Emergency defibrillation performed by coronary nursing staff: a pilot report

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The time taken to initiate defibrillation is a key factor in determining survival after cardiac arrest; all first-responding medical or paramedical personnel are thus recommended to receive training in defibrillation skills. We have recently established a working programme that allows trained coronary care nurses to defibrillate in emergencies. Prospective data collected from 1 October 1996 to 31 January 1997 showed that a total of 11 witnessed episodes of ventricular fibrillation or pulseless ventricular tachycardia occurred in nine patients, and were defibrillated by nurses. All the defibrillations were started within 1 minute of cardiac arrest. In five patients, defibrillation was commenced before the arrival of the crash team of doctors; three of the five patients survived. There were no violations of the resuscitation protocol or complications relating to defibrillation. Through programmed training in advanced cardiac life-support, coronary care nurses are capable of providing safe and prompt defibrillation. The importance of training and re-certification is also stressed.

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Introduction

Effective defibrillation may be life-saving during an unexpected cardiac arrest following ventricular tachyarrhythmia (ventricular fibrillation [VF] or pulseless ventricular tachycardia [VT]). In this context, the most important determinant of survival is early intervention, which includes the early application of basic cardiopulmonary resuscitation (CPR) and defibrillation.[1] The success of defibrillation, however, declines with the duration of CPR before the first shock, or if there is systemic acidosis or hypoxia.[2] In 1991, a statement issued by the American Heart Association (AHA) endorsed early fibrillation and called for the training of all emergency personnel to operate a defibrillator. This included "both hospital and non-hospital first-responding emergency personnel (for example, emergency medical technicians, fire-fighters, volunteer emergency personnel, physicians, nurses, and paramedics)".[3] In the United Kingdom, senior nurses from high-dependency areas, such as coronary care or intensive care units, are normally trained in advanced cardiac life-support and may carry out prompt defibrillation when appropriate. Nevertheless, defibrillation by nurses has not been widely adopted in hospitals in Hong Kong. We report our early experience of a programme recently introduced at the United Christian Hospital to allow nursing staff of the coronary care unit (CCU) to perform defibrillation in clinical emergencies.

Methods

All episodes of emergency defibrillation that were delivered by CCU nurses from 1 October 1996—the first day of the coronary care nurse defibrillation programme—to 31 January 1997 were prospectively studied. Episodes of defibrillation that were performed by doctors within this period were excluded from the study. All nursing staff who were qualified to defibrillate attended and passed an 8-hour cardiac resuscitation course that was organised by the Hospital Resuscitation Committee at the United Christian Hospital within the preceding 12 months. In addition to passing a written test, graduates had to satisfy the

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examiners (most of whom were certified Advanced Cardiac Life Support [ACLS] instructors) of their competence to defibrillate, and to manage other dysrhythmias in a resuscitative setting.

Disposable electrode pads were used in all cases, at the standard apex-lateral sternum electrode position. Dermal nitroglycerin patches, if present, were removed prior to defibrillation. The defibrillator used was the Nihon-Kohden TEC 7200K portable defibrillator (Nihon-Kohden Corporation, Tokyo, Japan) or the Zoll PD 1200 pacemaker/defibrillator (Zoll Medical Corporation, Massachusetts, USA). For each episode of defibrillation, the following details were recorded: the nurse's name, time of the event, initial and subsequent rhythms during cardiac arrest, the patient's clinical and demographic details, name of doctor present (if any) during defibrillation, time taken to initiate defibrillation, number and magnitude of electric shocks, electrode positioning, any violation of defibrillation protocol, outcome after resuscitation, and any defibrillation-related complications.

