ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Does Intubation Affect Survival Among Patients Experiencing In-Hospital Cardiopulmonary Arrest?

Entübasyon Hastane İçi Kardiyopulmoner Arrest Hastalarında Sağkalımı Etkiliyor mu?

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ABSTRACT

Aim: Cardiopulmonary arrest is an important public health problem that contributes substantially to in-hospital morbidity and mortality. The present study aimed to determine the factors that affect in-hospital mortality and determine whether intubation contributes to survival among patients experiencing in-hospital cardiopulmonary arrest.

Material and Methods: This retrospective, cross-sectional study was conducted by examining the event notification forms of all patients with a "Code Blue" call between January 1, 2014, and December 31, 2018. Patients who died and those who did not die after intervention were compared concerning age, sex, location and time of the call, and interventions implemented. Patients who received cardiopulmonary resuscitation alone and those who received cardiopulmonary resuscitation + intubation were compared concerning in-hospital mortality; p-values < 0.05 were considered statistically significant.

Results: In total, 924 patients were included in the present study. The most frequent calls were made from the wards in the hospital, at a rate of 64.4%. The in-hospital mortality rate was 42.4%. In-hospital mortality rates were significantly higher in the elderly, in those who were given overtime and service calls, and in those who received cardiopulmonary resuscitation or cardiopulmonary resuscitation + intubation. Among patients who received CPR, intubation did not affect survival. Sex, age, time of call, and intervention were significant predictors of in-hospital mortality.

Conclusion: Code blue calls occurred primarily in the hospital wards outside of working hours, and improper call rates were high. Moreover, age, location and time of call, and interventions were independent risk factors for in-hospital mortality; intubation did not contribute to survival among patients experiencing in-hospital cardiopulmonary arrest.

Keywords: Cardiopulmonary arrest, cardiopulmonary resuscitation, intubation, survival, in-hospital mortality

ÖZ

Amaç: Kardiyopulmoner arrest, hastane içi morbidite ve mortaliteye anlamlı katkı sağlayan önemli bir halk sağlığı sorunudur. Bu çalışma, hastane mortalitesini etkileyen faktörleri belirlemeyi ve hastane içi kardiyopulmoner arrest geçiren hastalarda entübasyonun sağkalıma katkı sağlayıp sağlamadığını belirlemeyi amaçladı.

Gereç ve Yöntemler: Bu retrospektif, kesitsel çalışma, 1 Ocak 2014 ile 31 Aralık 2018 tarihleri arasında "Mavi Kod" çağrısı olan tüm hastaların olay bildirim formları incelenerek yapılmıştır. Müdahale sonrası ölen ve ölmeyen hastalar yaş, cinsiyet, çağrının yeri, zamanı ve yapılan müdahaleler açısından karşılaştırıldı. Tek başına kardiyopulmoner resüsitasyon uygulanan hastalar ile kardiyopulmoner resüsitasyon + entübasyon yapılan hastalar hastane içi mortalite açısından karşılaştırıldı; p değerleri <0,05 istatistiksel olarak anlamlı kabul edildi.

Bulgular: Bu çalışmaya toplam 924 hasta dahil edildi. En sık arama %64,4 oranıyla hastanenin servislerinden yapıldı. Hastane içi ölüm oranı %42,4 idi. Hastane içi ölüm oranları yaşlılarda, fazla mesai ve servis çağrılarında, kardiyopulmoner resüsitasyon veya kardiyopulmoner resüsitasyon + entübasyon uygulananlarda anlamlı olarak daha yüksekti. CPR yapılan hastalarda entübasyon sağkalımı etkilemedi. Cinsiyet, yaş, arama zamanı ve müdahale, hastane içi mortalitenin önemli belirleyicileriydi.

Sonuç: Mavi Kod aramaları öncelikle hastane servislerinden mesai saatleri dışında yapılıyordu ve uygunsuz arama oranları yüksekti. Ayrıca yaş, yer ve çağrı zamanı ve müdahaleler hastane içi mortalite için bağımsız risk faktörleriydi; entübasyon, hastane içi kardiyopulmoner arrest geçiren hastalarda sağkalıma katkıda bulunmadı.

