

# From Wards 5 and 6 to Sainsburys

(The history of out-of-hospital cardiac arrest.)

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When history is written, one J Frank Pantridge will appear high on the list of original thinkers who changed the face of medical practice and who has been responsible for saving countless lives across the length and breadth of the globe. (Fig1)

Appalled at the high mortality from ischaemic heart disease in the province, his studies showed that there was a substantial delay between the onset of symptoms and the call for professional help. Moreover, there was little being done to treat these patients in the pre-hospital phase, apart from reassurance, and perhaps some analgesia and basic life support should cardiac arrest occur. The results were poor.

In the early 1960's, it was beginning to be realised that many patients with cardiac arrest due to ischaemic heart disease were suffering, not from terminal asystole but from ventricular fibrillation. External defibrillators had recently been introduced into clinical hospital practice and were producing survivors if used early. Frank Pantridge, together with his colleague John Geddes, after experience in defibrillation in hospital at the "Royal" in Wards 5 and 6, set about bringing defibrillation and advanced cardiac care provided by physicians into the community.

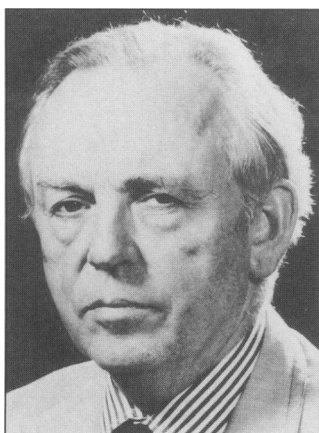


Figure 1 J. F. Pantridge

By hook or by crook, as was his wont, he acquired a "coronary ambulance" based at the "Royal", staffed by one or more of his own trainees and equipped with a huge defibrillator and a wide variety of drugs.

In landmark papers, Pantridge and Geddes reported their results in the *Lancet*<sup>1,2</sup>. The concept of Mobile Coronary Care was very soon picked up in the United States<sup>3,4</sup> and continental Europe but, except in a few

isolated instances, was not supported in the UK.

In the US, pre-hospital care was provided by non-physician paramedics and in continental Europe by physicians - mostly anaesthetists. In the UK, family doctors provided diagnostic skills but, by and large, they were ill equipped for cardiac emergencies. The majority of the UK was provided for by an ambulance service who had only very basic training. Only in Brighton, and in Bristol, where Douglas Chamberlain and I struggled against the establishment, and in Hampshire was any effort made to train paramedics who could provide defibrillation, intravenous access, drug therapy and sophisticated management of the airway and ventilation.<sup>5,6</sup>

Despite published exhortations<sup>7</sup>, this dismal situation continued until the 1980's when common sense at last began to prevail under the leadership of an enlightened Chief Medical Officer at the Department of Health - Sir Donald Acheson, who gave the go ahead for paramedic training and the provision of defibrillators on all front line ambulances.

## THE EARLY DEFIBRILLATORS

In the 1960s and 70s, the defibrillator was a massive piece of apparatus - barely liftable by one man and powered by mains electricity. (Fig 2) Pantridge, who was now working with John Geddes, Jennifer Adgey and Sam Webb, set about designing a portable model

