



“COMPARISON OF HANDS OFF & HANDS ON TRAINING IN BASIC LIFE SUPPORT: A MANNEQUIN-BASED STUDY “

Anaesthesiology

Dr. Arun Ahirwar* Assistant Professor, Department of Anaesthesiology, Rajkiya Medical College, Jalaun
*Corresponding Author

Dr. Chhavi Jaiswal Assistant Professor, Department of Paediatrics, Rajkiya Medical College, Jalaun

Dr. J.K. Gupta Assistant professor, Department of Medicine, Rama Medical College Hospital & Research Centre, Kanpur

Harsh Maheshwari Medical Student, Rajkiya Medical College, Jalaun

ABSTRACT

Background Cardiopulmonary Resuscitation (CPR) is a life-saving technique that can reduce the mortality in patients with cardiopulmonary failure by upto 3 times. Its effectiveness relies on the correct knowledge, technique and most importantly skill of the performer which has been found to be inadequate even among healthcare professionals. This may be improved by designing better training methods that aim at enhancing the skills of the performer. **Objective** This study aims to compare the hands-on training method utilising mannequin (Mannequin Group) versus training without use of mannequin (non-mannequin group or control group) in the Basic Life Support (BLS) training. We evaluated the effect and utility of using mannequins to follow along with BLS training. **Method** This prospective experimental study was done on final year medical students and interns. Participants were randomly assigned to either mannequin group or non-mannequin (control group). Both groups were given 3 hours long BLS training but all participants of mannequin group were given a mannequin for follow along practice during the training while the other group was kept as control. Both groups were analysed for knowledge via MCQ based test and skills were assessed on 3-point Likert scale immediately after the training. **Results** A total of 179 participants enrolled for the study (randomly assigned 90 in mannequin group and 89 in non-mannequin group). Post-training knowledge scores were 17.20 ± 11.17 for the mannequin group versus 16.53 ± 2.28 for the control group ($p > 0.05$). Post-training skill scores were significantly higher for mannequin group in 28 of the 30 skills tested when compared to control group ($p < 0.05$). **Conclusion** Use of mannequins to follow along with BLS training is an effective tool that significantly improves the skills of participants but has no effect on the knowledge levels of participants. Hence, mannequins hands-on training should be made mandatory in every BLS training as it significantly improves the skill level of healthcare professionals which may result in the reduction of patient mortality.

KEYWORDS

INTRODUCTION

Sudden Cardiac Death (SCD) means unexpected death from a cardiac arrest in which heart abruptly stops beating. This is often accompanied by loss of consciousness & cessation of breathing. SCD accounts for more than 17 million deaths every year which denotes around 25% of all global mortality [1-3].

Cardiopulmonary Resuscitation (CPR) is an emergent lifesaving technique of manual thoracic compressions (which provides perfusion to vital organs) and rescuing breaths by artificial ventilation. Early and effective CPR delivered by a skilled person is a key in improving the patient's survival [3,4]. It is done in unresponsive patient whose spontaneous cardiopulmonary function has acutely reduced to a level which is not adequate to support a normal life. Existing literature shows that immediate bystander CPR before the arrival Emergency Medical Services (EMS) can reduce the mortality by up-to three times [5]. But, the quality of CPR is of vital importance and it depends on the correct knowledge and skill level of the person delivering CPR. This level has been found to be universally inadequate even among healthcare professionals and also in those who have performed CPR in past [5-7].

It demands a good level of cognitive, psychological and motor skills of the performer to deliver CPR effectively. Various studies have shown a great variability in CPR training methods and devices used in training. But, the trends among existing literature shows that although BLS training improves the skills, but the retention is unsatisfactory (even on testing immediately after completion of training), resulting in less than the ideal performance [6-11]. Hence, it is very important to develop learning strategies that ensure adequate level of skills among healthcare professionals to effectively provide CPR to the patient.

This study compares traditional instructor-based training methods versus Mannequin based training methods for BLS training (includes CPR, use of Automated External Defibrillators [AED] and choking maneuvers) to find any statistically significant difference between the two study groups in the acquisition of BLS skills and knowledge required to deliver an effective CPR.

