Evaluation of Code Blue Calls in the Pre-Pandemic and Pandemic Period: A Tertiary Care Hospital Experience

Pandemi Öncesi ve Pandemi Döneminde Gerçekleşen Mavi Kod Çağrılarının Değerlendirilmesi: Üçüncü Basamak Tek Merkez Deneyimi

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ABSTRACT

Objective: Code blue is the universal emergency management in which a professional team effectively intervenes in cases requiring emergency intervention, such as cardiopulmonary arrest in the hospital. This study aimed to contribute to the literature by analyzing code blue calls before and after the pandemic.

Method: Code blue calls between 01.03.2019–01.03.2021 were examined retrospectively. Patients' demographic data, the reason for code blue and the place it was given, the time for the team to reach the scene, and all the interventions and their results were recorded.

Results: Two hundred and seventeen code blue calls were included in the study. Mean age of the patients was 60.3±22.2 years, and 52% were females. Of the calls, 54% were reported during the pandemic period. While 50% of the calls were reported during working hours, the time for the team to reach the scene was 2.3±0.9 minutes. While cardiopulmonary resuscitation was performed in 47% of the patients, 23% died. Cardiopulmonary arrest was the most common cause of code blue (39%). The most frequently called places were internal medicine services, with 20% before and pandemic services with 17% after the pandemic. The number of patients who underwent defibrillation was significantly lower in the pandemic group (p=0.04).

Conclusion: This study observed an increase in the number of calls and a significant decrease in the number of patients undergoing defibrillation during the pandemic period. We think that the results of the code blue application can be improved with practical training against pandemics that may occur in the future.

Keywords: Cardiopulmonary arrest, cardiopulmonary resuscitation, code blue, in-hospital mortality, pandemic

ÖZ

Amaç: Mavi kod, hastane içinde kardiyopulmoner arrest gibi acil müdahale gerektiren durumlarda profesyonel bir ekip tarafından etkin müdahalenin yapıldığı, evrensel acil durum yönetimidir. Bu çalışmanın amacı, mavi kod çağrılarının pandemi öncesi ve sonrası dönemde analizini yaparak literatüre katkı sağlamaktır.

Yöntem: 01 Mart 2019–01 Mart 2021 tarihleri arasındaki mavi kod çağrıları retrospektif olarak incelendi. Hastaların demografik verileri, mavi kod nedeni ve verildiği yer, ekibin olay yerine ulaşma süresi, yapılan tüm müdahaleler ve sonuçları kaydedildi.

Bulgular: Toplam 217 mavi kod çağrısı çalışmaya dahil edildi. Hastaların ortalama yaşları 60,3±22,2 yıl ve %52'si kadındı. Çağrıların %54'ü pandemi döneminde ve %50'si çalışma saatlerinde bildirildi. Ekibin olay yerine ulaşma süresi 2,3±0,9 dakika idi. Hastaların %47'sine kardiyopulmoner resüsitasyon uygulanırken, %23'ü vefat etti. Pandemi öncesinde %20 ile iç hastalıkları servisi ve pandemi sonrasında %17 ile pandemi servisleri en sık çağrı yapılan yerler idi. Pandemi grubundaki hastalarda defibrilasyon uygulanan hasta sayısı anlamlı düşüktü (p=0,04).

Sonuç: Bu çalışmada, pandemi döneminde çağrı sayısında artış ve defibrilasyon uygulanan hasta sayısında anlamlı azalma gözlenmiştir. İlerleyen zamanlarda meydana gelebilecek pandemilere karşı etkin eğitimlerle mavi kod uygulaması sonuçlarının iyileştirilebileceği düşünülmüştür.

Anahtar kelimeler: Hastane içi mortalite, kardiyopulmoner arrest, kardiyopulmoner resüsitasyon, mavi kod, pandemi

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INTRODUCTION

Code blue is the universal emergency management in which a professional team effectively intervenes in cases requiring emergency intervention within the hospital. Thus, intervention can be made in cardiopulmonary arrest and respiratory distress cases as soon as possible. It is ensured that patients, patient relatives, and hospital personnel who need urgent medical attention in the hospital are intervened as soon as possible. Thus, emergencies such as cardiopulmonary arrest are quickly recognized and moderated to reduce mortality and morbidity.[1]

The code blue team consists of a physician, anesthesia technician, or nurse experienced in cardiopulmonary resuscitation and security personnel. From the beginning to the end of the call, the patient's vital signs, the procedures, and treatments applied, and the event's outcome is recorded in the code blue notification form.

