Determination of the nurses' opinions on open and closed suctioning system, effect of closed suctioning system training on knowledge and opinions.

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Abstract

B Aspiration is one of the invasive methods that are most commonly used in the care of patients requiring artificial airway support. Many complications may develop when this practice is not applied by a proper method. Therefore aspiration should be performed very carefully and gently. Today, aspiration is performed by two different methods including open and closed suctioning systems. In open suctioning system, patients who are on mechanical ventilation are disconnected from the ventilator during aspiration; and if the patient is not on mechanical ventilation, aspiration is performed by a disposable sterile catheter which is placed on the end of vacuum system directly.

Keywords: Intensive Care, ICU, Aspiration, Ventilation, Disposable sterile, Vacuum system.

Introduction

Closed suctioning system is a new method that has been used for patients who are connected to mechanical ventilation since 1980s. In this system, aspiration catheter is as a connection of the ventilator line and a part of ventilator circuit. This catheter can be used for 24 hours repeatedly since it can be stored in a protective sleeve. The procedure is carried out by moving the catheter in the cannula back and forth and closing aspiration valve by thumb. Since the patient is not disconnected from the mechanical ventilator during closed suctioning system method, the incidence of hypoxia and contamination of the surrounding by secretions decreases [1]. The emergence of using closed suctioning system revealed the necessity of comparing it with open suctioning system. In the previous studies, the suppliers of closed suctioning system catheters made an emphasis on decreasing costs, decreasing cross contamination and protection of 0.2 saturation during endotracheal aspiration whereas clinical studies underlined the use of closed suctioning system catheter in order to prevent the development of ventilation-associated pneumonia. Recent studies have shown that closed suctioning system is better than open suctioning system in terms of mortality, morbidity and cost-benefit ratio [2].

In the study by Blackwood (1998), it was indicated that more clinical studies were needed to clarify the benefits of closed suctioning system. Moreover, nurses' concerns about the efficiency of the system were identified. These concerns were reported to be the possibility of contamination of a secretion to their hands from the irrigation port, the difficulty of cleaning inner tube after use, inability to aspirate secretions sufficiently and the presence of fresh blood in the secretions associated with tracheal trauma [3]. Nurses had inadequate information regarding the steps of closed suctioning system method. Nurses' states of making decision for tracheal suction, its forms of application and affecting factors. Knowledge and practice scores of the nurses regarding tracheal suction were found to be low. In performed studies, the frequencies of the application of open and closed suctioning system methods and nurses' opinions and knowledge levels regarding these methods were reported to be limited. Besides, studies have focused on the procedures relevant with closed suctioning system method and the necessity of in-service training [4].

Aim

This study aimed to determine the opinions of nurses regarding the methods of open and closed suctioning system and the effect of training given about closed suctioning system on the knowledge and opinions of the nurses [5].

Research Questions and Hypothesis

The problem of the study was to seek answers for the questions such as "Is there a difference in knowledge levels of the nurses regarding procedural steps of closed suctioning system before and after training?" and "Is there a difference in the opinions of nurses regarding the preference of open and closed suctioning system before and after training?"

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Materials and Methods

The study was quasi-experimental and performed as pre-test and post-test including a single group. The sample of the study was composed of nurses who were working in adult intensive care units (anesthesia, internal medicine, neurology, cardiovascular surgery, brain surgery and coronary intensive care units) in a university hospital located in a city in the Aegean Region and who approved to participate in the study (n=54). Participation rate was 76% in the study. Both open and closed suctioning methods were used in the institutions where the study was conducted in line with the initiatives of the nurses. Data in the study were collected by a questionnaire form which was prepared by the researcher. The questionnaire form consisted of four parts. In the first part, there were questions regarding socio-demographic and descriptive characteristics of the nurses. The second part included 13 multiple choice questions evaluating knowledge levels of the nurses for the procedural steps of closed suctioning system. For scoring questions of knowledge, each true answer was calculated as 1 point and false was scored as 0 point. Second and third parts were composed of 20 hypotheses including "Nurses' opinions regarding closed and open suctioning system" and seven open-ended questions including their reasons to choose [6-9].

