

Efficiency of code blue in a tertiary care hospital: A lesson we learned

Code blue in a tertiary care hospital

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Abstract

Aim: Code Blue (CB) is an emergency that requires appropriate sequential actions gained through training with organized teamwork. This research has been conducted to evaluate the efficacy, efficiency, and application results of code blue which is used in our hospital. **Material and Method:** CB was called between years 2014 and 2015 and 303 patients were examined retrospectively. **Results:** The mean age of the patients was 68.74 (range 24-92), the number of female patients was 157 (51.81%), and male patients was 146 (48.19%). The mean time to reach the patient was 2.83 ± 1.15 (range: 0.16-8.53) minutes, and the time when most CB were called was between 13.00 and 15.00 pm ($p > 0.059$). CB calls were most commonly made from neurosurgery, neurology, and respiratory intensive care units. The most often CB calls were made on weekdays ($p > 0.05$). Sex was not associated with mortality ($p > 0.05$). Worst outcome was associated with the outpatient ward, nephrology ward, nephrology ICU, and obstetrics ward ($p < 0.05$). CB team's reaching time to the patient was not associated with mortality ($p > 0.05$). Time of CB calls was associated with mortality. Worst outcome was observed during 01:00 to 06:00 am ($p < 0.05$). Mortality was observed in patients who have received a statistically significant longer period of CPR ($p < 0.05$). **Discussion:** The outcome of CB call is particularly dependent on critical interventions. Although the time to reach our patients was similar to the literature values; survival rate will be increased by the providing continuous CPR training for all hospital staff at intervals not longer than 6 months for the intervention to be performed until the arrival of the CB team.

Keywords

Cardiopulmonary Resuscitation; Cardiac Arrest; Rapid Response Teams; Blue Code; Hospital arrest

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Introduction

Cardiac arrest (CA) continues to be the leading cause of death in America as in many parts of the world. Cardiopulmonary resuscitation (CPR) is the whole process of interventions to provide oxygenation and circulation to the body during CA. About 350,000 Americans die of CA every year. The most common cause of sudden CA in adults is ventricular fibrillation. Of these deaths, 70% occur outside the hospital, and there was nobody next to the victim in half of them. Despite all new techniques and technologies, survival in non-traumatic CA patients with resuscitation is 10.8% [1]. In contrast, although many studies on CA within the hospital are different, survival is less than 20% [2]. One in every 500 people admitted to a health facility dies. In order to reduce the risk of death, to health institutions it has been proposed to establish "Quick Intervention" or "Code blue" (CB) teams and systems, equivalent to the emergency services in these hospitals [3]. CB is an emergency call and management means that it provides basic interventions such as CPR in the shortest possible time to the individuals whose basic life functions are at risk or those whose functions have been stopped. Although it originated in the United States, it is an internationally accepted monochrome code application. It was launched in 2008 individually in Turkey and in 2011 it became mandatory for all hospitals to implement it and has become criteria for Service Quality Standards [3-5]. The aim of this study was to evaluate the efficacy, efficiency and the results of the application of CB in our hospital.

Material and Method

This study consisted of 303 patients who underwent CPR according to American Heart Association (AHA) protocols [6] with the call of CB between February 2014 and February 2015 at Tertiary Care Hospital with 1131 bed. All procedures performed in the studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Table 1 shows the distribution of patients by months. Age, gender, date and time of receiving CB, location, duration of transportation to the patient, time of CPR application, code blue call forms, patient registration documents, hospital quality meetings, patient safety committee meeting reports were evaluated retrospectively in electronic environment preventing bias and wrong records. Written informed consent was not obtained from patients due to the retrospective nature of this study. All data were transferred into the Statistical Package for Social Science 18,0 (SPSS Inc., Chicago, Illinois, USA), a portable package program for Windows, and analyzed.

In our hospital, the call system (Pager SMS) is activated when 2222, the number of CB, is called via the hospital switchboard. This system was preferred to prevent fear and panic among other patients who were followed up in the hospital and their relatives. CBT (Code Blue Team); during the working hours in weekdays, specialist physicians and anesthesia technicians from branches other than basic medical sciences such as biochemistry, microbiology, and pathology, in after-hours and at weekends, anesthesia specialists and technicians are working as two different teams. CBT arrives to the arrest unit within 3

Table 1. Blue code calls according to months

February 2014	30
March	37
April	16
May	20
June	17
July	49
August	35
September	18
October	17
November	13
December	14
January 2015	37
Total	303

minutes by the incoming call, until the MKE comes, the health personnel of the unit given CB maintains basic life support. As a preliminary preparation and precaution for this purpose, Emergency Trolleys with all the predefined and necessary drugs and materials have been placed in each service without exception. Daily checks are performed by the responsible person of the relevant service and kept ready for audit. In our study, units with permanent anesthesia such as operating room, reanimation, and emergency department and/or having the possibility of direct intervention were included in the study. If the calls were false and CPR was not applied, they were excluded from the study. The study was kept limited for data security basing on the correct and complete forms entered after the application of the cases especially given CB and underwent CPR.