Anahtar Kelimeler: Kardiyopulmoner arrest, kardiyopulmoner resüsitasyon, entübasyon, sağkalım, hastane içi mortalite

Received: January 15, 2022 Accepted: May 25, 2022

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Atıf için/Cited as: *Yadigaroglu M, Katipoglu B, Asik O, Sabak M.* Does Intubation Affect Survival Among Patients Experiencing In-Hospital Cardiopulmonary Arrest? Anatolian J Emerg Med 2022;5(3):103-108. https://doi.org/10.54996/anatolianjem.1058127

Introduction

Hospital emergency codes are emergency call and guidance systems that aim to mobilize hospital staff to respond to various emergencies to minimize in-hospital mortality and are applied by using the same colors worldwide (1). Cardiopulmonary arrest contributes substantially to in-hospital morbidity and mortality (2). Although there are various definitions for cardiopulmonary arrest, the most commonly used description comprises the discontinuation of cardiac mechanical activity, as confirmed by the absence of a detectable rhythm, unresponsiveness, and apnea. A cardiopulmonary arrest occurs in the hospital in patients with a rhythm during admission, known as an in-hospital cardiopulmonary arrest; its incidence is 3–4/1000 in adult patients (3,4). Because of the low survival rate among such patients, in-hospital cardiopulmonary arrest is an important public health problem. The main reasons for the low survival rate include age, the presence of multiple additional diseases, late detection of cardiopulmonary arrest, low level of knowledge (among hospital staff) of basic life support algorithms, defective equipment (e.g., monitors, defibrillators, and resuscitation cards), lack of qualified resuscitation teams, and lack of organization (5). The "Code Blue" serves to provide patients with rapid intervention during in-hospital cardiopulmonary arrest; it focuses on recovery and the maintenance of basic life support in the shortest possible time (0–5 min) (6). It has been reported that improved training, training of field staff, creation of resuscitation teams, and improved organization might improve survival rates (5,7). Establishing the leader and intra-team roles is the most critical factor in the success of the resuscitation team (8). Establishing code blue teams, ensuring that each member has a clear understanding of their role during training and exercises, and critiquing the resuscitation after each code blue event will increase survival and team success (9). Current guidelines for primary cardiopulmonary arrest recommend continuing circulation with chest compressions before airway and ventilation intervention; if necessary, defibrillation can then be applied (10). Some emergency services recommend high-quality, uninterrupted chest compressions together with oxygenation using an oropharyngeal airway or simple oxygen mask, as well as passive oxygenation; with a shockable rhythm, up to 600 chest compressions may delay advanced airway intervention during instances of out-of-hospital cardiopulmonary arrest with witnesses (11). European guidelines permit a pause in chest compression for not more than 5 seconds for tracheal intubation (12). Comparisons between airway interventions are difficult because of the use of multiple airway procedures during cardiopulmonary resuscitation (CPR), the importance of rescuer experience in the selection of the airway intervention technique, as well as patient status (e.g., obesity, location of cardiopulmonary arrest, and other interventions), and the need for advanced airway intervention in early returning patients (13). During resuscitation, the interventions and success rates are affected by many factors, including patient factors, rescuer experience, and resuscitation stage (10). The recommendations for optimal interventions are unclear, as the evidence to support recommendations in both in-hospital and out-of-hospital cardiopulmonary arrest consists entirely of observational studies (14).

This study aimed to identify factors that affect in-hospital mortality rates by evaluating code blue events and determining whether intubation for patients experiencing in-hospital cardiopulmonary arrest contributed to increased survival.

Material and Methods

This retrospective cross-sectional study was conducted by examining the event notification forms of all patients for whom a "code blue" was called at Trabzon Kanuni Training and Research Hospital, during the period from January 1, 2014, to December 31, 2018. All necessary permits were obtained from the Health Directorate before the study, and the Ethics Committee of Trabzon Kanuni Training and Research Hospital Clinical Researches Ethical Committee approved the study (Date: 17.09.2020, Decision No: 2020/42). Age, sex, location and time of cardiopulmonary arrest, source of cardiopulmonary arrest (cardiac or non-cardiac), interventions (aspiration, CPR, intubation, non-CPR call, or non-intervention), and results (death, hospitalization, intensive care follow-up, emergency room referral, or discharge) were recorded. Calls made by the hospital emergency department, calls for drills, accidental code blue calls, and calls for the patients below 18 years old were excluded from the study. Patients who died and did not die after intervention were compared concerning age, sex, location and time of call, and interventions implemented. In addition, patients who received CPR alone and those who received CPR + intubation were compared concerning in-hospital mortality.

