PAPER DETAILS

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RESEARCH ARTICLE

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The Effects of Ventilation During Cardiopulmonary Resuscitation Using Manual Bag-Valve or Mechanical Ventilator on the Return of Spontaneous Circulation and Lactate Levels

Kardiyopulmoner Resüsitasyon Sırasında Ventilasyonun Manuel Balon-Valf Veya Mekanik Ventilatör ile Sağlanmasının Spontan Dolaşımın Geri Dönüşü ve Laktat Düzeyi Üzerine Etkisi

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ABSTRACT

Aim: *The aim is to investigate the effect of manual ventilation using a bag-valve versus mechanical ventilation on the return of spontaneous circulation and the progression of lactate levels during cardiopulmonary resuscitation.*

Materials and Methods: *The study was conducted at the Emergency Medicine Department of Fatih Sultan Mehmet Training and Research Hospital, between January 4, 2019, and January 4, 2021, following ethical approval. It was designed as a prospective, randomized study. Advanced cardiac life support was administered to patients who presented with cardiac arrest. The patients were randomized into two groups, with 15 patients included in each group. The resuscitation team provided manual ventilation with a bag-valve for one group and mechanical ventilation in 'CPR mode' for the other group. Lactate levels at 0, 5, 10, 15, and 20 minutes during the intervention, as well as the duration of return of spontaneous circulation, if achieved, were recorded and compared between the groups.*

Results: *The mean age of the patients was 47.8, with 16 male and 14 female patients. CPR was applied for a minimum of 20 minutes. Return of spontaneous circulation (ROSC) was achieved in 4 patients. Lactate levels showed a decrease in the mechanical ventilator group, while an increasing trend was observed in the bag-valve manual ventilation group. There was no significant difference between the groups regarding the effect of the ventilation method on the return of spontaneous circulation ($p > 0.05$).*

Conclusion: *It was observed that the use of a mechanical ventilator instead of manual bag-valve ventilation did not negatively affect the return of spontaneous circulation. Furthermore, a tendency for lactate levels to decrease was noted in the mechanical ventilation group compared to the bag-valve manual ventilation group.*

Keywords: *Advanced airway, bag-valve ventilation, mechanical ventilation during CPR, ventilation*

ÖZET

Amaç: *Kardiyopulmoner resüsitasyon sırasında balon-valf ile manuel olarak uygulanan ventilasyon ile mekanik ventilatör aracılığıyla uygulanan ventilasyonun spontan dolaşımın geri dönüşü ve laktat düzeyinin seyri üzerine etkisini araştırmaktır.*

Gereç ve Yöntemler: *Çalışma; Sağlık Bilimleri Üniversitesi İstanbul Fatih Sultan Mehmet Eğitim ve Araştırma Hastanesi Acil Tıp Kliniği'nde 04.01.2019 ile 04.01.2021 tarihleri arasında etik kurul onayı alınmasını takiben yürütüldü. Prospektif, randomize olarak tasarlanan çalışma kliniğimize gelen kardiyak arrest hastalar üzerinde yapıldı. Kardiyak arrest olarak gelen hastalara Güncel American Heart Association İleri Kardiyak Yaşam Desteği algoritmasına uygun bir şekilde ileri kardiyak yaşam desteği başlandı ve yönetildi, hastaların ileri havayolu endotrakeal entübasyon ile sağlandı. Hastalar randomize edilerek iki gruba ayrıldı. Her gruba 15'er hasta dahil edildi. Resüsitasyon ekibi tarafından bir gruba balon-valf ile manuel; diğer gruba da mekanik ventilatör ile 'KPR modu'nda ventilasyon yapıldı. Müdahale boyunca 0-5-10-15-20. dakikalardaki laktat düzeyleri, spontan dolaşımın geri dönüşü sağlanması, sağlandı ise süresi kaydedildi ve gruplar arasında karşılaştırıldı.*

Bulgular: *Hastaların yaş ortalaması 47.8 ve 16sı erkek 14ü kadın cinsiyette idi. Minimum 20 dk kardio pulmoner resüsitasyon uygulandı. 4 hastada rosc sağlandı. Laktat düzeyleri mekanik ventilatör grubunda 0-20. dakika arasında azalırken balon-valf ile manuel ventilasyon grubunda artış eğiliminde izlendi. Ventilasyon yönteminin spontan dolaşımın geri dönüşü üzerine etkisi açısından gruplar arasında anlamlı bir fark bulunmadı ($p>0.05$).*

Sonuç: *Mekanik ventilatör kullanımının, manuel bag-valve ventilasyon yerine spontan dolaşımın geri dönüşünü olumsuz etkilemediği gözlemlendi. Ayrıca, mekanik ventilasyon grubunda, bag-valve manuel ventilasyon grubuna kıyasla laktat*

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seviyelerinin düşme eğiliminde olduğu not edilmiştir.

