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Analysis of the Effect of Ambulatory Chemotherapy (Portable Infusion Pump Use) Video Education on Knowledge, Self-efficacy, and Anxiety of Colorectal Cancer Patients

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Abstract: *Objective:* To analyze the effect of video education on ambulatory chemotherapy with a portable infusion pump on the knowledge, self-efficacy, and anxiety of colorectal cancer patients. *Methods:* This study employs a quasi-experimental study as a nonequivalent control group and a non-synchronized design. The 48 participants selected in this study were colorectal cancer patients who received chemotherapy with a portable infusion pump through an ambulatory care unit. Patient education was divided into printed materials and videos, and the patient's knowledge, self-efficacy, and anxiety were measured. Data were analyzed using independent *t*-test, paired *t*-test, and Wilcoxon's signed rank test. *Results:* In the video education group, the patient's knowledge ($Z = -4.09$, $P < 0.001$) and self-efficacy ($Z = -2.72$, $P = 0.012$) significantly increased after education, and anxiety significantly decreased ($Z = 2.24$, $P = 0.035$). However, there was no difference in knowledge ($t = 0.09$, $P = 0.931$), self-efficacy ($t = 1.22$, $P = 0.229$), and anxiety ($t = -1.16$, $P = 0.250$) between the two groups after education. *Conclusion:* To improve the quality of life of cancer patients, it is necessary to promote self-efficacy and reduce anxiety. The results of this study suggested that more diverse educational methods should be attempted to improve knowledge and self-efficacy and reduce anxiety in colorectal cancer patients.

Keywords: Anxiety; Chemotherapy; Colorectal cancer; Knowledge

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1. Introduction

1.1. The need for the study

Cancer is one of the top three causes of death in the Republic of Korea. The incidence of cancer increased steadily from 1999 to 2012, followed by a slight decrease until 2015. However, since 2016, the incidence of cancer increased again, and in 2019, the cancer incidence rate was 475.3 per 100,000 people. If Koreans reach a life expectancy of 83 years, the incidence of cancer is 37.4% (34.2% for women and 39.8% for men), where

colorectal cancer is the fourth most common cancer after thyroid, lung, and stomach cancers [1].

Looking at the trend of cancer mortality rates in Korea, colorectal cancer is the third leading cause of death after lung and liver cancer, with an increasing mortality rate. According to the World Health Organization's (WHO) Cancer Branch of the WHO's International Agency for Research on Cancer (IARC), the incidence of colorectal cancer in 186 countries in 2018 was 44.5 per 100,000 people. The incidence rate of colorectal cancer in the Republic of Korea was reported to be the second highest globally [1,2].

Chemotherapy is used as an adjuvant treatment after surgery in colorectal patients in some second and third-stage cases according to the National Comprehensive Cancer Network's (NCCN) Colorectal Cancer Guidelines, or as a curative treatment in stage IV of the disease. The chemotherapy drugs used for colorectal cancer are mainly FOLFOX (Folinic acid, 5-fluorouracil, and Oxaliplatin) and FOLFIRI (Folinic acid, 5-fluorouracil, and Irinotecan) in patients with metastatic colorectal cancer [3]. The FOLFOX and FOLFIRI chemotherapy regimen consists of 12 chemotherapy treatments given every 2 weeks for a total of 6 months [4].

Recently, hospitalization for chemotherapy has been shortened, and due to the patient's medical condition, cancer treatment can be performed through outpatient injection rooms or treatment centers. In this study, patients received chemotherapy for 5–6 hours, and at the end of the process, the patient was discharged with a portable chemotherapy (chemo) infusion pump [5]. While the portable chemo infusion pump offers patients economic and time-saving benefits of reducing hospitalization periods, there are concerns about the side effects of infusing chemotherapy drugs at home. This causes anxiety about patients not being able to take immediate action due to uncertainties and inexperience in managing infusers, along with the fluctuations in the end time of chemotherapy infusion due to the changes in temperature and viscosity of medications in different environments. Despite these drawbacks, the utilization of chemo infusion pumps is increasing due to their advantages. However, there is a lack of research measuring the cancer patient's knowledge of such devices whereby education on chemo infusion pumps is usually limited to printed materials distributed by medical device manufacturers [3,5].

