Two ECGs and a history: a guide to early hospital discharge of patients with 'chest pain? cause'

ABSTRACT - Objectives: To shorten the stay in hospital of patients admitted with chest pain of uncertain origin, using clinical history and an unchanging ECG as a basis to inform patients on the post-take ward round of imminent discharge that same day (pending normal cardiac enzyme results), thereby facilitating actual discharge on the same day.

Design: A prospective observational study over a two-month period of consecutive patients admitted with chest pain of uncertain origin.

Setting: District general hospital in North-West England with a regional cardiothoracic centre on site.

Results: Of the 115 patients enrolled in the study (15% of acute medical admissions), 43 (37%) were identified by the investigators as likely to have normal cardiac enzymes and only one of them had evidence of important cardiac ischaemia (median actual length of stay, 3 days). The specificity of the protocol was 98%, with a sensitivity of 89%.

Conclusions: A careful clinical history taken by experienced junior staff together with two sequential ECGs, can identify patients who may be discharged within 24 hours of admission with chest pain of uncertain origin. Significant bed savings would result from the instigation of this practice, with minimal requirement for extra resources.

'Chest pain - possibly of cardiac origin' precipitates admission of patients to coronary care and general medical units throughout the country, forming a significant proportion of acute medical workload.

Investigation of patients with chest pain usually includes serial electrocardiogram (ECG) and cardiac enzyme analyses. The 'result' of an ECG is available immediately, but the results of serial cardiac enzyme measurements are rarely available until late on the day after admission. Patients informed late in the day that they are suitable for discharge frequently have to remain in hospital overnight - they may need to be mobilised, transport arranged, relatives contacted and discharge medications obtained. These issues are seldom easy to arrange in the late afternoon when the blood results become available, thus delaying actual discharge to the following day.

We postulated that a structured clinical history obtained the morning following admission, could indicate with high specificity and sensitivity those patients likely to have normal cardiac enzymes and thus be suitable for discharge. These patients could then be informed early in the day that they would almost certainly be able to go home later that same day, allowing arrangements for discharge to be set in motion. Receipt of normal cardiac enzyme results would merely confirm the earlier discharge decision, allowing the patient to leave hospital that day. An observational study was undertaken to investigate the validity of this postulate, and to investigate the potential effects of such a policy in a large district general hospital.

Patients and methods

All patients admitted with chest pain of possible cardiac origin over a period of two months were prospectively entered into the study. Patients with acute myocardial infarction (MI) evident on admission (World Health Organisation criteria) were excluded.

A history was obtained from the patient by the investigators (TM, SDH), working independently of the clinical team, on the morning following admission using a predetermined protocol (Table 1). The admission 12-lead ECG and a second ECG recorded on the morning following admission were analysed. A clinical diagnosis was then made (Table 2), together with a judgement as to whether the patient:

1) could plan to leave hospital later that day pending the (expected) normal results of cardiac enzyme analyses; or
2) required further assessment as an inpatient.

The second category would apply both to patients with suspected unstable angina and also to those who could not be discharged for reasons other than chest pain (concomitant pathology, poor mobility, etc), ensuring that study procedures mirrored actual clinical practice as closely as possible.

The decision regarding discharge was made on the basis of the history and two unchanging ECGs. The systematic recording of the data, together with the help of logistic regression analysis, allowed us to investigate prospectively which aspects of the history were most useful in coming to the clinical conclusion. At three months, the notes of each patient were reviewed to establish:

- the results of serial cardiac enzyme analyses
- the final diagnosis reached by the admission team
- the length of hospital stay (number of nights in hospital).
Results

There were 115 consecutive admission episodes eligible for the study in the eight-week recruitment period (15% of acute general medical admissions). The patients’ mean age was 61.3 years (range, 27–90 years), and 51% were men. In six further admission episodes, patients were not seen by the study team (death within 24 hours, own discharge, etc), and in three cases the time of assessment was not noted.

On the basis of clinical review and an unchanged ECG on the morning following admission, 43 patients (37%) were considered suitable for discharge later that day pending cardiac enzyme results. In all but one of these patients, two sets of cardiac enzymes (taken 9–20 hours apart) were subsequently reported as normal. The diagnoses were:

- gastrointestinal pain: 17 patients
- stable angina: 8
- non-specific chest pain: 16
- pericarditis: 1

The only patient with abnormal enzymes suffered an uncomplicated non-Q wave MI.

