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ORIGINAL ARTICLE

Complications of cardiopulmonary resuscitation in non-traumatic cases and factors affecting complications

Umit Kaldırım [a], Mehmet Toygar [b], Kenan Karbeyaz [c,*], Ibrahim Arzıman [a], Salim Kemal Tuncer [a], Yusuf Emrah Eyi [a], Murat Eroglu [d]

[a] *Gulhane Military Medical Academy, Emergency Medicine, Ankara, Turkey*
[b] *Gulhane Military Medical Academy Forensic Medicine, Ankara, Turkey*
[c] *Council of Forensic Medicine, Eskisehir, Turkey*
[d] *Gulhane Military Medical Academy, Haydarpasa Training Hospital, Emergency Medicine, Istanbul, Turkey*

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Abstract In this study, bodily injuries related to chest compression were examined in non-traumatic death cases that underwent autopsy. This study aimed to evaluate factors that can affect these injuries.

Data were collected retrospectively, and injuries related to chest compression during cardiopulmonary resuscitation were determined over a 10-year period. Age, gender and cause of death were determined, and when cardiopulmonary resuscitation was performed, cardiopulmonary resuscitation duration, intubation and the injury that occurred due to chest compression were also determined.

The study included data from 203 cases. The most frequent injuries were a single fracture in the left ribs (19.7%). Only the duration of cardiopulmonary resuscitation was determined to be associated with injuries. Ventricle rupture in 1 case and liver laceration in 2 cases were the most significant injuries.

It has been shown that during cardiopulmonary resuscitation, severe injuries can occur due to thoracic compression. Only a positive correlation with the duration of cardiopulmonary resuscitation was found in our study.

* Corresponding author.
E-mail addresses: umitkaldirim@hotmail.com (U. Kaldırım), mehmetoygar@gmail.com (M. Toygar), drkenankarbeyaz@hotmail.com (K. Karbeyaz), ibrahimarz@hotmail.com (I. Arzıman), salimkemaltuncer@hotmail.com (S.K. Tuncer), dremraheyi@yahoo.com (Y.E. Eyi), drmeroglu@yahoo.com (M. Eroglu).

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1. Introduction

The importance of the quality and number of chest compressions applied during cardiopulmonary resuscitation (CPR) is emphasized in current CPR guides. For effective CPR, 30 unit compressions should be implemented to depress the rib cage

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4–5 cm and should be repeated every 15–18 s.[1] Depending on these compressions, several injuries ranging from simple ecchymosis in tissues and organs of the chest to life-threatening myocardial rupture/laceration may occur.[2,3] In bone structures and soft tissue, costal fractures are the most frequently seen injuries.[3] These injuries that may occur during CPR have been determined with various radiological imaging techniques (radiography, computed tomography (CT), magnetic resonance imaging (MRI)) and autopsy studies.[4,5] Some studies have found that as age and CPR duration increase, the frequency and number of injuries may also increase.[6] The presence of other factors that may affect the occurrence of these injuries remains unclear. In addition, it is important to determine whether these injuries are life-threatening and what factors cause an increase in the risk of life-threatening injuries. In this study, injuries that occurred related to CPR were determined from the autopsy results of non-traumatic cases where CPR had been performed. The presence of a probable relationship was examined between the injuries and factors such as age, gender, CPR duration, CPR performed before arriving at the hospital and advanced airway usage. We also aimed to review whether these injuries have a life-threatening effect and to determine what the effect of the above mentioned factors is on life-threatening injuries.

