ARAŞTIRMA MAKALESİ / *RESEARCH ARTICLE*

Code Blue Application and Results in Our Hospital: a 5-Year Single-Center Analysis

Hastanemizin Mavi Kod Uygulama ve Sonuçları: Beş Yıllık Tek Merkez Analizi

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ABSTRACT

Aim: *The code blue (CB) system is used in hospitals to provide a rapid and effective response in situations requiring emergency medical intervention. We aim to evaluate CB calls in our hospital and raise awareness retrospectively.*

Materials and Methods: *CB forms related to calls received via the CB system at Muş State Hospital between 01.05.2019 and 01.05.2024 were retrospectively reviewed and recorded.*

Results: *In our study, there were a total of 295 CB calls for patients. The average age of the patients was 65.36±8.89 years, and 124 (42%) were female. Of the 295 calls, 137 (46.4%) were made during working hours, and 158 (53.6%) were made outside. The difference between the number of CB calls made during and outside working hours was not statistically significant (p=0.433). The average response time to CB calls was 1.80±0.87 minutes, with no significant difference in response times between working hours and outside of working hours (p=0.471). The average duration of CPR performed on patients was 30.4±12.7 minutes. Incorrect CB calls were identified in a total of 45 cases. Of these calls, 16 (35.5%) were made during working hours, and 29 (64.5%) were made outside of working hours, with the incorrect CB calls being significantly higher outside of working hours (p=0.019). Among the departments and units where CB calls were made, the highest number of calls came from the Internal Medicine Department (16.27%). This was followed by the Angio Unit (11.86%) and the Pulmonology Department (9.49%). The most common probable diagnosis for CB calls was cardiac arrest, with a total of 98 cases (33.22%) related to this diagnosis. This was followed by respiratory depression (23.39%) and low oxygen saturation (15.25%).*

Conclusion: *The rapid and well-trained response of the team attending CB calls increases patients' chances of survival. Regular in-hospital training and drills are important to reduce the rates of incorrect CB calls.*

Key words: *code blue; response time; cardiopulmonary resuscitation; incorrect code blue; in-hospital training*

ÖZET

Amaç: *Mavi kod, hastanelerde acil tıbbi müdahale gerektiren durumlarda hızlı ve etkili bir yanıt sağlamak amacıyla kullanılan bir sistemdir. Amacımız hastanemizdeki mavi kod çağrılarını retrospektif olarak değerlendirmek ve farkındalık oluşturmaktır.*

Materyal ve Metod: *01.05.2019–01.05.2024 tarihleri arasında Muş Devlet Hastanesi'nde mavi kod sistemiyle alınan çağrılara ait mavi kod formları retrospektif olarak incelenip kaydedilmiştir.*

Bulgular: *Çalışmamızda toplam 295 hastaya ait mavi kod çağrısı mevcuttur. Hastaların yaş ortalaması 65,36±8,89 yıl olup hastaların 124'ü (%42) kadındı. İki yüz doksan beş çağrının 137'si (%46,4) mesai saatleri içinde, 158'i (%53,6) ise mesai saatleri dışında yapılmıştır. Mesai saatleri içinde ve dışında yapılan mavi kod çağrıları arasındaki fark istatistiksel olarak anlamlı deildi (p=0,433). Mavi kod çağrılarına ulaşma süresi ortalama 1,80±0,87 dakika olup, mesai saatleri içinde ve dışında bu süreler arasında anlamlı bir fark yoktur (p=0,471). Hastalara yapılan CPR süresi ortalama 30,4±12,7 dakikadır. Yanlış mavi kod çağrıları, toplam 45 çağrıda tespit edilmiştir. Bu çağrıların 16'sı (%35,5) mesai saatleri içinde, 29'u (%64,5) ise mesai saatleri dışında yapılmış olup, mesai saatleri dışındaki yanlış mavi kod çağrıları anlamlı derecede fazla bulundu (p=0,019). Mavi kod çağrılarının yapıldığı servis ve üniteler arasında en yüksek çağrı sayısı, Dâhiliye Servisi'nden (%16,27) yapılmıştır. Bunu sırasıyla Anjiyo Ünitesi (%11,86) ve Göğüs Hastalıkları Servisi (%9,49) takip etmiştir. Mavi kod çağrılarının en yaygın olası tanısı kardiyak arrest olup, toplam 98 vaka (%33,22) bu tanı ile ilişkilendirilmiştir. Bunu solunum depresyonu (%23,39) ve oksijen saturasyonu düşüklüğü (%15,25) takip etmiştir.*

Sonuç: *Mavi kod çağrılarına giden ekibin hızlı ve eğitimli olması hastaların hayatta kalma şansını artırmaktadır. Yanlış mavi kod oranlarının azaltılması için düzenli olarak hastane içi eğitimler ve tatbikatların yapılması önemlidir.*

Anahtar kelimeler: *mavi kod; ulaşma süresi; kardiyopulmoner resüsitasyon; yanlış mavi kod; hastane içi eğitimler*

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Introduction

Code blue (CB) is a hospital emergency call and response system that ensures professional teams respond swiftly to patients requiring immediate medical intervention[1,2]. The CB system was first implemented in the United States in 2000. In international colored code applications, blue is universally used for CB[3]. Approximately 200.000 in-hospital cardiac arrests occur annually in the United States. Despite the poor prognosis, the survival rate varies between 11% and 35% among hospitals[4,5].