Code blue first started to be implemented in the United States. It is the only code in which blue color is used in common in international color code applications. In Türkiye, it was implemented by the Ministry of Health in 2008 and became compulsory in 2011.[2]

The COVID-19 pandemic has had severe effects on our country's health system and all over the world. During this period, elective surgical operations and hospitalizations were stopped, and the hospitals' wards and intensive care units were reserved for COVID-19 patients. Although there are many studies investigating the code blue application in the literature, there are limited studies investigating the effect of the pandemic period. This study aimed to examine the effectiveness and results of code blue calls in a tertiary healthcare institution to contribute to the literature and clinical practice by comparing the pre-pandemic and the pandemic period.

METHOD

This study was carried out by retrospectively examining the code blue calls between 01.03.2019–01.03.2021 at the 700-bed University of University of Health Sciences, Kanuni Sultan Süleyman Training and Research Hospital, İstanbul, Türkiye. All code blue calls statements reported in our hospital are recorded in the code blue notification form. Code blue calls reported during the two years between the relevant dates were analyzed from the code blue notification forms. The first positive case of COVID-19 in Turkey was reported on March 11, 2020. Code blue notifications one year before and one year after this date were classified and analyzed as pre-pandemic and pandemic groups.

Approval for this study was obtained from the Clinical Research Ethics Committee of the University of Health Sciences, Kanuni Sultan Süleyman Training and Research Hospital, with the decision dated 11.05.2022 and numbered 123. The study was conducted following the principles of the Declaration of Helsinki. In our hospital, the blue code call works with the phone activation system, number 2222, as in all of Türkiye. Anesthesiology and Reanimation specialists and assistant physicians lead the code blue application. Code blue notification forms are filled in regularly by the team and delivered to the quality unit of our hospital.

Since anesthesiology and reanimation specialists and assistants actively work in our hospital's adult intensive care units and operating rooms, code blue calls are not given from these units. Specialists and assistant physicians are on duty in adult and pediatric emergency services. Routine blue code calls are not provided. However, code blue calls can be made when unsuccessful intubation or support is required.

Patients' age, sex, place and time of the code blue call, time of arrival of the code blue team, prolonged call situations (arrival time of the team over 3 minutes), in addition to cardiopulmonary resuscitation requirements, and drugs used are recorded in the blue code notification forms. Code blue call forms with incomplete or unclear information, notifications are given by mistake, or to control the application were excluded from the study.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS software version22. Inc., Chicago, Illinois, USA) program was used to analyze the data. Conformity of the variables to normal distribution was evaluated analytically (Shapiro-Wilks test) and visually (histogram). Mann-Whitney U test was used to analyze quantitative variables that did not show normal distribution between the groups. Pearson and Fisher's exact chi-square test was used to evaluate the qualitative data between the groups. Numerical data were expressed as mean±standard deviation and categorical data as frequency and percentage. Statistical significance limit was accepted as $p < 0.05$.

RESULTS

Two hundred and thirty-four code blue calls were made two years before and during the COVID-19 pandemic. Seven percent (n=17) of the blue code calls were considered inappropriate, and 217 blue code notifications were included in the study. Inappropriate code blue calls were reported from policlinics with 47% (n=8). Code blue calls reported according to

