ORIGINAL REPORT

The Validity of Cardiopulmonary Resuscitation Skills in the Emergency Department Using Video-Assisted Surveillance: An Iranian Experience

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Abstract- The present study was designed to evaluate the quality of CPR procedures performed in Tehran's Rasool-e-Akram Hospital-- the first Emergency Medicine academic center in Iran-using a videotaped real-life (actual) CPR technique, with the aim of pointing out the defects and shortcomings in this regard. The performance of the CPR team in the emergency resuscitation room of Rasool-e-Akram Hospital was evaluated through videotaping. In an expert panel in the educational council of the emergency medicine group scored each item, which could be evaluated through videotaping, based on the existing guidelines. Fifty CPRs were videotaped between May to July 2008. From among the 33 CPRs which were recorded from the very first moment, 25 of them were started which the correct procedure, chest compression and ventilation, whereas procedures such as checking for pulse, getting an IV-line or intubation were performed as the first action in the remaining cases. While many believe CPR is performed properly in our center, the present study revealed that the performance is still distant from the desired ideal.

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Introduction

It was approximately half a century ago when Kouwenhoven and his colleagues came up with "closed chest Cardiopulmonary resuscitation (CPR)" (1). In the past 50 years, the method of practicing CPR has altered significantly. A fact, however, remains unchanged: The quality of Practicing CPR determines its effectiveness (2-4). It has been revealed that an appropriate CPR can increase the patients' survival rate by up to 2-3 times (5). Many studies have, similarly, demonstrated noticeable shortcomings in handling cardiac arrest, especially among inexperienced physicians (6). There is no strong correlation between CPR guidelines and its proper application (7). CPR is usually done inappropriately even by professionals: excessive ventilation along with interrupted too slow and too shallow chest compressions may contribute to reduced coronary perfusion pressure and subsequently poor outcomes (8).

Techniques to improve the quality of CPR could emphasize education, practice, or real-time feedback. Videotaping was first applied as realia (instructional material) in emergency medicine in 1969 by Peltier (9). Hoyt *et al*, similarly, reported the effectiveness of videotaping in improving the quality of performance among house staff (10). Nowadays, videotaping during CPR, as an accepted issue in some developed countries, is frequently used in teaching CPR skills (11,12). The technique has shown promising results in enhancing the individuals' capability of analyzing and applying their knowledge (13). Videotaping can also allow the possibility to assess the performance of the team during CPR, without interfering with the task or introducing any bias while gathering data in simulated conditions.

The present study was, therefore, designed to evaluate the quality of CPR procedures performed in Tehran's Rasool-e-Akram Hospital, the first Emergency Medicine academic center in Iran, using a videotaped real-life (actual) CPR technique, with the aim of pointing out the defects and shortcomings in this regard.

To the best of our knowledge, this is the first study to assess CPR using such a technique in our country, where Emergency Medicine has a history of no longer than a

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decade.

Materials and Methods

Study design

In this study, the performance of the CPR team in the emergency resuscitation room of Rasool-e-Akram Hospital was evaluated through videotaping. This cross-sectional descriptive study was approved by the Ethical Board Committee of the Emergency Medicine Department of our University.

Study setting and population

Rasool-e-Akram is a hospital complex with an annual emergency turnover of roughly 45000 patients, of whom a rough estimate of 400 patients undergoes CPR. Between mid May and mid July 2008, 50 consecutive non-traumatic patients with sudden cardiac arrest underwent CPR (due to asystole, pulseless ventricular tachycardia, ventricular fibrillation, and pulseless electrical activity). The CPR team comprised of an emergency medicine specialist (an academic staff of the emergency medicine department in our hospital), a post-graduate year 2 (PGY2), a PGY3 and 2 emergency interns along with one or two nurses. All of the aforementioned individuals had attended the basic and advanced CPR courses in separate workshops according to the protocol recommended by the American Heart Association (AHA) from 2005.

Study protocol

All the CPR projects were videotaped. A camera, which was placed approximately two meters above the CPR bed, recorded a clear picture of the whole process and the monitor located beside the patient.

As the patient entered the CPR room, the nurse turned on the camera. In order to control the function of the camera and the existence of a blank tape in the camera, a daily check was done. The tapes were separately watched and the information was extracted every 3 days by 2 observers (an emergency medicine specialist and a nurse) and afterwards the tapes were erased. In case of any discrepancies between the two observers, a third observer who was an emergency specialist expressed his opinion regarding the challenging skill.

Measurement

The standard technique was defined based on AHA 2005 guidelines. Afterwards, an expert panel in the educational council of the emergency medicine group scored each item, which could be evaluated through videotaping, based on the existing guidelines.