2. Material and methods

This study was a cross-sectional survey, and data were collected retrospectively. Data from cases that underwent autopsy in the Institution of Forensic Medicine over a 10-year period, between January 1, 2003 and December 31, 2012, were evaluated. Cases were excluded from the study if the cause of death was associated with force or trauma. The study initially included 245 non-traumatic death cases that had undergone CPR. Forty-two cases with insufficient data were excluded from the study, leaving a total of 203 cases from hospital files and emergency team records for evaluation. Age, gender and cause of death were determined, and when CPR was performed, CPR duration and the injury that occurred due to chest compression were also determined. Life-threatening injuries were determined and evaluated using the guideline "Evaluation of injury crimes with regards to forensic medicine defined in Turkish Criminal Law" which is based on the Abbreviated Injury Scale (AIS).[7] AIS is a guide that is used to analyze the threat to life of individual injuries. According to this guide, an injury that creates a life risk is assessed to determine whether the injury has the potential to endanger the patient's life rather than being a concrete life risk. Data were analyzed using the SPSS 15.0 software program. Values are expressed as number, percentage and mean ± standard deviation. *T*-test was used in the comparison of continuous variables, and the Chi-square test was used for the comparison of discrete variables. Logistic regression analysis was performed to determine the factors affecting complications. A value of $p < 0.05$ was considered statistically significant.

3. Results

Data of 203 non-traumatic death cases that underwent autopsy were analyzed. The cases included 143 males (70.4%) and 60 females (29.6%), with an average age of 47.1 ± 17.1 years (range of 17–78 years). The most common cause of death was found to be causes associated with cardiovascular disease (Table 1). No injury associated with the application of CPR was determined in 116 cases. A single fracture in the left ribs was determined in 40 cases, multiple fractures in the left ribs in 37 cases and left rib fractures with sternum fractures in 10 cases (Table 2).

When demographic data were analyzed, no statistically significant difference was found between male and female individuals in terms of injury ($p = 0.183$). There was also no statistically significant difference between the groups with injury and without injury in terms of mean age ($p = 0.798$). A total of 133 cases were intubated with advanced airway (endotracheal tube), and 70 cases were not intubated. There was injury in 40.6% ($n = 54$) of intubated cases and 47.1% ($n = 33$) of non-intubated cases. When the data from the two groups were compared, there was no statistically significant relationship associated with compression between the intubation process and thorax injuries ($p = 0.371$). CPR was performed in 90 cases before arriving at the hospital and in 113 cases in the hospital. Injury was detected in 47.8% ($n = 43$) of the group that received CPR before arriving at the hospital and in 38.9% ($n = 44$) of the group that received CPR in the hospital. No statistically significant difference was found between the two groups ($p = 0.206$). Compression was performed for 0–30 min in 46 cases, 31–60 min in 90 cases and ⩾61 min in 67 cases. Injury occurred in 23.9% ($n = 11$) of the 0–30 min CPR group, 23.9% ($n = 11$) of the 31–60 min CPR group and 55.2% ($n = 37$) of the ⩾61 min CPR group. A statistically significant relationship was determined between CPR duration and injury ($p = 0.004$). As a result of logistic regression analysis on the factors of age, gender, place of CPR implementation, forward airway method and CPR duration, only CPR duration was determined to have an effect on the occurrence of injury. In cases with 31–60 min of CPR, the odds ratio (OR) was calculated as 2.953 (95% CI: 1.283–6.796), and in cases with ⩾61 min of CPR, the OR was 6.117 (95% CI: 2.270–16.486) compared to cases with ⩽30 min of CPR (Table 3). According to the reports evaluated by forensic medicine specialists, 19.2% ($n = 39$) of cases had a life-threatening injury. Left ventricle rupture in 1 case was the most significant of these injuries. This case was a 67-year-old female who died due to cerebral hemorrhage, and she had a history of hypertension, myocardial infarction and osteoporosis. CPR was applied for 60 min by the doctors in the intensive care unit (ICU). The patient had a laceration with 0.7 × 1 cm breadth and 0.8 cm depth in the apex of the left ventricle. In the myocardia sections, old microscopic infarct areas were partly observed by the laceration region. Segmental multiple fractures between 3 and 6 ribs, including the fourth rib,

Table 1 Causes of death.

Causes of death	*n*	%
1. Cardiovascular disease	80	39.4
2. Pathological brain hemorrhage	53	26.1
3. Medical drug poisoning	24	11.8
4. Pesticide poisoning	13	6.4
5. Cancer	12	5.9
6. Other	21	10.3