ORIGINAL ARTICLE

Are district general hospital patients with unstable angina at a disadvantage?

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Postgrad Med J 2003;79:93-98

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Submitted
8 November 2002
Accepted
29 November 2002

Objective: To determine whether patients with non-ST elevation acute coronary syndromes requiring coronary angiography and revascularisation have inferior access to these services if admitted to district general hospitals (DGHs) compared with similar patients admitted to a base hospital containing a tertiary cardiac centre.

Design: Prospective, consecutive monitoring of all patients with acute coronary syndromes accepted by the tertiary cardiac centre for angiography and revascularisation over a three month period (1 April to 30 June 2002).

Participants: All patients accepted for angiography from DGHs and from within the base hospital with a diagnosis of acute coronary syndromes.

Setting: Tertiary cardiac facility (Manchester Heart Centre at Manchester Royal Infirmary (MRI)).

Main outcome measure: Time waited from referral to angiography and revascularisation.

Results: A total of 184 patients with a diagnosis of non-ST elevation acute coronary syndromes underwent angiography with a view to revascularisation. Of these, 89 (48%) were admitted initially to MRI and 95 (52%) were admitted to a feeder DGH. DGH patients waited significantly longer from admission to angiography than MRI patients (median 13 days (25th-75th percentiles 7-19) v 5 days (3-8) respectively; $p < 0.0005$). DGH patients therefore also waited longer from admission to revascularisation (15 days (6-20) v 6 days (3-9) respectively). Once transferred into the Manchester Heart Centre, DGH patients underwent angiography within a median of 1 day (1-2). More DGH patients than those from MRI underwent both coronary artery bypass grafting (21 (22%) v 8 (9%) respectively; $p = 0.015$) and percutaneous coronary intervention (44 (46%) v 32 (36%) respectively; $p = \text{NS}$).

Conclusion: Patients admitted to feeder DGHs with non-ST elevation acute coronary syndromes wait significantly longer for access to invasive coronary assessment and revascularisation than similar patients admitted in the hospital that incorporates the tertiary cardiac centre. This inequity of access is determined by postcode rather than clinical priority.

One of the fundamental principles of the National Service Framework for Coronary Heart Disease published by the Department of Health in 2000 was to reduce inequality in the provision of cardiac services across the UK.¹ The National Service Framework acknowledged the existence of inequity of access to cardiac services and indeed in the foreword the Secretary of State for Health wrote "this 'postcode' lottery of care is unacceptable and we are determined to end it".

The management of non-ST elevation acute coronary syndromes has undergone a revolution over the last few years as a result of improvements in the understanding of the pathophysiology of these conditions and their poor prognosis. Between them, non-ST elevation acute coronary syndromes, a group comprising unstable angina or non-ST elevation myocardial infarction (NSTEMI), account for at least 120 000 admissions to UK hospitals each year² and carry a prognosis that is far from benign. Thus, in the PRAIS-UK registry of 1046 patients with acute coronary syndromes without ST elevation, the rate of death or non-fatal myocardial infarction at six months after admission was 12.2% and of death, new myocardial infarction, refractory angina, or readmission for unstable angina was 30%.³ Similarly, in the OASIS registry that included nearly 8000 patients with unstable angina and NSTEMI the rates for equivalent end points was 10.1% and 22% respectively.⁴ Furthermore, studies have identified clear markers indicative of high risk in such patients: ongoing ischaemia; ST depression on admission electrocardiography (ECG) and raised serum levels of cardiac specific troponins.⁵⁻⁹ Finally, trials such as FRISC-II¹⁰ and TACTICS- TIMI 18¹¹ have

demonstrated prognostic benefit for early invasive investigation and revascularisation in these "high risk" patients. As a result of these data, clinical practice has changed. Patients with non-ST elevation acute coronary syndromes are now risk stratified early after admission and those fulfilling accepted criteria for "high risk" are referred for in patient coronary angiography with a view to revascularisation. This practice is now recommended by national and international guidelines.^{2 12 13}

In the real world, this change in clinical practice has inevitably had important resource implications. More patients are being kept in hospital for angiography, even when their symptoms have settled. The rate limiting step in their management therefore has become access to invasive angiographic facilities. In the case of district general hospitals (DGHs) without their own catheter laboratories this inevitably means transfer to their regional cardiac centre according to the "hub and spoke" model. In the majority of cases, such DGH patients will be competing for access to angiography with patients with exactly the same condition who were admitted to the base hospital containing the regional cardiac centre.