The portable infuser is attached to the patient at the hospital and medication is administered by the patient at home until the infusion is complete. Patients need to be aware of how to manage the pump themselves and how to act in cases of unexpected side effects, unexpected changes to medications, or unexpected situations. Thus, patients need to have a sense of self-efficacy and follow the instructions [6]. Patient self-efficacy is a key factor in treatment adherence, reducing stress, and improving quality of life [7,8]. Higher self-efficacy is associated with a greater will to live, physical, emotional, and social functioning, along with better-coping mechanisms for dealing with cancer [9]. Social and emotional support is a key factor in fostering a sense of well-being. Adequate training of healthcare providers is important to provide such support to patients [6,9].

Anxiety in cancer patients is most often caused by uncertainty about treatment and prognosis and the psychological shock of being diagnosed with cancer. Anxiety has been linked to the patient's quality of life [10]. Patients require social, physical, and emotional support to reduce their anxiety [11]. Cancer patients undergoing chemotherapy may experience peripheral neuropathic pain and a variety of side effects, including nausea, vomiting, and increased levels of anxiety. Appropriate education about chemotherapy and cancer was reported to be effective in reducing anxiety [12,13].

Recently, outpatient and ambulatory cancer drug administration and the use of portable anti-cancer infusion devices have been popularized. Currently, only a small number of domestic and international studies have demonstrated the effectiveness of these devices and their impact on the overall quality of life for cancer patients [3,5,14,15]. In the oncology infusion rooms, oncology nurses provide education not only about chemotherapy but also on the use of portable chemo infusion pumps and coping strategies to manage symptoms

that may arise. However, there is a lack of research on the effectiveness of education regarding these portable chemo infusers. A previous study measured the knowledge of colorectal cancer patients through print and video education and found that video education was more effective than print education.

Based on the above, this study aimed to determine the effectiveness of video education on the training of using a portable chemo infusion pump in colorectal cancer patients [16].We also aimed to determine whether colorectal cancer patients possess knowledge of the Hugh substitute cancer infusion device, how to use it, and the necessary precautions in case of an emergency. We seek to assess the changes in participants' knowledge, self-efficacy, and anxiety through this intervention. This study can serve as a basis for developing a portable chemo infuser training program to enhance the patient's overall quality of life and ability to cope with cancer.

1.2. Purpose of the study

The purpose of this study is to determine the effectiveness of video training on portable chemo infusion devices on colorectal cancer patients' knowledge, self-efficacy, and anxiety.

The hypothesis to validate the effectiveness of the education program is as follows.

Hypothesis 1: The experimental group will use portable chemo infusers more than the control group and have higher knowledge regarding the device.

Hypothesis 2: The experimental group will have better self-efficacy than the control group.

Hypothesis 3: The experimental group will have less anxiety than the control group.

2. Research methods

2.1. Study design

This experimental group received handheld chemo injector video training, while the control group received traditional training using print materials. This was a quasi-experimental study that used a non-equivalent control group to compare the before and after results.

2.2. Study subjects

This study included patients with colorectal cancer diagnosed at G University Hospital in City I and who were receiving chemotherapy using portable chemo infusion pumps. The number of subjects was calculated using the G-power 3.1.9.4 program and calculated by a *t*-test, with a significance level of 0.05 and a power of 80%. A moderate effect size of 0.5 was chosen, which resulted in a minimum of 24 subjects per group. Considering a 20% dropout rate, 60 participants were selected with 30 per group. Six patients dropped out due to hospital transfer or personal reasons (3 in the control group, and 3 in the experimental group), leaving 48 participants in the final analysis, and 24 in each group. The first 30 people were selected as the control group in the order of their visits to the hospital. The experimental group received an enhanced video training program on the use of portable chemo infusers. The control group received conventional training via printed materials. Both groups were surveyed after the intervention.

