Precipitant profile of acute heart failure: experience of a tertiary level cardiac centre in Sri Lanka

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ABSTRACT

Introduction and objectives Heart failure (HF) is a common cause of hospitalisation in most countries. Data on acute precipitants of HF and hospitalisation is not available in Sri Lanka.

Background and methods A prospective study of 100 sequential admissions with HF to the cardiology unit (National Hospital of Sri Lanka) to describe the precipitants and clinical outcome of HF.

Results Fifty-eight male and 42 female admissions were studied. Mean age was 60.66 years. Mean hospital stay was 5.5(SD 4.6) days. Sixty had de novo HF and 40 had pre-existing HF.

The most common identifiable precipitants were acute ischaemia 37 (37%), anaemia 41 (41%), respiratory tract infection 10 (10%), arrhythmia 11 (11%), worsening renal function 11 (11%) and alcohol 5 (5.7%). Non-adherence to medication 4 (4.6%), smoking 3 (3.9%), exposure to environmental stress 3 (3.4%) and uncontrolled hypertension 1 (1%) were also observed as precipitants. The most common arrhythmia was atrial fibrillation. Out of 34 patients in whom angiotensin-converting enzyme inhibitors or angiotensin-converting enzyme receptor blockers were indicated, 11% were not on the drug. Among 29 patients in whom spironolactone was indicated, seven patients were not on the drug.

Conclusions Most precipitating factors of HF are preventable. Early identification and prevention of anaemia, preventing respiratory tract infection by vaccination, aggressive revascularisation for patients with ischaemia, monitoring of renal functions, and patient education regarding drug and diet compliance, would reduce the number of admissions.

INTRODUCTION

Heart failure (HF) is a common cause of emergency hospital admissions. In Europe, 5% of all acute medical emergencies are related to HF[1] while in USA, it is the leading cause of hospitalisation for adults[2] with hospitalisation rates of 23 per 1000 for men over age 64 years and 20 per 1000 for women over 64 years of age.[3] As the survival rates of ischaemic heart disease, hypertension and chronic kidney disease improve, HF is frequently encountered as an end-stage complication.

Readmission with exacerbations is another major problem associated with HF. The readmission rates are high all across the world. Several studies have shown that the readmission rates of HF hospitalisations range from 20–27% within a year.[4 5] This highlights the importance of addressing the predisposing factors to avoid recurrences.

Hospitalisation accounts for 60% of the total cost of managing HF patients and it is also an indicator of increasing mortality and morbidity.[6] The funds expended do not give an acceptable cost-benefit ratio as acute HF has a poor prognosis with survival estimates of 50% and 10% at 5 years and 10 years, respectively.[7] Identifying the predisposing factors of HF would therefore help clinicians to direct their management towards minimising exacerbations which in turn would reduce readmissions.

Many factors have been identified as predisposing towards a relapse of HF. These include arrhythmias, myocardial ischaemia, respiratory tract infections (RTIs), uncontrolled hypertension and non-adherence to medication.[8]

Sri Lanka is a developing country with a free healthcare system. Though Sri Lanka has a well-developed healthcare system, it is yet to be adequately extended into the emergency care and paramedical service arenas. Managing emergencies such as acute HF, in such a resource-limited setting is a challenge especially when tertiary-care centres which offer facilities for revascularisation are situated only in Colombo and in two other outstation units. The logistics of resource allocation essentially deprives a larger population from timely access to emergency care. In this setting, identification and prevention of exacerbations of HF may have a larger impact on survival.

There have been no published studies on precipitants of acute heart failure in Sri Lanka. This study aims to describe the precipitant profile of acute heart failure and the outcome of hundred sequential patients having physician-determined worsening HF admitted to a tertiary-care cardiology unit in Sri Lanka. This knowledge would enable physicians and cardiologists to optimise care given to patients with HF, reduce hospital admissions and thereby reduce health costs.

METHODS

A descriptive cross-sectional study was carried out among 100 sequential patients with HF admitted to the cardiology unit of the National Hospital of Sri Lanka (NHSL) during the year after obtaining ethical clearance from the ethical review committee of the NHSL. The study setting was selected as it is the largest state sector hospital and major cardiac centre in the country at present. The patients admitted to the hospital are from the clinic follow-up and also from referrals from physicians and cardiologists all over the country. The patients admitted to the general medical wards at the NHSL are also transferred to the cardiology unit for management of HF especially when it is severe and when it is associated with ischaemia.

