The Effect of Nursing Simulation on the Clinical Judgment of Nursing Care for Patients with Increased Intracranial Pressure (IICP)

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Abstract

Background: Nursing educators commonly adopt simulations to educate nursing students and evaluate their clinical thinking, clinical reasoning, and clinical judgment. We aimed to determine the effectiveness of established nursing care simulations by evaluating, through video, a select number of nursing students in scenarios that simulate nursing care for Increased Intracranial Pressure (IICP) patients.

Methods: The participants were students in their senior year at a nursing college in South Korea in 2018. We adopted a mixed-method design by first conducting a nonequivalent control group pre-test/post-test research design, then analyzing the experimental group's simulation videos. The participants consisted of 38 students in the experimental group and 39 students in the control group, and each group consisted of 9 teams. This study measured the level of anxiety (Cronbach's $\alpha=0.780$), critical thinking (Cronbach's $\alpha=0.895$), performance (Cronbach's $\alpha=0.927$), theoretical knowledge (Cronbach's $\alpha=0.970$), and analyzed clinical judgments by directly reviewing video from the experimental group. We used a mixed methods appraisal tool (MMAT) version 2018 as its research checklist.

Results: Confidence ($P=0.000$), theoretical knowledge ($P=0.000$), clinical performance ($P=0.017$) indicated statistically significant increases in the experimental group. We subsequently identified 10 clinical judgment processes, including "Identify the patient's condition" to "Reassess the condition after symptoms improve" by analyzing the simulation videos.

Conclusion: Developing a simulation for nursing care is effective in honing students' clinical judgment and enhancing their theoretical knowledge, confidence, and clinical performance.

Keywords: Clinical judgment; Nursing care; Adult nursing; Critical thinking; Simulation

Introduction

In South Korea, cerebrovascular disease is the fourth leading cause of death after cancer, cardiac disease, and pneumonia, and the third leading cause of death among the elderly population aged over 60 (1). Moreover, 23.5% of cerebrovascular-

disease-related deaths are caused by brain hemorrhages (2). The intracerebral volume increase caused by a brain hemorrhage leads to increased intracranial pressure (IICP). IICP exacerbates hemorrhaging and negatively influences the neurological prognosis, which requires early detection and treatment for a positive outcome (3).

The Korean Stroke Society (KSS) (4) addressed this by recommending nursing interventions that include observation and treatment in the ICU, intracranial pressure measurement, keeping the head upright for pressure control, osmotic therapy in case of active pressure control, and hypothermia therapy. Accurate and immediate clinical judgment is essential because it allows nurses in clinical settings to offer appropriate care based on accurately identifying and analyzing IICP symptoms. The precise identification and analysis of symptoms allow nurses to make early neurological assessments and manage potential changes in nursing care for IICP patients (5).

Clinical judgment requires critical thinking and quick decision-making, supported by clinical reasoning (6). However newly graduated nurses find it difficult to make correct clinical judgments compared to experienced nurses (7). Thus, educators have long pursued methods for how to educate nursing students effectively (8).

Simulation-based education is effective in improving nursing students' clinical judgment (9-11), problem-solving skills (12), clinical competence, and critical thinking (13). Ergo, nursing institutions have commonly adopted simulations to educate nursing students and evaluate their critical thinking, clinical reasoning, and clinical judgment. The National Council of State Boards of Nursing Clinical Judgment Model (NCSBN-CJM) suggested a cognitive process model for decision-making in clinical settings to enhance nurses' clinical judgment (8). However, there has been no definitive study analyzing nursing students' clinical judgment processes during a simulation class based on scenarios in their respective clinical settings.

Hence, we aimed to determine the effectiveness of established nursing care simulations by evaluating, through video, selected nursing students in simulations of nursing care for IICP patients.

Materials and Methods

We developed simulations of nursing care for IICP patients to evaluate their effectiveness and adopted a mixed-methods design by conducting a nonequivalent control group pretest-posttest design study, then analyzing the experimental groups' simulation videos. The participants were students in their senior year at a nursing college in South Korea, who provided written consent to be included in the study. Nursing students taken classes on the nervous system (adult health nursing) were excluded because it would be difficult to determine if their performance was based on the simulations or the nervous systems classes. Those who did not agree to be documented (pictures and video) or did not sign the confidentiality agreements were also excluded.

