

# Effects of the main green tea polyphenol epigallocatechin-3-gallate on cardiac involvement in patients with AL amyloidosis

Derliz Mereles · Sebastian J. Buss ·  
Stefan E. Hardt · Werner Hunstein ·  
Hugo A. Katus

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## Abstract

**Background** Amyloid light chain (AL) amyloidosis is a rare disease with poor prognosis and limited therapeutic alternatives. Recently, one clinical case with cardiac involvement, as well as a compelling evidence of green tea polyphenol, epigallocatechin-3-gallate (EGCG), inducing the formation of benign aggregation products that do not polymerize into fibrils were published. This is a report of the cardiac effects of green tea consumption in these patients.

**Methods** Patients with known cardiac involvement in AL amyloidosis were examined by routine cardiovascular examinations that took place every 3–6 months. Of 59 patients with cardiac involvement, 11 revealed a decrease of at least 2 mm of interventricular wall thickness, after initiation of regular green tea consumption (GT). A matched historic control group ( $n = 22$ ) was selected. Comprehensive echocardiography was conducted at every control examination and analyzed offline by two independent examiners.

**Results** GT patients showed an improvement in New York Heart Association (NYHA) class from a median of 3 (25th, 75th percentiles: 2, 3) to 2 (2, 3),  $P = 0.038$ . Septal thickness decreased from 18 (18, 20) to 16 (16, 17) mm,

$P = 0.021$ . Left ventricular mass index decreased from 175 (154, 180) to 133 (128, 154)  $\text{g}/\text{m}^2$ ,  $P = 0.007$ . Comparing both groups, an increase in left ventricular ejection fraction could be found in the GT group, 65 (51, 73) versus 53 (47, 59)%,  $P = 0.012$ . These changes could not be observed in the control group.

**Conclusion** Consumption of green tea polyphenol EGCG in patients with cardiac involvement with AL amyloidosis causes a significant decrease in left ventricular wall thickness and mass, as well as an improvement in NYHA functional classification and left ventricular ejection fraction.

**Keywords** Systemic light-chain amyloidosis · Epigallocatechin-3-gallate · Echocardiography

## Introduction

Systemic immunoglobulin light-chain (AL) amyloidosis is a rare disease with very poor prognosis and limited therapeutic alternatives. Clinical outcome and even the likelihood of a response to therapy are in large part determined by the extent of cardiac involvement at diagnosis [1]. The most common cause of death is a progressive congestive cardiomyopathy or sudden death due to ventricular fibrillation [2]. Even after heart transplantation for severe, therapy refractory cardiac involvement, prognosis remains poor [3].

Green tea (*Camellia sinensis*) has long been ascribed as a health promoting substance with no known toxicities and ubiquitous properties. Recently, a retired member of our faculty, suffering from AL amyloidosis himself, alerted us on the positive effect on cardiac involvement of the main green tea polyphenol, epigallocatechin-3-gallate (EGCG) [4]. Experimental proof of the ability of EGCG as an agent

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D. Mereles and S. J. Buss contributed equally to this work.

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D. Mereles (✉) · S. J. Buss · S. E. Hardt · H. A. Katus  
Department of Internal Medicine III, Cardiology,  
Angiology and Pneumology, University of Heidelberg,  
In Neuenheimer Feld 410, 69120 Heidelberg, Germany  
e-mail: derliz.mereles@med.uni-heidelberg.de

W. Hunstein  
Internal Medicine and Hematology,  
University of Heidelberg, Heidelberg, Germany

with potent and specific antimyeloma activity [5], to induce apoptotic cell death in the leukemic B-cells [6, 7], or to reduce cerebral amyloidosis in Alzheimer transgenic mice through modulation of amyloid precursor protein cleavage were reported previously [8]. Experimental evidence showing EGCG acting as a positive inotropic substance and preventing cardiac hypertrophy induced by pressure overload were published recently [9, 10]. Furthermore, in vitro experiments have shown that EGCG very efficiently prevents amyloidogenesis and modulates protein complex formation by promoting the formation of benign aggregation products that do not polymerize into fibrils [11, 12], whereas clinical observations support of these experimental findings [4, 13], more convincing evidence of clinical benefit, as well as possible side effects and optimal dosage is still lacking.

