Effects of Artificial Intelligence on Surgical Patients' Health Education

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Article

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Abstract: Today, the various abilities that nurses require to meet patients' healthcare needs adequately are all affected by AI-enabled systems. This research used an experimental study design in which 60 subjects were randomly assigned to either an experimental (AI image e-book guidance) group or a control (text paper guidance) group after meeting the admission conditions and agreeing to participate in the study. It was proven that providing AI image e-book guidance before surgery significantly changed the behavior of patients and promoted relief of urinary catheter discomfort through self-efficacy to reduce urinary catheter pain after surgery (p = 0.000). It was found that providing AI image e-book guidance can shorten the time for health education and provide patients with repeated medical education and familiarity with health guidance, which can help to address the important clinical service demand issue and the shortage of nursing staff.

Keywords: artificial intelligence; health education; surgical patients

1. Introduction

The literature indicates that the prevalence of catheter-related bladder discomfort (CRBD) after urological surgery is about "47%–84.5%" [1,2], and the prevalence after discectomy is 62.9% [3]. Common symptoms of discectomy are sciatica, weakness, and numbness in the lower limbs. More seriously, cauda equina syndrome, which can affect urinary and defecatory functions, has a 0.2%-1% combined occurrence after surgery [4]. As many as 47%-91% of patients who regain consciousness in the recovery room after anesthesia experience CRBD caused by the placement of urinary catheters during surgery [5]. The symptoms of CRBD can lead post-surgery patients to experience distress and agitated emotions, even to the point of self-removal of the catheter because they cannot bear the discomfort it causes [6]. Moreover, it can lead to the intensification of post-surgery pain or unstable vital signs, ultimately affecting post-surgery recovery and increasing days of hospitalization. Considering the importance of patient safety, mutual dedication to the effective health education of patients with urinary catheters is a pressing and required matter.

Images and words are easier to learn from than words alone, which in psychology is called the "image effect" [7]. Images are often used to assist the understanding and learning of words, and the use of rich and diverse images in health and education resources can provide concise and clear visual communication to improve memory, so that the teaching content can be easily stored in the right brain, and learning through puzzles can often strengthen learners' knowledge and skills [8].

Health education uses complementary teaching to provide or improve patient health knowledge, develop healthy attitudes, construct healthy behaviors, or change behaviors to promote health through cognitive, situational, and skill-level interventions, with the aim of teaching patients the skills and knowledge that they require to take care of themselves. Health education is mainly used to help patients achieve enhanced self-care to improve their quality of life [9]. In view of the short time available for a patient's pre-operative education, text paper guidance content is not a simple and clear option; pictures and images can promote deepening of the patient's memory,

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enhance comprehension and attention as well as learners' interest in reading, and clearly express the health content [10].

Scholars believe that patients' awareness of their own diseases is related to self-care behavior, and health education guidance can improve patients' disease awareness and effectively improve their self-care ability [10]. In addition, studies have shown that health education has a positive impact on patient cognition, and that self-efficacy enables patients to take action after obtaining relevant knowledge from healthcare professionals [11]. The construction of self-efficacy is the inner process of self-persuasion, which is a complex cognitive process. People with higher self-efficacy will continue to work hard, accept, and overcome, even when encountering difficulties; thus, enhancing personal self-efficacy will lead to behavioral changes. Therefore, if patients have a good understanding of themselves, have self-confidence, and learn breathing relaxation skills, it can help to alleviate the bladder discomfort caused by urinary catheterization and encourage them to participate in self-care motivation, implement healthy self-management in life, and strive for their own health and quality of life [12].

Medicine serves common human needs, such as promoting patient well-being and making adequate health care available to all. Meanwhile, we have a good picture of what patients want and need with regard to their own care. Making sure that it is patients who benefit the most from the surge of AI health technology [13].

This study investigated the effectiveness of AI image e-book guidance and text paper guidance to improve CRBD, patients' self-efficacy to improve discomfort caused by urinary catheters, the level of pain caused by urinary catheters, and the severity of CRBD. Through AI image e-book guidance, the learners' ability to solve health-related problems and to improve behaviors of self-care was strengthened, thus effectively reducing the discomfort caused by catheterization.

