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The Effect of Bag-Valve Mask Using Skill Education with Flowmeter

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[Abstract]

This study is to evaluate the intervention effect using a flowmeter in bag-valve mask skill education. The purpose of this study was to compare the accuracy of bag-valve mask skill between intervention group with flowmeter and control group without flowmeter, understand the improvement effect of skill education of bag-valve mask, and provide basic data to suggest the method of skill education. The total number of subjects of this study was 60, with 30 intervention group and 30 control group. In comparison of the optimal number of normal tidal volume range at pre-test and post-test, the normal range percentages of the intervention group before and after education were 32.8% and 86.7%, respectively, and there was a significant difference($p<0.01$). The normal range percentages of the control group before and after education were 20.0% and 34.7%, respectively, and there was a significant difference($p<0.05$). To evaluate the factors associated with good performance of bag-valve mask skill of the subjects including the normal range of tidal volume, the logistic regression analysis has been performed, and the significant influential factors were gender(10.305, 1.20-87.98), educational experience of field practice(31.674, 1.25-805.16), and intervention(92.750, 4.58-1879.69). Through this study, it was confirmed that the intervention using flowmeter for the skill education of bag-valve mask was effective, and it is necessary to consider reflecting it in the education of students majoring in emergency medical technology in the future.

▸ **Key words**: Bag-valve mask, Flowmeter, Skill education, Tidal volume, Skill accuracy

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[요 약]

본 연구는 백-밸브마스크 술기교육에 호흡량측정기를 활용한 중재 효과를 평가하기 위한 연구이다. 본 연구의 목적은 호흡량측정기를 적용한 중재군과 적용하지 않은 대조군의 백-밸브마스크 술기의 정확도를 비교하여 호흡량측정기를 활용한 백-밸브마스크 술기교육에 의한 일회 환기량 제공 개선 효과를 파악하여 술기교육 방안을 모색하기 위한 기초자료를 마련하고자 실시하였다. 중재군 30명, 대조군 30명으로 총 60명을 대상으로 한 본 연구에서 교육 전·후 일회환기량 정상범위 대상자 수를 비교하면 중재군의 정상범위 백분율은 교육 전 32.8%, 교육 후 86.7% 이었으며, 유의한 차이가 있었다($p<0.01$). 대조군도 교육 전 20.0%, 교육 후 34.7% 이었으며, 유의한 차이가 있었다($p<0.05$). 일회환기량 정상범위 포함 횟수의 영향요인을 알아보기 위해 로지스틱 회귀분석을 실시한 결과, 성별(10.305, 1.20-87.98), 소방실습경험(31.674, 1.25-805.16), 중재여부(92.750, 4.58-1879.69)가 유의한 영향 요인이었다. 이 연구를 통해 백-밸브마스크를 이용한 교육에 호흡량측정기를 활용한 중재가 효과적이었다는 것을 확인할 수 있었으며, 향후 응급구조(학)과 전공 학생 교육에 반영할 것을 검토할 필요가 있다.

▸ **주제어**: 백-밸브마스크, 호흡량측정기, 술기교육, 일회환기량, 술기의 정확도

I. Introduction

A bag-valve mask is a device that is mainly used to perform artificial respiration during emergency rescue CPR[1]. The ventilation method by a single rescuer using a bag-valve mask is to provide oxygen to the patient by attaching the mask to the patient's face with one hand and compressing the bag with the other hand.

The bag-valve mask can be used alone to maintain the airway when no airway is secured in patients with cardiac arrest or respiratory failure. Skillfully and effectively performing bag-valve mask ventilation eliminates the need to rush intubation urgently and reduces anxiety about intubation failure[2].