The study's experimental group consisted of 38 students and the control group with 39 students. Both groups consisted of 9 teams each. The G-power 3.1 program was adopted to pick the study participants (14), using the mean difference between two dependent means (matched pairs) method, and calculations using the effect size 0.5, $\alpha=0.05$, and power 0.90. Videos of the nine experimental groups were used for analysis.

Testing homogeneity included two factors: first, the level of anxiety that affects the simulation education experience (15), and second, clinical thinking that affects clinical judgment (6). The study measured the anxiety level using STAI-X adapted to Korean standards (16). The measuring tool consisted of 20 questions, with scales from 1 to 4 indicating the higher status of instability as the score increases. The STAI-X tool had a Cronbach's α of 0.93, whereas this study has a Cronbach's α of 0.780 (16). Critical thinking was measured using a critical thinking disposition scale devised by Yoon (17), comprised of 27 questions with scales from 0 to 4, indicating a higher tendency to think critically as the score increases. During development, Yoon's disposition scale (17) had a Cronbach's α of 0.84, whereas this study has a Cronbach's α of 0.895.

The researchers then measured participants' performance confidence while caring for IICP patients using a tool comprised of 7 questions, with scales from 1 to 5 indicating better confidence as the score increases. The Cronbach's α in this study is 0.927. Next, the researchers measured participants' theoretical knowledge using a tool comprised of 10 questions. Each correct answer is worth 1 point, while an incorrect answer is worth none, indicating a higher level of theoretical knowledge as the score increases. The clinical performance measuring tool is comprised of 28 questions, with scores of 0 points ("Bad or Not Performed"), 1 point ("Average"), and 2 points ("Good"), for a total range of 0–56 points. Here, the Cronbach's α was 0.970. These measures were selected based on categories having a cutoff value over 1.0 and a validity verification approved by two professors in the adult health nursing department and two clinical nurses.

As of this writing, the simulation operator in this study has 7+ years of clinical experience and 2+ years of simulation operation experience. The simulation moderator has 2+ years of clinical experience and 2+ years of simulator operation experience. They both understood the study's purpose and willingly participated in it, undergoing scenario-training and reviewing study-related information during two 2 h sessions. In one instance, the operator participated in simulation-related academic conferences for over 8 hours. Research assistants administered the data collection process, in which the primary researchers were not involved. The researchers instructed the research assistants on survey completion methods and cautions in two 1 h sessions before testing them on what they learned.

In developing the simulations for nursing IICP patients, the simulation operation class was designed based on Jeffries' simulation model (18). The scenario was based on the intracranial pressure control of an acute stroke diagnosis from the KSS (4) and organized based on the CJM (8). Via email, two clinical nurses with 5+ years of experience in hemato-oncology, two nursing department professors in charge of the simulation, two adult health nursing professors, and one internist verified the content validity of the designed scenario. The final scenario was established based on modifications suggested after the pilot test.

The simulation elements are as follows. The patient in the scenario is a 78-yr-old woman on antithrombotics after being diagnosed with cerebral infarction 10 years prior. She slipped and fell in the bathroom and was taken to the emergency room in an ambulance, and then transferred to a neurosurgery ICU after hematoma evacuation through a craniectomy. During the simulation, the patient was attached to a Foley catheter and an ICP sensor, and a drain bag was attached to the surgical site on her head. The patient experienced severe headaches, necessitating a brain CT, MRI, and a physician's prescription. An input-output sheet, a blood test, and other laboratory tests were conducted on the patient. The researchers established "mental change," "neurological state change," "nausea/vomiting," and "pain" as situations that required clinical judgment, as expected in clinical nursing settings in which IICP patients were involved. Students were tasked with performing and evaluating appropriate responses based on hypotheses to identify various cues related to the established situations. Each team had 4-5 members, with the simulation operator acting as the doctor and the simulator moderator acting as the patient. This study was conducted under the approval of the Korea National Institute for Bioethics Policy (KONIBP #P01-201902-13-002) and used a Mixed Methods Appraisal Tool (MMAT) version 2018 as its research checklist (Supplementary_File_MMAT). Data were collected from Feb 8 to Apr 6, 2019, at a nursing college simulation center in South Korea. This study provided the participants with pre-study materials in video format and asked them to complete a pre-survey and a general characteristics survey. The pre-test and post-test were taken four weeks apart to avoid research expansion. Post-evaluation was conducted after simulations by the experimental group. Meanwhile, a post-evaluation was conducted after a theoretical lecture for the control group. Each step of the simulation in the experimental group

was recorded on video. Upon the study's completion, a similar theoretical lecture was provided to the experimental group, and a similar simulation was conducted in the control group to provide equal treatment for both groups.

