

Towards full paramedic training in Hong Kong: defibrillation capability is just one step forward

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Defibrillation training within the Hong Kong Fire Services Department commenced in January 1991, supervised by the Ambulance Service and the Hong Kong Medical Association. Trainees were required to pass a certifying examination. Defibrillator-equipped ambulances or motorcycles were dispatched when a patient was found to be unconscious or thought to be suffering from myocardial infarction. Defibrillation success was defined as pulse resumption after ambulance treatment. Two groups of patients were compared. In group 1, patients were treated from an ambulance equipped with a defibrillator, while in group 2, patients were treated from an ambulance with no defibrillator. There were 772 patients in group 1 and 471 in group 2; 358 group 1 patients received defibrillation treatment. Thirty two of the group 1 patients regained a pulse compared with 17 of the group 2 patients (8.94% versus 3.61%, $p < 0.01$). However, only 15 of 32 group 1 patients were admitted to hospital, compared with 15 of 17 group 2 patients (47% versus 88%, $p < 0.01$). The fact that there was no increase in the number of patients admitted to hospital suggests that defibrillation therapy alone is insufficient to increase the salvage rate. Future paramedic training in Hong Kong should include endotracheal intubation, intravenous access and the administration of drugs.

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Introduction

The final outcome of pre-hospital resuscitation is highly dependent on early access, with emphasis on early cardiopulmonary resuscitation (CPR), early defibrillation and early advanced cardiac life support (ACLS). In Hong Kong, the pre-hospital care of cardiac arrest victims prior to 1990 was limited to basic life support without defibrillation capability. In December 1987, the Hong Kong Government Advisory Group on Extended Training for Ambulancemen was formed under the auspices of the Ambulance Services Review Steering Group, to examine the feasibility and need for extended training for ambulance personnel.

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The Advisory Group recommended that ideal paramedic care in ambulances should include intubation, intravenous infusion, defibrillation, and drug administration. However, taking into consideration all the economic and training implications, paramedic care was to be initially confined to the use of defibrillators in ambulances. This paper reports on the initial experience with the use of automatic defibrillators in Hong Kong.

Subjects and methods

The Fire Services Department undertook to select a suitable defibrillator for use by ambulance personnel. For simplicity in training and ease of operation, the defibrillator was to be an automatic defibrillator capable of detecting ventricular fibrillation (VF), so that only minimal training of ambulance personnel would be required.

Following a comparative study of three different automatic defibrillators—namely Physiocontrol Lifepak 5 and 250, Marquette 900, and Heartstart

2000—the Lifepak 5 and 250 was selected. This is an automatic machine which records the electrocardiogram (ECG) through a pair of defibrillation electrodes, and is capable of analysing the ECG, as well as advising on whether electric shock is needed. The defibrillator incorporates a dual channel cassette recorder which provides an audible record of the event together with an ECG tracing, and activates automatically whenever the machine is in use. The recording tapes can be played back to retrieve the patient's ECG through a voice translator and a desk-top computer (Macintosh Apple Inc., Seattle, US).

As a pilot scheme, the defibrillation service was provided on a limited scale and 18 sets were purchased, of which three sets were to be used for training and two for maintenance reserve purposes. Two Apple Macintosh computers and ECG/voice translators were also acquired to analyse the retrieved information.

With the assistance of the Hong Kong Medical Association (HKMA), a training programme was set up in April 1990. Potential trainees were selected to attend a pre-course briefing session prior to the course proper. These trainees included ambulance officers and ambulance motorcycle riders with basic education of at least Form 5 secondary school level.

The programme included the theory and practice

of CPR, basic electrophysiology of the heart, monitoring techniques, interpretation of dysrhythmias with an emphasis on VF, and the operation of the defibrillator according to a strict protocol. Following the training, practical examinations were conducted in which each candidate was assessed.

The course lasted for one week, with doctors from the HKMA acting as training instructors and two paramedically qualified ambulance officers as assistant instructors. All trainees were attached to an intensive care unit in a general hospital for a period of two days. During these two days, the trainees had the opportunity to learn basic electrocardiography, management of acute myocardial infarction (MI), and to witness the handling of cardiac emergencies.

