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Thirst trajectory and factors associated with persistent thirst in patients with heart failure

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ABSTRACT

Background: Thirst is often increased in patients with Heart Failure (HF) and can cause distress during the course of the condition. The aim of the present study was to describe the trajectory of thirst during an 18-month period and to identify variables associated with persistent thirst in patients with HF.

Methods and Results: Data were collected from 649 patients with HF with the use of the Revised Heart Failure Compliance Scale at 1, 6, 12 and 18 months after a period of hospital treatment for worsening HF. Thirst trajectory was described for the four follow-up visits and logistic regression analysis was used to identify factors independently associated with persistent thirst. In total, 33% (n= 212) of the patients reported thirst on one or more occasions and 34% (n= 46) continued to have thirst at every follow-up visit. Nineteen percent (n=121) of the patients had persistent thirst. Patients with persistent thirst were more often younger and male and had more HF symptoms. Higher body mass index and serum urea also increased the risk of persistent thirst.

Conclusions: Patients with HF who were thirsty at the 1-month follow-up were more often also thirsty at subsequent visits. Assessment of thirst is warranted in clinical practice because one-fifth of patients suffer from persistent thirst.

Keywords: Thirst, heart failure, trajectory, persistent thirst

Introduction

The prevalence of patients with heart failure (HF) in society is increasing owing to an aging population and improvement of cardiovascular treatment. From 10% to 20% of people aged 70-80 years are estimated to have HF.¹ These patients experience a large number of symptoms, such as dyspnoea and fatigue, which affect their daily functioning and quality of life.¹⁻⁴ Thirst is a well recognized but rarely studied symptom. In a recent review we showed that patients with HF have increased thirst, which causes distress.⁵ Thirst is a natural physiological function, which serves to maintain fluid balance. It can be defined as a desire for drinking water and develops into a strong desire to drink that is difficult to ignore.⁶

In patients with HF, thirst intensity was graded as 23-75 mm on a visual analogue scale (100 mm), and patients with worsening HF graded the thirst to be of relatively higher intensity.^{5,7} Forty-six percent of patients with HF described thirst as troublesome⁸ and could not find anything that helped to reduce their thirst for more than a short period of time.⁹

Persistent thirst can affect the patient's ability to manage daily activities, including self-care and adherence to fluid restriction.^{2,5,9} There is no knowledge of the thirst trajectory in HF or of the number of patients who suffer from persistent thirst. Persistent thirst has been described only in patients with HF during their last 6 months of life⁴ and is possibly related to factors associated with HF treatment, psychological factors, such as anxiety, and higher New York Heart Association (New York Heart Association) functional class.⁵

To increase the knowledge about thirst in patients with HF, the main objectives of the present study were to (i) examine the thirst trajectory and describe HF patients with persistent thirst during an 18-month period and (ii) determine factors associated with persistent thirst. Displaying changes over time helps us to understand how many patients with HF continuously experience thirst. Mapping the thirst trajectory is also a first step toward alerting health care professionals to the possibility of persistent thirst and the need for intervention.

Methods

For this study we used a descriptive, prospective design with data from the Coordinating Study Evaluating Outcomes of Advising and Counselling in Heart Failure (COACH) study.¹⁰ This was a randomised, controlled study with 1,023 HF patients that aimed to determine the effectiveness of two interventions with basic and intensive nurse-led HF care, compared to conventional care as presented elsewhere.^{10,11} Inclusion criteria for COACH were hospital

admission for HF, evidence of structural underlying heart disease, and age > 18 years. Exclusion criteria were participation in another study, inability to complete questionnaires and a recent or planned invasive cardiac intervention. The central Ethics Committee approved the study, and every patient provided written informed consent. The study complied with the Declaration of Helsinki.

Data collection for patients in the COACH study took place by an independent data collector on 5 occasions: at the index hospitalization (baseline) and at follow-up visits 1, 6, 12 and 18 months after discharge. The patients completed questionnaires about compliance with fluid restriction (all data collection time points) and depressive symptoms (baseline). Prescription of treatment, such as fluid and sodium restriction, was made by the physician at the clinic based on clinical judgement, current guidelines, and hospital protocol.