This is a report of a longitudinal observation of patients with cardiac amyloidosis who decided to consume daily large amounts of green tea, encouraged by a publication on a first successful self-treatment published recently [4].

## Methods

### Study population and design

This is a longitudinal observational study, with prospective offline analysis of digitally stored echocardiographic data. Consecutive patients with known cardiac involvement in AL amyloidosis were examined in the setting of routine cardiovascular assessments at our department. Follow-up examinations took place every 3–6 months, also in a usual manner. Patients that showed a decrease in at least 2 mm of interventricular wall thickness were asked on potential changes in lifestyle since the last examination, as well as their current functional capacity. Common to this cohort was a significant change in lifestyle, since they have started to drink large daily amounts of green tea (1.5–2 L/daily) after they got information based on the publication of a case report [4]. Two patients did not tolerate the taste of green tea, so they went on commercial available capsules with green tea extracts, taking a total daily doses of an equivalent of 600–800 mg EGCG. Retrospective anamnesis on green tea consumption was conducted in all other consecutive patients with cardiac involvement in AL amyloidosis examined during the same period of time. It was not possible to perform assessment of plasma concentrations of EGCG in these patients.

All patients signed a statement previously approved by the internal institutional review board, in which patients agreed to the use of their medical information in an anonymized form for research purposes.

### Historic control group

This cohort was built based on a databank of comprehensive echocardiography examinations and reports that took place before September 2007, of patients with confirmed AL amyloidosis under conventional therapy at the Department of Hematology from our institution. This time period was well ahead of the first publication on a possible beneficial effect of green tea on cardiac amyloidosis [4]. There was no evidence of consumption of significant amounts of green tea in this cohort. Patients were matched to age, gender, body mass index (BMI), New York Heart Association (NYHA) functional classification, interventricular wall thickness and indexed left ventricular mass.

### Echocardiography

Comprehensive echocardiography examination at rest was conducted according to current recommendations of the American Society of Echocardiography [14] with conventional equipment (Vivid 7 Dimension, GE Medical systems, Horten, Norway) by experienced cardiac sonographers, which were blinded to patient's symptoms. Diastolic left ventricular function (E/E' and LVEFP) was assessed according to current guidelines [15]. Left ventricular long axis function was assessed by mitral annular systolic plane excursion (MAPSE) and the mitral annular systolic velocity (MASV). Pulmonary artery systolic pressure (PASP) was estimated from peak tricuspid regurgitation jet velocities according to the modified Bernoulli equation:  $PASP = 4 \times V^2 + \text{right atrial pressure}$ , where  $V$  is the peak velocity (m/s) of tricuspid valve regurgitant jet. In the absence of obstruction to right ventricular outflow, right ventricular systolic pressure equals PASP [16]. Right atrial pressure was estimated from characteristics of the inferior vena cava [17]. Offline analysis of echocardiography examinations of both cohorts were conducted on a commercial available workstation (Centricity Cardiology CA1000 2.0, GE Medical Systems, Milwaukee, WI, USA). Three cardiac cycles were stored in cine loop format for offline analysis. All data were analyzed by two independent expert examiners who were unaware of the patients' clinical status.

### Cardiac biomarkers

Serum levels of *N*-terminal prohormone brain natriuretic peptide (NT-proBNP) and cardiac troponin T (cTnT) were measured routinely in all patients at first assessment and then at every control examination.