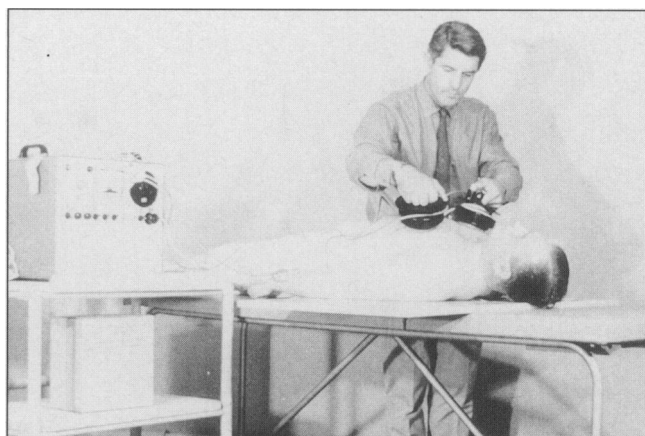


Figure 2 Demonstration of early difibrillator by author

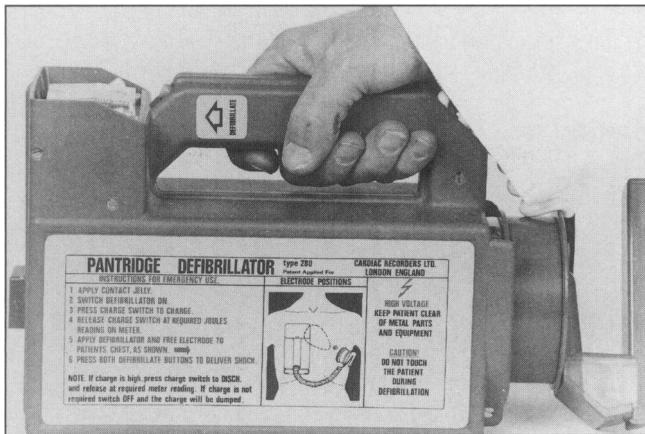


Figure 3 The Pantridge defibrillator

to be battery powered which would be much more suitable for use in the community and for an in-hospital cardiac arrest service. The Pantridge Defibrillator developed with Cardiac Recorders Ltd, was a milestone<sup>8</sup>(Fig 3). It was small, portable and simple. It was unencumbered by an ECG recorder for that would have increased the cost and the size and weight. Pantridge believed that the survival rates from asystole were so poor that the only potential for a good outcome was to treat the patient blindly as if they had ventricular fibrillation. The patient with asystole had nothing to lose and the patient with ventricular fibrillation had everything to gain.

In the United States leading defibrillator manufacturers such as PhysioControl improved the technology on a steady basis and the portable defibrillator became quite sophisticated and incorporated a ECG trace, a paper recording and a synchronised facility for cardioversion of ventricular tachycardia and atrial fibrillation.

All defibrillators at that time were manually operated with hand-held paddles and required the operator either to defibrillate blindly based on a clinical diagnosis of cardiac arrest or interpret the ECG rhythm as being ventricular fibrillation and defibrillate accordingly. The potential for artefact with hand-held paddles, particularly in the prehospital arena, was high.

### THE AUTOMATED EXTERNAL DEFIBRILLATOR

In the early 1980s space and computer technology were applied to defibrillators and the automated device was produced by Laerdal; PhysioControl and some other leading manufacturers. (Fig 4) The ECG signal was detected through large adhesive pads applied to the chest, and the signal was reliably interpreted within the apparatus so removing the

diagnostic onus from the operator.

A shock was either delivered automatically if the rhythm was one remediable by defibrillation (the completely automatic defibrillator) or audible and/or visual signals indicated that the operator should deliver a shock by pressing a button (the semi automatic or shock advisory defibrillator).

This major advance revolutionised the practice of defibrillation, particularly in the prehospital arena. Now defibrillation was no longer the sole province of the physician or the paramedic.

Defibrillation became a relatively simple affair that could be used by basic ambulance technicians, firemen and policemen. Substantial clinical experience began to be acquired on a world wide basis.



Figure 4 The HEARTSTART semi-automatic defibrillator by Laerdal

### RECENT CLINICAL EXPERIENCE WITH DEFIBRILLATION

Cummins has surveyed the reports of early defibrillation from a number of centres in the US which give the survival rates before and after the introduction of the programme<sup>9</sup>. In King County, Washington survival rates rose from 7% to 29%, in Iowa from 3% to 19%, in SE Minnesota from 4% to 17%, and in Wisconsin from 4% to 11%. Weaver reported an improvement from 21% to 30%<sup>10</sup>. In Scotland, Cobbe reported the experience of the ambulance service using technicians and paramedics who defibrillated 602 patients with a 29% survival to arrival at hospital and 12.5% survival to hospital discharge<sup>11</sup>. In Berlin, Arntz reported on a series of 209 cases of ventricular fibrillation occurring out of hospital with survival to hospital admission in 51% and survival to discharge in 22%<sup>12</sup>. In West Yorkshire,

ambulance staff achieved an 11% survival to discharge in a series of 910 patients with ventricular fibrillation. In Gothenburg 11% were admitted alive to hospital and 7% were discharged in series of 949 patients<sup>13</sup>.

