Adherence to Guidelines Improves the Clinical Outcome of Patients with Acutely Decompensated Heart Failure

Eyal Braun MD[1,2], Keren Landsman MD[2], Robert Zuckerman MD[1], Gidon Berger MD[1,2], Ahuva Meilik PhD[4] and Zaher S. Azzam MD[1,2,3]

[1]Department of Internal Medicine B, Rambam Health Care Campus, Haifa, Israel
[2]Rappaport Faculty of Medicine and [3]Rappaport Family Institute for Research in the Medical Sciences, Technion-Israel Institute of Technology, Haifa, Israel
[4]Clinical Performances Research and Operational Unit, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel

ABSTRACT: **Background:** Acutely decompensated heart failure/pulmonary edema is one of the most common medical problems in clinical practice. Approximately 500 patients are admitted to Rambam Health Care Campus yearly with the diagnosis of ADHF/PE. As a result, Rambam established local instructions and guidelines for the treatment of ADHF/PE based on the guidelines published by the American Heart Association, American College of Cardiology and The European Society of Cardiology.
Objective: To examine whether adherence to guidelines improves the outcome of patients with ADHF/PE in internal medicine wards.
Methods: Data were collected from the charts of 78 patients admitted to Rambam with ADHF/PE and were compared to a matched historic cohort.
Results: Echocardiography was performed more commonly in the study group patients as compared to the control group, 85% vs. 37.7% respectively ($P = 0.0001$). In patients who were treated according to the guidelines, angiotensin-converting enzyme inhibitors and beta-blockers were prescribed more commonly as compared to the control group. The 3 month mortality rate was significantly lower in the study group ($P = 0.021$).
Conclusions: Adherence to guidelines for treatment of ADHF/PE decreased the short-term mortality and increased the use of medications known to reduce mortality and morbidity in patients with systolic heart failure. Echocardiography is an important tool to guide treatment of ADHF/PE.

IMAJ 2009;11:348–353

KEY WORDS: pulmonary edema, congestive heart failure, guidelines, echocardiography, angiotensin-converting enzyme inhibitors, beta-blockers

Heart failure is one of the most common problems among adults seen in clinical practice. In hospitalized Medicare patients in the United States, heart failure is the most frequently cited diagnosis [1,2]. Clinical practice guidelines are believed by most clinical experts to result in the best possible health outcomes for patients [3]. A systematic review (not specific for heart failure) has shown that guidelines do affect the process and sometimes improve patient outcomes [4].

Mehatat et al. [5] have shown that implementation of guideline-based tools for acute myocardial infarction may facilitate improvement in quality of treatment among a variety of institutions, patients and caregivers. Weil and colleagues [6] have shown that adherence to guidelines published by the American Heart Association regarding treatment of congestive heart failure reduced the mortality and morbidity that accompany CHF, especially pulmonary edema.

At Rambam Health Care Campus in Haifa, approximately 500 patients are admitted annually with the diagnosis of acutely decompensated heart failure/pulmonary edema; most of them are admitted to internal medicine wards and cardiac intensive care units. The rate of in-hospital mortality reaches 10%. Therefore, a committee consisting of internists and cardiologists mapped the process the approach to patients with ADHF/PE. Based on the conclusions of the committee, guidelines of international heart societies [2,7,8] and large-scale studies, local instructions and guidelines for the treatment of pulmonary edema were established [Appendix 1].

The aims of this study were to investigate the extent of adherence to the guidelines by physicians in the internal wards at Rambam and whether adherence contributed to the improvement in both quality of treatment and life as measured by reductions in readmission rates. A secondary aim was to examine whether adherence to the guidelines had a beneficial effect on short-term survival. The hospital Institutional Review Board approved the study and informed consent was obtained from all participants.