Statistical analysis

Data was recorded and compared using SPSS software (version 25.0; IBM Corp., Armonk, NY, USA). Descriptive statistics for continuous variables (characteristics) are presented as medians, while those for categorical variables are presented as counts and percentages. The chi-squared test was used to compare categorical data. Univariate and multivariate logistic regression analyses were used to identify independent risk factors for in-hospital mortality. Parameters with a p-value < 0.1 in univariate analysis were included in the multivariate model; odds ratios and 95%

confidence intervals were calculated; p-values < 0.05 were considered statistically significant.

Results

In total, 924 patients were included in this study; 464 (50.1%) were women, with a mean age of 71.4 years (range: 45.2–82.6 years). The remaining 460 patients (49.9%) were men, with a mean age of 68.7 years (56.7–77.5 years). Most calls were made from the wards (n = 596, 64.4%), followed by the intensive care unit (18.6%), clinics (14.1%), and other locations (2.9%) (e.g., hospital garden or cafeteria).

Concerning patients' final statuses after code blue calls, 393 (42.4%) died; 223 (24.1%) continued hospitalization in the intensive care unit or the wards (no change in location); 140 (15.1%) were admitted to the intensive care unit, and 168 (18.1%) were discharged after intervention or following emergency service observation. Table 1 shows the results of interventions during each year of the study period concerning sex, call time, location of the call, and intervention distribution.

Regarding interventions implemented after code blue calls, patients were divided into two groups: those who experienced in-hospital mortality (42.4%) and those who did not (57.6%). Table 2 shows differences between the groups in terms of the year, age, time of call (during working or non-working hours), location of the call, and intervention. In-hospital mortality rates were significantly higher in patients with an older age (73.7 years versus 66.2 years; p < 0.001), in calls made during non-working hours (p < 0.001), in patients with service hospitalization (p < 0.001), and in patients who received CPR or CPR + intubation (p < 0.001).

The present study also evaluated whether the in-hospital mortality rate differed between patients who received CPR alone and those who received CPR + intubation. Notably, there was no change in survival when intubation was performed in combination with CPR (p = 0.431) (Table 3).

Table 4 shows the results of univariate and multivariate logistic regression analyses performed to determine independent risk factors for in-hospital mortality. Multivariate regression analysis showed that sex, age, time of call, and intervention were significant predictors of in-hospital mortality (p = 0.008, p = 0.001, p < 0.001, and p < 0.001, respectively).

Discussion

One of the most important findings of the present study is that intubation did not affect in-hospital mortality in CPR patients. In a prior study of adult and pediatric patients who received CPR in the emergency department, survival rates were reportedly significantly increased in patients who did not also receive advanced airway intervention (15). In addition, advanced airway intervention during CPR allegedly did not result in improved survival or 28-day neurological functionality, compared with balloon mask ventilation (16,17).

Guidelines for in-hospital cardiopulmonary arrest indicate that intubation performed in the first 15 minutes of the cardiopulmonary arrest event reduces survival compared with no intubation (18).