CB working hours were defined as follows: weekday working hours between 08⁰⁰-16⁰⁰ from Monday to Friday; after-hours between 16⁰⁰-08⁰⁰ on the same days; and the weekend was defined as the period from Friday 16:00 to Monday 08:00. Public holidays, religious and national holidays were evaluated as the weekend group.

The time between the arrival of the team at the scene on receiving the alarm to the pager and ending the call and taking over the patient was defined as the travel time and recorded in minutes.

Results

The mean age of the patients was 68.74 (range 24-92), the number of female patients was 157 (51.81%) and male patients was 146 (48.19%). The mean time to reach the patient was 2.83 ± 1.15 (range: 0.16-8.53) minutes (Table 2), and the time when most CB calls were made was between 13.00 and 15.00 pm (Table 3) (p > 0.059). Code blue calls were most commonly

Table 2. Response (in minutes) to code blue

Time	n=
1 minute	48
2 minutes	89
3 minutes	108
4 minutes	50
5 minutes	3
6 minutes	2
7 minutes	2
8 minutes	1

Table 3. Blue code calls according to hours of day

Hour	number of patient:
1	9
2	5
3	9
4	12
5	7
6	11
7	11
8	12
9	9
10	17
11	9
12	10
13	21
14	19
15	19
16	13
17	11
18	21
19	19
20	12
21	12
22	10
23	13
24	12

made from neurosurgery (51), neurology (40) and respiratory intensive care units (Table 4), respectively. One patient from the emergency service and one from reanimation clinics received CPR by the anesthesiologist from the CBT on duty due to intubation difficulties during the weekdays. Normal distribution parameters were evaluated with the Kolmogorov-Smirnov test. Student's t-test and Mann-Whitney U-test were used for inter-group evaluations which did not follow the normal distribution. Chi-Square test and Fisher test were used to compare qualitative data. P-value less than 0.05 (<) was considered statistically significant. Survival between the two groups was analyzed by the log-rank test. A maximum of 137 (37.29%) after-hours in-week CBs were performed (Table 5). Gender was not associated with death ($p > 0.05$). The worst results were associated with polyclinics, nephrology, intensive care of nephrology and gynecology ($p < 0.05$). The time spent to reach the patient by CB team was not associated with mortality ($p > 0.05$). The time of CB related to mortality and the worst time was determined to be between 01.00-06.00 hours in the morning ($p < 0.05$). The duration of CPR in lost patients was longer and statistically significant ($p < 0.05$). As a result of the application of CB, 146 (48.18%) patients were referred to a unit with advanced life support, 124 (40.92%) patients died and 33 (10.89%) patients improved their general condition.

Discussion

Our current modern approach to the CPR process comes from the study of three doctors only on 14 diseases in the 1960s [7]. The most widely accepted guidelines in North America are the guidelines one of which was published in 1966 by the American

Table 4. Blue code Calls according to clinics

Department/ Clinics	Number (total n=303)
Emergency	1
Urology	2
Neurosurgery	2
Neurosurgery ICU	51
Internal Medicine	5
Internal Medicine ICU	2
Hemodialysis Unit	1
Delivery Room Unit	1
General Surgery ICU	9
Gastroenterology	3
Thoracic Surgery	4
Thoracic Surgery ICU	17
Ophthalmology	1
Chest (Pulmonary diseases) ICU	12
Pulmonary Diseases	40
Obstetrics and Gynecology	14
Ear, Nose and throat	1
Coronary ICU	13
CVS ICU (1.st level)	22
CVS	4
CVS ICU (3.rd level)	2
Nephrology	9
Nephrology ICU	13
Neurology	15
Neurology ICU	27
Oncology	8
Ortopedics and Traumatology	8
Policlinics	13
Postoperative ICU	2
Reanimation ICU	1