ADHF/PE = acutely decompensated heart failure/pulmonary edema

CHF = congestive heart failure

PATIENTS AND METHODS

A study group comprising 78 patients with ADHF/PE who were enrolled prospectively were compared to a historic cohort of 75 matched patients who were given the same diagnosis during the 6 months that preceded the guidelines (control group).

The diagnosis of ADHF/PE was based on a medical history of dyspnea, paroxysmal nocturnal dyspnea and orthopnea, physical examination of bilateral rales in at least the lower third of the lung fields, ventricular gallop rhythm, third heart sound, and chest X-ray of interstitial or alveolar congestion.

Data were collected from hospital records and discharge reports. During the process of data collection, we noted whether physicians complied with the guidelines based on the following criteria: medications that were prescribed at different stages of the hospitalization and at discharge, the rate of patients who underwent echocardiography, and adequate assessment of left ventricular systolic function. Two cardiologists checked these data in both groups and decided whether physicians adhered to the guidelines. Patients who did not meet these criteria were considered non-adherent. The 3 month mortality rate and the rate of readmissions within 1 month were retrieved from the database of our hospital.

STATISTICAL ANALYSIS

All data were entered and analyzed using SPSS software, version 11 (Statistics Products Solution Services Inc., Chicago, IL, USA). Group averages were expressed as mean value ± SD. A comparison between the two study groups was performed using the chi-square test. A two-sided P value of < 0.05 was considered statistically significant. A logistic regression analysis (forward stepwise) was done to isolate the influence of adherence to guidelines on mortality in 30 days. In this model we included age (younger or older than 74 years old), gender, and adherence to guidelines (as judged by two cardiologists).

RESULTS

The cohort consisted of 153 patients who were admitted to an internal medicine ward – 78 patients in the study group and 75 in the control group. Average age was 73.0 and 75.2 years in the study and control groups respectively. As depicted in Table 1, both groups were similar in gender, history of ischemic heart disease, hypertension, diabetes mellitus, valvular disease, atrial fibrillation, and length of hospital stay. There was no statistical difference between the two groups regarding the basic laboratory results and duration of hospital stay.

Echocardiography was performed more commonly in the study group patients as compared to the control group: 85%

Table 1. Baseline demographic and clinical characteristics of the study patients

	Treated according to guidelines		
	Yes (n=76)	No (n=71)	P value
Age (yrs, mean ± SD)	73 ± 10.6	75.2 ± 12.5	NS
No. (%) of patients aged ≥ 75 yrs	31 (39.7)	37 (50.7)	
Gender			
Male (%)	55.3	49.3	NS
Length of hospital stay (days)	6.02 ± 3.38	6.57 ± 5.29	NS
Known CHF (%)	52.7	53.4	NS
History of IHD (%)	61.5	56.1	NS
Hypertension (%)	65.4	68.5	NS
Diabetes mellitus (%)	48.7	54.8	NS
Valvular disease (%)	21.8	21.9	NS
Known atrial fibrillation (%)	24.4	32.9	NS
Echocardiography performed (%)	85.5	37.7	0.0001
LVEF ‹ 0.4 (%)	60	57.7	NS
Hemoglobin level (g/dl)	12.3 ± 1.7	12.1 ± 1.9	NS
Sodium levels (mEq/L)	137.4 ± 14.9	138.1± 5.6	NS
Potassium levels (mEq/L)	4.3 ± 0.6	4.4 ± 0.6	NS
Creatinine levels (mg/dl)	1.7 ± 1.7	1.7 ± 1.2	NS
Patients with creatinine › 2.0 (mg/dl)	20	18	NS

CHF = congestive heart failure, IHD = ischemic heart disease, LVEF= left ventricular ejection fraction

vs. 37.7% respectively (*P* = 0.0001). Among patients who underwent an echocardiographic examination, we did not find a significant difference in left ventricular ejection fraction between the two groups.

