CARDIOVASCULAR MEDICINE

Prognosis for patients newly admitted to hospital with heart failure: survival trends in 12 220 index admissions in Leicestershire 1993–2001

H M Blackledge, J Tomlinson, I B Squire

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Objective: To examine rates of, prognosis following, and the influences on first hospital admission with heart failure in Leicestershire during 1993–2001.

Design: Historical cohort study using record linked discharge and mortality data.

Setting: Leicestershire, England.

Patients: 12 220 individual patients newly hospitalised with heart failure between 1 April 1993 and 31 March 2001.

Main outcome measures: 30 day and one year survival, temporal trends in survival, and the influence on prognosis of age, sex, comorbidity, social deprivation, and year of hospital admission.

Methods and results: Between 1993/94 and 2000/01, rates of first hospitalisation increased by 62%, from 29 to 47/10 000 population, confined largely to those aged > 65 years. Rates did not increase after 1998. Median age at presentation increased from 74 years in 1993/94 to 77 years in 2000/01 for men but was unchanged (80 years) for women. Overall one and five year survival was 57% and 27%, respectively. There was a 43–45% increase in risk of death for each decade of age at admission and a 14–17% increase associated with male sex. There was a clear influence on outcome of comorbidity but no influence of social deprivation score. Both one month and one year survival were lower for patients whose first heart failure admission was concomitant with acute myocardial infarction. Between 1993/94 and 2000/01 postdischarge cardiovascular survival improved by 50% ($p < 0.001$).

Conclusions: Rates of first hospital admission with heart failure reached a plateau in the late 1990s. Case fatality rates remain high and prognosis poor, in particular for those of increasing age, for men, and for patients with concomitant acute myocardial infarction. However, clear trends to improved survival were seen over this time.

See end of article for authors' affiliations

Correspondence to:
Dr I Squire, Department of
Medicine & Therapeutics,
Clinical Sciences Building,
Leicester Royal Infirmary,
Leicester LE2 7LX, UK;
is11@le.ac.uk

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Heart failure is a major public health issue in developed countries with increasingly elderly populations.^{1–2} Clinical trials in the 1980s and 1990s showed mortality and morbidity benefits with a variety of treatments in chronic heart failure^{3–6} and in heart failure following acute myocardial infarction (AMI).^{7–8} In the years 1980–1993 studies from the UK (Scotland),⁹ Sweden,¹⁰ Spain,¹¹ New Zealand,¹² the Netherlands,¹³ and the USA¹⁴ showed increasing numbers of heart failure hospitalisations. Recent reports have suggested that admission numbers may have peaked in the early 1990s^{15–16} and that prognosis improved over the period 1979–1996.¹⁷

The majority of first diagnoses of heart failure are made in hospital¹⁸ and the prognosis for patients hospitalised is worse than for those remaining in the community. Accurate hospitalisation data thus provide relatively accurate measures of trends in incidence and prognosis for heart failure. Leicestershire has a mixed rural and urban population of approximately one million. All available routine measures of coronary heart disease (CHD) morbidity and mortality are in line with average national rates. The aim of this study was to investigate trends in outcome following a first ever hospitalisation with a diagnosis of heart failure in a large cohort of patients in the modern treatment era. We used record linked discharge data to investigate survival, potential aetiological conditions, and the influence on outcome of comorbidity, social deprivation, and demographic factors.

METHODS

Study population

Leicestershire Health Authority has a comprehensive record linkage system, which is linked to information held at the Office of National Statistics. This allows for follow up of all residents registered with primary care (956 000 in 2001) in terms of events such as hospitalisations and mortality. The system provides details of the dates of events, discharge diagnoses, and the patient's age, sex, and domicile postcode.

