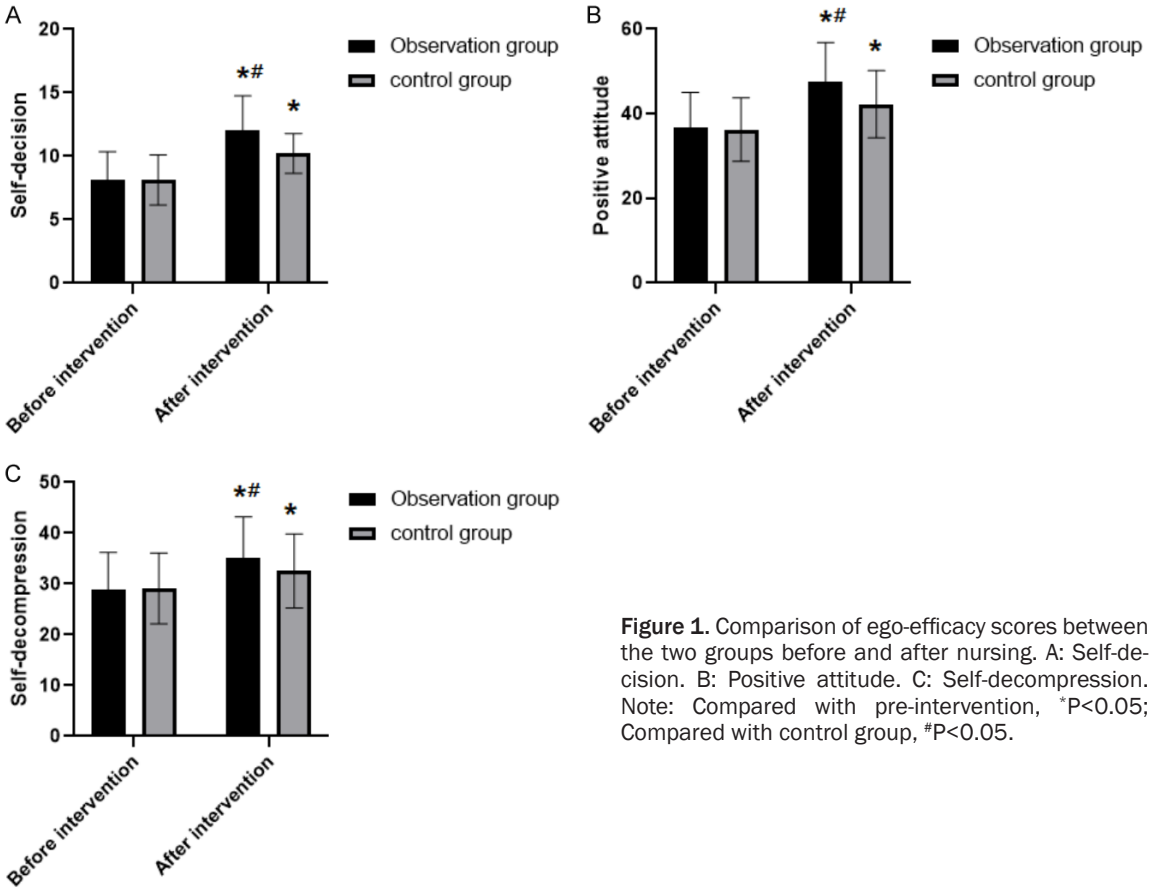

Figure 1. Comparison of ego-efficacy scores between the two groups before and after nursing. A: Self-decision. B: Positive attitude. C: Self-decompression. Note: Compared with pre-intervention, *P<0.05; Compared with control group, #P<0.05.