	2014, % (n:234)	2015, % (n:233)	2016, % (n:174)	2017, % (n:137)	2018, % (n:146)
Result, % (n)					
Exitus	47.9 (112)	47.6 (111)	44.3 (77)	35.0 (48)	30,8 (45)
Continue hospitalization	25.2 (59)	23.6 (55)	22.9 (40)	23.4 (32)	25,3 (37)
Intensive Care	14.1 (33)	10.3 (24)	11.5 (20)	26.3 (36)	18,5 (27)
Other	12.8 (30)	18.5 (43)	22.4 (39)	15.3 (21)	24,0 (35)
Gender, % (n)					
Female	51.7 (121)	48.5 (113)	49.4 (86)	54.0 (74)	46.6 (68)
Male	48.3 (113)	51.5 (120)	50.6 (88)	63 (46.0)	53.4 (78)
Call Time, % (n)					
In-office hours	43.6 (102)	42.5 (99)	50.6 (88)	52.6 (72)	47.9 (70)
Out-of-the-office hours	56.4 (132)	57.5 (134)	49.4 (86)	47.4 (65)	52.1 (76)
Place of call, % (n)					
Clinic	9.4 (22)	17.6 (41)	16.1 (28)	14.6 (20)	13.7 (20)
Service	57.3 (134)	51.9 (121)	77.0 (134)	72.3 (99)	74.0 (108)
Intensive Care	30.3 (71)	29.2 (68)	2.9 (5)	10.2 (14)	9.6 (14)
Other	3.0 (7)	1.3 (3)	4.0 (7)	2.9 (4)	2.7 (4)
Intervention, % (n)					
CPR	45.3 (106)	35.6 (83)	27.6 (48)	29.9 (41)	30.1 (44)
CPR + Intubation	28.6 (67)	32.2 (75)	43.1 (75)	40.1 (55)	13.0 (19)
Intubation	2.1 (5)	5.6 (13)	1.1 (2)	0.0 (0)	4.8 (7)
Call place + Other	23.9 (56)	26.6 (62)	28.2 (49)	29.9 (41)	52.1 (76)

Table 1. Distribution of the patients in terms of the result after the intervention, gender, time and place of the call, and the intervention by years.

	Group 1 (n:393)	Group 2 (n:531)	p value
Age, median (IQR)	73.7 (20.5)	66.2 (35.5)	<0.001
Call time, % (n)			
In-office hours	30.8 (121)	58.4 (310)	<0.001
Outside office hours	69.2 (272)	41.6 (221)	
Call place, % (n)			
Clinic	1.0 (4)	23.9 (127)	
Service	78.1 (307)	54.4 (289)	
Intensive Care	20.1 (79)	17.5 (93)	<0.001
Other	0.8 (3)	4.1 (22)	
Intervention, % (n)			
CPR	50.1 (197)	23.5 (125)	
CPR + Intubation	47.6 (187)	19.6 (104)	
Intubation	0.3 (1)	4.9 (26)	<0.001
Treatment + Other	2.0 (8)	52.0 (276)	

Table 2. Significance levels of the statistical differences between the groups in terms of a year, time and place of the call, and intervention between those with incident mortality and those without incident mortality.

According to the American Heart Association, it is critical to minimize the pause between compressions for advanced airway intervention in the patients with cardiopulmonary arrest (19). The most common reasons for cardiopulmonary arrest in adult patients are cardiac-related. Consequently, the present study shows that non-invasive ventilation was adequate for these adult patients because of the cardiac origin of the arrest. Due to the study's retrospective nature, it is unclear whether the non-intubated patients received any airway intervention. This is a limitation of the study. In addition, in-hospital mortality did not increase in patients who did not receive intubation, potentially because compression was not paused to enable advanced airway intervention. Because of the above uncertainties in the literature, we believe that the results of our study represent a substantial contribution.

	CPR (n:322)	CPR + Intubation (n:291)	p value
Group 1	61.2 (197)	64.3 (187)	0.431
Group 2	38.8 (125)	35.7 (104)	

Table 3. The effect of intubation on in-hospital event mortality in patients who receive CPR.

Although the rate of true and false code blue status was not regarded as a formal outcome in our study, the rate of improper code blue calls was 31%, assuming that all patients with true code blue status had received CPR. An excessive number of foul calls results in labor losses, and measures that may be taken to reduce such calls have frequently been discussed in the literature; improper calls occurred in 11–74% of cases and varied widely among studies. Differences among improper call rates may reflect the attitudes of the code blue teams in the hospitals where the studies were conducted. Only completing a form for the actual code blue may reduce recorded improper call rates. At the hospital where the study was conducted, a form is completed for each code blue call notification; thus, the rates may be relatively higher.

