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Mind Mapping as a New Strategy to Improve Cardiopulmonary Resuscitation Learning for Medical Interns

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Abstract

objective Sudden cardiac death (SCD) caused by unexpected cardiovascular arrest remains a major public health threat globally. Cardiopulmonary resuscitation (CPR) is a basic but critical first aid skill to rescue patients with sudden cardiac arrest. This study aimed to ascertain whether the mind mapping technique, a note-taking and graphic thinking tool, could improve the learning of CPR among medical interns. **Methods** A total of 79 medical interns rotating in the emergency department in our center were selected as research participants. They were randomly divided into the control group (n=40) and the experimental group (n=39). The control group was trained with traditional PowerPoint (PPT) slide courseware combined with practical operations, while the experimental group was trained with mind mapping technique on the basis of traditional PPT courseware combined with practical operations. The theoretical test, operational assessment, and the survey regarding the satisfaction with the training were conducted between the two groups of interns after training. **Results** Although the interns in both groups mastered the CPR technique successfully with theoretical and operational assessment scores >90 (out of 100), the experimental group performed significantly better in both theoretical tests (score: 96.13±2.47 vs 93.71±4.48, p=0.0041) and operational assessment (score: 94.82±3.22 vs 91.32±3.46, p<0.0001). Moreover, all interns (100%) in the experimental group were satisfied with the CPR training experience, while only 75% of the interns in the control group were satisfied with the training. **Conclusions** Mind maps as a supplementary teaching tool could facilitate CPR learning for medical interns and improve their learning interest.

Keywords: Sudden cardiac death; Cardiopulmonary resuscitation; Interns; Mind Map; Medical education

1. Introduction

Sudden cardiac death (SCD) due to unexpected cardiovascular arrest is the most common cause of death and remains a major public health issue globally. It is estimated that SCD accounts for 15–20% of all deaths [1–3]. According to the systemic analysis by Feng *et al.*, in China, the incidence of SCD is around 40.7 per 100000 person-year; based on the documented locations of events of the studied subjects, around 30% of individuals developed cardiac arrest in or after arrival at hospitals [4]. Therefore, despite the ongoing efforts in healthcare improvement, SCD remains a critical public issue.

Cardiopulmonary resuscitation (CPR) is the basic clinical operating procedure and one of the most important clinical first aid skills to rescue patients with sudden cardiac arrest. Since SCD usually occurs within the first hour of the onset of symptoms, minimizing the time to initiation of CPR is essential for improving survival chances in cases of cardiac arrest [5]. Also, timely, proper, and effective CPR can reduce brain damage and improve patient outcomes [6]. Therefore, CPR learning has been one of the critical basic courses in medical internship training — a necessary step for medical students to become doctors. For the medical interns, challenges such as the insufficient connection between theory and practice, lack of clinical experience as well as corresponding clinical thinking may prevent them from mastering the CPR technique. Given that it is particularly important for interns to master CPR operations and apply them correctly during the short internship rotation in the emergency department, seeking efficient ways to improve their CPR learning is critical as a part of medical education.

Mind mapping, a concept as well as a powerful note-taking tool firstly established by Tony Buzan, is an effective method of graphic thinking and has emerged as an innovative and effective method in enhancing the memory capacity of the medical college students in medical education [7]. This method has proven to be effective in information retrieval, and therefore it helps with learning enhancement [7–9]. A mind map can easily establish the logical relationship between relevant knowledge points by drawing, highlighting the key points, and making the information clear, easy to remember and understand. Some studies suggested that mind mapping technique may help improve CPR learning [10]. However, more evidence is needed to support this new method in medical training. Therefore, in this study, we aimed to confirm the efficiency of the mind mapping technique for CPR training for interns studying in the emergency department.

2. MATERIALS AND METHODS

2.1 Research participants

A total of 79 medical interns who were doing the rotation in the emergency department of our hospital from August 2020 to October 2021 were enrolled in this study. They all agreed to participate and signed the informed consent form. These interns were randomly divided into the experimental group ($n=39$) and the control group ($n=40$). There were 13 males and 26 females in the experimental group with ages between 20–22 years old and 14 males and 26 females in the control group with ages between 21–24 years old. No significant difference regarding the gender and age between the two groups ($P>0.05$).

