13.4.1 - Management of Out-of-Hospital Cardiac Arrest

Automated external defibrillator delivery by a drone in a mountainous region to treat sudden cardiac arrest

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Funding Acknowledgements: Type of funding sources: Private company. Main funding source(s): ZOLL

Introduction: Out-of-hospital cardiac arrest (OHCA) poses a tough medical challenge with poor survival rates. Factors that may enable survival include resuscitation measures initiated by a bystander, early use of an automated external defibrillator (AED), and further performance of advanced life support. The latter will arrive on scene with an inevitable time-delay due to logistics challenges and potential AED unavailability, especially in rural areas. Here, drones might deliver an AED in order to increase the probability of survival.

Methods: Ten paramedics and nineteen medical laypersons were confronted with a person suffering from OHCA within a field test scenario in a mountainous region (Bodental, Carinthia, Austria) without detailed information. The scenario included a mock-call to the emergency response center responsible for the Austrian State Carinthia that dispatched a semi-autonomously flying drone towards the caller's GPS coordinates. During the emergency call, participants should perform cardiopulmonary resuscitation (CPR) measures and were informed that a drone delivers a training-AED. Various timepoints (time to (tt) emergency call, tt start CPR, tt drone start, tt first shock, hands-off times) as well as CPR quality were subject of analysis.

Results: The paramedics realized the cardiac arrest after 21 ± 11 seconds, the emergency call was performed after 40 ±43 seconds, the drone started after 5:15 ± 2:11 minutes and dropped off the AED after 10:52 ± 2:06 minutes, and the first shock was delivered after 12:15 ± 2:03 minutes. 70 % performed adequate chest compressions and 50 % provided sufficient mouth-to-mouth ventilation. Hands-off times were 50 ± 22 seconds. Only 37 % of the medical laypersons reported to know the algorithms for basic life support while 32 % performed adequate chest compressions and 68 % performed adequate mouth-to-mouth ventilation. In this group, the cardiac arrest was realized after 51 ±40 seconds, the emergency call was performed after 53 ±43 seconds, the drone started after 6:15 ± 1:33 minutes and dropped off the AED after 10:54 ± 1:56 minutes, and the first shock was delivered after 14:04 ± 2:10 minutes. Hands-off times were 2:11 ± 0:39 minutes.

Conclusion: The delivery and usage of an AED via a semi-autonomously flying drone in a remote region is feasible and safe. The drone delivery of an AED in mountainous regions can lead to early application of shocks. CPR quality performed by medical laypersons is suboptimal and emphasises the need for regular trainings.

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table 1

Table 1

	Paramedics (n = 10)	Layperson (n = 19)
Emergency call performed [%]	100	100
Started chest compressions [%]	100	100
Correct position of chest compressions [% of time]	83	81
Adequate chest compression depth [%]	80	73
Average chest compression depth [mm]	58 ± 4	49 ± 8
Adequate chest compression rate [%]	90	53
Average chest compression rate [min^{-1}]	115 ± 9	98 ± 18
Adequate ventilation performed [%]	50	68
Average volumes if ventilation was performed [mL]	677 ± 373	527 ± 150
Time from scenario start to emergency call [s]	40 ± 44	53 ± 43
Time from emergency call to drone start [s]	275 ± 156	341 ± 87
Flight time of the drone [s]	337 ± 125	291 ± 61
Time from AED dropped to first shock [s]	83 ± 22	172 ± 72
Average hands-off times for AED use [s]	50 ± 22	131 ± 39
Continuation of CPR measures after first shock [%]	100	100
Adequate support via emergency call taker [%]	0 *	86
Pre-trial questions		
Age of the participants [years]	26 ± 6	53 ± 15
I know the resuscitation algorithms for laypersons [%]	100	37
I feel comfortable to handle a cardiac arrest as a bystander [%]	100	68
I used a training AED at least once in my life [%]	100	42
I used a real AED at least once in my life [%]	90	16
I once witnessed or performed CPR measures [%]	100	21
In general, I can handle unknown situations [%]	100	63
Post-trial questions		
I felt safe in my actions during the scenario [%]	100	90
I received enough support and information from the emergency call taker [%]	50	100
I felt comfortable when the drone approached on scene [%]	90	95
I could get to the AED without problems [%]	100	100
I felt myself at risk when the drone approached on scene [%]	20**	0
I think a drone is useful in such a scenario	100	100

Table 1: qualitative and quantitative evaluation of the CPR and pre- and post-trial interview.

* All paramedics ended the phone call after receiving the information of the AED delivery via drone.

** In one case, the drone landed accidentally before dropping off the AED due to a loss of communication during the landing phase of the scenario

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