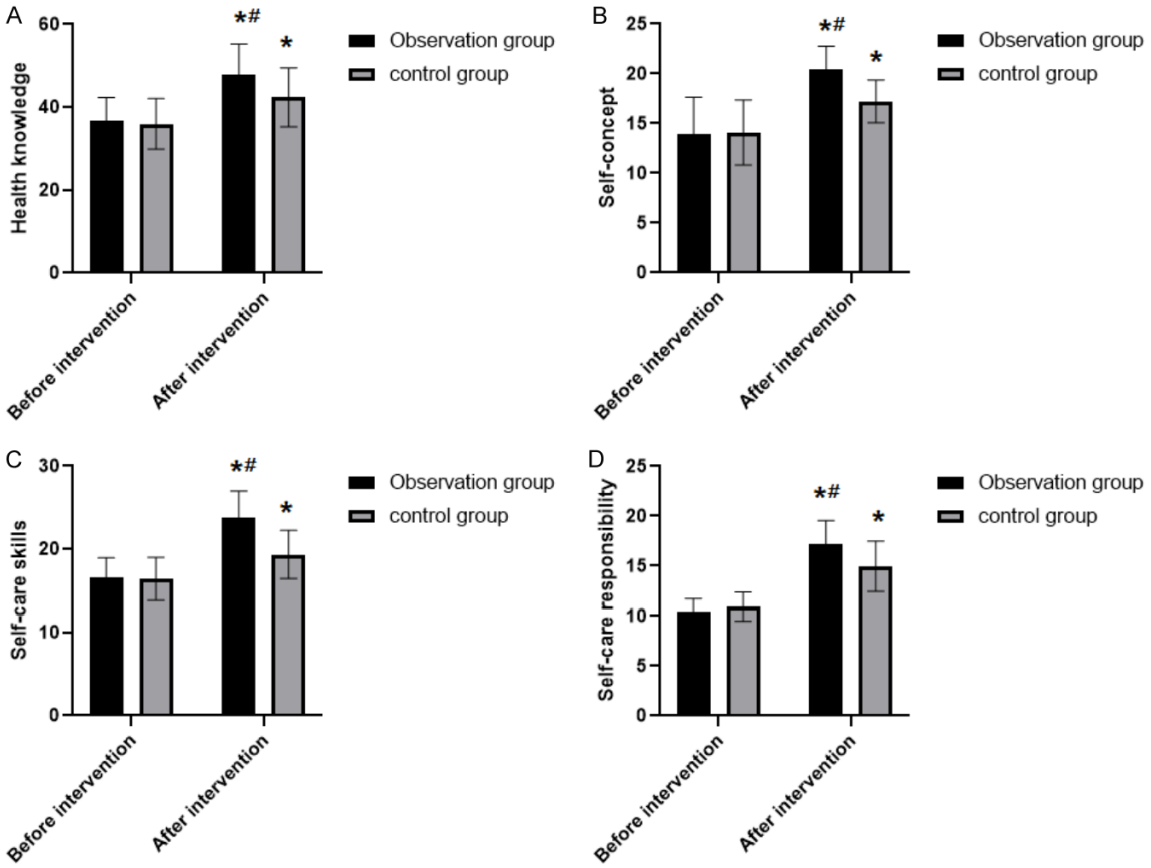

Figure 2. Comparison of self-care ability scores between the two groups before and after nursing. A: Health knowledge. B: Self-concept. C: Self-care skills. D: Self-care responsibility. Note: Compared with pre-intervention, *P<0.05; Compared with control group, #P<0.05.

group were significantly higher across all dimensions compared to the control group (all *P<0.05*) (**Figure 3**).

Comparison of mental states between the two groups

After the intervention, both groups showed significant reduction in anxiety and depression scores (all *P<0.05*), and the observation group demonstrated lower post-intervention anxiety and depression scores than the control group (*P<0.05*), as shown in **Figure 4**.

Comparison of treatment compliance between the two groups

After intervention, the observation group had higher compliance rates for treatment adherence, functional exercise, regular reviews, and timely medical visits compared to the control group (all *P<0.05*) (**Table 2**).

Comparison of complication rate between the two groups

In the observation group, there was 1 case of catheter detachment (1.43%), 2 cases of catheter-associated infection (2.86%), 1 case of catheter obstruction (1.43%), with a total complication rate of 5.71%. In the control group, there were 3 cases of catheter detachment (4.92%), 6 cases of catheter-associated infection (9.84%), and 2 cases of catheter obstruction (3.28%), with a complication rate of 18.03%. The observation group exhibited a significantly lower complication rate than the control group (*P<0.05*) (**Table 3**).

