



Clinical paper

The impact of post-resuscitation feedback for paramedics on the quality of cardiopulmonary resuscitation[☆]



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ABSTRACT

Purpose: The Guidelines place emphasis on high-quality cardiopulmonary resuscitation (CPR). This study aims to measure the impact of post-resuscitation feedback on the quality of CPR as performed by ambulance personnel.

Materials and methods: Two ambulances are dispatched for suspected cardiac arrest. The crew (driver and paramedic) of the first arriving ambulance is responsible for the quality of CPR. The crew of the second ambulance establishes an intravenous access and supports the first crew. All resuscitation attempts led by the ambulance crew of the study region were reviewed by two research paramedics and structured feedback was given based on defibrillator recording with impedance signal. A 12-months period before introduction of post-resuscitation feedback was compared with a 19-months period after introduction of feedback, excluding a six months run-in interval. Quality parameters were chest compression fraction (CCF), chest compression rate, longest peri-shock pause and longest non-shock pause.

Results: In the pre-feedback period 55 cases were analyzed and 69 cases in the feedback period. Median CCF improved significantly in the feedback period (79% vs 86%, $p < 0.001$). The mean chest compression rate was within the recommended range of 100–120/min in 87% of the cases in the pre-feedback period and in 90% of the cases in the feedback period ($p = 0.65$). The duration of longest non-shock pause decreased significantly (40 s vs 19 s, $p < 0.001$), the duration of the longest peri-shock pause did not change significantly (16 s vs 13 s, $p = 0.27$).

Conclusion: Post-resuscitation feedback improves the quality of resuscitation, significantly increasing CCF and decreasing the duration of longest non-shock pauses.

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Introduction

The Guidelines of 2010 (and onward) emphasize the importance of high-quality cardiopulmonary resuscitation (CPR).^{1,2} High quality CPR involves optimal compression depth and rate, avoiding leaning on the chest and minimizing interruptions of compressions for pre-shock rhythm analysis and charging, post-shock pauses and pauses for other measures such as intubation. Many pauses cannot be explained by mandated Advanced Life Support (ALS) activities but should be avoided as well.

Several studies of the quality of CPR as performed in hospitals and by emergency medical services (EMS), found that providers

often did not perform CPR up to the standards for recommended rate, depth and minimizing pauses in chest compressions.^{3–5} A resuscitation attempt involves a complex set of actions and has to be carried out by multiple rescuers, often under suboptimal conditions. It is perhaps not surprising that providers not always perform CPR according to the standards because of these difficult conditions. Efforts to improve CPR performance by the use of real-time feedback of chest compression rate and depth have demonstrated improvements in CPR quality but did not yield improvements in clinical outcomes.^{6–8} Post-resuscitation feedback involves the evaluation of written run-reports, but also of the recorded tracings from the EMS defibrillator that offers objective data of crew performance.^{9–12} Such post-resuscitation feedback is costly in terms of personnel involvement but could be justified as part of a program if it indeed results in quality improvement.

We studied the impact of post-resuscitation feedback on the quality of CPR performed by EMS personnel in the setting of a Dutch ambulance system.

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Table 1
Patient characteristics.

	Pre-feedback period	Feedback period	P-value	Missing
Number of cases, n	55	69		
Age, mean (SD)	68 (17)	66 (17)	0.54	0 (0)
Male, n (%)	39 (71)	48 (70)	0.87	0 (0)
Shockable initial rhythm, n (%)	13 (24)	22 (32)	0.31	0 (0)
AED used, n (%)	20 (36)	33 (48)	0.20	0 (0)
Survival, n (%)				
Admission to hospital	22 (42)	32 (46)	0.59	2 (2)
Survival to discharge	8 (15)	14 (20)	0.43	1 (1)

AED = automatic external defibrillator.

Method

Setting

The study took place in the southern region of Amsterdam. This area covers approximately 121 km² and has a population of 157,443 people. The study group were ambulance crews (17 paramedics and 17 drivers) of a single operational unit, part of EMS Amsterdam and who attend most of out-of-hospital cardiac arrests (OHCA) occurring in this area.