Assessment of thirst

To assess thirst at each follow-up visit, the subscale ‘compliance with fluid restriction’ from the Revised Heart Failure Compliance Scale was used.¹² When patients reported problems complying with fluid restriction, they were asked “Why is it difficult to maintain fluid restriction?” Possible answers were: ‘lack of self-motivation’; ‘unable to control fluid restriction’; ‘I did not know I had to restrict my fluid intake’; ‘thirst’; or ‘other’. When a patient reported thirst as being the reason for problems with fluid restriction, 1 point was assigned.

Data on thirst from baseline were not incorporated into the thirst trajectory, because worsening HF was regarded to be a confounder.⁷ For this sub-study, we included patients who completed the questionnaire on compliance with fluid restriction on at least 3 out of 4 follow-up occasions. When patients had 1 missing value regarding measurement of compliance with fluid restriction, this was substituted by the most frequently reported answer for having thirst (yes or no) on the 4 follow-up occasions. The total thirst score could theoretically range from 0 to 4 points (Fig. 1). In the analyses for this sub-study, 102 patients were excluded because they completed the fluid restriction compliance questionnaire < 3 times. Another 272 patients died during the study period (Fig. 2) which led to high percentages (38 to 99) of nonavailable data from 1 to 18 months.

The description of the thirst trajectory, defined as the course of thirst, thus began at the 1-month follow-up with the number of patients with or without thirst. The patients were then followed with the same questionnaire on each follow-up occasion up to 18 months after discharge. Persistent thirst was defined as having thirst ≥ 2 times, and not having persistent thirst was defined as having thirst ≤ 1 times during the study period (Fig. 1).

Additional data

Clinical and demographic variables at baseline were retrieved from the patients' medical records. Depressive symptoms were assessed with the use of the Centre for Epidemiological Studies Depression Scale (CES-D).¹³ This 20-item self-report questionnaire measures the presence of depressive feelings and behaviours on a 4-point Likert scale ranging from 0 (rarely or none of the time) to 3 (most or all the time). The total sum score ranges from 0 to 60 points, with higher scores indicating higher presence of depressive symptoms. A score of ≥ 16 points indicates presence of depressive symptoms.¹³

Presence of the following 10 symptoms was assessed by interviewing the HF patients: ankle oedema after waking up, ankle oedema during course of the day, difficulty sleeping, decreased appetite, fatigue, dyspnoea during rest, dyspnoea lying down, dyspnoea during exercise, cough, and dry cough. The total number of symptoms was obtained by summing all symptoms.

Data analysis

To examine the thirst trajectory, the occurrences of thirst (yes or no) were summarised in each follow-up examination (1, 6, 12, and 18 months). Descriptive statistics were used to describe the study population at baseline depending on the presence or absence of persistent thirst. Data is presented as mean $\pm$ SD, median (interquartile range [IQR]), or n (%). The Cochran Q test was used to compare the occurrences of thirst at each follow-up with the occurrence of thirst at 1 month after the hospital discharge for worsening HF. Univariate analyses were used to identify variables associated with persistent thirst. These included the independent t test (continuous normally distributed), and the Mann-Whitney U test (continuous skewed). Categorical variables were analysed with the use of chi-square tests. Variables showing a difference of $P < 0.15$ were entered in a logistic regression analysis, which was performed with a backward method to identify which theoretically relevant factors were independently associated with persistent thirst. An odds ratio > 1 indicates higher probability for persistent thirst, and an odds ratio < 1 indicates lower probability for persistent thirst. A P value of less than 0.05 was considered to be significant. Data were analyzed with the use of Statistical Package for Social Sciences (SPSS) version 20 (SPSS, Chicago, Illinois).

Results

Study population

A total of 649 patients were included in this substudy. Mean age of the included patients was 69 ± 12 years, and 62% (n= 404) were men. The mean left ventricular ejection fraction was $33\% \pm 14\%$, 44% (n= 282) were in NYHA functional class III-IV at discharge from hospital, and 95% (n= 619) were prescribed diuretics (Table 1). Of the 1023 patients in COACH a total of 374 were not included in this substudy: 272 patients died, and 102 completed the fluid restriction compliance questionnaire < 3 times. Excluded patients were slightly older (74 vs 69 years) and more often in NYHA functional class III-IV (57% vs 44%).

In total, 66% (n=382) of the included patients were advised to restrict their fluid intake and 87% (n= 564) to restrict their sodium intake (Table 1). Of the patients with persistent thirst 60% were prescribed 2000 mg sodium/day and 40% were prescribed 3000 mg sodium/day compared with 70% and 30%, respectively, of patients without persistent thirst.

