

# Cardiopulmonary resuscitation in parturients: Assessment of anesthesiologists' knowledge

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## Abstract

**Aim:** Cardiac arrest in pregnancy is one of the most challenging clinical scenarios. Correct intervention plays a crucial role in increasing the chance of survival of both the baby and the mother. In this study we aimed to evaluate knowledge about resuscitation of parturients among anesthesiologists.

**Materials and Methods:** A total of 356 anesthesiologists (162 anesthesiology residents, 146 anesthesiology specialists and 48 faculty member) were included in the study. The subjects of the study population were chosen among the anesthesiologists with various levels of experience who attended to national anesthesia meetings that were held from January 2015 to December 2015 in Turkey. The assessment was based on a questionnaire containing 10 questions and questions were designed to draw out knowledge deficiencies in critical areas of cardiopulmonary resuscitation in parturients.

**Results:** There was a significant correlation between the age and the total score ( $r=0.198 / p=0.000$ ). Concerning the effect of the occupational title, we found that the total score of the specialist group was significantly higher than that of the resident group ( $p=0.001$ ). There was no correlation between the total score and having a CPR experience in parturients.

**Conclusion:** The results of our study indicate that there is a lack of knowledge about the CPR in parturients in Turkey. Therefore education programs about the management of cardiac arrest and CPR in parturients should be planned and repeated on a regular basis.

**Keywords:** Anesthesiologists' knowledge; Cardiopulmonary resuscitation; parturients

## INTRODUCTION

Due to the rare occurrence of cardiopulmonary arrest in parturient, the acquaintance with its management is little when compared to other patient groups. Anatomical and physiological alterations of pregnant women require modified algorithms that are constituted for cardiopulmonary resuscitation (CPR) in general. Despite the implementation of guideline-based required modifications, the practice and teaching needs of the medical staff to be monitored in order to achieve better outcomes.

Maternal death is considered as a developmental index worldwide (1). Cardiac arrest related death is the major cause of maternal mortality in developed countries, whereas birth related complications such as infections and bleeding are more frequent causes of mortality in developing countries (2). Maternal mortality is defined as the death of a woman during pregnancy and up to 42 days after delivery or termination of pregnancy, provided that the cause of death is related to or aggravated by the pregnancy or its management. Recent data from the US Nationwide

Inpatient Sample suggest that cardiac arrest occurs in 1:12000 admissions for delivery (3). Globally, 800 deaths occur daily, with a large variation between the countries (4). Cardiac arrest in pregnant women can be seen sporadically particularly in young and healthy women. Amniotic fluid or pulmonary embolism, eclampsia, magnesium sulfate overdose, anesthesia-related complications, lower urinary tract sepsis, cardiomyopathy, and acute hemorrhage can be listed as possible causes of cardiac arrest in pregnancy. It is a known fact that the current data on resuscitation of pregnant women were obtained from case series, expert opinions, and the practices on non-pregnant individuals, since the establishment of a conventional randomized study is impractical and unethical. On the other hand, limited knowledge on the matter and poor resuscitation skills could be major contributors to adverse outcomes once a cardiac arrest has occurred (3).

The aim of our study was to evaluate the knowledge level of attending anesthesiologists, anesthesiology residents, and faculty members with regard to CPR in pregnant women.

**Received:** 04.09.2020 **Accepted:** 01.12.2020 **Available online:** 26.01.2021

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## MATERIALS and METHODS

This study was approved by the Institutional Ethics Committee of the Uludag University Faculty of Medicine. (Ethics Committee Number: 2014-19/19)

The 10-question survey (Appendix 1) was developed based on the 2015 European Resuscitation Council (ERC) CPR guidelines and the Society for Obstetric Anesthesia and Perinatology Consensus Statement on the management of cardiac arrest in pregnancy with the purpose to investigate the knowledge level of anesthesiologists on cardiopulmonary resuscitation of pregnant women (5, 6).

The subjects of the study population were chosen among the anesthesiologists with various levels of experience who attended national anesthesia meetings that were held between January -December 2015 in Turkey. A total of 356 anesthesiologists (162 anesthesiology residents, 146 anesthesiologists, and 48 faculty members) were included in the study. Since all subjects were anesthesiologists, they were considered to be given formal CPR training before they were involved in the survey. The written questionnaires were distributed by the anesthesiology residents to the study population in the meeting area and were collected after ten minutes. The aim of the study was explained at the title of the written questionnaire. The identities of the subjects were kept confidential.