We obtained data on residents aged ≥ 40 years who were admitted for a first heart failure to any of the hospitals serving the population of Leicestershire between 1 April 1993 and 31 March 2001. We excluded all those with a recorded heart failure diagnosis in the five years before the start of, and counted only the first heart failure hospitalisation during the observation period. A heart failure admission was defined as heart failure (*International classification of diseases* (ICD) 10th revision or ICD 9th revision code I50* or 428*, respectively) in any discharge coding position. As a relatively small degree of migration occurs in those aged over 40, we included only patients resident in the district for at least five years before the index admission, thus omitting all those who may have had a diagnosis while resident outside the county. Although our data

Abbreviations: AMI, acute myocardial infarction; CHD, coronary heart disease; CI, confidence interval; ICD, *International classification of diseases*; IMD, index of multiple deprivation

Table 1 Demographic and clinical features of all newly diagnosed cases (including all secondary diagnoses)

Variable	Diagnosis in any position	Primary diagnosis
Total number	12 220	4335
Age (years)		
Mean (SD)	76.8 (10.2)	76.9 (10.0)
40–64	1429 (12%)	494 (11%)
65–74	3032 (25%)	1098 (25%)
≥75	7759 (63%)	2743 (64%)
Sex		
Men	6055 (49%)	2207 (51%)
Women	6164 (51%)	2128 (49%)
Deprivation*		
Median (interquartile range)	16.6 (9.8–33.3)	17.2 (10.7–33.4)
Q1	1364 (11%)	447 (10%)
Q2	1497 (12%)	525 (12%)
Q3	1797 (14%)	629 (15%)
Q4	2400 (20%)	882 (20%)
Q5	5124 (42%)	1852 (43%)
Unknown	38 (1%)	0
Length of stay on admission (days)		
Median (interquartile range)	9 (5–16)	8 (5–14)
<7 days	4460 (37%)	1644 (38%)
7–29 days	6659 (55%)	2414 (56%)
30–89 days	1018 (8%)	259 (6%)
≥90 days	83 (1%)	18 (0%)
Comorbidity (total length of stay per year in five years before admission)		
None	6258 (51%)	2240 (52%)
<7 days	4714 (39%)	1679 (39%)
7–29 days	1152 (9%)	384 (9%)
≥30 days	97 (1%)	32 (1%)

*Index of multiple deprivation (DETR 2000) (Q1–least deprived, Q5–most deprived).

may have omitted a small number of residents, it constitutes a large cohort from a demographically varied population. Incidence data are presented as age standardised annual rates.

Survival

Mortality was identified from death certification records provided by the Office of National Statistics. Survival was measured from the date of admission to the date of death or to the end of follow up (30 September 2001), providing a minimum of six months of follow up for those alive at the end of the period. For patients who migrated from the area before 30 September 2001, the date of migration was taken as the end of follow up. Analysis was undertaken in respect of both all cause and cardiovascular mortality (ICD-9 39–45, diseases of circulatory system, excluding 43, cerebrovascular disease), as defined by the recorded cause of death. Demographic variables

potentially affecting survival were age at the date of diagnosis and sex. As a proxy measure of social deprivation we used the index of multiple deprivation (IMD 2000)¹⁹ at the electoral ward level, matched to the patient's domicile postcode, expressed as quintiles (quintile 5 being most deprived). Variables related to hospitalisation were year of admission, duration of index admission, and diagnoses related to the index and previous hospitalisations.

Previous hospitalisations

We used two measures of comorbidity. Firstly, we used diagnoses related to the index and to previous hospitalisations. In particular we focused on conditions associated with the development of heart failure; myocardial infarction, CHD, other heart disease, hypertension, and diabetes. Secondly, we used average length of hospital stay, by definition for causes other than heart failure, in each of the five years before the index admission. From these same five year data we obtained information on conditions associated with the development of heart failure: AMI (ICD 410/I21), other CHD (ICD 411–414/I20/I22–I25), heart disease other than CHD (ICD 415–429/I26–I52), hypertension (ICD 40/I1), heart valve disease (ICD 39/I0), and diabetes mellitus (ICD 250/E10–E14).

Statistical analysis

We used the χ^2 test for trend in ordered categories to analyse temporal changes in proportions and evaluated differences between population subsets using normal approximation confidence intervals. Crude survival was estimated using the Kaplan-Meier method, with log rank test to assess temporal (annual) trends in these estimates. Cox proportional hazards modelling was used to investigate the influence on outcome of potential explanatory variables. The stratified Cox procedure was used to analyse survival according to previous and concomitant diagnoses. The strategy for multivariate model selection was that published by Collett,²⁰ with the significance level for inclusion of variables at 10%. Statistical analyses were performed using SPSS software (SPSS Inc, Chicago, Illinois, USA).