The prevalence of thirst at the 1-month follow-up was 21% (n=136), but decreased slightly for each follow-up during the study, ending with 17% (n= 108) at 18 months. Of the 649 patients, 19% (n=121) had persistent thirst, which was defined as having thirst at ≥ 2 follow-up occasions (Fig. 1).

Trajectory of thirst in heart failure

Figure 3 shows the observed thirst trajectory depending on whether the patients reported thirst or not, starting with the first follow-up visit at 1 month and proceeding to the last follow-up visit at 18 months. At the 1-month follow-up, 136 (21%) of all patients were thirsty, of which 46 (34%) continued to report thirst during the rest of the follow-up, 44 (32%) no longer reported thirst after the 1-month follow-up, and 46 (34%) reported thirst on two or three of the follow-up occasions.

Out of the 513 (79%) patients who did not report thirst at 1 month, 29 (6%) had thirst on the following two or three occasions and 47 (9%) had thirst on one occasion (Fig. 3).

Figure 4 shows the number of times on which the patients reported thirst. A total of 212 (33%) patients reported thirst on at least one occasion. Of these patients, 91(43%) reported thirst on one occasion and 121 (57%) reported thirst on two to four occasions. Patients who reported thirst at 1 month were significantly more often thirsty also at 6, 12 and 18 months (about 50%) compared with those who did not report thirst at 1 month (7-8%) ($P < 0.003$) (Table 2).

Factors related to persistent thirst in heart failure

A univariate analysis showed that patients with persistent thirst were significantly younger (64 vs 70 years old; $P < 0.01$), and more often male (75% vs 59%; $P < 0.01$) (Table 1). They also had a higher body mass index (BMI; 29 ± 6 vs 27 ± 5 kg/m²; $P < 0.01$). Patients with persistent thirst also had more HF symptoms (4 ± 3 vs 3 ± 2 ; $P < 0.01$), and higher depression scores, with CES-D scores of 14.5 (interquartile range [IQR] 8-25) versus 12.0 (IQR 6-19; $P < 0.02$).

There were no significant differences between patients with and without persistent thirst regarding prescribed fluid restriction (62% vs 67%; $P = 0.3$) and sodium restriction (88% vs 87%; $P = 0.8$) (Table 1).

In the multivariate logistic regression model, higher BMI (odds ratio [OR] 1.06; $P < 0.01$), higher serum urea (OR 1.05; $P < 0.05$), and more HF symptoms (OR 1.14; $P < 0.05$) were independently associated with persistent thirst (Table 3). Older age (OR 0.96; $P < 0.001$) and being female (OR 0.43; $P < 0.01$) decreased the odds of having persistent thirst. There was a trend that the CES-D score was higher in those with persistent thirst (OR 1.04; $P = 0.07$).

Discussion

To our knowledge, this is the first study to examine thirst trajectory in patients with HF and factors associated with persistent thirst. The findings show that one-third of the patients who were thirsty at the 1-month follow-up continued to be thirsty at all follow-up time points. Whereas temporary thirst focuses on momentarily alleviating thirst by drinking,⁶ persistent thirst can be experienced as an ongoing and troublesome sensation.⁵ Based on our definition, 19% had persistent thirst, because they were thirsty at ≥ 2 of 4 follow-up visits. This subgroup might require greater involvement by health care providers.

Patients with worsening of HF and patients with HF at the end of life are known to frequently suffer from persistent thirst.^{4,5} However, some patients with HF apparently remain in this troublesome situation for a much longer period of time during stable parts of their chronic condition, or at least for 18 months as shown in the present study. Patients who were once thirsty were still more likely to once again become thirsty, which indicates the importance of assessment of thirst. Our analysis shows that the likelihood of thirst over time is greatly dependent on whether thirst was reported or not at 1 month. As presented in Table 2, the majority of those who were not thirsty at one month did not report thirst on later occasions.

