Variations in quality of care for heart failure

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Summary

Background: The objective of our study was to assess hospital-to-hospital variations for the management and treatment of heart failure (HF) patients.

Methods: We performed a cross-sectional study among randomly selected patients with ICD-10 (International Classification of Disease, 10th revision) HF hospitalised in three Swiss university hospitals in 1999. Demographic characteristics, risk factors, symptoms and findings at admission and discharge medications were abstracted. The main outcome measure was the percentage of patients receiving appropriate management and treatment as defined by quality of care indicators derived from evidence-based guidelines. Quality indicators were considered only when they could be applied (no contra-indications).

Results: Among 1153 eligible patients with HF the mean age (SD) was 75.3 (12.7), 54.3% were male. Among potential candidates for specific interventions, left ventricular function (LVF) was determined in 68.5% of patients; 53.8% received target dose of angiotensin converting enzyme inhibitors (ACEI), 86.0% any dose of angiotensin receptor blockers; 21.9% β-blockers, and 62.1% anticoagulants at discharge. Compared to hospital B (reference), the adjusted odds ratios (OR) (95% CI) for LVF not determined were 3.82 (2.50 to 5.85) in hospital A and 3.25 (1.78 to 5.93) in hospital C. The adjusted OR (95% CI) for not receiving target dose ACEI was 1.76 (0.95 to 3.26) for hospital A and 3.20 (1.34 to 7.65) for hospital C compared to hospital B.

Conclusions: Apparently, important hospital-to-hospital variations in the quality of care given to patients with HF could have existed between three academic medical centers.

Key words: quality of health care; variations; heart failure

Introduction

Heart failure (HF) is a syndrome with high morbidity and mortality that often leads to hospital admission. Over the past ten years, the management of HF has evolved considerably. Recent clinical trials have proved that early detection and treatment of left ventricular dysfunction (LVSD) is particularly important [1, 2]. There is good evidence that angiotensin converting enzyme inhibitors (ACEI) [3–6] and β-blockers improve clinical outcome in patients with LVSD [7]. Based on this evidence, clinical practice guidelines have been published in the USA [8–10], in Europe [11] and also in Switzerland [12]. However, the assessment of the left ventricular function (LVF) is often not performed and many patients do not receive ACEI or β-blockers when appropriate. For several years, efforts have been made to standardise the evaluation of quality of care for HF patients [13]. In the United States, quality indicators have been used nationwide showing that globally 65% of HF patients had an evaluation of their LVF and that 69% received ACEI if they suffered from LVSD [14].

For over 20 years, hospital-to-hospital variations have been observed; Wennberg et al. demonstrated large differences in the way similar patients were treated in different hospital settings [15–17]. Variations between hospitals were also shown for patients with HF, demonstrating that hospital care is not always optimal. For example, a study in five US States across 69 hospitals among Medicare beneficiaries demonstrated that the prescription of ACEI at discharge in patients with documented systolic dysfunction ranged from 54 to 94% [18]. The objective of this study was to assess hospital-to-hospital variations in quality of care of HF patients in three Swiss academic medical centres.

Methods

Setting and patients

A cross-sectional study included adult patients hospitalised for HF in three Swiss academic medical centres. All three are urban, public, university hospitals and the main hospital for their respective areas. Patients included in the study were discharged from January 1 to December 31, 1999, with a principal or secondary diagnosis of HF (International classification of diseases, 10th revision (ICD-10) codes: I50.0, I50.1, I50.9, I11.0, I13.0 and I13.2).

We found respectively 976 and 774 eligible patients in two hospitals. Among those 700 patients were randomly chosen in each hospital. In the third hospital, all 234 eligible patients were included. From this total of 1634, we excluded 134 patients transferred to another acute care facility, six patients who left the hospital against medical advice and four patients with an incoherent date of discharge. We also excluded 306 patients for one or more of the following conditions: aortic stenosis (n = 111), acute myocardial infarction (n = 107), chronic renal failure on dialysis (n = 31), cor pulmonale or chronic obstructive pulmonary disease (COPD) requiring home oxygen (n = 30), mitral stenosis (n = 9), heart failure attributed to thyrotoxicosis (n = 30), amyloidosis (n = 5) or thiamine deficiency (n = 1). The final sample size was 1153.

Data

Medical records were examined by trained abstractors in each hospital. Inter-rater reliability was assessed by a random replicate sample of 100 charts, which were re-abstracted [19]. The kappa values for quality of care measures were 0.91 for the determination of LVF (proportion of positive and negative agreement 0.96 and 0.95 respectively) [20] and 1.0 for anticoagulants atrial fibrillation (proportion of positive and negative agreement 1.0 and 1.0 respectively) [20].