However, there is also a problem that due to the physical diversity of the rescuer and the diversity of compression methods, it is not possible to provide an appropriate tidal volume in artificial ventilation using a manual resuscitator such as a bag-valve mask[3]. Positive pressure ventilation provided to adults during cardiopulmonary resuscitation is recommended at 6-7ml/kg and hyperventilation increases chest pressure to suppress blood flow into the heart, so even if effective chest pressure is performed, it negatively affects spontaneous circulation recovery rate by reducing cardiac output, cerebral blood flow, and coronary perfusion pressure[4, 5, 6]. Patients who are provided with hypoventilation can have side effects such as reduced cardiac output and hypoxia[7, 8]. Artificial respiration in hyperventilation causes an increase in chest cavity pressure, which also negatively affects the prognosis and survival rate of cardiac arrest patients by interfering with blood flow into the heart.

As such, bag-valve mask skill that can affect the mortality rate of patients at the emergency rescue site depend on visual judgment or theoretical guidelines.

According to the 2015 CPR guideline[6], it is recommended that artificial respiration using a bag-valve mask provides 500-600ml of tidal volume, which is enough to confirm the patient's chest elevation. It is suggested that 1/2-1/3 of the bag will be pressed if 1L of bag is used in that way, and 1/3 of the bag if 2L of bag is used, but it is not clear how and how much of the bag should be pressed, and other emergency rescue textbooks lack information[9]. In addition, in the 119

paramedics' on-site first aid standard guideline[2], there is no other way than to check whether the ventilation volume through the bag-valve mask is appropriate, and to check whether the chest rises well while ventilating with positive pressure.

Although the Emergency Medical Technicians standard practical training item in the United States includes a bag-valve mask for apnea patients, it is only suggested that the target number of ventilation items should be performed more than 20 times under the observation of the educator in charge[10]. In a study on the standardization of the emergency rescue department curriculum[11], there are ventilation items among the skill items in the standard of practical training items in the school. As the detailed items, a simple face mask, a bag-valve mask, a partial rehab mask, a non-rebreathing mask, and a demand valve are presented, but standardized learning goals for the detailed items and objective methods for acquiring personal skills are not presented.

Therefore, this study attempted to propose a skill education plan to provide an appropriate tidal volume, and to determine the effect of improving the provision of tidal volume by bag-valve mask skill education using flowmeter by comparing the accuracy of the bag-valve mask skill in the intervention group with flowmeter and the control group without it.

II. Method

1. Research Methods

1.1 Research Design

This study is a similar experimental study using the design before and after the inequality control group to find out the effect of skill education using a flowmeter that can confirm the accurate ventilation volume[Fig. 1].

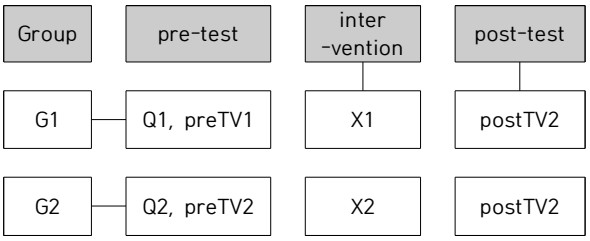

Fig. 1. Research design

G1: Intervention group
G2: Control group
X1: Lecture + Bag-valve mask skill education with flowmeter
X2: Lecture + Traditional bag-valve mask skill education
Q1, Q2: Questionnaire survey general characteristics & bag-valve mask knowledge, Practice evaluation of bag-valve mask skill protocol
TV1, TV2: Tidal volume

1.2 Participants

This study selected students who completed the first semester of the first grade curriculum of the emergency rescue department of two different colleges in K-do by sampling convenience. The purpose of the study is fully explained. Among the subjects who filled out the consent form, students who had musculoskeletal and neuro-related diseases in their hands and wrists or who did not recover full function due to their experience were excluded. After announcing the educational schedule of this study, the researcher and two research assistants distributed papers with numbers from 1 to 60, and odd numbers were assigned to the intervention group and even numbers were assigned to the control group, and opinions on the study were not shared between groups.

In terms of the number of samples, the significance level (α) was 0.05, the power ($1-\beta$) was 0.8 and the effect size was 0.7, and according to Cohen's table [12], 26 people were required in each group, a total of 52 people were required. In consideration of the dropout rate, 30 subjects were selected in both groups.