Although the proportion of thirst seems to be stable over time, there were also new-onset cases. Nevertheless, for many of the patients, thirst came and went during the 18-month study period. The finding of temporary thirst is consistent with other symptom trajectories in HF, including depressive symptoms or sexual problems, which shows that symptoms often disappear spontaneously or at least without clear medical intervention.^{14,15} Other patients develop new symptoms^{14,15} that cause distress, trigger hospitalization, and increase mortality.^{14,16}

In the present study, patients with persistent thirst were significantly younger than those without persistent thirst. Studies have shown that thirst becomes blunted with age. Reduced cerebral blood flow and attenuated sensitivity of receptors responding to changes in central blood flow serve to explain thirst impairment in the elderly.^{17,18} Men with HF were also more prone to have persistent thirst. Studies on healthy persons show that men are usually slightly dehydrated, which can initiate increased thirst.¹⁹

The number of symptoms experienced in patients with HF can be as many as 15.³ Dyspnea, lack of energy and dry mouth are the most prevalent ones. We found that the number of HF symptoms was associated with persistent thirst. It is previously known that increased symptom prevalence in HF has a negative impact on well-being and quality of life.³

High serum urea was one of the factors related to persistent thirst. Serum urea might be a guide to patient hydration status, but can also serve as a surrogate for neurohormonal activation.^{20,21} Angiotensin II, which initiates drinking, is a vasoactive hormone and a part of the well known hormonal activation cascade.^{6,22} Finally, BMI was associated with persistent thirst. One explanation of this finding could be that the prescribed fluid restriction was the same regardless of body weight. Fluid restriction is generally prescribed as a specific volume of fluids and not adjusted to physiologic needs, which vary with body mass.^{2,6}

Earlier studies described that troublesome thirst is promoted by fluid restriction in patients with HF,^{5,9} but this association was not found in the present study. However, the prescribed fluid restriction is not necessarily the same as the amount of fluids consumed. Two randomized studies showed no differences in perceived thirst between HF patients with fluid restriction versus normal fluid intake.^{23,24} In contrast, two other studies found a significant decrease in thirst intensity with liberal fluid intake compared with fluid restriction.^{25,26} Evidently, thirst can be reduced by fluid intake that is adjusted according to body mass. In healthy volunteers, sympathetic arousal from physiologic strain, eg. tachycardia, was another factor that stimulates thirst.²⁷ However, the importance of this mechanism is unclear in patients with HF.

A regular follow-up of the thirst trajectory may help health care professionals to display changes in thirst over time and to identify patients with troublesome thirst. Assessing thirst in

patients with HF regularly, not only once, in hospital care as well as outpatient settings can be a key strategy to identify those who develop or have persistent thirst. Introducing a routine screening of thirst in treatment programs and clinical practice would be helpful in order to address troublesome thirst in patients with HF. Identification of signs and symptoms of worsening HF and or assessment of the effects of individual treatment such as diuretic therapy (too much or too little, etc) certainly plays a vital role in the ongoing and continuous care and maintenance of the outpatient HF patient.

Further research is needed to achieve a broader understanding of the thirst trajectory. The present findings should be confirmed by assessment directed at the presence of thirst in the daily life of patients with HF. It could provide an insight into HF as a syndrome, and information about thirst is necessary also to improve quality of life in many patients with HF.

Study limitations and strengths

One limitation is that the data collection was originally intended to answer other research questions. The assessment of thirst was based on self-reported answers on thirst in a questionnaire about compliance with fluid restriction, and this might have caused underreporting. Finally, since there is no official definition on persistent thirst, we used an arbitrary cutoff score to differentiate between patients with and without persistent thirst.

Nevertheless, the strengths of this study were the repeated assessments of thirst over a period of 18 months in a large sample of patients with HF. The prospective design examined the thirst trajectory and persistent thirst, which has not been done previously.

Conclusions

One third of patients with HF had thirst on one out of four regularly timed follow-up occasions during an 18-month study period. The patients who were thirsty at the 1-month follow-up visit were more often thirsty at subsequent examinations up to 18 months later. These findings suggest a need for assessing thirst to recognize and detect an incipient problem for patients with HF. The results may also be a guide to identify patients with a potential risk for persistent thirst, such as patients with a higher number of HF symptoms, higher BMI or serum urea and male sex.

Disclosures

None.

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Tables

Table 1. Characteristics of the study patients, with and without persistent thirst