Anahtar Kelimeler: *İleri havayolu, balon-valf ventilasyon, KPR sırasında mekanik ventilasyon, mekanik ventilatör, ventilasyon*

INTRODUCTION

In cases of cardiac arrest, cardiopulmonary resuscitation (CPR) is performed to maintain tissue perfusion until return of spontaneous circulation (ROSC) is achieved. This involves cardiac compressions and airway management. Ensuring tissue oxygenation requires not only the effectiveness of cardiac compressions but also maintaining an open airway and providing adequate ventilation (1).

In cases of cardiac arrest, patients in the emergency department are managed according to the latest American Heart Association (AHA) guidelines for Advanced Cardiovascular Life Support (ACLS). The guidelines recommend that while chest compressions are performed continuously, ventilation of the patient should be ensured through the use of a bag-valve mask or advanced airway devices. Advanced airway interventions include endotracheal intubation and supraglottic airway devices, with endotracheal intubation being known as the method that minimizes the risk of aspiration and provides the safest airway management when performed by experienced rescuers. The guidelines do not provide a definitive recommendation for the ventilation method in intubated patients. Ventilation for these patients can be managed either by a mechanical ventilator or manually with a bag-valve. During manual ventilation with a bag-valve, one member of the resuscitation team is responsible for maintaining the airway, while the other team members continue with chest compressions (1).

Hyperventilation has been shown to decrease the effectiveness of CPR and increase mortality, as evidenced by research (2,3). Using a mechanical ventilator for ventilation helps optimize the tidal volume and respiratory rate, thereby avoiding the state of hyperventilation (4).

Preventing hyperventilation and having the rescuer who performs manual ventilation with a bag-valve also join the chest compression team is thought to improve the quality of compressions and positively contribute to the ROSC (1).

Lactate is an important parameter indicating tissue perfusion. In patients experiencing cardiac arrest, there is a disruption in the delivery of oxygen to tissues, leading to anaerobic metabolism and an increase in serum lactate levels (5). Strong evidence exists showing a direct relationship between high serum lactate levels and mortality. It has been reported that a reduction in lactate levels as tissue perfusion is restored is a good prognostic indicator (6,7).

Although current resuscitation guidelines and the literature do not provide a definitive recommendation regarding the patient's ventilation method, there are also no studies investigating the relationship between ventilation methods during CPR and ROSC.

The primary aim of our study is to investigate the effects of manual ventilation with a bag-valve versus mechanical ventilation on ROSC during CPR. Secondarily, we compared the trends in lactate levels, which are considered a good indicator of perfusion adequacy during CPR, between the groups. To our knowledge, this is the first study in the literature that randomizes and compares ventilation strategies in patients with cardiac arrest.

MATERIALS and METHODS

Our study was conducted at the Emergency Medicine Clinic of Istanbul Fatih Sultan Mehmet Training and Research Hospital, Health Sciences University. This prospective, randomized study was carried out on patients with cardiac arrest, who were treated by emergency medicine specialists and residents working in our clinic, following ethical approval with decision no: 2019/21 and dated 14.11.2019.

According to the current AHA guidelines (1), the study included patients who presented with cardiac arrest to the hospital or developed cardiac arrest within the hospital and received ACLS with advanced airway management via endotracheal intubation. Patients under 18 years of age, those who were pregnant, patients who developed cardiac arrest due to trauma, those with incomplete assessment forms, and those whose arterial blood gas analyses could not be monitored were excluded from the study.

In the power analysis conducted using MedCalc Statistical Software version 19.6.4, the minimum number of participants required for each group was determined to be 15 (Type I error: 0.05, Type II error: 0.10, test power: 0.9). A total of 30 patients were included in the study. The patients were divided into two groups based on the ventilation method. In the mechanical ventilation group,

15 patients were ventilated using a mechanical ventilator, while in the manual ventilation with a bag-valve group, 15 patients were manually ventilated with a bag-valve. Patient selection was performed after randomization using a simple randomization method.