2. Research Tools

2.1 Knowledge on bag-valve mask

I developed the measurement tool, a total of 10 questions for knowledge on bag-valve mask [table

1], based on the contents of the CPR guideline [6] in 2015. The tool was verified by a total of four people, including two emergency rescue investigators in the emergency room with more than 10 years of experience and two professors in the emergency rescue department with basic resuscitation instructor certificates of the Korean Cardiovascular Association. This tool consists of 2 questions in the form of correct answers and wrong answers, and 8 questions in the form of 5 multiple choices. Each question was given 1 point if it was correct and 0 point if it was wrong. It was processed as a total of 10 points and the higher the score means the higher the knowledge.

Table 1. Knowledge on bag-valve mask

No.	Questions
1	I can identify the bag-valve mask.
2	When using a bag-valve mask for ventilation, place the sharp part of the mask facing the nose.
3	When using a bag-valve mask for ventilation what finger should be in the shape of 'C'?
4	When using a bag-valve mask for ventilation, what finger should be in the shape of 'E'?
5	What is the squeeze capacity of a 1 L bag of vag-valve mask?
6	What is the squeeze capacity of a 2 L bag of bag-valve mask?
7	What is the tidal volume to be supplied by bag-valve mask ventilation?
8	What level of consciousness does the patient need for ventilation of the bag-valve mask?
9	What bag size of bag-valve mask is appropriate for adult patient?
10	What are the possible side effects and complications of using a bag-valve mask?

1, 2: True or False question
3-10: Five tribes multiple-choice question

2.2 Practice check list of bag-valve mask skill protocol

The evaluation of compliance with the bag-valve mask skill guidelines of the study subjects was evaluated as 'Good' and 'Not good'[table 2] by using the published protocol of the 「Bag-Valve Mask Ventilation Act after insertion of the pharyngeal organ」 among 2015 CPR guidelines and the national examination practical test items for paramedic.

Table 2. Practice check list of bag-valve mask skill protocol

No.	Questions	Performance	
		Good	Not good
1	Is the sharp part of the mask pointing towards the nose?		
2	Is the shape of 'C' well maintained using the thumb and forefinger?		
3	Is the shape of 'E' well maintained using the other three fingers, is chin lift performed?		
4	Is the mask and face fully sealed?		
5	Is the ventilation performed every 5-6 seconds?		

2.3 Measurement of tidal volume

According to the 2015 CPR guidelines, it is recommended to maintain 500-600ml enough to raise the chest.

Tidal volume measurements were measured using a mannequin for evaluation(Brayden pro®, Inosonion, Korea), and the measured ventilation volume was collected in the built-in software through Bluetooth[Fig. 2]. In this study, ventilation using 30 chest pressures and 2 bag-valve masks was provided to the evaluation mannequin in accordance with the CPR guidelines to measure ventilation volume.

In this study, the average of the provision of two times of ventilation was presented as tidal volume.

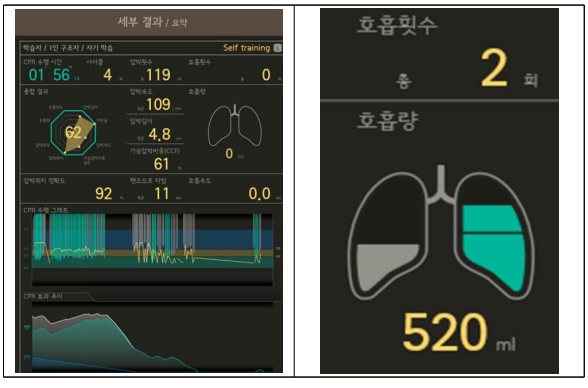

Fig. 2. Example of ventilation volume measurement

2.4 Skill education

In the skill education conducted on the intervention group and the control group, 30 chest compressions and 2 ventilation using a bag-valve

mask were considered as 1 cardiopulmonary resuscitation and the number of cardiopulmonary resuscitation techniques for each subject was at least 20 times.