ICU: Intensive Care Unit, CVS: Cardiovascular Surgery

Table 5. Blue code calls according to working hours:

week days		weekends
during working hours	off-hours	
n=89 (29.37%)	n=113 (37.29%)	n=101 (33.33%)

Heart Association (AHA). They have been published and updated every five years since the 2000 meeting by the International Resuscitation Committee (ILCOR International Liaison Committee on Resuscitation) established in 1993. The current manual has undergone several significant changes [4]. The CAB sequence is now recommended in place of the previous ACB sequence consisting of airway (A), respiration (B) and compression (C) [8]. These are not strict rules, but a recommendation for health staff. Current clinical approaches should not be perceived as unsafe or ineffective. In our country, AHA and European Resuscitation Council (ERC) applications are followed. These are basically the same but minor changes due to geographical, economic, system, and drug-device usage differences in applications [7]. Two things that do not change from the beginning are quality or excellent CPR and fast defibrillation. Delay in treatment is associated with lower survival and poor neurological outcomes. CA should be promptly diagnosed and intervened whether it is in the hospital or outside the hospital [1, 2].

Table 6. Results of studies related to Code Blue in Turkey

Authors	Year of study	health care provider	Number of beds	Number of BC	Average reach time (min.)	Results	
						Exitus	Survival
Koltka et Al.	2008	Göztepe Training and Research Hospital	660	610	4,02	%66	%34
Canural et Al.	2009	Denizli State Hospital	735	23	8	?	?
Bal et Al.ve ark.	2010	Giresun State Hospital	350	137	2,17	%33	%67
Mehel et Al.	2010	Çarşamba State Hospital	205	164	1,34	%38	%62
Yılmaz et Al.	2011	Süreyyapaşa Chest and Thoracic Surgery Training and Research Hospital	665	65	1,81	%5	%95
Murat et Al.	2012	Malatya State Hospital	800	180	2,72	%53	%47
Çiçekci et Al.	2013	Konya Numune State Hospital	500	301	1,7	%64	%36
Özütürk et Al.	2014	Arnavutköy State Hospital	250	225	1,10	%39	%61
Eroğlu et Al.	2014	Pendik Training and Research Hospital	600	89	1,75	%2	%98
Taş et Al.	2014	Ordu Training and Research Hospital	165	652	1,51	% 58	%42

CRP has two levels; one is basic life support (BLS) with ventilation and chest compressions without additional devices and the other is advanced life support (ALS) using all drugs and devices required for resuscitation. It can provide up to one-third of normal cardiac output and oxygenation even when BLS is performed appropriately [2]. It shows the importance of the time until intervention, drugs, and devices. Therefore, the survival difference between CPR performed inside and outside the hospital is more than double.

In accordance with the literature and below the targeted time, we reached the patients at an average of 2.83 minutes. In our study, out of 303 cases, 48 patients (15.8%) were reached within the first minute, 89 patients (29.4%) in the second minute, 108 (%35,6) patients in the third minute and 50 patients (19.4%) were reached in the fourth minute. Only one patient, 45 years old, in the intermediate intensive care unit of cardiovascular surgery (CVS) clinic, was reached in 8 minutes as the latest. Despite 45 minutes of resuscitation, the patient was lost. Only 8 patients (2.6%) were reached in five minutes and above, which is the upper limit of the targeted time. CBT is located on the second floor of the hospital where the operating theatres are located. There are five floors in between the intermediate intensive care unit. However, the same place was reached by a different team in 2.2 minutes and the patient was transferred to the advanced life support. All of the patients reached over the targeted duration were those in distant places from CBT such as CVS, nephrology, oncology, chest diseases services, and polyclinic building. All patients were lost. Although there was no statistically significant difference between mortality and the time spent to reach the patient and the gender, fewer patients died when the same clinics were reached at the targeted time and below. Naturally, CB and loss of patients are higher in critical and risky patient care fields and the third-stage healthcare institutions such as our hospital [5]. The question of whether these patients were lost because of concomitant diseases or late access was unanswered. Their medical records indicated that they died of CA caused by the accompanying disease. We think that if these patients were reached earlier, the result could be different.