RESULTS

Patient characteristics

Between 1 April 1993 and 31 March 2001 a total of 12 220 patients were admitted to hospital for the first time with a diagnosis of heart failure. In 4335 (36%) heart failure was recorded as the primary diagnosis. Demographic features and duration of index admission were similar for patients with heart failure in the primary coding position and in the total cohort (table 1). Half of the patients were women and more than 60% were older than 75 years. The deprivation score, median 16.7, was similar to the national value of 16.9 for all English wards. More than half of the patients came from areas

Table 2 Annual trends in incidence, mean age of incident cases, and hospital mortality for any heart failure diagnosis (including all secondary codes)

Year	Number	Rate (95% CI)	Length of admission (days, median (interquartile range))	Median age (years (male/female))	Hospital deaths*	Median age (hospital deaths) (years)	Heart failure in first diagnostic position
1993/4	1100	29.2 (27.5 to 31.0)	9 (5–15)	78 (74/80)	248 (24.8%)	80	443 (37%)
1994/5	1157	30.5 (28.7 to 32.3)	9 (5–16)	77 (74/79)	214 (20.3%)	79	433 (34%)
1995/6	1361	35.3 (33.4 to 37.2)	8 (5–14)	78 (75/80)	281 (20.6%)	81	465 (34%)
1996/7	1381	35.3 (33.4 to 37.1)	8 (5–15)	78 (75/80)	271 (19.6%)	81	442 (32%)
1997/8	1636	41.3 (39.3 to 43.3)	9 (5–15)	77 (76/81)	302 (18.5%)	81	609 (37%)
1998/9	1957	49.0 (46.8 to 51.1)	8 (5–16)	78 (76/80)	409 (20.9%)	80	675 (34%)
1999/0	1912	47.3 (45.2 to 49.4)	8 (5–16)	78 (76/80)	376 (19.7%)	81	718 (38%)
2000/1	1920	46.8 (44.7 to 48.9)	9 (4–16)	79 (77/80)	393 (20.5)	82	702 (37%)

Rate is age and sex directly standardised rate per 10 000 resident population >40 years of age.

*Deaths during first heart failure admission.

CI, confidence interval.

Figure 1 Trends in first heart failure admission rates between 1993 and 2001. (A) All diagnostic positions; (B) first diagnostic position. Rates for population older than 40, standardised for age and sex.

in the lowest two quintiles of deprivation score. With 30% of the population and 42% of cases, patients from the lowest quintile were over represented.

Over the study period there was a significant increase in the number and population rate of admissions. The age of men at presentation increased while that of women was unchanged (table 2). Age and sex adjusted hospital incidence rate among those aged ≥ 40 rose by 62%, from 29/10 000 population in 1993/94 to 47/10 000 in 2000/01, with no sex difference (fig 1). This increase was seen primarily in those aged ≥ 65 years, in whom the rate increased from 75 to 120 cases per 10 000 population. Corresponding trends were observed for heart failure in the primary coding position (fig 1, table 2). Rates also increased almost exclusively in those aged > 65 years, from 27 to 43/10 000. Overall numbers and population rates appeared to plateau after 1998/99 (fig 1, table 2). The median length of hospital stay was unchanged over the observation period (table 2).

Conditions leading to heart failure: previous hospitalisations

Table 3 shows the recorded frequency of comorbid conditions on the index and prior hospitalisations. Overall, in nearly 42%

of patients ($n = 5098$) a form of CHD was recorded either before or during the first heart failure admission. A further 10% of patients ($n = 1218$) had other heart disease coded. With regard to the index admission, for one third of patients ($n = 4195$) there was a concomitant diagnosis of CHD, including 13% ($n = 1542$) with AMI.

