

## PAPERS AND ORIGINALS

**Impact of the new generation coronary care unit**

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*British Medical Journal*, 1976, 2, 837-839**Summary**

**A 30-bed coronary care unit with facilities for fluoroscopy, haemodynamic monitoring, mechanical heart assistance, and long-term electrocardiographic monitoring operated at a reasonable cost over five years. Much of the work was entrusted to trained nurses, and there was close consultation with cardiac surgeons over those patients who needed catheterisation or surgery. New procedures greatly reduced the numbers of early deaths from cardiac arrest and cardiac failure but had less influence on late mortality. Hospital mortality for all 3353 patients was 6.8%, and for patients under 65 with definite infarction, who were admitted direct it was 5.7%.**

**Introduction**

While it is generally accepted<sup>1-6</sup> that coronary care units have reduced hospital mortality from acute myocardial infarction, questions have been raised about the cost-effectiveness of such units,<sup>7</sup> the degree of benefit to be expected,<sup>9,10</sup> and even whether some patients may best be treated at home.<sup>9,11</sup> Though such reports represent minority views and have all been challenged, they have a substantial impact on health authorities,<sup>12</sup> who demand further justification of coronary care before acquiescing to demands for improved prehospital and hospital facilities.

Such queries about coronary care have prompted this report of our experience in a coronary care ward over five years after the introduction of new monitoring and treatment facilities.

**Facilities and procedures**

The new coronary care ward at this hospital was opened in March 1971 as a whole floor of a new ward block. The 30-bed ward comprised

acute (six-bed) and subacute (24-bed) sections. In all six acute beds and 12 of the subacute beds the electrocardiogram (ECG) could be monitored at the bedside and at two separate consoles. The acute and subacute sections functioned as separate units with separate nursing staff but with the same nursing supervisor (BW). The total nursing complement for the 30 beds was 17 trained nurses, 17 trainees, and one supervisor. Other staff in the acute section of the ward included one medical registrar and one technician.

Patients were admitted to the acute section of the ward and remained there until stable, when they were transferred (usually on the third day) in the same bed to the subacute section. Electrocardiographic monitoring was continued in the subacute section until patients were mobilised, usually on the fourth to eighth day. Patients were discharged home from the subacute section of the ward. There was no definite age limit for admission to the ward, but patients aged over 70 were often managed elsewhere when intensive measures seemed inappropriate or when the ward's capacity to accept younger patients would be jeopardised by their presence.

One cardiologist (MO) was responsible for the overall operation of the whole ward and for managing all the patients in the acute section. Medical care reverted to the admitting cardiologist or physician when the patient moved to the subacute section.

Advances in patient care included facilities for monitoring systemic and pulmonary artery pressures (introduced in March 1971) and for arterial counterpulsation<sup>13</sup> (introduced in November 1971). By the end of 1975 three dual channel manometer systems and three Avco intra-aortic balloon counterpulsation pumps were available. A ceiling-mounted image intensifier was installed in 1973, enabling monitoring, pacing, and counterpulsation catheters to be positioned quickly and accurately. Throughout the whole period diagnostic cardiac catheterisation and cardiac surgical facilities were available in another building, and a coronary ambulance service staffed by ward personnel<sup>14,15</sup> operated from the hospital.

When the ward was opened responsibilities were defined and lines of communication clarified. Close liaison was maintained between the responsible cardiologist and nursing supervisor. Team work was encouraged through active participation and collaboration between medical, nursing, and paramedical staff. In the absence of a doctor nurses administered lignocaine intravenously and performed cardiac massage, positive pressure respiration, and defibrillation according to a set protocol. Cardiac surgeons were consulted early over patients for whom surgical procedures were contemplated. Surgeons performed all balloon catheter insertion and removal procedures, and jointly supervised all patients undergoing circulatory assistance. Experience in the ward was reviewed at regular meetings of the cardiovascular unit.

**Results**

Over the five years up to 24 March 1976 3353 patients were admitted to the coronary care ward. Most came from the emergency

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department but just over 10% were transferred from other hospitals without comparable facilities. This transfer rate of about 70 patients a year was considerably greater than that in earlier years, when only three or four patients a year were transferred for coronary care. Patients transferred from other hospitals usually had coronary insufficiency and were admitted for consideration of aortocoronary bypass surgery or they had complicated infarction and were admitted for consideration of arterial counterpulsation or cardiac pacing. These patients with infarction were usually gravely ill on admission.

In the five years 96 patients with infarction (67 transferred from other hospitals) were treated with arterial counterpulsation. Indications for counterpulsation were cardiogenic shock (69 patients) or "pre-shock" (27 patients)—acute severe heart failure that was not responding to conventional treatment and which was associated with other complications.<sup>13 16</sup> Forty-three of the 96 patients survived.

Pulmonary or systemic arterial pressures, or both, were monitored in over 250 patients. Indications for such monitoring included moderate or severe cardiac failure and hypertension or hypotension complicating infarction. Over 100 patients were paced, the indications being heart block with a heart rate under 50/min or anterior infarction associated with bifasicular block. Complications of counterpulsation, described elsewhere,<sup>17</sup> were not responsible for death in any patient. Complications of haemodynamic monitoring were relatively trivial apart from one episode of ventricular fibrillation, promptly corrected, that occurred when a Swan-Ganz catheter was being passed through the right ventricle.