METHODS

Study Design

The study was designed using PICO model where our Population(P): Final year undergraduate medical students & medical interns who had not taken any BLS training before. Intervention (I): a training method utilizing mannequins to follow along. Comparison(C): Standard Instructor led Classroom style approach. Outcomes(O): BLS knowledge, quality & skill performance.

For this prospective experimental study, the participants were randomly divided into two groups. Group A (non-mannequin group or control group) was given Standard Instructor led training for 3 hours (Classroom tutorial).

Group B (mannequin group) was also given same Instructor led training for 3 hours (Classroom tutorial) but every participant was given a separate mannequin to follow along with the training.

Algorithm

The BLS algorithm followed in this study taken from American Heart Association (AHA). Performance Evaluation Test format to assess the skills of the participants was jointly created by the Department of Paediatrics and Department of Anaesthesiology of Rajkiya Medical College, Jalaun.

Data Collection

The knowledge of both groups was tested before and immediately after training using pre-intervention and post-intervention tests both of which were in Multiple Choice Questions (MCQ) based format. These questions were designed jointly by Departments of Paediatrics and Anaesthesiology at Rajkiya Medical College, Jalaun.

The practical skills were also tested immediately after the training by an independent team of physicians who assessed the participants on 3-point Likert scale in the following pattern.

0 = Not performed at all

1 = Incompletely/ Improperly performed

2 = Performed completely and properly

Statistical Analysis

Both Quantitative and categorical data were assessed. The paired t-test and independent t-tests were used for numerical scores and chi-

squared test was used for categorical data. Z-test was used to compare proportions. Statistical significance was considered if the *p-value* was found to be less than 0.05.

Ethical Considerations

Participation in this training and study was voluntary. Participants were assured that their identities will be kept confidential and their performance in this study will not affect their academic scores, work status or stipends. The investigators did not coerce anyone to complete the MCQ test and any participant could decline to submit the answers. Submission of answers was considered to constitute implied consent. The voluntary nature of appearing for practical test and inclusion of these scores in this study was made explicit and unambiguous to the participants.

No written consent was taken as there were no personal identifiers, and this study was approved & rendered exempt by Institutional Ethics Committee (IEC) of RMC, Jalaun.

RESULTS

Analysis of knowledge of participants

Baseline levels of knowledge of participants were assessed before the start of study and both groups showed similar pre-training scores (10.01 ± 3.16 vs 9.92 ± 3.69).

After the training, both groups were re-tested and a boost was found in the knowledge of both groups (mannequin = 17.20 ± 11.17 versus non-mannequin = 16.53 ± 2.28). This increase in knowledge was significant for both groups when compared with their respective pre-training scores but post-training scores of the Mannequin group were not found to significantly differ from the non-mannequin group.

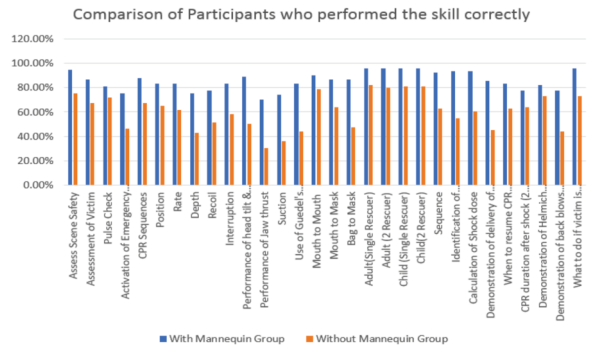
Table 1: Knowledge comparison

	Mannequin Group	Non-mannequin group	p-value
Pre-training scores	9.92 ± 3.69	10.01 ± 3.16	0.9297
Post-training scores	17.20 ± 11.17	16.53 ± 2.28	0.5879
	<0.00001	<0.00001	

Table 2: Skill Comparison-proportion of participants who performed the skills correctly & completely (score=2).

