

Middle Articles

HOSPITAL TOPICS

A Year's Experience with a Mobile Coronary Resuscitation Unit

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Summary: A mobile unit for the emergency treatment of cases of coronary thrombosis in the patient's home and for their supervised conveyance to hospital has been operating in the City of Newcastle upon Tyne for a year. In that time 134 cases have been attended, and of these 39 benefited appreciably from use of the unit. The value of such a unit must be balanced in relation to the current mortality of the disease outside and inside hospital and the staff available

Introduction

The unit here described was modelled closely on that pioneered in Belfast by Pantridge and Geddes (1967), but differs in some respects in its mode of operation and still more in its results. This unit was started in the City of Newcastle upon Tyne on 17 December 1967.

The prime object of such a unit is obviously to bring the patient with a myocardial infarct under intensive care as rapidly as possible and thus to reduce the risk to life in those early hours after onset when it is by nature at its highest. A further purpose is so to improve the patient's condition by treatment in his home and by skilled supervision during transport to hospital that the journey there will enhance rather than diminish his chances of recovery. In practice, as will be seen, a third function has sometimes been fulfilled—namely, the successful treatment of some cardiac crises quite unconnected with coronary thrombosis. Now that intensive care units for the treatment of myocardial infarctions are being widely established in general hospitals—where, if properly equipped and staffed, they do reduce the hospital death-rate by up to 20% (Oliver *et al.*, 1967)—it is clear that the nursing of such patients at home must come under scrutiny. An increased admission rate to a hospital may well result. The mobile unit ought at least to ensure that this change does not increase the risks of death on the journey.

The first year's working of such a unit in one medium-size city is described below in relation to the purposes defined above, and an account is given of its successes and failures, how often it helped, and how often it made no difference to the outcome. It is not unseemly that it should also measure the cost of the effort in terms of money and time, and especially of the time of its operating staff.

The Unit

Funds for establishing the unit were provided by a donation of £4,000 from the Jacobson Trust, thus freeing the organizers of all financial problems in initiating the scheme. The idea of establishing the unit was discussed with the Medical

Officers of Health of Newcastle and Northumberland County Council, Drs. R. C. M. Pearson and J. B. Tilley, respectively, who co-operated enthusiastically. Newcastle is served by two large general hospitals of about 900 beds each. Both provide intensive care facilities for the reception of cases, though, as yet, only in the Royal Victoria Infirmary, and since August 1968, have these been available in a separate unit. It was intended that both hospitals should share in operating the mobile unit, but unfortunately the ambulance centre in the city, unlike that in Belfast, is situated about a mile (1.6 km.) from each. Since it would not be economic to station a driver permanently on duty in either hospital, Dr. Pearson suggested an ingenious system whereby the doctor in the team drove the specially equipped ambulance to the patient's house while another ambulance was summoned by radio to proceed to the same address and leave a driver there to bring the former vehicle back to hospital with patient and team. This system, while a stimulating challenge to many young doctors, naturally did not commend itself to everyone. To those from overseas in particular there was little attraction in driving an antiquated vehicle through a foreign city on a Northern winter's night.

In consequence the service was run for the first six months by medical staff from the teaching hospital only, though the regional board hospital accepted a proportion of the cases dealt with. Since June 1968 the system has been changed so that the vehicle is now stationed in the ambulance centre, and on receipt of a telephone call the driver on emergency duty there drives it to whichever hospital is on duty, collects the team, and proceeds to the patient's address. The general practitioners of the area served were notified of the unit through their executive councils.

The first vehicle purchased was an over-age Morris ambulance which had completed about 50,000 miles (80,000 km.) in the city's service. Its interior was stripped by the Health Department's engineering staff and re-equipped with a fixed platform in the centre. This was covered in 1-in. (2.5-cm.) plastic foam and hinged to provide a back-rest. Fold-up padded seats were laid over the hub-caps to let down flush with the platform so that doctor and nurse could then sit on either side of the patient to attend him. The arrangement also allows for easy external cardiac compression. In the ceiling is a hook for a drip-set and also a powerful spotlight. The recess over the driver's cabin takes much of the equipment. Large oxygen cylinders lie under the platform and smaller ones stand in a corner. A battery-operated defibrillator is clipped to the wall and an E.C.G. machine and oscilloscope rest on small shelves. A map of the city is fixed to the wall

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and a two-way radio is operated from the front seat next to the driver. Suitcases contain the drugs and other equipment, and are stored in the recess mentioned above the cabin.

