The use of radiotelemetry after discharge from the coronary care unit

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ABSTRACT—Forty-six of 110 consecutive admissions to the coronary care unit (CCU) were monitored by telemetry after discharge from the unit. One of three patients with sudden cardiac death was resuscitated successfully and four patients developed atrial fibrillation which resulted in investigation by echocardiography and treatment with anticoagulants. Significant ventricular ectopic activity was detected in four other patients. Arbitrary selection of patients resulted in those with complicated courses in the CCU being more likely to be monitored by telemetry after transfer to the ward than those which were uncomplicated. There were no cases of sudden cardiac death in patients who did not have telemetry. The cost of telemetry was £2,775 per system. All 19 districts in the North-West region of the UK responded to a questionnaire. Five of the 19 used telemetry but only two of these used the technique routinely after discharge from the CCU whereas four used radiotelemetry to monitor patients on the ward when coronary care beds were unavailable. Eight districts wanted telemetry but needed funds. We conclude that radiotelemetry is an inexpensive way to detect serious arrhythmias in patients transferred from the CCU to the general ward. Monitored from the CCU, cardiac arrest can be immediately detected and treated by experienced staff. Asymptomatic atrial fibrillation leads to prompt investigation by echocardiography and possible treatment with anticoagulants. The importance of noticing major ventricular ectopic activity is likely to increase with the possibility of selecting patients with a high risk of life-endangering arrhythmias so that antiarrhythmic drugs or techniques such as automatic defibrillators can be used appropriately. The ability to continue monitoring on the general ward allows more rapid turnover of the CCU beds which is increasingly important as extra demand is created by the widespread use of thrombolysis.

Enthusiasm for continuous electrocardiographic monitoring after discharge from the coronary care unit (CCU) has waned since the late 1970s in keeping with reduced interest in the value of detection and treatment of arrhythmia in the post-infarction patient. In Lancaster radiotelemetry was started to relieve pressure on the coronary care beds. The successful resuscitation of one patient with ventricular fibrillation who collapsed on the general ward while on telemetry led us to assess the use of the system in post-coronary care patients. The rhythm abnormalities and the interventions that resulted were observed, as well as any effect that the detection and treatment of such arrhythmias had on subsequent management and outcome.

Patients and methods

The coronary care unit (CCU) in Lancaster accepts patients under four consultants on an 'on call' basis. Consecutive admissions under the care of two of the consultants were in the study over a period of 6 months. The diagnosis of acute myocardial infarction (AMI) was based on standard ECG and enzyme criteria. Arrhythmias during the period in the CCU were monitored and details of arrhythmias and their management were recorded. More than 10 ventricular ectopic beats (VEs) per hour were regarded as significant, and ventricular tachycardia was defined as three or more VEs at more than 120 beats per minute.

On transfer to the general medical wards patients with suspected AMI were considered for 72 hours of continuous monitoring using radiotelemetry. Hewlett-Packard transmitters and receivers, models 78100A and 78101A respectively, with a range of up to 70 metres were used. While on telemetry the patients were as mobile as their individual cardiac rehabilitation programme allowed. Only four units of transmitters and receivers were available. Reasons for not putting a patient on telemetry or for telemetry lasting less than 72 hours were recorded. Changes in treatment, cardiac symptoms, recurrent infarction, referral for coronary arteriography and those patients who underwent bypass surgery or PTCA were recorded for up to 14 months after admission.

Questionnaires, sent to consultants in each district with an interest in cardiology, asked whether or not telemetry was available to monitor cardiac rhythms after AMI. If the answer was affirmative, further questions ascertained if telemetry was used (i) after a period in the CCU, (ii) when CCU beds were full, (iii) instead of a formal CCU. Finally, comments were solicited.

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Results

From the 110 patients admitted with a provisional diagnosis of AMI, twelve were excluded from the study, seven because they were transferred from the CCU to wards other than general wards, three were visitors to the area and two were transferred for electrophysiological studies before telemetry could be started.

Of the remaining 98 patients, 77 were men (age range 37–84 years, mean 62 years). The length of stay on the CCU was 1–12 days (mean 3.4 days) for patients not receiving telemetry. Patients on telemetry spent 1–10 days (mean 4.8 days) on the CCU and the duration on telemetry was 1–19 days (mean 3.3 days). Forty-six patients were monitored by telemetry; the remaining forty-one were not put on telemetry mainly because transmitters were not available. Nine patients died on the CCU so were not available for telemetry and two patients were kept on the CCU because of lack of beds on the general ward.