2.3. Video training of portable chemo infuser

Video training on the portable chemo infusion pump was available through the research institute and was developed collaboratively by the principal investigator and other researchers. The video details the usage of the portable chemotherapy infusion pump, the location of the speed control, the impact on daily activities when using the device, the changes in the shape of the drug infusion over time, the operation of the portable anticancer infuser clamp, and the necessary precautions. Two post-operative specialists, a nursing professor, 5

head nurses in the chemotherapy ward, and 10 nursing staff were deployed to review the video's content.

Standard training for portable chemo infusers was provided by the manufacturer, which provided printed materials on how to use the portable chemo infusion device and the necessary precautions. When the experimental group visited the research center for anticancer treatment, they were shown the video for 9 minutes with a tablet, and an education session was conducted. The control group received traditional training with printouts and a brief explanation. Portable chemo infusion machine.

2.4. Research tools

2.4.1. Knowledge of portable anti-cancer infusers

The assessment of the level of knowledge was developed by the research team. The 10-item questionnaire covers the content of the video training (role and use of the portable chemo infusion pump). To validate the instrument's validity, 2 female nursing professors, one colorectal cancer nurse, and one cancer center and ambulatory center nurse were interviewed. We interviewed a total of 6 nurses, 3 with at least 5 years of ward experience. The Item-Content Validity Index (I-CVI) was rated on a scale of 1 for "not very relevant" to 4 for "very relevant." Items that received more than 80% of responses in the ratings of 3 and 4 were selected. The content validity coefficient was 0.95 and all 10 items in the initial construct were adopted. For each question, patients were asked to respond yes, no, or do not know, where 1 point for a correct answer and 0 points for an incorrect or do not know answer. The higher the score, the higher the level of knowledge. The instrument had a KR-20 value of 0.89.

The participants' self-efficacy was assessed by the Self-Management Resource Center, which provides chronic disease management resources for research without requiring approval [18]. The tool used was the Self-Efficacy for Managing Chronic Disease 6-item scale (SECD-6) translated by Kim *et al*. [19]. The tool consisted of 6 questions on a 10-point Likert scale, from 1 (not at all confident) to 10 (completely confident). The total score ranges from 6–60, with higher scores indicating higher self-efficacy. The reliability of the tool at the time of its development showed a Cronbach's α value of 0.91, and the reliability of this tool in this study was 0.96.

The participants' state of anxiety before and after the training program was measured using the State-Trait Anxiety Inventory by Spielberger, which was adapted by Kim et al. [20,21]. The side scale consisted of a total of 20 questions, answered on a 4-point Likert scale. The total score ranges from 20–80, with higher scores indicating higher levels of anxiety. The original scale had a Cronbach's α value of 0.97. In this study, the reliability of the scale was 0.97 and a Cronbach's α value of 0.83 was obtained.

2.5. Data collection

Data collection for this study took place from August 1, 2021, to September 1, 2021. This study was conducted for a total of 6 weeks, and the subjects included were colorectal cancer patients undergoing chemotherapy with a portable chemo infusion pump. The research protocol was explained to the participants and their written consent was obtained. Participant education was conducted in the consultation room of the outpatient treatment center of the institution. This study examined the treatment effect between the experimental and control groups. To control the spread of the treatment effect between both groups, the control group training was staggered by two weeks. The pre-and post-survey intervals between each group were two weeks. Details are shown in **Table 1**.

Table 1. Research design

Group	Pretest	Intervention	Post-test	Pre-test	Intervention	Post-test
Experimental group (n = 24)				Ye1	Xe	Ye2
Control group (n = 24)	Yc1	X	Yc2			

Xe= Portable infusion pump video education; Ye1, Ye2, Yc1, Yc2= Knowledge, Self-efficacy, Anxiety

2.5.1 Preliminary research

In this study, the subjects were trained by a principal investigator and a co-investigator, and a questionnaire was administered before the start of the training to determine the general characteristics and knowledge level of the subjects. Self-efficacy and anxiety were measured using self-report measures.

2.5.2. Experimental treatment

The control group was provided with traditional printed materials. The experimental group was provided with video training of the portable chemo infusion pump along with the existing printouts.

2.5.3. Post-intervention

Two weeks after the intervention, when the subjects returned to the ambulatory care center, the post-test questionnaire was administered in the same way as the pretest questionnaire.