The evaluation sheets were then developed based on these items. Table 1 outlines these items along with their standards and acceptable range.

A scoring system was developed to assess the 13 studied skills in each CPR, separately. In this regard, the correct performance of the skill and/or its correct method was scored 1, while inaccurate performance or the use of incorrect method was scored 0. The final score was calculated through summing up the scores given to each of the studied skills. In order to score repetitive skills such as the accurate number of cardiac massage or ventilation as well as the proportion between them, the measurement was conducted in 3 different intervals, each one third of the whole operation. For instance, in a 45-min long resuscitation, the middle 5 minutes from 15-minute thirds were calculated and then divided by the total sum of the minutes (15 minutes) to achieve an average. Then, they were scored considering the acceptable number of cardiac massages (between 80 and 120).

Results

Fifty CPRs were videotaped between May to July 2008 (Table 2). We were not able to assess the initiating procedure in 17 of CPRs as the nurse had forgotten to turn on the camera on time. However, considering the fact that the longest delay in starting the operation, based on the patients' medical record, was 2 minutes, we therefore concluded that other variables are not affected and can be assessed. From among the 33 CPRs which were recorded from the very first moment, 25 of them were started which the correct procedure, chest compression and ventilation, whereas procedures such as checking for pulse, getting an IV-line or intubation were performed as the first action in the remaining cases.

Electrical shocking (item 7) and rapid resumption of CPR after electrical shock (item 8) were performed accurately whenever needed. It should be noted that electric shock was only given to 13 of the studied patients based on the available guidelines.

Intravenous drug administration (item 9), on the other hand, was performed incorrectly in all of the cases. While a proper amount of vasopressors were administered in all the studied patients, the limb was not held up in none of the cases after the injection of the medication in the peripheral vein.

Table 1. Items assessed during the study, their standard and accepted range.

	Parameter	Guideline standard	Accepted correct range	Accepted correct performance
1	Initiation of CPR	Immediately after patient's entering with ventilation plus cardiac massage	A maximal 5 second delay after patient placement	N/A
2	Chest compression/ventilation ratio (before intubation)	30/2 (15)	14.5 to 15.5	During all the study period
3	Chest compression per minute (after intubation)	100	100 (±20)	During >80% of the study period
4	Ventilation per minute (after intubation)	8-10	8-10	During >80% of the study period
5	Cessation of chest compression for iv line placement or drug administration(hand off time)	0	0	During >80% of the study period
6	Checking the patient's pulse	After observing organized rhythm	After observing organized rhythm	During >80% of the study period
7	Electrical shock for shockable rhythms	One shock(for VF/ VT (pulseless))	One shock (for VF/VT)	During all the study period
8	Rapid resuming CPR after electrical shock	CPR for 2 minutes, or for 5 cycles	CPR at least for 2 minutes (±10 seconds), or for 5 (±1) cycles	During all the study period
9	Usage of vasopressor drugs	Peripheral venous administration as a bolus dose with 20 cc of fluid, with elevated limbs for 2-10 seconds or: intratracheal, 2-2.5 times as much dose with 5-10 cc of fluid	Peripheral venous administration as a bolus dose with 20 cc solvent, with elevated limbs for 2-10 seconds	During >80% of the study period
10	Replacement of chest compressor person	Every 2 minutes	Every 2 minutes (±15 second)	During >80% of the study period
11	Administration of the 1st antiarrhythmic drug	When shockable rhythm continues after 2-3 shocks and vasopressor drug administration	When shockable rhythm continues after 2-3 shocks and vasopressor drug administration	N/A
12	Time interval between vasopressor doses	Every 3-5 minutes	Every 3-5 minutes	During >80% of the study period
13	Timing of the 1st vasopressor drug administration	In unshockable rhythm: After the 1st check of rhythm In shockable rhythm: After 1-2 shocks	In unshockable rhythm: After the 1st check of rhythm In shockable rhythm: After 1-2 shocks	N/A

While 16 cases needed the administration of vasopressors through tracheal tube, only seven patients received the medication in this form. The correct dosage of the drug was not administered in none of the cases requiring intratracheal medication. In view of the fact that none of the 50 studied patients required central vein catheterizing, the accuracy of administrating medication through this route was not assessed. As a result, none of the operations received the score corresponding to the mentioned item.

Seven of the nine patients who required anti-arrhythmia drugs (item 11), based on the guidelines, received the medication properly. The administration of the drug, however, started with an unacceptable delay, after the patient had experienced an asystole, in two cases.

Considering the other studied items, the number of cases performed accurately was significantly higher (Table 2).

Table 2. The correctness rate among the studied indices.