Variables, abstracted from medical records included demographic characteristics, risk factors, and symptoms and findings at admission. The final serum creatinine and potassium values recorded during the hospitalisation were also considered, as well as discharge medications and the confirmation of AF on the admission electrocardiogram (EKG).

Specific process quality indicators

Process quality indicators were developed from evidence based guidelines in collaboration with key clinicians. Table 1 summarises these quality indicators (QI) with their respective level of evidence.

Determination of the left ventricular function (LVF)

Determination of LVF was identified in the medical record by the presence of the value of a previously measured ejection fraction (EF) on echocardiography, cardiac catheterisation or radio-nuclide ventriculography. LVSD was defined as any measured value of the EF equal to or less than 40% documented in the chart from a previous or current hospitalisation. If no information regarding EF was found in the chart, the patient was classified as having LVSD based on an existing narrative statement.

ACEI use and dosing for systolic dysfunction

Prescription of ACEI and angiotensin receptor blockers (ARB) was recorded from charts. Level of target dose ACEI used corresponded to the doses found to increase survival in patients with LVSD in controlled clinical trials, and was defined as: captopril 50 mg three times daily, enalapril 10 mg twice daily, lisinopril 20 mg once daily or ramipril 5 mg twice daily [21]. If evidence from clinical trials was not available, target dose levels were based on the manufacturer's stated average dose, which were the following: benazapril 20 mg once daily, fosinopril 20 mg once daily, quinapril 10 mg twice daily, perindopril 4 mg once daily and cilazapril 1 mg once daily [22]. This QI was defined by three treatment groups among LVSD patients: 1) patients receiving no ACEI at discharge, 2) a sub-optimal dose of ACEI and 3) the target dose of ACEI or any dose of ARB. We excluded patients from the analysis with any of the following recorded contraindications to ACEI: cough, renal insufficiency, skin rash, hyperkalaemia, angiooedema, neutropenia and hypotension related to ACEI use.

ß-Blockers for systolic dysfunction

To calculate the quality indicators related to β-Blockers prescription at discharge for patients with LVSD, patients with contraindication to β-Blockers were excluded. These contraindications were: hypotension, asthma or COPD, dementia, bradycardia and bundle block.

Table 1

Guidelines for the diagnosis and management of heart failure with level of evidence.

	Quality Indicator	Guideline	Level of evidence ACC*
1	Identification of the underlying pathophysiology of heart failure	Patients with suspected heart failure should undergo echocardiography or radionuclide ventriculography to measure the ejection fraction (if information about LVF is not available from previous tests).	Class I Level C
2	Use and dosing of ACEI in patients with LVSD	Patients with LVSD should be given trial of ACEIs unless contra-indicated. Doses of ACEIs should be titrated upward over to the doses shown to decrease mortality in large, randomised, controlled trials.	Class I Level A
3	*Use of β-blocker in patients with LVSD	Patients with stable NYHA class II and III heart failure due to LVSD should receive a β-blocker unless contraindicated.	Class I Level A
4	**Use of warfarin in patients with heart failure and atrial fibrillation	Heart failure patients with a history of systemic or pulmonary embolism, recent atrial fibrillation or mobile left-ventricular thrombi should be anticoagulated to a prothrombin time ratio of 1.2–1.8 times each individual laboratory control time (International Normalised Ratio of 2.0–3.0).	Class I Level A

LVF, Left Ventricular Function; ACEI, Angiotensin Converting Enzyme Inhibitor; LVSD, Left Ventricular Systolic Dysfunction; NYHA, New York Heart Association

* American College of Cardiology (ACC) rating system. Class I: conditions for which there is evidence and/or general agreement that a given procedure/therapy is useful and effective. Class II: conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of performing the procedure/therapy. Class III: conditions for which there is evidence and/or general agreement that a procedure/therapy is not useful/effective and in some cases may be harmful. Level A: data was derived from multiple randomised clinical trials. Level B: data was derived from a single randomised trial or non-randomised studies. Level C: when consensus opinion of experts was the primary source of recommendation [10].

** Anticoagulation for atrial fibrillation not discussed in the ACC Heart Failure Guidelines but in ACC Guidelines for the management and treatment of patients with atrial fibrillation [31].

Anticoagulation for atrial fibrillation

For this QI only patients with atrial fibrillation and no known contraindication to anticoagulants were considered (recent bleeding, hepatic disease, alcoholism, coagulopathy, pregnancy, gastric ulcer, recent stroke and allergy to anticoagulants).