2.2 CPR training process between the two groups

The control group was taught in the traditional way based on the "2015 International Guidelines for Cardiopulmonary Resuscitation". Specifically, the corresponding slides for training courseware were made, and the theoretical teaching was delivered combined with the operation demonstration. After the teaching, the students practiced on the "Annie" simulator for CPR until they mastered this technique. For the experimental group, the corresponding slides of training courseware were also based on the "2015 International Guidelines for Cardiopulmonary Resuscitation". The theory training was delivered first. During the practical training, the teacher started by introducing the basic concepts of mind mapping. According to the training content and operation process, the teacher would draw a mind map with the students in the way of asking questions and guided thinking, and the teacher would further analyze and explain in combination with the mind map. Next, the teacher would carry out a demonstration of CPR according to the steps listed in the mind map. The teachers of the two groups are all the same full-time teachers. The teaching materials, slide content, and operation process-scoring table were the same between the two groups.

2.3 Design of the mind map

The mind map of the CPR operation training was drawn with the Mind Mapping software-Visio Professional. Based on the "2015 International Guidelines for Cardiopulmonary Resuscitation", with the keyword CPR as the main trunk, six major branches of grade 1 are radiated, namely preoperative assessment, chest compression (C-circulation), and airway opening (A-airway), Artificial breathing (B-breathing),Electrical defibrillation and post-operative assessment (Representative mind map for CPR training in Figure 1). Radial lines were used to connect knowledge points to each other. Different colors were used to distinguish each branch or keyword to make the overall level clearer, highlight the key points, and help memory.

2.4 Outcome evaluation

Theoretical test

After the theoretical and operational training, the teachers would use the unified theoretical written test and CPR operation process-scoring standard. The theoretical test covers the location, frequency, depth of chest compression, chest compression to ventilation ratio, ventilation frequency, etc.

Operational assessment

After the training, the two groups of interns would be assessed for operation using the same scoring standard. The operation test is mainly based on the Simpad feedback device to objectively score indicators such as compression depth, frequency, and artificial ventilation tidal volume. Both theory and operation assessments are based on a total score of 100.

Interns' satisfaction survey for two different teaching methods

After the training, the teachers distribute the training effect satisfaction questionnaire to the interns. The survey content includes training methods, training effects, professional levels of teachers, students' self-assessment for the CPR knowledge, and training gains.

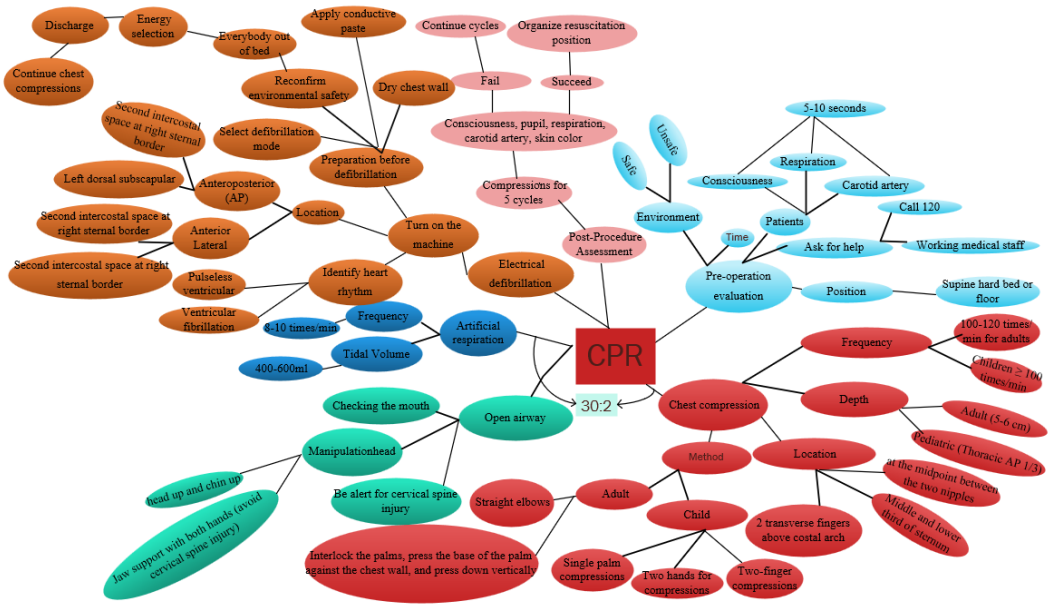


Figure 1. Representative mind map for CPR training.

Interns make comprehensive evaluations according to different satisfaction scales, including "very satisfied", "satisfied" and "dissatisfied". A total of 79 evaluation forms were issued, and 79 valid evaluation forms were eventually retrieved, with an effective recovery rate of 100%.