In patients who were treated according to the guidelines, angiotensin-converting enzyme inhibitors/angiotensin receptor blockers and beta-blockers were prescribed more frequently as compared to the control group. The prescription of calcium channel blockers, spironolactone, furosemide and nitrates was similar in both groups, while digoxin was used more in the control group although it did not reach statistical significance [Table 2]. We found a significant difference between the two groups regarding 3 month mortality (*P* = 0.021). However, there was no difference in the number of readmissions between the two groups [Table 3]. Factors that predicted improved survival was age younger than 74 years old and adherence to guidelines [Table 4].

DISCUSSION

Pulmonary edema and acute decompensated heart failure have a major impact on the health system and are responsible for at least 20% of hospital admissions in persons older than 65 [9]. Recently, several guidelines for treatment of

Table 2. Medications used to treat patients with pulmonary edema during the study

Medications n (%)	Patients treated according to guidelines (%)	Control group (%)	P value
ACEI/ARB	63 (82.9%)	34 (47.9%)	0.000
Beta-blockers	65 (85.5%)	13 (18.3%)	0.000
Carvedilol	34 (45.3%)	6 (8.5%)	0.000
Calcium channel blockers	17 (22.7%)	12 (16.9%)	0.4
Sprinolactone	16 (21.1%)	11 (15.7%)	0.5
Fusid	61 (80.3%)	58 (81.7%)	0.5
Nitrates	16 (21.1%)	9 (12.7%)	0.2
Digoxin	10 (13.2%)	18 (25.4%)	0.09
Antiplatelets	53 (69.7%)	46 (64.8%)	0.5
Antocogulants	15 (19.7%)	14 (19.7%)	1
Amiodarone	8 (10.5%)	6 (8.5%)	0.7

ACEI = angiotensin-converting enzyme inhibitor, ARB = angiotensin receptor blocker

Table 3. Three month mortality and readmission rate within 30 days

Characteristic	Treated according to guidelines		P value	OR	95% CI
	Yes (n = 76)	No (n = 71)			
3 month mortality (%)	11.8	28.2	0.021	2.92	1.23–6.90
Readmitted within 30 days (%)	26 (39.4)	16 (32.7)	NS	1.25	0.65–2.39

OR = odds ratio, CI = confidence interval

Table 4. Prognostic factors

Prognostic factors	Mortality rate	CI	OR	P value
Age › 75	19/153	1.2–7.2	2.96	0.017
Age ‹ 74	12/153			
Patients treated according to guidelines	7/79	1.1–6.6	2.73	0.027
Control group	24/74			

ACEI = angiotensin-converting enzyme inhibitors
ARB = angiotensin receptor blockers

CHF and pulmonary edema have been published [2,7,10]. Based on these guidelines, our institute published, in 2003, local instructions for the treatment of ADHF/PE. In order to verify the effectiveness of these instructions, we designed a study to test the implementation of these guidelines in an internal medicine ward and compared the outcome to that in a historical cohort of matched patients.

The ADHERE registry, published in 2005, showed a relatively low use of medications indicated for CHF during hospitalization. Only 53% of the patients were on ACEI /ARB and fewer than 50% were treated with beta-blockers. It was estimated that about one-third of eligible individuals were not treated properly, despite the well-documented advantages of these medications. Moreover, the use of medications that gave immediate relief, but little if any long-term benefits (e.g., diuretics) was found to be high. These findings may explain the high readmission rates of patients with CHF [11].

The major findings of our study were that echocardiography was more commonly performed in the study group, and that 3 month mortality was significantly lower in this group. The recent American Heart Association/American College of Cardiology guidelines state that echocardiography "is the single most useful test in evaluation of patients with heart failure." However, it is not easy to demonstrate that echocardiography predicts outcome and response to therapy [2]. We believe that the more frequent use of echocardiography in the study group may have led to a greater use of medications that were shown to prolong life expectancy in patients with congestive heart failure such as ACEI/ARB and beta-blockers. Notably, there was no statistical difference in left ventricular ejection fraction among patients who underwent echocardiography in the two groups, but patients who were treated according to the guidelines were much more likely to get ACE/ARB. Indeed, the rates of use of these medications were much higher than in recently reported studies [10,12,13]

The 3 month mortality rate was significantly lower among patients treated according to the guidelines. The mortality rate is still relatively high in our institute, even in this group of patients treated according to the guidelines as compared to the Israeli nationwide heart failure survey [14]. This high rate of mortality reflects patients who were relatively older than reported in studies of patients with CHF and have relatively lower ejection fraction.

