Original Article

Evaluation of the Impact of Reinforced Training of BLS on the Ability to Retain the Imparted Knowledge and Skill amongst OT Personnel Including Nursing Staff and Technicians : A Prospective Interventional Study

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Background : Operation Theatre being a critical area, it is vital for OT staff to have knowledge and skills of Basic Life Support (BLS). Although this training is conducted as a part of induction, retention of knowledge and skills remains questionable. This prospective interventional study included OT nurses, technicians and patient attendants. A pre-test comprising of 25 structured questions was used to assess baseline knowledge of BLS and training was conducted based on AHA guidelines, followed by assessment. Reinforced training was conducted every month, which concentrated on specific aspect of BLS. Post-test and Objective Structured Clinical Examination (OSCE) were conducted immediately, 3 months and 6 months later to assess retention of Knowledge and Skills.

Results : Average scores for questionnaire were 12.54 (Pre-test), 16.61 (Post test), 18.24 (3 months) and 19.60 (6 months). OSCE scores were 13.24 immediately following training, 13.6 at 3rd months and 13.7 at 6th months. Teamwork with good team dynamics is essential for favorable outcome of cardio-pulmonary resuscitation. In Crisis situations in OT, optimum assistance must be ensured for better outcome. It has been observed that knowledge and skills were improved immediately following training, but it does not ensure retention. AHA proposes reinforced training at shorter intervals with focus on specific content, thus ensuring retention. Reinforcing BLS training of OT personnel at periodic intervals results in positive outcome especially in critical zone such as Operation Theater. BLS training should be reinforced for staffs in critical areas at regular interval

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Key words **: Cardio Pulmonary Resuscitation, Nurse Training.**

Cardiac arrest is a medical emergency that mandates immediate initiation of Cardio-pulmonary Resuscitation for improved survival. Literature suggests an incidence of more than 3 million cardiac arrests per year worldwide with a survival rate less than 8%[1-3]. Along with updated knowledge and skills, a good team dynamic is essential for a favourable outcome of Cardio-Pulmonary Resuscitation (CPR)[4] Operation Theatre (OT) being a critical area in the hospital, it is essential for OT staff to have knowledge and skills regarding Basic Life Support (BLS) Anaesthesiologist, being the team leader in critical situations, needs assistance from the team members including nurses, technicians and helpers. Ours being a new teaching institute, we do not have support of postgraduate students and are dependent on technicians and nursing staff while handling crisis situations in perioperative period. Although Basic Life Support (BLS) training is conducted as a part of induction, retention of knowledge and skills remains questionable which in turn affects the outcome**.** Unlike western countries, strict adherence to licensing of BLS training is yet to be developed[5]. American Heart Association (AHA) has emphasized on reinforcement of knowledge and skills by conducting short frequent training sessions but it has not been implemented yet.

Thus, we conducted the present study with the objectives to assess the current knowledge, to estimate the gain in knowledge and skill of performing BLS following training and to evaluate the retention of knowledge and skills with reinforced training at one, three and six months.

Editor's Comment :

- Reinforced training of BLS shows improvement in retention of knowledge and skills amongst the OT personnel.
- It would be advisable to incorporate BLS trainings of OT team at regular intervals as a hospital protocol.

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Material and Methods

Study Design :

It was a prospective interventional study conducted in a Tertiary Care Medical College Hospital.

Study Population :

The OT staff inclusive of nurses, technicians and patient care attendants willing to participate were included in the study after informed consent. Those with incomplete questionnaires or drop outs during the duration of study were excluded.

Sampling Technique :

Sampling was purposive.

Sample Size Calculation :

Materials and Methods

After obtaining ethical clearance from the IEC and CTRI registration, the study was conducted in the Department of Anaesthesiology at a Tertiary Care Centre, Symbiosis Medical College for Women. A pre-test comprising 25 structured questions was prepared based on AHA 2020 guidelines and conducted prior to training to assess the baseline knowledge. Structured and standardized training was conducted based on AHA 2020 guidelines. The format of training comprised lectures, demonstration, videos and hands-on training using mannequins.

Instructor to student ratio was 1:6 using one mannequin at skill stations. AHA certified instructors were recruited from the Department of Anaesthesiology. The skills taught were chest compression, bag-mask ventilation, chest compression and bag-mask ventilation together, defibrillation and management of cardiac arrest scenario as a team. Objective Structured Clinical Examination (OSCE) and post test questionnaire for knowledge-based assessment were administered at the end of the training session.

