Controlled trial of automated external defibrillators in the London Ambulance Service

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Summary

This controlled trial was performed in London and compared outcomes of patients treated by ambulance staff using either basic life support alone or an automated external defibrillator (AED) as an adjunct to basic life support.

Five of the 212 (2%) patients were successfully resuscitated by crews using basic life support alone, compared with seven of 186 (4%) patients treated by crews equipped with the AED. Neurological outcomes in the AED group were better. However, meaningful statistical comparisons are not possible with so few survivors.

The AED used (Lifepak 200, PhysioControl Corp) was found to be sensitive and specific, and ambulance staff operated the defibrillator correctly.

The use of AEDs is an option to maximize the provision of defibrillators in the community and could readily be incorporated into basic ambulance training.

Introduction

Ambulance staff are eligible to be trained in a variety of advanced cardiac life support techniques. Prehospital resuscitation schemes range from those which include training in all aspects of advanced cardiac life support (ACLS), ie endotracheal intubation, intravenous infusion, defibrillation and drug administration, to those which involve training in only one of these aspects. Superiority of any one of these systems has not been proven, and therefore ambulance services need to decide which method will prove the most suitable in their local community.

In London, outcomes of patients treated by ambulance staff who had undergone extended training in all aspects of ACLS have already been assessed[1]. The present study concerns the outcomes of patients treated by ambulance staff who had undergone minimal training in the use of an AED and those treated by ambulance staff trained in basic life support alone.

American studies have demonstrated that paramedic ambulance services are effective in saving lives because the time interval from collapse to definitive care is shortened, but survival from pre-hospital cardiac arrest is also dependent upon a short time to basic cardiopulmonary resuscitation (CPR)[2]. A previous study in London using ambulance crews trained in all ACLS skills showed that community and system factors were not conducive to survival. A small number of lives were saved and defibrillation was the only advanced skill associated with success[1]. This research supports the findings of previous studies elsewhere, ie patients when found with rhythms other than VF have very little chance of survival, irrespective of therapy[3,4], and the majority of patients who are resuscitated by paramedics are converted to a perfusing rhythm after one or two early shocks, without drug administration[5].

'Defibrillation only' programmes are already in existence in England[6], and the USA[7]. Training in defibrillation only is shorter than full paramedic training, and this allows faster and more widespread provision of defibrillators in the community. However, regular monitoring and refresher training of staff is still required to ensure optimum performance and safe practice[8], and this may be a limitation once large numbers of staff have been trained. Training ambulance staff in the use of an AED requires a training programme which is shorter, and theoretically demands less monitoring of staff and refresher training, because this device incorporates an electronic logic system which is capable of analysing and interpreting the patient's electrocardiagram (ECG).

The first AED was described in 1979[9]. Laboratory and field trials have shown these devices to be sufficiently sensitive (ability to recognize VF and advise a shock), specific (ability to recognize non-VF), and effective in the termination of VF[10,11]. Controlled trials comparing the use of AEDs and conventional defibrillators by emergency medical technicians in suburban[12] and rural areas[13] have shown comparable sensitivity, specificity and patient admission and discharge rates. A further advantage of AED use was a faster delivery of shocks by emergency medical technicians using the AED than those using conventional defibrillators.

Methods

A trial was carried out between 1 February 1987 and 31 May 1988, involving all qualified ambulance staff at eight stations in South London. The defibrillator used was the Lifepak 200 AED (Physio-Control Corporation). One hundred and ninety staff were trained to use the defibrillator during a one-day (8 h) course. At the time of training, 26 people were already trained in endotracheal intubation and intravenous infusion.

The catchment area incorporated urban and suburban areas. Eight (50%) of the ambulances in the study area were equipped with defibrillators. Staff were allocated to these vehicles in rotation. Ambulance control did not know the whereabouts of the defibrillators, and there is no selective deployment policy in the London Ambulance Service, therefore calls were not allocated according to the capabilities of the crew.

Ambulance staff were asked to submit a report form

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on every adult victim of non-traumatic cardiac arrest whom they attempted to resuscitate out-of-hospital, whether or not they were equipped with a defibrillator. The defibrillator incorporates a dual channel cassette recorder which provides an audible record of the event and an ECG trace, which is activated automatically whenever the machine is used.

Data collection

From patient report forms completed by the ambulance staff, data regarding witnessed arrest, bystander CPR, time intervals from collapse to CPR, and collapse to ambulance arrival, patient characteristics, and whether or not the patient was intubated were collected.

Patient outcome following arrival to, and discharge from hospital, and disease aetiology were obtained from hospital records and GP records, and in the cases of patients who died, from postmortem reports and death certificates.

Those patients who returned to pre-arrest neurological status, and those who were able to return home without assistance were defined to have been successfully resuscitated.

Results

In total, 572 cases were reported. In 398 patients who had postmortem examinations, the arrest was due to cardiac causes. These patients will be considered exclusively from now on. One hundred and eighty-six (47%) of patients were treated by crews equipped with defibrillators and 212 (53%) were treated by crews without defibrillators.

In 85 (21%) of the 398 victims, arrests were witnessed, and it was estimated that basic life support was given within 4 min, and ambulance arrival was within 8 min of collapse.

Chi-squared tests were performed to detect any differences between the two study groups. These results can be found in Table 1. The only significant difference between the two groups was a greater number of ambulance crew-witnessed arrests in the control group.

