

Effect of End-Tidal Carbon Dioxide Measurement on Resuscitation Efficiency and Termination of Resuscitation

End Tidal Karbonmonoksit Ölçümünün Resüsitasyon Etkinliği ve Sonlandırılması Üzerine Etkisi

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SUMMARY

Objectives

In this study, the value of end-tidal carbon dioxide (ETCO₂) levels measured by capnometry were evaluated as indicators of resuscitation effectiveness and survival in patients presenting to the emergency department with cardiopulmonary arrest.

Methods

ETCO₂ was measured after 2 minutes of compression or 150 compressions. ETCO₂ values were measured in patients that were intubated and in those who underwent chest compression. The following parameters were recorded for each patient: demographic data, chronic illness, respiration type, pre-hospital CPR, arrest rhythm, arterial blood gas measurements, ETCO₂ values with an interval of 5 minutes between the measurement and the estimated time of arrest, time to return to spontaneous circulation.

Results

Cardiac arrest developed in 97 cases, including 56 who were out of the hospital and 41 who were in the hospital. Fifty of these patients returned to spontaneous circulation, and just one of these had an initial ETCO₂ value below 10 mmHg. The mean of the final ETCO₂ levels was 36.4±4.46 among Patients who Return to Spontaneous Circulation (RSCPs) and 11.74±7.01 among those that died. In all rhythms; Asystole, pulseless electrical activity (PEA) and VF/VT; Overall, RSCPs had higher ETCO₂ levels than the cases who died. Among the PEA patients undergoing in-hospital arrests and those asystolic patients undergoing out of hospital arrest, the ETCO₂ values of the RSCPs were significantly higher than those of the cases who died.

Conclusions

ETCO₂ levels predicted survival as well as the effectiveness of CPR for patients who received CPR and were monitored by capnometry in the emergency department. As a result, we believe that it would be suitable to use capnometry in all units where the CPR is performed.

Key words: Capnography; capnometry; cardiopulmonary arrest; resuscitation.

ÖZET

Amaç

Çalışmamızda acil servise kardiopulmoner arrest ile gelen hastalarda kapnometre ile ölçülen endtidal karbondioksit seviyelerinin uygulanan KPR'nin etkinliği ve hasta sağkalımının göstergesi olarak kullanılabilmesinin araştırılması amaçlandı.

Gereç ve Yöntem

Acil servisimize göğüs kompresyonuna başlanarak entübe edilen (acil ambulansla getirilmişse tüp kontrolü yapılan) ve göğüs kompresyonunun ikinci dakikanın sonunda ya da 150 bası sonrası ilk ölçülen end-tidal karbondioksit (ETCO₂) değeri 0. dakika ETCO₂ olarak kabul edildi. Daha sonra beşer dakika ara ile ETCO₂ değerleri kaydedildi. Hastaların demografik verileri, kronik hastalık varlığı, 112 ile gelmiş neyle solutulduğu, hastane öncesi KPR uygulanması, hasta arrest ritmi, kan gazı değerleri, tahmini arrest süresi ile hastanın spontan dolaşımın dönme süresini içeren parametreler kaydedildi.

Bulgular

Çalışmaya alınan 97 olgunun 56'sı hastane dışı (HDKA), 41'i hastane içi gelişen arrest (HİKA) hastalardan oluşmaktaydı. Spontan dolaşıma geri dönen (SDGD) 50 olgudan sadece bir tanesinin ilk ETCO₂ düzeyi 10 mmHg'nin altında olarak ölçüldü. Son ETCO₂ düzeyi ortalamaları SDGD'lerde 36.4±4.46, hayatını kaybedenlerde 11.74±7.01 olarak bulundu. Asistoli, NEA, VF/VT ritimlerinin tamamında SDGD olgularında ETCO₂ düzeyleri exitus olanlardan yüksekti (p=0.001). Hastane içi nabızsız elektriksel aktivite (NEA) hastaların ve hastane dışı asistolik hastaların, SDGD olgularında ETCO₂ değerleri eksitus olan olguların ETCO₂ değerlerinden yüksekti.

Sonuç

Acil servislerde KPR uygulanan ve kapnometre ile izlenen hastalarda ETCO₂ düzeyi sağ kalım, KPR'nin etkinliği ve devamı açısından yol göstericidir bu yüzden KPR uygulanan tüm birimlerde kapnometre kullanımının uygun olacağını düşünüyoruz.

Anahtar sözcükler: Kardiopulmoner arrest; kapnometre; resüsitasyon.