Follow-up was 6 months or more in all except ten patients, of whom nine failed to attend for subsequent appointment and one died of malignancy soon after discharge from hospital.

Inpatients who did not receive telemetry

Acute infarction was confirmed in 31 patients (Table 1). Nine patients died in the CCU; in three of these patients the cause of death was ventricular fibrillation, in four cardiogenic shock, and two died in asystole. The arrhythmias developed by patients in this group while in the CCU are shown in Table 2.

One patient was transferred to the ward with severe hypotension and subsequently died. The rest of the patients who were not followed up by telemetry had no complaints attributed to arrhythmias during the remaining period in hospital.

Subsequent fate of patients not on telemetry

Four patients died: two from cerebrovascular incidents, one from septicaemia after cholecystectomy and one from heart failure. Two patients were readmitted with acute infarction. One was successfully cardioverted for ventricular tachycardia but subsequently died with asystole while on telemetry. This patient was in the group of patients who did not have proven infarction during the inital admission. Two women, aged 57 and 47, who did not have proven infarction underwent angiography because of recurrent chest pain. One had severe three-vessel disease and subsequently underwent coronary bypass surgery. The other patient had minor narrowing of the right coronary artery and surgery was not advised.

Patients monitored by telemetry

Eleven of the 46 patients had no evidence of acute infarction (Table 1).

The arrhythmias that occurred on the CCU and while on telemetry are noted in Table 2. Three patients required emergency intervention: one for ventricular tachycardia and fibrillation, one for asystole and one for ventricular standstill. The last of these three patients was the only survivor.

Follow-up in this group of patients showed that the survivor from ventricular standstill was readmitted 4 months later with an acute infarction. He had no further rhythm disturbances while on the CCU or subsequently on further telemetry. Three of the patients

Table 1. Types of infarction

	Non-telemetry	Telemetry
Inferior Q	11	11
Inferior non-Q	3	4
Anterior Q	9	10
Anterior non-Q	2	1
Raised enzymes only	6	9
No infarction	21	11
Total	*52*	*46*

Table 2. Arrhythmias

Type	Non-telemetry patients on CCU	Telemetry patients on CCU	Telemetry patients on telemetry in general ward
Premature ventricular beats	13	11	4
Ventricular tachycardia	1	10	1
Ventricular fibrillation	3	3	1
Supraventricular tachycardia	3	1	0
Atrial fibrillation	3	4	4
Nodal rhythm	2	0	0
Atrial ectopics	2	0	1
Heart block			
First degree	0		0
Second degree	0	1	2
Complete heart block	2	2	0
Bradycardia		3	

with acute infarction later had positive coronary angiograms, and two of them underwent successful bypass surgery; the third patient was regarded as a poor surgical risk. One other patient who suffered infarction was awaiting coronary angiography as the study period finished. Two patients without infarction subsequently had angiography. One showed normal coronary arteries and the other, who had intermittent Wenckebach phenomena while on telemetry, was shown to have ST segment depression during 24-hour electrocardiograms; coronary arteriography and angiography showed occlusion of the left anterior descending artery with poor left ventricular function and a huge thrombus in the left ventricle

The survey by questionnaire

Replies were received from 19 of the districts in the region. Five used radiotelemetry after infarction; four used it when the coronary care beds were occupied. Only two districts used telemetry to monitor patients who had been treated in the CCU initially, and one other district used it occasionally in such cases. One district used telemetry instead of a formal CCU. Comments from the 14 districts without telemetry showed that eight cardiac physicians wanted telemetry but funds were not available. One physician had used telemetry previously but was unconvinced of the value because the monitoring nurses 'seemed not to watch the monitors assiduously'.

Discussion

The detection and immediate treatment of sudden cardiac death (SCD) remains the main justification for CCUs. The prediction of life-threatening arrhythmias from the recognition of electrocardiographic abnormalities such as ventricular ectopic beat frequency, salvos and R on T led to the establishment of intermediate CCUs. Reassessment of the value of the intermediate coronary care by Weinberg [1] has shown a lack of proven value and cost effectiveness; he suggests that such beds used without discrimination are wasteful and in some instances merely serve as status symbols. An alternative is to use beds in a general ward as intermediate care beds by utilising radiotelemetry coupled to the specialist knowledge and skills of the coronary care staff who monitor rhythm abnormalities in these patients as well as in those occupying beds in the CCU. In our unit no additional staffing is required because it is the coronary care staff who observe and activate treatment of any rhythm abnormalities. This restricts expense to the capital cost of acquiring telemetry units plus the annual maintenance charge. Our CCU uses a computerised electrocardiogram monitoring system and to add four additional units for central monitoring costs £1,357. Each individual patient telemetry system with a transmitter and receiver costs £2,775.