Thereafter, reinforcement training was planned which included short sessions related to cardiac arrest algorithm, chest compressions, bag- mask ventilation and defibrillation conducted every month. At the end of 1st month, 3rd months and 6th months, knowledge and skill-based assessments were repeated.

Questionnaire :

(1) BLS is advocated by

a) American Thoracic Society
b) World Health Organization
c) Academic Emergency Medicine
d) American Heart Association

(2) What does 'BLS' stand for?

a) Best Life Support
b) Basic Life Support
c) Basic Lung Support
d) Basic Life Services

(3) In Basic Life Support guidelines, the order of steps for initially starting CPR is

a) Circulation, Airway, Breathing (C-A-B)
b) Airway, Circulation, Breathing (A-C-B)
c) Airway, Breathing, Circulation (A-B-C)
d) Breathing, Circulation, Airway (B-C-A)

(4) When you find someone unresponsive in the middle of the road, what will be your first response? (Note: You are alone there)

a) Open airway
b) Start chest compression
c) Look for scene safety
d) Give two breathings

(5) Respiratory efforts should be assessed by:

a) Looking for Chest and/or abdominal movement
b) Listening for breath sounds
c) Feeling for expired air
d) All of the above together.

(6) If you confirm somebody is not responding to you even after shaking and shouting at him, what will be your immediate action?

a) Start CPR
b) Activate EMS
c) Put him in recovery position
d) Observe

(7) What does the abbreviation 'EMS' stand for

a) Effective Medical Services
b) Emergency Management Services
c) Emergency Medical Services
d) External Medical Support

(8) In BLS, how long will you check pulse and breathing to confirm cardiac arrest?

a) 1–5 seconds
b) 5–10 seconds
c) 10–20 seconds
d) 30–60 seconds

(9) We should check for pulse during CPR every

a) 2 minutes
b) 3 minutes
c) 5 minutes
d) 1 minute

(10) Which location is preferred to check the pulse?

a) Carotid
b) Brachial
c) Femoral
d) Radial

(**11) What is the location for chest compression in adults?**

a) Left side of the chest
b) Right side of the chest
c) Lower half of sternum
d) Xiphisternum

(**12) What is the location for chest compressions in infants?**

a) One finger breadth below the nipple line
b) One finger breadth above the nipple line
c) At the intermammary line
d) At xiphisternum

(**13) Depth of chest compressions in adults during CPR**

a) 5- 6 cm
b) 4- 5 cm
c) 3- 4 cm
d) 2- 3 cm

(14) Depth of compression in infants during CPR should be

a) ½ – 1 inch
b) 1 – 1½ inches
c) 2 – 2 ½ inches
d) 2½ – 3 inches

(**15) Rate of chest compression in adult and children during CPR**

a) 120 -140/ min
b) 100 - 120/ min
c) 80 -100/ min
d) 60 -80/ min

(**16) Ratio of chest compressions to ventilation in adult is**

a) 15:2
b) 10:2
c) 20:2
d) 30:2

(**17) In children the chest compression and ventilation ratio in case of lone rescuer is**

a) 10:2
b) 15:2
c) 20:2
d) 30:2

(**18) Which of the following is not a part of the triple manoeuvre used to clear an obstructed airway?**

a) Head lift
b) Head tilt
c) chin lift
d) jaw thrust

(**19) If you do not want to give mouth-to-mouth CPR, the following can be done EXCEPT**

a) Mouth-mask ventilation and chest compression
b) Chest compression only
c) Bag mask ventilation with chest compression
d) Wait for EMS to arrive

(**20) How do you give rescue breathing in infants?**

a) Mouth-to-mouth with nose pinched
b) Mouth-to-nose only
c) Mouth-to-mouth without nose pinched
d) Mouth-to- mouth and nose

(**21) What does the abbreviation AED stand for?**

a) Automated External Defibrillator
b) Automated Electrical Defibrillator
c) Advanced Electrical Defibrillator
d) Advanced External Defibrillator

(**22) If you and your friend are having food in a canteen and suddenly your friend starts expressing symptoms of choking, what will be your first response?**

a) Give abdominal thrusts
b) Give chest compression
c) Confirm foreign body aspiration by talking to him
d) Give back blows