The Turkish Ministry of Health initiated a professional CB system in 2008 following the establishment of quality standards. The use of CB in hospitals became mandatory with the regulations published in 2009 and the "Patient and Employee Safety Regulation" enacted in 2011. The Ministry of Health designated "2222" as the phone system for CB calls[6,7]. If implemented effectively and understood by the entire CB team, the CB system allows rapid identification and intervention in cases of in-hospital cardiopulmonary arrest, helping to reduce mortality and morbidity[1,2].

This study aims to retrospectively evaluate CB incidents in a secondary care state hospital and raise awareness about CB.

Materials and Methods

This retrospective study was approved by the non-interventional ethics committee of Kafkas University Medical Faculty (No: 2024/05/463/36) and conducted following the Helsinki Declaration. Data from CB calls at Muş State Hospital between 01.05.2019 and 01.05.2024 were recorded. Muş State Hospital is a secondary care state hospital with 445 beds, including 30 tertiary intensive care beds. Patients with complete data attended via CB calls were included in the study, while those with incomplete data were excluded.

Data recorded included patient age, gender, the unit or ward where the call was made, whether the call was during or outside working hours, the CB team's response time, the possible reason for the CB, duration of cardiopulmonary resuscitation (CPR), outcome of CPR, and the post-CB process (death, transfer to intensive care, admission to the emergency department for observation, referral to another center, follow-up, and treatment at the scene). Information was collected from CB forms and the hospital information system.

The response time was defined as the duration between the CB call and the team's arrival. According to the Utstein model, in-hospital cardiac arrest is defined as a patient not requiring basic or advanced life support[8]. The CB team in our hospital comprises an anesthesiologist, an anesthesia technician, and a security officer, with the team led, coordinated, and supervised by a specialist doctor. Upon receiving a CB notification, the team proceeds to the scene with an emergency response bag. The CB ends when the team reaches the scene. After evaluating and intervening with the patient, the team fills out the CB form.

Call times were classified as within working hours (weekdays 08:00–16:00) and outside working hours (weekdays 16:00–08:00 and weekends). Official holidays and public holidays were also considered outside working hours.

Statistical Analysis

Numerical variables are presented as mean ± standard deviation. Frequency and percentage values were used to describe categorical variables. The statistical significance of differences between mean values was calculated using Student's t-test. Fisher exact test or chi-square test was used to analyze incidence data. A p-value of less than 0.05 ($p < 0.05$) was considered statistically significant. Calculations were performed using IBM Statistical Package for Social Sciences (SPSS) program version 22 software (IBM Inc., Chicago, IL, USA).

Results

A total of 295 CB calls were reviewed. The mean age of the patients was 65.36±8.89 years, with no significant difference in age distribution between calls made during and outside working hours (p=0.362). Gender distribution included 124 (42%) female and 171 (58%) male patients, with no significant difference between genders (p=0.643). Of the 295 calls, 137 (46.4%) were made during working hours, and 158 (53.6%) were outside working hours, with no significant difference between them (p=0.433) (Table 1).

The average response time for CB calls was 1.80±0.87 minutes, with no significant difference between working and nonworking hours (p=0.471). The average CPR duration was 30.4±12.7 minutes. There were 45 false CB calls, 16 (35.5%) during working hours and 29 (64.5%) outside working hours, with a significant increase in false calls outside working hours (p=0.019) (Table 1).