Pre-treatment

Knowledge questions and choice hypotheses were primarily presented to expert opinions (five faculty members/ instructors). Content validities of knowledge questions and opinion statements were questioned by expert opinions. Besides, they were asked to report that prepared questions and opinions served for the aim of the study and to provide suggestions for revisions for inappropriate statements. Following expert opinions, the number of opinion statements was decreased to 20 and multiple choice questions were decreased to 13. Then, these forms were applied to 10 nurses who had an experience in intensive care and who were working in different departments during the application of the forms. The statements which were misunderstood during pre-treatment were revised [10,11].

Training booklet

It includes the indications for suction procedures, its complications, types, closed suctioning system method, the catheter used, its features and procedural steps. The photographs which were captured specially for this study and showing procedural steps were used. Required revisions were made after presenting to expert opinion [12].

Training video

An 8-minute video was captured including the application of the procedural steps of closed suctioning system by the researcher. The treatment was performed on a patient who was hospitalized in intensive care; and details that could reveal the identity of the patient were not presented in the content of the video. Necessary revisions were made after its presentation to expert opinion [13].

Collection of data and implementation of training

Whole questionnaire forms were distributed to all nurses (N=54) between 07/10/2012 – 08/30/2012 before the training; and they were asked to complete the forms on their own. Nurses, who approved to participate in the training session of the study, were provided face-to-face trainings each lasting for one hour in three groups including 10, 14 and 30 individuals at distinct dates. Visual presentations with the information included in the training booklet and captured video presentation were included in the training program. Video was stopped during training when required; and researcher answered the questions of the nurses. Training was carried out interactively as question and answer. Following training sessions, training booklets were distributed to all nurses who did and did not participate in the training. Questionnaire forms were reapplied one month after the training in order to determine whether there was a change in their reasons to prefer open and closed suctioning systems following the training. It was aimed to evaluate the permanence of training by reapplication of the questionnaire forms after one month [14-17].

Data analysis

Data were analysed by SPSS package program. Continuous variables were given as mean ± standard deviation and categorical variables were given as numbers (percentages). In the comparisons of dependent groups, paired t test was used for continuous variables, and McNemar test or Marginal Homogeneity Test was used for the categorical variables based on the number of categories [18].

Ethics

Necessary approvals were obtained from the respective institutions where the study was conducted and from Clinical Research Ethics Committee of the University. Moreover, written/verbal consents were provided by all nurses and relatives of the patients who were hospitalized in the intensive care and underwent closed suctioning method for the video recording that would be used in the training of nurses [19].

Limitations of the study

Nurses, who were working in the pediatric intensive care, were not included in the study since pediatric suctioning method was performed differently from the adults.

Theoretical framework

An overall literature review was performed; and both domestic and foreign scientific articles and books were used in the study.

Results

Ages of the nurses included in the study were between 20 years-45 years old; and mean age was 29.8 years ± 5.7 years old. Their mean duration at profession was 7.2 years ± 6.2 years; and it was 3.4 years ± 3.1 years at intensive care. Other socio-demographic and working characteristics of the nurses were summarized (Table 1).

It was found that all nurses gave true answers to the question as "Which of the following below is not one of the evaluation

Table 1. *The distribution of socio-demographic and working characteristics of the nurses.*

Socio-demographic and working characteristics n%		
Age		
18-27 year	24	44
28-37 year	26	48
38 year and older	4	7.4
Gender		
Female	46	85
Male	8	15
Education		
High school	11	20
Associate degree	4	7.4
Baccalaureate	39	72
Experience in nursing		
1-10 year	38	70
11-20 year	13	24
21 year and older	3	5.6
Experience in intensive care units		
1-5 year	44	82
6-10 year	9	17
10 year and older	1	1.9
Status of in-service training on endotracheal aspiration		
Received training	19	35
She/He did not receive training	35	65
Status of in-service training on closed system aspiration*		
Received training	14	74
She/He did not receive training	35	26
Total	54	100

criteria for determining suction need of the patient?" (KQ8) before as well as after training [20]. Statistically significant differences were found between pre- and post-training answers for the questions including "How is the patient positioned before closed suctioning system procedure?" (KQ1), "To which mm/Hg suction pressure should be adjusted before closed suctioning system procedure?" (KQ2), "Which of the procedural steps of closed suctioning system is not proper?" (KQ3), "How long catheter should be pushed forward along the artificial airway at closed suctioning system?" (KQ7), "How long should closed suctioning system last?" (KQ9), "How long should patient rest between two suction procedures?" (KQ11), "When and how long should oxygenation be performed by adjusting oxygen to 100% in the ventilator at closed suctioning system?" (Table 2) [21].