Variable	All patients (n= 649)	Persistent Thirst		P-value
		Yes ^a (n= 121)	No ^b (n= 528)	
Demographics				
Age, years	69 ± 12	64 ± 12	70 ± 11	<0.01
Men, %	62	75	59	<0.01
Cohabiting, %	62	68	61	0.14
Clinical characteristics				
NYHA class III-IV, %	44	45	44	0.87
Left ventricular ejection fraction, %	33 ± 14	33 ± 14	33 ± 14	0.74
Duration of HF, days	50 (19-1058)	98 (21-1331)	44 (18-964)	0.22
BMI, kg/m ²	27 ± 5	29 ± 6	27 ± 5	<0.01
Systolic blood pressure, mmHg	119 ± 21	119 ± 22	119 ± 21	0.87
Diastolic blood pressure, mmHg	69 ± 12	71 ± 12	69 ± 11	0.06
Sodium, mmol/L	139 ± 4	139 ± 4	139 ± 4	0.44
Urea, mmol/L	12 ± 6	12 ± 6	11 ± 5	0.11
Creatinine, umol/L	117 ± 44	121 ± 38	116 ± 45	0.29
NT-proBNP, pmol/L	2165 (1115-4286)	2073 (992-4456)	2171 (1129-4252)	0.63
Comorbidities, %				
Type II diabetes	15	14	15	0.88
Type I diabetes	10	10	10	0.88
Hypertension	41	41	42	0.97
Medication, %				
ACE-inhibitors	76	77	76	0.90
Angiotensin receptor blockers	12	12	13	0.78
Calcium channel blockers	15	17	15	0.66
Diuretics	95	99	95	0.03
Antidepressive	6	10	6	0.07
Aldosterone antagonist	54	62	53	0.06
Fluid- and sodium restriction, %				
Fluid 1200-1800 ml/day	66	62	67	0.33
Sodium 2000-3000 mg/day	87	88	87	0.84
Depressive symptoms				
Total scores	12.0 (7-20)	14.5 (8-25)	12.0 (6-19)	0.02
Depressive symptoms, %	38	44	37	0.15
HF symptoms				
Number of HF symptoms at 1 month	3 ± 2	4 ± 3	3 ± 2	<0.01

Data is presented as mean ± SD, median (25th and 75th percentiles), or as frequency.

HF: heart failure; NYHA: New York Heart Association; BMI: body mass index

^a Patients reporting thirst ≥ 2 times out of 4 follow-up visits.

^b Patients reporting thirst ≤ 1 time out of 4 follow-up visits.

Table 2. The proportion of patients with heart failure who were thirsty during the follow-up depending on whether thirst was present or not at 1 month

1 month N (%)	6 months N (%)	12 months N (%)	18 months N (%)
Not thirsty (n=513)	40 (7.8)	18+21 (7.6)	11+3+8+15 (7.2)
Thirsty (n=136)	75 (55.1)	57+8 (47.8)	46+12+4+9 (52.2)

Table 3. Logistic regression with factors associated with persistent thirst

Variable	Odds Ratio	95 % CI for Odds Ratio		P value
		Lower	Upper	
Age, years	0.96	0.94	0.98	<.001
Gender, female	0.43	0.23	0.74	<0.01
BMI, kg/m ²	1.06	1.02	1.12	<0.01
Serum Urea, mmol/l	1.05	1.01	1.10	<0.05
Heart failure symptoms, number	1.14	1.01	1.26	<0.05
Depressive symptoms, score	1.04	1.00	1.05	0.07
Diuretics	5.21	0.65	41.7	0.12
Antidepressive medication	1.72	0.66	4.44	0.26
Depressive symptoms	0.74	0.31	1.77	0.50
Co-habiting	1.21	0.68	2.15	0.51
Aldosterone antagonist	1.09	0.65	1.84	0.75
Diastolic blood pressure, mmHg	1.00	0.68	2.15	0.82

Model: $R^2 = 0.19$ (Nagelkerke); CI, confidence interval; BMI, body mass index.

Figures

Follow-up	Patient A	Patient B	Patient C	Patient D	Patient E
1 month	No thirst	Thirst	Thirst	Thirst	Thirst
6 months	No thirst	No thirst	Thirst	Thirst	Thirst
12 months	No thirst	No thirst	No thirst	Thirst	Thirst
18 months	No thirst	No thirst	No thirst	No thirst	Thirst

SCORE	0	1	2	3	4
Not persistent thirst			Persistent thirst		

Fig. 1. Scoring for reported thirst at four follow-up visits over 18 months. Not persistent thirst is scored 0-1, and persistent thirst is scored 2-4.

Fig. 2. Flowchart of patient inclusion. Patients were divided into groups with and without persistent thirst. HF, heart failure.

Fig. 3. The observed thirst trajectory presented with the number of heart failure patients with (white boxes) and without (grey boxes) thirst at each follow-up visit, and the summed number of times patients reported thirst (thirst score).

Fig. 4. Number of times thirst was reported during the 18-month follow-up.