Our study has several limitations: First, the relatively small number of patients included in both groups may have contributed to the high mortality rate. Second, the control group is a historical cohort. For obvious ethical reasons, we could not continue treating patients in a control group without adhering to the guidelines once they were published. Third, we did not check the use of new modalities, such as cardiac resynchronization therapy and ventricular assist devices. Lastly, we focused our study on assessing the treatment in the medical ward, but not before hospitalization, namely, out of hospital or in the emergency department.

In conclusion, adherence to the guidelines for treatment of cardiogenic pulmonary edema and acutely decompensated heart failure decreased the short-term mortality and increased the use of medications that were shown to improve mortality and morbidity in patients with systolic heart failure. Conceivably, guiding treatment by echocardiographic findings is important for increasing adherence to guidelines.

Correspondence:
Dr. E. Braun
Dept. of Internal Medicine B, Rambam Health Care Campus, P.O. Box 9602, Haifa, 31096, Israel
Phone: (972-4) 854-2676
Fax: (972-4) 854-3252.
email: e_braun@ rambam.health.gov.il

References

1. Ahmed A. American College of Cardiology/American Heart Association Chronic Heart Failure Evaluation and Management Guidelines: relevance to the geriatric practice. *J Am Geriatr Soc* 2003; 51(1): 123-6.

2. Hunt SA, Abraham WT, Chin MH, et al. ACC/AHA 2005 Guideline Update for the Diagnosis and Management of Chronic Heart Failure in the Adult: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2001 Guidelines for the Evaluation and Management of Heart Failure): developed in collaboration with the American College of Chest Physicians and the International Society for Heart and Lung Transplantation: endorsed by the Heart Rhythm Society. *Circulation* 2005; 112(12): e154-235.

3. Krumholz HM, Baker DW, Ashton CM, et al. Evaluating quality of care for patients with heart failure. *Circulation* 2000; 101(12): E122-40.

4. Grimshaw JM, Russell IT. Effect of clinical guidelines on medical practice: a systematic review of rigorous evaluations. *Lancet* 1993; 342(8883): 1317-22.

5. Mehta RH, Montoye CK, Gallogly M, et al. Improving quality of care for acute myocardial infarction: the Guidelines Applied in Practice (GAP) Initiative. *JAMA* 2002; 287(10): 1269-76.

6. Weil E, Tu JV. Quality of congestive heart failure treatment at a Canadian teaching hospital. *CMAJ* 2001; 165(3): 284-7.

7. Hunt SA, Baker DW, Chin MH, et al. ACC/AHA guidelines for the evaluation and management of chronic heart failure in the adult: executive summary. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to revise the 1995 Guidelines for the Evaluation and Management of Heart Failure). *J Am Coll Cardiol* 2001; 38(7): 2101-13.

8. Nieminen MS, Bohm M, Cowie MR, et al. Executive summary of the guidelines on the diagnosis and treatment of acute heart failure: the Task Force on Acute Heart Failure of the European Society of Cardiology. *Eur Heart J* 2005; 26(4): 384-416.

9. Brozena SC, Jessup M. The new staging system for heart failure. What every primary care physician should know. *Geriatrics* 2003; 58(6): 31-6; quiz 38.

10. Cleland JG, Swedberg K, Follath F, et al. The EuroHeart Failure survey programme – a survey on the quality of care among patients with heart failure in Europe. Part 1: Patient characteristics and diagnosis. *Eur Heart J* 2003; 24(5): 442-63.