Comparison of patient satisfaction between the two groups

In the observation group, 56 patients were very satisfied (80.00%), 11 were satisfied (15.71%),

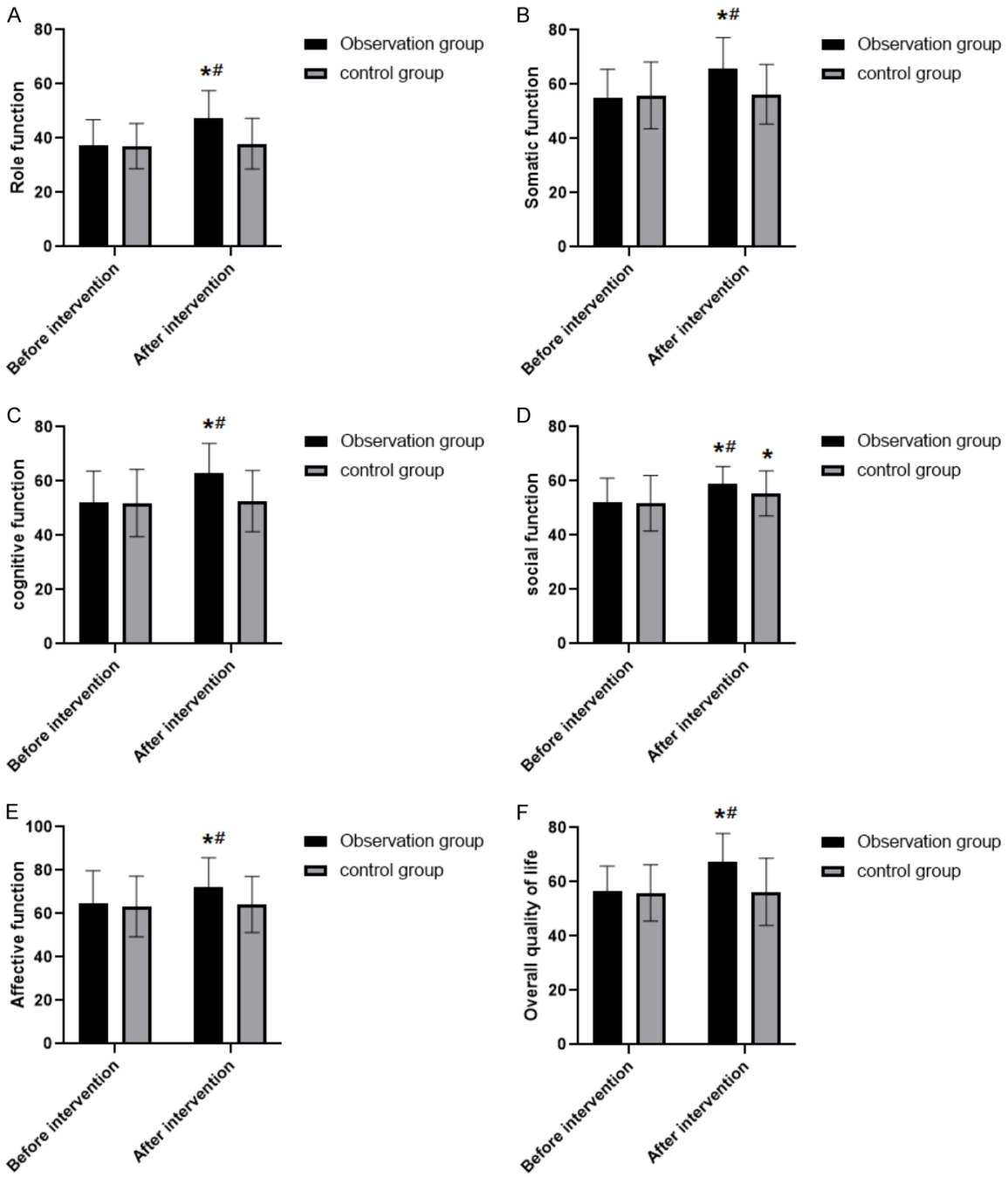

Figure 3. Comparison of living quality between the two groups before and after nursing. A: Role function. B: Somatic function. C: Cognitive function. D: Social function. E: Affective function. F: Overall quality of life. Note: Compared with pre-intervention, *P<0.05; Compared with control group, #P<0.05.

and 3 were dissatisfied (4.29%), leading to a satisfaction rate of 95.71%. In the control group, 37 (60.66%) were very satisfied, 15 (24.59%) were satisfied, and 9 were not satisfied, with a total satisfaction rate of 85.25%. Compared with the control group, the observation group demonstrated significantly greater satisfaction with nursing (P<0.05) (**Table 4**).