The flowmeter(Amflow®, Medison, Korea) used as a skill education tool for the intervention group can control the ventilation volume of breathing using a pressure graph[Fig. 3]. The intervention group conducted skill education by connecting a flowmeter in the middle of the compression bag and the bag-valve mask. The control group was trained on the existing bag-valve mask ventilation method. In the results of this study, the value of the experimental measurement result for 30 chest compressions was excluded.

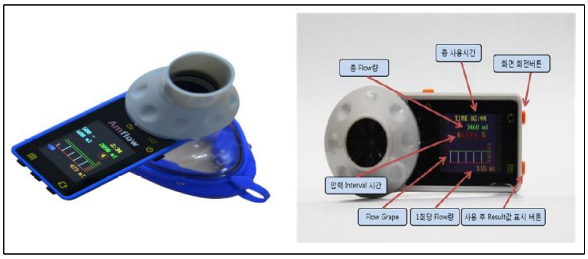

Fig. 3. The external appearance and measuring screen of flowmeter

3. Data Analysis

The collected data were analyzed using the SPSS 20.0 statistical program. General characteristics of the intervention group and control group, bag-valve mask knowledge, and bag-valve mask skill guidelines were evaluated using technical analysis, cross-analysis, and t-test. The comparison of tidal volume before and after education was analyzed by cross-analysis, repeated measurement variance analysis, and the difference in change in tidal volume before and after education was analyzed by covariance analysis. The comparison of the number of subjects of the normal range of tidal volume before and after education in the intervention group and the control group was conducted with a corresponding sample t-test, and the total number of normal range of disposable one-time before and after education in the intervention group and control group was tested.

Of the total five measurements of tidal volume, subjects included in the normal range more than three times were classified as 'Good' performance subjects, and subjects included in the normal range less than two times were classified as 'Not good'. The tidal volume before and after education of the intervention group and the control group was analyzed by cross-analysis and the factors influencing the appropriate performance of tidal volume were analyzed using logistic regression analysis.

III. Results

1. General characteristics of subjects

Among a total of 60 subjects, there were 36(60.0%) male and 24(40.0%) female. The intervention group was 20(66.7%) male and 10(33.3%) female, while the control group was 16(53.3%) male and 14(46.7%) female.

There were 11(18.3%) first grade, 43(71.7%) second grade, and 6(10.0%) third grade. And 11(36.7%) first grade, 13(43.3%) second grade, 6(20.0%) third grade were in the intervention group, while all subjects in the control group were second grade students.

There were 35(58.3%) who had educational experience of clinical practice and 25(41.7%) who had not. 12(40.0%) who had educational experience of clinical practice and 18(60.0%) who had not were in the intervention group while 23(76.7%) who had educational experience of clinical practice and 7(23.3%) who had not were in the control group[Table 3].

Table 3. General characteristic of the subject

Category		No(%)	Intervention group	Control group	*p*
Gender					
	Male	36(60.0)	20(66.7)	16(53.3)	.300
	Female	24(40.0)	10(33.3)	14(46.7)	
Age					
	<21	31(51.7)	19(63.3)	12(40.0)	.073
	≥21	29(48.3)	11(36.7)	18(60.0)	
Grade					
	1	11(18.3)	11(36.7)	0(0.0)	<0.001
	2	43(71.7)	13(43.3)	30(100.0)	
	3	6(10.0)	6(20.0)	0(0.0)	
Educational experience of clinical practice					
	Yes	35(58.3)	12(40.0)	23(76.7)	0.003
	No	25(41.7)	18(60.0)	7(23.3)	
Educational experience of field practice					
	Yes	25(41.7)	12(40.0)	13(43.3)	0.798
	No	35(58.3)	18(60.0)	17(56.7)	
Total		60(100.0)	30(100.0)	30(100.0)	

Measured by X^2-test

2. Knowledge on bag-vavle mask

The bag-valve mask knowledge score was 6.67±1.42 points for the intervention group and 7.70±1.06 points for the control group out of 10, showing a significant difference in average scores between the two groups (p=0.002) [Table 4].