Patient outcomes

Figure 1 shows the neurological outcomes and the number of patients who survived for at least 6 months in the experimental group and the control group. Twelve patients were successfully resuscitated. Approximately 1200 patients per group would be required to compare the success rates between the

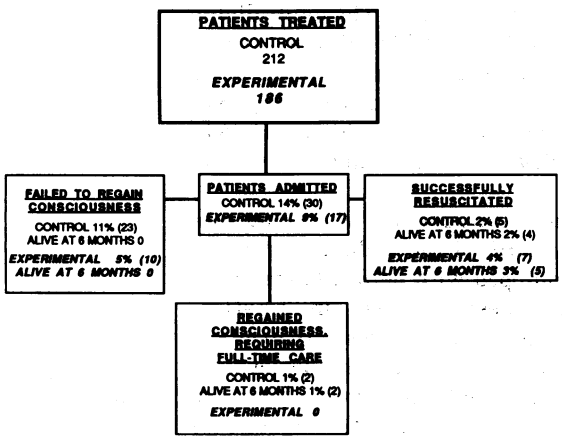

Figure 1. Outcome of patients treated

Table 1. Comparision of the experimental and control groups

Variable	*Experimental*	*Control*	*P (chi-square)*
Sex			
Males	150 (81%)	155 (73%)	
Females	36 (19%)	57 (27%)	$P>0.05$
Total 398			
Age			
<65 years	85 (46%)	78 (37%)	
>65 years	101 (54%)	133 (63%)	$P>0.05$
Total 397			
Missing 1			
Location			
Home	111 (60%)	134 (63%)	
Public place	75 (40%)	78 (37%)	$P>0.05$
Total 398			
Arrests witnessed by crew			
Yes	5 (3%)	32 (15%)	
No	181 (97%)	180 (85%)	$P<0.01$
Total 398			
Witnessed arrest			
Witnessed	121 (67%)	139 (67%)	
Unwitnessed	60 (33%)	70 (33%)	$P>0.05$
Unknown	5	3	
Total 398			
Bystander CPR (arrests not witnessed by crew)			
Yes	55 (30%)	60 (33%)	
No	126 (70%)	120 (67%)	$P>0.5$
Arrests witnessed by crew=37			
Total 361			
Airway management			
E-T intubation	64 (34%)	62 (29%)	
No E-T intubation	122 (66%)	150 (71%)	$P>0.05$
Total 398			
Time from collapse to CPR of less than 4 min			
Less than or equal to 4 min	63 (36%)	82 (42%)	
More than 4 min	111 (64%)	113 (58%)	$P>0.05$
Unknown	12	17	
Total 398			
Time from collapse to ambulance arrival of 8 min or less			
Less than or equal to 8 min	52 (30%)	73 (39%)	
More than 8 min	121 (70%)	114 (61%)	$P>0.05$
Unknown	13	25	
Total 398			
Outcome at hospital			
Dead on arrival	128 (69%)	135 (64%)	
Died in casualty	41 (22%)	47 (22%)	
Admitted	17 (9%)	30 (14%)	$P>0.05$
Total 398			

two groups statistically, since successful resuscitation was uncommon.

Discussion

These results confirm the unfavourable community and system factors previously found in London[1], with few victims (85 of 398, 21%) sustaining witnessed arrests and receiving basic and advanced cardiac life support within the optimum time intervals for survival[14] (4 min from collapse to basic life support and 8 min to advanced life support). These findings are reflected in the poor success rates, for BLS trained staff only, 5 of 212 (2%) successful resuscitations, and for staff equipped with the AED, 7 of 186 (4%).

An additional factor which may contribute to the low proportion of survivors is the lack of well defined resuscitation exclusion criteria in London. In 20% of patients, although the ambulance staff estimated the time from collapse to ambulance arrival was at least 17 min, they still commenced resuscitation and transported patients to hospital. The converse situation seems to exist in the United States. In Pittsburgh, 53% of patients with cardiac arrest were not resuscitated by paramedics, but classified as dead on scene on the grounds that they had no vital signs, and bystander CPR was not being provided[15]. Comparisons of survival rates between different systems should therefore be made with caution.

More patients were successfully resuscitated in the experimental group and neurological outcomes appeared better, in spite of the results being confounded by the significantly greater number of arrests witnessed by the ambulance crew in the control group. This difference can be explained by the actions of the ambulance staff. In 6 cases of crew-witnessed arrest, where the crew were equipped with a defibrillator, they continued to hospital rather than stop to use it, disregarding instructions given during training (these patients were included in the control group). It is possible that this occurred more often than was reported for this reason. Two patients who were successfully resuscitated in the control group arrested in the presence of the ambulance crew, whereas all the patients successfully resuscitated in the experimental group had already arrested by the time of ambulance arrival.

Would the results have been any better had the crews been trained to use conventional defibrillators? More in-depth knowledge of cardiac arrhythmias, the ability to monitor patients at risk, and the greater level of understanding expected in staff who have undergone a more lengthy training in conventional defibrillation, might have resulted in operators acting immediately rather than proceeding to hospital in the case of crew-witnessed arrests. However, any advantages of conventional defibrillation must be weighed against the bigger investment in time and resources needed to select appropriate staff, train, monitor and maintain the skill[8]. If resources are limited, greater numbers of staff could potentially be trained to defibrillate using automated defibrillators.

The results obtained demonstrate that victims of pre-hospital cardiac arrest can be successfully resuscitated by rescuers using automated defibrillators. Staff operated the machine safely, but the training programme may need modification, since, despite emphasis and feedback, rapid defibrillation did not occur in all cases.

Automated external defibrillators can maximize the provision of pre-hospital defibrillation. They are likely to be beneficial in areas such as London, where community and system factors reduce the potential for successful resuscitation, and extensive training has not been shown to result in appreciably more survivors[2].

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