2. Materials and Methods

2.1. Study Design and Participants

In this experimental research design, study participants were randomly selected using Excel from the list of all cases from a certain hospital that fit the criteria. Those who agreed to receive AI image e-book guidance were randomly assigned to the experimental and control groups using Excel. Pre-tests were completed by both groups prior to AI image e-book guidance. The experimental group members received AI image e-book guidance that was provided to reduce urinary catheter discomfort, as well as the text paper guidance received by the control group. Both groups completed a post-test 15 minutes after the intervention, and both groups completed a questionnaire assessing self-efficacy to improve bladder discomfort caused by the urinary catheter, the scale of CRBD severity, and the level of pain caused by the urinary catheter, in order to collect pre-test and post-test data. In order to compare the differences in scores on the scale of self-efficacy to improve discomfort caused by the urinary catheter, severity of CRBD, and the level of pain caused by the urinary catheter before image e-book guidance, 15 minutes after intervention, 6 hours after surgery, and 24 hours after surgery, independent-sample t-tests and repeated-measures ANOVA were conducted.

The researcher obtained the data of orthopedic and neuro-spinal surgery patients from a certain medical center in central Taiwan. Those subjects who met the collection criteria and agreed to participate in the research were incorporated into the sample pool. The cases were numbered, and Excel was used for random number sampling to group subjects into experimental and control groups. There were 30 subjects in each of the experimental and control groups, for a total of 60 samples. Basic information such as age and level of education of the two groups did not have significant differences when examined with an independent-sample t-test, showing good homogeneity. The basic information of the two groups was examined using a chi-square test and showed no significant differences, with a chi-square distribution of $\chi 2 = 0.34$, degrees of freedom df = 2, and $p = 0.735 > 0.05$; thus, the two groups had similar conditions prior to intervention.

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2.2. Measurement

2.2.1. AI Image e-book guidance to improve urinary catheter discomfort

The design of the AI image e-book guidance to improve urinary catheter discomfort referred to previous literature related to discomfort caused by catheters after surgery and the characteristics of the research subjects [14]. The whole AI image e-book guidance process took approximately 10–15 minutes, and the process was as follows: before the surgery, patients were allowed to understand the purpose, function, and placement time of the urinary catheter through AI image e-book guidance, and the placement process and principle of urine drainage were explained. Catheter-related discomfort and symptoms after awakening from anesthetics were also explained, and methods were provided to relieve the discomfort by diverting attention (listening to music, reading books, watching TV, and taking comfortable lying positions). The nursing staff took a one-on-one approach to teach patients, using the AI image e-book guidance to allow patients to watch and understand the breathing and relaxation techniques to relieve catheter discomfort. The patients were shown breathing and relaxation techniques that they could utilize whenever they felt discomfort from the catheter.

The AI image e-book guidance was assessed for expert validity. In the AI image e-book guidance design process, the researcher invited five expert scholars in related fields: a urology attending physician (assistant professor in the School of Medicine), another urology attending physician, two urology nurse practitioners, and the head nurse of the urology ward. The five experts provided improvement suggestions on the content of the AI image e-book, ensuring that the AI image e-book possessed good expert validity. The expert content validation assessed the usability, clarity, and suitability of the scale questions. The researcher used the index of content validity (CVI) to assess the content of the AI image e-book. The researcher calculated the average score of the usability, clarity, and suitability of each question, and the results showed that each question had a CVI between 0.86 and 1.

2.2.2. Scale of self-efficacy to improve discomfort caused by urinary catheterization

The scale of self-efficacy to improve discomfort caused by urinary catheterization was taken from the "General Self-Efficacy Scale (GSE)" which is public and can be freely used by researchers [15]. The researcher added the words "improve discomfort caused by urinary catheter" to each question based on the current clinical situation, and with the premise of not changing the original meaning of the question. The CVI assessment was conducted based on necessity, suitability, and importance, and the CVI values were mostly between 0.88 and 0.93; in terms of reliability, the Cronbach's value was 0.83–0.93; a standard Likert scoring method of a 5-point scale was used, and scores were graded between 1 and 5. The lowest total score was 10, and the highest was 50; the higher the summed score, the better the self-efficacy for the improvement of discomfort caused by the catheter.