Patients who arrived at the hospital with cardiac arrest or developed cardiac arrest within the hospital were standardized and CPR was initiated by CPR providers trained in ACLS according to the latest AHA guidelines, with chest compressions at a rate of 100-120/min. Airway patency was then ensured through endotracheal intubation. The ventilation method for the patients was selected according to a predetermined randomization sequence. Patients included in the balloon-valve manual ventilation group were manually ventilated at a frequency of 10 breaths/min with standardization using the balloon-valve with serial number 06946430500000 (2018, China, Xiamen Compower Medical Tech. Co. Ltd.) by providers trained in ACLS according to the latest AHA guidelines. Patients in the mechanical ventilator group were ventilated in CPR mode using the 'eSeries e600®' (O-Two Medical Technologies Inc., 2018, USA) transport ventilator with closed triggering, Pmax: 60 cmH2O, frequency: 10/min, and a tidal volume of 6-8 ml/kg. The CPR mode of the device used in the study resembles the CMV and IPPV modes, where each breath is volume-controlled, and mandatory breaths are not triggered by spontaneous breaths.

The study was terminated once 15 patients meeting the inclusion criteria were recruited for each group.

Arterial blood gases and lactate levels were measured at the 0, 5, 10, 15, and 20-minute marks during CPR. The status of ROSC was recorded, including the duration if ROSC was achieved. The data collected was recorded on prepared forms by a physician who was not part of the resuscitation team and was observing the resuscitation.

Statistics Analysis

In summarizing the data obtained from the study, descriptive statistics were used. Continuous variables were presented as mean ± standard deviation or median with interquartile range, depending on the distribution. Categorical variables were summarized as counts and percentages. IBM SPSS Statistics 22 (IBM SPSS, Turkey) software was used for statistical analyses of the findings. The normality of data distribution was assessed using the Shapiro-Wilk test. Descriptive statistical methods (frequencies) were used to summarize the data. For comparisons of continuous variables with normal distribution between two groups, the Student's t-test was employed. For within-group comparisons of normally distributed parameters, repeated measures ANOVA was used, and the Bonferroni test was applied to identify periods causing differences. Significance was assessed at the $p<0.05$ level.

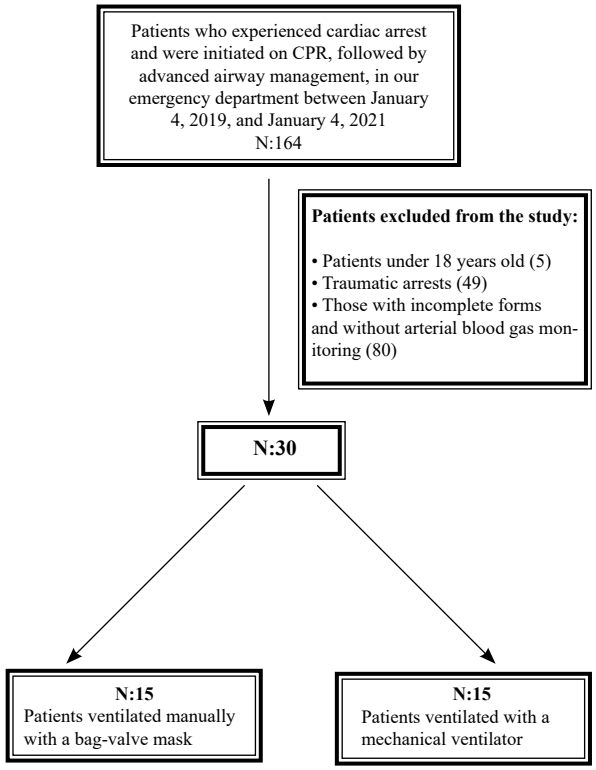

Figure 1: Flowchart

RESULTS

Our study examined a total of 30 patients between January 4, 2019, and January 4, 2021, categorized into two groups: 15 patients (50%) ventilated manually with a bag-valve mask and 15 patients (50%) ventilated with a mechanical ventilator. Among these patients, 24 experienced out-of-hospital cardiac arrest, while 6 had in-hospital cardiac arrest. Out-of-hospital cardiac arrest patients were those brought to the emergency department by emergency medical personnel from 112, who identified cardiac arrest at the scene, along with CPR. In-hospital cardiac arrest patients were those who developed cardiac arrest while being monitored in the emergency department. The mean age of the patients was 47.8, with 16 male and 14 female patients. CPR was applied for a minimum of 20 minutes.