A new vehicle with a purpose-built body on a standard Morris ambulance chassis is scheduled to come into service in 1969. As well as being more reliable it will be more capacious and comfortable than the old one, and instead of a fixed central platform on which to carry the patient it will have a mobile trolley. This will allow the patient to be placed on it inside the house, to be wheeled to the vehicle, and to be lifted up a ramp to the interior, where the trolley will then be bolted to the floor. On arrival at the hospital the trolley will be wheeled out right up to the ward. The patient should therefore need to be transferred only once, or twice at the most—in his home according to whether he is upstairs or downstairs, and once more in the hospital. The trolley has a rigid base covered with 1-in. (2.5 cm.) foam rubber so that external cardiac compression can be performed with ease and efficiency, but it is not uncomfortable.

Equipment

Diagnostic and Monitoring.—Cambridge portable electrocardiograph and Newmark oscilloscope, spare batteries, aneroid blood-pressure manometer, Baxter central-venous-pressure manometer, clinical thermometer, blood specimen tubes, stethoscope.

Therapeutic.—Battery-operated defibrillator (American Optical Co.). Drugs: adrenaline, aluminium hydroxide mixture, aminophylline, ampicillin, atropine, calcium gluconate, chlorothiazide, chlorpromazine, diamorphine, diazepam, digoxin, frusemide, heparin, hydantoin, Hypertensin, isoprenaline, lignocaine, mephentermine, metamamol, morphine, nalorphine, nitroglycerin, noradrenaline, ouabain, phenobarbitone, phentolamine, procainamide, propranolol, thiopentone. Intravenous infusion equipment, oesophageal tube (Jaques), syringes, cutting-down set.

Ventilating.—Laryngoscope and endotracheal tubes, Brooke airway, Guedel airways, Ambu resuscitator, MinEpak emergency ventilator, oxygen cylinders with humidifier, masks, hand-operated sucker.

Pacemaking.—Intracardiac needle with wire electrode (Elecath), pacemaker (battery and mains operated).

Nursing.—Blankets, pillows, towels, bedpan, razor, scissors and forceps, bandages, safety-pins, receptacles, tourniquet, files, soap.

Staff

The emergency coronary resuscitation unit (E.C.R.U.) team has always consisted of a doctor and a State-registered nurse. Many medical students have taken part. The doctors in the Royal Victoria Infirmary have taken duty on a sessional basis, 9 a.m. to 1.30 p.m., 1.30 p.m. to 6 p.m., and 6 p.m. to 9 a.m., and are drawn from a panel. Their status has been: consultants, 3; senior registrars, 4; registrars, 5; senior house officers, 10; anatomy demonstrators, 6. Some of the doctors, especially at night and weekends, have been on call at their homes and have driven to the hospital in their own car when required, usually arriving just before the ambulance. Since the Newcastle General Hospital staff joined the operating service the team from there has consisted of two senior house officers attached to the cardiovascular unit, performing alternate 24-hour spells of duty.

Procedure

Calls are accepted from any doctor in practice in the area, which is the City of Newcastle upon Tyne and the Urban

District of Gosforth, comprising some 320,000 persons. Calls are also accepted from a relative or friend instructed by the doctor to make one. In a few instances agreement has been reached to accept calls from nurses or ambulance workers of known reliability in factories and shipyards. Owing to the high risk of erroneous diagnosis, calls are not ordinarily accepted from the general public. Responsibility for accepting or rejecting a call is always laid on the E.C.R.U. doctor and not on the telephonist or nurse.

All calls are made to the Royal Victoria Infirmary. If that hospital is on duty the telephonist informs the doctor by special "bleep" (internal radio call system) and puts him in touch with the caller, who then provides details of the case and of the address. The doctor then asks the telephonist to call the E.C.R.U. ambulance at the depot and to "bleep" the nurse on duty and the medical student, who then assemble with the doctor at the hospital gates. If the Newcastle General Hospital is on duty that week the telephonist links the caller by direct telephone line to the hospital's switchboard operator, who then carries out the same procedure in his hospital.

When the E.C.R.U. vehicle arrives at the patient's house the two suitcases containing drugs and equipment and the E.C.G. machine are taken in by the team. The ambulance driver is asked to follow with the defibrillator and to deposit it just outside the patient's room. He is asked to wait in case anything further is needed, including sometimes his own personal assistance. The great majority of cases are brought back to hospital and only in exceptional circumstances left in their own home. Electrodes are kept attached to the patient so that his E.C.G. can be observed on the oscilloscope throughout the journey to hospital.