3. Data analysis methods

The collected data were analyzed using the IBM SPSS/WIN 22.0 (IBM Corp. Armonk, NY, USA) program. The general characteristics of the subjects were expressed as mean ± standard deviation, frequency, and %. The data were compared and analyzed using an independent *t*-test and the chi-squared (χ^2) test to verify the homogeneity of the subjects. To compare the effectiveness of the experimental and control groups before and after the training, the normality was tested using the Shapiro-Wilk test. Anxiety scores were compared using a paired *t*-test. The knowledge scores were not normally distributed and were analyzed using paired *t*-test or Wilcoxon signed rank test. The differences between both groups after training were analyzed using an independent *t*-test. Results were considered statistically significant at $P < 0.05$.

4. Ethical considerations

The ethical aspects of the study were approved by the Institutional Review Board (IRB) of G University Hospital, Chihan, China. Ethical review approval (IRB: No. GFIRB2021-31). All patient data were kept confidential.

5. Findings

5.1. Verification of the general characteristics and homogeneity of both groups

The average age of the subjects in this study was 60.50 ± 9.09 years old, with a mean age of 62.3 ± 8.84 years for the control group and 58.67 ± 9.15 years for the experimental group. The control group consisted of 20 (83.3%) males and 4 (16.7%) females. The experimental group consisted of 16 (66.7%) males and 8 (33.3%) females. In terms of marital status, a majority of the subjects were married, followed by 6 (5.5%) who were widowed or divorced 6 (12.5%). Twenty subjects 20 (83.3%) in the control group and 15 (62.5%) subjects in

the experimental group were unemployed. In terms of education, 13 (54.2%) and 12 (50.0%) of the participants in the control group and experimental group had graduated from high school, respectively.

As for the metastasis status, 18 (75.0%) patients in the control group and 12 (50.0%) patients in the experimental group had metastasis. The mean number of chemotherapy treatments was 1.96 ± 1.00 times in the control group and 1.58 ± 0.58 times in the experimental group. The general characteristics of the experimental and control groups did not show statistically significant differences, confirming the homogeneity of the two groups ($P > 0.05$) Details are shown in **Table 2**.

Table 2. Differences in general characteristics between the two groups (mean ± standard deviation, [*n* (%)])

Characteristics	Categories	Total (*n* = 48)	Control group (*n* = 24)	Experimental group (*n* = 24)	χ^2 or *t*/*P*
Age (year)		60.50 ± 9.09	62.33 ± 8.83	58.67 ± 9.15	-1.45 (0/165)
Gender	Male Female	36 (75.0) 12 (25.0)	20 (83.3) 4 (16.7)	16 (66.7) 8 (33.3)	1.78 (0.182)
Marital status	Single Married Other	1 (2.1) 41 (85.4) 6 (12.5)	0 (0.0) 20 (83.3) 4 (16.7)	1 (4.2) 21 (51.2) 2 (8.3)	1.69 (0.429)
Job	Yes No	13 (27.1) 32 (66.7)	4 (16.7) 20 (83.3)	9 (37.5) 15 (62.5)	2.61 (0.193)
Religion	Yes No	25 (54.2) 22 (45.8)	10 (41.7) 14 (58.3)	16 (66.7) 8 (33.3)	3.02 (0.147)
Level of education	Elementary school Middle school High school College	6 (12.5) 8 (16.7) 25 (52.1) 9 (18.7)	2 (8.3) 5 (20.8) 13 (54.2) 4 (16.7)	4 (16.7) 3 (12.5) 12 (50.0) 5 (20.8)	3.45 (0.485)
Metastasis	Yes No	30 (62.5) 18 (37.5)	18 (75.0) 6 (25.0)	12 (50.0) 12 (50.0)	3.20 (0.074)
Number of chemotherapies		1.77 ± 0.83	1.96 ± 1.00	1.58 ± 0.58	-1.56 (0.119)

5.2. Validation of the homogeneity of the dependent variable

As shown in **Table 3**, the knowledge, self-efficacy, and anxiety did not differ between the experimental and control groups and homogeneity was confirmed ($P > 0.05$).