**Table 1** Characteristics of patients at echocardiographic examination before starting consumption of green tea

Patient	Age (years)	Sex	BMI (kg/m <sup>2</sup> )	NYHA	Diagnosis	Therapy
1	75	F	20.1	III	AL $\kappa$	M-Dex
2	49	M	23.9	II	AL $\lambda$	M-Dex
3	52	m	27.8	III	MM, AL $\kappa$	ASCT <sup>a</sup> , Bortezomib <sup>b</sup>
4	44	F	17.1	II	AL $\lambda$	ASCT <sup>c</sup>
5	57	M	24.5	III	AL $\lambda$	M-Dex
6	51	M	26.8	I–II	MG, AL $\lambda$	None <sup>d</sup>
7	73	M	23.0	III	AL $\lambda$ , CAD	M-Dex
8	57	M	24.0	III	AL $\lambda$	M-Dex
9	50	M	22.8	III	AL $\kappa$	M-Dex
10	51	M	20.1	II–III	AL $\lambda$	M-Dex
11	74	F	20.1	III	AL $\lambda$	M-Dex

*BMI* body mass index, *NYHA* New York Heart Association functional classification, *AL* immunoglobulin light chain (AL) amyloidosis,  $\kappa$ ,  $\lambda$  kappa and lambda types of AL amyloidosis, *MM* multiple myeloma, *MG* monoclonal gammopathy, *CAD* coronary artery disease, *M-Dex* oral melphalan and dexamethasone, *ASCT* high doses intravenous melphalan and autologous stem cell transplantation

<sup>a</sup> Conducted in 2005

<sup>b</sup> Started in 2006

<sup>c</sup> Conducted in 2007

<sup>d</sup> First cardiac evaluation before therapy starts

## Statistical methods

Continuous variables are expressed as median (25th, 75th percentiles). Normality was assessed with the Kolmogorov–Smirnov test. Comparisons between groups were made using Student's *t* test or Mann–Whitney *U* test as appropriate. Categorical variables were compared using the  $\chi^2$  test. *P* values <0.05 were considered statistically significant.

## Results

### Study population

Of 59 consecutive patients with new diagnosed cardiac involvement in AL amyloidosis, 11 selected patients, median age 52 (51, 65) years, 3 females, with known cardiac involvement in AL amyloidosis showed a decrease in at least 2 mm of interventricular septum thickness in a period of 6 (3, 10) months between digitally stored comprehensive echocardiographic examinations (Tables 1, 2, GT group). Two patients received high doses intravenous melphalan followed by autologous stem cell transplantation, eight patients were treated with oral melphalan and dexamethasone and one patient was in an evaluation period, receiving fortuitously two echocardiographic examinations within a 1 month interval and had no specific therapy (Table 1). Retrospective anamnesis on green tea consumption in the remaining 48 patients was negative.

Patients in the GT group showed an improvement in the functional classification at the follow-up examination compared to the first assessment, with a median decrease of 3 (2, 3) to 2 (2, 3), *P* = 0.038 (Table 3).

In the historic control (HC, *n* = 22) group with cardiac involvement in AL amyloidosis, eight patients showed no change in septal wall thickness, in nine patients an increase of 1 mm and in one patient even of 2 mm in septal wall thickness was observed. A decrease in 1 mm thickness was also observed in four patients. All these changes were not significant to initial measurements or compared to similar changes in the GT group (Table 3). Nine patients received high doses intravenous melphalan followed by autologous stem cell transplantation, eight patients were treated with oral melphalan and dexamethasone and five patients with high doses melphalan alone. No difference in functional classification could be observed within the HC group at start compared to follow-up examination (Table 3).

None of the patients had a history of systemic arterial hypertension. Body mass index (BMI), a predictor for increased left ventricular mass [18], with a median of 23.9 (21.5, 24.4) kg/m<sup>2</sup> in the GT group and 23.4 (22.5, 26.5, *P* = ns) kg/m<sup>2</sup> in the HC group showed no significant obesity any patient of both groups.