11. Gheorghiade M, Filippatos G. Reassessing treatment of acute heart failure syndromes: the ADHERE registry. *Eur Heart J* 2005; 7(Suppl B): B13-19.

12. Gotsman I, Rubonivich S, Azaz-Livshits T. Use of angiotensin-converting enzyme inhibitors and angiotensin receptor blockers in patients with congestive heart failure: an observational study of treatment rates and clinical outcome. *Isr Med Assoc J* 2008; 10(3): 214-18.

13. Olomu AB, Watson RE, Siddiqi AE, et al. Changes in rates of beta-blocker use in community hospital patients with acute myocardial infarction. *J Gen Intern Med* 2004; 19(10): 999-1004.

14. Garty M, Shotan A, Gottlieb S, et al. The management, early and one year outcome in hospitalized patients with heart failure: a national Heart Failure Survey in Israel – HFSIS 2003. *Isr Med Assoc J* 2007; 9(4): 227-33.

Capsule

Benzothiazinone: a new weapon for the TB wars

Tuberculosis is a major human disease of global importance resulting from infection with the airborne pathogen *Mycobacterium tuberculosis*, which is becoming increasingly resistant to all available drugs. An antituberculosis benzo-thiazinone compound kills Mycobacterium in infected cells and in mice. Makarov and colleagues have identified a sulfur atom and nitro residues important for benzothiazinone's activity, and they used genetic methods and biochemical analysis to identify its target in blocking arabinogalactan biosynthesis during cell-wall synthesis. The compound affects the same pathway as ethambutol, and thus a benzothiazinone drug has the potential to become an important part of treatment of drug-resistant disease and, possibly, replace the less effective ethambutol in the primary treatment of tuberculosis.