Table 3. Homogeneity of the dependent variable between the two groups (mean ± standard deviation, [*n* (%)])

Variables	Control group (*n* = 24)	Experimental group (*n* = 24)	*t*/*P*
Knowledge (0–10)	2.83 ± 2.93	1.92 ± 3.08	-1.06 (0.296)
Self-efficacy (6–60)	33.00 ± 13.44	34.83 ± 15.20	0.44 (0.660)
Anxiety (20–80)	45.25 ± 8.06	44.79 ± 10.15	-0.17 (0.863)

5.3. Differences in the pre-and post-training knowledge, self-efficacy, and anxiety

As shown in **Table 4**, the knowledge and self-efficacy of the experimental group increased as compared to the control group, and the levels of anxiety decreased ($P < 0.05$).

Table 4. Differences in knowledge, self-efficacy, and anxiety score before and after education (mean ± standard deviation, [*n* (%)])

Variables	Categories	Control group (*n* = 24)	Experimental group (*n* = 24)	*t*/*P*
Knowledge	Pre-test	2.83 ± 2.93	1.92 ± 3.08	0.09 (0.931)
	Post-test	7.92 ± 2.00	7.96 ± 1.23	
	Difference	5.09	6.04	
	P	-4.00 (< 0.001)	-4.09 (< 0.001)	
Self-efficacy	Pre-test	33.00 ± 13.44	34.83 ± 15.20	1.22 (0.229)
	Post-test	36.21 ± 13.98	40.54 ± 10.39	
	Difference	3.21	5.71	
	P	-1.63 (0.116)	-2.72 (0.012)	
Anxiety	Pre-test	45.25 ± 8.06	44.79 ± 10.15	-1.16 (0.250)
	Post-test	43.67 ± 8.86	41.08 ± 6.30	
	Difference	-1.58	-3.71	
	P	1.17 (0.256)	2.24 (0.035)	

6. Discussion

It is reported that 80%–90% of all cancer patients will receive chemotherapy at least once in their lifetime. For colorectal cancer patients, FOLFOX and FOLFIRI are two of the most commonly used chemotherapy drugs [3]. Recently, many healthcare organizations have been offering chemotherapy at outpatient and ambulatory treatment centers because of the economic and time benefits advantages. In addition, the use of portable chemotherapy infusion devices has led to high patient satisfaction and is cost-effective [4].

Training on the usage of portable chemo infusion pumps has traditionally been provided through printed materials distributed by manufacturers. These teaching methods are simple and time-saving, but there was no way to assess how well patients understood and retained the content. In this study, the content of the printed materials was modified and improved to make them more interesting and understandable. A researcher was assigned to produce and distribute the video educator materials.

This study found that both groups showed improvements in knowledge and self-efficacy and had decreased anxiety, but the difference in the post-training scores of these variables was significantly different. In the experimental group, the level of knowledge increased from 1.92 to 7.96 and the self-efficacy improved from 34.83 to 40.54 post-intervention. In addition, anxiety decreased from 44.79 to 41.08 post-intervention. This is because print education has always been a convenient and easy way for healthcare providers but the patient's level of knowledge, self-efficacy, and anxiety are taken into account. It was noted that the video training method increased the knowledge level of the subjects and was convenient, highlighting the significance of this study.

The video training and knowledge measures used in this study are not comparable. While direct comparisons are difficult to make due to the lack of prior research, several studies have been conducted in cancer and colorectal cancer patients, hence we will discuss how this study compares to other studies on education, self-efficacy, and anxiety in cancer patients and colorectal cancer patients. The knowledge level of the subjects about the portable chemo infusion device showed significant changes between both groups, however, there was no difference between both groups. This is similar to the results of Meade, who measured the knowledge level of colorectal cancer patients after education using various media [16] and found no difference in the knowledge level of the two groups.