One hundred and fifty eight ambulance staff attended the course, passed the certifying examination, and were deemed qualified to operate the defibrillator. Thirteen defibrillators were deployed to 12 strategic locations in or near densely populated areas (Table 1).

A mobilising protocol was designed to help the Fire Services Communication Centre (FSCC) staff assess the patient's condition and decide quickly whether or not the patient required defibrillation. Information on the level of consciousness, breathing, chest pain, age, and medical history were collected by the FSCC staff

Table 1. Deployment of defibrillators by location and type of vehicle

Region	Ambulance depot	Vehicle
Hong Kong Island	Sai Wan Ho	Emergency ambulance
	Morrison Hill	Ambulance motorcycle
	Pokfulam	Emergency ambulance
Kowloon	Ma Tau Chung	Ambulance motorcycle
	Yau Ma Tei	Emergency ambulance
	Wong Tai Sin	Emergency ambulance
	Ngau Tau Kok	Ambulance motorcycle
	Ngau Tau Kok	Mobile treatment centre
New Territories	Tsuen Wan	Ambulance motorcycle
	Castle Peak Bay	Emergency ambulance
	Yuen Long	Ambulance motorcycle
	Shatin	Emergency ambulance
	Fanling	Ambulance motorcycle

and a defibrillator-equipped ambulance/motorcycle was dispatched if the patient was thought to be unconscious or suffering from MI.

The application of the defibrillator was strictly guided by a protocol approved by doctors from the HKMA. Under the protocol, ECGs of cardiac arrest victims were analysed by the defibrillator, which recommended shock application when VF was detected. Otherwise, CPR was continuously performed by the ambulance crew. Ambulance staff regularly generated paper print-outs of patient's ECGs throughout the course of treatment and submitted this with the patient report to the medical officer on arrival at the hospital.

The performance standard of the defibrillation service was monitored by a senior ambulance officer through analysis of cassette tapes and carbon copies of patient reports. Due to the retrospective nature of the study, the following parameters could not be assessed: time lapse from cardiac arrest to ambulance arrival; time to CPR; time to defibrillation; and whether there was bystander-initiated CPR. Data on survival after hospital admission were also unavailable.

Defibrillation success was defined as the ability to regain the pulse in a cardiac arrest victim, whether or not the patient survived to reach the hospital. The effectiveness of the defibrillation service was evaluated by comparing the defibrillation success rates of two groups of patients, namely, group 1 patients, treated by crews equipped with defibrillators, and group 2 patients, treated by crews without a defibrillator. Whenever a cardiac arrest was reported, the nearest available defibrillator-equipped ambulance or motorcycle would be dispatched. However, when all 13 defibrillator-

equipped vehicles had been deployed, an ambulance without a defibrillator would be dispatched.

Results

The trial ran for six months in 1991. During this period, 772 patients were treated by crews equipped with defibrillators. In the three months from 28 April 1991 to 27 July 1991, a total of 471 patients were treated with CPR alone (Tables 2 and 3). ECG segments of a patient with favourable response to defibrillation are shown in Fig 1.

Discussion

Defibrillation requires advanced knowledge of arrhythmias. Semi-automatic external defibrillators, such as the ones employed in this study, require much less operator training and expertise before use.¹ In a study on automatic defibrillators, the results achieved by teams using such defibrillators compared with teams equipped with standard defibrillators showed that the former had a higher survival rate (30% versus 19%).²

Ironically, less than half of the victims with pulse resumption in the defibrillator group were admitted to hospital after initial treatment in the emergency room, compared with 88% of the control group. This is despite the fact that training paramedics to provide defibrillation in the field has been shown to improve survival of cardiac arrest victims.^{3,4} There are many reasons for this apparent lack of efficacy in our study. Although defibrillation is an essential resuscitative technique, it is only one of several components of ACLS. Most major studies in the past involved paramedics who were fully trained in defibrillation,