2.2.3. Level of pain caused by urinary catheters

The pain visual analogue scale (VAS) is a continuous straight line, where the left- and right-most sides of the 10 cm line represent the level of pain. A score of 0 represents "no pain at all," and 10 represents "unbearable pain". Patients can give scores indicating their self-perceptions of their pain and discomfort [16]. In terms of the construct validity of the NRS, results showed that the NRS and VAS had a high correlation ($r = 0.847$, $p < 0.001$). On this scale, 1–3 points represents mild pain, 4–6 points represents medium pain, and 7–10 points represents severe pain; the higher the score, the greater level of discomfort and pain caused by the urinary catheter [17].

2.2.4. Severity of catheter-related bladder discomfort

The severity of catheter-related bladder discomfort scale did not previously have a Chinese version; thus, the scale was translated and the CVI was analyzed on the basis of necessity, suitability, and importance, with the results mostly between 0.97 and 1; the Cronbach's value of reliability was 0.88–0.90 [2,3,18]. A standard scoring method involving a Likert 4-point scale was used and scores were graded between 1 and 4, with 1 being the lowest and 4 being the highest; 1 point represents no

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discomfort, 2 points mild discomfort, 3 points medium discomfort, and 4 points severe discomfort. The higher the score, the greater the severity of catheter-related bladder discomfort.

2.3. Research Time and Place

This research required 48 hours of time between February 17th, 2022 and May 9th, 2022. The researcher chose to start the test from the day before the surgery and after completing the admission process, so that the activities were not interfered with by others. The experimental group received AI image e-book guidance for 15–20 minutes (including relaxation techniques and repeated demonstrations). The pre-test was conducted before image e-book guidance was provided, and the post-test timings were 15 minutes after image e-book guidance, 6 hours after surgery, and 24 hours after surgery. The control group received text paper guidance for 15–20 minutes (including relaxation techniques and repeated demonstrations). The pre-test was conducted before text guidance was provided, and the post-test timings were 15 minutes after text guidance, 6 hours after surgery, and 24 hours after surgery.

2.4. Ethical Considerations

This research project was reviewed and approved by the IRB of China Medical University Hospital (No: CMUH110-REC3–211). The patients could quit at any time and had the right to raise questions, and the questionnaires were anonymous. The questionnaire results were numbered anonymously to de-link and ensure confidentiality. The patients' names and conditions will never be publicized, and the results are for academic use only.

2.5. Data Collection and Analysis

This study took 450 orthopedic and neuro-spinal surgery patients from a certain medical center in central Taiwan as the research population. The collection criteria were patients who could communicate in Mandarin or Taiwanese, diagnosed by a physician to have herniated intervertebral discs in the lumbar area, and admitted to the hospital for lumbar vertebral surgery. The exclusion criteria were the following: those who were unconscious and could not communicate; those who did not wish to participate; those with cystitis, frequent urination, difficulty urinating or neurogenic bladder, terminal kidney disease (urine volume less than 500 mL/24 h), coagulopathy, overactive bladder, and long-term usage of painkillers. The data collection process randomly assigned cases that fit the criteria into experimental and control groups, confirmed the research subjects, and acquired IRB consent. The data collection personnel collected data for the researcher via questionnaire; the collection tools were the scales, and the questionnaire structure was close-ended (self-efficacy to improve discomfort caused by the urinary catheter, level of pain caused by the urinary catheter, and severity of CRBD). The method of data analysis was confirmed, an oral explanation was given to the patients, and then the scaled questionnaires were distributed in a public setting. The collected data were examined, and the pre-test and post-test data were formally collected.

SPSS for Windows 25.0 Mandarin version was used for statistical analysis, and the independent t-test and chi-square test were conducted to compare the homogeneity of the experimental and control groups. For assessment of the effectiveness of the AI image e-book guidance in improving catheter discomfort, analyses involving independent t-tests and repeated-measures ANOVA were conducted to analyze the differences according to variables of the experimental and control groups at different times.

3. Results

3.1. Homogeneity examination of each index in both groups prior to intervention

The basic information of both groups was analyzed using the chi-square test and t-test to examine the homogeneity; the results indicated no significant difference (p>0.05). Therefore, this showed that the two groups were comparable.