Other potential contributory conditions such as hypertension or diabetes were recorded less commonly in the previous five years of hospitalisation data. Heart valve disease was recorded very infrequently (table 3). Nearly half of the patients either had no recorded hospitalisation ($n = 3782$, 31%) in the prior five years or had been hospitalised only for conditions not normally associated with heart failure ($n = 1987$, 16%).

Survival

For all 12 220 patients, mean follow up was 651 days (22 months) with a range of 0–3103 days (8.5 years). For those alive at the end of the study, length of follow up was 183–3103 days.

Table 4 presents Kaplan-Meier estimates of survival for all patients and for the subset with heart failure as the primary

Table 3 Numbers and proportions of all 12 220 incident cases in patients hospitalised for recognised aetiological conditions at any time during five years before or during the index admission

	Previous admissions	Index admission	Previous/index admission
AMI	803 (6.6%)	1542 (12.6%)	2187 (17.9%)
Other CHD (no AMI)	1610 (13.2%)	2653 (21.7%)	2911 (23.8%)
Other heart disease (no CHD or AMI)	1218 (10.0%)	8025 (65.7%)	7121 (58.3%)
Hypertension	1801 (14.7%)	1940 (15.9%)	3158 (25.8%)
Heart valve disease	179 (1.5%)	404 (3.3%)	534 (4.4%)
Diabetes mellitus	1281 (10.5%)	1724 (14.1%)	2040 (16.7%)
Admitted for reason other than above	1987 (16.3%)	0	0
No admission	3782 (31.0%)	0	0

AMI, acute myocardial infarction; CHD, coronary heart disease.

Table 4 Kaplan-Meier survival estimate for the total cohort and the primary diagnosis subcohort: all cause and cardiovascular mortality

Time from admission	All diagnoses (n=12 220)		Primary diagnosis (n=4335)	
	All cause survival (95% CI)	Cardiovascular survival (95% CI)	All cause survival (95% CI)	Cardiovascular survival (95% CI)
1 month	79.1 (78.3 to 79.9)	83.8 (83.2 to 84.4)	80.8 (79.6 to 82.0)	84.5 (83.5 to 85.5)
6 months	64.4 (63.6 to 65.2)	73.2 (72.4 to 74.0)	66.5 (65.1 to 67.9)	73.6 (72.2 to 75.0)
1 year	57.1 (56.1 to 58.1)	67.7 (66.9 to 68.5)	58.6 (57.0 to 60.2)	67.6 (66.2 to 69.0)
3 years	38.9 (37.9 to 39.9)	52.6 (51.6 to 53.6)	37.6 (36.0 to 39.2)	49.6 (47.8 to 51.4)
5 years	27.0 (26.0 to 28.0)	41.8 (40.6 to 43.0)	24.4 (22.8 to 26.0)	37.9 (35.7 to 40.1)
6 years	23.2 (22.2 to 24.2)	38.0 (36.6 to 39.4)	20.4 (18.6 to 22.2)	34.1 (31.7 to 36.5)

diagnosis. Overall, 7818 patients (64%) died by the end of follow up, including 5364 (44%) from cardiovascular causes. One month and one year case fatality was 21% and 43%, respectively, the majority being cardiovascular. By six years of follow up case fatality was 75–80%, with slightly worse outcome for those with heart failure in the primary diagnostic position. Hospital mortality remained unchanged at around 20% over the period of observation. Patients dying during the index admission were on average 2–3 years older than the population as a whole (table 2).

Influence of demographic factors

Many of the measured demographic variables were strongly related to the risk of death (table 5). After adjusting for all other factors, there was a 43–45% increase in risk of death for each 10 years of age at the time of admission and a 14–17% increase associated with male sex. There was a clear relation to time spent in hospital in the prior five years, but no apparent influence on survival of social deprivation score.

We observed a number of associations between measures of comorbidity and prognosis. Our general measure of comorbidity—the average number of days in hospital in each of the previous five years—was strongly related to outcome (table 5). More specifically, when adjusted for other factors, prognosis for both all cause and cardiovascular mortality was worse for patients whose first heart failure admission was

concomitant with AMI. For these 1542 patients, 30 day cardiovascular survival was 74% (95% confidence interval (CI) 72% to 76%) compared with 86% (95% CI 85% to 87%) in the non-myocardial infarction group. One year survival was also lower at 61% (95% CI 58% to 64%) compared with 70% (95% CI 69% to 71%) in those without concomitant AMI.