The death rate in hospital for patients admitted to the ward was 6.8% (229 out of 3353 patients). A detailed analysis was made of patients admitted to the ward over two years (July 1973 to June 1975) that should have been representative of the whole five-year period. This recent experience was compared with that in our first three-bed coronary care ward in 1967-9 from records prepared at the time. (A Breslin and C Eastman, unpublished data).

Patients were classified according to World Health Organisation criteria<sup>18</sup> for definite infarction. By these criteria just under half (620) the 1364 patients had suffered definite infarction while another 361 (26.5%) were judged as having possible infarction or angina pectoris. In 122 (8.9%) the final diagnosis was cardiac arrhythmia without myocardial infarction. Another diagnosis was made in the remaining 261 patients. The average age of patients with infarction was 59.4 years, and their average stay in hospital lasted 16.2 days.

The mortality rate in hospital was 7.3% (100 out of 1364 patients) over the two years. As expected, it was higher in patients with definite infarction (14.2%; 88 out of 620) than in patients with other diagnoses (1.6%; 12 out of 744). The mortality rate was high in patients with definite infarction referred from other hospitals (38.8%; 38 out of 98) and in those 65 and over with definite infarction who were admitted direct (20.3%; 28 out of 138). Mortality was quite low (5.7%) in the 384 patients under 65 who were admitted direct. Some of these patients under 65 were disabled by cardiovascular disease before presentation and were not considered for arterial counterpulsation or other active measures. Excluding these, the mortality for patients under 65 with definite infarction, admitted direct, was under 5% (17 out of about 349).

These hospital mortality rates in the new ward compared favourably with those in the original coronary care unit, where the mortality rate for definite infarction was 26% overall, 24.6% for patients admitted direct, and 18.8% for patients under 65 admitted direct to this hospital. The improvement in mortality figures seemed to be real and not merely attributable to selection of patients. Patients who died after transfer to other wards, during cardiac investigation, or after surgery were considered to have died in the ward. It seemed possible that there may have been undue delay in transferring patients from the emergency department and that many deaths may have occurred there. Records of the emergency department for the same two years were checked, and we found that only five patients with definite infarction had died there; three of these would not have been admitted to the ward because of extreme age or infirmity and, of the remaining two, only one was under 65 years of age.

The decline in mortality in the coronary care ward has been reflected in hospital statistics for all patients treated for myocardial infarction in the coronary care and other wards. Between 1966 and 1970 the mortality rate for myocardial infarction in the hospital as a whole was 27.8%, while between 1971 and 1975 it was 22.0%. This decline occurred despite the many patients transferred from other hospitals and an apparent increasing tendency to attribute death in terminal patients with other diseases to myocardial infarction.

The table shows the causes of death in patients admitted direct to the coronary care unit with definite infarction over the two years and in those admitted to the original ward. The three most common

*Causes of death in patients with definite infarction admitted direct to coronary care unit*

	1967-9	1973-5
<i>Early death (in acute section)</i>		
Cardiac failure . . . . .	21 (10.7%)	17 (3.3%)
Complete heart block . . . . .	6 (3.1%)	1 (0.2%)
Ventricular fibrillation . . . . .	3 (1.5%)	0 (0)
Unrelated . . . . .	2 (1.0%)	0 (0)
Cardiac rupture . . . . .	0 (0)	4 (0.8%)
<i>Late death (after leaving acute section)</i>		
Cardiac failure . . . . .	7 (3.6%)	13 (2.5%)
Cardiac arrest . . . . .	7 (3.6%)	12 (2.3%)
Unrelated . . . . .	2 (1.0%)	0 (0)
Cardiac rupture . . . . .	0 (0)	3 (0.6%)
Total patients	196	522
Total deaths	48 (24.5%)	50 (9.6%)

causes of death in the new unit were cardiac failure, cardiac arrest, and cardiac rupture. There was a dramatic reduction in the proportion of deaths from cardiac arrest (0.2% v 4.6%) and cardiac failure (3.3% v 10.7%) in the acute section of the ward. The number of deaths from later cardiac arrest and cardiac failure after discharge from the acute section fell modestly (from 3.6% to 2.3% and from 3.6% to 2.5% respectively).

Over the past two years 22 patients under 65 died in the coronary care ward. Eleven died of cardiac failure. Five of these had previously been disabled by cardiac disease and were not considered for arterial counterpulsation. One declined counterpulsation, and three died of cardiac failure despite counterpulsation. Cardiac rupture occurred in two patients on the first and fifth day. No patient under 65 died of arrhythmias in the acute section of the ward, but nine died thus in the subacute section. Most of these patients had suffered extensive infarction. Eight of the nine were not being monitored at the time of cardiac arrest and were progressing well towards discharge. Seven of the nine were not receiving antiarrhythmic therapy.