Results

During the 4-month study period, 11 discrete episodes

Table. Descriptive profile of patients receiving defibrillation from nurses

Patient	Sex/ age (yr)	Arrhythmia	Clinical details	Shock (direct current)	Doctor present?	Outcome
1	M/67	VT*	Diabetes mellitus; ischaemic heart disease; wide complex tachycardia during electrophysiological study	200 J	Yes	Sinus rhythm; discharged
2	M/62	VT	DeBakey type 1 aortic dissection; acute anteroseptal myocardial infarction	200 J	No	Sinus rhythm; died
2		VT		300 J 360 J	Yes	Pulseless electrical activity; died
3	F/71	VF†	Chronic renal failure; ischaemic heart disease; slow atrial fibrillation	200 J	Yes	Complete heart block; discharged with permanent pacemaker
4	M/81	VT	Acute inferior myocardial infarction	200 J	No	Sinus rhythm; discharged
5	M/68	Torsade de pointes	Extensive anterior myocardial infarction	200 J 300 J 360 J	No	Sinus rhythm; discharged
6	F/79	VF	Diabetes; infective endocarditis; *Burkholderia cepacia* septicaemia; pancreatitis; multiple organ failure	200 J	No	Atrial fibrillation; died 7 days later
7	F/80	VT	Hypertension; ischaemic heart disease; heart failure; previous cerebral infarction	200 J	No	Complete heart block; required pacemaker
7		VT	During permanent pacemaker insertion	200 J 300 J	Yes	VT aborted; discharged
8	M/69	VF	Acute inferior myocardial infarct; cardiac rupture	200 J 300 J 360 J 360 J 360 J	Yes	VT VT VF VF Pulseless electrical activity; died
9	M/59	VT	Ischaemic heart disease; congestive cardiac failure	200 J	Yes	Asystole; died

*VT pulseless ventricular tachycardia
†VF ventricular fibrillation

of sudden cardiac arrests were sustained by nine patients (six men, three women) who received rapid defibrillation from a qualified CCU nurse. The mean age of the patients was 71 years (range, 59-81 years). Each patient's underlying diagnoses, type of arrhythmia, and details of defibrillation treatment and outcome are presented in the Table.

Five nurses delivered a total of 19 defibrillation shocks. There were seven episodes of pulseless VT, three episodes of VF and one episode of torsade de pointes. Seven of the nine patients had one or two external shocks applied for each episode of ventricular arrhythmia, which was successfully treated in each case. Patient 5 required three shocks and had a successful outcome; patient 8 received five shocks but there was a subsequent deterioration into pulseless electrical activity. All 11 episodes were witnessed cardiac arrests; the cardiac rhythm in each case was also immediately diagnosed by bedside monitoring. Each episode occurred in the vicinity of resuscitative equipment and all defibrillations were performed within 1 minute from the onset of cardiac arrest.

On five occasions, rapid defibrillation was given before the arrival of the emergency team (patients 2, 4-7). Four of the five patients were critically ill with extensive myocardial infarctions (patients 2, 5), heart failure (patient 7), or multiple organ failure with sepsis (patient 6). Patient 4 was an elderly man with an acute inferior myocardial infarction; he suffered an episode of sudden pulseless VT which was successfully defibrillated by just one shock of 200 joules. He then underwent uneventful thrombolytic therapy and was discharged with no further complications. In patient 5, torsade de pointes complicated an extensive anterior myocardial infarction, but sinus rhythm was restored by three successive shocks; he was subsequently discharged. Patient 7 developed complete heart block with hypotension and cardiac failure, and her episode of pulseless VT was treated with 200 joules of external shock. Temporary pacing was uneventful but during the subsequent insertion of a permanent pacemaker, VT recurred: this was aborted, however, with two shocks of 200 and 300 joules. She too was later discharged.

Defibrillation was carried out by a nurse in the presence of a doctor on six occasions. Three patients (patients 1, 3, 7) had satisfactory outcomes. Patients 1 and 7 were successfully defibrillated during cardiological procedures, and illustrate the essential role of the assisting nurse during invasive procedures. There were four subsequent deaths or immediately unsuccessful resuscitations among the nine patients. These comprised a case of acute myocardial infarction complicating acute aortic dissection (patient 2); infective endocarditis with septicaemia and multi-organ failure (patient 6); cardiac rupture secondary to acute myocardial infarction (patient 8); and severe congestive cardiac failure (patient 9).