In the 54 (75%) of the 72 patients thought unsuitable for early discharge the final diagnosis was cardiac chest pain; this included 23 patients with MI or unstable angina. At three months, there had been no deaths in the early discharge group, in contrast to the other group in which there was a 14% three-month mortality (all cardiac).

Through the study protocol we identified, within 24 hours, patients suitable for early notification of discharge with a sensitivity of 89% and a specificity of 99% and, also within 24 hours, patients whose chest pain was of cardiac origin, with a sensitivity of 98% and a specificity of 95%. One of the nine patients with angina considered suitable for early discharge was detected by the pre-discharge enzymes as non-Q wave MI, but unstable angina was not a feature of any of these patients at final diagnosis.

Length of stay

Length of overall hospital stay was 1–24 days (median, 4 days). In patients considered suitable for discharge on the day the decision was made, actual length of stay was 1–14 days (median, 3 days). Only 29% of these patients were actually discharged the same day, with a further 15% the following day.

Objective assessment of structured clinical history

**Demography.** The older the patient, the more likely was the chest pain to be of cardiac origin, with a relative risk of 7.3% per year. There was no effect of gender.

**Nature of chest pain**

- Central chest pain was strongly associated with a cardiac origin (p<0.003)

**Table 1. Structured clinical history.**

| Site of chest pain          | Radiation          |
|-----------------------------|--------------------|
| central, sternal            | none               |
| substernal                  | to: back           |
| right-sided                | arm(s)             |
|                            | jaw                |
|                            | epigastrium        |

| Nature of chest pain | Duration | Relieving factors |
|----------------------|----------|-------------------|
| heavy, crushing      | constant | nothing           |
| burning              | intermittent | rest             |
| sharp, stabbing      | single episode, now resolved | food            |
| like usual angina    |          | antacids          |
| like usual indigestion |      | burping          |
| other                |          | nitrates         |
|                      |          | other             |

| Exacerbating factors | Associated features |
|----------------------|---------------------|
| nothing              | sweating            |
| exercise             | light-headedness    |
| cold/windy weather   | palpitations        |
| deep breathing       | excess wind         |
| hunger               | abdominal pain      |
| food                 | shortness of breath |
|                      | nausea              |

**Table 2. Diagnostic categories.**

| Diagnostic category                                           | Type of chest pain |
|---------------------------------------------------------------|-------------------|
| No diagnosis                                                  | Non-cardiac       |
| Non-specific pain (eg related to anxiety)                     |                   |
| Upper gastrointestinal pain                                   |                   |
| Musculoskeletal pain                                          |                   |
| Pleural pain                                                  |                   |
| Pericarditis (history + ECG changes)                          |                   |
| Angina (typical history ± established IHD)                   | Cardiac           |
| Unstable angina (history, transient ECG changes, no enzyme rise) |                   |
| Myocardial infarction (WHO classification)                    |                   |
| Aortic dissection                                             |                   |

IHD = ischaemic heart disease
WHO = World Health Organisation

- Substernal chest pain was significantly less likely to be of cardiac origin (relative risk, 0.187)
- 'Heavy' chest pain was four times as likely to be cardiac as 'sharp' pain (p≤0.005)
- Radiation to the arms doubled the likelihood of the pain being cardiac, whilst radiation to the back halved this risk (p<0.05)
• Reports of pain similar to the usual angina or indigestion were positively helpful ($p<0.0001$; $p<0.003$, respectively)

• If exercise made the pain worse, cardiac pain was three times more likely ($p<0.02$), with a trend toward exacerbation by deep breaths and hunger being negatively associated with a cardiac diagnosis ($p<0.1$; $p<0.06$, respectively)

• Pain relieved by nitrates was five times more likely to be cardiac ($p<0.001$), whilst relief by rest or antacids was not helpful ($p>0.1$).

Associated features. No associated symptom reliably distinguished cardiac from non-cardiac pain, including reports of sweating, palpitations or shortness of breath ($p>0.1$).