Survival analysis

The median survival time was 42.38 months in the observation group and 34.46 months in the control group. The survival rate of patients in the observation group was significantly higher than that of the control group (χ^2=5.190, P=0.023) (**Figure 5**).

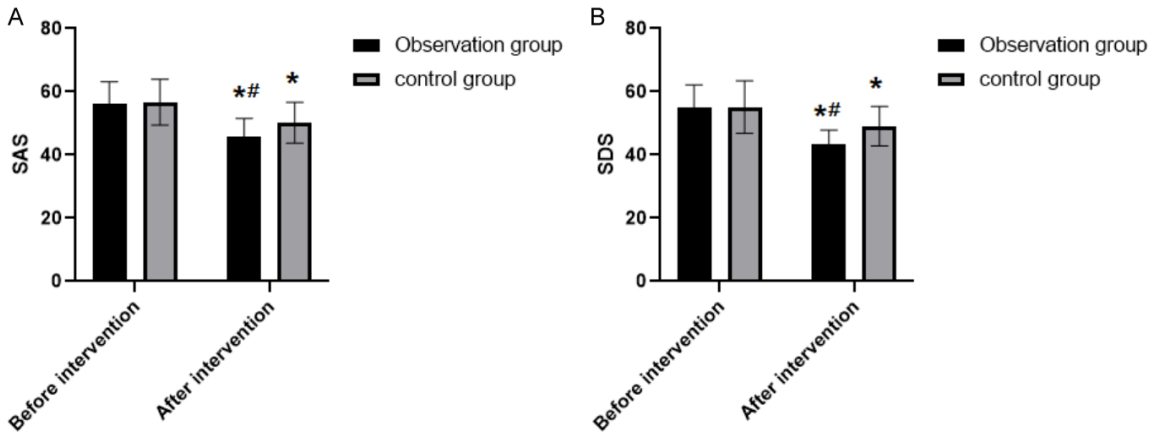

Figure 4. Comparison of mental states. A: Self-rating anxiety scale (SAS). B: Self-rating depression scale (SDS). Note: Compared with pre-intervention, *P<0.05; Compared with control group, #P<0.05.

Table 2. Comparison of treatment compliance between the two groups [n (%)]

Group	Number of cases	Treatment compliance	Functional exercise	Regular review	Timely visit
Observation group	70	64 (91.43)	61 (87.14)	58 (82.86)	62 (88.57)
Control group	61	47 (77.05)	43 (70.49)	41 (67.21)	45 (73.77)
χ^2	-	5.210	5.523	4.231	4.772
P	-	0.023	0.019	0.038	0.029

Table 3. Comparison of complication rates between the two groups [n (%)]

Group	Number of cases	Catheter detachment	Catheter-associated infection	Catheter obstruction	Complication rate
Observation group	70	1 (1.43)	2 (2.86)	1 (1.43)	4 (5.71)
Control group	61	3 (4.92)	6 (9.84)	2 (3.28)	11 (18.03)
χ^2	-	-	-	-	4.878
P	-	-	-	-	0.027

Table 4. Comparison of satisfaction with nursing between the two groups [n (%)]

Group	Number of cases	Very satisfied	Satisfied	Dissatisfied	Satisfaction degree
Observation group	70	56 (80.00)	11 (15.71)	3 (4.29)	67 (95.71)
Control group	61	37 (60.66)	15 (24.59)	9 (14.75)	52 (85.25)
χ^2	-	-	-	-	4.293
P	-	-	-	-	0.038

Discussion

Patients with malignant tumors often undergo multiple courses of chemotherapy which can be harsh on the vasculature due to the irritating nature of chemotherapy drugs. Long-term chemotherapy may lead to adverse reactions such as pain, skin redness and swelling, and even disrupt the effectiveness and regularity of treatment. In addition, repeated venous puncture tends to exacerbate patients' treatment pain [11, 12]. The use of Peripherally Inserted Central Catheters (PICC) is a widely adopted method for administering chemotherapy that offers several advantages over traditional catheter placement techniques, including simple operation, convenience, and less vascular damage. However, without proper management, there remains a risk of catheter-related infections and occlusions [13, 14].