While mean score of the nurses was 7.06 ± 1.74 before training, it was found to be 10.2 ± 1.63 after training. Statistically significant increases were observed in total scores following training (p=0.001) (Table 3).

The hypotheses which were responded truely by the nurses before training were the following ones: "Closed suctioning system method prevents the contamination of secretions to the patient (H1,94.4%)", "Closed suctioning system method prevents the contamination of secretions to the nurse (H2, 96.3%)", "Closed suctioning system method prevents the contamination of secretions to the surrounding (H3, % 96.3)", "Closed suctioning system catheter provides ease of work due to its use for 24 hours (H16, 94.4%)" [22]. The hypotheses which were responded as "true" by most of the nurses were as follows: "Closed suctioning system method prevents the contamination of secretions to the patient (H1, 96.3%)", "Closed suctioning system method prevents the contamination of secretions to the nurse (H2, 98.1%)", "Closed suctioning system method prevents the contamination of secretions to the surrounding (H3, 96.3%)", "Preparation time for closed suctioning system is shorter compared to open suctioning system (H4, 94,4%)", "It is appropriate to choose closed suctioning system catheter for the patients requiring frequent aspiration (H15, 98.1%)", "Closed suctioning system catheter provides ease of work due to its use for 24 hours (H16, 96.3%)" [23].

The hypothesis, which was responded as "no" by most of the nurses, was found as the following: "It is difficult to use closed suctioning system catheter". Statistically significant differences were found after training in the hypotheses including "Disconnection of the patient from the ventilator in open suctioning system may lead to atelectasis (H10; p=0.001)" and "Bloody secretions are more commonly observed inside the catheter in closed suctioning system compared to open suctioning system method" (Table 4).

All nurses chose closed suctioning system before and after training due to its ability to protect patient and practitioner from the infections. Closed suctioning system was selected due to ease of application by 98.1% and due to application time by 98.0% after training.

Majority of the nurses (76.5%) were found to choose open suctioning system for aspirating secretions due to its efficiency before and after training. As seen in the table, no statistically significant differences were found in any of the hypotheses (p>0.05) (Table 5).

Table 2. *True answers given by the nurses for the knowledge questions regarding closed suctioning system before and after training.*

Question Roots of Knowledge Questions	Before training	After training	p
	S (%)	S (%)	
KQ1. How is the patient positioned before closed system aspiration procedure?	36 (69.2)	49 (94.2)	0
KQ2. To which mm/Hg suction pressure should be adjusted before closed suctioning system procedure?	19 (38.0)	42 (84.0)	0
KQ3. Which of the procedural steps of closed suctioning system is not proper?	7 (14.6)	19 (39.6)	0
KQ4. Which of the following is not one of the things that should be performed during closed system aspiration?	8 (16.3)	33 (67.3)	0
KQ5. How soon should closed system aspiration catheter be changed after providing its connection with the patient?	44 (88.0)	49 (98.0)	0.06
KQ6. Which of the following is not one of the preparation steps before closed system aspiration?	43 (84.3)	47 (92.2)	0.39
KQ7. How long should catheter be pushed forward along the artificial airway at closed suctioning system?	22 (44.9)	48 (98.0)	0
KQ8. Which of the following below is not one of the evaluation criteria for determining suction need of the patient?	51 (100.0)	51 (100.0)	-
KQ9. How long should closed suctioning system last?	27 (50.9)	46 (86.8)	0
KQ10. Which of the following options shows that aspiration procedure is effective?	29 (70.7)	23 (56.1)	0.21
KQ11. How long should patient rest between two suction procedures?	10 (20.0)	33 (66.0)	0
KQ12. When and how long should oxygenation be performed by adjusting oxygen to 100% in the ventilator at closed suctioning system?	19 (36.5)	33 (63.5)	0
KQ13. Which patients are eligible for the use of closed suctioning system method?	46 (88.5)	49 (94.2)	0.45