Table 1. *Comparison of demographic characteristics of patients and CB calls during and outside working hours*

	Total patients	Working hours	Outside working hours	P-value
Number of patients n (%)	295(100)	137(46.4)	158(53.6)	0.433
Age (years) mean ± SD	65.36±8.89	65.02±7.23	64.15±8.14	0.362
Gender				
Female n (%)	124(42)	59(43)	65(41.1)	0.643
Male n (%)	171(58)	78(57)	93(58.9)	
Response time (minutes) mean ± SD	1.80±0.87	1.73±0.86	1.81±0.73	0.471
CPR duration (minutes) mean ± SD	30.4±12.7	30.5±12.2	30.2±16.9	0.684
Incorrect CB n (%)	45(100)	16(35.5)	29(64.5)	0.019
Post CB process				
Exitus n (%)	106(35.9)	43	63	0.023
Admitted to ICU n (%)	76(25.7)	33	43	0.014
Transferred to other centers n (%)	22(7.5)	10	12	0.745
Admitted to ER for observation n (%)	26(8.8)	12	14	0.543
Treatment and follow-up on site n (%)	65(22.1)	30	35	0.456

n: number of patients; %: percentage; SD: standard deviation; CB: code blue; CPR: cardiopulmonary resuscitation; ICU: intensive care unit; ER: emergency room; p<0.05 was considered statistically significant.

Following CB calls, 106 patients (35.9%) died, with 43 during working hours and 63 outside working hours (p=0.023). Seventy-six patients were transferred to intensive care, with 33 during working hours and 43 outside working hours (p=0.014). The number of patients referred to another center was 22, with no significant difference between working and outside working hours (p=0.745). The number of patients admitted for observation in the emergency department was 26, with no significant difference between working and outside working hours (p=0.543). The number of patients treated and monitored at the scene was 65, with a similar distribution between working and outside working hours (p=0.456) (Table 1).

The Internal Medicine Department received the highest number of CB calls (16.27%), followed by the Angio Unit (11.86%) and the Pulmonary Diseases Department (9.49%). The Interventional Radiology Unit received the lowest number of calls (1.02%), and the General Surgery Outpatient Clinic received the lowest number of calls (1.02%) (Table 2).

The most common probable diagnosis for CB calls was cardiac arrest, with a total of 98 cases (33.22%). This was followed by respiratory depression (23.39%) and low oxygen saturation (15.25%). Less common diagnoses included asthma attacks (1.02%) and conversion disorders (1.02%) (Table 3).

Table 2. *Department and units where CB calls are issued*

	Total Calls n (%)	Correct Calls	Incorrect Calls
Palliative care unit	18(6.10)	16	2
Hemodialysis unit	21(7.12)	19	2
Angio unit	35(11.86)	31	4
Phlebotomy unit	9(3.05)	8	1
Endoscopy unit	13(4.41)	11	2
Chemotherapy unit	15(5.08)	13	2
Internal medicine department	48(16.27)	44	4
Pulmonology department	28(9.49)	25	3
General surgery outpatient clinic	3(1.02)	2	1
General surgery department	7(2.37)	5	2
Internal medicine outpatient clinic	7(2.37)	5	2
Obstetrics and delivery room	10(3.39)	8	2
Orthopedics department	10(3.39)	8	2
Cardiology department	9(3.05)	7	2
Ophthalmology outpatient clinic	4(1.36)	3	1
Infectious diseases department	6(2.03)	5	1
Plastic surgery department	8(2.71)	6	2
Interventional radiology unit	3(1.02)	2	1
COVID-19 department	18(6.10)	14	4
ENT department	4(1.36)	3	1
Pediatric ICU/ department	8(2.71)	6	2
Urology department	6(2.03)	5	1
Physical therapy department	5(1.69)	4	1

n: number of patients, %: percentage, CB: code blue, ENT: ear, nose and throat, ICU: intensive care unit.

Table 3. *Possible diagnoses of CB calls*

	n (%)
Cardiac arrest	98(33.22)
Respiratory depression	69(23.39)
Low oxygen saturation	45(15.25)
Hypotension	27(9.15)
Syncope	18(6.10)
Aspiration	14(4.75)
Epileptic seizure	9(3.05)
Anaphylaxis	5(1.69)
Hypoglycemia	4(1.36)
Asthma attack	3(1.02)
Conversion	3(1.02)

n: number of patients, %: percentage, CB: code blue.

Discussion

In-hospital cardiac arrests are one of the leading causes of high morbidity and mortality. Cardiac arrest occurs in one to five out of every 1.000 patients, leading to an in-hospital mortality rate of approximately 80%[9,10]. Despite this high death rate, there has been no significant improvement in in-hospital survival rates over the past few decades[11,12]. A study conducted in Korea on 958 patients with in-hospital cardiac arrest found that 28% of these patients were discharged alive[13]. This once again emphasizes the need for rapid detection and intervention in cases of in-hospital cardiac arrest.

In the study by Senem et al.[14], 46.8% of CB calls were for women, and the average age of patients was 48.8±21.06 years. Another study reported that 38% of calls were for women, with an average age of 64.25±20.6 years[15]. In another study, 44% of calls were for women, with an average age of 75.14±12.86 years[8]. A different study found that 33.3% of calls were for women, with an average age of 56.06 years[16]. In line with the literature, 42% of CB calls in our study were for women, with an average age of 65.36±8.89 years. The lower arrest rates in women may be related to the less frequent occurrence of coronary problems such as myocardial infarction and angina pectoris in women[17]. These findings suggest that lower rates of cardiac arrest in women are associated with a possible prevalence of coronary disease, but further investigation is warranted.