The aim of this study was to test the hypothesis that patients admitted to a DGH with non-ST elevation acute coronary syndromes are at a disadvantage in terms of access to

Abbreviations: DGH, district general hospitals; ECG, electrocardiography; MRI, Manchester Royal Infirmary; NSTEMI, non-ST elevation myocardial infarction

coronary angiography and subsequent revascularisation when compared with patients with the same condition admitted to the hospital with the “regional” cardiac facility on site. Proof of this hypothesis would confirm that clinical management of these high risk patients is currently determined on the basis of their postcode.

METHODS

Patient selection

The sample population consisted of all patients presenting with non-ST elevation acute coronary syndromes who underwent non-elective coronary angiography at the Manchester Heart Centre, based in Manchester Royal Infirmary (MRI), from 1 April until 30 June 2002.

Data were collected on consecutive patients using the following sources. Firstly, the Manchester Heart Centre Patient Database (CARDEX). This database documents every patient who has any procedure in the catheter laboratory and can therefore highlight all patients whose angiogram and/or percutaneous coronary intervention was performed on a non-elective basis. To ensure that all patients who had undergone a non-routine procedure were identified, the list of patients obtained from the database was then cross checked against the cardiac catheter laboratory log books. These hand written records chronicle every patient who passes through the catheter laboratory. The third source of data acquisition was the most valuable in terms of prospective surveillance. All referrals accepted for urgent angiography are listed on a “hit list” board, which is checked and updated daily. Finally, the cardiology activity coordinator keeps a separate record of all transfers of patients to and from the catheter laboratories.

The medical notes of all of those patients who were identified as having a non-elective coronary angiogram for the investigation of non-ST elevation acute coronary syndromes during the three month study period were then reviewed.

Data acquisition

All of the data were obtained from patients’ notes except for the date on which patients were referred to the Manchester Heart Centre by the feeder DGHs. This information was found on the referral sheets filled in at the time of referral by the accepting Manchester Heart Centre cardiologist. A dataset was then completed on each patient in a spreadsheet constructed in SPSS version 10.1 for Windows, which thereby served as a data collection tool.

Patients initially admitted to one of the feeder DGHs and then transferred to Manchester Heart Centre at MRI for angiography with a view to revascularisation were termed “DGH patients”. Patients initially admitted to MRI under its general physicians were termed “MRI patients”.

Data were collected on the length of time each patient had to wait for inpatient angiography and revascularisation. The journey of each patient from admission to angiography and to revascularisation was broken up into segments in order to evaluate waiting times in more detail (fig 1). Waiting times for each section were recorded. Total times from admission to angiography and admission to revascularisation were also recorded.

Waiting times of MRI patients were then compared with those of DGH patients in order to evaluate equity of access to care. Other data collected included the reason for each patient being “hit listed”, the type of revascularisation each patient underwent, and whether each patient was treated with a glycoprotein IIb/IIIa inhibitor.

The basic demographic, coronary risk factor and previous cardiac history data were collected for each patient so that the baseline characteristics of the MRI patients and the DGH patients could be compared.

Figure 1 Breakdown of steps in patient journey assessed in this study (MHC, Manchester Heart Centre).

Statistical analysis

Data analysis was performed using SPSS version 10.1 for Windows software. Graphical presentation of data was produced employing either SPSS or Microsoft Excel.