Table 4. Knowledge on bag-valve mask

No.	Questions	G1(n=30) Correct answer(%)	G2(n=30) Correct answer(%)
1	I can identify the bag-valve mask.	100.0	100.0
2	When using a bag-valve mask for ventilation, place the sharp part of the mask facing the nose.	100.0	100.0
3	When using a bag-valve mask for ventilation what finger should be in the shape of 'C'?	100.0	100.0
4	When using a bag-valve mask for ventilation, what finger should be in the shape of 'E'?	100.0	100.0
5	What is the squeeze capacity of a 1 L bag of vag-valve mask?	76.7	90.0
6	What is the squeeze capacity of a 2 L bag of bag-valve mask?	60.0	56.7
7	What is the tidal volume to be supplied by bag-valve mask ventilation?	43.3	86.7
8	What level of consciousness does the patient need for ventilation of the bag-valve mask?	36.7	43.3
9	What bag size of bag-valve mask is appropriate for adult patient?	26.7	73.3
10	What are the possible side effects and complications of using a bag-valve mask?	23.3	20.0
Total(full score: 10)		6.67±1.42	7.70±1.06
p-value		0.002	

G1: Intervention group, G2: Control group
Measured by t-test

3. Practice score of bag-valve mask skill protocol between two groups at pretest

The score of compliance with the bag-valve mask skill guidelines was 4.43±1.07 points for the intervention group and 4.23±1.22 points for the control group out of 5 points [Table 5].

Table 5. Practice score of bag-valve mask skill protocol between two groups at pretest

No.	Questions	G1(n=30) Correct answer(%)	G2(n=30) Correct answer(%)
1	Is the sharp part of the mask pointing towards the nose?	100.0	100.0
2	Is the shape of 'C' well maintained using the thumb and forefinger?	100.0	100.0
3	Is the shape of 'E' well maintained using the other three fingers, is chin lift performed?	90.0	83.3
4	Is the mask and face fully sealed?	76.7	70.0
5	Is the ventilation performed every 5-6 seconds?	76.7	70.0
Total(full score: 5)		4.43±1.07	4.23±1.22
p-value		0.503	

G1: Intervention group, G2: Control group
Measured by t-test

4. Comparison of tidal volume

4.1 Tidal volume before training

The number of subjects in the normal range of a total of five times of ventilation volume measured before training and the average tidal volume are as follows. In the intervention group, there were 8(26.7%, 922.10ml) in the 1st trial, 15(50.0%, 652.10ml) in the 2nd trial, 12(40.0%, 609.30ml) in the 3rd trial, 9(90.0%, 615.57ml) in the 4th trial, and 5(16.7%, 1117.77ml) in the 5th trial. Of the total 150 trials, 49 trials(32.7%, 783.4ml) were included in the normal range. In the control group, there were 5(16.7%, 735.07ml) in the 1st trial, 5(16.7%, 663.67ml) in the 2nd trial, 7(23.3% and 758.90ml) in the 3rd trial, 7(23.3% and 703.53ml) in the 4th trial, and 6(20.0%, 651.70ml) in the 5th trial. Of the total 150 trials, 30 trials(20.0%, 702.6ml) were included in the normal range. Before training, there was a significant difference in tidal volume as 738.4ml of the intervention group and 702.6ml of the control group(p<0.001) [Table 6].

Table 6. Comparison of tidal volume at pretest

Trial	G1(n=30)	G2(n=30)
	No. of normal range(%)	No. of normal range(%)
1st	8(26.7)	5(16.7)
2nd	15(50.0)	5(16.7)
3rd	12(40.0)	7(23.3)
4th	9(30.0)	7(23.3)
5th	5(16.7)	6(20.0)
Total	49(32.7)	30(20.0)

G1: Intervention group, G2: Control group
Measured by repeated measure ANOVA
*p<0.001
Normal range: 500-600ml

4.2 Tidal volume after training

The number of subjects in the normal range and tidal volume of a total of five times ventilation volume measured after training are as follows. In the intervention group, there were 24(80.0%, 534.13ml) in the 1st trial, 26(86.7%, 551.33ml) in the 2nd trial, 26(86.7%, 558.33ml) in the 3rd trial, 26(86.7%, 563.90ml) in the 4th trial, and 28(93.3% and 554.40ml) in the 5th trial. Of the total 150 trials, 130(86.7%, 552.4ml) trials were included in the normal range.