Table 3. *Mean knowledge scores of the nurses regarding closed suctioning system before and after training.*

Total score average of correct answers			
	Min-Max.	X ± SS	p
Before training	01-Nov	7.06 ± 1.74	0.001
After training	May-13	10.2 ± 1.63	t=-8,855

Table 4. *Answers given by the nurses to the hypotheses regarding open and closed suctioning system methods before and after training.*

Hypotheses	Before training S (%)			After training S (%)			
	Yes	No	Do not know	Yes	No	Do not know	P
H1. Closed suctioning system method prevents the contamination of secretions to the patient	51 (94.4)	2 (3.7)	1 (1.9)	52 (96.3)	1 (1.91)	1 (1.9)	0.739 MH=0,333
H2. Closed suctioning system method prevents the contamination of secretions to the nurse	52 (96.3)	1 (1.9)	1 (1.9)	53 (98.1)	1 (1.9)	0 (0)	0.414 MH=0,816
H3. Closed suctioning system method prevents the contamination of secretions to the surrounding	52 (96.3)	1 (1.9)	1 (1.9)	52 (96.3)	0 (0)	2 (3.7)	0.782 MH=-0,277
H4.Preparation time for closed suctioning system is shorter compared to open suctioning system	47 (87)	3 (5.6)	4 (7.4)	51 (94.4)	2 (3.7)	1 (1.9)	0.144 MH=1,46
H5. It is difficult to use closed suctioning system catheter	3 (5.6)	48 (88.9)	3 (5.6)	3 (5.6)	51 (94.4)	0 (0)	0.366 MH =0,905
H6. The sleeve around closed suctioning system catheter prevents the suction of secretions sufficiently	18 (33.3)	29 (53.7)	7 (13)	7 (13)	45 (83.3)	2 (3.7)	0.273 MH=-1,095
H7. Secretions are efficiently cleaned by closed suctioning system method	23 (42.6)	27 (50)	4 (7.4)	38 (70.4)	14 (25.9)	2 (3.7)	0.004 MH=2,874
H8. Closed suctioning system method is inadequate in aspirating dark and sticky secretions	37 (68.5)	15 (27.8)	2 (3.7)	39 (72.2)	13 (24.1)	2 (3.7)	0.715 MH=0,365
H9. It is better to use closed suctioning system catheter for the patients having more secretions	41 (75.9)	8 (14.8)	5 (9.3)	36 (66.7)	16 (29.6)	2 (3.7)	0.695 MH=-0,392
H10. Disconnection of the patient from the ventilator in open suctioning system may lead to atelectasis	19 (35.2)	18 (33.3)	17 (31.5)	42 (77.8)	7 (13)	5 (9.3)	0.001 MH=4,214
H11. Closed suctioning system method is suitable for use in all patients undergoing endotracheal intubation	37 (68.5)	11 (20.4)	6 (11.1)	46 (85.2)	2 (3.7)	6 (1.1)	0.189 MH=1,313
H12. Closed suctioning system catheter leads to the concern of insufficient aspiration of the patient due to the sleeve around	21 (38.9)	29 (53.7)	4 (7.4)	25 (46.3)	27 (50)	2 (3.7)	0.303 MH=1,029
H13. Preparation phase for open suctioning system method makes nurse to lose time	42 (77.8)	9 (16.7)	3 (5.6)	44 (81.5)	10 (18.5)	0	0.225 MH=1,213
H14. Secretions are efficiently cleaned by open suctioning system method	47 (87)	4 (7.4)	3 (5.6)	48 (88.9)	4 (7.4)	2 (3.7)	0.695 MH=0,392
H15. It is better to use closed suctioning system catheter for the patients having more secretions	47 (87)	2 (3.7)	5 (9.3)	53 (98.1)	1 (1.9)	0 (0)	0.022 MH=2,294
H16. Closed suctioning system catheter provides ease of work due to its use for 24 hours	51 (94.4)	1 (1.9)	2 (3.7)	52 (96.3)	2 (3.7)	0 (0)	0.317 MH=1,00
H17. The manipulation of closed suctioning system catheter is difficult	6 (11.1)	40 (74.1)	8 (14.8)	6 (11.1)	45 (83.3)	3 (5.6)	0.384 MH=0,870
H18. Bloody secretions are more commonly observed inside the catheter in closed suctioning system compared to open suctioning system method	17 (31.5)	24 (44.4)	13 (24.1)	24 (44.4)	24 (44.4)	6 (11.1)	0.02 MH=2,333
H19. Open suctioning system procedure may cause mucosal trauma	39 (72.2)	7 (13)	8 (14.8)	45 (83.3)	5 (9.3)	4 (7.4)	0.068 MH=1,826
H20. Closed suctioning system procedure may cause mucosal trauma	21 (38.9)	21 (38.9)	12 (22.2)	10 (18.5)	38 (70.4)	6 (11.1)	0.411 MH=-0,822