Analysis

We conducted bivariate analyses first, using, when appropriate chi-square tests, Fisher exact tests and ANOVA methods. Then, a multivariate analysis was performed to adjust for potential confounding factors using modelling techniques [23]. Logistic regression was used to calculate adjusted odds ratios with associated 95% confidence intervals. Considering the relatively small samples size and the large number of potential confounders, we could not use the traditional modelling strategy defined by Kleinbaum of looking first for an interaction term and then by backward elimination for confounding factors

[23]. Instead, we used a priori consideration for covariate adjustment. We included in the model any baseline parameter differing between hospitals to some extent and being associated with type or severity of heart failure, irrespective of statistical significance.

To take into account the different sampling fractions of the three hospitals, we used the "weight statement" in the SAS procedure "proc genmod". None of the models had evidence of co-linearity. For the three categories variable, we used an ordinal logistic regression. The proportional odds assumption was met. In sensitivity analyses, we did two alternative analyses. We fitted a continuation odds ratio model, and also investigated the pattern of the means of the dependent variable across hospitals. They each yielded qualitatively similar results, and indicated similar trends across hospitals. All analyses were implemented with the SAS software, version 9.1 (SAS Institute Inc., Cary, NC, USA).

Results

Among the 1153 cases available for analysis, 455 (39.5%) were hospitalised in hospital A, 544 (47.2%) in hospital B and 154 (13.4%) in hospital C. The mean (SD) age of the entire sample was 75.3 (12.7), 54.3% were male, 33.7% had a previous history of myocardial infarction, 60.1% hypertension, 23.1% diabetes mellitus, 20.4% COPD and 15.4% were current smokers.

Patient characteristics by hospitals

Table 2 illustrates the association between demographic characteristics, risk factors, symptoms and findings at admission of patients with HF by hospital. We found significantly more patients in hospital B either with a previous history of HF or a prior myocardial infarction, compared to patients in hospital C. Globally, more cardiovascular related symptoms and findings were observed in hospital B patients. On average these patients had seen a cardiologist more often than patients from the other two hospitals (table 3).

Table 2

Demographic characteristics, risk factors, symptoms and findings at admission of patients with heart failure by hospital, n = 1153.

Characteristics	N (%) or mean (SD)	Hospital		
		Hospital A N (%) or mean (SD) N = 455	Hospital B N (%) or mean (SD) N = 544	Hospital C N (%) or mean (SD) N = 154
Mean age (SD)	75.3 (12.7)	76.0 (13.3)	74.9 (12.5)	74.8 (11.8)
Sex				
Male	625 (54.3)	234 (51.4)	307 (56.5)	84 (54.6)
Female	527 (45.8)	221 (48.6)	236 (43.5)	70 (45.5)
Previous history heart failure (N = 1060)	601 (56.7)	238 (54.0)	298 (64.0)	65 (42.5)
Prior myocardial infarction (N = 1129)	369 (32.7)	120 (27.2)	209 (39.1)	40 (26.1)
COPD, bronchitis, emphysema (N = 1128)	230 (20.4)	64 (14.5)	126 (23.6)	40 (26.1)
Hypertension (N = 1135)	682 (60.1)	257 (58.0)	338 (62.7)	87 (56.9)
Diabetes (N = 1137)	263 (23.1)	86 (19.6)	140 (25.8)	37 (24.0)
Current smoker (= 1105)	170 (15.4)	66 (15.1)	76 (14.5)	28 (19.6)
Symptoms and findings				
PND (N = 791)	188 (23.8)	50 (11.4)	115 (57.2)	23 (15.2)
DOE (N = 1032)	790 (76.6)	292 (66.5)	396 (89.6)	102 (67.6)
Orthopnea (N = 838)	380 (45.4)	180 (41.0)	157 (63.3)	43 (28.5)
Leg oedema (N = 972)	517 (53.2)	195 (44.5)	252 (65.6)	70 (46.7)
Pulmonary rales (N = 998)	583 (58.4)	230 (52.3)	283 (69.5)	70 (46.4)
S3 gallop (N = 939)	39 (4.2)	16 (3.7)	23 (6.5)	0 (0.0)
JVD (N = 871)	280 (32.2)	110 (25.5)	126 (42.0)	44 (31.4)
Atrial fibrillation (N = 951)	261 (27.4)	75 (20.6)	148 (33.0)	38 (27.3)

COPD, Chronic Obstructive Pulmonary Disease; PND, Paroxysmal Nocturnal Dyspnoea; DOE, Dyspnoea On Exertion; JVD Jugular Vein Distension.