In the control group, there were 12(40.0%, 653.10ml) in the 1st trial, 13(43.3%, 661.63ml) in the 2nd trial, 12(40.0%, 633.20ml) in the 3rd trial, 9(30.0%, 665.63ml) in the 4th trial, and 6(20.0%, 684.87ml) in the 5th trial. Of the total 150 trials, 52 (34.7%, 665.7ml) were included in the normal range. After training, there was a significant difference in the tidal volume as 552.4ml of the intervention group and 665.7ml of the control group(p<0.001) [Table 7].

In addition, it was confirmed that many of the intervention groups were distributed within the normal range compared to the control group in the viscosity chart of tidal volume after training [Fig. 4, 5].

Table 7. Comparison of tidal volume at posttest

Trial	G1(n=30)	G2(n=30)
	No. of normal range(%)	No. of normal range(%)
1st	24(80.0)	12(40.0)
2nd	26(86.7)	13(43.3)
3rd	26(86.7)	12(40.0)
4th	26(86.7)	9(30.0)
5th	28(93.3)	6(20.0)
Total	130(86.7)	52(34.7)

G1: Intervention group, G2: Control group
Measured by repeated measure ANOVA
*p<0.001
Normal range: 500-600ml

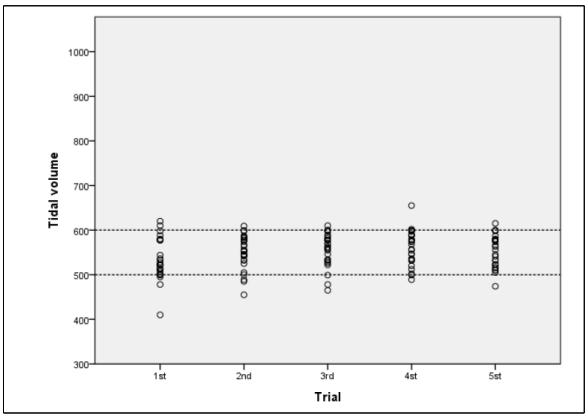

Fig. 4. Tidal volume distribution of intervention group at posttest

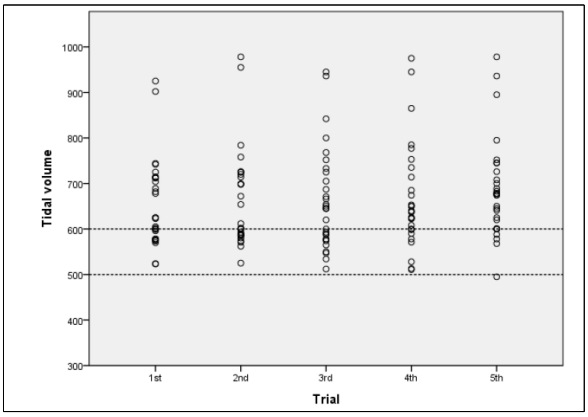

Fig. 5. Tidal volume distribution of control group at posttest

4.3 Comparison of tidal volume at pre and posttest between two groups

The average tidal volume at pretest was 783.4ml of the intervention group and 702.6ml of the control group, 552.4ml of the intervention group and 665.7ml of the control group at posttest. The average of tidal volume skills at pretest adjusted with a covariate before training was 547.4ml of the intervention group and 670.7 mlof the control group, and there was a significant difference (p<0.001) [Table 8].

Table 8. Comparison of tidal volume at pre and posttest between two groups

Group	N	Tidal volume			*p*
		pretest	posttest	posttest (estimate)	
G1	30	783.4±145.3	552.4±28.6	547.4±13.9	<.001
G2	30	702.6±125.9	665.7±103.4	670.7±13.9	

G1: Intervention group, G2: Control group
Measured by ANOVA
Tidal volume: M±SD

4.4 Comparison of optimal number of normal tidal volume range at pretest and posttest

The average number of subjects in the normal range of tidal volume at pretest and posttest was 1.63 before and 4.33 after training, indicating that the number of subjects in the normal range of tidal volume after training increased, and there was a statistically significant difference($p<0.001$) [Table 9]. On the other hand, there was no significant difference in the number of subjects in the normal range of tidal volume at pre and post test in the control group.