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Table 5. *The distribution of the answers of nurses for their reasons to choose methods before and after training.*

Reasons to choose methods	Before Training		After Training		p
	Closed system aspiration	Open system aspiration	Closed system aspiration	Open system aspiration	
Ease of application	50 (94.3)	3 (5.7)	52 (98.1)	1 (1.9)	0.5
Application time	48 (96)	2 (4)	49 (98)	1 (2)	1
Protection of patients and practitioners from	53 (100)	0(0)	53 (100)	0 (0)	-
Prevention of nosocomial infection	43 (97.7)	1 (2.3)	42 (95.5)	2 (4.5)	1
Efficacy in aspirating secretions	12 (23.5)	39 (76.5)	12 (23.5)	39 (76.5)	1
Prevention of complications	45 (93.8)	3 (6.3)	46 (95.8)	2 (4.2)	1
Cost	24 (53.3)	21 (46.7)	30 (66.7)	15 (33.3)	0.26

Discussion

In this current study, the opinions of nurses regarding open and closed suctioning system methods were determined, and a training program was organized for closed suctioning system methods.

The researcher prepared videos and photographs including the application of procedural steps of closed suctioning system in order to use in training program. Modelling, target behaviour and the steps required were described visually by the video. In this study, it was found that there was a significant increase in the mean knowledge scores of the nurses after training. A positive change occurred towards closed system in the answers of nurses given to the hypotheses regarding closed and open suctioning system after training. The training video used was considered to have an effect on this positive change. To evaluate the efficiency of training with video in acquiring pediatric diagnostic skills, it was observed that video training was effective in bringing pediatric diagnostic skills to the student and in making them perform these skills at a better level [24].

In this study, it can be stated that training given to the nurses was beneficial in terms of practicing suction properly, patient-practitioner safety and enhancing the quality of nursing care. Discussion part was addressed under two titles.

Examination of true answers given by the nurses to knowledge questions regarding closed suctioning system method

The percentage of the true answers given to the question as "To which mm/Hg suction pressure should be adjusted before closed suctioning system procedure?" after training was increased compared to before training. Suction pressure should be between 80 mmHg-120 mmHg for adults. Pressures higher than 120 mm/ Hg create severe damage on the mucosa. If the secretions of the patient are dark, increasing pressure of the aspirator will only cause catheter to stick on the mucosa more strongly. In a previous study, it was found that nurses knew the most appropriate suction pressure, but there were not any nurses having proper practice. According to the observational results of the same study, it was indicated that nurses generally turned on the manometer of aspirator until the end and applied suction without checking the pressure. During the interviews with the nurses during training in our study, nurses stated that they only used turn on/off switch in central suction system and they did not do any pressure adjustment. They also reported that pressure increased up to 200 mm/Hg and more when this switch was first turned on, and they aspirated the patient with this pressure. The increase in true answers regarding pressure settings after training suggests that nurses' awareness's have been enhanced [25].

The percentages of true answers for the question as "Which of the procedural steps of closed suctioning system is not proper?" were found to be highly low before and after training. Since majority of the nurses thought that serum physiological (SF) should be given during aspiration, they thought that the option stating that "SF is not administered to airway while performing aspiration" was wrong. Previous studies have indicated that administration of SF into the artificial airway cause many complications. It has been reported that SF decreases oxygenation when administered to trachea rather than softening secretions, and increases infection risk, heart rate and arterial blood pressure. SF was administered to airway by 93.3% of the nurses in open suctioning system aspiration and by 97.2% in closed suctioning system. 68% of the nurses used SF before the aspiration and 24% used in the presence of dark secretions. In several practice guidelines, it is indicated that SF use before aspiration among the patients who undergo Mechanical Ventilation treatment, is not an evidence-based practice; and routine use of SF is not recommended due to its harmful effects.