(**23) You are witnessing an infant who suddenly started choking while he was playing with the toy, you have confirmed that he is unable to cry (or) cough, what will be your first response?**

a) Start CPR immediately at the rate of 100-120/min
b) Try to remove the suspected foreign body by blind finger sweeping technique
c) Back blows and chest compression of five cycles each then open the mouth and remove foreign body only when it is seen
d) Give water to the infant and open his mouth

(**24) You are witnessing an adult unresponsive victim who has been submerged in fresh water and just removed from it. He is unresponsive. What is the first step?**

a) Compress the abdomen to remove the water
b) Give 2 rescue breaths followed by chest compressions
c) CPR for one minute and inform EMS
d) Keep him in recovery position

(**25) CPR should be stopped in the following conditions except?**

a) The patient starts breathing normally
b) Patient is not revive2d after 20 minutes of CPR
c) Trained medical personnel arrive to take over
d) Too exhausted to continue

Answer key: 1 (d), 2 (b), 3 (a), 4 (c), 5 (d), 6 (b), 7 (c), 8 (b), 9 (a), 10 (a), 11 (c), 12 (c), 13 (a), 14 (c), 15 (b), 16 (d), 17 (d), 18 (a), 19 (d), 20 (a), 21(a), 22 (c), 23 (c), 24 (c), 25 (b).

OSCE Checklist :

(1) Check the patient's surroundings are safe before approaching

(2) Check the patient for a response

(3) Call for help if there is no response from the patient

(4) Position the patient on their back

(5) Assess for a carotid pulse for 5-10 seconds

(6) Simultaneously look, listen and feel for signs of breathing

(7) If there are no signs of life commence CPR

(8) Position the hand over lower half of the sternum

(9) Perform chest compressions at a rate of 100-120 compressions per minute

(10) Perform chest compressions of depth 5-6 cm

(11) Allow complete chest recoil

(12) Minimum interruptions between the compression

(13) Advocate triple maneouver to maintain the patency of airway

(14) Deliver one breath over a second to cause adequate chest rise and to avoid excessive ventilation

(15) Deliver 2 ventilations after performing 30 chest compressions

(16) Switch the personel performing chest compression every two minutes

(17) Check for pulse every 2 minutes between the CPR

(18) Identifies ROSC

(19) Enumerates 5 H and 5 T

(20) Stops BLS once ROSC is achieved

Statistical Analysis :

Data was entered in MS excel spreadsheet and was analysed using EPI INFO 7.0. Appropriate statistical methods including ANOVA, Student t-test and multivariate logistic regression analysis was applied. Accounting for Boneferonni correction, a P Value <0.005 was considered statistically significant.

The scores obtained in the pre-test and post test, at 1 month, 3 months and 6 months was compared

OSCE scores on the day of training, at 1st month, 3rd months and 6th months were compared.

Discussion

Evidence shows a poor survival rate following in hospital cardiac arrest despite having defined resuscitation teams. Multiple factors contribute towards effective resuscitation namely early identification, immediate initiation of CPR, high quality CPR and early defibrillation. Each step is critical and deficiency at any of the steps has a negative impact on the outcome. Bircher, *et al* suggested that a delay in CPR for longer than 2 minutes decreases survival rates by 2.4%[6]. Failure of a swift response and inability to follow the algorithm-based protocols, lack of coordination among team members may result in failure to revive[7].

Literature review shows that poor resuscitation skills of the team is a reality. Inadequate knowledge, training, practice and lack of update are often responsible. [8,9] Superior patient outcome is often achieved by BLS-ACLS trained personnel. It has been observed that a gap in cognitive and psychomotor components have an adverse influence on participation and, performance of other team members, not limited to individual performance. [10,11]

High quality CPR is a fundamental requirement for improved survival. AHA 2020 guidelines recommend chest compressions at a rate of 100-120/minute, depth 5-6 cm, ensuring adequate preload as well as outflow. Avoiding excessive ventilation, leaning over the chest, allowing complete chest recoil further aid in optimum venous return prior to the next compression. Use of real time audio-visual feedback devices and minimum interruptions in compressions help in achieving the target chest compression fraction of 80%. CPR coach, a new role introduced in 2020 guidelines primarily focuses on high quality CPR, in turn enhancing the team dynamics[12,13].