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All patients who were diagnosed to have HF according to the criteria below were included to the study. HF was identified according to the European Society of Cardiology guidelines for the diagnosis and treatment of acute and chronic HF[9] as a syndrome 'where symptoms of HF, typically shortness of breath at rest or during exertion, and/or fatigue; signs of fluid retention such as pulmonary congestion or ankle swelling; and objective evidence of an abnormality of the structure or function of the heart are present'.

The criteria used to diagnose acute worsening HF were those discussed by Cotter *et al*[10] for 'Physician-Determined Worsening of Heart Failure'. This diagnosis was made irrespective of whether it warranted increasing the dose of intravenous therapy or use of mechanical ventilation.

Demographic data were obtained by the interview-based method. The documentation was also used to obtain further data. Once the patients were stable a physical examination was carried out by a single medical officer for detection of HF. Investigations were requested for serum sodium and creatine in all patients and troponin in relevant cases. The patients were followed up until discharge to assess their outcome. Drugs given during the hospital stay were recorded regularly.

Causative factors were the prime cause of the HF. Precipitant factors were those factors identified during the current admission, and not documented before; these are known to precipitate HF. In defining the precipitants, uncontrolled hypertension was defined as blood pressure >140/90 at the time of admission. Non-adherence to medication, defined as not having taken medicine prescribed for cardiovascular conditions for 48 h; and exposure to environmental pollutants in the past 48 h was ascertained on direct questioning. The questions asked to determine pollutant exposure were, exposure to construction sites, dusty roads and any other exposure to polluted environments. Alcohol use was defined as more than three units a day for men and two units a day for women over the last 1 month. If the subject had experienced a significant life event in the past 1 month it was taken as leading to significant mental stress. The significant life stresses were, marital separation, loss of job, retirement, loss of crop, business failure, being subjected to violence, major intrafamily conflict, major personal injury or illness, death or major illness of a close family member and death of a spouse. Anaemia was defined as haemoglobin <10 mg/dl during the hospital admission. The comorbidities were identified by documented evidence in clinical records and diagnosis cards. The patient's ejection fraction (EF) was measured using 2D echocardiogram during the hospital stay.

Statistics were analysed using SPSS (V.16, Chicago, Illinois, USA). The χ^2 test was used for comparison between groups of patients: de novo HF and pre-existing HF.

RESULTS

Basic characteristics

The basic characteristics of the study population are given in table 1. There was a predominance of men (58 were men and 42 were women). There was a wide age distribution with a mean age of 60.7 (SD 13.26) years. The range was 28–88 years.

The main presenting complaint was shortness of breath which was present in 68% of patients. In 19 (19%), the presenting complaint was ankle oedema.

The most frequent physical sign elicited was the presence of bibasal crepitation. Ankle oedema was present in 19% while ascites was detected in 3%.

The mean EF was 40.25% (SD 12.68). Eighteen patients showed evidence of valvular lesions: 1 aortic stenosis, 4 mitral stenosis, 13 mitral regurgitation, 1 mitral valve prolapse and 4 aortic regurgitation.

Table 1 Basic characteristics of the study population (N=100)

Demographic characteristics	Variable	Number (%)
Sex	Males	58 (58)
	Females	42 (42)
Age	20–29	1 (1)
	30–39	6 (6)
	40–49	6 (6)
	50–59	26 (26)
	60–69	22 (22)
	70–79	22 (22)
	80–89	4 (4)
Comorbidities	DM	40 (40)
	High serum creatine	39 (39)
	Cerebrovascular disease	6 (6)
	Cirrhosis	2 (2)
Hospital stay	Inward	100 (100)
	ICU	44 (44)
Duration of stay	Inward	5.5 (SD 4.62)
	ICU	5.5 (SD 3.31)
Clinical features on admission	NYHA II	7 (7)
	NYHA III	11 (11)
	NYHA IV	50 (50)
	Ankle oedema	19 (19)
	Crepitation	61 (61)
	Ascites	3 (3)
2D Echocardiographic findings	Aortic stenosis	1 (1)
	Mitral stenosis	4 (4)
	Mitral regurgitation	13 (13)
	Mitral valve prolapse	1 (1)
	Aortic regurgitation	4 (4)
	Ejection fraction	40.25–Mean

DM, diabetes mellitus; ICU, intensive care unit; NYHA, New York Heart Association.

The common comorbidities found in the study population were diabetes mellitus in 40%, high serum creatine in 39%, cerebrovascular disease in 6% and cirrhosis in 2%.

Mean hospital stay was 5.5 (SD 4.6) days. Forty-four patients were given intensive care of which 28 were patients who had de novo HF and 16 were patients with pre-existing HF.