The waiting time data were found to be non-parametric. Therefore waiting times were quoted in median days and the 25th and 75th percentiles were used to show the spread of waiting times. The Mann-Whitney U test was used to assess the significance of the difference between the waiting times of DGH patients and the waiting times of MRI patients. Box plots of waiting times were used to graphically represent the median waiting times, the interquartile range, and the 10th–90th percentiles.

Pearson’s two sided χ^2 test was used to assess the significance of the difference between the number of DGH patients and the number of MRI patients who were revascularised, were treated with a glycoprotein IIb/IIIa inhibitor, were “hit listed” for chest pain without a troponin rise or ECG changes, and who had a “high risk” troponin level.

Pearson’s two sided χ^2 test was also used to assess if any of the baseline characteristics of DGH patients were significantly different from those of MRI patients, except for age, where the independent sample *t* test was used.

Table 1 Baseline characteristics of the 184 patients in the study; values are number (%) except where stated otherwise

Variable	MRI patients (n=89)	DGH patients (n=95)	p Value
Age, sex, and race			
Mean (SD) age	62 (13)	61 (12)	
Men	54 (61)	59 (62)	
Non-white	20 (23)	11 (12)	0.05
Coronary risk factors			
Hypertension	46 (52)	48 (51)	
Raised cholesterol	49 (56)	76 (81)	<0.0005
Diabetes	24 (27)	22 (23)	
Smoker	52 (58)	63 (66)	
Family history	40 (49)	48 (52)	
Previous cardiac disease			
Angina history >2 months	62 (70)	54 (58)	
Previous MI	36 (40)	30 (32)	
Previous PCI	15 (17)	6 (6)	0.026
Previous CABG	17 (19)	8 (9)	0.037
Previous CVA	10 (11)	9 (10)	

CABG, coronary artery bypass graft; CVA, cerebrovascular accident; MI, myocardial infarction; PCI, percutaneous coronary intervention.

Table 2 The reasons why patients were referred for inpatient angiography (and put on to the hit list); values are number (%)

Reason for being hit listed	MRI patients (n=89)	DGH patients (n=95)	p Value
Chest pain, raised troponin, and ST depression	18 (20)	29 (31)	0.018
Chest pain and raised troponin	35 (40)	38 (40)	
Chest pain and ST depression	2 (2)	6 (6)	
Raised troponin and ST depression	1 (1)	0	
Raised troponin	4 (5)	2 (2)	
Chest pain and T wave inversion	8 (9)	8 (8)	
Chest pain	21 (24)	10 (11)	
"High risk" exercise tolerance test	0	2 (2)	

RESULTS

In the three month period of study, 184 patients with a confirmed diagnosis of unstable angina or NSTEMI underwent coronary angiography with a view to revascularisation at Manchester Heart Centre. Eighty nine (48%) patients were initially admitted to MRI under its general physicians (MRI patients) and 95 (52%) were initially admitted to one of the feeder DGHs and then transferred to Manchester Heart Centre at MRI for angiography (DGH patients).

Patient characteristics

The MRI and DGH groups of patients were well matched (table 1). The mean age was 62 years, and 60% of patients were men. There were no significant differences in the baseline characteristics between the two groups in terms of their demographics, coronary risk factors and previous cardiac disease, except that more MRI than DGH patients had previously undergone coronary revascularisation. Fifteen patients (17%) compared with six patients (6%) respectively ($p=0.026$) had previously had percutaneous coronary intervention and 17 patients (19%) compared with eight patients (9%) respectively ($p=0.037$) had previously had a coronary artery bypass graft. Also, significantly more DGH than MRI patients had raised cholesterol (76 (81%) v 49 (56%) respectively; $p<0.0005$).