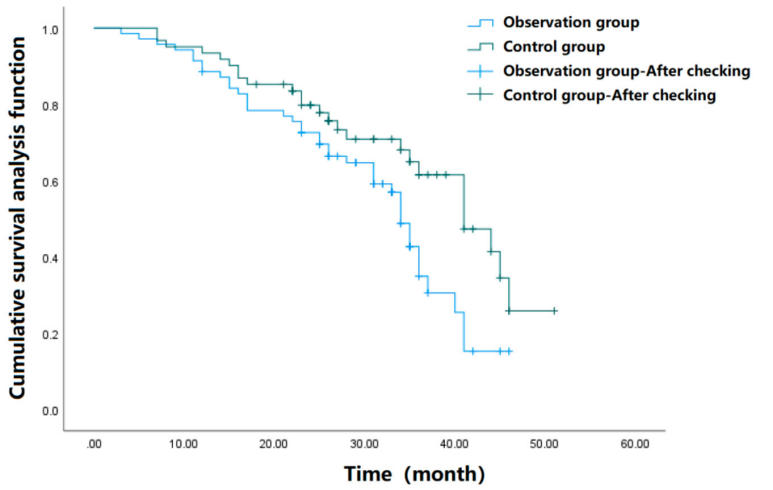

Figure 5. Survival analysis for the two groups of patients.

Traditionally, continuity of care for home-based patients with PICC has been maintained through telephone and home visits. Telephone follow-ups, while cost-effective, often fail to capture detailed insights into the patients' physical and mental conditions and can be hindered by factors like reception issues or communication difficulties, leading to high rates of follow-up loss. Home visits, on the other hand, are limited by the availability of nursing staff and high operational costs, making them impractical for large-scale implementation [15, 16]. WeChat, as a new type of internet tool, offers a modern solution by facilitating text, image, and voice communications. This capability significantly enhances the timeliness and effectiveness of nursing communications and information exchange, addressing many of the limitations associated with traditional methods of continuity nursing [17, 18].

This study leverages the WeChat public account and WeChat group platform, along with multidisciplinary support, to implement continuous nursing. A multidisciplinary continuity care team composed of nurses, physicians, nutritionists and psychotherapists provides patients with comprehensive personalized remote care services. Self-efficacy a core concept in self-management, embodies an individual's confidence in managing their condition and is a strong predictor of behavioral changes and outcomes [19]. Several studies have proclaimed [20-22] that strong ego-efficacy can enhance the living quality of life and adaptability to disease for cancer patients, thereby improving their psychological state and health behaviors. Results from this study demonstrated that the self-efficacy and self-care skill of the observation group were remarkably improved after 6-month intervention compared with the control group. Besides, the post-intervention anxiety and depression scores of the two groups greatly decreased, and the observation group had lower post-intervention scores than the control group. The multidisciplinary continuity care model facilitated through an internet platform effectively enhances patient self-efficacy and self-care abilities and ameliorates negative psychological states. This aligns with findings from other scholarly work [23, 24]. The potential reason for these improvements is multifaceted: upon discharge, patients receive continuous education about PICC catheter management and their condition via the WeChat platform, enhancing their ability to make informed decisions. The platform's communication tools, such as picture, voice, and video chat, allow timely interaction with healthcare providers, alleviating discomfort and boosting confidence in managing their condition [25, 26]. Moreover, tailored interventions by nutritionists and psychotherapists further strengthen patients' capabilities to cope with life and illness challenges, fostering a positive outlook and improving their overall psychological state.

After intervention, the observation group exhibited significant improvement in the quality of life scores across all dimensions, while the control group only showed an increase in social function scores. These results suggest that continuous care with multidisciplinary assistance through an Internet platform can have a positive impact on patients' quality of life. This may be related to the improvement of patients' mental state, self-efficacy and self-care ability. The use of the Internet platform enables more effective communication between physicians and patients, enhancing the patients' ability to manage their condition and thereby improving

their overall quality of life. Additionally, the multidisciplinary approach on the Internet platform not only promotes better treatment compliance and reduces PICC-related complications but also boosts patient satisfaction with nursing services and strengthens the nurse-patient relationship. The platform facilitates easy access to disease-related nursing knowledge, which empowers patients to better manage their health; and the improved management capability boosts patients' confidence in disease management, forming a positive cycle, further stimulating patients' desire to acquire disease knowledge and enthusiasm for disease management.