The lactate levels of patients who achieved ROSC, the ventilation methods, and the times to ROSC are presented in Table 1. ROSC was achieved in 4 patients, and the method of ventilation used, the time to ROSC, and lactate levels at 0, 5, 10, 15, and 20 minutes are detailed in Table 1.

Table 1. Ventilation methods, time to ROSC, and lactate levels in patients who achieved ROSC

Patients with ROSC	Bag-Valve Group		Mechanical Ventilation Group	
	1st patient (76,M)		3rd patient (81,F)	
	2nd patient (68,M)		4th patient (65,M)	
	1st patient	2nd patients	3rd patients	4th patients
Time to ROSC	8 minutes	13 minutes	11 minutes	9 minutes
Lactate levels				
0 minute	16	7.6	13.3	14.5
5 minutes	18	9.4	11	14
10 minutes	14	12.5	11.4	15.3
15 minutes	10	11	9	13.1
20 minutes	7.7	13.4	8.2	11.2

ROSC: *Return of Spontaneous Circulation*

There is no statistically significant difference between the groups in terms of the number of patients who achieved return of spontaneous circulation (n1:2, n2:2, p:0.12).

There is no statistically significant difference in the average times to return of spontaneous circulation between the two groups (n1 (median):10, n2 (median):10.5, p>0.05).

There is no statistically significant difference in the delta values showing the lactate changes between 0 and 20 minutes in patients who achieved ROSC (p > 0.05).

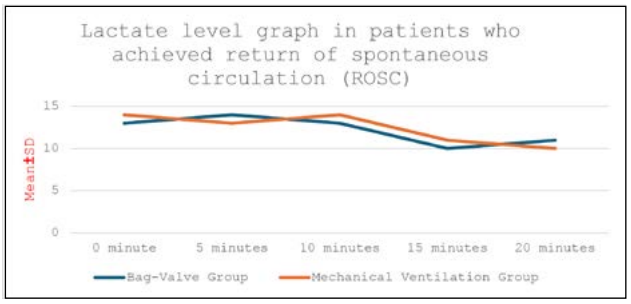

Figure 2. Lactate curves between 0 and 20 minutes in patients who achieved return of spontaneous circulation (ROSC), comparing the bag-valve group and the mechanical ventilation group.

In the group ventilated with a bag-valve, the lactate levels at 0 minutes were found to be statistically significantly lower than those in the mechanical ventilation group (p: 0.012; p < 0.05).

There is no statistically significant difference in lactate levels between the groups at 5 minutes, 10 minutes, 15 minutes, and 20 minutes (p > 0.05).

In the bag-valve manual ventilation group, there is a statistically significant difference in lactate levels between 0 minutes, 5 minutes, 10 minutes, 15 minutes, and 20 minutes (p: 0.006; p < 0.05). To determine which time point the significance originated from, pairwise comparisons showed that there was no significant change in lactate levels at 5 minutes compared to 0 minutes (p > 0.05), while the increases observed at 10 minutes, 15 minutes, and 20 minutes were statistically significant (p < 0.05). Compared to the lactate levels at 5 minutes, there were no statistically significant changes at 10 minutes, 15 minutes, and 20 minutes (p > 0.05). There were also no statistically significant changes in lactate levels at 15 minutes and 20 minutes compared to 10 minutes (p > 0.05). Finally, there were no statistically significant changes in lactate levels at 20 minutes compared to 15 minutes (p > 0.05) (Table 2).

In the mechanical ventilation group, there is a statistically significant difference in lactate levels between 0 minutes, 5 minutes, 10 minutes, 15 minutes, and 20 minutes (p: 0.012; p < 0.05). To determine which time point the significance originated from, pairwise comparisons revealed that there were no statistically significant changes in lactate levels at 5 minutes, 10 minutes, 15 minutes, and 20 minutes compared to 0 minutes (p > 0.05). The decreases observed in lactate levels at 10 minutes and 15 minutes compared to 5 minutes were significant (p < 0.05), while there was no statistically significant change at 20 minutes (p > 0.05). The decrease in lactate levels at 15 minutes compared to 10 minutes was significant (p < 0.05), but there was no statistically significant change at 20 minutes compared to 10 minutes (p > 0.05) (Table 2).