Comparison of Correctly & Completely done	Mannequin Group	Non-Mannequin or Control Group	Difference	p Value
Assess Scene Safety	94.44%	75.28%	19.16%	0.00034
Assessment of Victim	86.67%	67.42%	19.25%	0.00222
Pulse Check	81.11%	71.91%	9.20%	0.14706
Activation of Emergency Response System	75.56%	46.07%	29.49%	< 0.00001
CPR Sequences	87.78%	67.42%	20.36%	0.00108
Position	83.33%	65.17%	18.16%	< 0.00001
Rate	83.33%	61.80%	21.54%	0.00124
Depth	75.56%	42.70%	32.86%	< 0.00001
Recoil	77.78%	51.69%	26.09%	0.00026
Interruption	83.33%	58.43%	24.91%	0.00024
Performance of head tilt & Chin lift	88.89%	50.56%	38.33%	<0.00001
Performance of Jaw thrust	70.00%	30.34%	39.66%	< 0.00001
Suction	74.44%	35.96%	38.48%	< 0.00001
Use of Guedel's Airway/Nasopharyngeal Airway	83.33%	43.82%	39.51%	< 0.00001
Mouth to Mouth	90.00%	78.65%	11.35%	0.03662
Mouth to Mask	86.67%	64.04%	22.62%	0.00044
Bag to Mask	86.67%	47.19%	39.48%	< .00001
Adult (Single Rescuer)	95.56%	82.02%	13.53%	0.00410
Adult (2 Rescuer)	95.56%	79.78%	15.78%	0.00128
Child (Single Rescuer)	95.56%	80.90%	14.66%	0.00228
Child (2 Rescuer)	95.56%	80.90%	14.66%	0.00228
Sequence (AED)	92.22%	62.92%	29.30%	< .00001

Identification of shockable/unshockable rhythm	93.33%	55.06%	38.28%	< .00001
Calculation of Shock dose	93.33%	60.67%	32.66%	< .00001
Demonstration of delivery of shock	85.56%	44.94%	40.61%	< .00001
When to resume CPR duration after Shock	83.33%	62.92%	20.41%	0.00208
CPR duration after shock (2 min)	77.78%	64.04%	13.73%	0.04338
Demonstration of Heimlich Manoeuvre in Adults	82.22%	73.03%	9.19%	0.13888
Demonstration of back blows to chest thrusts	77.78%	43.82%	33.96%	< .00001
What to do if victim is unresponsive	95.56%	73.03%	22.52%	< .00001



Graph 1

The ability of the participants to perform each skill correctly and completely (given score =2) was assessed in each group. Table 2 shows the percentage of participants in each group who performed the skill correctly and completely when tested immediately after the training.

The Mannequin group demonstrated overall better performance in every CPR skill tested. The most significant differences were seen in Activation of emergency response system (75.56 % vs 46.07% p <0.00001), Position of hand placed on hand (83.33% vs 65.17% p<0.00001), Depth of compressions (75.56% vs 42.70% p<0.00001), Performance of head tilt & chin lift (88.89% vs 50.56% p<0.00001), Performance of Jaw thrust (70.00% vs 30.34% p<0.00001), Use of Suction (74.44% vs 35.96% p< 0.00001), Use of Guedel's Airway/Nasopharyngeal Airway (83.33% vs 43.82% p<0.00001), Bag to Mask ventilation (86.67%vs 47.19% p< .00001), Use of correct sequence of AED (92.22% vs 62.92% p<0.00001), Identification of shockable/ unshockable rhythm (93.33% vs 55.06% p< 0.00001), Calculation of Shock dose(93.33% vs 60.67% p<0.00001), Demonstration of delivery of Shock (85.56% vs 44.94% p<0.00001), Demonstration of back blows to chest thrusts (77.78% vs 43.82% p<0.00001), What to do if victim is unresponsive (95.56% vs 73.03% p<0.00001).