EMS system in the study region

When the EMS dispatcher suspects an OHCA during an emergency call, the dispatcher sends out two ambulances from a single ALS tier and first responders (mostly firefighters/policemen) with an automated external defibrillator (AED). Ambulance personnel is equipped with a manual defibrillator (LIFEPAK 12, Physio-Control, Redmond, WA) and qualified to perform ALS according to the Guidelines of the European Resuscitation Council.¹³

Lay-rescuer CPR and AED takeover

The crew (driver and paramedic) of the first arriving ambulance is in the lead. If first responders are already performing CPR, they are requested to continue chest compressions, enabling the ambulance crew to perform other ALS related activities, but also to monitor the CPR quality. The crew of the second ambulance establishes an intravenous access and supports the first crew.

The Dutch Resuscitation Guidelines recommend in case of a connected AED, to leave the AED connected until after the next rhythm analysis and a defibrillation shock if required.¹⁴

Data collection and storage

The Medical Ethics Review Board of the Academic Medical Center in Amsterdam approved the study and gave a waiver for the requirement of informed consent as only routinely collected data were analyzed.

The study was performed within the framework of the Amsterdam RESuscitation STUDies (ARREST). The ARREST study collects data from all resuscitation cases and is an ongoing, prospective registry of all-cause OHCA in the North-Holland province of the Netherlands. EMS personnel sends all continuous recordings of EMS defibrillators to the study center by Lifenet (Physio-Control, Redmond, WA, USA). If an AED is used, ARREST personnel visits the AED site shortly after the OHCA, and collects the AED data using AED specific software and stored and analyzed them with dedicated software. Clock drift from all AEDs is also corrected to standardized times for each ECG at the moment of data download. Data concerning the CPR process are collected according to Utstein recommendations¹⁵ with a pre-specified set of questions

that ambulance staff are required to answer and by retrieving EMS defibrillator data of the event.

All ECG recordings of resuscitations in the study region were reviewed with CodeStat 9.0 software (Physio-Control Inc., Redmond, WA, USA) and annotated by the research paramedics of the study region (EB and HV). If an AED was connected before ambulance arrival, the AED information was also reviewed.

Study period and data analysis

All recordings made between September 2011 and September 2014 were annotated for initiation and termination of a compression period, return of spontaneous circulation (ROSC), and to correct possible errors in the automatic annotation of chest compressions. The twelve months period (September 2011–August 2012) before introduction of post-resuscitation feedback was retrospectively annotated and compared with the 19-months period (March 2013–September 2014), after excluded a six months run-in interval (September 2012–February 2013) after introduction of post resuscitation feedback.

Recordings were reviewed on screen and discussed with the attending crew of the first arriving ambulance. We linked resuscitation data to individual ambulance crews and as a result could analyze individual performance. Feedback was given based on objective measurements of the ECG with impedance signal that permitted quantification of the duration of each pause in chest compressions. Quality parameters were chest compression fraction (CCF, defined as percentage of the total time with chest compressions), chest compression rate, longest peri-shock pause, in accordance with the 2010 Guidelines.² We added the longest non-shock pause as a quality parameter, as this has proven to be independent associated with survival.¹⁶ It also includes evaluating the moment of transition from the AED to the manual defibrillator as described in the ambulance Guidelines. Intubation could not be assessed because the moment of the intubation attempt was not marked on the recording.

Statistical analysis

Statistical analysis was performed with standard software (SPSS for Mac, version 20, IBM SPSS Inc.). Continuous data were summarized as means and standard deviation (SD) or medians with 25th and 75th percentiles. Comparisons were performed using Student's t-test for parametric data, the Mann-Whitney U test for non-parametric continuous data, and the chi-square statistic for proportions.

Results

During the study period, Amstelveen EMS attended 164 cases of OHCA as the first arriving ambulance crew. Due to a missing impedance signal, 16 cases could not be analyzed and 8 because

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