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3.2. Analyzing the amount of change during the pre- and post-tests of both groups in self-efficacy to improve the discomfort caused by the urinary catheter, level of pain caused by the urinary catheter, and severity of CRBD

3.2.1. Comparative analysis of experimental and control groups regarding self-efficacy to improve the discomfort caused by the urinary catheter

The pre-test of the experimental group on self-efficacy to improve the discomfort caused by the urinary catheter (catheter was not placed prior to the health education intervention) produced an average score of 1.21, and the third post-test score (24 hours after surgery, catheter placed) averaged 4.87. The average amount of change in the score was 3.66 points; the pre-test of the control group on self-efficacy to improve the discomfort caused by the urinary catheter (catheter was not placed prior to the health education intervention) produced an average score of 1.12, and the third post-test score (24 hours after surgery, catheter placed) averaged 1.17. The average amount of change in the score was 0.05 points; the amount of change in the score between the pre-test and third post-test of self-efficacy to improve the discomfort caused by the urinary catheter in the two groups underwent independent t-test analysis which produced a result of t = 33.560, p = 0.000. The two groups had significant differences in the average score change between the pre-test and the third post-test, indicating that AI image e-book guidance improved patients' self-efficacy to improve the discomfort caused by their catheters (Table 7).

3.2.2. Level of pain caused by urinary catheter

The pre-test of the experimental group on the level of pain caused by the catheter (catheter was not placed prior to the health education intervention) produced an average score of 0, and the third post-test score (24 hours after surgery, catheter placed) averaged 0.1. The average amount of change in the score was 0.1 points. The pre-test of the control group on the level of pain caused by the catheter (catheter was not placed prior to the health education intervention) produced an average score of 0, and the third post-test score (24 hours after surgery, catheter placed) averaged 5.13. The average amount of change in the score was 5.13 points; the amount of change in the score between the pre-test and third post-test of the level of pain caused by the catheter in the two groups underwent independent t-test analysis which produced a result of t = 36.924, p = 0.000, indicating that the AI image e-book guidance reduced the level of pain caused by the catheter (Table 7).

3.2.3. Severity of catheter-related bladder discomfort

The pre-test of the experimental group on the severity of CRBD (catheter was not placed prior to the health education intervention) produced an average score of 0, and the third post-test score (24 hours after surgery, catheter placed) averaged 0.07. The average amount of change in the score was 0.07 points; the pre-test of the control group on the severity of CRBD (catheter was not placed prior to the health education) had an average score of 0, and the third post-test score (24 hours after surgery, catheter placed) averaged 2.97. The average amount of change in the score was 2.97 points; the amount of change in the score between the pre-test and third post-test of the severity of CRBD in the two groups underwent independent t-test analysis which produced a result of t = 22.209, p = 0.000, indicating that AI image e-book guidance reduced the severity of catheter-related bladder discomfort (Table 7).

3.3. Analysis of score change between pre- and post-tests of both groups on the self-efficacy to improve the discomfort caused by the urinary catheter, level of pain caused by the urinary catheter, and severity of CRBD

3.3.1. Self-efficacy to improve the discomfort caused by the urinary catheter

Regarding the self-efficacy to improve the discomfort caused by the catheter, the average scores of the pre-test and post-test at 15 minutes after the health education intervention in the experimental group were 1.21 and 3.28, respectively; the 2.06 difference in average value was significant (p = 0.000); the average scores of the post-tests 15 minutes after the health education intervention (catheter not yet placed) and 6 hours after surgery (catheter already placed) were 3.28 and 4.42, respectively; the

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difference in average value was 1.14 (p = 0.000); 6 hours after surgery (catheter already placed) and 24 hours after surgery (catheter already placed), the average scores were 4.42 and 4.87, respectively, with the difference in average value being 0.44 (p = 0.000); the average scores of the pre-test and post-test 24 hours after surgery (catheter already placed) were 1.21 and 4.87, respectively, with the difference in average value being 3.65 (p = 0.000). The above results indicate that self-efficacy to improve the discomfort caused by the catheter was significantly improved after AI image e-book guidance was provided (Table 1).