Teaching-learning methodology plays an important role in achieving the desired outcome. Mannequin-based skill training is perceived as a contextualized methodology, hence augments learning[14,15]. This methodology resonates with the adult learning theory involving discussions, active participation, hands-on training and constructive feedback. We feel that the OT team being professionals involved in patient care, would have related to the scenario-based training as a reflection of actual work.

BLS training is included in the curriculum for all the Healthcare Workers in OT, namely doctors, nurses, anaesthesia technicians. In spite of this, lacunae are observed in practical application during crisis situations. Difficulty in teaching, learning and retaining the skills and correct sequence of steps in CPR has been documented. This may be attributed to CPR being a complex task involving cognitive as well as psychomotor components[4,16-18]. In the present study, the pre-test scores were lower than expected, with similar results found in literature. This could be attributed to lack of continuous medical education programs with a lack of opportunity to practice and refresh BLS knowledge since completion of educational qualification.

With the inception of the "chain of survival" concept, effective CPR training of the whole team involved in resuscitation should be a part of the institutional goal. Despite inclusion in institutional training program, it has been observed that proficiency immediately following training is inadequate along with poor retention of skills, as evident from literature. Unlike western countries, protocol for licensing and renewal is not mandatory in India. yet to be developed. [19] To achieve the aim of improved outcome of CPR, hospitals should ensure availability of trained resuscitation teams as highest priority[7].

The above said reasons further highlight the need to refresh training for proficiency, ensuring standardized quality of CPR[16,17]. Guidelines are reviewed at regular intervals and updated based on research. AHA has recommended six-month interval as the optimum time for repeat training of professionals in CPR to counter the deterioration of knowledge retention[12].

In our study, the scores for both knowledge as well as skill assessment were highest immediately following the training as expected. We observed a slight dip in knowledge which further improved at 6 months, values being more prominent compared to the OSCE values. This suggests success of the small bursts of training conducted at regular intervals in this sustained effect. The OSCE scores were maintained but not improved at 6 months in contrast to the knowledge gain. We feel that lack of adequate time for practising skills by each individual during sessions for reinforcement may be responsible for the same.

OT is a critical zone in a hospital where crisis situations are encountered frequently. This mandates

Table 1— *Distribution of Mean scores of the post test at various months*

Mean± SD	0 month	1 month	3 month	6 month
Post test	19.59±2.7	16.61±3.13	16.93±2.79	18.24±2.14
OSCE	13.67±1.19	13.24±1.85	13.34±1.45	13.59±2.12
Pretest mean : 12.54±2.96 given at zero month				

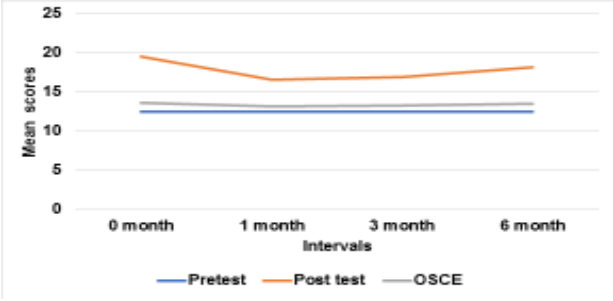

Fig 1 — *Distribution of mean scores of the tests conducted at various intervals*

According to the Fig 1, the pre-test was considered constant which was given once at 0 month. Both Post test and OSCE line graphs suggest improvement better than pre-test scores at all levels.

The above line graph suggests that the mean values of the tests are maximum immediately post intervention at zero month, followed by steady decline at 1st month. However, at 3rd and 6th month, there is a steady improvement in performance. The post-test values are more prominent due to the intervention compared to the OSCE values. This suggests the success of knowledge gained by the participants immediately post intervention more and retention of knowledge gained in only few participants over a period of 6 months.