Discussion

Compelling evidence from numerous studies supports rapid defibrillation as the single most important therapy for pulseless VT or VF.[2,4-6] A prolonged delay in initiating defibrillation is a significant factor in defibrillation failure.[7,8] Myocardial energy stores of adenosine triphosphate have been shown to decline in a non-linear fashion with increasing duration of VF and, if they drop below a critical level, successful defibrillation might not be achievable.[9] Current opinions on resuscitation are steering away from the traditional concept of waiting for the crash team to assemble before trained medical personnel can defibrillate.[7,10] Delays are often caused by the long distance between the resuscitating team–doctor and the patient in desperate need. Data from the United Kingdom show a greater resuscitation success in high-dependency areas than in general wards, as well as a better outcome in patients whose arrests are witnessed as opposed to those who are found in arrest.[11] As implied from this large-scale study, the time delay in initiating therapy may be detrimental.

Coronary care unit nurses are frequently the first responders and they witness nearly all the cardiac arrests in the unit. In all the patients in the present report, defibrillation was started within 1 minute. This contrasts with results of our recent audit on cardiopulmonary resuscitation in medical wards which showed the mean time for team arrival to be 2 minutes but with a range of up to 10 minutes.[12] The timing is so crucial that emphasis is now turning to training as many people as possible. For example, the statement issued in 1991 by the AHA regarding early defibrillation advocated all first-responding emergency personnel, including nurses, to be trained to operate a defibrillator.[3] In 1995, the AHA published a further statement on 'Public access defibrillation' that supported the principle that early bystanders should practise CPR using automatic external defibrillation.[13]

To provide rapid defibrillation before the arrival of the doctors from the resuscitation team can be life-saving. In our series, three of the five patients who received emergency shocks in the absence of a doctor

survived and were subsequently discharged. Thus, the prognosis of these patients was changed substantially. In the absence of a doctor, the trained nurse was able to correctly diagnose cardiac arrest, identify the type of arrhythmia and the need to defibrillate, and execute sequential steps to complete defibrillation. In circumstances where one or more doctors were present during the cardiac arrest, the role of the nurse was not diminished. This was exemplified in two cases where the doctors were occupied during electrophysiological study and permanent pacemaker implantation. Successful defibrillation delivered by the nurse facilitated the smooth completion of the procedure, and the nurse played an active role rather than just being a helpful bystander. In both cases, ventricular arrhythmia was aborted and the patients achieved a good outcome.

The key to greater resuscitation success remains in the adequate training in cardiac life-support. The Royal College of Physicians in the United Kingdom has long recognised the need for training programmes in cardiopulmonary resuscitation.[14] Before the era of formal training, studies had shown poor standards of hospital nurses' advanced resuscitative skills.[15] Unfortunately, few reports focus on defibrillating skills alone. We learned from our experience and others[16] that delays in initiating defibrillation could be reduced by training nursing staff in advanced cardiac life-support. Strict training programmes are essential. Our CCU nursing staff had to complete a course set by ACLS instructors, or its equivalent, and had to satisfy the examiners of their overall competence before being qualified to defibrillate any patient. This scheme changed the structure of our conventional resuscitation team and provided designated nurses with a more positive role in resuscitation. By the implementation of the programme, individual staff members could also regularly achieve personal satisfaction by the favourable outcome from a life-saving procedure. Because of the increased responsibility required, some nurses regarded this as an advancement of their career. Our experience concurs with established recommendations that nursing staff should be trained to perform the important skill of defibrillation. Nevertheless, to safeguard patients' safety, to maintain high standards, and to allay any fear about inappropriate defibrillation, we have implemented a regular assessment and resuscitation drill. We have also made it obligatory for all staff to be re-certified in their skills every 2 years.

Long-term results of resuscitation continue to be disappointing in non-coronary units, in patients over 70 years, in non-witnessed arrests, and where the initial rhythm is not VF.[17] These groups probably represent a much larger proportion of patients in need. As with coronary care nurses, ward nurses should be encouraged to receive training in advanced cardiac life-support. These skills may save more lives and avoid the often belated, prolonged, and futile resuscitations. We hope that this report may provide some stimulus for local health care personnel to consider the strategy of defibrillation by nurses as a way of optimising the resuscitation process.

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