This study used SPSS Win. 20.0(Chicago, IL, USA) to process and analyze the collected data. The participants' general characteristics and each variable's values were analyzed according to frequency, percentage average, and standard deviation. Then, skewness and kurtosis were used to verify data normality. Moreover, homogeneity was tested using a Chi-square test and a t-test. Changes before and after the simulations were analyzed using a one-way analysis of variance (ANOVA), and the credibility level of the measurement was approved based on the Cronbach's α coefficient.

The video analysis was inspired by grounded theory (19). Investigating clinical judgment behavior in a dynamic context requires a thorough video review. The review was done by two researchers, one with 9+ years of clinical experience and the other with 4+ years of simulation operating experience. These researchers were able to identify all actions and interactions in the simulation affected by clinical judgments. The actions and interactions were then reviewed independently by a professional with 7+ years of ICU nursing experience (nervous system) and 3+ years of simulation operation experience. This analysis and review have been abstracted, and major clinical judgments were confirmed based on the video data at hand.

Results

Characteristics of participants and the homogeneity test

There were no notable differences between the two groups in terms of gender, age, adult health nursing score in the previous semester, satisfaction level of nursing major, anxiety level, or critical thinking (Table 1).

Table 1: General characteristics and homogeneity of experimental and control groups (N = 77)

Characteristics	Categories	Exp. (n = 38)	Con. (n = 39)	χ2 or t	p
		N (%) or M ± SD	N (%) or M ± SD		
Gender	Female	29 (76.32)	33 (84.62)	.832	.365
	Male	9 (23.68)	6 (15.38)		
Age		23.76 ± 1.13	23.63 ± 1.51	.427	.671
Score of related subjects in the previous semester		3.64 ± 0.64	3.58 ± 0.53	.422	.674
Satisfaction with the Nursing program		1.95 ± 0.77	2.05 ± 0.65	-.642	.523
Level of anxiety		46.04 ± 6.80	45.15 ± 7.36	.550	.584
Critical thinking		97.97 ± 11.85	93.28 ± 9.46	1.922	.058

Pre-homogeneity test of dependent variables

There were no significant differences in terms of confidence, theoretical knowledge, and clinical performance in between experimental and control groups. Moreover, a normality test against dependent variables was conducted using skewness and kurtosis, confirmed to comply with normal distribution (Table 2).

Table 2: Homogeneity test and normality test of variables (N = 77)

Variable	Exp. (n = 38) M ± SD	Cont. (n = 39) M ± SD	χ^2 or t	p	Skewness	Kurtosis
Confidence	22.13 ± 7.40	20.64 ± 4.61	1.06	.294	-.258	.463
Knowledge	3.47 ± 1.67	3.97 ± 1.94	-1.21	0.229	-.485	-.224
Clinical performance	39.74 ± 13.87	35.25 ± 12.36	1.50	.138	-.307	-.922

Verification of effectiveness of the scenario

Confidence, theoretical knowledge, and clinical performance indicated statistically significant increases in the experimental group ($P=0.000$, $P=0.000$, $P=0.017$). In the control group, theoretical knowledge and clinical performance showed statistically significant results ($P=0.001$, $P=0.000$) except for confidence, although the clinical performance scores decreased from 35.25 to 28.58. After the simulations, the experimental group showed a statistically significant higher result in confidence and clinical performance ($P=0.000$,

$P=0.000$) compared to the control group. Although these results reported no statistically significant results in terms of theoretical knowledge, the experimental group displayed a higher score of 6 points than the control group's 5.62 points.

The experimental group's confidence and clinical performance indicated a statistically significant increase based on the pre-test and post-test scores ($P=0.001$, $P=0.000$). Although their theoretical knowledge showed no statistically significant results, the experimental group reported a higher increase of 2.53 points than the control group's 1.64 points (Table 3).