The best evidence for the value of telemetry is the detection and management of SCD. Out of our 46 patients who were monitored by telemetry, three received emergency management including defibrillation for SCD and one survived. In another series [2], two of 49 patients monitored by telemetry after AMI were treated for ventricular tachycardia but none of them required defibrillation. However, the authors say that patients with AMI were placed on telemetry after several days of monitoring in the CCU. This seems to remove one of the main uses of telemetry — to relieve pressure on the coronary care beds and allow quicker turnover.

When atrial fibrillation is detected during telemetry we go ahead with two-dimensional echocardiography and then decide whether or not to anticoagulate. The drug treatment of ventricular arrhythmias remains debatable but it seems likely that radiotelemetry will be increasingly useful in the selection of patients with high-risk arrhythmias who may need antiarrhythmic drugs, the use of ablation techniques or automatic defibrillation.

Our series is undoubtedly considerably affected by having only four telemetry sets and by the attitudes of the nursing staff in the CCU. Although they try to find telemetry systems for all patients leaving the unit, there is a bias towards those who have more serious arrhythmias. This is reflected in the number of patients without telemetry who suffered ventricular tachycardia in the CCU (1) compared with those who received telemetry (10). As there were no instances of SCD on the general ward in patients without telemetry, it may be that this spontaneous selection process has been successful. The series is also affected by a natural reluctance to transfer to the general ward patients who remain haemodynamically compromised. This is reflected in the longer time spent in the CCU by patients subsequently on telemetry (3.4 days to 4.8 days). Five of the nine patients who died in the CCU belong to this category but the other four were patients who were relatively well with no major arrhythmias. All four died about 48 hours after admission while awaiting beds on the general ward. As a practical consequence our current practice is to use telemetry in patients with major ventricular arrhythmias while in the CCU, in patients with no arrhythmias who may be discharged to the ward after less than 48 hours in the CCU, and to reduce the period in the CCU for patients with haemodynamic problems and arrhythmias who have required longer than 48 hours on the unit.

A general benefit of the availability of radiotelemetry is to relieve pressure on CCU beds. At times we have to use telemetry as an addition to CCU beds because all its beds are occupied but the main advantage is to speed up the turnover. Medical and nursing staff feel confident to transfer patients to the general ward even though arrhythmias persist through the period in the CCU. Patients too are aware of medical interest in arrhythmias during the stay on the unit and have commented favourably about continuation of monitoring on the ward. Our series predates the regular use of thrombolysis in patients with suspected AMI which has added to the pressure on the coronary care beds.

In our survey of the 19 other districts in the North-West region, eight of the 14 cardiac physicians who do not have telemetry say they would like the facility but funds are not available. It is difficult to assess cost effectiveness. Our cost of £2,775 per system is an amount that is collectable by local cardiac support groups; this has enabled us to add to telemetry capability since the end of the study. We have concentrated on the value of monitoring patients when they have left the CCU. In answer to our questionnaire, only two of the five districts that use telemetry monitor patients routinely after leaving the CCU, and one other district uses telemetry occasionally in these cases. The most frequent use is to monitor patients when CCU beds are unavailable (four of five districts), and we find this valuable also. None of the physicians commented on the relief of pressure on CCU beds by increasing turnover and throughput which we find so valuable.

We conclude that radiotelemetry of patients after they have left the CCU is a relatively cheap and effective method to detect arrhythmias. It allows more rapid turnover of patients from the CCU and is clearly of benefit to patients with SCD who receive prompt attention because the coronary care staff initiate resuscitation immediately. When atrial fibrillation occurs without haemodynamic problems, telemetry provides early diagnosis, so decisions on anticoagulation can be made. Patients who have suffered severe complications of AMI while on the CCU are particularly at risk of subsequent arrhythmias. Nursing and resident medical staff feel much happier when such patients are monitored by telemetry during the days after discharge from the CCU. Thus time spent on the CCU may be reduced by transferring such patients to the general ward and by considering transfer of uncomplicated cases in less than 48 hours. The rapid turnover of CCU beds is likely to become more important with the extensive use of thrombolysis and the resultant increase in demand.

References

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