Science 2009; 324: 801

Eitan Israeli

Capsule

Dieter's dilemma – health vs. taste

The ability to exercise self-control is central to human success and wellbeing. However, little is known about the neurobiological underpinnings of self-control and how or why these neural mechanisms might differ between successful and unsuccessful decision makers. Hare et al. used brain imaging in a dieting population undergoing real-life decisions between a healthy or a tempting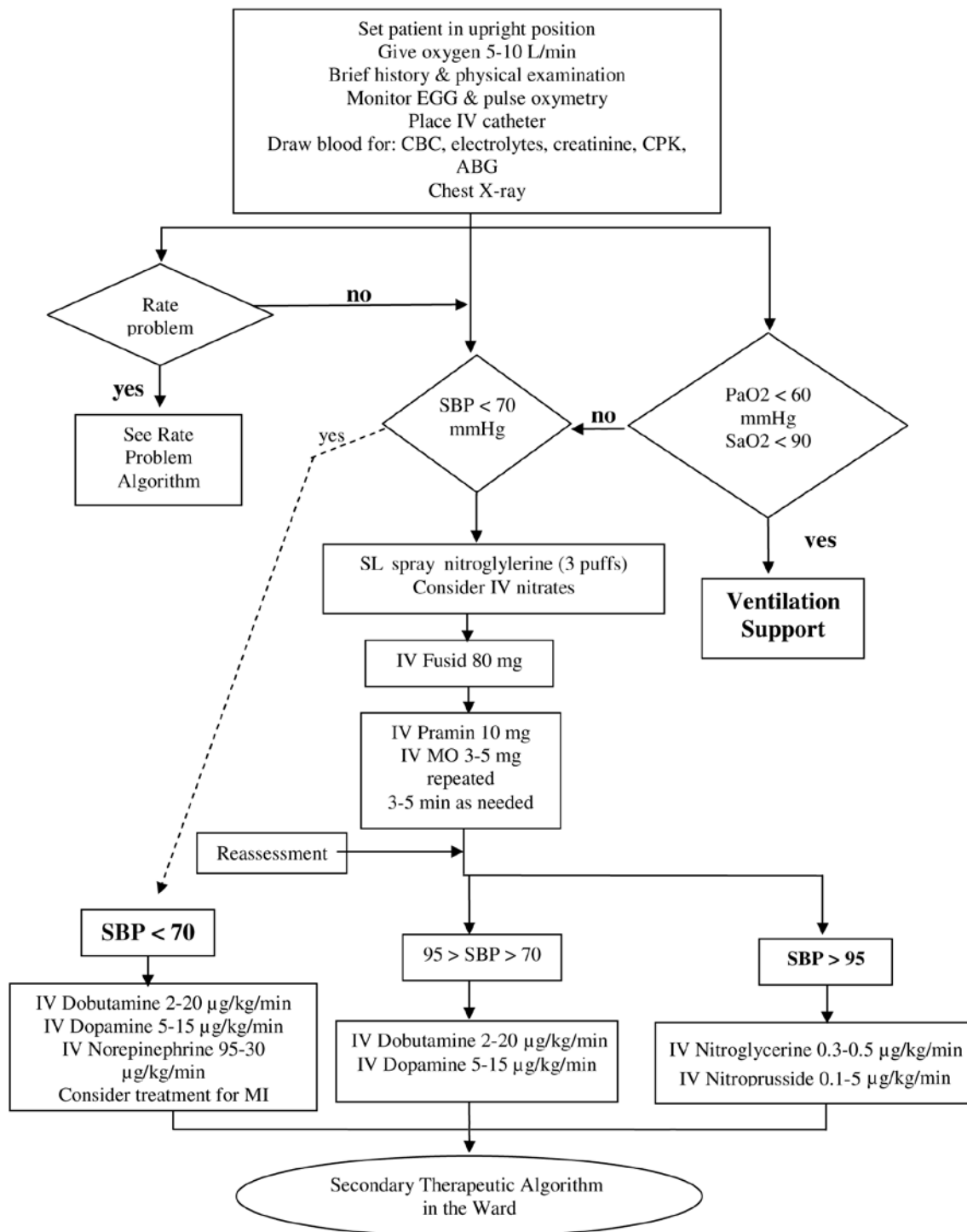, yet nutritionally inferior, choice of food. Activity in the ventromedial prefrontal cortex correlated with the value of the stimulus, termed goal value. Importantly, this activity integrated both health and taste values in individuals who were able to exert self-control in their choices, while reflecting only taste in those unable to exert self-control.

Science 2009; 324: 646

Eitan Israeli

Appendix 1: Guidelines for the treatment of ADHF/PE at Rambam Health Care Campus

[A] Primary care (Emergency Department) of ADHF/PE Guidelines

Set patient in upright position
Give oxygen 5-10 L/min
Brief history & physical examination
Monitor EGG & pulse oxymetry
Place IV catheter
Draw blood for: CBC, electrolytes, creatinine, CPK, ABG
Chest X-ray

Rate problem

no

yes

See Rate Problem Algorithm

SBP < 70 mmHg

no

PaO2 < 60 mmHg
SaO2 < 90

yes

ves

SL spray nitroglylerine (3 puffs)
Consider IV nitrates

Ventilation Support

IV Fusid 80 mg

IV Pramin 10 mg
IV MO 3-5 mg
repeated
3-5 min as needed

Reassessment

SBP < 70

95 > SBP > 70

SBP > 95

IV Dobutamine 2-20 μg/kg/min
IV Dopamine 5-15 μg/kg/min
IV Norepinephrine 95-30 μg/kg/min
Consider treatment for MI

IV Dobutamine 2-20 μg/kg/min
IV Dopamine 5-15 μg/kg/min

IV Nitroglycerine 0.3-0.5 μg/kg/min
IV Nitroprusside 0.1-5 μg/kg/min

Secondary Therapeutic Algorithm in the Ward

[B] Guidelines of secondary care of ADHF/PE in the medical ward