The occurrence of out-of-hospital cardiac arrest (OHCA) carries high mortality and morbidity even though treatments for coronary heart disease and the practice of cardiopulmonary resuscitation (CPR) have been improving for decades. The survival rate of all OHCA patients is still poor and is estimated to be below 5% from most reports throughout the world. The prevalence of ventricular fibrillation as the initial rhythm recorded is lower in Taipei City compared to western countries. The lower chance of coronary heart disease in Taiwan may account for it. Those OHCA patients with initial rhythm of ventricular fibrillation have better prognosis. The community-wide use of automatic external defibrillator was launched in 2000, utilizing the model of biphasic 150 joules of fixed energy. The survival-to-discharge rate of the OHCA patients has been improved after the introduction of automatic external defibrillators in Taipei City. The concepts of treating OHCA patients have been changing recently. The adequate quality of cardiopulmonary resuscitation, especially effective cardiac compression, has been proved to be the key to improving the outcomes of resuscitated patients. The concept of defibrillation first for patients with prolonged VF has been challenged. The optimum in post-resuscitation care, including hypothermia treatment, is beneficial to the long-term outcomes of the OHCA patients.

**Key Words:** Out-of-hospital cardiac arrest • Ventricular fibrillation • Automatic external defibrillation • Cardiopulmonary resuscitation • Taipei City

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**Less VF as the Initial OHCA Cardiac Rhythms in Taipei City**

Generally, ventricular fibrillation (VF) and ventricular tachycardia (VT) are not so common as the initial rhythm recorded for OHCA in Taipei City compared to western countries. A previous OHCA study in Taipei City in 1993 revealed that only 4.1% of victims presented with VF when arriving at hospital. For these sudden death patients, the events happen unexpectedly and carry huge impact on their family and the society. Thus, it has become an important issue to examine how to improve outcome in such cases and to ultimately save more patients.

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as compared with western countries may be linked to the importance of different racial backgrounds or underlying cardiovascular disease patterns. It is known that the prevalence of coronary heart disease is lower in Taiwan compared to that in western countries, and this may account for the low VF rate in OHCA events. In addition to OHCA patients, the low frequency of initial VF (13.6%) and of pre-existing coronary heart disease (17%) also has been documented in the in-hospital resuscitation setting in Taiwan. It has also been found that the incidence of VF as the initial OHCA rhythm is going down worldwide. A decrease from 45% in 1991 to 28% in 2001 was noted in a Swedish nation wide registry study and from 61% in 1980 to 41% in 2000 in Seattle, Washington, United States. It is postulated that improvement in treatment of coronary heart disease may partly account for the change in the incidence of ventricular fibrillation as the primary arrhythmia in out-of-hospital cardiac arrest patients. One hypothesis is that with the introduction of new therapeutic regimes like coronary interventions and medications, patients with ischemic heart disease live longer, and once they suffer from cardiac arrest, they have reached end-stage heart disease where asystole or pulseless electrical activity is more common than ventricular fibrillation. However, VF is thus far the most favorable survival cardiac rhythm for OHCA patients.

**Automatic External Defibrillator in Taipei City**

Strengthening the chain of survival in emergency cardiac care, which is comprised of early access, early CPR, early defibrillation and early advanced care, is the most important way to improve the outcomes of sudden death patients. Early defibrillation is the key manner in which to save patients with cardiovascular diseases presenting with life-threatening ventricular arrhythmia. Early defibrillation for the witnessed ventricular fibrillation (VF) carries high survival rate of more than 90%. Each minute of delay when treating VF leads to a 10% reduction of survival. The automatic external defibrillator (AED), a small portable defibrillator which can analyze the cardiac rhythm utilizing a built-in computer program, has been developed for decades to improve the survival of sudden cardiac death patients. Defibrillation is suggested when it recognizes shockable rhythm of VF or rapid ventricular tachycardia (VT). The operator can decide to shock or not after assessing the general condition of the victim. It is easy to learn and operate the AED machine correctly; laymen, even sixth-grade children, can use the AED after a short period of training. The Taipei City early defibrillation programs began in June 2000. AEDs, using an impedance-compensated biphasic truncated exponential waveform with a fixed 150-joule (J) energy protocol, have been deployed in all ambulances in the emergency medical system (EMS) in Taipei City. All EMTs receive a training course with American Heart Association guidance. After the implementation of the city-wide AED program, the overall survival rate for OHCA victims in Taipei City was brought up to 3.9% in 2001 from 1.9% in the basic-life-support-only era in 1993. The survival-to-discharge rate was even up to 18.8% for patients when initial rhythm was VT/VF. The chance of survival to discharge for the witnessed VF/VT patients was 25%. For those victims gaining return of spontaneous circulation (ROSC) after defibrillation on the scene, the prognosis was good, with a more than 90% chance of survival to discharge. Comparing with other Asian countries, the survival-to-discharge rate was 1.6% in Hong Kong, 3.5% in Singapore for all OHCA patients and 6.0% for VF patients. The rates of survival to discharge were 17% and 30%, respectively, for VF/VT patients after introducing the AED for the OHCA patients for Seattle and Iowa groups in the United States. The public accessible defibrillator program (PAD), which deploys AED in public, well-marked areas and trains local employees how to use AED, improved markedly the survival of OHCA patients in casinos and the Chicago airport. The PAD program has been launched also in the Haneda airport and at the Nagoya World Expo in Japan, where 4 patients were rescued by use of AED. The treatment recommendation on AEDs made by the Internal Liaison Committee on Resuscitation (ILCOR) is “Use of AEDs by trained lay and professional responders is recommended to increase survival rates in patients with cardiac arrest. Use of AEDs in public settings (airports, casinos, sports facilities, etc.) where witnessed cardiac arrest is likely to occur can be useful if an effective response plan is in place.”