Overall, there was no significant difference in the total number of patients with either raised troponin levels or ST

Figure 2 Box plots of waiting times from admission to angiography and admission to revascularisation for MRI and DGH patients. The solid line in the middle of each plot represents the median. The box represents the interquartile range (25th–75th percentiles) and the whiskers represent the 10th–90th percentiles.

segment depression at admission between DGH and MRI patients. However, 21 (24%) MRI patients were hit listed because of ongoing chest pain without any other "high risk" features (that is, without a troponin rise and without any ECG changes). This was significantly higher than the number of DGH patients who were listed for the same reason (10 (11%); $p=0.018$; table 2).

Waiting times

DGH patients waited significantly longer than MRI patients did from admission to angiography (13 days median (25th–75th percentiles 7–19) v 5 days (3–8) respectively; $p<0.0005$; fig 2). Thus, 27% of DGH patients underwent angiography within seven days of admission whereas 72% of MRI patients underwent angiography in this time (table 3).

DGH patients also waited significantly longer than MRI patients did from admission to revascularisation (15 days (6–20) v 6 days (3–9) respectively; $p<0.0005$). For example, 35% of DGH patients underwent revascularisation within 10 days of admission whereas 78% of MRI patients underwent revascularisation in this time.

Table 3 Amount of time that MRI and DGH patients waited from admission to angiography, revascularisation, percutaneous coronary intervention (PCI), and coronary artery bypass grafting (CABG), and percentage of MRI and DGH patients who underwent angiography within seven days and revascularisation within 10 days of admission. All days are median days (25th–75th percentiles). Also shown is the total number of MRI and DGH patients who underwent revascularisation, PCI, and CABG

Variable	MRI patients (n=89)	DGH patients (n=95)	p Value
Angiography			
Total number of patients	89	95	
Days (range) from admission to angiography	5 (3–8)	13 (7–19)	<0.0005
Angiography ≤7 days (%)	72	27	
Revascularisation			
Total number (%) of patients	40 (45)	65 (68)	0.001
Days (range) from admission to revascularisation	6 (3–9)	15 (6–20)	<0.0005
Revascularisation ≤10 days (%)	78	35	
PCI			
Total number (%) of patients	32 (36)	44 (46)	
Days (range) from admission to PCI	5 (3–8)	13 (4–20)	0.001
CABG			
Total number (%) of patients	8 (9)	21 (22)	0.015
Days (range) from admission to CABG	12 (9–20)	21 (13–25)

Figure 3 Box plot representation of the breakdown of patient journey time from admission to revascularisation. The solid line in the middle of each plot represents the median. The box represents the interquartile range (25th–75th percentiles) and the whiskers represent the 10th–90th percentiles (CABG, coronary artery bypass grafting; PCI, percutaneous coronary intervention).

DGH patients who had percutaneous coronary intervention had to wait significantly longer from admission to procedure than MRI patients (13 days (4–20) v 5 days (3–8); $p=0.001$). DGH patients waited longer from admission to coronary artery bypass graft than MRI patients, but the difference was not found to be statistically significant.

A more detailed assessment of the components of the patient journey from admission to revascularisation was performed. DGH patients waited a median of three days (25th–75th percentiles 1–8) from admission to referral to the cardiologists at the Manchester Heart Centre. This was significantly longer than MRI medical patients who were referred within one day (0–1) ($p<0.0005$; fig 3).

Furthermore, DGH patients waited a median of six days (2–10) from referral to the Manchester Heart Centre to transfer into the regional centre. This was significantly longer than MRI patients waited from referral to the (Manchester Heart Centre) cardiologists to being seen (0 days (0–1); $p<0.0005$). However, once transferred into the heart centre, DGH patients underwent angiography within a median of 1 day (1–2) (fig 3). This was significantly shorter than MRI patients waited from being seen by a (Manchester Heart Centre) cardiologist to angiography (3 days (1–5); $p<0.0005$).

All but five (7%) patients in the study who underwent percutaneous coronary intervention had it done at the same time as angiography. Patients from both groups who underwent coronary artery bypass grafting waited the same length of time (median 8 days) from angiography to operation. Overall, both sets of patients waited the same length of time from angiography to revascularisation.