We observed no difference in survival between patients with (one month all cause survival 81%, 95% CI 79% to 83%) or without (80%, 95% CI 79% to 81%) diagnosed diabetes. At three years these probabilities were 37% (95% CI 34% to 40%) and 40% (95% CI 39% to 41%), respectively. Similarly, the diagnosis of diabetes did not alter cardiovascular mortality.

Trends in survival

When stratified by the year of index admission there was a clear trend to improvement in the Kaplan-Meier estimate of survival between 1993/94 and 2000/01 ($\chi^2 = 13$, $p < 0.001$). Multivariate modelling confirmed this trend, showing up to 50% reduction in the relative risk of cardiovascular death over the period, most evident in the last three years (fig 2, table 5). Using a stratified model with adjustment for age, sex, and comorbidity, the one month, all cause survival estimates were 72% (95% CI 69% to 75%) in 1993/94 and 82% (95% CI 80% to 84%) in 2000/01. One year survival was 45% (95% CI 42% to 48%) in 1993/94 compared with 62% (95% CI 60% to 64%) in 2000/01. Similar improvements were seen in cardiovascular

Table 5 Results of Cox proportional hazards modelling of all cause and cardiovascular mortality in 12 220 patients with incident heart failure admissions: hazard ratios with corresponding 95% CI

		All cause mortality		Cardiovascular mortality	
		Univariate	Multivariate*	Univariate	Multivariate*
Sex	Male†				
	Female	1.03 (0.98 to 1.08)	0.86 (0.82 to 0.90)	1.00 (0.90 to 1.05)	0.83 (0.78 to 0.88)
Age	10 year	1.43 (1.39 to 1.46)	1.44 (1.40 to 1.48)	1.43 (1.38 to 1.47)	1.45 (1.41 to 1.50)
Deprivation‡	Q1†				
	Q2	1.01 (0.91 to 1.11)	1.03 (0.93 to 1.12)	0.99 (0.88 to 1.11)	1.01 (0.90 to 1.13)
	Q3	0.95 (0.87 to 1.04)	0.98 (0.89 to 1.07)	0.94 (0.85 to 1.05)	0.97 (0.87 to 1.08)
	Q4	0.96 (0.95 to 1.04)	1.00 (0.91 to 1.08)	0.96 (0.87 to 1.06)	1.00 (0.90 to 1.11)
	Q5	0.87 (0.86 to 0.94)	0.94 (0.87 to 1.01)	0.87 (0.79 to 0.95)	0.94 (0.85 to 1.03)
Comorbidity§	None†				
	<7 days	0.97 (0.92 to 1.02)	1.06 (1.00 to 1.12)	0.90 (0.85 to 0.96)	1.00 (0.93 to 1.07)
	7–29 days	1.52 (1.40 to 1.64)	1.56 (1.43 to 1.67)	1.35 (1.22 to 1.48)	1.43 (1.28 to 1.58)
Year of diagnosis	≥30 days	1.76 (1.39 to 2.22)	1.87 (1.47 to 1.36)	1.44 (1.06 to 1.94)	1.58 (1.17 to 2.15)
	1993/4†				
	1994/5	0.81 (0.73 to 0.89)	0.79 (0.71 to 0.87)	0.80 (0.71 to 0.89)	0.78 (0.69 to 0.87)
	1995/6	0.80 (0.73 to 0.88)	0.75 (0.68 to 0.82)	0.77 (0.68 to 0.86)	0.73 (0.65 to 0.81)
	1996/7	0.81 (0.73 to 0.89)	0.74 (0.66 to 0.81)	0.83 (0.74 to 0.92)	0.78 (0.69 to 0.87)
	1997/8	0.80 (0.73 to 0.88)	0.70 (0.63 to 0.77)	0.79 (0.70 to 0.88)	0.72 (0.63 to 0.80)
	1998/9	0.86 (0.78 to 0.94)	0.75 (0.68 to 0.83)	0.82 (0.73 to 0.91)	0.74 (0.66 to 0.83)
	1999/0	0.77 (0.69 to 0.84)	0.65 (0.59 to 0.72)	0.70 (0.62 to 0.78)	0.63 (0.55 to 0.71)
	2000/1	0.77 (0.70 to 0.85)	0.65 (0.59 to 0.72)	0.59 (0.52 to 0.67)	0.52 (0.45 to 0.59)

*Adjusted for age, sex, social deprivation, and comorbidity.