Table 3

Hospital Stay Characteristics of Patients with Heart failure by Hospital, n = 1153.

Characteristics	N (%) or mean (SD)	Hospital		
		Hospital A N (%) or mean (SD) N = 455	Hospital B N (%) or mean (SD) N = 544	Hospital C N (%) or mean (SD) N = 154
Chest X-Ray confirms heart failure (n = 738)	425 (57.6)	131 (55.0)	234 (60.0)	60 (54.6)
Mean (SD) potassium in mmol/l (n = 1099)	4.1 (0.7)	4.2 (0.5)	4.1 (0.6)	4.3 (1.1)
Mean (SD) creatinine in mmol/l (n = 1103)	114.5 (53.5)	116.4 (56.2)	112.0 (52.3)	118.3 (49.8)
Mean (SD) Minimum EF in % (n = 547)	36.5 (15.8)	39.6 (16.4)	32.8 (12.5)	39.0 (19.7)
Mean (SD) Charlson co-morbidity index (n = 1153)	1.94 (1.43)	2.14 (1.32)	2.16 (1.42)	0.53 (0.94)
Consultation by a Cardiologist (n = 1134)	614 (54.1)	199 (45.3)	338 (62.3)	77 (50.7)
ACEI on admission (n = 1071)	440 (41.1)	176 (41.2)	192 (39.0)	72 (47.7)
Mean (SD) length of stay (days) (n = 1153)	14.0 (15.3)	14.5 (18.3)	13.6 (12.5)	13.9 (14.1)

EF, Ejection Fraction; ACEI, Angiotensin Converting Enzyme Inhibitor

Table 4

Quality indicators in patients with heart failure by hospital, n = 1153.

Indicators	Total n (%) n = 1153	Hospital A n (%) n = 455	Hospital B n (%) n = 544	Hospital C n (%) n = 154
Quality indicators				
Determination of the left ventricular function* (n = 1153)	790 (68.5)	237 (52.1)	452 (83.1)	101 (65.6)
ACEI dose in 3 categories if LVSD (n = 370)				
No ACEI	52 (14.1)	17 (20.2)	24 (10.2)	11 (21.6)
Less than target dose ACEI	119 (32.2)	24 (28.6)	75 (31.9)	20 (39.2)
Target dose ACEI or ARB	199 (53.8)	43 (51.2)	136 (57.9)	20 (39.2)
β-blockers at discharge in patients with LVSD (n = 297)	65 (21.9)	8 (10.4)	44 (23.2)	13 (43.3)
Anticoagulation at discharge in patients with atrial fibrillation (n = 211)	131 (62.1)	31 (50.8)	81 (67.5)	19 (63.3)

ACEI, Angiotensin Converting Enzyme Inhibitor; LVSD, Left Ventricular Systolic Dysfunction; ARB, Angiotensin Receptor Blockers
* Out of 478 patients with LVSD (respectively 144, 275, and 59 in hospitals A, B, and C), 374 (78.2%) were identified based on value of an ejection fraction in the chart (respectively 132, 188, and 54 in hospitals A, B, and C), and 104 (21.8%) from a narrative statement in the medical chart (respectively 12, 87, and 5 in hospitals A, B, and C).

Quality indicators across hospitals

The determination of LVF was assessed in 68.5% of the entire sample of HF patients. Large variations were observed between hospitals ranging from 52.1%, to 83.1%. Similar variations were observed for the prescription of ACEI in patients with LVSD and no contraindication to ACEI. In hospital B, 57.9% of the patients received target dose of ACEI or any dose of ARB, compared to 51.2% in hospital A and 39.2% in hospital C. Similarly, we observed the following variations for prescription of β-blockers at discharge in patients with LVSD and no contraindication to β-blockers, with respectively 43.3%, 23.2%, and 10.4% who were prescribed β-blockers (table 4).

Results of multivariate analyses, presented in table 5 for the same quality indicators, show that the risk of no LVF measured during hospitalisation was higher in hospital C (OR = 3.25, 95% CI: 1.78 to 5.93) and even higher in hospital A (OR = 3.82, 95% CI 2.50 to 5.85) compared to hospital B. For discharge prescription of ACEI, the ordinal logistic regression model provided an odds ratio (OR) of 1.76 (95% CI 0.95 to 3.26) for hospital A and of 3.20 (95% CI 1.34 to 7.65) for hospital C, compared to hospital B, controlling age, sex, the Charlson co-morbidity index, history of myocardial infarction, orthopnoea, pulmonary rales and the ejection fraction. For β-blockers an OR of 0.70 (95% CI 0.19 to 2.64) for hospital C and of 3.85 (95% CI 1.50 to 9.88) for hospital A were obtained by comparison with hospital B.