The accuracy of AED analysis and reading of cardiac rhythms in the field is an issue, since the AED is used not only by medical doctors, but also by first responders, including personnel with patient contact in or
out of hospitals. From a study of OHCA patients in Taipei City, the overall specificity for detecting shockable rhythms was 100% and the sensitivity was 90%. The sensitivity for individual rhythm was as high as 97.5% for detecting coarse VF as the shockable rhythm and as low as 60% for slow VT, respectively. The results are similar to a study in the Boston area showing high specificity (99.9%) and moderately high sensitivity (81%) in detecting shockable unstable cardiac rhythms (VF or VT) in the out-of-hospital setting. It is not surprising that the sensitivity of detecting shockable rhythm is not perfect in Taipei and Boston. It would be a dilemma to promote both sensitivity and specificity for the AED machine. The high specificity of the AED machine use by the EMTs in the out-of-hospital setting prevents unnecessary defibrillation for the non-indicated victim, which is unacceptable in medical practice.

### Changing Concepts and Future Challenges for Treating OHCA Patients

With the development of evidence-based medicine, many concepts and routine clinical practices have been rechecked regarding improving outcomes. In addition to the shortening of the interval from patient collapse to defibrillation, the quality of CPR is highly stressed to improve the prognosis of OHCA patients in the recent published guidelines for emergency cardiac care of the American Heart Association. With the help of cardiac rhythm and voice recording by AED in the field, the CPR quality was found to be a major determinant for survival to discharge among OHCA patients in Taipei City. The patients with adequate CPR, which is defined as more than 50 effective cardiac compressions per minute and limited hands-off time, had a 53% chance of survival to discharge compared to only 8% for those without adequate CPR performance. Using prompting devices, such as the audio prompt, improved CPR quality by enhancing the cardiac compression rate and limiting the hands-off time for OHCA patients in Taipei City. The ratio of cardiac compression to ventilation has been brought to 30:2 in the new guidelines instead of 15:2 in the previous guidelines for CPR in basic life support, which implicates the importance of adequate cardiac compression during resuscitation efforts. The traditional recommendation for defibrillation sequence has been revised in the new guidelines. The rule of 200-300/360-360 joules (J) 3 shocks in a row has been changed to use only one shock with 360 J for monophasic defibrillator or 150 J to 200 J for the initial shock with a biphasic truncated exponential waveform for sudden cardiac death patients. The reason is the current biphasic defibrillators have a high first shock efficacy, with an average of more than 90%. If one shock fails to eliminate VF, the VF may be of low amplitude and the incremental benefit of another shock is low. In such patients, immediate resumption of CPR, particularly effective chest compressions, is likely to confer a greater value than an immediate second shock. The treatment recommendation of ILCOR is the following: a one-shock strategy may improve outcome by reducing interruption of chest compressions. A three-stacked shock sequence can be optimized by immediate resumption of effective chest compressions after each shock (irrespective of the rhythm) and by minimizing the hands-off time for rhythm analysis.

Some of the “paradigms” are being challenged with the rapid development of resuscitation science. The concept of “defibrillate as soon as possible” for treating the VF has been argued, although not conclusively, since it is found that patients with short-term CPR before defibrillation have a better outcome than those treated with standard “CPR first” strategies in prolonged out-of-hospital VF situation. There is no well-documented effective anti-arrhythmia agent so far to improve the long-term outcomes of out-of-hospital VF patients. The new promising treatment for OHCA patients is therapeutic hypothermia, which has improved the long-term survival and neurological recovery of out-of-hospital VF patients by reducing the body temperature to 32 to 34 °C for 12 to 24 hours in well-designed randomized control studies and is now formally suggested by American Heart Association in their new guidelines.

In conclusion, the outcomes of OHCA patients have been improving worldwide, including Taipei City, after great efforts to enhance resuscitation medicine. Refining the resuscitation clinical practices, researching the pathophysiological changes and introducing new concepts and instruments are key to promoting and upgrading the level and quality of management for OHCA patients.
REFERENCE


台北市到院前心跳停止患者之特性與處置之新進展

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雖然近年來對於冠狀動脈心臟病的治療及心肺急救復甦的實務操作有許多的進展，然而院外心跳停止的發生還是伴隨著高死亡率及嚴重的後遺症。根據世界各地的報告，發生院外心跳停止的患者其存活率仍小於百分之五。以台北市內發生院外心跳停止的患者為對象，近來的研究顯示此類患者以心室纖維顫動為首先被紀錄到心律的比例較西方國家為低，此現象可能與國人罹患冠狀動脈心臟病比率較西方國家為低有關，不過此類以心室纖維顫動為首先被紀錄到心律的患者其預後較其他心律者較佳。台北市於西元2000年開始全面使用150焦耳固定能量之雙向自動體外電擊器做為院外心跳停止患者的標準治療之一，與過去的研究相比，此治療方式提高了整體患者存活至出院的機會。由於實證醫學觀念的影響，治療院外心跳停止患者及急救的觀念仍持續進步改變中，足夠的心肺復甦急救，特別是有效的胸部按壓，是改善急救患者預後最重要的因素之一。而對於心室纖維顫動已持續較久的患者，優先電擊或優先心肺復甦急救及胸部按壓的觀念也已被重新評估及思考。在復甦後症候群的治療上，改善患者復甦後的治療及照護，特別是治療性低溫的運用，可使急救患者的長期預後更佳。

關鍵詞：到院前心跳停止、心室纖維顫動、自動體外電擊器、心肺復甦急救、台北市。