However, due to the small sample size included in this study, the research results may be biased, indicating a need for further research with a larger cohort to validate and refine these findings.

In summary, multidisciplinary continuing nursing delivered via the Internet platform can significantly enhance self-management efficiency, quality of life, and self-care abilities in home-based patients with PICC catheters for treating malignant tumors. This approach also substantially improves their mental state, increase compliance to treatment, and enhances satisfaction with nursing work, as well as reduce the incidence of complications associated with catheterization.

Disclosure of conflict of interest

None.

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References

[1] Wan L, Yin L, Zhang W, Yang J, Yi X and Guo L. Application value of modified skin expansion in PICC catheterization under the guidance of B-ultrasound in gastrointestinal cancer patients with chemotherapy. Am J Transl Res 2022; 14: 7932-7941.

[2] Scrivens N, Sabri E, Bredeson C and McDiarmid S. Comparison of complication rates and incidences associated with different peripherally inserted central catheters (PICC) in patients with hematological malignancies: a retrospective cohort study. Leuk Lymphoma 2020; 61: 156-164.

[3] Hu H, Kang L, Zhang J, Wu Z, Wang H, Huang M, Lan P, Wu X, Wang C, Cao W, Hu J, Huang Y, Huang L, Wang H, Shi L, Cai Y, Shen C, Ling J, Xie X, Cai Y, He X, Dou R, Zhou J, Ma T, Zhang X, Luo S, Deng W, Ling L, Liu H and Deng Y. Neoadjuvant PD-1 blockade with toripalimab, with or without celecoxib, in mismatch repair-deficient or microsatellite instability-high, locally advanced, colorectal cancer (PICC): a single-centre, parallel-group, non-comparative, randomised, phase 2 trial. Lancet Gastroenterol Hepatol 2022; 7: 38-48.

[4] Wang Y, Li J, Wang Y, Wang L, Xiang Y, Huang M, Wang D and He L. The influential factors and intervention strategies that engage malignant cancer patients in health-promoting behaviors during PICC line maintenance. Am J Transl Res 2021; 13: 5208-5215.

[5] Burbridge B, Lim H, Dwernychuk L, Le H, Asif T, Sami A and Ahmed S. Comparison of the quality of life of patients with breast or colon cancer with an arm vein port (TIVAD) versus a peripherally inserted central catheter (PICC). Curr Oncol 2021; 28: 1495-1506.

[6] Pu YL, Li ZS, Zhi XX, Shi YA, Meng AF, Cheng F, Ali A, Li C, Fang H and Wang C. Complications and costs of peripherally inserted central venous catheters compared with implantable port catheters for cancer patients: a meta-analysis. Cancer Nurs 2020; 43: 455-467.

[7] Wang G, Li Y, Wu C, Guo L, Hao L, Liao H, Xiao X, Liu S and Luo L. The clinical features and related factors of PICC-related upper extremity asymptomatic venous thrombosis in cancer patients: a prospective study. Medicine (Baltimore) 2020; 99: e19409.

[8] He J and Xia J. Effect of a WeChat-based perioperative nursing intervention on risk events and self-management efficacy in patients with thyroid cancer. Am J Transl Res 2021; 13: 8270-8277.

[9] Demirağ H, Kulakaç N, Hintistan S and Çilingir D. Relationship of cachexia with self-care agency and quality of life in cancer patients: the case of Turkey. Asia Pac J Oncol Nurs 2021; 8: 547-554.

[10] Hou IC, Lin HY, Shen SH, Chang KJ, Tai HC, Tsai AJ and Dykes PC. Quality of life of women after a first diagnosis of breast cancer using a self-management support mHealth app in Taiwan: randomized controlled trial. JMIR Mhealth Uhealth 2020; 8: e17084.