Discussion

This study suggests that many patients with HF may have received sub-standard care in the observed hospitals. In addition, substantial variations existed between these academic centres. Our findings that the LVF was determined in 69% (52–83%) of patients is similar to the results of a study conducted in five US states among Medicare patients hospitalised with HF in 1996 in 69 hospitals [18]. In the latter study, LVF was determined in 70% (18–97%) of patients. However, regarding the proportion of patients receiving target dose of ACEI, our results were better (54%) compared to

Table 5

Results of the multivariate analyses of quality indicators in patients with heart failure by hospital, n = 1153.

Quality indicators	Hospital A n = 455 Adjusted OR (95% CI)	Hospital B n = 544 Adjusted OR (95% CI)	Hospital C n = 154 Adjusted OR (95% CI)
LVF not determined	3.82* (2.50–5.85)	1.00	3.25* (1.78–5.93)
ACEI by dose categories if LVSD (n = 370) – No ACEI – Less then target dose ACEI – Target dose ACEI or ARB	1.76** (0.95–3.26)	1.00	3.20** (1.34–7.65)
No β-blockers if LVSD (n = 297)	3.85*** (1.50–9.88)	1.00	0.70*** (0.19–2.64)
No anticoagulants if atrial fibrillation (n = 211)	0.87**** (0.26–2.98)	1.00	0.88**** (0.19–4.20)

LVF, Left Ventricular Function; ACEI, Angiotensin Converting Enzyme Inhibitor; LVSD, Left Ventricular Systolic Dysfunction; ARB, Angiotensin Receptor Blockers.

* Controlling for age, sex, the Charlson co-morbidity index, history of hypertension, history of myocardial infarction, smoking status, serum creatinine, orthopnoea and pulmonary rales.

** Results from the ordinal logistic regression (proportional odds model) summarising the effect of the three categories and controlling for age, sex, the Charlson co-morbidity index, history of myocardial infarction, orthopnoea, pulmonary rales and the ejection fraction.

*** Controlling for age, sex, the Charlson co-morbidity index, history of myocardial infarction, orthopnoea, pulmonary rales and the ejection fraction.

**** Controlling for age, sex, the Charlson co-morbidity index, history of myocardial infarction and the ejection fraction.

the US study (19%) [18]. These differences may reflect our inclusion of patients who received ARB in the target group, based on a recent clinical trial showing the benefits of this type of drug in HF patients [24], while the US study did not. Our results also are similar to those found by Krumholz and colleagues who evaluated the care of Medicare patients with HF in nine Connecticut hospitals. They reported that 75% (62–92%) of the patients had LVF documented [25]. Variations have also been found in other studies that evaluated the treatment and management of Medicare HF patients in the USA [26, 27].

Over the past few decades, differences have been repetitively observed in the way similar patients are treated in one heath care setting compared to another [28]. Several explanations have been proposed for variations in medical practice. Firstly, physicians have unique knowledge on how to diagnose and treat illness, and that each patient is different. Secondly, some authors argue that variations in health care are due to differences in available health care resources, such as hospital beds or number of specialists. The nature and amount of available resources could influence physicians' clinical decisions. A third argument is related to practice volume [29]. Fourthly, one author has argued for the "enthusiasm hypothesis." This theory reflects ideas that key personalities locally influence physicians in an area on how to treat patients [30]. Variations in health care are associated with differences in quality of care. One way to reduce these variations is to apply widely distributed, evidence-based clinical guidelines for the management and treatment of heart failure [8–12].

Several limitations may have biased our results. The first is specific to the Swiss health care system. Administrative discharge data have been monitored in Switzerland since 1998. The quality of data is improving but is still very heterogeneous across providers. In particular, only 234 patients with HF were identified through ICD-10 codes in hospital C, which has about the same patient volume as the two other hospitals in our study, corresponding to a 3 to 4-fold ratio of the number of cases identified. A selection bias may have occurred because of this lower figure in the identification of HF patients in hospital C. Furthermore, in two hospitals, the entire medical chart was available to the abstractors, but in the third, only the electronic discharge letter, laboratory findings and reports from cardiology testing were available.

In conclusion, we found significant hospital-to-hospital variations in the quality of care delivered to HF patients between three Swiss academic medical centres for patients with HF. We believe that these variations are unlikely to be fully explained by systematic errors and are therefore at least partially real. Our findings suggest that the management and treatment of HF patients is not optimal and might be improved, according to published evidence of effectiveness.

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