Age, gender, occupational experience, CPR experience, and titles were recorded. A total of ten questions were included in the study about the CPR in the parturient. In the questionnaire the participants were asked if they have had an experience of maternal CPR, if they were aware of the main reasons of maternal cardiac arrest, interventions in maternal CPR, ventilation support during the CPR, aortocaval compression, the optimum angle that the patient needs to be laid down to her left side, the factors that affect the viability of the fetus, the timing about the perimortem cesarean section and whether they were aware of the indications of manual uterine maneuver (Appendix 1). Each question was valued with 10-points in case of a correct answer. The maximum and minimum score of the questionnaire were 100 and 0 points, respectively. Correlation between the total score and age, CPR experience, and the occupational experience were assessed.

### Statistical analysis

The mean value, standard deviation, median, the lowest and highest frequency and ratio values were used in the descriptive analysis of the data. The distribution of the variables was tested by the Kolmogorov-Smirnov test. Kruskal-Wallis and Mann-Whitney U tests were used in the analysis of the quantitative data. Spearman's Correlation Analysis test was used for testing the correlation between the study variables. SPSS 22.0 software (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp) was used for statistical analysis.  $p < 0.05$  was considered as statistically significant.

## RESULTS

Of the 450 questionnaire forms distributed, 356 were returned within 10 minutes following the initiation of the survey. Those forms were filled by 356 participants where 45.5% consisted of anesthesiology residents, 41% anesthesiology specialists, and 13.5% were faculty members.

The lowest and highest values, median and mean values alongside the standard deviation concerning age, occupational seniority and duration, maternal CPR experience and total points obtained in the evaluation of the survey were shown in Table 1.

**Table 1. The lowest and highest values, median, average and standard deviation concerning age, duty, occupational period, maternal CPR experience and obtained total points in the survey**

	Min-Max	Median	Average		n (%)
			± SD	n (%)	
<b>Age (years)</b>	23.0 - 62.0	34.0	35.6 ± 7.6		
<b>Duty</b>					
Resident				162 (45.5%)	
Specialist				146 (41.0%)	
Faculty Member				48 (13.5%)	
<b>Occupational Period (years)</b>	0.0 - 27.0	4.0	6.5 ± 6.0		
<b>CPR Experience</b>					
No experience				45 (12.6%)	
Once				55 (15.4%)	
Twice				256 (71.9%)	
<b>Total Score</b>	0.0 - 95.0	45.0	47.7 ± 20.7		

The highest ratio of the correct answers were 71.5% for the question on what angle should the parturient be laid down at the left lateral position during CPR; 57.2% for the question on the initial drug administration if the patient has been receiving magnesium during the prearrest period; and 55.1% for the element questioning three of the causes of maternal cardiac arrest using the 'BEAU-CHOPS' mnemonic.

The highest ratio of the inaccurate answers were 75.5% for the question on the probability of aortocaval compression depending on gestational age; 67% for the question on what is wrong to do during maternal CPR; and 63.5% for the reason for preference of manual uterine maneuver instead of left lateral positioning.

The mean age was calculated as  $35.6 \pm 7.6$  years. A positive correlation ( $r=0.198 / p=0.000$ ) was found between age and the total score. No correlation was present ( $r=0.133 / p=0.104$ ) between the occupational duration and the total score Table 2.

**Table 2.** The r and p correlation values of age and the occupational period with the total score obtained by the Spearman Correlation Test

		Age (years)	Occupational Period (years)
Total Score	r	0.198	0.133
	p	<b>0.000</b>	0.104

When the effect of maternal CPR experience on the total score was analyzed, it was determined that maternal CPR experience had no significant effect on the total score ( $p=0.081$ ). Concerning the effect of the occupational seniority, we found that the total score of the specialist group was significantly higher than that of the resident group ( $p=0.001$ ). Among the groups studied, specialists scored highest overall with a median score of 55 points. Faculty members had a median score of 45 points and the total score of the group consisting of faculty members was not significantly different when compared to the specialist and the resident groups ( $p > 0.05$ ). The distributions of the total scores concerning the working position and the maternal CPR experience were shown in Table 3.