CA shows that physiological symptoms of patients at risk are worsening many hours ago. It was found that the time of CB was associated with mortality and the worst time was in the morning between 01.00 and 06.00 am. In accordance with the

literature [3-5, 7, 9] in our study, 89 (29.37%) CB calls were made during the working hours on weekdays when more health teams were present. We think the reason for this is that the general deterioration in the general situation is detected earlier and that the health personnel are more during after-hours and weekend. Therefore, most CB calls were made off-hours during the week with 113 (37.29%) calls. Likewise, CB is similar on weekends and holidays with 101 (33.33%) calls. Two hundred and fourteen (70.62%) CB calls were made in the period when the health personnel of CB were minimum. It shows the continuity and importance of 7 days 24 hours application. Although MK criteria are defined by strict rules, inconvenient and incorrect implementations were found higher by Eroglu et al. These are attributed to insufficient hospital staff, deterioration of the patient's general condition, need for help, overcrowded health institutions, limited time per patient, and pressure as far as physical violence from patients' relatives. As for CBT, the agitation pressure of the relatives of the patients decreases and this is attributed to the fact that they are relieved when they see at least two health personnel who are interested only in their patients [9]. As far as we can reach the literature and the studies conducted in our country, the rate of incorrect or inappropriate CB reaches 75% [3]. Therefore, without CPR and incorrect/inappropriate CB calls were not included. In our study, the number of females was found to be higher than in the literature. We think that the reason for this is that our hospital is a third step center in our region and wrong CB calls are not included. The first studies conducted in our country started with the study by Koltka et al. (Table 6) in 2008; the average reaching time is detected to be 4.02 minutes. In the study of Canural et al., the time period was 8 minutes at Denizli State Hospital with 735 beds; and in the other researches, time decreased gradually; and at Arnavutköy State Hospital with 250 beds it decreased to 1.1 minutes. It is proven by the hospital staff that CB is adopted and improved by achieving the targeted period in a short time (5). In the literature, it is the largest hospital with 1131 sickbeds built in our country. In terms of sickbeds, it is 8.06 times bigger than the smallest hospital and 1.4 times than the proximate hospital, [4,5,10]. In only one study conducted in our country, the issue of size is discussed and the distance covered, the storeys of the building and lengths were expressed in meters [11]. Murat et al. from Malatya State Hospital with 800 beds reported the average reaching time as 2.72 minutes. The difference between our

hospitals is 0.01 minutes. Our results are successful and targeted to be less than 3 minutes. In addition, our study planned between February 2015 and February 2019 has been going on. Although the number of studies conducted in our country before ours is limited to nine, ours does not overlap the others due to the fact that the common parameters have not been used or interpreted differently. It is mandatory by the Ministry of Health for each organization and used to evaluate the quality standards [5]. In this evaluation, the size, step, and physical conditions of the hospital concerned should also be considered. Our hospital consists of 5 blocks and 38.000 m² area. The size of the hospital should be evaluated according to the level and physical conditions. CB guarantees the inherent right to life and support. In fact, it is a component and continuation of the ICU. In just six years, the response time was reduced from 8 minutes to 1.1 minutes. Its contribution to health institutions, such as respectability and reduction of legal disputes, is an indisputable fact. Good CPR and / or CB application; can be achieved with reliable, well-trained and experienced teams, who define the patients completely, respond quickly and appropriately to the call system [12]. It is recommended by the AHA to carry out the CPR and/or CB trainings every two years. Studies on CPR requiring continuous training showed that even the most basic knowledge-skills worsened in the first 6 months after the training [2,4]. Therefore, an ongoing training program to achieve existing clinical goals and to maintain competence if these objectives have been achieved should be maintained with a management structure that improves standards and quality [12]. As all studies, our study had limitations. The first point is that it is a single center and a third step, the second is the limited number of patients, the third is a short period of time, and the common point in almost all studies conducted in our country is unawareness of the long-term results of the patients due to the lack of follow-up and medical records after CPR. We think that health institutions should be evaluated by standardized parameters with wide participation preferably covering the whole country with more precise and complete data after the criteria such as size, step, and physical conditions is determined by the health care planners. In this way, the wrong and deficiencies in the system can be found precisely and resolved as soon as possible.

Conclusion

Although CBT is increasingly accepted by health staff and hospitals all over the world and in our country, its effect on hospital mortality has not been demonstrated. The standardization of CB members in all hospitals in Turkey is incomplete. CB is an emergency that requires appropriate sequential actions gained through training with an organized teamwork. The outcome of CA and CPR is particularly dependent on critical interventions such as early defibrillation, effective chest compressions, and co-ventilation. Although the time to reach our patients was similar to the literature values (80-341 sec) with 2.83 minutes; survival rate will be even higher by the providing continuous CPR training for all hospital staff at intervals not longer than 6 months for the intervention to be performed until the arrival of the CB team.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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