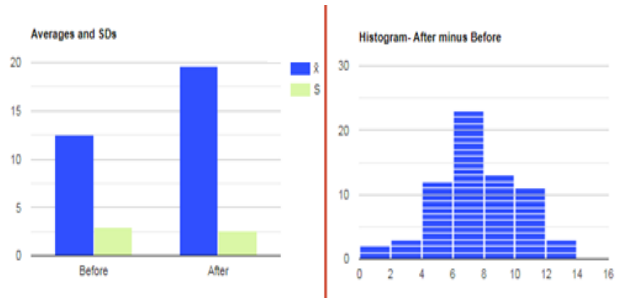

Fig 2 — Graphs at 0 month

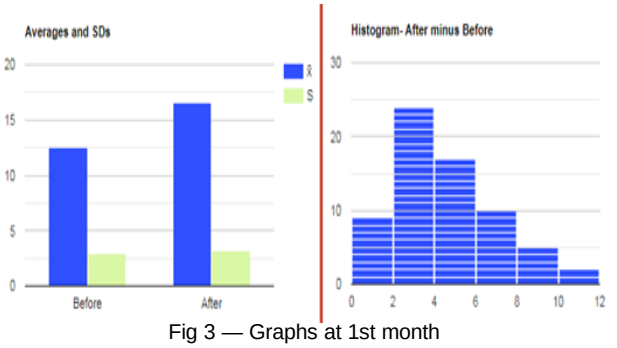

Fig 3 — Graphs at 1st month

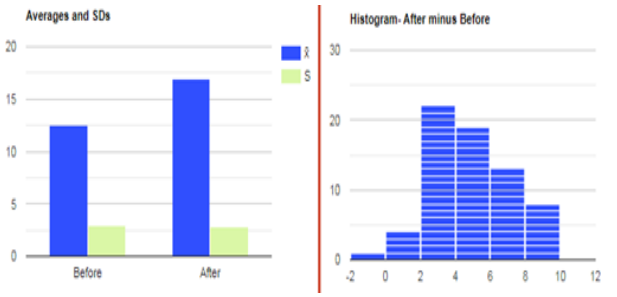

Fig 4 — Graphs at 3rd month

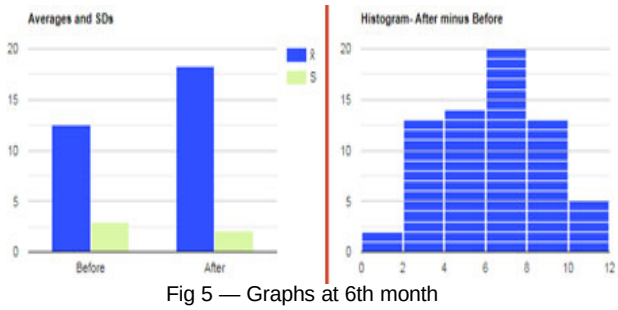

Fig 5 — Graphs at 6th month

The above Figs 2, 3, 4 and 5 depict pictorially with bar graph and histogram the same Mean±SD at various months showing maximum mean score values post 1st intervention at 0 month.

Table 2 — *Distribution of paired t test scores and effect size of knowledge at various intervals*

Month	Pre-test Mean±SD	Post test Mean±SD	't' statistic	P-value	Effect size
0	12.5±3	19.6±2.6	22.6	<0.001	2.76
1	12.5±3	16.6±3.1	13.7	<0.001	1.67
3	12.5±3	16.9±2.8	15.7	<0.001	1.92
6	12.5±3	18.2±2.1	18.5	<0.001	2.26

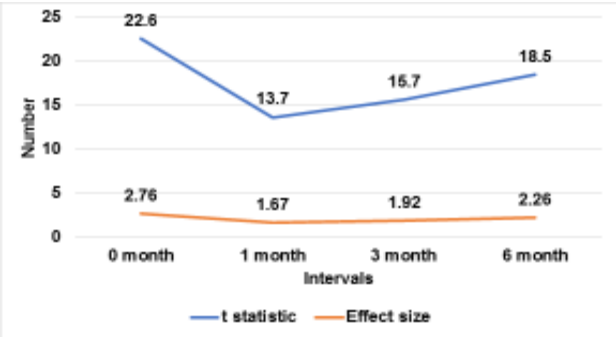

Fig 6 — Distribution of paired 't' test scores and effect size of knowledge at various intervals

According to table 2, the paired 't' test at various months shows highly significant for post tests with highest magnitude at immediately after knowledge dissemination at zero month with 't' value of 22.6 at p<0.001. This is followed by a steady decline at 1st month. However, a quick rise at 3rd month and catchup rise at 6th month. This suggests a good gain in knowledge level at 1st time with few drop in knowledge retention levels. The same is depicted in the line graph shown in Fig 6. The effect size is the magnitude of difference between average of observed differences and expected differences which is larger at zero month comparatively and follows similar in trend with that of 't' value. The results are found to be highly significant statistically.