Table 9. Comparison of optimal number of normal tidal volume range at pretest and posttest

Group		N	Subject No. of normal tidal volume range	*p*
G1	pretest	30	1.63	<0.001
	posttest	30	4.33	
G2	pretest	30	1.00	0.06
	posttest	30	1.73	

G1: Intervention group, G2: Control group
Measured by paired t-test
Optimal number of normal tidal volume range: 0~5

4.5 Comparison of number of normal tidal volume range at posttest by the number of normal tidal volume range at pretest

The following is the distribution of the number of subjects in the normal range of tidal volume at posttest according to the number of normal range of tidal volume at pretest. In the intervention group, 6 people in 0 trial at pretest were improved to 6 people in 5 trials at posttest, and 7 people in 1 trial at pretest were improved to 2 people in 4 trials and 4 people in 5 trials at posttest.

In the control group, 10 people in 0 trial at pretest were improved to 9 people in 0 trial at posttest and 1 person in 4 trials at posttest. Also, 11 people in 1 trial at pretest were improved to 2 people in 0 trial, 1 person in 1 trial, 2 people in 2 trials, 2 people in 4 trials, and 4 people in 5 trials at posttest, and the last 8 people in 2 trials at pretest were improved to 3 people in 0 trial at posttest[Table 10].

Table 10. Comparison of number of normal tidal volume range at posttest by the number of normal tidal volume range at pretest

Group			posttest					
			0	1	2	3	4	5
pretest	G1	0	0	0	0	0	0	**6**
		1	0	0	0	0	**2**	**5**
		2	0	**1**	0	**1**	**5**	**4**
		3	0	**1**	0	0	0	**3**
		4	0	0	**1**	0	0	**1**
		5	0	0	0	0	0	0
	G2	0	**9**	0	0	0	**1**	0
		1	**2**	1	2	0	2	**4**
		2	**3**	**1**	**1**	**1**	**1**	**1**
		3	**1**	0	0	0	0	0
		4	0	0	0	0	0	0
		5	0	0	0	0	0	0

G1: Intervention group, G2: Control group

4.6 Performance number of normal range tidal volume from total 150 trials at each group

Compared to the total number of 150 bag-valve mask trials in each groups before and after training[Table 6, 7], the number of normal ventilation trials was 49 times(34.7%) before training, 130 times(86.7%) ($p=0.008$) after training in the intervention group, 30 times(20.00%) before training and 52 times after training($p=0.032$) in the control group[Table 11].

Table 11. Performance number of normal range tidal volume from total 150 trials at each group

Group	No. trials	pretest	posttest	*p*
		n(%)	n(%)	
G1	150	49(32.7)	130(86.7)	0.008
G2	150	30(20.0)	52(34.7)	0.032

G1: Intervention group, G2: Control group
Proportion analysis

4.7 Comparison of optimal number of normal tidal volume range at pre and posttest between two groups

In the comparison of the number of normal ranges of tidal volume between the intervention group and the control group, the average of 1.63 in the intervention group was higher than the average of 1.00 in the control group before training. Even after training, the average of the intervention group was 4.33 people, higher than the average of 1.73 people in the control group. Significant results showed that

there were differences between groups in both pretest(p=0.02) and posttest(p<0.001) [Table 12].

Table 12. Comparison of optimal number of normal tidal volume range at pre and posttest between two groups

Test group		No. subjects	Optimal number of normal tidal volume range	*p-value*
pretest	G1	30	1.63	0.020
	G2	30	1.00	
posttest	G1	30	4.33	<0.001
	G2	30	1.73	

G1: Intervention group, G2: Control group
Measured by t-test
Number of normal tidal volume range: 0~5

4.8 Comparison of number of times to include normal tidal volume range

Among the total five measurements of tidal volume per study subject, cases included in the normal range more than three times were defined as 'Good' performance. Of the total 5 measurements of tidal volume, 6 subjects(20.0%) of the pretest intervention group and 1 subject in the control group(3.3%) were appropriate. For the posttest, appropriate performance was 27 times(90.0%) in the intervention group and 10 times(33.3%) in the control group.

