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Flying rescuers and doctors in an urban setting for cardiac arrest: just a dream?

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Every day, physicians, particularly emergency physicians, are confronted with serious and fatal illnesses, out-of-hospital cardiac arrest being one example.[1] Indeed, despite improvements in cardiopulmonary resuscitation techniques, such sudden deaths affect over 500,000 adults a year in the USA, and continue to have very low survival rates on discharge from hospital - 8% on average - varying from 0% to 18%.[2,3] That is why these practitioners have never ceased to innovate in order to improve and reduce the mortality rate, and this quest for innovation is still ongoing, notably through medical innovations, some of which are invasive. It also involves technological innovation.[4–8] It is a race against time, based on the physiopathology of cardiac arrest and its severity, which is linked to the duration of tissue hypoperfusion. Making defibrillation accessible to the public or in workplaces has been a way of reducing defibrillation time through the development of automated external defibrillators.[9–11] Some colleagues, seeing the limits of this type of approach, began to dream of alternatives, and envisaged the development of a network of drones or other devices to find victims more quickly at an avalanche site in the mountains, for example.[12,13] However, many questions were raised about such devices, especially the impossibility of bringing rescuers to the site.[14] Some work has been developed in this research axis on the potentiality of air ambulances with advanced vertical take-off and landing technologies in an urban environment. This is highlighted in the article by Matthieu Heidet et al. entitled "Improving EMS response times for out-of-hospital cardiac arrest in urban areas using drone-like vertical take-off and landing air ambulances: an international, simulation-based cohort study".[15]

The authors considered two cities of significant size, but with very different densities: the wider Paris area, which they call "Greater Paris", with a population close to 7 million over less than 762 km² and a density of close to 10,000 people per square kilometre, and the Metro regional district of Vancouver in Canada, with a population of 2.6 million over 2879 km², and a density of less than 1,000 people per square kilometre. Both of these cities have a two-step response for out-of-hospital cardiac arrest: first responders with basic life support and an advanced unit capable of advanced life support. Using data collected from cardiac arrest registries in these two cities, they were able to simulate the contribution of air ambulances with vertical take-off and landing based on the characteristics of one of the available models, to determine the time saved between the occurrence of a cardiac arrest and the arrival of any ambulance (first responders and advanced units, ground ambulance, or simulated air ambulance) and the arrival of only the first responders and advanced units. Selecting only cardiac arrests where the location was known, a witness was present, and where this type of technology might be beneficial, the authors were able to include more than 6200 cases over two years between January 2017 and December 2018 (around 3700 in Paris and 2500 in Vancouver). They were able to determine that the time taken for emergency services to arrive could potentially be shortened significantly, particularly for first aiders, and concluded that such vertical take-off and landing air ambulances might improve emergency medical system intervals, with a possible improvement in response time.

In terms of inherent limitations, the devil is in the detail in such simulation studies, where the hypotheses significantly affect the results, which is mentioned honestly by the authors. The location of the drop zones was discussed, though other possibilities have not been mentioned (Heliport). Other issues include the missing data relating to the location (one third), the time to reach the victim possibly being underestimated (for instance, if located in a subway or workplace), the old data (over than 5 years old, prior to Covid) with known changes to transportation, the real effect of a reduced response time in terms of survival and quality of life, and the inclusion of a multitude of other real-life parameters needed to accurately assess the effectiveness of this type of measure.

These relate to questions surrounding the hypotheses, which have been tested and validated using these same data, with the risk of over-learning in a relatively early period, and the take-off and landing zones, which have been studied and described, being easily debatable. The data may also be limited by retrospective filling, with almost a third of the data missing. Finally, a multitude of other real-life parameters are needed to accurately assess the effectiveness of this type of measure.

Of course, this is only an initial study, and not too many next steps are required to transform such a dream into reality. Questions also arise in terms of flight technique skills and certifications, accident risk management, as well as the question of cost-effectiveness, which remains crucial; as we already mentioned, saving time does not necessarily mean a long-term improvement in survival rates. Costing and financing are other issues - the question of how money could be used more effectively for prevention, first-aid training, and the development of community applications if intervention times are also to be reduced. Cost-effectiveness implies preparation (training, procedure, budgets) and pre-flight/in-flight and post-flight management, as has also been highlighted for drones.[14]

It is, however, especially important to have practitioners and researchers who dream and innovate together. Moreover, some significant perspectives must be taken into account, especially where it concerns large numbers of people at special events, as Paris will soon be hosting the 2024 Olympic Games (as Vancouver has), or specific events or locations where take-off and landing is required in smaller spaces; reducing the likelihood and magnitude of a brownout might therefore be beneficial. There are also other innovations associated with such devices, with a network using an application that sends the location automatically to the pilot, as well as the nearest bystanders or the location of an automated external defibrillator,[16] along with technical improvements in distance or even computer-assisted piloting that would enable the evacuation of people.[17]

In conclusion, the authors, like many before them, have embraced an imaginative search for technological innovations which, although seemingly far-fetched, should not be dismissed without rigorous step-by-step research to improve survival during cardiac arrest. Even though dreaming does not equate to reality, an improved future starts with vision and research.

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