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Introduction

Modern cardiopulmonary resuscitation (CPR) began with airway opening methods by Peter Safar in 1959 and external cardiac compression by William Kouwenhoven in 1960. However, resuscitation trials have been reported for several centuries.^[1,2] Since modern resuscitation applications have been used, researchers have been studying ways to prevent cardiac arrest and have been working to develop effective resuscitation techniques.

Capnometry is a method used to verify the accuracy of the endotracheal tube placement in cardiopulmonary arrest patients.^[3] High end-tidal carbon dioxide (ETCO₂) level measurements by capnometry may be important to successful resuscitations.^[4-6] In this study, we aimed to investigate the effect of quantitative ETCO₂ measurement with capnometry during CPR to determine the effectiveness of CPR and patient prognosis in cardiopulmonary arrest patients.

Materials and Methods

After obtaining approval from the ethics committee and conforming to the provisions of the Declaration of Helsinki in 1995 (as revised in Seoul 2008), non-traumatic out-of-hospital and in-hospital cardiopulmonary arrest patients over 18 years of age were enrolled in this cross-sectional study between February 1, 2012 and June 30, 2012.

Resuscitations were performed according to the American Heart Association (AHA) Advanced Cardiac Life Support (ACLS) guidelines. ETCO₂ levels were measured and the time of admission to the emergency department was noted as was the time of intubation. ETCO₂ values were recorded after the 6th ventilation in patients who underwent cardiopulmonary arrest during the emergency service follow-up. ETCO₂ levels were measured and noted in five minute intervals starting at the time of resuscitation. Resuscitation time was determined by the responsible doctor who managed the resuscitation. Patients who underwent a second cardiopulmonary arrest and were resuscitated were excluded from the study.

The patients were divided into two groups: 1. Exitus patients (EP), and 2. Returned to spontaneous circulation patients (RSCP). Demographic data, chronic disease, ventilation method in the ambulance, out-of-hospital CPR application, arrest rhythm, blood gases, ETCO₂ levels recorded at intervals of five minutes, predicted arrest time period and return time of spontaneous circulation were recorded. Patients brought by ambulance who then underwent cardiac arrest in the emergency department were accepted as in-hospital cardiac arrest patients.

We used a standard capnography device (Medilab Cap 10) for ETCO₂ measurements.

SPSS 15.0 for Windows program was used for statistical evaluation. Chi-square test and Fisher's exact test was used to compare data between groups. One Way Anova and independent sample t-tests were used for parametric variables. Kruskal Wallis and Mann Whitney U-tests were used to compare nonparametric variables. Results were considered statistically significant at $p < 0.05$.

Results

In our study, 37 (38.1%) of the 97 patients were female, and 60 (61.9%) were male. The mean age of the males was 66.75 ± 13.84 years (min: 56, max: 89) and was 71.57 ± 11.52 years (47-87) for females. The overall mean age of males and females combined was 68.59 ± 13.15 years (26-89). The ages of the males and females were not significantly different ($p > 0.05$).

Forty-one (42.3%) patients were In-hospital cardiac arrest patients (IHCAP) and 56 (55.7%) were Out-hospital cardiac arrest patients (OHCAP). Twenty two (75%) of the in-hospital arrest patients died and 19 (72%) of them returned to spontaneous circulation. Twenty-five (66.64%) out-of-hospital patients (OHCAP) died and 31 (63.55%) returned to spontaneous circulation. The mean ages of the patients who died and those who returned to spontaneous circulation were not significantly different ($p > 0.05$).

Survival due to ventilation techniques (Laryngeal Mask Airway, Bad Valve, Combitube, etc.) performed on patients in the ambulance before admission to the emergency department admission of the IHCAPs and OHCAPs were not significantly different ($p > 0.05$).

In our study ages of 72 (74.6%) patients were over 60 years of age. Seventy-one (73.2%) patients were brought to our emergency department by ambulance. There were no significant differences in the survival of the groups with regards to admission time, arrival by ambulance, location of cardiac arrest, and the diagnosis and presence of chronic disease ($p > 0.05$). However, the survival of the patients with regards to arrest time period were significantly different ($p < 0.05$).

CPR application ratios were not significantly different between the groups in OHCAPs ($p > 0.05$). Survival due to arrest rhythm ($p < 0.05$) and arrest time period ratios ($p < 0.05$) were significantly different between groups ($p = 0.001$). Eighty-one percent of asystole patients, 36% of pulseless electric activity (PEA) patients and 58% of the VF/VT patients died.

The exitus cases' arrest rhythms were 36.2% ($n = 17$) asystole, 40.4% ($n = 19$) PEA, and 23.4% ($n = 11$) VF/VT. Of 50 RSCPs, 27

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