Clinical course

Out of all admissions, 60 had de novo HF that was defined as not having any medical records indicating they have had HF or been treated for HF prior to the current admission. Forty patients had HF diagnosed and treated before and the present admission was for an exacerbation. Table 2 gives the breakdown of the variables studied in the two groups.

Causative factors

The common causes of pre-existing HF were, ischaemic heart disease in 54 (54%), hypertension in 40 (40%), valvular lesions in 18 (18%) and atrial fibrillation in 3 (3%) patients. There are given in table 3.

Precipitants

The most common identifiable precipitants were acute ischaemia 37 (37%), anaemia 41 (41%), RTI 10 (10%), arrhythmia 11 (11%), worsening of renal function 11 (11%) and alcohol 5 (5.7%). Non-adherence to medication 4 (4.6%), smoking 3 (3.9%) and exposure to environmental stress 3 (3.4%), uncontrolled hypertension 1 (1%) were also observed as precipitants.

Table 2 Characteristics of patients with de novo heart failure (HF) and pre-existing HF

Characteristic	De novo HF	Pre-existing HF	p Value
Basic characteristics			
Males	37	21	0..363
Females	23	19	
EF%	40.70	39.58	0.096
Number of Hospitalised days	5.85	4.96	0.052
Comorbidities			
Diabetes	17	23	0.004
Cerebrovascular disease	3	3	0.606
Precipitating factors			
Ischaemia	25	12	0.071
Anaemia	24	17	0.083
Arrhythmia	5	6	0.786
Worsening renal function	6	3	0.754
Exposure to environmental stress	0	3	0.003
Causative factors			
IHD	28	26	0.132
Hypertension	22	18	0.608
Arrhythmias-AF	1	2	0.565
Valvular lesions	10	8	0.662
Drugs			
ACE I/ARB	2	19	0.000
Spironolactone	0	12	0.000
β-blockers	0	39	0.000

EF, ejection fraction; IHD, ischaemic heart disease; AF, atrial fibrillation; ARB, angiotensin receptor blocker.

The most frequent arrhythmia was atrial fibrillation. The precipitants categorised against the type of HF are given in table 4.

Use of drugs

Certain drugs are known to reduce the mortality of HF. We studied the use of these agents before the current admission. Out of 34 patients whose EF<40%, who had no contraindication for ACE inhibitors (ACEIs) or ACE receptor blockers (ARBs), 11 were not on the drug. There was no difference in the patients who were on ACEIs or ARBs and development of de novo HF (p=0.772). Among 29 patients who had an EF ≤35%, seven patients without any contraindication for spironolactone were not on the drug.

Outcome

Eight (8%) patients succumbed to their illness and they were all treated in the intensive care unit (ICU). Out of 92 discharged patients, 32 (32%) required intensive care.

Table 3 Causative factors of heart failure

Causative factors	
IHD	54 (54%)
Hypertension	40 (40%)
Arrhythmias-AF	3 (3%)
Valvular lesions	18 (18%)

IHD, ischaemic heart disease; AF, atrial fibrillation.

Table 4 Precipitant factors*

	Number
Precipitant	
Anaemia	41 (41%)
Ischaemia	37 (37%)
Idiopathic	17 (17%)
Worsening renal function	11 (11%)
Arrhythmia	11 (11%)
Respiratory tract infections	10 (10%)
Non-adherence to diet	7 (7%)
Alcohol	5 (5%)
Non-adherence to medication	4 (4%)
Smoking	3 (3%)
Exposure to environmental stress	3 (3%)
Uncontrolled hypertension	1 (1%)
Mental stress	1 (1%)

*A Patient may have had more than one precipitant factor.

The mortality in our patient group was 8%. Those who had ischaemia as the precipitating factor were more likely to have a higher mortality compared with those who had other precipitating factors (p=0.023). Other causative factors and precipitants were as not significantly different in the two groups: deaths and discharged patients.

The characteristics of patients who survived and were discharged and those who died are shown in table 5.

DISCUSSION

This study enrolled all admissions with physician-determined worsening of heart failure. Several significant findings were highlighted when comparing the two groups of patients with de novo HF and those with pre-existing HF. The study had a higher proportion of patients with de novo HF (60%) when compared with worsening of pre-existing HF. The Euro Heart Failure Survey II (EHFS II)[11] had 37% of patients with de novo HF and another study done in Lithuania had only 27.5%[12] of