In all cases a written report on a standard form is given to the service organizer, a carbon copy of it being left with the patient in the admitting hospital.

Training and Instructions

Virtually all the doctors manning the service have had experience in looking after coronary thrombosis patients in hospital. They are shown the equipment available in the vehicle and given written technical instructions about the management of any complications that may arise. The nurses have also been given special training, and most of them are capable of intubating a patient.

Costs

The original vehicle cost £40, but alterations and repairs, including fitting of a new radio, brought this to £330, and the mobile equipment installed added a further £900. This equipment will be transferred to the new vehicle, which without it will cost £1,011 for the chassis and £1,675 for the purpose-built body.

Running Costs.—The vehicle is maintained by the City Ambulance Centre. The hospital, however, pays the charges for this, which have been roughly £10 a month, with a further £10 for meals for medical staff on call.

Staff.—The drivers of the Ambulance Centre run the vehicle as part of their routine duties. Medical staff have throughout given their services voluntarily. The nurses serve on an "on-call" basis, mostly in the department of anaesthetics, but at other times in other departments, some being on night duty in the wards, though the service has of course inevitably meant some addition to hospital staff. The amount of this addition is difficult to assess; overall it has probably meant the salaries of two staff nurses. In its first year of running the unit has been fortunate in having been given a substantial contribution

towards these nurses' salaries, as well as towards some of its equipment, from a privately launched appeal very generously responded to.

Results

In the first 12 months there have been 134 calls, 93 to men and 41 to women. The service is available to 129 general practitioners in the City of Newcastle upon Tyne and the district of Gosforth; 54 (42%) of them have taken advantage of it. The following table gives the time relations concerning calls:

Time Relations	Mean	Range
Time from onset to G.P.'s call ...	4½ hours	5 minutes to 5 days
Time from G.P.'s call to departure of ambulance	9 minutes	1-50 minutes
Journey to patient's house	12½ minutes	5-30 minutes
Time spent in house ...	40 minutes	1 minute to 3 hours
Return journey ...	13½ minutes	5-45 minutes
Total time spent on call...	1¼ hours	35 minutes to 3½ hours

Diagnoses.—The patients have been divided into four groups: (1) Definite myocardial infarction, 83; (2) coronary pain, 27; (3) other diagnoses pertaining to the heart, 8; (4) other diagnoses, 16. The second group were those who suffered severe pain of coronary type but in whom it was impossible to confirm myocardial infarction at the time. In 17 of these infarction was later confirmed, so that 75% (100/134) of the calls were to patients with definite infarction.

Other Cardiac Diagnoses.—These comprised atrial fibrillation 3, acute left ventricular failure 2, pericarditis 1, isoprenaline hydrochloride (Saventrine)-induced ventricular tachycardia 1, dissecting aneurysm of aorta 1. Four of these cases recovered; the patient with the dissecting aneurysm died later in hospital.

Other Diagnoses.—Sixteen patients had no cardiac disease; their diagnosis included pneumonia 3, dyspepsia 4, acute blood loss 1, syncope 1, anxiety state 1, acute tubular necrosis with pulmonary oedema 1, morphine overdose 1, epilepsy 1, bronchitis 1, pleurisy 1, unknown 1. All these patients recovered except the one with acute tubular necrosis, who died four days later in hospital.

Assessment of Benefit

An attempt has been made to classify the patients into categories according to the benefit they received from the visit of the ambulance: (1) lives definitely saved, 3; (2) patients substantially improved by treatment, 16; (3) patients appreciably improved by treatment, 20; (4) patients already dead when E.C.R.U. arrived, 12; (5) patients who died at home despite treatment, 9; (6) patients whose prognosis was uninfluenced by E.C.R.U., 75. Significantly it can be seen that 12 patients died at home between receipt of the call and arrival of the unit. Of the three patients in category 1, two had complete heart-block with long episodes of asystole, and one had ventricular fibrillation. Of the patients substantially improved by treatment, the majority were suffering from acute left ventricular failure or serious arrhythmias.