Revascularisation procedures carried out

Of the 184 patients in the study, 105 (57%) underwent revascularisation. Of these 105 patients, 76 (72%) underwent percutaneous coronary intervention and 29 (28%) underwent coronary artery bypass grafting. Of the 76 patients who underwent percutaneous coronary intervention, 75 (99%) had at least one stent inserted.

Revascularisation according to hospital type

Significantly more DGH patients underwent revascularisation than MRI patients (65 (68%) v 40 (45%) respectively; $p=0.001$; table 3). Specifically, more DGH patients than MRI patients underwent both coronary artery bypass grafting (21 (22%) v 8 (9%) respectively; $p=0.015$) and percutaneous coronary intervention (44 (46%) v 32 (36%) respectively),

although for percutaneous coronary intervention the difference was not statistically significant.

Glycoprotein IIb/IIIa inhibitor use

Fourteen (15%) of DGH patients were given an intravenous glycoprotein IIb/IIIa inhibitor before transfer and angiography. This was significantly more than the number of MRI patients (1 (1%); $p=0.001$).

All patients who underwent percutaneous coronary intervention were treated with a glycoprotein IIb/IIIa inhibitor during and after the procedure.

DISCUSSION

This is the first UK study to show that patients admitted to DGHs with unstable angina or NSTEMI and who are stratified at high risk wait significantly longer for angiography and revascularisation than similar patients admitted to a hospital containing a tertiary centre for cardiac services. Specifically, DGH patients were found to wait over two and a half times longer for angiography and over twice as long for revascularisation. The study hypothesis has therefore been proved.

The baseline characteristics of the MRI and DGH groups of patients were well matched except that more MRI than DGH patients had previously undergone coronary revascularisation. This is probably due to the fact that patients who have had a coronary procedure tend to represent to the hospital where they had it done and often remain under regular follow up at the tertiary centre. It is not clear why significantly more DGH patients had raised cholesterol.

If the “hit list” for invasive assessment and treatment of patients with acute coronary syndromes without ST-elevation at the Manchester Heart Centre were to operate as a true “regional” service, patients admitted to MRI with this condition would have no access advantage to these facilities. This study has confirmed that access is not equitable.

The fact that in the three month period of study the same number of MRI and DGH patients had inpatient angiography is interesting in itself. The combined catchment population of the 13 DGHs that transferred patients is much larger than the MRI catchment population. Even allowing for those DGH patients who were transferred to other tertiary referral centres, it appears that patients in the MRI area are more likely to receive inpatient angiography for unstable angina and NSTEMI. It has certainly been demonstrated that the median time from admission to referral for angiography is considerably shorter in patients admitted to MRI. This may

partly be explained by a programme of ongoing education of the general physicians. Clear protocols in the MRI (written by cardiologists) allow identification of patients with non-ST elevation acute coronary syndromes deemed at "high risk" within 12–24 hours. The same protocols encourage referral of such patients to cardiology. By contrast, DGH patients waited a median of three days from admission to being referred to the Manchester Heart Centre, possibly reflecting a delay before assessment by the local cardiologist. Thirty seven percent of DGH patients had ST-segment depression on admission. According to national² and European¹² guidelines these patients could therefore have been stratified as "high risk" on admission and so could have been referred within 24 hours. Forty percent of DGH patients had a troponin rise without ECG changes. Blood samples for troponins are usually taken 12 hours after admission. Allowing for this and processing time, these patients could also have been identified as "high risk" the day after admission. Therefore, the majority of DGH patients could have been referred within 24 hours of admission.