Indices	Correct (%)	Incorrect (%)	95% CI
Item 1: initiation of CPR	25 (75)	8 (25)	0.60-0.91
Item 2:chestcomp./vent. Ratio(before intubation)	18 (64)	10 (36)	0.45-0.83
Item 3: chest compressions per minute	42 (84)	8 (16)	0.73-0.95
Item 4: frequency of ventilations	39 (78)	11 (22)	0.66-0.90
Item 5: Cessation of …(hand off time)	37 (74)	13 (26)	0.61-0.87
Item 6: checking patient's pulse	10 (58)	7 (42)	0.33-0.85
Item 7: electrical shocking (for shockable rhythm)	13 (100)	0 (0.0)	-
Item 8: rapid resumption of CPR after electrical shock	13 (100)	0 (0.0)	-
Item 9: intravenous drug administration	0 (0.0)	50 (100)	-
Item 10: compressor-ventilator swap	37 (74)	13 (26)	0.61-0.87
Item 11: first anti-arrhythmic drug administration	7 (78)	2 (22)	0.44-1.12
Item 12: time interval between vasopressor doses	47 (94)	3 (6)	0.87-1.01
Item 13: timing of first vasopressor administration	38 (76)	12 (24)	0.64-0.88

Discussion

This study was conducted to assess the quality of skills performed during cardiopulmonary resuscitation operations. Video recording is an effective tool in measuring the accuracy of the skills and it can help the CPR team identify their setbacks and overcome them, and subsequently improves the outcome of the procedure. Most of the 13 items, studied in this survey, were accurately performed in approximately two thirds of the cases. This study, however, revealed a considerable discrepancy between the acquired knowledge and the performance of the Iranian academic emergency medicine service.

The quality of CPR may influence its effect (2,14). Many studies showed similar survival rate between patients who receive poorly performed chest compressions or no chest compressions; as for those who receive better quality CPR have increased survival rates (2,4).

Videotape reviews, as an educational tool, can reveal uncovered problems in the CPR procedure. Berg *et al.* reported that the audio-prompted guidance through videotaping resulted in higher end-tidal carbon dioxide partial pressures, suggesting improved CPR performance (15). Milander *et al.*, similarly, reported that an audible tone could improve compliance with the recommendations (16). Chiang *et al*, in the first such study conducted in actual resuscitation setting, reported that audio-prompt videotaping can significantly improve adherence to guidelines, resulting in a higher number of chest compressions, a shorter time for intubation attempts, and shorter hands-off periods during CPR (17).

The present study showed that our team suffers from major problems when it comes to CPR, stressing that the administration of drugs, which seems to be a simple procedure, is the worst on the list. It should be stressed that team working is not quite accurate in our group. The comparison of the proportion of chest compression and ventilation ratio before intubation to each of them after the procedure can confirm this result. In other words, the correctness of chest compression rate following intubation shows that the resuscitator concentrates more on the technique after the intubation, as there is no need for him/her to adjust themselves with the individual responsible for ventilation.

Considering the results of the present study, it could be concluded that skills, including constant chest massage or with minimal cessation, proper application of electric shock and immediate commencement of resuscitation that their correct application and effectiveness are emphasized in the available guidelines, are the same skills which gained the highest scores. The proper administration of the drugs, on the contrary, is less emphasized in the guidelines and hence achieved no scores.

Compared with the results of the study conducted by Brown *et al*, chest compression and the chest compression/ventilation ratio were better in the present study (7). This discrepancy might be on the grounds that the leader of the team provides his/her team with feedback during CPR and corrects defects such as inaccurate number of chest compressions or incorrect chest compression/ventilation ratio throughout the process. The effect of giving feedback to the team on their performance is approved in various studies (18). In this regard, Chiang *et al.* concluded that audio prompting can not only positively reduce the hand-off

time but also make them perform correct number of chest compressions (17).

Considering the fact that CPR is a complex intervention always performed under stressful conditions, having a greater knowledge and skill about the procedure would improve the results. In other words, training the skills to the responsible team would improve CPR knowledge and performance, leading to a higher survival rate in patients.

While many believe CPR is performed properly in our center, the present study revealed that the performance is still distant from the desired ideal. As a result, the responsible teams should be educated and made aware of their deficiencies thereafter a new study is needed to compare the results of the intervention with the present study.

Limitations

The present study failed to provide required details regarding certain parts of the process, including the depth of the cardiac massage or the amount of ventilated air, due to the application of video recording. Moreover, considering the fact that a single camera was placed to record the process, the entire resuscitation process could not be assessed in this study. The fact that the staff were aware of the recording process may also have affected the results of the study.

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