Table 13. Comparison of number of times to include normal tidal volume range

group		No. subjects	No. of times to include normal tidal volume range		*p-value*
			Good performance	Inadequacy	
pretest	G1	30	6(20.0)	24(80.0)	0.051
	G2	30	1(3.3)	29(96.7)	
posttest	G1	30	27(90.0)	3(10.0)	<0.001
	G2	30	10(33.3)	20(66.7)	

G1: Intervention group, G2: Control group
Measured by χ^2-test
Good performance: Three or more in normal tidal volume range from 5 trials in a subject
Inadequacy: Two or less in normal tidal volume range from 5 trials in a subject

4.9 Factors associated with good performance of bag-valve mask skill of the subjects

As a result of conducting a logistic regression analysis to find out the influencing factors of proper performance of tidal volume, gender, presence or absence of firefighting practice experience, and intervention were significant influencing factors. In terms of gender, female were 10.305 times more likely to perform properly than male, 31.674 times more likely than those with no experience in firefighting practice, and 92.750 times more likely to perform in the intervention group than in the control group [Table 14].

Table 14. Factors associated with good performance of bag-valve mask skill of the subjects

Variables	Exp(B)	95% CI
Gender(ref=Male)		
Female	10.305	1.207-87.984
Age(ref=<21)		
≥21	3.912	0.485-31.571
Grade(ref=1)		
2	39.780	0.434-3643.957
3	213.614×10^9	0.0000-0.000
Satisfaction on major(ref=High)		
Moderate	3.966	0.614-25.631
Low	0.257	0.014-4.689
Educational experience of clinical practice(ref=Yes)		
No	12.579	0.758-208.638
Educational experience of field practice(ref=Yes)		
No	31.674	1.246-805.162
Group(ref=G2)		
G1	92.750	4.5777-1879.688
Constant	0.022	
Chi-squared	41.541	
-2 Log-Likelihood	38.340	
Cox and Snell R^2	0.500	
Nagelkerke R^2	0.679	

G1: Intervention group, G2: Control group
Measured by logistic regression analysis

IV. Conclusions

This study was attempted to present the need for a skill education method to increase the accuracy of the tidal volume provided as a bag-valve mask skill frequently used for ventilation assistance in the pre-hospital stage. As a result of this study, the

average tidal volume before training was higher in the intervention group than in the control group, and the measurement range was distributed out of the normal range. The average tidal volume at posttest was lower in the intervention group than in the control group, and the measurement range was also distributed close to the normal range. Of the total 150 ventilation procedures, 5 times per person, the ratio of normal-range ventilation volume increased from 34.7% at pretest in the intervention group to 86.7% and from 20.0% in the control group to 34.7%. Through skill education using a flowmeter, the improvement of an individual's skill ability can lead to the provision of a normal range of tidal volume on-site. An increase in tidal volume and ventilation accuracy were demonstrated using a bag valve mask ventilation device in a study on the development and effectiveness of a bag valve mask ventilation facilitation aid[13].

In a study that verified the effect of mask assistance sealer on ventilation accuracy, it is estimated that the reason for the increase in both the control group and the intervention group was due to the increase in the proficiency of the study subjects. and education and training of paramedics in respiratory support therapy increases the level of first aid for patients with respiratory arrest[14].

This study is also thought to increase the skill level of the bag-valve mask to a certain extent with repeated skill education alone, as both the intervention and control groups have increased the number of normal ventilation after the skill education. Therefore, it was found that the intervention of the intervention method in the bag-valve mask skill education could increase the effectiveness of the education, and I would like to propose a study to confirm the effectiveness by attempting various intervention methods during the skill education.

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