The procedures which have proved most rewarding have been the treatment of acute left ventricular heart failure with intravenous aminophylline and frusemide and inhalation of oxygen, of heart-block with or without Adams-Stokes attacks, and of multiple ectopics, paroxysmal tachycardias, and ventricular fibrillation. For the Adams-Stokes attacks external cardiac compression, isoprenaline infusion, and direct intraventricular insertion of an Elecath pacemaker have all been used successfully. For the tachycardias digoxin, lignocaine, and procainamide have been used appropriately. For

ventricular tachycardia and ventricular fibrillation the battery-operated defibrillator has been most successful. Where, with ventricular tachycardia, the patient has been conscious, 10 mg. of diazepam intravenously appears for about half an hour to prevent all feeling of pain and ensures no recollection of the defibrillation afterwards.

Least successful have been attempts to treat shock not due to disturbances of rhythm, and asystole. Both, especially the former, are doubtless most often reflections of the great extent of cardiac damage. External cardiac pacing has never proved of use, and it is thought that the blind intravenous insertion of pacemaking catheters is much more likely to do harm than good.

Discussion

The value of the service must be considered in relation to various factors. One is the number of deaths due to atherosclerotic heart disease which occur outside hospital. McNeilly and Pemberton (1968) showed that 60% of them did so occur and that of these deaths outside hospital just over 60% took place within an hour of onset. The same pattern was seen in a very useful seven-month review which Professor R. C. Wofinden, medical officer of health for Bristol, carried out in that city in 1965 (personal communication) and from which he concluded that in a full year its ordinary ambulance service would find some 74% of 180 cases—that is, 133 persons—dead of heart disease when it arrived. Sixteen more patients might die in the ambulance on the way to hospital. Although the time taken by his city ambulance service to reach these cases was only seven minutes from receipt of the call from the public, he asks the very pertinent question, "Is anyone ever resuscitated anywhere in an ambulance?"—that is, one with standard equipment and staff. The contribution towards reducing mortality of a unit such as the one here described must inevitably be small and far inferior to the results one hopes to obtain in future from primary prevention or radical treatment of ischaemic heart disease on first recognition when these do become practical propositions. But at least the sophisticated equipment and the highly trained staff do present a reasonable possibility of successful resuscitation.

Compared with an inpatient intensive care unit, of course, the dividend of lives saved by a mobile service is small, since the patients are under observation for so much shorter a time. It is certainly quite wrong to organize a mobile unit unless one has adequate special inpatient facilities for the reception of the patients for whom it is intended to cater. Continuous monitoring, properly trained nursing staff exclusively allocated, and readily available medical staff are essential prerequisites, as Oliver *et al.* (1967) have stressed. Where problems of staffing preclude the provision of both services the inpatient one must unquestionably have priority.

From the year's working of this unit in Newcastle it is very evident, firstly, that, despite what seemed adequate publicity at its inception, only a minority of doctors (42%) avail themselves of the service, and their numbers are not increasing; secondly, the service has proved of value to only a minority of the patients on whom it has attended. There can be no doubt that practitioners discriminate concerning the cases for which they summon the unit's services, sending the mild ones into hospital in an ordinary ambulance or keeping them at home, and occasionally dispatching the not-so-mild cases in an ordinary ambulance as being quicker. No attempt has been made by the mobile unit to lay down indications for its use, since it is felt that this cannot be done reliably. Experience with inpatient treatment units has shown most clearly that both ventricular fibrillation and asystole, especially the former, can arise without warning of any kind, though, equally certainly, danger signals are more often obvious. The service of the unit is being used with responsibility and its staff have

no complaints. The only way in which that use may be extended in the near future is in the geographical area for which it is made available and in the personnel, especially ambulance men from whom calls in future may be accepted.

Two Problems

Finally, mention must be made of two problems. These are:

Delays.—The time elapsing from onset of illness to receipt of call from a general practitioner is four and a half hours, with a range of five minutes to five days, and this is most discouragingly long. A large part of this time appears to be spent by the patient or his relatives either deciding whether the doctor needs to be called or in finding him. Also the doctor is sometimes unsure of the diagnosis and awaits events, or decides to treat the patient at home and then finds that he does badly there. Clearly it is very desirable to cut down this time but not entirely easy to see how it can be done. The time, too, taken by the unit to reach the patient is longer than is desirable, and the mean of that time has risen from 18 minutes to 21½ minutes since the medical staff ceased to drive the ambulance. But the former method has several disadvantages and is unlikely to be resumed. To send the ambulance independently and for the medical team to travel by car is one possible solution, but the matter is under debate. The comparatively large number of cases in which the patient has died between the time the call was received and the arrival of the unit at the house is a standing reproach.