In a study that examined code blue data from a secondary state hospital in 2017, the most frequent code blue calls were reportedly made from the wards (20). Similarly, Bayramoğlu et al. found that the most frequent call sites were the wards (21). Conversely, Eroğlu et al. found that the most frequent code blue calls were from the phlebotomy unit (22). Çiçekçi et al. included intensive care calls in their study and found that 80.8% of the calls were made from intensive care units (23). Notably, the hospital where the present study was conducted is a tertiary hospital; in addition to the general intensive care unit, many departments have separate intensive care units (e.g., chest, cardiology, and neurology departments). Because there is an anesthesiologist in the general intensive care unit, calls from that unit were not included in the present study; however, other intensive care calls were included. It is reasonable that calls were most frequently made from intensive care units, as critical patients are hospitalized in such units. Because of the number of beds in various hospital wards, the calls are likely to be made most frequently from the wards when intensive care units are not included. In the study, although calls made from intensive care units were included in the research, the most frequent calls were made from wards; this is because there was a doctor in charge in each intensive care unit and when the medical state of the patients deteriorates, interventions can be made before a cardiopulmonary arrest occurs. The code blue call in intensive care units was made after this stage.

The rate of calls during non-working hours was 69.2% in the present study. In the literature, many studies have reported significantly higher nighttime cardiopulmonary arrest rates compared to rates during working hours (24,25), as follows: nighttime rates, 53–64%; weekday rates, 24–26%; and weekend rates, 26–28% (26,27). This difference is possible because cardiopulmonary arrest in adults is frequently of cardiac origin, and heart attacks occur more often in the early morning due to increased beta-adrenergic activity, hypercoagulability, and platelet hyperreactivity (28). Çiçekçi et al. reported the rate of cardiopulmonary arrest during non-working hours as 77.4%.

Variables	Univariate analysis			Multivariate analysis		
	OR	95% CI	P	OR	95% CI	P
Gender (female vs. male)	0.560	0.430-0.729	<0.001	1.641	1.136-2.370	0.008
Age	0.978	0.971-0.986	<0.001	0.983	0.973-0. 993	0.001
Call time	3.153	2.395-4.151	<0.001	0.417	0.287-0.607	< 0.001
Call place	0.640	0.521-0.786	<0.001	1.082	0.769-1.523	0.651
Intervention	3.821	3.146-4.642	<0.001	3.446	2.695-4.408	< 0.001

Table 4: Determining the independent risk factors for in-hospital incidence mortality with the Univariate and Multivariate Logistic Regression Analysis.

Similarly, Murat et al. reported that the rate of cardiopulmonary arrest during non-working hours was greater (56%) than during working hours; therefore, the authors proposed a 24-h readily availablecode blue team because it corresponded to the period when fewer professional health personnel were present in the hospital (23,29).

With respect to instant discharge rates following code blue calls, the present study demonstrated a rate of 18.1%. This rate is similar to the 22% recently reported by Kaykasız et al. in an analysis of a secondary hospital (20). Another study showed a rate of instant discharge of 15–20%, whereas long-term discharge rates have been reported as approximately 30% (21,30). Among patients who are followed-up in intensive care units following successful resuscitation, discharge rates are expected to be high. In addition, age, additional disease, single-center or multicenter study design, and resuscitation team characteristics can affect discharge rates. The results of our study are consistent with the literature.

Our study has some limitations. False or fake calls were not excluded from the study. In addition, the form of airway interventions other than intubation could not be determined clearly.

Conclusion

In the present study, code blue calls occurred at the greatest frequency in wards during non-working hours; moreover, the improper call rate was high. Age, time, and location of calls and interventions were independent risk factors for in-hospital mortality; intubation did not contribute to survival in patients experiencing in-hospital cardiopulmonary arrest. In the future, multicenter, prospective studies with larger patient groups are needed to support the findings of this investigation.

Conflict of Interest: The authors declare no conflict of interest regarding this study.

Financial Disclosure: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors' Contribution: All authors contributed equally to the preparation of the article.

Ethical Statement: Approval was obtained from Trabzon Kanuni Training and Research Hospital Clinical Researches Ethical Committee Date: 17.09.2020, Decision No: 2020/42). All authors declared that they follow the rules of Research and Publication Ethics.

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