Table 2. Evaluation of lactate levels between and within groups

Lactate	Bag-Valve Group	Mechanical Ventilation Group	Total	p[1]
	Mean ± Standard Deviation (SD)	Mean ± SD	Mean ± SD	
0 minute	10,93±5,6	15,85±4,4	13,39±5,54	**0,012***
5 minutes	12,09±4,64	15,13±3,74	13,61±4,42	**0,059**
10 minutes	12,76±4,96	13,94±3,68	13,35±4,33	**0,465**
15 minutes	13,64±4,99	12,69±3,75	13,16±4,36	**0,559**
20 minutes	14,73±5,26	12,44±4,5	13,59±4,95	**0,210**
p[2]	**0,006***	**0,012***		
0 min-5 minp[3]	0,066	1,000		
0 min-10 minp[3]	0,020*	0,559		
0 min-15 minp[3]	0,049*	0,133		
0 min-20 minp[3]	0,020*	0,311		
5 min-10 minp[3]	1,000	0,048*		
5 min-15 minp[3]	0,580	0,005*		
5 min-20 minp[3]	0,121	0,092		
10 min-15 minp[3]	0,772	0,012*		
10 min-20 minp[3]	0,293	0,277		
15 min-20 minp[3]	0,383	1,000		

1Student t Test 2Repeated Measures Analysis of Variance (ANOVA) 3Bonferroni Test *p<0.05

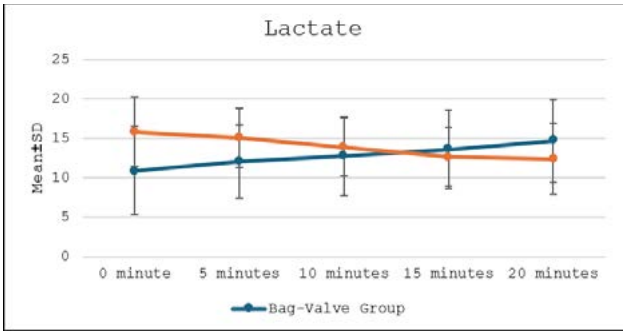

Figure 3. Lactate curves between 0 and 20 minutes in the bag-valve group and the mechanical ventilation group

The delta1 lactate values of the bag-valve manual ventilation group were found to be statistically significantly higher than those of the mechanical ventilation group (p: 0.032; $p < 0.05$). The delta2 lactate values of the bag-valve manual ventilation group were found to be statistically significantly lower than those of the mechanical ventilation group (p: 0.003; $p < 0.05$). The delta3 lactate values of the bag-valve manual ventilation group were also found to be statistically significantly lower than those of the mechanical ventilation group (p: 0.001; $p < 0.05$). There was no statistically significant difference between the groups in terms of delta4 lactate values ($p > 0.05$) (Table 3).

Delta1: Lactate change between 0-5 minutes
Delta2: Lactate change between 5-10 minutes
Delta3: Lactate change between 10-15 minutes
Delta4: Lactate change between 15-20 minutes

Table 2. Evaluation of delta values between groups

Lactate	Bag-Valve Group	Mechanical Ventilation Group	*Total*	p
	Mean±SD	Mean±SD	*Mean±SD*	
Delta1	1,16±1,41	-0,73±2,85	*0,22±2,41*	**0,032***
Delta2	0,67±1,74	-1,19±1,37	*-0,26±1,8*	**0,003***
Delta3	0,88±1,79	-1,25±1,2	*-0,19±1,85*	**0,001***
Delta4	1,09±1,85	-0,25±1,79	*0,42±1,91*	**0,055**

Student t Test **p<0.05*

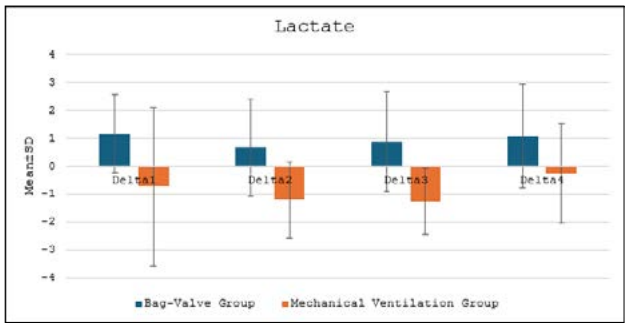

Figure 4. Lactate curves between 0 and 20 minutes in the bag-valve group and the mechanical ventilation group