Staffing.—Logically the mobile service should be regarded as an extension, earlier in time, of the inpatient treatment unit and should be staffed by the same doctors and nurses, so that the patient would be brought under their care sooner. This has not consistently been possible under the present organization, and without the many doctors who have volunteered to take part the service would not and could not have run.

Whether in future more generous staffing of the hospital service will enable them to be dispensed with is for the country, through its Government, to decide. Certainly for most hospitals, and especially the district general hospital, the mounting of such a unit must usually pose a severe problem of staffing. The vehicle and equipment needed are inconsiderable expenses for such an important task, but to have a driver, a doctor, and a nurse always immediately available without wasting the time of the first and dangerously and inconveniently depleting the wards and outpatient departments of the other two would seem far from easy. Nevertheless, it is clear from this year's experience that such a unit does have potential in saving lives from myocardial infarction and in doing a substantial amount of good to other patients, whether they have had an infarct or simply had some other cardiovascular crisis. The great extra confidence which patients and their relatives have derived from the attention of the unit is also a factor which should not be ignored, and it does compensate the staff for the many journeys that are, strictly medically, fruitless.

Apart from the many persons mentioned in the text who have helped to set up and maintain the service, acknowledgement must also be made of the assistance given by Mr. H. M. Roberts, Chief Ambulance Officer of the city, and his Chief Engineer, Mr. Henderson; by Mr. T. V. Roberts and Mr. W. O. H. Collins, House Governor and Deputy House Governor, respectively, of the Royal Victoria Infirmary; and by Mr. K. C. Booker, Secretary of Newcastle Hospital Management Committee, by the Misses F. Shaw, Matrons of the two hospitals, by Professor E. A. Cooper of the Department of Anaesthetics, Royal Victoria Infirmary, and by Dr. W. G. A. Swan of the Regional Cardiovascular Centre.

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CONFERENCES AND MEETINGS

Euthanasia

[FROM A SPECIAL CORRESPONDENT]

Euthanasia was discussed at a meeting of the library (scientific research) section of the Royal Society of Medicine on 13 October. Opening the discussion, LORD PLATT (Cambridge) put forward the view that euthanasia was justified, but only under certain circumstances. There was no justification for keeping alive a patient who was suffering from irrevocable brain damage and leading an unconscious vegetable-like existence—particularly when life was being supported solely by laboratory means. Moreover, patients in the terminal stage of a fatal illness, particularly if in pain, should not have their life prolonged.

In a poll of 1,000 doctors, 76% had subscribed to euthanasia for such patients. Lord Platt stated that personally he would not intervene if a patient of his wished to take his own life because he was on the point of death and could not tolerate any more suffering. Nevertheless, he warned against a blanket approval of euthanasia. Each patient should have the right to accept or reject it, voluntarily, if his illness became unbearable. There were, however, some objections to signing the necessary documents in advance. Lord Platt would not want any

meddlesome doctor to start his own heart beating again, with the aid of scientific gadgets, if it stopped at his age. Acute cardiac arrest in the younger person was another matter. He failed to see why the elderly should have to die two or three times because of interfering doctors; once was enough. Most doctors agreed to euthanasia in cases such as Lord Platt outlined, but few were prepared to administer the "coup de grâce." However much pain a patient was suffering, few doctors would want to administer a lethal drug.

Social Aspects

LORD BROCK (London), who was not opposed in principle to euthanasia, considered that it was a social rather than a medical problem. If euthanasia became legal the State should have the responsibility of selecting patients, stating how and where it should be done, and even of appointing its own executioners. Lord Brock hoped that doctors and nurses would have nothing to do with the act of euthanasia; they had a duty to their patients, but this did not extend to killing them. If the State wanted euthanasia

it should appoint those who were willing to undertake the means. An Act of Parliament could not force doctors to carry it out. Furthermore, it was pointed out that the patient's confidence in his doctor or nurse would be seriously undermined if he thought that every time they came into his room they might be planning to destroy him. Important points at issue, stated Lord Brock, were where euthanasia should be carried out—whether in the home, a hospital, or in special centres—and whether the Post Office should issue the necessary forms. Voluntary euthanasia was just the beginning, but without stringent control the next step would be involuntary euthanasia.

Legal Aspects

Professor GLANVILLE WILLIAMS, Q.C. (Cambridge), considered that legalized euthanasia might cause much apprehension among the old and infirm, and that it was more of a moral than a medical problem. Morally there was no difference between helping a suicide to die and assisting the decease of a patient with a terminal illness. When a doctor, under the pretext of relieving