2.5 Statistical analysis

The SPSS 22.0 statistical software was used to analyze the data. Measurement data were expressed as mean ± standard deviation (SD). Independent student's t-test was used for comparison between groups. Enumeration data were expressed as the number of cases (n) or percentage (%), and the 2 test was used for comparison between groups. P<0.05 was considered to be statistically significant.

3. RESULT

3.1 The experiment group performed better than the control group in terms of both theoretical and operational tests

As shown in Table 1, although both groups achieved good performance after the training, compared with the control group, the theoretical and operational performances of the experimental group were significantly better (both P<0.05). These data demonstrated that applying the mind mapping technique in CPR training could help interns better master the CPR techniques in comparison to the traditional teaching method.

Table 1. The scores of the theoretical and operational assessments between the two groups

Parameters	Control group(n=40)	Experimental group(n=39)	T value	P value
Theoretical test	93.71±4.48	96.13±2.47	2.916	0.0041
Operational test	91.32±3.46	94.82±3.22	4.589	<0.0001

3.2 The interns in the experiment group were more satisfied with the training experience than the control group

According to the survey we conducted post-training session, all interns (100%) in the experiment group were “very satisfied” or “satisfied” with the teaching method with the mind mapping technique. However, in the control group, 25% of the interns were “dissatisfied” with the training experience (Table 2). These data suggested that applying the mind mapping technique in the CPR training is more popular among the interns.

Table 2. Survey on the satisfaction for the CPR training experience

Parameters	Control group (n=40)	Experimental group(n=39)	χ^2	P value
Very satisfied	25	32	-	-
Satisfied	5	7	-	-
Dissatisfied	10	0	-	-
Satisfaction percentage	75%	100%	11.18	0.0037

4. DISCUSSION

Given that sudden cardiac arrest is not a rare medical emergency in the hospital, mastering CPR technique is critical for medical interns. In this study, our test results and survey data support that utilizing mind mapping as an innovative teaching method in CPR training could facilitate the learning of CPR among the medical interns and enhance their training experience. Therefore, compared to the traditional training method, adding mind mapping in teaching may help the intern better master the critical CPR technique.

CPR learning is a long-term and iterative process, and it is difficult to achieve the training effect of correctly implementing CPR without mastering the key points of CPR knowledge. For traditional training, students usually learned through listening, watching, or taking pictures of slides/operations to memorize the CPR steps. In this process, students usually do not have much time to do their own logical thinking. Therefore, this “cramming” teaching method is difficult to connect all knowledge, and students’ memory of what they have learned appears scattered and unsystematic. The mind map is a tool for expressing divergent thinking in simple words, graphics, etc. By sorting out knowledge through a mind map, a complete logical system can be constructed, so that the learning efficiency could be improved [9, 11]. Visualization of thinking, to a certain extent, realizes the visualization and explication of hidden knowledge, which is convenient for teachers and interns to analyze, think, summarize and consciously explore knowledge. Therefore, this method

can improve teaching and learning efficiency, and cultivate students' autonomous learning ability and problem-solving ability [12, 13].

In this study, mind mapping was introduced in the training of the experimental group. This teaching method emphasizes both graphics and texts. This teaching method emphasizes both pictures and texts, and uses a clear knowledge structure framework, prominent points, bright colors, and image symbols to express the relationship between the themes at all levels in terms of mutual subordination and correlation. This "visualized" information stimulates the visual perception, thereby exerting the potential of the brain and deepening the understanding of CPR knowledge points and operating procedures. At the same time, it can improve learning efficiency and problem-solving ability [14, 15]. The results of this study showed that the theoretical and operational performance and satisfaction of CPR learning in the experimental group were significantly higher than those in the control group ($P < 0.05$). Our data shows that the application of a mind map for CPR training improves the learning efficiency of medical interns. In the process of using a mind map for training, students change from passive to active, give full play to their subjective initiative, increase teaching interactivity, and their potential and interest in learning are stimulated.

In conclusion, this study suggested that utilizing mind mapping could promote the learning of CPR among medical interns. This new and effective learning method could promote their logical thinking, help them analyze and summarize the related medical knowledge of CPR, and they are more satisfied with this new teaching method.