Figure 1. Distribution of code blue calls by month
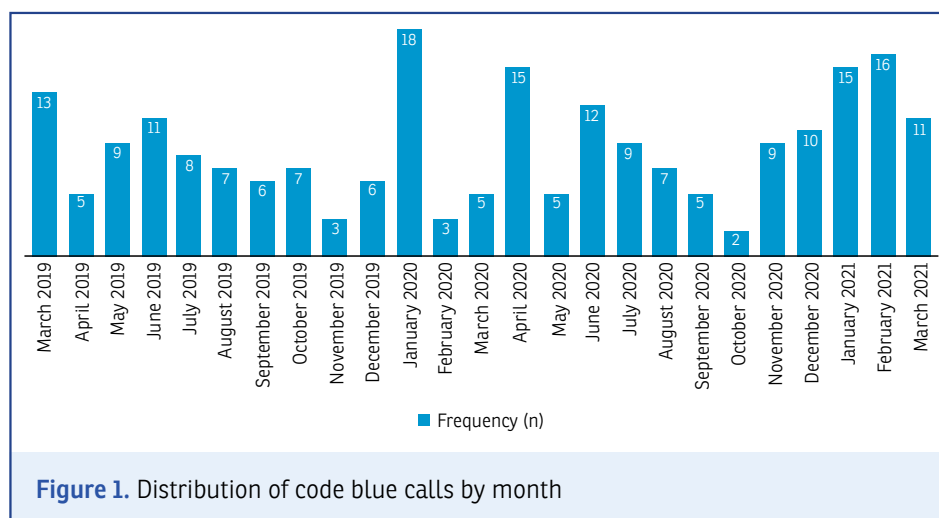
the months between the relevant dates are shown on Figure 1. Mean age of the patients who received the code blue call was 60.3±22.2 years, and 52% (n=114) were females. Fifty percent (n=109) of the blue code calls were made between working hours (08.00–17.00). The time for the code blue team to reach the scene was 2.3±0.9 minutes.

The first rhythms detected in patients with code blue calls were 53% (n=117) sinus rhythm, 43% (n=95) asystole, and 2% (n=5) ventricular fibrillation and pulseless ventricular tachycardia. While cardiopulmonary resuscitation (CPR) was applied to 47% (n=103) of the patients, 66% (n=144) were endotracheally intubated. Defibrillation was applied to 7% (n=16) of the patients. Clinical features and findings of the patients for whom the code blue call was made are shown in Table 1.

When the causes of code blue calls are examined, cardiopulmonary arrest with 39% (n=85), respiratory distress or arrest with 31% (n=68), and syncope with 9% (n=20) were the most common causes. Cardiopulmonary arrests were more common in males than females, with 51%. Spontaneous circulation was observed in 76% (n=166) of the patients after the intervention, while 23% (n=51) of the patients died. While 36% (n=79) of the patients were followed in services, 21% (n=46) were transferred to the emergency room, and 17% (n=38) were taken to the intensive care unit. The reasons for the blue code notification according to the groups are shown in Table 2.

Considering the places where the code blue call was reported, the most frequently reported units were internal medicine services with 20% (n=44), pandemic services with 17% (n=38), and general surgery services with 9% (n=21). The places where code blue calls are reported are shown in Table 3.

When the groups were compared, 17% was observed in the number of code blue calls during the pandemic. Demographic characteristics of the groups were similar. Although mean age of the patients in the pandemic group, the time to reach the code blue team, and the death rate in patients who underwent CPR were high, no significant difference was observed (respectively, p=0.62, p=0.31, p=0.17). When code blue was given, no difference was observed between the groups in terms of prolonged code blue call numbers, CPR application status, endotracheal intubation status, the first rhythm detected in the patients, and the outcome after the intervention (respectively, p=0.54, p=0.50, p=0.68, p=0.78, p=0.73, p=0.17). The number of patients who underwent defibrillation was significantly lower in the pandemic group (p=0.04) (Table 1).

DISCUSSION

Code blue is an emergency call system that aims to provide effective intervention as soon as possible in life-threatening situations such as in-hospital cardiopulmonary arrest. This practice, which is obligatory by the Ministry of Health in our country, is an essential standard for patient safety. In addition, this practice has become a vital criterion for evaluating the service quality standards of hospitals.[3] Standardizing effective and timely intervention will increase survival. The health system of our country, like the whole world, has been seriously affected by the COVID-19 pandemic. Significant changes have been observed in almost all health institutions in Türkiye. In line with the decisions taken by the Ministry of Health, policlinics and elective operations were stopped, and a significant part of hospital services and intensive care units were reserved for COVID-19 patients.