**Table 3.** The distributions of the total scores concerning the position of the duty and the maternal CPR experience

	Total Score			p
	Min-Max	Median	Average $\pm$ SD	
<b>Occupational title</b>				
Resident	0-85	40	43.2 $\pm$ 20.1	
Specialist	0-95	55	52.7 $\pm$ 19.6	<b>0.001</b>
Faculty Member	0-90	45	47.8 $\pm$ 23.6	
<b>CPR Experience</b>				
No experience	0-80	50	48.8 $\pm$ 21.2	
Once	10-95	55	53.2 $\pm$ 22.5	0.081
Twice	0-90	45	46.4 $\pm$ 20.1	

## DISCUSSION

Maternal cardiac arrest is a complex clinical scenario and resuscitation of the pregnant woman involves multi specialties and complex care decisions. Cardiac arrest during pregnancy can be encountered in emergency services, in delivery rooms or in the operating theatre. Furthermore, pregnant women also carry the risk of cardiac arrest as the women of a similar age group, due to external reasons such as trauma, anaphylaxis, drowning, and intoxication. Since a cardiac arrest is a rarely encountered situation in pregnant women, medical professionals often possess limited experience concerning its management (7).

In our study, the mean score was calculated as  $47.7 \pm 20.7$  points on a maximum score of 100 points. This result indicates that there is a lack of knowledge about this

particular subject. Similarly; in a study conducted on 200 Canadian anesthesiologists via an online questionnaire, more than half of the participants selected the wrong answers that would have lead to higher mortality ratios (8).

Although most features of resuscitating a pregnant woman are similar to standard adult resuscitation, several aspects and considerations are uniquely different. The most essential difference is the fact to intervene with two patients, the mother, and the fetus. In addition, well-known physiological alterations, increased cardiac output, ventilation, oxygen consumption and compression of the uterus on the major vessels, particularly in the late periods of pregnancy might complicate the CPR process. The members of the resuscitation team should be well-trained and optimally be aware of the specific intervention methods that need to be used in these patients in order to make an efficient resuscitation.

The mortality rate of cardiac arrest in parturients is high, and the management of CPR in these patients is quite challenging. Given the rareness of the situation, physicians with former experience of CPR in parturients can be expected to have a higher level of knowledge. In contrast, there was no significant difference even in physicians with more than one experience of CPR in parturients. It is also expected physicians with longer job experience would possess a higher knowledge of CPR in parturients. In our study, anesthesiology specialists had a significantly higher total score compared to residents. A significant correlation was found between the total score and age. Therefore we can assert that anesthesiologists with a higher occupational experience are much more likely to have a better level of knowledge.

Education of the anesthesiologists on CPR of parturients is crucial since there are important differences compared to CPR of the normal adult population. Although CPR in pregnant women is a part of anesthesiology training, it is very critical to repeat this education program with the data from recent reports and guidelines. In a report about the confidential inquiry into maternal deaths in the United Kingdom; the knowledge of healthcare professionals were considered as poor in a considerably high number of cases (9). In another study, it was indicated that more than 50% of the patients could have been survived if adequate and correct treatments had been applied on time by health professionals (10). The most important reasons for substandard care were listed as misdiagnosis, wrong and ineffective treatment. Hence, in their current guideline, Royal College of Obstetricians and Gynaecologists recommend that all frontline, emergency medicine and anesthesiology staff should undergo training at least annually for the management of maternal collapse in pregnancy. Although data on the optimum number of the trainees per course time is not clear, evidence supports small group of applicants for each training session (11).

One of the most important results of our study was that the mean total score of faculty members was not significantly

different from that of anesthesiology specialists and residents. Since the faculty members are the responsible physicians who educate medical students and future anesthesiologists, it is expected that they would score a higher grade. However, their total score obtained was not significantly different from that of the anesthesiology residents and specialists. It is also possible to address the lack of knowledge of faculty members as one of the main reasons for an inadequate level of knowledge of anaesthesiologists and residents. On the other hand, theoretical and practical conditions often vary, and being in the field of practice might yield more knowledge on the matter. Although faculty members are expected to present and provide adequate education to future anesthesiologists and medical students about CPR in parturients, residents and specialists are the physicians deal with the on-hand practice of situations in particular. Furthermore, this group of physicians is more prone to learning, with their career-based future strategies, and easier access to online sources.

In our study, the highest ratio of correct answers in the questionnaire was on the angle of the patient or the tilting operating table during maternal CPR, drugs of choices on special circumstances, and causes of the maternal cardiac arrest. The questions mostly answered incorrectly were on the aortocaval compression of the uterus during pregnancy, precautions during the maternal CPR and manual maneuver of the uterus. These data suggest that the theoretical knowledge of CPR in the pregnancy was superior to the practical experience. Thus, the questions on the similarities of maternal CPR to the unpregnant adult individuals were answered more correctly. However, while the peri-resuscitation factors have been questioned, incorrect answers accounted for the majority, possibly due to a lesser experience on this specific patient population.