Table 5 Characteristics of patients discharged and deaths

Characteristic	Deaths	Survivals
Basic characteristics		
Male	3 (3%)	55 (55%)
Female	5 (5%)	37 (37%)
Pre-existing HF	0	8 (8%)
Diabetes Mellitus	2 (2%)	38 (38%)
Cardio vascular disease	1 (1%)	5 (5%)
Chronic kidney disease	1 (1%)	35 (35%)
Precipitating factors		
Ischaemia	4 (4%)	33 (33%)
Anaemia	3 (3%)	38 (38%)
Arrhythmia	0	11 (11%)
Worsening renal function	0	11 (11%)
Causative factors		
IHD	5 (5%)	49 (49%)
Hypertension	3 (3%)	37 (37%)
Atrial fibrillation	0	3 (3%)
Valvular lesions	0	8 (8%)

IHD, ischaemic heart disease; HF, Heart failure.

patients with de novo HF. The causative factors of the two types of HF are quite similar. Ischaemia, hypertension and vavular heart disease are the most common causes identified in this study. This is the same for the studies done elsewhere.[13] Therefore the explanation for the higher incidence of de novo HF is not known. It may be that undiagnosed compensated HF presents as a hospital admission with de novo HF where significant physician inertia in prescribing ACE inhibitors may be a contributing factor. A thorough assessment of potential causative factors in the outpatient clinics could help reduce the development of de novo HF. Optimising management of ischaemia, controlling blood pressure and assessment of symptomology of HF in patients with valvular disease at every clinic visit could reduce de novo HF.

There was no significant statistical difference in the precipitant profile between de novo HF and pre-existing HF except for anaemia which was higher in the group with pre-existing HF. Gastrointestinal bleeding with antiplatelet therapy could be a contributing cause and it may explain as to why patients already diagnosed with HF had a higher percentage of anaemia (as they were more likely to be on antiplatelet therapy if ischaemia had been identified).

This study identified a number of precipitants which have clinical significance. If future curative and preventive programmes are targeted toward these precipitants the burden of HF could be lessened.

Studies in different settings have had different profiles of precipitants. A study in Lithuania found non-compliance with therapy and valvular causes to be the most common precipitants. A study in Chicago, USA found non-adherence to therapy and cardiac arrhythmias as the most common precipitants.[14] The most common precipitants in our study were anaemia and ischaemia. Though non-adherence to prescribed medicine has been an important precipitating factor in studies elsewhere[12] it was not one of the top precipitants in our study. The reason for good adherence to medicine could be attributed to the fact that Sri Lanka has a free healthcare system and the essential drugs are given free to the patients from the government hospitals. Cost of medication is therefore not a barrier for good compliance.

Anaemia was found in 41% patients in this study. Three patients were given blood transfusions as they had haemoglobin <6.9%. The aetiology of anaemia was not investigated in this study. The possible aetiologies of anaemia in a country such as ours could be high consumption of tea, poor socioeconomic status of the patients leading to poor dietary choices and hookworm infestation.[15] Most of the patients with pre-existing HF were followed up in the outpatient clinics of the cardiology unit. Regular assessment of haemoglobin levels, health education on dietary diversification, and antihelminthic treatment, are steps that could easily reduce the burden of anaemia in this population.

Ischaemia was the second most common precipitant in this study second to only anaemia. It can be postulated that less aggressive revascularisation of patients with ST elevation myocardial infarctions (STEMIs) could have been a contributing factor in a proportion of patients who had worsening HF due to ischaemia. Percutaneous coronary intervention (PCI) has been recognised as one of the best modalities of treatment for acute ischaemia in STEMI. Primary PCI within 6–12 h after symptom onset in high-volume, experienced centres results in less reocclusion and improved residual left ventricle function in the setting of acute ischaemia.[16] Compared with standard treatment, a pharmacoinvasive strategy of routine early PCI within 6 h after thrombolysis is associated with a 6% absolute (46% relative) reduction in the composite of death, reinfarction, recurrent ischaemia, HF and shock, as shown in the Trial of Routine ANgioplasty and Stenting after Fibrinolysis to Enhance Reperfusion in Acute Myocardial Infarction (TRANSFER-AMI).[17] PCI has been recognised as a major component of therapy in ischaemia precipitating HF.[18] But the efficacy of PCI depends on the experience of the operator, the door-to-needle time and proper patient selection. Sri Lanka being a poor resource setting has only one centre in the government sector (free of charge to patients) performing PCI. Even transferring a patient to a PCI performing centre is a challenging task due to the non-availability of a central triage protocol. The cost of PCI and non-availability of paramedical services are other logistical constraints encountered in Sri Lanka.