Table 1. Characteristics of the patients and findings related to code blue calls							
	All population (n=217)		Pre-pandemic group (n=98)		Pandemic group (n=119)		p
	n	%	n	%	n	%	
Years (year)	60.3±22.2		59.0±23.3		61.4±22.1		0.62
Sex							0.21
Female	114	52	56	57	58	48	
Male	103	47	42	42	61	51	
Arrival time (min)	2.3±0.9		2.3±1.0		2.4±0.9		0.31
Working status							0.54
Overtime	109	50	47	47	62	52	
Non-Overtime	108	49	51	52	57	47	
CPR	103	47	48	48	55	46	0.68
Endotracheal intubation	144	66	66	67	78	35	0.78
Vascular insertion+fluid therapy	201	92	91	92	110	92	0.90
IV adrenaline	106	48	48	48	58	48	0.97
IV atropine	15	6	9	9	6	5	0.17
Defibrillation	16	7	11	11	5	4	0.04
Prolonged Call	17	7	9	9	8	6	0.50
First cardiac rhythm							0.73
Sinus rhythm	117	53	51	52	66	55	
Asystole	95	43	44	44	51	42	
VF/ pVT	5	2	3	3	2	1	
Results							0.17
Exitus	51	23	18	18	33	27	
Transfer to intensive care unit	38	17	23	23	15	12	
Transfer to emergency room	46	21	21	21	25	21	
Follow-up in the inpatient service	79	36	34	34	45	37	

Data are given as mean±standard deviation, number of patients (n), and percentage. Min: minute; CPR: Cardiopulmonary resuscitation; IV: Intravenous; VF: Ventricular fibrillation; pVT: Pulseless ventricular tachycardia

Studies have shown that rapid intervention in cardiopulmonary arrest and early defibrillation, when necessary, increases the chance of survival and discharge rates.[4,5] In the American Heart Association (AHA) guidelines, effective intervention and defibrillation are aimed in less than 2 minutes in cardiopulmonary arrest.[6,7] In studies reported from Türkiye, it has been reported that the response time to code blue calls has been less than 3 minutes in the last 15 years.[8,9] However, Esen et al.[10] have determined the response time to code blue calls as 3.45±1.92 minutes and reported a response time of 15 minutes. It has been reported that spontaneous return to circulation, hospital discharge rates, CPR applications in witnessed cardiopulmonary arrests, and response times to emergency calls have increased

significantly after cardiac arrest during the COVID-19 pandemic.[11] Ocak and Taşcanov[12] have evaluated code blue calls before and during the pandemic and reported that the response time to code blue calls increased significantly during the pandemic period. In our study, while the response time to code blue calls was 2.3±1.0 minutes before the pandemic, it was 2.4±0.9 minutes during the pandemic period, and no significant difference was observed (p=0.31). Our response time to code blue calls was compatible with the literature. During the COVID-19 pandemic, 92% of the blue code calls were responded to in less than 3 minutes. The longest response time was 5 minutes.

It has been reported that in-hospital cardiac arrests are more common in men, with a rate of 56–70% compared

Table 2. Comparing the reasons for calling code blue between the pre-pandemic and pandemic periods

Reason for call	All population (n=217)		Pre-pandemic group (n=98)		Pandemic group (n=119)	
	n	%	n	%	n	%
Cardiopulmonary arrest	85	39	41	41	44	36
Respiratory distress	68	31	27	27	41	34
Syncope	20	9	7	7	13	10
Seizure	16	7	10	10	6	5
General condition disorder	14	6	9	9	5	4
Hypotensive attack	7	3	2	2	5	4
Anaphylaxis	4	1	2	2	2	1
Chest pain	3	1	1	1	2	1

Data are given as the number of patients (n) and percentage

Table 3. Comparison of the call place for code blue between the pre-pandemic and pandemic periods

Call place	All population (n=217)		Pre-pandemic group (n=98)		Pandemic group (n=119)	
	n	%	n	%	n	%
Internal medicine service	44	20	29	29	15	12
Pandemic service	38	17	0	0	38	31
General surgery service	21	9	7	7	14	11
Radiology/imaging unit	20	9	12	12	8	6
Polyclinics	18	8	3	3	15	12
Orthopedic service	16	7	10	10	6	5
Urology service	11	5	7	7	4	3
Gastroenterology unit	10	4	7	7	3	2
Emergency service	9	4	7	7	2	1
Neurosurgery service	9	4	6	6	3	2
Gynecology and obstetrics service	6	2	4	4	2	1