In Scotland and Northern Ireland, some family doctors equipped themselves with defibrillators and more than matched the ambulance service figures with survival rates to hospital discharge and beyond of 34% and 41% respectively in patients who were defibrillated.

Very high survival rates can be achieved in patients with ventricular fibrillation if defibrillation is achieved within 3 minutes. Weaver reported survival rates of 70% within this time frame. It is estimated that survival rates fall by about 7% per minute of delay to defibrillation.

Cardiopulmonary resuscitation (CPR) may provide a circulation which will stave off neurological damage but probably buys only limited time.

Clearly for high survival rates to be achieved CPR and defibrillation must be applied within 5 minutes. These response times are plainly outside the ability of the ambulance services capability, particularly in rural areas. What then is to be done to realise the full potential of defibrillation?

## THE FUTURE

Two features bring hope for the future for victims of ventricular fibrillation. Firstly, international medical opinion has realised and admitted that early CPR and defibrillation is the way forward. Secondly, the defibrillator technology has taken a further step forward with the introduction of the biphasic waveform which allows defibrillators such as the *FORERUNNER* by Heartstream to be just as effective with lower energy and therefore to be smaller, lighter, cheaper and even simpler to operate. (Fig 5) Battery technology has improved to produce greater reliability and regular self testing.

As a consequence, august bodies such as the American Heart Association and the European and Australian Resuscitation Councils have issued statements encouraging the introduction of early access to defibrillation programmes and acknowledging that defibrillation can be performed in the community by trained individuals who are not necessarily health care professionals.

In the future, defibrillation will be provided by the police, fire brigade, St John, the Red Cross, sports event marshals, transport stewards (rail and air) and by

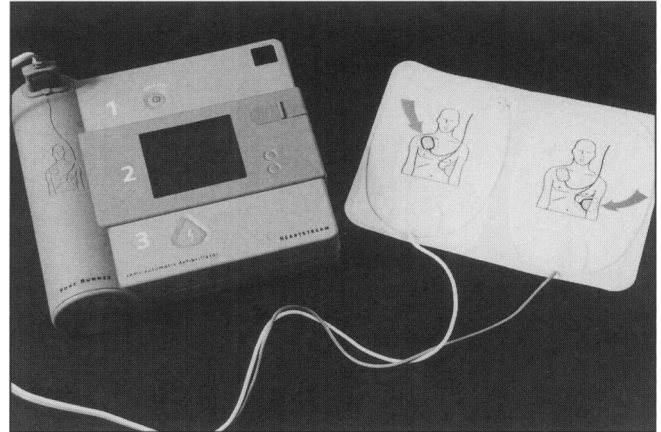


Figure 5 The *FORERUNNER* Semi-automatic defibrillator

designated trained individuals in public places including shopping malls and large department stores. It will be essential that such community activities must be operated through the ambulance service who will be able to give advice, and perhaps more importantly, moral support. As such it will be necessary to have a communication system between the rescuer and the ambulance service. The answer may be a mobile telephone although at present there is evidence that these devices interfere with defibrillator function.

In the first decade of the new millennium, defibrillators will be as common as fire extinguishers but smaller, cheaper and used more frequently.

To enhance the benefits of defibrillation, the other factor in resuscitation that needs to be sorted out is the airway. I suspect that the laryngeal mask will have a major role to play<sup>14</sup>. But that's another story.....

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