The time to echocardiographic end-point in the GT group, 6 (3, 10) months and time between two examinations under therapy in the HC group, 6 (4, 8) months were similar (Table 3, TEP, *P* = ns).

**Table 2** Changes observed under sustained daily consumption of green tea at first significant change of left ventricular thickness assessed with echocardiography

Patient	TEP (m)	NYHA	IVS <sup>a</sup> (mm)	IVS <sup>b</sup> (mm)	$\Delta^c$ (mm)	LVm <sup>d</sup> (g)	LVm <sup>e</sup> (g)	$\Delta^f$ (mm)
1	6	II	18	15	−3	278.0	208.1	−69.9
2	3	II	18	16	−2	297.8	232.1	−65.7
3	7	II	15	11	−4	290.8	162.4	−128.4
4	3	I	20	18	−2	262.1	198.6	−63.5
5	6	III	21	19	−2	444.8	341.6	−103.2
6	1	I	18	16	−2	228.9	195.8	−33.1
7	16	III	22	19	−3	505.6	330.5	−175.1
8	10	II	18	16	−2	318.2	293.5	−24.7
9	10	II	19	16	−3	348.6	284.9	−63.7
10	3	I	17	15	−3	339.6	266.3	−73.3
11	11	III	18	16	−2	243.2	216.0	−27.2

TEP time to end-point (at least 2 mm decrease in wall thickness), NYHA New York Heart Association functional classification

<sup>a</sup> Interventricular septum before starting green tea

<sup>b</sup> Interventricular septum under green tea at examination where echocardiographic end-point was reached

<sup>c</sup> Difference showing decrease in wall thickness

<sup>d</sup> Left ventricular mass as calculated with the Devereux equation before green tea

<sup>e</sup> Left ventricular mass at echocardiographic end-point

<sup>f</sup> Difference showing decrease in ventricular mass

## Echocardiography

All patients met echocardiography criteria for cardiac involvement in histologically confirmed and immunohistochemically typified AL amyloidosis, with left ventricular wall thickness >12 mm with otherwise no other cardiac cause [1]. Other common characteristics for cardiac amyloidosis were also present: diffuse hyperrefractile “granular sparkling” [19], impaired left ventricular diastolic [20–22] and long axis and function [23].

None of the patients had a significant valvular stenosis, and none showed more than mild valvular regurgitation.

### Wall thickness and left ventricular mass

Interventricular septum (IVS) thickness decreased significantly in the GT group compared to first examination, 18 (18, 20) to 16 (16, 17) mm,  $P = 0.021$  (Table 3, Fig. 1). Posterior wall thickness decreased also in the same manner, from 17 (16, 18) to 15 (14, 16) mm,  $P = 0.047$ . Left ventricular mass, indexed to the body surface area (LVMI) decreased correspondingly from 175 (154, 180) to 133 (128, 154) g/m<sup>2</sup>,  $P = 0.006$  (Table 3; Fig. 2).

Changes in the HC group were not statistically significant. Median values of IVS thickness were even increased compared to the first examination, from 17 (17, 18) to 18 (17, 19) mm,  $P = \text{ns}$  (Table 3). Similar findings could be observed at the calculation of the LVMI.

Left ventricular wall thickness and mass decreased also significantly at follow-up examination in the GT group compared to the HC group (Table 3; Figs. 1, 2).

### Left atrium

Left atrial (LA) volume indexed to body surface area showed a decreasing trend at the follow-up examination in the GT group, 35 (20, 24) to 34 (19, 37) mL/m<sup>2</sup>. However, when comparing second examinations of both groups, a significant decrease in LA volume could be documented in the GT group, 34 (19, 37) versus HC group, 43 (29, 48) mL/m<sup>2</sup>,  $P = 0.042$  (Table 3).