Regarding the self-efficacy to improve the discomfort caused by the catheter, the average scores of the pre-test and post-test at 15 minutes after the health education intervention among the control group were 1.21 and 1.15, respectively; the 0.03 difference in the average value was not significant (p = 0.533); the average scores of the post-tests 15 minutes after health education (catheter not yet placed) and 6 hours after surgery (catheter already placed) were 1.15 and 1.14, respectively, with the difference in average value being -0.01 (p = 0.654); 6 hours after surgery (catheter already placed) and 24 hours after surgery (catheter already placed), the average scores were 1.14 and 1.17, respectively, with the difference in average value being 0.03 (p = 0.202); the average scores of the pre-test and post-test at 24 hours after surgery (catheter already placed) were 1.12 and 1.17, respectively, and the difference in average value was 0.05 (p = 0.222). The above results with no significant differences indicate that self-efficacy to improve the discomfort caused by the catheter was not improved after text paper guidance was provided for the improvement of catheter discomfort (Table 2).

Table 1. Repeated-measures ANOVA of self-efficacy to improve the discomfort caused by the urinary catheter in experimental group (N = 30).

Timing (Visit)	Self-efficacy to improve discomfort caused by catheter			
	Mean (SD)	Difference in average	p-value [a]	p-value [b]
Pre-Test (Catheter not yet placed)	1.21(0.279)	3.65	0.000	-
15 minutes after health education (Catheter not yet placed)	3.28(0.724)	2.06		0.000
6 hours after surgery (Catheter placed)	4.42(0.662)	1.14		0.000
24 hours after surgery (Catheter placed)	4.87(0.468)	0.44		0.000

[a] Paired-sample t-test. [b] Repeated-measures ANOVA.

Table 2. Repeated-measures ANOVA of self-efficacy to improve the discomfort caused by the urinary catheter in control group (N = 30).

Timing (Visit)	Self-efficacy to improve discomfort caused by catheter			
	Mean (SD)	Difference in average	p-value [a]	p-value [b]
Pre-Test (Catheter not yet placed)	1.12(0.207)	0.050	0.222	-
15 minutes after health education (Catheter not yet placed)	1.15(0.140)	0.030		0.533
6 hours after surgery (Catheter placed)	1.14(0.894)	-0.013		0.654
24 hours after surgery (Catheter placed)	1.17(0.114)	0.033		0.202

[a] Paired-sample t-test. [b] Repeated-measures ANOVA.

3.3.2. Level of pain caused by urinary catheter

Regarding the level of pain caused by the catheter, the catheter was not placed at the time of the pre-test and the post-test 15 minutes after the health education intervention; the score for the

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experimental group was 0 for both tests; the average scores of the post-tests 15 minutes after health education (catheter not yet placed) and 6 hours after surgery (catheter already placed) were 0 and 0.60, respectively, with the difference in average value being 0.60 (p = 0.000); 6 hours after surgery (catheter already placed) and 24 hours after surgery (catheter already placed), the average scores were 0.60 and 0.10, respectively, with the difference in average value being -0.50 (p = 0.000); the average scores of the pre-test (catheter not yet placed) and post-test 24 hours after surgery (catheter already placed) were 0 and 0.10, respectively, and the difference in average value was 0.10 (p = 0.184). The above results indicate that the level of pain caused by the catheter was significantly improved after AI image e-book guidance was provided for the improvement of catheter discomfort (Table 3).

In terms of the level of pain caused by the catheter, the catheter was not placed at the time of the pre-test and the post-test 15 minutes after the health education intervention; the score of the control group was 0 for both tests; the average scores of post-tests 15 minutes after health education (catheter not yet placed) and 6 hours after surgery (catheter already placed) were 0 and 5.00, respectively, with the difference in average value being 5.00 (p = 0.000); 6 hours after surgery (catheter already placed) and 24 hours after surgery (catheter already placed), the average scores were 5.00 and 5.13, respectively, and the difference in average value was 0.13 (p = 0.595); the average scores of the pre-test and post-test 24 hours after surgery (catheter already placed) were 0 and 5.13, respectively, with the difference in average value being 5.13 (p = 0.000). The above results show significant differences, and the average score for the level of pain caused by the catheter after patients received text paper guidance alone was higher than that for the experimental group (Table 4).