This study demonstrates that the service for patients who are admitted to MRI under its general physicians is relatively efficient in terms of time waited from admission to angiography and subsequent revascularisation. MRI patients were found to wait a median of five days for angiography. This is very similar to the length of time waited by those patients who were managed with an early invasive strategy in the FRISC II trial (four days).¹⁰ Also, 78% of MRI patients who underwent revascularisation (percutaneous coronary intervention or coronary artery bypass grafting), had the procedure done within the first 10 days of admission. This is higher than the proportion of patients in the invasively managed group in the FRISC II study who underwent revascularisation in the first 10 days (71%). It is clear therefore that MRI patients are undergoing an early invasive management strategy in line with the evidence base available in the FRISC II trial and therefore will gain the benefits demonstrated by the trial. Unfortunately, by contrast, the waiting times of DGH patients are much longer than those of the invasively treated patients in FRISC II, as well as TACTICS-TIMI 18 trials (the waiting times of the invasively treated patients in the TACTICS-TIMI 18 trial were shorter than those in the FRISC II trial).¹¹ It is therefore not certain whether DGH patients achieve the full benefits of early revascularisation demonstrated in these trials.

A breakdown of the patient journey shows that the main part of the delay occurs as patients wait to be transferred into the Manchester Heart Centre. This is due to the lack of protected bed space. A patient requiring inpatient angiography who is admitted to MRI eases the unrelenting pressure on general medical beds when they are taken over into a cardiology bed. By contrast, the incoming patient from a DGH adds to the hospital bed pressure at the centre. This inevitably introduces a selection bias in favour of the MRI patient. Such bias is pragmatic, but unfair. It is unlikely that this scenario is unique to this centre. Equity of access could be achieved by establishing independent function for an invasive facility so that it serves the "region" in a more uniform manner. The tertiary referral service would then be provided equally to all secondary referral sources, including the one with whom the centre shares a building. The hypothesis that an increase in the number of protected beds would substantially improve access is supported by the analysis of the patient journey once they have arrived at the heart centre. Once they have been transferred, the data demonstrate that it is possible to provide a very efficient service for DGH patients (median of 1 day to angiography), and one that is equitable with the service received by MRI patients.

Revascularisation and "high risk" status

One hundred and five (57%) patients in the study underwent revascularisation and of these, 76 (72%) underwent percuta-

neous coronary intervention. In the TACTICS TIMI-18 trial a similar proportion of those in the early invasive management strategy arm underwent revascularisation (60%) and of these, 68% underwent percutaneous coronary intervention.¹¹ However, in the FRISC II trial 78% of those in the early invasive strategy arm were revascularised.¹⁰ The reason why the proportion of patients being revascularised was not higher in this study and the reason why a large proportion of MRI patients in particular (55%) did not undergo revascularisation, may be due to the process of selecting and accepting "high risk" patients. Seventeen percent of patients in this study were "hit listed" for chest pain without any other "high risk" features—that is, without a troponin rise and without any ECG changes. Ongoing or recurrent chest pain is one of the criteria for "high risk" stratification. However in most studies, the proportion of patients with unstable angina or NSTEMI with ongoing pain after optimal medical treatment is uniformly around 10%.

Limitations of the study

This study contains no data regarding the outcome of patients admitted at any hospital with unstable angina and NSTEMI when they were not referred for invasive assessment. Likewise, we cannot identify the fate of patients who were referred to the Manchester Heart Centre but then removed from the transfer list.

CONCLUSION

This study has unequivocally proved its hypothesis. The management of unstable angina/NSTEMI is determined by "post-code" in the sense that patients admitted to DGHs with this condition wait significantly longer than if they are admitted to the hospital containing the tertiary cardiac centre. There is also evidence that patients within the MRI are referred more rapidly than those admitted to DGHs. This is despite data demonstrating a higher frequency of markers of high risk in the DGH population. Establishing equity of access to early invasive assessment and revascularisation services for these patients should be treated as a priority, particularly now that there are robust data to demonstrate the prognostic benefit of this strategy. Tertiary centres must be allowed to work independently of the bed pressures created elsewhere in their parent hospital.

ACKNOWLEDGEMENTS

The authors thank Mrs Dot Crone, Cardiology Activity Coordinator at MRI, for her invaluable help.

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