Table 3: Comparison between experimental and control groups' mean scores in every variable (N=77)

Variable	Group	Pre-test M ± SD	Post-test M ± SD	t(p)	F(p)	Post-test M ± SD	Pre-test F(p)
Confidence	Exp. (n = 38)	22.13 ± 7.40	27.45 ± 4.98	-4.149(.000)	42.084 (.000)	5.32 ± 7.90	11.552 (.001)
	Cont. (n = 39)	20.64 ± 4.61	20.72 ± 4.08	-.088(.930)		0.08 ± 5.43	
Knowledge	Exp. (n = 38)	3.47 ± 1.67	6.00 ± 1.59	-7.151(.000)	1.072 (.304)	2.53 ± 2.18	2.425 (.124)
	Cont. (n = 39)	3.97 ± 1.94	5.62 ± 1.66	-3.703(.001)		1.64 ± 2.77	
Clinical performance	Exp. (n = 38)	39.74 ± 13.87	44.76 ± 8.73	-2.507(.017)	57.944 (.000)	5.03 ± 12.36	20.988 (.000)
	Cont. (n = 39)	35.25 ± 12.36	28.58 ± 9.88	4.188(.000)		-6.67 ± 9.95	

The following clinical judgments were identified from analyzing video from the experimental group simulations:

1) Identify the patient's condition.

2) Additional checks on cues based on subjective complaints.

3) Recognize changes in the patient's condition.

4) Discuss cues.

5) Supplement the lack of cues.
6) Decide on an immediate response.
7) Divide secondary tasks.
8) Assign low priority hypothesis such as education and prevention after stabilization.
9) Take action based on hypothesis priority.

10) Reassess the patient's condition after symptoms improve.

These clinical judgments were classified into five domains: Collect cue, Analyze cue, Prioritize hypothesis, Generate solution/Take action, and Evaluate outcome (Table 4).

Table 4: Identified clinical judgment behaviors expanded upon with examples and supporting qualitative statements (N=38)

Domain	Clinical judgment behavior	Example/action taken
Collect cue	Identify the patient's condition	Check pupil reaction
		Motor examination
		Apply EKG monitor
		Check currently injecting medication
	Additional check on cues based on subjective complaints	Identify headache condition
		Check ICP
		Check laboratory test result (Labo result)
	Identify changes in patient's condition	Instantly recognize shifting loss of consciousness
		Respond to seizure
Analyze cue	Discuss cue	Report the patient's condition to treating doctor based on the collected cue
		Exchange opinions on cue with teams
	Supplement lack of cue	Divide tasks on additional analysis of insufficient cues
		Request additional data including Labo result or urine output for objective data
Prioritize hypothesis	Make a decision on immediate response	Determine the necessity of immediate response including putting the head in upright or lateral position (vomiting)
		Provide priority nursing such as airway insertion or oxygenation when the patient loses consciousness
		In the case of seizure, immediately report to treating doctor and respond
		Evaluate low priority actions including patient education after stabilization
	Divide secondary tasks	Determine the necessity of antibiotic after immediate response
		Determine the necessity of electrolyte adjustment
	Assign low priority hypothesis such as education and prevention after stabilization	Education or activities to prevent bedsores are determined to be the last to be conducted in this scenario
Generate solution/ Take action	Take action based on the hypothesis priority	Put head in an upright position when vomiting
		Provide oxygen based on the oxygen saturation level
		Assist intubation
		Inject Mannitol
		Inject pain control medication
		Adjust electrolytes
		Perform activities to prevent bedsore
		Clear airway during a seizure
		Perform patient safety nursing
Evaluate outcome	Reassess the patient's condition after symptom improvement	Reassess level of consciousness after stabilization
		Check patient's vital signs

Discussion

This study developed a simulation for providing nursing care for IICP patients to educate nursing students and evaluate their clinical judgment. The study identified differences in confidence, theoretical knowledge, and clinical performance among nursing students in giving nursing care to patients. After identifying these differences, the researchers analyzed the types of clinical judgments that appeared in the simulation. Based on the study's results, two main points were further discussed: the simulation's effect on nursing students' confidence, theoretical knowledge, and clinical performance; and the types of clinical judgments that the students made in the simulation and how those judgments can be included in the NCSBN-CJM.

On the first point, the experimental group's confidence, theoretical knowledge, and clinical performance showed a statistically significant increase after the simulation. There was a significant difference in terms of both confidence and clinical performance when comparing the experimental and control groups. Although the experimental and control groups displayed no statistical difference in terms of theoretical knowledge, performance scores in the experimental group were higher than those in the control group. This particular result was similar to another study (13), which assessed the viability of simulations in clinical practicums for juniors and seniors at a nursing college. Seniors presented with repetitive simulations had a statistically significant increase in clinical performance ($t=-13.75$, $P<0.001$) and confidence ($F=177.86$, $P<0.001$) compared to juniors.