Table 3. Repeated-measures ANOVA of level of pain caused by urinary catheter in experimental group (N = 30).

Timing (Visit)	Level of pain caused by catheter			
	Mean (SD)	Difference in average	p-value [a]	p-value [b]
Pre-Test (Catheter not yet placed)	0.00(0.000)	0.100	0.184	-
15 minutes after health education (Catheter not yet placed)	0.00(0.000)	0.000		-
6 hours after surgery (Catheter placed)	0.60(0.814)	0.600		0.000
24 hours after surgery (Catheter placed)	0.10(0.403)	-0.500		0.000

[a] Paired-sample t-test. [b] Repeated-measures ANOVA

Table 4. Repeated-measures ANOVA of level of pain caused by urinary catheter in control group (N = 30).

Timing (Visit)	Level of pain caused by catheter			
	Mean (SD)	Difference in average	p-value [a]	p-value [b]
Pre-Test (Catheter not yet placed)	0.00(0.00)	5.13	0.000	-
15 minutes after health education (Catheter not yet placed)	0.00(0.00)	0.00		-
6 hours after surgery (Catheter placed)	5.00(1.050)	5.00		0.000
24 hours after surgery (Catheter placed)	5.13(0.629)	0.13		0.595

[a] Paired-sample t-test. [b] Repeated-measures ANOVA.

3.3.3. Severity of catheter-related bladder discomfort

Regarding the severity of CRBD, the catheter was not placed at the time of the pre-test and the post-test 15 minutes after the health education intervention; the score of the experimental group was 0 for both tests; the average scores of the post-tests 15 minutes after the health education intervention (catheter not yet placed) and 6 hours after surgery (catheter already placed) were 0 and 0.43,

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respectively, and the difference in average value was 0.43 (p = 0.000); 6 hours after surgery (catheter already placed) and 24 hours after surgery (catheter already placed) the average scores were 0.43 and 0.07, respectively, with the difference in average value being -0.36 (p = 0.000); the average scores of the pre-test and post-test 24 hours after surgery (catheter already placed) were 0 and 0.07, respectively, with the difference in average value being 0.067 (p = 0.161). The above results indicate that the severity of CRBD significantly improved after AI image e-book guidance was provided for the improvement of catheter discomfort. The average score difference between the pre-test (catheter not yet placed) and 24 hours after surgery was 0.067 (p = 0.161), indicating that the severity of catheter-related bladder discomfort was the same as when the catheter was not yet placed (Table 5).

In terms of the severity of CRBD, the catheter was not placed at the time of the pre-test and the post-test 15 minutes after the health education intervention; the score for the control group was 0 for both tests; the average scores of the post-tests 15 minutes after health education (catheter not yet placed) and 6 hours after surgery (catheter already placed) were 0 and 2.8, respectively, with the difference in average value being 2.8 (p = 0.000); 6 hours after surgery (catheter already placed) and 24 hours after surgery (catheter already placed) had average scores of 2.8 and 2.97, respectively, with the difference in average value being 0.167 (p = 0.444); the average scores of the pre-test (catheter not yet placed) and post-test 24 hours after surgery (catheter already placed) were 0 and 2.97, respectively, and the difference in average value was 2.97 (p = 0.161). The above results indicate that the average score of the severity of CRBD after the health education intervention was provided was higher than the experimental group, and the intervention therefore did not significantly reduce the severity of CRBD (Table 6).

Table 5. Repeated-measures ANOVA of severity of CRBD in experimental group (N = 30).

Timing (Visit)	Severity of CRBD			
	Mean (SD)	Difference in average	p-value [a]	p-value [b]
Pre-Test (Catheter not yet placed)	0.000(0.000)	0.067	0.161	-
15 minutes after health education (Catheter not yet placed)	0.000(0.000)	0.000		-
6 hours after surgery (Catheter placed)	0.433(0.568)	0.433		0.000
24 hours after surgery (Catheter placed)	0.07(0.254)	-0.367		0.000

[a] Paired-sample t-test. [b] Repeated-measures ANOVA.

Table 6. Repeated-measures ANOVA of severity of CRBD in control group (N = 30).