Discussion

This study was specifically designed for the results to be directly applicable to general medical practice. Decisions regarding discharge were made holistically, taking into account concomitant medical problems and social circumstances.

The discharge decision was made with a clinical history taken in more relaxed circumstances on the morning after admission, and the analysis of two ECGs recorded at least 12 hours apart. An unchanging ECG was the important indicator. Taking this pragmatic approach, we found that up to 40% of patients admitted with chest pain of uncertain origin could be identified on the post-take ward round as suitable for discharge from hospital later the same day (ie within 24 hours of admission). Discharge can be confidently planned pending normal results of cardiac enzyme measurements, secure in the knowledge that very few such decisions will need to be reversed, and hospital stay is shortened by 50–67%.

The specificity of this technique is very high, so that few patients will be mistakenly identified (requiring discharge arrangements to be cancelled); the lower, but acceptable, sensitivity also confirms that this is a useful and safe protocol. Importantly, no patient with a final diagnosis of unstable angina was assigned to the early discharge group. In our study this would amount to a saving of 100 bed-days over two months (or 600 bed-days per year). With the pressure on acute medical services, any saving, however small, is welcome.

What are the thought processes involved in clinical decision making in chest pain of uncertain origin? It comes as no surprise that the features of cardiac chest pain learnt in medical school are excellent discriminators. It is interesting, however, that similarly learnt associated symptoms of palpitations, breathlessness, etc may often be misleading, perhaps because they relate more to non-specific generalised overactivity of the sympathetic nervous system. The quality of the chest pain (including its response to nitrates) and the patients' own views on the aetiology of the pain remain the best guides.

Previous studies have concentrated on the assessment of likely clinical outcome from the single set of data available on admission, and have been largely directed towards establishing which patients require admission to a coronary care facility. Few reports have been published on the far greater number of patients admitted to general medical wards awaiting a definitive diagnosis. The limited value of a single ECG in the assessment of recent chest pain was highlighted by Norrell and colleagues. Nordlander and Nyquist reported the importance of ECG changes during admission with chest pain unassociated with MI, concluding that such transient changes were an important predictor of subsequent non-fatal MI and/or cardiovascular death. Our findings are entirely in keeping with these observations.

Instigation of the changes suggested by the findings of this study would involve little modification of present working practice: the assessment and ECG analysis described are easily incorporated into the post-take ward round. There is evidence that such a shift in practice can be assimilated with ease by cardiologists and general physicians alike.

Conclusions

Using a clinical history and sequential ECG, a substantial number of patients admitted acutely with chest pain not associated with MI may be identified on the post-take ward round as suitable for discharge from hospital later that day, pending the results of cardiac enzyme measurements. Adoption of such a policy of early arrangements for discharge may result in a saving of 600 bed-days per year in an average district general hospital. Few, if any, extra resources are required.

References

1 Hampton P, Harrison L, Gray D. Demand for hospital services following admission with suspected myocardial infarction in 1983 and 1989. Health Trends 1994;25:91–4.

2 Wilcox R, Roland J, Hampton J. Prognosis of patients with 'chest pain ?cause'. Br Med J 1981;282:431–3.

3 Jonsbu J, Aase O, Rollag K, Leistol K, Errkisen J. Prospective evaluation of an EDB-based diagnostic program to be used in patients admitted to hospital with acute chest pain. Eur Heart J 1993; 14:441–6.

4 Lee T, Juarez G, Cook E, Weisberg M, et al. Ruling out acute myocardial infarction. N Engl J Med 1991;324:1239–46.

5 Norrell M, Lythall D, Coghlan G, Cheng A, et al. Limited value of the resting electrocardiogram in assessing patients with recent onset chest pain: lessons from a chest pain clinic. Br Heart J 1992;67:53–6.

6 Nordlander R, Nyquist O. Patients treated in a coronary care unit without myocardial infarction: identification of high risk subgroup for subsequent myocardial infarction and/or cardiovascular death. Br Heart J 1979;41:647–53.

7 Weingarten S, Agocs L, Tankel N, Sheng A, Ellrodt A. Reducing length of stay for patients hospitalised with chest pain using medical practice guidelines and opinion leaders. Am J Cardiol 1993; 71:259–62.