However, other studies (20, 21) showed a stark difference in theoretical knowledge between the experimental and control groups, compared to this study. The experimental group that underwent simulations in cardiopulmonary emergency nursing education showed a higher level of theoretical knowledge compared to the control group merely given a lecture (20). Similarly, its experimental group and control group displayed significant differences in terms of theoretical knowledge level in

simulations for a nursing patient with respiratory difficulties (21).

The current educational process only used simulations as a replacement for clinical practice and allowing practice only after a theoretical lecture. Nevertheless, this study's results did not show statistically significant differences in theoretical knowledge between the experimental and control groups. Despite this, the experimental group reported a higher score in terms of knowledge than the control group can serve as the reason for shifting from the current educational process to an infusion approach of education integrating theory and practice. Ryall et al.'s systematic review (22) of simulation-based assessments in health professional education confirmed sufficient validity and effectiveness. Supported by these results, this study indicates that it is much more effective for nursing students to experience real clinical settings after undergoing simulations of nursing IICP patients than simply receiving theoretical education.

On the second point, the researchers conducted a qualitative analysis of the students' clinical judgments during the simulation by analyzing simulation videos. Rather than measure the students' ability to make clinical judgments through a survey, which multiple simulation-based education studies have done (9, 11–13), by directly analyzing students' simulation videos, the study attempted to avoid previous errors stemming from students' rough estimates obtained from self-administered questionnaires. To this end, documenting and arranging missing parts and errors in performing simulations by debriefing students on their clinical performance through video was helpful in self-evaluating their simulation performance (23).

In this study, students in the experimental group were identified to have made 10 clinical judgments, reclassified into 5 domains: "Collect cue," "Analyze cue," "Prioritize hypotheses," "Generate Solutions/Take action," and "Evaluate Outcome" based on the NCSBN-CJM. Nevertheless, generating hypotheses and solutions from complex clinical judgments (8), along with intuitive clinical judgments like "Recognize cue" and "Analyze

cue," indicates the significant impact of simulation-based learning on students' clinical judgment process. Moreover, confirming in-depth knowledge based on analyzing scientific information is required to determine whether the results are the exact solution to the problem (8). Thus, the increase of theoretical knowledge in this study's experimental group can be used as a basis for assessing clinical judgment.

Furthermore, the researchers identified notable clinical judgments in their analysis of the students' simulation performances, including "Check pupil reaction," "Check motor," and "Monitor oxygen saturation level." These judgments are parts of neurological assessment categories for stroke patients (5). From the students' performances, it is safe to say that the simulation developed in this study effectively bolstered students' clinical performance training.

As this study was conducted for nursing students in one university, some limitations remain in generalizing these results. However, the considerable educational benefits of training students using simulations are well known. In this context, various scenarios need to be developed and then applied to integrate theoretical and practical education, thereby overcoming the limitations of recent observation-centered practice education models. Previously a more refined was suggested, objective way of evaluating critical thinking, clinical judgment, and clinical performance-which nursing educators need to pursue as a basis for evaluating nursing education (24). Thus, this study is worthwhile in clearly presenting students' clinical judgment process in a simulation of nursing care for IICP patients.

Conclusion

Developing a simulation of nursing care for IICP patients is effective in honing students' clinical judgment and enhancing their theoretical knowledge, confidence, and clinical performance. Although the knowledge difference between the experimental and control groups was not statistically significant, the post-simulation theoretical knowledge in the experimental group was higher compared to their pre-simulation theoretical knowledge. Moreover, students can learn to make proper clinical judgments based on NCSBN-CJM after undergoing simulations. Therefore, IICP patient care simulations can be used by nursing students as an effective studying method that enhances confidence, clinical performance, theoretical knowledge, and clinical judgment.

This study proposes the following improvements. First, the researchers propose designing additional scenarios based on the CJM that lets students experience making clinical judgments while performing simulations. Second, considering the diversity of clinical situations that nursing graduates experience, the researchers propose conducting recurrent studies aimed at developing and applying scenarios reflecting diverse and complex clinical situations like cardiovascular and respiratory cases. Third, including a separate item for clinical judgment processes and conducting a comparative analysis are necessary when developing simulation scenarios. Finally, the researchers propose the establishment of a longitudinal study aimed at verifying the effect of CJM simulation-based education on clinical judgment competence.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that they have no conflict of interest.

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