Timing (Visit)	Severity of CRBD			
	Mean (SD)	Difference in average	p-value [a]	p-value [b]
Pre-Test (Catheter not yet placed)	0.00(.000)	2.967	0.000	-
15 minutes after health education (Catheter not yet placed)	0.00(.000)	0.000		-
6 hours after surgery (Catheter placed)	2.80(0.88)	2.800		0.000
24 hours after surgery (Catheter placed)	2.97(0.66)	0.167		0.444

[a] Paired-sample t-test. [b] Repeated-measures ANOVA.

After the AI image e-book guidance for improvement of catheter-related bladder discomfort, the self-efficacy to improve the discomfort caused by the urinary catheter in the experimental group significantly increased, and its utilization was associated with significant reductions in pain and discomfort compared to the control group in terms of the level of pain caused by the urinary catheter and the severity of CRBD (Table 7).

Table 7. Average scores and their differences for the three scales before and after the AI image e-book guidance for improvement of the discomfort caused by the urinary catheter was provided: self-efficacy to improve discomfort caused by urinary catheter, level of pain caused by urinary catheter, and severity of CRBD (N = 60).

Type	Group	Average		Average of change in score	t	p	Average		Average of change in score	t	p	Average		Average of change in score	t	*p*
		Pre-Test (catheter not yet placed)	First Post-Test (catheter not yet placed)				Pre-Test (catheter not yet placed)	Second Post-Test (catheter placed)				Pre-Test (catheter not yet placed)	Third Post-Test (catheter placed)			
Self-efficacy to improve discomfort caused by urinary catheter	Experimental Group	1.21	3.28	2.07	12.443	0.000	1.21	4.42	3.21	24.812	0.000	1.21	4.87	3.66	33.560	0.000
	Control Group	1.12	1.15	0.03			1.12	1.14	0.02			1.12	1.17	0.05		
Level of pain caused by urinary catheter	Experimental Group	0	0	0	-	-	0	0.6	0.6	18.137	0.000	0	0.1	0.1	36.924	0.000
	Control Group	0	0	0			0	5.0	5.0			0	5.13	5.13		
Severity of CRBD	Experimental Group	0	0	0	-	-	0	0.43	0.43	12.308	0.000	0	0.07	0.07	22.209	0.000
	Control Group	0	0	0			0	2.8	2.8			0	2.97	2.97		

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4. Discussion

The AI image e-book guidance provided for the improvement of the discomfort caused by urinary catheterization resulted in significant improvement in the patients' self-efficacy to improve discomfort caused by the catheter, level of pain caused by the catheter, and the severity of CRBD. During the AI image e-book guidance process in this research, it was found that patients could focus on the AI image e-book guidance, and understand and remember its content quickly. Patient familiarity with and correctness of relaxation techniques were improved when the techniques were demonstrated repeatedly. It is suggested that AI image e-book guidance for improvement of the discomfort caused by urinary catheterization can be incorporated into pre-surgery preparation, in order to benefit patients' understanding of the related purpose and principles of urinary catheters before they are placed. The relaxation techniques can also be utilized immediately after surgery to improve the discomfort caused by the catheter.

This research proves that AI image e-book guidance provided for the improvement of discomfort caused by urinary catheters can significantly improve patients' self-efficacy to improve the discomfort caused by urinary catheters, the level of pain caused by urinary catheters, and the severity of CRBD. If data from multiple departments that can be compared and analyzed, there will be more departments able to clarify the requirements of the intervention. This is the limitation of the study; hence, this work can be combined with work conducted in other departments or medical centers for expanded sample collection in the future, in order to continue and deepen the research.

5. Conclusions

This research discovered that providing AI image e-book guidance can reduce the time required for repeated health education to patients to familiarize them with instructions. Providing AI image e-book guidance for the improvement of discomfort caused by urinary catheters prior to surgery can assist patients to learn and enhance their self-efficacy to alleviate the discomfort caused by catheters and relieve the discomfort and pain caused by catheters after surgery. This can help to address the important clinical service demand issue and shortage of nursing staff.