Data are given as the number of patients (n) and percentage

to women, and the risk increases with age. The lower incidence of in-hospital cardiac arrest in women has been attributed to coronary problems such as myocardial infarction and angina pectoris than men.[4,5,13] In their study, Ocak and Taşcanov[12] have stated that 54% of code blue calls are reported for men. In our study, 52% of the patients who received the code blue call were females, and no significant difference was observed between the sexes (p=0.21). However, following the literature, 52% of patients with cardiopulmonary arrest were males.

Some studies reported from our country were evaluated as code blue calls that do not require cardiopulmonary resuscitation. Ocak and Taşcanov[12] and Canural et al.[13] have reported inappropriate code blue calls with 47% and 74%, respectively. Sahin et al.[1] have found a significant decrease in code blue calls reported for anxiety, conversion disorder, and hypotension with in-hospital education. In our study, 7% (n=17) of all code blue calls were considered inappropriate. These reports generally belonged to patients with psychological disorders such as conversion. Half of the inappro-

priate code blue calls were reported by policlinics. We think that improper code blue calls and unnecessary occupation of the code blue team can be prevented by regular training of the personnel working in the hospitals.

In the literature, it has been stated that code blue calls are reported more outside of working hours.[9,14] Özmete[14] has noted in her study that 54% of code blue calls were made outside working hours. On the other hand, Ocak and Taşcanov[12] have reported that more code blue calls were made during working hours with 55.7%. In our study, code blue calls were almost evenly distributed. 50% of them were reported during working hours. We think the effects of the COVID-19 pandemic and our hospital's dynamics caused this situation.

There is no consensus in the literature when looking at the rhythm types at the time of cardiopulmonary arrest. While the first rhythm detected in some studies[7,15] is ventricular fibrillation (VF) and pulseless ventricular tachycardia (PVT), studies have reported that asystole is the most common rhythm.[3–5,16] In our research, sinus rhythm was found in 53% of the patients called to code blue, asystole in 43%, and VF/PVT in 2%. In our study, following the literature, the cause of 39% of code blue calls was found to be cardiopulmonary arrest and first rhythm asystole. The first rhythm, VF/PVT detected in 2% of the patients. However, 7% of the patients were defibrillated. When comparing the groups, significantly less defibrillation was applied during the pandemic (p=0.04). We think this may be due to the efforts of the code blue team to protect themselves against contamination, depending on the dynamics of the COVID-19 pandemic.

Despite the developments in medicine and the continuous development of the code blue application, mortality rates in in-hospital cardiac arrest remain as high as 85%.[3,14] In the literature, survival rates in in-hospital cardiac arrests have been reported as 13–40%.[4,13,16] In our study, cardiopulmonary arrest was the cause of 39% of code blue calls, and spontaneous circulation was seen in 45% of patients after successful CPR.

When we look at the places where the code blue call is made, it is seen in the literature that most notifications are made from the internal medicine service, the internal medicine intensive care unit, and the emergency service.[9,10,14] In another study, code blue call has been reported from policlinics before and from the pandemic services most frequently after the pandemic.[12] In our study, by the literature, code blue calls were made most often from the internal medicine services before the pandemic and from the pandemic services during the pandemic period.

The main limitation of this study is that it is single-center and retrospective. We think that multicenter studies with a larger sample size are needed.

CONCLUSION

In conclusion, in this study, in which the effects of the COVID-19 pandemic on code blue calls were evaluated, mean age of the patients in the pandemic group, the arrival time of the code blue team, and the death rate in patients who underwent CPR were found to be high. However, no significant difference was observed. The number of patients who underwent defibrillation in the pandemic group was significantly lower. The reluctance of the code blue team to defibrillate may have caused this situation. We think that the results of the code blue application can be improved with practical training against pandemics that may occur in the future.

Disclosures

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