When total mean scores of true answers given to knowledge questions regarding closed suctioning system method were examined, it was seen that total scores were increased after training compared to before training; and there was a statistically significant difference between both (p=0.001). In most of the knowledge questions, true answers were achieved after training at a high ratio; but, the percentages of proper practices were found to be low in the studies also including observations. Lack of observations is among the limitations of this study.

Examination of the answers of nurses for the hypotheses regarding closed and open suctioning system methods and open-ended questions

Nurses were found to give more "yes" answers to the question as "Disconnection of the patient from the ventilator in open suctioning system may lead to atelectasis" after training. Similar results were obtained for the same hypothesis. Studies in the literature also indicated that open suctioning system caused more loss of volume in the lungs compared to closed suctioning system.

It was stated that nurses in the study chose closed suctioning system before and after training due to ease of application, duration of application, prevention of patient and practitioner from the infections, prevention of nosocomial infections, prevention of complications and cost; and they only preferred open suctioning system for aspirating secretions. In the study, nurses preferred open suctioning system for aspirating secretions in terms of efficiency at a ratio of 76.5% before and after training. In the study author identified that insufficient suction of secretions was found to be among the concerns of nurses regarding closed suctioning system [6]. The amount of secretions aspirated by closed suctioning system was less than open suctioning system. The support the statement of the nurses indicating inefficiency of closed suctioning system in aspirating secretions [26]. It was observed that all nurses chose closed suctioning system before and after training in terms of preventing patient and practitioner from infections. Studies showed that contamination of surrounding with the secretions was decreased since the connection of patient with mechanical ventilator continued during closed suctioning system method.

Nurses included in the study preferred closed suctioning system at a similar and high ratio before and after training in terms of the duration of application. In another study evaluating nurses' application times for open and closed suctioning system methods, it was indicated that each application of open system endotracheal suction procedure was 153 seconds and each closed system endotracheal suction lasted for 93 seconds.

In the study, nurses preferred closed suctioning system in terms of the prevention of nosocomial infections. Intubation and endotracheal suction increase mortality and morbidity and adversely affect duration of hospitalization in intensive care unit and cost by blocking normal defence mechanisms, and nosocomial pneumonia are responsible for 9%-50% of the infections acquired in the hospital. In the performed studies, it was shown that aspiration by closed suctioning system method decreased the rates of infections, ventilator-associated pneumonia and mortality. In terms of cost, more than half of the nurses chose closed suctioning system. Studies in the literature showed distinct results regarding cost.

The use of closed suctioning system catheter for 24 hours and lack of need for materials such as sterile gloves, mask and eye glasses during this suction procedure decrease its cost. The cost, which was calculated as patient/day, did not differ between open and closed suctioning systems, and the cost of closed system was found to be lower than open system after exceeding the duration of mechanical ventilation. The closed suctioning system method has 1.6-fold higher cost than open suctioning system method. However, cost data of the previous studies are outdated. Closed suctioning system method was found to be more advantageous than open system in terms of preventing patient, nurse and surrounding from contamination by the secretions, decreasing the time spent by the nurses during the procedure and protecting patient from infection and complications of the procedure. In the study closed suctioning system method was chosen at a ratio of 79% compared to open suctioning system. Considering these results, it can be suggested that promotion of the use of closed suctioning system method and material supply by the hospital managements are highly important [27].

Conclusion

In this study which was carried out to determine opinions of the nurses regarding the application of open and closed suctioning systems and the effect of training given about closed suctioning system on their knowledge and opinions, it was found that there was a significant increase in their knowledge levels regarding closed suctioning system method following training. Their reasons to choose closed suctioning system were identified as protecting patient, surrounding and nurse from the infections, ease of application and the shortness of the duration of application.

Implications and recommendations for practice

Planned and continuous in-service trainings about open and closed suctioning system procedures should be organized for the nurses working in the units where aspiration procedures are performed; and these trainings should be supported with videos and visual instruments. It is recommended to conduct more advanced studies regarding the use of open and closed suctioning system methods.

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