### Left ventricular function and PASP

When comparing second examinations of both groups, a significant increase in left ventricular ejection fraction (LVEF) could be found in the GT group, 65 (51, 73) versus HC group, 53 (47, 59)%,  $P = 0.012$  (Table 3). This change went correspondingly to the decrease in left ventricular end-systolic diameter in the GT cohort. Furthermore, no changes in LVEF within the HC group could be assessed, and an increase in LVEF observed within the GT group, 53 (49, 64) versus 65 (51, 73)% was not statistically significant.

Mitral annular systolic plane excursion and systolic velocities were similar in both groups at the first examination, as well as at the follow-up examination (Table 3).

**Table 3** Parameters of both groups as assessed at echocardiographic examination before (A) and after a median follow-up of 6 months under therapy (B)

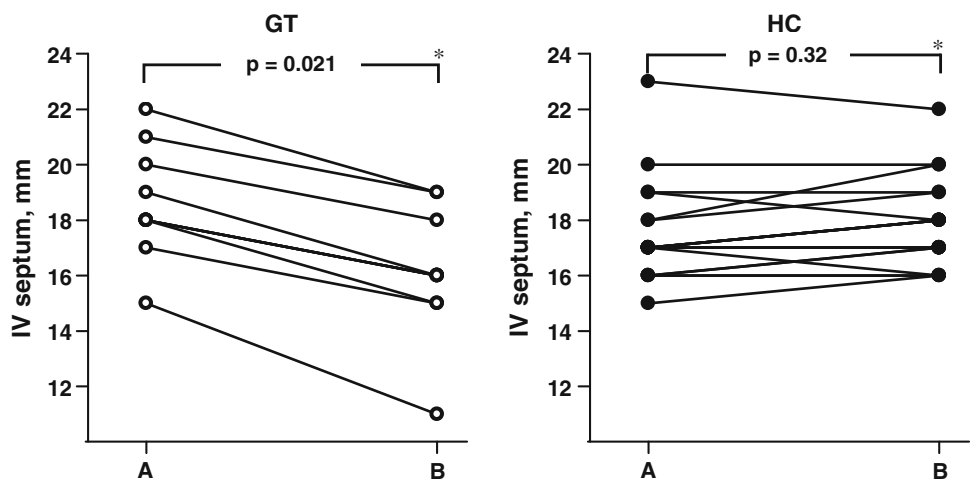
Parameters	GT ( <i>n</i> = 11)		HC ( <i>n</i> = 22)	
	A	B	A	B
Age (years)	52 (51, 65)		60 (56, 65)	
Gender (F/M)	3/8		9/13	
NYHA	3 (2, 3)*	2 (2, 3)*	2 (2, 3)	2 (2, 3)
TEP (m)	6 (3, 10)		6 (4, 8)	
<b>Echocardiography</b>				
IVS (mm)	18 (18, 20) <sup>†</sup>	16 (16, 17) <sup>†, ‡</sup>	17 (17, 18)	18 (17, 19) <sup>‡</sup>
PW (mm)	17 (16, 18) <sup>§</sup>	15 (14, 16) <sup>§</sup>	16 (14, 17)	16 (15, 17)
LVEDD (mm)	42 (39, 45)	40 (39, 44)	42 (40, 45)	42 (40, 46)
LVESD (mm)	28 (24, 30)	25 (24, 29) <sup>  </sup>	27 (25, 31)	30 (27, 31) <sup>  </sup>
LVMI (g/m <sup>2</sup> )	175 (154, 180) <sup>¶</sup>	133 (128, 154) <sup>¶, #</sup>	157 (146, 182)	175 (151, 192) <sup>#</sup>
LVEF (%)	53 (49, 64)	65 (51, 73) <sup>**</sup>	50 (46, 57)	53 (47, 59) <sup>**</sup>
LAVI (mL/m <sup>2</sup> )	35 (20, 40)	34 (19, 37) <sup>††</sup>	37 (29, 44)	43 (29, 48) <sup>††</sup>
MAPSE (mm)	9 (6, 11)	8 (7, 12)	8 (6, 12)	7 (5, 10)
MASV (cm/s)	6 (5, 8)	6 (5, 9)	7 (5, 7)	5 (4, 7)
E/E'	15 (9, 27)	18 (8, 24)	15 (11, 19)	18 (13, 24)
LVEDP (mmHg)	21 (13, 35)	24 (12, 32)	21 (16, 26)	24 (18, 32)
PASP (mmHg)	30 (26, 40)	30 (23, 35) <sup>‡‡</sup>	30 (25, 31)	35 (30, 41) <sup>‡‡</sup>
<b>Biomarkers</b>				
NT-proBNP (ng/L)	3,751 (1,048, 7,037)	3,452 (925, 6,419)	4,644 (2,224, 8,343)	5,164 (1,897, 20,617)
cTnT (μg/L)	0.04 (0.02, 0.08)	0.03 (0.02, 0.06)	<0.01 (<0.01, 0.05)	<0.01 (<0.01, 0.11)