DISCUSSION

In our study comparing mechanical ventilation and bag-valve manual ventilation in patients undergoing CPR, it was observed that the ventilation method had no effect on ROSC. Additionally, during CPR, lactate levels tended to decrease in patients receiving mechanical ventilation compared to those receiving manual ventilation. To our knowledge, our study is the first randomized controlled trial in the literature to investigate the relationship between ventilation method and ROSC in this patient group.

Bag-valve manual ventilation is a positive pressure ventilation method where the respiratory rate and tidal volume are determined by a healthcare provider using a bag-valve device. The bag-valve device is the most frequently preferred method due to its accessibility, low cost, and ease of application.

However, there are several disadvantages associated with the dependence on the operator. Studies have shown that the operator is unable to maintain a consistent frequency, that the frequency is often higher than intended, and that the correct frequency, pressure, and volume are related to the operator's experience or grip technique.

An increase in frequency can lead to hyperventilation, an increase in intrathoracic pressure, a reduction in venous return, and impaired cerebral perfusion, negatively affecting the achievement of ROSC (2,9,11).

Mechanical ventilation is a positive pressure ventilation method in which the frequency and tidal volume can be adjusted, and the targeted ventilation can be monitored and tracked. While it has been used for many years in operating rooms and intensive care units, today mechanical ventilators are also found in emergency departments in resuscitation rooms where ACLS interventions occur, as well as in ambulances with transport-type mechanical ventilators. Mechanical ventilators have two basic modes: pressure-controlled and volume-controlled, allowing effective and controlled ventilation after settings for frequency, tidal volume, flow rate, and trigger are adjusted according to the patient's needs.

In the current AHA resuscitation guidelines, there is no definitive recommendation regarding the method of ventilation, leaving the choice of ventilation method to the clinician. A survey conducted with 548 clinicians from 54 different countries investigated the preferred ventilation methods during CPR. It was found that bag-valve manual ventilation is the most commonly used method, although the use of mechanical ventilation is also preferred. The same study reported that clinicians who preferred mechanical ventilators most often favored volume-controlled modes; however, there was heterogeneity among clinicians regarding settings such as PEEP,

triggering, and FiO_2. Some clinicians reported that when using a mechanical ventilator during chest compressions, they frequently encountered issues such as low PaO_2, high pressure alarms, and high or low tidal volumes, leading them to switch to the bag-valve manual ventilation method (8).

In the literature review conducted, it was observed that studies on the use of mechanical ventilators and the definition of optimal settings during CPR have primarily been conducted using animal and artificial lung mannequin models.

In a study comparing the effectiveness of a turbine-driven ventilator with bag-valve manual ventilation, it was reported that in the artificial lung mannequin model, the bag-valve manual ventilation group exhibited significantly higher respiratory rates and tidal volumes, leading to hyperventilation, while the average duration of chest compressions was longer in this group (12). In our study, although the interruption duration of chest compressions was not recorded, it can be assumed that an additional person participating in chest compressions may have positively contributed to reducing this duration and improving ROSC.

In a study conducted on intubated pigs undergoing advanced cardiac life support (ACLS) after cardiac arrest, a ventilator mode developed to provide synchronized ventilation with chest compressions (Chest Compression Synchronized Ventilation, CCSV) was compared with the IPPV mode. The developed CCSV mode aimed to create an 'artificial cough resuscitation' by applying a brief positive pressure ventilation at the beginning of each chest compression. The study reported that this mode achieved higher PaO_2 levels than the IPPV mode (13).

In another study conducted on a CPR simulator, the effectiveness of different ventilator modes was investigated. The IPPV, BiLevel, and CCSV modes were compared, and it was reported that the target tidal volume and pressure were optimally achieved with the CCSV mode (14).