Pulmonary congestion in HF increases the risk of RTIs. Hospitalisation for HF is higher during epidemics of influenza.[19] Influenza vaccination has proven efficacy in reducing hospitalisation in patients with cardiac disease.[20] The Center for Disease Control has recommended influenza and pneumococcal vaccination in all patients with HF. Given the fact that a significant proportion of our study group had RTI as the precipitating factor, vaccination becomes very relevant. Immunisation has been a core component of the primary healthcare programme. The national immunisation programme of Sri Lanka has high coverage (more than 95 per cent) for all Expanded programme of Immunisation (EPI) vaccines. The influenza vaccine is presently not included in the EPI programme and therefore not available free of charge to patients. The influenza vaccine is recommended for specific high-risk groups which include patients with HF. As there is no programme at present which routinely advocates or administers the vaccine to high-risk groups the coverage by vaccination aimed against lower RTIs is questionable. The cost of the vaccine is also an issue in a third-world country like Sri Lanka.

Patients with HF are known to be sensitive to ambient air pollution.[21 22] In this study, there were three patients who had worsening symptoms after being exposed to housing construction dust and vehicle fumes. However, this could not be verified as the sole precipitant of the exacerbation and further studies are clearly indicated.

Limited resources is a major setback for the development of any healthcare prevention programme. Our study setting, the NHSL, is the largest teaching hospital and tertiary-care cardiac centre in Sri Lanka. It is the final referral centre in the country. There are daily outpatient clinics on all weekdays and Saturdays. The average patient turnover each day is around 500–600 patients. The patients are form all over the country. The admissions consist of patients referred from all other hospitals from all over the country. This is a blessing and a curse when it comes to optimal management of patients with HF. The fact that there is a well-established clinical setting ensures that all patients are followed up. However the high patient turnover limits the care given to one patient. This makes it difficult for the physician to advise the patient extensively on infection prevention, dietary modification and to have lengthy symptom analysis to identify worsening of HF early. The holistic management approach is difficult in such a busy clinical setting. If steps are taken to reduce the number of patients seen per day by reducing the frequency of clinical visits at the NHSL and encouraging local hospital follow-up, it could provide an opportunity for more time to concentrate on precipitant prevention, etc. This is easier said than done as it requires strengthening of hospitals around the major city of Colombo in order to avoid

patients bypassing them. Establishing special HF clinics would be an alternate method to address the specific problem discussed above. In addition to the above, the use of nursing staff for the management of patients with HF has been successful in other countries. Nurses-led clinics, where drugs are optimised, patients are educated on avoiding precipitating factors, could lead to reduced hospital admissions.[23–25] Sri Lanka also could initiate such a programme in the future to strengthen the health-care system to optimise the management of HF patients.

The mean hospital stay was 5.6 days. It was shorter than the hospital stay reported in the Euro Heart Failure Survey II, 9 (6–14) days.[26] The discharge criteria in our setting are affected by the lack of beds. The study centre is the largest cardiac centre in the government sector with a cardiac ICU facility. The total number of ICU beds in this facility is 15 which is grossly inadequate considering the large number of referrals and transfers received. This affects the discharge criteria as patients are discharged as soon as they are clinically stable.

Physician inertia is a remediable factor in improving outcome in patients with HF. The use of ACEI/ARB is suboptimal when compared with the ESC guidelines.[9] Out of 34 patients who had EF<40% and who had no contraindication for ACEI, 11 were not on the drug. Though ACEI and ARB have been used for asymptomatic left ventricular failure for retardation of progression of disease, there was no difference in the development of de novo HF in those on the drugs and those not on them. However, this finding cannot be used to infer therapeutic or epidemiological implications for Sri Lankans as this is a small scale preliminary study and as we did not have the EFs of patients prior to admission.

Three patients were readmitted during the study period. All three had pre-existing HF. However, few studies in other regions show that readmission is more frequent in patients with de novo HF.[27] The clinical characteristics related to readmission could not be studied as the number of readmissions was small.

LIMITATIONS

This study was a preliminary study on HF requiring hospital admission. Further research is required to address some of the findings of this study; namely the role of anaemia, renal impairment in precipitating HF and reasons for physician inertia in optimising management. Furthermore a study on the exact timing of patient's arrival in hospital to time to revascularisation and the factors which prevented early revascularisation were not included in this study. Since this was a single-centre study the patients studied might not represent the patients seen at rural hospitals in the country who do not have severe HF which warrants treatment at NHSL.

CONCLUSIONS AND RECOMMENDATIONS

This study identifies important remediable factors in avoiding an acute precipitation of HF such as ischaemia, lower RTIs and anaemia in a group of patients referred to a tertiary care centre in Sri Lanka. It also highlights the importance of patient and physician collaboration on optimising management and the need for good outpatient care. Further studies are needed to study the cost benefit of aggressive and timely revascularisation and annual influenza vaccination versus the cost of treating repeated episodes of HF in a poor resource setting such as Sri Lanka.

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