†Reference categories.

‡Index of multiple deprivation (DETR 2000) score by patient's ward of residence in quintiles (Q1—least deprived, Q5—most deprived).

§Defined as average annual stay in hospital in five years preceding the index heart failure admission.

Figure 2 Estimated hazard ratios and their 95% confidence intervals for all cause and cardiovascular mortality in 12 220 patients, according to the year of first admission, adjusted for age, sex, comorbidity, and social deprivation. Probability (p) values represent the contribution of year of diagnosis to multivariate model. Dotted line indicates linear trend in hazard estimates.

survival, from 78% to 88% at one month and from 59% to 76% at one year. Trends were similar for heart failure as the primary diagnosis.

DISCUSSION

This study—the largest epidemiological study from England of patients newly admitted to hospital with heart failure—has three main findings. Firstly, numbers of heart failure related admissions increased dramatically between 1993 and 1998 but did not increase thereafter. Secondly, survival improved greatly over the period of the study. Thirdly, and importantly, the outlook for patients hospitalised with heart failure remains poor, with 20% dying within 30 days and 40% within one year of admission. Our observations add to those from earlier, large cohort studies from Scotland 1986–1995^{15 17} and Canada 1994–1997²¹ and a number of smaller studies.^{10–14 16 22–26}

Rates of first hospitalisation

Following steady increases from 1993–98, we observed a plateau in numbers and population rates from 1998–2001. A slowing in admission rates in recent years has been noted in studies from Scotland¹⁵ and the Netherlands.¹⁶ While requiring further observation to clarify its reality, this finding is encouraging. Importantly, the increase in numbers of admissions in the current study was seen largely in those aged 65 years or more. The age of men continued to increase in the latter part of the 1990s, reaching a median of 79 in 2000/01. The median age of women in our study was unchanged at 80, in contrast to the increase in Scotland from 76 in 1986 to 79 in 1995.¹⁷ Such findings have clear implications for increasingly elderly populations.

SURVIVAL TRENDS

Improved case fatality rates after heart failure hospitalisation were reported from 1980–1995.^{17 25} We observed major improvement in both one month and one year survival over the period 1993–2001, despite a continuing increase in the age of the patients during this period. The current study and previous reports^{17 21 25} cover two decades during which evidence accumulated of the benefits of various pharmacological treatments in heart failure.^{3–8} The impact of such treatments in standard clinical practice is difficult to quantify. A plateau in heart failure hospital admissions coincident with increasing angiotensin converting enzyme inhibitor prescription was observed in the Netherlands.¹⁶ While we cannot with certainty ascribe either improved outcomes or a plateau in numbers to prescription of such agents, it is tempting to do so.

Despite encouraging trends in admission rates, it is important to emphasise that the outlook for patients with heart failure remains poor. Overall one month and one year case fatality rates were 20% and 40%, respectively, and by five years nearly 75% of patients were dead. These figures are very similar to those reported in studies of hospitalised patients from Scotland during 1986–1995¹⁷ and Canada during 1994–1997.²¹ In-hospital mortality was high and unchanged at around 20% between 1993/94 and 2000/01, which compares with rates of approximately 29% in 1984 and 21% in 1992 reported from the Scottish database.²⁶ There is clearly a consistent proportion of patients for whom the prognosis is bleak at the point of first admission with heart failure. It is likely that their greater age is a major contributory factor.