References

- [1] Adabag AS, Luepker RV, Roger VL, Gersh BJ. Sudden cardiac death: epidemiology and risk factors. *Nat Rev Cardiol.* 2010 Apr;7(4):216–25. doi: 10.1038/nrcardio.2010.3. Epub 2010 Feb 9. PMID: 20142817.
- [2] Agwu ME, Murray JP (2014) Drivers and inhibitors to e-commerce adoption among SMEs in Nigeria. *Journal of Emerging Trends in Computing and Information Sciences* 5(3): 192–199.
- [3] Agwu ME, Murray JP (2015) Empirical study of barriers to electronic commerce adoption by small and medium scale businesses in Nigeria. *International Journal of Innovation in the Digital Economy*, 6(2): 1–19.
- [4] Mehra R. Global public health problem of sudden cardiac death. *J Electrocardiol.* 2007 Nov–Dec;40(6 Suppl):S118–22. doi: 10.1016/j.jelectrocard.2007.06.023. PMID: 17993308.
- [5] Feng XF, Hai JJ, Ma Y, Wang ZQ, Tse HF. Sudden Cardiac Death in Mainland China: A Systematic Analysis. *Circ Arrhythm Electrophysiol.* 2018 Nov;11(11):e006684. doi: 10.1161/CIRCEP.118.006684. PMID: 30571181.
- [6] Cummins RO, Eisenberg MS, Hallstrom AP, Litwin PE. Survival of out-of-hospital cardiac arrest with early initiation of cardiopulmonary resuscitation. *Am J Emerg Med.* 1985 Mar;3(2):114–9. doi: 10.1016/0735-6757(85)90032-4. PMID: 3970766.

- [7] Soar J, Böttiger BW, Carli P, Couper K, Deakin CD, Djärv T, Lott C, Olasveengen T, Paal P, Pellis T, Perkins GD, Sandroni C, Nolan JP. European Resuscitation Council Guidelines 2021: Adult advanced life support. *Resuscitation*. 2021 Apr;161:115-151. doi: 10.1016/j.resuscitation.2021.02.010. Epub 2021 Mar 24. Erratum in: *Resuscitation*. 2021 Oct;167:105-106. PMID: 33773825.
- [8] Kalyanasundaram M, Abraham SB, Ramachandran D, Jayaseelan V, Bazroy J, Singh Z, Purty AJ. Effectiveness of Mind Mapping Technique in Information Retrieval Among Medical College Students in Puducherry-A Pilot Study. *Indian J Community Med*. 2017 Jan-Mar;42(1):19-23. doi: 10.4103/0970-0218.199793. PMID: 28331249.
- [9] Yang H, Gao XB, Li MH, Ye Q, Sun Y, Huang Y. The use of mind mapping in health education in extended care for children with caries. *J Int Med Res*. 2020 May;48(5):300060519898053. doi: 10.1177/0300060519898053. PMID: 32468883; PMCID: PMC7263125.
- [10] D'Antoni AV, Zipp GP, Olson VG, Cahill TF. Does the mind map learning strategy facilitate information retrieval and critical thinking in medical students? *BMC Med Educ*. 2010 Sep 16;10:61. doi: 10.1186/1472-6920-10-61. PMID: 20846442.
- [11] Qin Shaokun, Xu Yinli, Jiang Jianmei, et al. Application of mind mapping in pre-job CPR training for clinical interns [J]. *Journal of Minimally Invasive Medicine*, 2020, 15(1): 84-86. DOI: 10.11864/j. issn.1673.2020.01.29.
- [12] Wu HZ, Wu QT. Impact of mind mapping on the critical thinking ability of clinical nursing students and teaching application. *J Int Med Res*. 2020 Mar;48(3):300060519893225. doi: 10.1177/0300060519893225. PMID: 32212879; PMCID: PMC7370812.
- [13] Farrand P, Hussain F, Hennessy E. The efficacy of the 'mind map' study technique. *Med Educ*. 2002 May;36(5):426-31. doi: 10.1046/j.1365-2923.2002.01205.x. PMID: 12028392.
- [14] Edwards S, Cooper N. Mind mapping as a teaching resource. *Clin Teach*. 2010 Dec;7(4):236-9. doi: 10.1111/j.1743-498X.2010.00395.x. PMID: 21134197.
- [15] Gossack-Keenan K, De Wit K, Gardiner E, Turcotte M, Chan TM. Showing Your Thinking: Using Mind Maps to Understand the Gaps Between Experienced Emergency Physicians and Their Students. *AEM Educ Train*. 2019 Sep 1;4(1):54-63. doi: 10.1002/aet2.10379. PMID: 31989071.