There were some skills where mannequin group performed better than the control group but the difference did not reach statistical significance. It includes Pulse Check (81.11% vs 71.91% p=0.14706 non-significant), Demonstration of Heimlich manoeuvre in adults (82.22% vs 73.03% p=0.13888 non-significant)

DISCUSSION

The present study compares the levels of knowledge and skills among participants receiving BLS training with or without mannequin. As depicted in table 2, if each participant is given a mannequin to follow along during the training, it can improve the participant's technique and skills of delivering CPR by a significantly large margin which reconfirms some previous studies [12]. This may be due to the feedback received while using the mannequin. The use of mannequin trains the participant closer to reality. The increased performance of mannequin group could be explained by the fact that while mannequin group was actually performing the steps during the training, the non-mannequin group could only speculate without experiencing what these steps actually are.

Contrastingly, there was no significant difference found between the

knowledge of these two groups after training (table 1). This implies that theoretical knowledge of participants about BLS is affected only by the instruction given in classroom tutorial and does not depend on the use of mannequins by the participants.

Limitations

This study has some limitations. First, the evaluation of participants could not be done in the setting of actual cardiac arrest in a live patient. Secondly, this study was conducted at one centre only. Lastly, no follow up was done to check the retention of BLS skills over the span of months or years.

Recommendations

Students should be actively involved and certified in CPR training with mannequins hands-on to ensure retentiveness of correct CPR skills and knowledge [13-15] Further, they must also be trained for post-resuscitation care aimed at improving the quality of life of successfully resuscitated patients and recorded videos of individual participants performing CPR on mannequins during training should be used in re-analysis and skill strengthening.

CONCLUSION

BLS is an important lifesaving skill but it's potential to save a life can be realised only if the performer is well versed with the correct technique. For this purpose, the performer must be trained to a level which is close to real life situations. Use of mannequin is an efficient and effective tool to serve this purpose. This study shows that hands-on training using mannequins significantly improves the technique of the trainees. Hence, we conclude that hands-on training on mannequins must be a part of every BLS training.

Acknowledgement

We thank Dr. Neha Mishra, Assistant Professor, Department of Community Medicine, Rajkiya Medical College, Jalaun for her help in statistical analysis of data. We also thank Dr. Sahil, Junior Resident, Rajkiya Medical College, Jalaun for his help in digitizing the forms of data collection.

Special thanks to Dr. GS Chaudhary, Head of Department of Pediatrics, Rajkiya Medical College, Jalaun & Dr. Apoorv Agrawal, Head of Department of Anesthesiology, Rajkiya Medical College, Jalaun for their guidance & mentorship.

Funding

This study was conducted using the existing resources of Rajkiya Medical College, Jalaun. This study was not externally funded.

Conflict of Interest

None

Tools and Software used

Microsoft Excel Professional plus 2016 was used for graph creation and for simple calculations like addition, percentage etc. Online website tools like www.mathcracker.com was used for statistical tests.

Author's Contribution

Conceptualization: CJ AA JG; Project administration: CJ; Methodology: AA CJ JG; Data Collection: CJ AA HM; Statistical Analysis: HM PU; Data Interpretation: CJ AA JG; Writing – original draft: CJ AA HM MC; Writing – review & editing: JG PU

REFERENCES

- Srinivasan NT, Schilling RJ. Sudden Cardiac Death and Arrhythmias. *Arrhythm Electrophysiol Rev.* 2018 Jun;7(2):111-117. doi: 10.15420/aer.2018.15:2. PMID: 29967683; PMCID: PMC602177.
- Kuriachan VP, Sumner GL, Mitchell LB. Sudden cardiac death. *Curr Probl Cardiol.* 2015 Apr;40(4):133-200. doi: 10.1016/j.epcardiol.2015.01.002. Epub 2015 Feb 7. PMID: 25813838.
- Harris AW, Kudenchuk PJ. Cardiopulmonary resuscitation: the science behind the hands. *Heart.* 2018 Jul;104(13):1056-1061. doi: 10.1136/heartjnl-2017-312696. Epub 2018 Jan 20. PMID: 29353251.
- Böttiger BW. Cardiopulmonary resuscitation and postresuscitation care 2015: saving more than 200 000 additional lives per year worldwide. *Curr Opin Crit Care.* 2015 Jun;21(3):179-82. doi: 10.1097/MCC.0000000000000208. PMID: 25922891.
- Sasson C, Rogers MA, Dahl J, Kellermann AL. Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. *Circ Cardiovasc Qual Outcomes.* 2010 Jan;3(1):63-81. doi: 10.1161/CIRCOUTCOMES.109.889576. Epub 2009 Nov 10. PMID: 20123673.
- Kaihula WT, Sawe HR, Runyon MS, Murray BL. Assessment of cardiopulmonary resuscitation knowledge and skills among healthcare providers at an urban tertiary referral hospital in Tanzania. *BMC Health Serv Res.* 2018 Dec 4;18(1):935. doi: 10.1186/s12913-018-3725-2. PMID: 30514275; PMCID: PMC6278030.
- Spinelli G, Brogi E, Sidoti A, Pagnucci N, Forfori F. Assessment of the knowledge level and experience of healthcare personnel concerning CPR and early defibrillation: an