Similarly, as in Scotland¹⁷ and Canada,²¹ unselected patients with heart failure in England are older and much more often women than those in heart failure trials. Moreover, case fatality rates in our population are much higher than those seen in these trials. This disparity between the populations in trials and in clinical practice is a consistent finding in epidemiological studies of heart failure.^{17 18 21} This observation once again raises the issue of the relevance to the majority of those with the condition in everyday practice of the evidence base for the treatment of this condition.

Influence of age and sex

Our observed association of greater age and male sex with higher mortality are not unexpected. Moreover, the strengths of these associations (hazard ratio of 1.4/10 years of age and 0.87 for female sex) are strikingly similar to those seen in previous studies.^{17 21} The differential risk associated with age and male sex has not changed over the period 1985–2001.

Influence of deprivation

In keeping with previous reports from the UK,²⁷ we observed no influence of deprivation on survival. However, a disproportionate number of index patients came from the most deprived areas, again in keeping with previous studies.¹⁷ These areas clearly have a heavy burden of disease associated with heart failure. In Leicestershire these areas are in the vast majority urban, with a high demand for hospital care. A lower threshold for referral to hospital for residents of these areas may explain the apparent lack of effect of social deprivation on mortality but cannot be verified without information on disease severity at diagnosis. More detailed comparison of the characteristics of patients from the various quintiles of deprivation may help clarify this issue.

Influence of comorbidity

When adjusted for demographic factors, comorbidity, and year of diagnosis, mortality was higher in patients for whom heart failure was recorded concomitant with AMI. Once again this is in keeping with data from both large epidemiological²¹ and small cohort²⁷ studies. Patients with AMI are an easily identifiable group at high risk of heart failure and to whom appropriate investigations and treatment should be targeted. Interestingly, only a small proportion of our cohort (7%) had a hospital discharge diagnosis of AMI in the previous five years, compared with 15% of first heart failure admissions in Scotland,¹⁷ perhaps reflecting regional differences in the incidence of CHD.

Although a small percentage of our cohort spent any considerable amount of time in hospital in the previous five years, this very general measure of overall comorbidity associated strongly with outcome. This very simple observation perhaps emphasises the importance of concomitant pathology and interactions between covariables in the natural history of heart failure.²¹

Limitations of the study

Our study is constrained by the limitations inherent in all studies of historical, observational design. Inaccuracies in the diagnosis and coding of heart failure in routine data are well recognised²⁸ and we have of necessity relied on the accuracy of such data. While we identified only hospitalised patients, patients remaining in the community are likely to have a better prognosis. Temporal changes in referral and coding practices, in diagnostic accuracy, and in awareness of heart failure as a diagnostic entity may have influenced our findings. Similar comments can be applied to concomitant diagnoses potentially influencing prognosis such as AMI and diabetes. We have incomplete information on prior diagnoses, disease severity, and drug treatment at presentation. Similarly, we have not assessed the potential impact on trends in outcome of all relevant cofactors, such as renal impairment. These potential criticisms apply equally to previous studies of hospitalised patients, and the demographic features and short term and long term prognosis of our population are very much in keeping with these studies.^{17, 21} The duration of index admission and inpatient fatality rate did not change during our observation period and are very similar to those reported previously from Scotland for the year 1996.¹⁵ This suggests that the severity of disease was on average similar throughout the study period. We feel that our work stands reasonable comparison with previous large, epidemiological studies of trends in heart failure hospitalisation and prognosis.

Summary

Following many years of increase, numbers of patients with first hospital admission with heart failure reached a plateau after 1998. Clear improvements in survival were observed between 1993 and 2001. However, the prognosis for patients newly admitted with heart failure remains poor, in particular for those of greater age, for men, and for those with heart failure recorded during admission with myocardial infarction. These groups are cohorts in whom screening for heart failure and asymptomatic left ventricular dysfunction are likely to be relatively cost effective. While the plateau in numbers and improvements in survival are welcome, the prevalence of heart failure remains high and the prognosis poor.

Authors' affiliations

H M Blackledge, J Tomlinson, Department of Public Health Medicine, Leicestershire Health Authority, Leicester, UK
I B Squire, Department of Medicine & Therapeutics, Clinical Sciences Building, Leicester Royal Infirmary, Leicester, UK

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