## Discussion

These results of coronary care in a large series seem to be better than previous results when considered in relation to age and mode of admission. Nevertheless, while "stone dead hath no fellow," the diagnosis of infarction in this type of study is not so clear cut. The time of referral can also influence mortality figures, with better results obtained the longer the initial delay.

We have tried to be as strict as possible in applying the WHO criteria of infarction and believe that the rather low incidence of definite infarction (45.5% of all admissions) is partly due to this. We have no reason to suspect any particular delay in direct admission to this hospital, especially when we were actively promoting a coronary ambulance service.<sup>14 15</sup> The time from onset of symptoms to start of coronary care was not determined for these patients. In a recent group of patients the median time for admission to hospital was four and a half hours and we believe that a similar period applied over the past five years. The emergency department at this hospital has excellent ECG monitoring facilities and it has been routine practice for patients to stay there one or two hours while admission procedures are arranged and ECG and chest x-ray pictures are taken. Deaths have occurred in the emergency department despite prompt resuscitation measures, but these would not have significantly influenced overall results, even if all such patients were considered to have died in the ward.

We believe that mortality from myocardial infarction has indeed been lowered by the new facilities we have been able to offer. In probing further we have been unable to be certain that any one measure was more important than another, although arterial counterpulsation might be expected to have played an important role, having opened a new dimension to the treatment of severe cardiac failure.<sup>13 19</sup> In the two years for which detailed results were obtained counterpulsation was needed in only 13 patients under 65 who were admitted direct, and nine survived. Even if all these nine patients would otherwise have died (which is unlikely) the mortality rate for patients under 65 would have

been 8.1%, instead of 5.7%. Fluoroscopic equipment in the ward has improved our capacity to place pacemaker catheters. This equipment may have contributed to the low incidence of primary cardiac arrest, but the reduction in the numbers of early arrhythmic deaths was more probably due to conventional preventive and resuscitative techniques and perhaps to the quiet and restful atmosphere of the ward.

We expected that the presence of monitoring facilities in the subacute section of the ward would decrease the incidence of late arrhythmic death. This may have occurred, but we still had a high incidence of sudden unexpected death during convalescence, usually after monitoring had been discontinued. We had to conclude that results would have been better had we used telemetry to monitor ambulant patients during convalescence or had we been more active in long-term arrhythmia prophylaxis.

Our experience suggests that with longer ECG monitoring and appropriate antiarrhythmic therapy the hospital mortality for myocardial infarction in patients under 65 can be reduced to well under 5%. Mortality may be even further reduced by interventions designed to limit infarct size applied in the very early stage of infarction. Most of our patients who died of late cardiac failure and late arrhythmias had suffered extensive infarction in the early stage of their hospital course. Many were considered for arterial counterpulsation but this was not used because strict criteria for intervention were not met.<sup>13</sup> Measures applied early for limiting infarct size may prevent many of these late deaths.<sup>20</sup>

A detailed costing of the new coronary care cannot be given here. Counterpulsation pumps and catheters together with haemodynamic monitoring facilities have cost about \$100 000 over the five years. Fluoroscopy cost another \$20 000. Except for the addition of one technologist, medical and ward staff have not been increased with the introduction of these new techniques despite the many extremely ill patients transferred from other hospitals.

We conclude that new advances in coronary care have led to a substantial reduction in hospital mortality. These advances hold the prospect of reducing even further mortality and late disability, and they seem to be justified on economic grounds.

Many physicians, surgeons, and nurses played important parts in the coronary care unit. In particular we acknowledge contributions made by members of the cardiovascular unit: H M Windsor, W A Seldon, G V Hall, J B Hickie, M X Shanahan, G Michell, J J Morgan, V P Chang, J Gunning, and P Roy. We thank Misses R Bull, L Mann, J Kennedy, and R Farren and Mr T Nash for help with data preparation. We acknowledge with thanks financial assistance provided by the Ramaciotti Foundation, National Heart Foundation of Australia, National Health and Medical Research Council of Australia, the Eastern Suburbs Leagues Club of Sydney, and by generous anonymous individuals.

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# Referred itch (Mitempfindungen)

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*British Medical Journal*, 1976, **2**, 839-841

## Summary

**About one person in four or five is conscious that scratching an irritation may produce an itch elsewhere. The sensation is well localised, comes and goes quickly, and recurs when scratching is repeated a short while later. Scratch and referred itch are ipsilateral; scratching the site of the referred itch does not cause the original spot to itch. Scratching face, palms, or soles does not produce**

**referred itching. Different people stimulated in the same region do not necessarily feel referred itch in the same place. The mechanism of the phenomenon is unknown, though it may be thalamic.**

## Introduction

When some people scratch an insect bite they may itch elsewhere. This phenomenon was clearly described by Kovalevsky in 1884.<sup>1</sup> He was professor of physiology in Kazan, but attempts to identify the journal containing his communication have failed. It was, however, summarised by Nawrocki in 1886.<sup>2</sup> Kovalevsky made 21 observations, presumably on himself, and noted most of the characteristic features. The sensations of the stimulus (which he called the irritation) and the response (*Mitempfung*; associated feeling) were not identical. They were ipsilateral. The response was limited to a small area of skin, little more than a point. It was quickly elicited and it