- internal survey. *BMC Cardiovasc Disord.* 2021 Apr 20;21(1):195. doi: 10.1186/s12872-021-02009-2. PMID: 33879072; PMCID: PMC8056553.
- Dine CJ, Gersh RE, Leary M, Riegel BJ, Bellini LM, Abella BS. Improving cardiopulmonary resuscitation quality and resuscitation training by combining audiovisual feedback and debriefing. *Crit Care Med.* 2008 Oct;36(10):2817-22. doi: 10.1097/CCM.0b013e318186fe37. PMID: 18766092.
 - Anantasit N, Vaewpanich J, Kuptanon T, Kamalaporn H, Khositseth A. Improvement of Skills in Cardiopulmonary Resuscitation of Pediatric Residents by Recorded Video Feedbacks. *Indian J Pediatr.* 2016 Nov;83(11):1242-1247. doi: 10.1007/s12098-016-2133-z. Epub 2016 May 13. PMID: 27173649.
 - Binkhorst M, Coopmans M, Draaisma JMT, Bot P, Hogeveen M. Retention of knowledge and skills in pediatric basic life support amongst pediatricians. *Eur J Pediatr.* 2018 Jul;177(7):1089-1099. doi: 10.1007/s00431-018-3161-7. Epub 2018 May 7. PMID: 29732502; PMCID: PMC5997099.
 - Devlin M. An evaluative study of the basic life support skills of nurses in an independent hospital. *J Clin Nurs.* 1999 Mar;8(2):201-5. doi: 10.1046/j.1365-2702.1999.00247.x. PMID: 10401353.
 - Nas J, Thannhauser J, Vart P, van Geuns RJ, Muijsers HEC, Mol JQ, Aarts GWA, Konijnenberg LSF, Gommans DHF, Ahoud-Schoenmakers SGAM, Vos JL, van Royen N, Bonnes JL, Brouwer MA. Effect of Face-to-Face vs Virtual Reality Training on Cardiopulmonary Resuscitation Quality: A Randomized Clinical Trial. *JAMA Cardiol.* 2020 Mar 1;5(3):328-335. doi: 10.1001/jamacardio.2019.4992. PMID: 31734702; PMCID: PMC6865329.
 - Pande S, Pande S, Parate V, Pande S, Sukhsahale N. Evaluation of retention of knowledge and skills imparted to first-year medical students through basic life support training. *Adv Physiol Educ.* 2014 Mar;38(1):42-5. doi: 10.1152/advan.00102.2013. PMID: 24585468.
 - Hopstock LA. Cardiopulmonary resuscitation; use, training and self-confidence in skills. A self-report study among hospital personnel. *Scand J Trauma Resusc Emerg Med.* 2008 Dec 16;16:18. doi: 10.1186/1757-7241-16-18. PMID: 19087259; PMCID: PMC2633269.
 - Farah R, Stiner E, Zohar Z, Eisenman A, Zveibil F. [The importance of CPR training for assessing the knowledge and skills of hospital medical and nursing personnel]. *Harefuah.* 2007 Jul;146(7):529-33, 574. Hebrew. PMID: 17803166.