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References

1. Li C, Liu Z, Yang F. Predictors of catheter-related bladder discomfort after urological surgery. J Huazhong Univ Sci Technolog Med Sci. 2014, 34(4), 559-562.
2. Binhas M., & Motamed C., & Hawajri N., & Yiou R., & Marty J. Predictors of catheter-related bladder discomfort in the post-anaesthesia care unit. Ann Fr Anesth Reanim. 2011, 30(2), 122-125.
3. Kwon Y., & Jang JS., & Hwang SM., & Lee JJ., & Tark H. Intraoperative administration of dexmedetomidine reduced the postoperative catheter-related bladder discomfort and pain in patients undergoing lumbar microdiscectomy. J Anesth. 2018, 32(1), 41-47.
4. Henriques T., & Olerud C., & Petrén-Mallmin M., & Ahl T. Cauda equina syndrome as a postoperative complication in five patients operated for lumbar disc herniation. Spine. 2001, 26(3), 293-297.

5. Bai Y., & Wang X., & Li X., & Pu C., & Yuan H., & Tang Y., & Li J., & Wei Q., & Han P. Management of Catheter-Related Bladder Discomfort in Patients Who Underwent Elective Surgery. J Endourol. 2015, 29(6), 640-649.
6. Tauzin-Fin P., & Stecken L., & Sztark F. Inconfort lié à la sonde vésicale en période postopératoire Catheter-related bladder discomfort in post-anaesthesia care unit. Ann Fr Anesth Reanim. 2012, 31(7-8), 605-608.
7. Baadte, C., & Meinhardt-Injac, B. The picture superiority effect in associative memory: A developmental study. The British journal of developmental psychology. 2019, 37(3), 382–395.
8. Yang, C. W.,Yen, Z. S.,McGowan, J. E.,Chen, H. C.,Chiang, W. C.,Mancini, M. E.,Ma, M. H. M. A systematic review of retention of adult advanced life support knowledge and skills in healthcare providers. Resuscitation. 2012, 83(9), 1055-1060.
9. Lopez-Olivo, M. A., & Suarez-Almazor, M. E. Digital Patient Education and Decision Aids. Rheumatic diseases clinics of North America. 2019, 45(2), 245–256.
10. Berhane, A., & Belachew, T. Effect of Picture-based health education and counselling on knowledge and adherence to preconception Iron-folic acid supplementation among women planning to be pregnant in Eastern Ethiopia: a randomized controlled trial. Journal of nutritional science. 2022, 11, e58.
11. Bandura, A., & Adams, N. E. Analysis of self-efficacy theory of behavioral change. Cognitive therapy and research. 1977,1 (4), 287-310.
12. Eller, L. S., Lev, E. L., Yuan, C., & Watkins, A. V. Describing Self-Care Self-Efficacy: Definition, Measurement, Outcomes, and Implications. International journal of nursing knowledge. 2018, 29(1), 38–48.
13. Topol, E.J. High-performance medicine: the convergence of human and artificial intelligence. Nat Med. 2019, 25, 44–56.
14. Zhou L., & Zhou L., & Tian L., & Zhu D., & Chen Z., & Zheng C., & Zhou T., & Zeng X., & Jiang X, Jiang C., & Bo L. Preoperative education with image illustrations enhances the effect of tetracaine mucilage in alleviating postoperative catheter-related bladder discomfort: a prospective, randomized, controlled study. BMC Anesthesia. 2018, 18(1), 204.
15. Scholz, U., & Doña, B. G., & Sud, S., & Schwarzer, R. Is general self-efficacy a universal construct? Psychometric findings from 25 countries. European journal of psychological assessment. 2002, 18(3), 242.
16. Ferreira-Valente MA., & Pais-Ribeiro JL., & Jensen MP. Validity of four pain intensity rating scales. Pain. 2011, 152(10), 2399-2404.
17. Bashir MS., & Khade A., & Borkar P., & Saleem M., & Lingaswamy V., & Reddy D. A comparative study between different pain rating scales in patients of osteoarthritis. Indian J Physiol Pharmacol. 2013, 57(2), 205-208.
18. Agarwal A., & Gautam S., & Gupta D., & Agarwal S., & Singh PK., & Singh U. Evaluation of a single preoperative dose of pregabalin for attenuation of postoperative pain after laparoscopic cholecystectomy. Br J Anaesth. 2008, 101(5), 700-704.