Table 3 — *Distribution of test scores of OSCE based on one way ANOVA test*

Source	DF	Sum of Square	Mean Square	F Statistic	P-value
Groups (between groups)	3	8.4478	2.8159	0.9831	0.4012
Error (within groups)	264	756.1792	2.8643		
Total	267	764.6269	2.8638		

Table 3 shows One way ANOVA test, using F distribution df(3,264) (right tailed) the difference between the averages of all groups is not big enough to be statistically significant as p-value equals 0.401205, [p(x ≤F)=0.598795]. The test statistic F equals 0.983104, and the observed effect size f is small (0.11) which indicates that the magnitude of the difference between the averages is small.

Table 4 — *Distribution of test scores based on Tukey HSD / Tukey Kramer test*

Pair	Difference	SE	Q	Lower CI	Upper CI	Critical Mean	p-value
0 month-1 month	0.4328	0.2068	2.0934	-0.3232	1.1888	0.756	0.4509
0 month-3 month	0.3284	0.2068	1.5881	-0.4277	1.0844	0.756	0.6757
0 month-6 month	0.07463	0.2068	0.3609	-0.6814	0.8306	0.756	0.9942
1 month-3 month	0.1045	0.2068	0.5053	-0.6515	0.8605	0.756	0.9843
1 month-6 month	0.3582	0.2068	1.7325	-0.3978	1.1142	0.756	0.6115
3 month-6 month	0.2537	0.2068	1.2272	-0.5023	1.0097	0.756	0.8215

Table 5 — *Distribution of test scores based on Tukey HSD / Tukey Kramer test and comparison with critical mean*

Group	1st month	3rd month	6th month
0 month	0.43	0.33	0.075
1 month	0	0.1	0.36
3 month	0.1	0	0.25

Applying the Tukey HSD / Tukey Kramer shows there is no significant difference between the means of any pair as shown in Table 4 and Table 5.

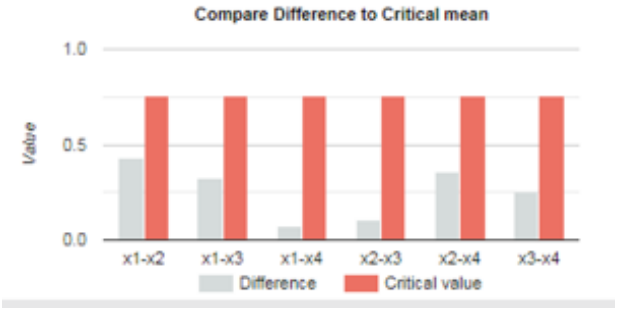

Fig 7 — Comparison of difference between mean values and critical values of different groups

Fig 7 shows that the difference of means between different groups where x1 – 0 month, x2 – 1 month, x3 – 3 month, x4 – 6 month. There is no difference and therefore OSCE has no difference as no intervention given at various levels and thus the knowledge gained remains same throughout almost.

a swift response of the whole team in a synchronized manner. Periodic training along with recreation of emergency scenarios in a simulated environment will enhance the performance. This will further boost the confidence and performance while handling emergencies[19].

Being a new institute, we often face a shortage of trained qualified junior anaesthetists for help. Thus, dependency on the team consisting of technicians and nursing staff is very high. Right timely assistance by a trained team helps the anaesthesiologist in the leader's role to focus on other important aspects such as decision making. Hence, regular revision of algorithms and practice of steps is extremely relevant and essential for OT personnel.

Stress associated with CPR is a known entity with multifactorial etiology. Lack of confidence, inadequate training, inappropriate conduct of CPR and poor outcome may contribute to the associated stress. Stress itself may result in suboptimal performance. Failure to revive a patient may lead to a negative perception about CPR. Protocol based training, supervised mannequine based practice, formative

feedback and remediation of all the team members will be helpful in gaining confidence and competence which in turn will aid in reducing stress level[7].

Conclusion

To summarize, we propose that video based BLS training using mannequins with hands on component is an effective Teaching-learning methodology. Cardiac arrest scenarios further added to the relevance, enhancing the team dynamics. Conduct of short bursts of training at regular intervals helps in reinforcing the knowledge and skills related to BLS, thus enhancing retention.

Limitations : Diversity of the inclusion critera may have influenced the results.

The present study was conducted over a limited period of 6 months. Long term investigation may be required for generalizing the results.

Future directives : Policy with respect to licensing and periodic revision of BLS among OT personnel needs to be developed at the institutional as well as national level.

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