Anesthesiologists are expected to be the most knowledgeable physicians about the CPR in pregnant women. However, since the arrest in parturients can be encountered not only in the delivery room but also in the home or emergency room, other physicians such as emergency medicine specialists or general practitioners also often perform CPR on these patients. Therefore, the knowledge level of this group of physicians is also important. The studies assessing the knowledge levels of physicians reveal that physicians including emergency medicine, gynecology and obstetrics, and anesthesiology specialties lack a sufficient level of knowledge about CPR in pregnant women (7, 12). These results show us the necessity of education of all physicians about the CPR in pregnant women. Cohen et al. assessed the knowledge about CPR of pregnant women among anesthesiologists, obstetricians and emergency service specialists, and among the groups of interest, anesthesiologists scored highest overall. However, emergency service specialists had the most correct answers in the advanced cardiac life support category (13). This variation might be a

consequence of the highly exceptional nature of the condition, and CPR in pregnant women remains a specific subject matter.

A detailed question about the perimortem cesarean section was also included in the questionnaire. The knowledge level of the participants was found similar regarding this question. Perimortem cesarean section might be decided in order to improve the survival chance of both the baby and the mother. Removing the placenta in the perimortem caesarean reduces the pressure to the major vessels in the abdomen, improving cardiac venous return and circulation. Furthermore, oxygen demand is also decreased with the removal of the fetus and placenta. Although it is a challenging situation to decide to perform perimortem fetal delivery, it can be a lifesaving intervention in certain cases and recommended to perform if hemodynamic stability cannot be restored within 5 minutes after the cardiac arrest for the fetuses within 24-25 weeks of age (14). The most important parameter in terms of the chance of survival of the baby seems to be the gestational age. The survival rate of the baby after perimortem cesarean was reported as 0%, 21%, 30%, 50%, 75%, 80% and 90% for 21st, 22nd, 23rd, 24th, 25th, 26th, and 27th gestational ages, respectively (15). Therefore, the gestational age is suggested as an important factor in deciding for a perimortem cesarean section. It was also reported that the survival rates are increased for the fetuses within 30-38 weeks of gestational age, and delivery after more than five-minutes following the cardiac arrest of the mother is possible in these cases.

Identification of the underlying reason for cardiac arrest is also essential in order to manage the best possible intervention for the patients. Postpartum hemorrhage due to placental or uterine conditions are among the mostly encountered reasons for cardiac arrest in pregnancy, thus a highly-experienced team of obstetricians and neonatologists are required as well as a well-prepared blood bank for the restoration of blood cells and plasma during and after the CPR. Obstetricians are an essential part of the resuscitation team, in case an emergency hysterectomy is required, which is a life-saving option for the mother at a gestational age of 20–23 weeks, and both mother and the baby with a gestational age of older than 24–25 weeks.

Early tracheal intubation of the patients should be also considered, and it should be recognized that gastroesophageal sphincter insufficiency is prevalent in the late periods of pregnancy, and airways are narrower compared to a woman of similar age. Thus, the utilization of appropriate types of equipment and proper knowledge of the intubation in pregnancy is also crucial.

Despite depending on the factors implemented in the current guideline, our study has several limitations to declare. First, we did not classify the anesthesiologists depending on their subspecialty. Specialization in one

particular subject might be the reason for a lack of knowledge in other practices. Secondly, although the survey forms were collected from the annual meetings during the entire 2015, the knowledge of physicians to date might have changed during this period. However, the data presented herein is similar in most aspects to the presented data worldwide. On the other hand, a future comparative study on the knowledge levels of physicians within a determined period would yield a more efficient data on the subject.

## CONCLUSION

In conclusion, the management of cardiac arrest in parturients is a challenging entity and shows important differences in comparison to the normal population. Early intervention and following correct treatment guidelines are crucial in order to increase the survival of both the baby and the mother. However, physicians are not adequately educated and trained on CPR in parturients since it is a rare condition. According to the findings of our current study, we can conclude that the knowledge level of anesthesiologists on CPR in parturients is not necessarily high enough to ensure optimal results for the patients. Therefore, education programs about this topic should be planned and repeated frequently.

*Conflict of interest : The authors declare that they have no competing interest.*

*Financial Disclosure: There are no financial supports.*

*Ethical approval: This study was approved by the Institutional Ethics Committee of the Uludag University Faculty of Medicine. (Ethics Committee Number: 2014-19/19).*

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