This indicates that the instructions given to the audience should be organized in a way that considers the intellectual and comprehension abilities of the patients. In this study, most of the subjects had a high school-

level education or higher. The number of subjects was small, making it difficult to conduct a proper assessment. Therefore, it is unlikely that there was a difference in the level of knowledge across the two teaching methods. Future research should focus on developing training programs for the use of portable chemo infusers catered for different ages and education levels. In addition, in this study, patients were only taught the theoretical content but did not practice it. In future studies, it is recommended to incorporate a hands-on component to measure the extent of knowledge gains.

The self-efficacy in the experimental group was significantly different before and after training (t = -2.72, P = 0.012). Self-efficacy is reported to be an important influencer of cancer survivorship in cancer patients and is a significant predictor of health behaviors and self-care activities [16]. Good self-efficacy has also been shown to improve the quality of life for cancer patients and positively impact their resilience [8]. This was similar to the results of Lee *et al*. who measured self-efficacy after implementing an integrated education program involving multidisciplinary professionals for breast cancer patients [22]. Additionally, the results correlated to a study by Tokdemir and Kav that examined patient self-efficacy in cancer patients receiving oral anticancer medications with specialized education on oral anticancer medications [23]. These results suggest that self-efficacy is dependent on one's knowledge and abilities and that improving one's knowledge through video training will improve one's self-efficacy [24]. Therefore, appropriate education will increase the knowledge and self-care behaviors of cancer patients, which will enhance their self-efficacy and thus improve their quality of life [6,9].

In this study, the experimental group showed a significant difference in pre- and post-training self-efficacy, but there was no difference in post-training self-efficacy between both groups. This is likely due to the small number of subjects and the frequency of training. A study by Merluzzi2 showed that regular training has a significant effect on improving self-efficacy in cancer patients [24]. Future studies will need to verify the effectiveness of providing regular training instead of one-time training. The patients' anxiety levels in the experimental group also showed a significant difference before and after training (t = 2.24, P = 0.035). Anxiety has been categorized as a quality-of-life impairment for colorectal cancer patients and is a psychological condition that many cancer patients experience throughout treatment, from diagnosis to chemotherapy [10,25,26]. Anxiety in cancer patients is one of the symptoms that must be controlled and many variables have been reported to influence anxiety, including cancer stage, education, and number of chemotherapy treatments [26–29]. In addition, Kim *et al*. reported that direct and indirect contact between healthcare providers and cancer patients, such as communication and nursing care, was reported to reduce anxiety in cancer patients [28]. Regular education and communication are effective in improving patients' self-efficacy and anxiety. Therefore, it is necessary to develop education programs that cover variables such as cancer stage, number of chemotherapy treatments, and education level to control anxiety in cancer patients. However, 62.5% of the subjects in this study were limited to stage 4 cancer patients with metastasis with high anxiety levels. Future follow-up studies should measure the effectiveness of education for cancer patients at various stages. Besides that, this study also did not include content aimed at reducing anxiety during training, which may explain the lack of differences between groups. Therefore, we recommend that future studies include interventions such as emotional support and deep breathing techniques to reduce anxiety.

As this study utilized a convenience sample from a single medical center, it is difficult to extrapolate the findings to bigger populations. Furthermore, we were unable to identify differences between groups due to the small number of subjects and the frequency of training, hence future studies should include a larger number of patients and conduct regular training to measure the effects of different training methods and the frequency of training. This study only examined self-efficacy and anxiety as psychosocial variables in cancer patients. As many psychosocial variables affect cancer patients, it is recommended that future studies examine a variety of

these variables to identify factors that positively affect the quality of life and prognosis of cancer patients. In addition, this study did not include training on improving self-efficacy and anxiety because the training was only on the use of portable chemo infusion devices. Future studies should include training on self-efficacy and anxiety to measure the effect of training on these variables.

7. Conclusion

Education via video and handprinted materials both improved the patient's knowledge regarding the use of portable chemo infusion pumps. However, the experimental group that received video experienced significant improvement in their knowledge, and self-efficacy, and experienced reduced anxiety as compared to those of the control group. Although the difference between the groups was not significant, based on the improvement of self-efficacy and reduction of anxiety in the group that received the video training program, it is recommended to develop various new training methods regarding the correct use of portable chemotherapy infusion machines.

Disclosure statement

The authors declare no conflict of interest.

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