In a study conducted on pigs, different 'trigger' settings of the mechanical ventilator were compared during CPR, and it was reported that disabling triggering provided the most effective ventilation. In devices where the trigger settings were not disabled, similar positive effects were observed when the triggering was disabled with high pressure upper limits in pressure-triggered mode, suggesting that high-pressure triggering could be an alternative preference (15). The only human study reported in the literature regarding the use of mechanical ventilators in CPR was conducted in 2013 by Luo et al. in China with 40 patients (16). The patients were divided into two groups: one group received conventional tidal volume (8-12 ml/kg) with a pressure upper limit of 40 cmH_2O, while the other group received low tidal volume (6-7 ml/kg) with a pressure upper limit of 60 cmH_2O. Lactate, PaO_2, $PaCO_2$, and SaO_2 levels were compared between the two groups. It was reported that the group receiving low tidal volume had lower lactate levels and did not experience any barotrauma. In our study, a significant decrease in lactate levels was observed in the mechanical ventilation group as time progressed during CPR ($p < 0.05$). The lower lactate levels in the group where oxygenation was achieved more effectively suggest that the mechanical ventilation group in our study also had more effective oxygenation.

The CPR mode of the device we used has features such as no flow or pressure triggering, a fixed frequency, and a pressure upper limit of 60 cmH_2O, which have been reported in the literature to demonstrate effectiveness and superiority (13-16). Fixing the frequency helps protect the patient from hyperventilation and its negative effects, while the 60 cmH_2O pressure upper limit allows for the creation of the target tidal volume without causing barotrauma.

In our study, when examining the lactate levels at 0 minutes in the groups, the lactate level in the bag-valve manual ventilation group was found to be lower than that in the mechanical ventilation group (BV: 10.93 ± 5.6, MV: 15.85 ± 4.4) (p: 0.012; $p < 0.05$). This may be due to the earlier initiation of CPR in the bag-valve manual ventilation group, while the mechanical ventilation group had the presence of additional conditions that could lead to lactic acidosis.

As CPR progressed over the minutes, a significant increase in serum lactate levels was observed in the bag-valve manual ventilation group (p: 0.006; $p < 0.05$), while a significant decrease was noted in the mechanical ventilation group. Considering the previously mentioned disadvantages of bag-valve manual ventilation, the increase in lactate levels in this group is a result consistent with the literature, suggesting that effective oxygenation at the tissue level could not be achieved.

The most important limitation of our study is that, although traumatic arrests, pregnant women, and pediatric patients were excluded from the study, the homogeneity of the cardiac arrest etiologies between the groups could not be ensured, and subgroup analyses could not be performed due to the small sample size. Indeed, the difference in lactate levels at the 0-minute mark between the two groups suggests that a homogeneous distribution in terms of effective CPR, early intubation, intervention time, and administered medications was not fully achieved.

In undiagnosed cardiac arrests, it has not been possible to determine the duration of the arrest without CPR

support, as well as the duration and effectiveness of CPR performed prior to arrival at the emergency department. This situation is likely to have an impact on our results.

In patients receiving bag-valve manual ventilation, tidal volume measurements could not be performed, and a fixed individual could not be designated as the operator of the bag-valve manual ventilation. Therefore, standardization could not be achieved. Although this may appear as a limitation, it is one of the fundamental issues in manual bag-valve mask ventilation practices.

Although delta lactate levels were primarily examined in our study, it is possible that lactate levels may vary according to the underlying etiological causes.

Conclusion

To the best of our knowledge, our study is the first randomized controlled trial in the literature examining the relationship between the method of ventilation and ROSC in cardiac arrest patients. In patients undergoing CPR, mechanical ventilation and bag-valve manual ventilation were compared, and it was found that the ventilation method had no effect on ROSC. Furthermore, it was demonstrated that lactate levels tended to decrease in patients receiving mechanical ventilation compared to those receiving manual ventilation. Future studies in larger patient populations, where specific subgroups related to the causes of cardiac arrest can be identified, may provide clearer results regarding the effectiveness of ventilation methods.

Ethics Committee Approval: Ethical approval was obtained from the Ethics Committee of Erciyes University, Faculty of Medicine (Approval Date: 31.05.2023, Number: 2023/379).

Conflict of Interest: The authors have stated that there are no conflicts of interest associated with this study.

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Author Contributions: Concept – G.Y., M.,Ç.; Design - N.A.Y, B.B, M.A., N.T.; Materials – N.A.Y, B.B., M.A.; Data Collection and/or Processing – N.A.Y, M.A., N.T.; Analysis and/or Interpretation – N.A.Y, M.A.; Literature Review – N.A.Y.; Writing – N.A.

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