Table 2. Comparison of defibrillation success rates

	Group 1 (with defibrillator)	Group 2 (no defibrillator)
Total number of cardiac arrest patients	358	471
Total number of patients shocked by defibrillator	69	na
Total number of patients who regained pulse	32	17
Overall success rate	8.94%	3.61%
		p < 0.05
Total number admitted to hospital	15/32 (47%)	15/17 (88%)
		p < 0.01
na not applicable		

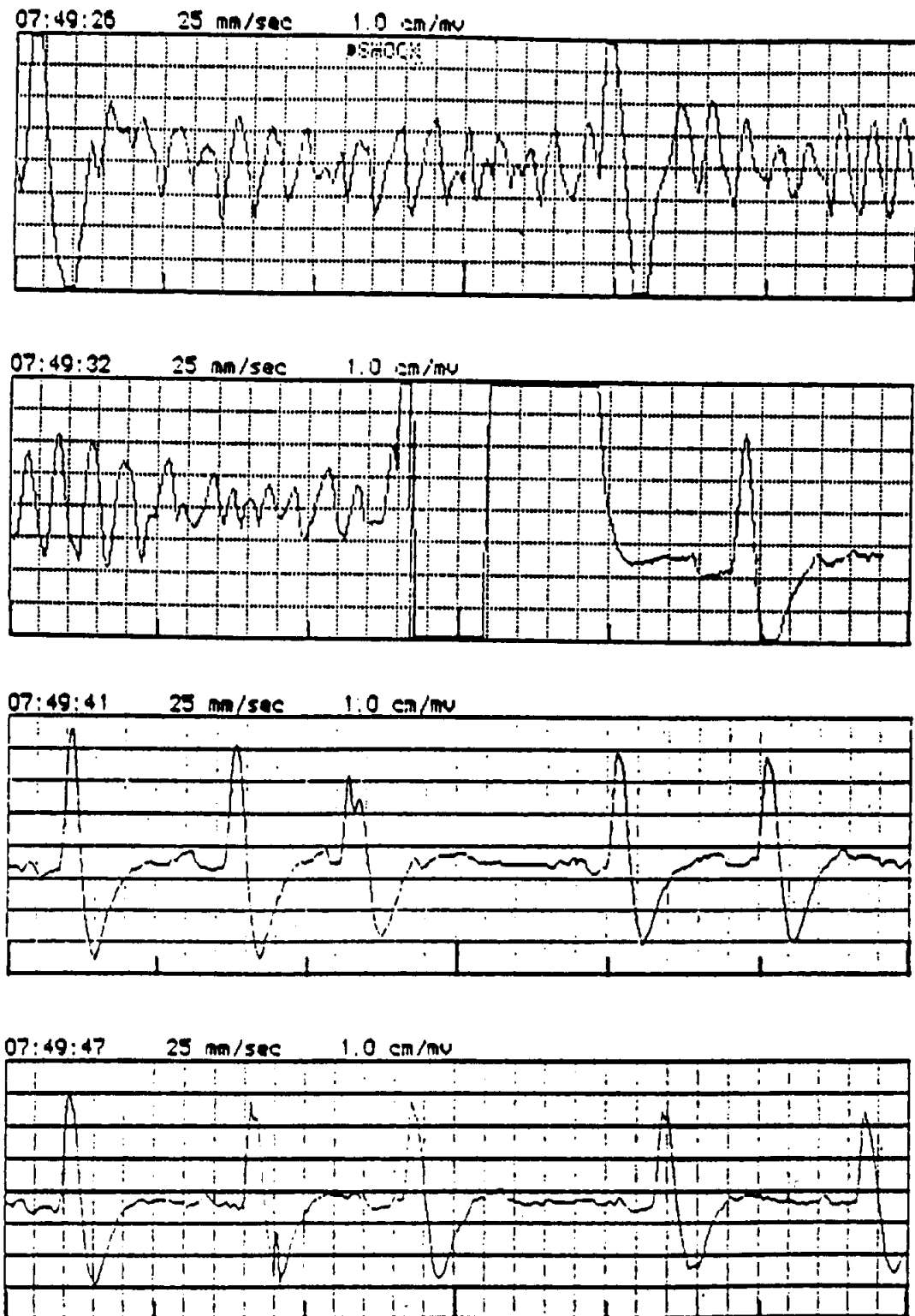


Fig 1. Successful defibrillation with conversion from coarse ventricular fibrillation to supraventricular rhythm with widened QRS

as well as endotracheal intubation and intravenous access. Apart from having basic CPR skills, our ambulancemen were only trained in the use of the defibrillator and not in endotracheal intubation.