[11] Park EJ, Park K, Kim JJ, Oh SB, Jung KS, Oh SY, Hong YJ, Kim JH, Jang JY and Jeon UB. Safety, efficacy, and patient satisfaction with initial peripherally inserted central catheters compared

with usual intravenous access in terminally ill cancer patients: a randomized phase II study. Cancer Res Treat 2021; 53: 881-888.
[12] Liu X, Tao S, Ji H, Chen S, Gu Y and Jin X. Risk factors for peripherally inserted central catheter (PICC)-associated infections in patients receiving chemotherapy and the preventive effect of a self-efficacy intervention program: a randomized controlled trial. Ann Palliat Med 2021; 10: 9398-9405.
[13] Yan M, Pan XT, Cheng X and Lu Y. Characteristics and significance of changes of thrombomodulin and plasma protein C in patients with cancer before and after PICC. Indian J Cancer 2020; 57: 27-30.
[14] Chen J, Zhao H, Xia Z, Zhang Y, Lv X, Zhou X, Dong X, Li J, Jiang H, Huang Y and Huang H. Knowledge, attitude, and practice toward the daily management of PICC in critically ill cancer patients discharged from intensive care units. Cancer Manag Res 2018; 10: 1565-1574.
[15] Bertoglio S, Cafiero F, Meszaros P, Varaldo E, Blondeaux E, Molinelli C and Minuto M. PICC-PORT totally implantable vascular access device in breast cancer patients undergoing chemotherapy. J Vasc Access 2020; 21: 460-466.
[16] Wang G, Wang H, Shen Y, Dong J, Wang X, Wang X, Zheng Y and Guo S. Association between ABO blood group and venous thrombosis related to the peripherally inserted central catheters in cancer patients. J Vasc Access 2021; 22: 590-596.
[17] Lv S, Liu Y, Wei G, Shi X, Chen S and Zhang X. The anticoagulants rivaroxaban and low molecular weight heparin prevent PICC-related upper extremity venous thrombosis in cancer patients. Medicine (Baltimore) 2019; 98: e17894.
[18] Zhang J, Si X, Li W, Yang J and Cao Y. Effect of peripherally inserted central catheter (PICC) parenteral nutrition on immune function and nutritional support after radical gastrectomy for gastric cancer. Pak J Pharm Sci 2019; 32: 1441-1445.
[19] Sakaue M, Takeno A, Kawai K, Sakamoto T, Murakami K, Katsura Y, Ohmura Y, Kagawa Y, Masuzawa T, Hata T, Takeda Y and Murata K. Deviation of peripherally inserted central catheter (PICC) during total parenteral nutrition (TPN) for a gastric cancer patient-a case of report. Gan To Kagaku Ryoho 2021; 48: 266-268.
[20] Li X, Wang G, Yan K, Yin S, Wang H, Wang Y, Bai X and Shen Y. The incidence, risk factors, and patterns of peripherally inserted central catheter-related venous thrombosis in cancer patients followed up by ultrasound. Cancer Manag Res 2021; 13: 4329-4340.
[21] Lin BX and Xu CS. Risk factors of PICC-related venous thrombosis in breast cancer patients undergoing chemotherapy. Int J Gen Med 2021; 14: 1337-1341.
[22] Li J, Chai Y, Zhu Y, Shen J, Liu S, Hu M and Qi Z. Application of intracavitary electrocardiogram classification in peripherally inserted central catheter localization in cancer patients. J Electrocardiol 2022; 70: 39-44.
[23] Yin YX, Gao W, Feng SY, Wang DX, Wan M, Liu CH, Wang LN, Cao MK and Zhang HJ. ECG-guided PICC insertion using a new silicon catheter with a conductive tip: a retrospective clinical study. J Vasc Access 2022; 23: 567-573.
[24] Capozzi VA, Monfardini L, Sozzi G, Armano G, Butera D, Scarpelli E, Barresi G, Benegiamo A and Berretta R. Peripherally inserted central venous catheters (PICC) versus totally implantable venous access device (PORT) for chemotherapy administration: a meta-analysis on gynecological cancer patients. Acta Biomed 2021; 92: e2021257.
[25] Chen K, Wang H, Collins G, Hollands E, Law IYJ and Toh JWT. Current perspectives on the importance of pathological features in prognostication and guidance of adjuvant chemotherapy in colon cancer. Curr Oncol 2022; 29: 1370-1389.
[26] Robinson A, Souied O, Bota AB, Levasseur N, Stober C, Hilton J, Kamel D, Hutton B, Vandermeer L, Mazzarello S, Joy AA, Fergusson D, McDiarmid S, McInnes M, Shorr R and Clemons M. Optimal vascular access strategies for patients receiving chemotherapy for early-stage breast cancer: a systematic review. Breast Cancer Res Treat 2018; 171: 607-620.