In-hospital cardiac arrests are common, and some CB calls can be false alarms. In the study by Betül et al.[18], 80 out of 419 CB calls were false alarms. Another study reported 74 false calls out of 694 CB calls[16]. A study found that 381 out of 1.035 CB calls were false alarms[15]. An analysis of four years of CB calls found that false alarms ranged from 4% to 31%[19]. Our study had 45 (15.25%) false CB calls. To reduce these false alarm rates, periodic CB training for all hospital staff can help create more aware personnel, thus reducing the rate. This can also increase motivation within the CB team and improve patient survival in other CB incidents.

Cardiopulmonary arrest is the cessation of respiration or circulation. The CB team must reach the call point within 3 minutes to start CPR. This duration is critical for patients experiencing arrest, as delayed intervention increases the death rate and worsens neurological damage[20,21]. The response time of the CB team to the call is crucial for mortality and morbidity. In the study by Müge et al.[8], this duration was 1.97±0.72 minutes. Another study found the average response time to be 1.85±0.45 minutes for outpatient cases and 2.10±0.55 minutes for inpatient cases[1]. A different study reported it as 108.83±42.83 seconds[14]. In line with the literature, our study found an average response time of 1.80±0.87 minutes. The rapid arrival of the team to the scene is critical in reducing mortality rates, and continuous training can contribute to shortening this time.

The hospital units where CB calls are made differ in various studies. In the study by Müge et al.[8], 33% of calls were from the palliative care unit, 24% from the internal medicine department, and 16% from the pulmonology department. Another study reported that 62% of calls were from inpatient units and 25% from outpatient clinics[14]. In another study, 21% of calls were from the orthopedic department, followed by 20% from the general surgery department [1]. A different study reported the highest number of calls from the palliative care unit, followed by the internal medicine department[19]. This situation shows a need for more emergency interventions in different hospital wards and that training and supervision in these units should be increased.

One of the most critical factors affecting mortality and morbidity in patients after cardiac arrest is the response time to CPR[13,22]. Studies have shown that mortality increases if CPR duration exceeds 10 minutes, while survival rates increase with CPR durations of less than 10 minutes[23]. Shin et al.[13] reported CPR durations of 26–30 minutes, Möhnle et al.[23] reported 17–20 minutes, and Vinay et al.[24] reported 12–19 minutes. In studies conducted in Türkiye, Özlem et al.[25] found an average CPR duration of 27 minutes (minimum: 10,

maximum: 50). Selçuk et al.[19] reported average CPR durations ranging from 22.1 to 28.6 minutes over four years. Our study found an average CPR duration of 30.4±12.7 minutes.

Various studies found that the rates of CB calls made outside working hours were 66.82%, 26.2%, 54%, 62.7%, 62.22%, and 52.5%[8,14–16,25,26]. In line with the literature, our study found this rate to be 53.6%.

In the study by Senem et al.[14], following CB intervention, 64.9% of patients were admitted for observation in the emergency department, and 35.1% were transferred to the intensive care unit. Another study reported that 41.2% of patients were admitted to the intensive care unit, 42.5% were declared deceased in the intervened unit, 15.8% received treatment in the unit, and 0.3% underwent emergency surgery[16]. A different study reported that 8.4% of patients were admitted to the intensive care unit, 39.1% were declared deceased, 41% were referred to another center, 9.7% were admitted for observation in the emergency department, and 0.42% underwent emergency surgery[26]. Another study found that 44% of patients were declared deceased, 39% were admitted to the intensive care unit, and 3% continued treatment in the intervened unit[8]. In our study, 35.9% of patients were declared deceased, and 25.7% were admitted to the intensive care unit.

Limitations

Our study has some limitations, including its retrospective nature, the inclusion of single-center data, and incomplete or missing data. Multicenter, prospective studies with a larger number of patients can be planned.

Conclusion

Code blue data serves as an indicator of hospital quality assessment. Code blue organization is critical for the survival of patients requiring advanced life support within the hospital. Accurate recording of all interventions the CB team performs is important for future studies and quality standards. Periodic training and drills with all hospital staff can reduce the rate of false CB calls in our study.

Conflict of Interest

There are no disclosed conflicts of interest for the authors.

Compliance with Ethical Statement

The non-interventional ethics committee of Kafkas university medical faculty gave its approval for the study to be conducted (Decision No: 2024/05/463/36).

Financial Support

There was no institutional or organizational funding for the study.

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