The most effective ventilation method to reverse hypoxaemia is endotracheal intubation. Out-of-hospital CPR is used only as a holding action and can hopefully only provide a sufficient alveolar pO_2 level to maintain the viability of the patient for a limited time until defibrillation is implemented. Intubation isolates the airway and prevents aspiration of material into the lungs. It facilitates suctioning of secretions, prevents wasted ventilation and gastric insufflation during positive pressure ventilation, and provides a route for the administration of inhalational drugs. It has been recommended that all paramedical personnel providing ACLS in prehospital care should have adequate training in this technique.⁵

Another essential part of ACLS is proficiency in gaining direct venous access as early as possible, so as to establish the lifeline for administration of essential drugs and fluids. One of the most important cardioactive drugs is epinephrine. The primary beneficial effect of epinephrine in cardiac arrest is peripheral vasoconstriction, as this improves coronary and cerebral perfusion pressures. Epinephrine makes VF more susceptible to direct current countershock.^{6,7} The American Heart Association now recommends that epinephrine be given every five minutes until a rhythm is restored.⁸ Even if a patient is successfully resuscitated, there may be a need to continue the administration of intravenous drugs to treat and/or prevent recurrent ventricular tachyarrhythmias. Lidocaine and bretylium tosylate are time-honoured drugs in this regard.⁹

Defibrillation in the out-of-hospital context is limited by the unavoidable time delay in initiating defibrillation. A witnessed arrest is more favourable than

an unwitnessed one because the earlier the emergency system is activated, the higher the likelihood of success. Bystander-initiated CPR, being a major prerequisite for effective defibrillation, also ensures that there is at least partial restoration of circulatory functions.^{9,10} We do not know if there was any bystander-initiated CPR in our study. Time is especially vital during the first few minutes after cardiac arrest. No matter how promptly and aggressively the emergency medical treatment is applied at the scene of collapse, the chance of the patient's survival without neurologic deficit is very low if CPR is not begun within the first few minutes of arrest.^{11,12} We also do not know if there was any significant delay before the arrival of the ambulance at the scene; this is particularly relevant in the context of Hong Kong where traffic congestion is a perennial problem. The data suggest that a greater contribution was made by motorcycle defibrillation treatment. The success rate for patients treated by motorcycle, compared with that by normal ambulance was 10.85% versus 7.86% ($p = 0.17$). Since motorcycles can negotiate heavy traffic and arrive sooner at the scene than can a normal ambulance, given the circumstances of Hong Kong, the fleet of motorcycles equipped with automatic defibrillators should be increased so that early defibrillation may be more easily achieved.

Major limitations of this study include the lack of the following: clinical demographic data to see if the two patient groups were at least comparable; response time of the ambulance; the hospital course of patients after admission. Moreover, the lack of patient randomisation and the retrospective nature of the study also present problems with statistical comparison.

In conclusion, the initiation of the defibrillation service represents a major step forward in the training of paramedics in Hong Kong. Defibrillation alone is insufficient to increase the survival rate of out-of-hospital cardiac arrests. Given the current state of knowledge

Table 3. Comparison of defibrillation success between ambulance and motorcycle groups

	Cardiac arrest	Defibrillated	Pulse regained	Pulse regained (% of total)
Motorcycle with defibrillator	129	25	14	10.85
Ambulance with defibrillator	229	44	18	7.86
				$p = 0.17$

of ACLS, future paramedic training in Hong Kong should also include endotracheal intubation, intravenous access and the administration of drugs.

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