Values are given as median (25th, 75th percentile)

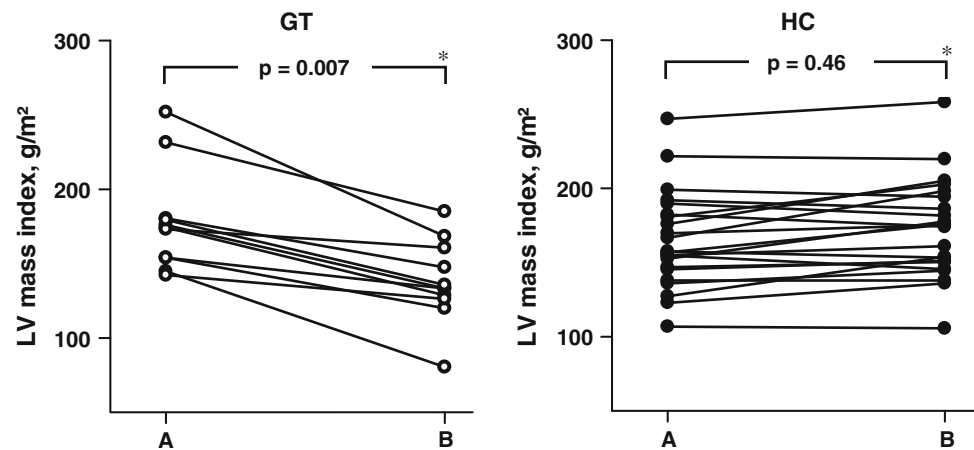
GT green tea group, HC historic control group, NYHA New York Heart Association functional classification, TEP time to end-point (at least 2 mm decrease in wall thickness, for HC a median of 3–6 months after last examination), IVS interventricular septum, PW posterior wall, LVEDD left ventricular end-diastolic diameter, LVESD left ventricular end-systolic diameter, LVMI left ventricular mass index, LVEF left ventricular ejection fraction, LAVI left atrial volume indexed to body surface area, MAPSE mitral annular plane systolic excursion, MASV mitral annular plane systolic velocity, E/E' relationship between mitral inflow E-wave and mitral annular E' velocities, LVEDP left ventricular end-diastolic pressure, as calculated with the formula  $1.24 \times (E/E') + 1.24$ , PASP pulmonary artery systolic pressure, NT-proBNP N-terminal prohormone brain natriuretic peptide, cTnT cardiac troponin T

\**P* = 0.038, †*P* = 0.021, ‡*P* = 0.013, §*P* = 0.047, ||*P* = 0.036, ¶*P* = 0.007, #*P* = 0.006, \*\**P* = 0.012, ††*P* = 0.042, ‡‡*P* = 0.041

**Fig. 1** Dimensions of the interventricular septum measured at examination before start of green tea consumption (a) and at the echocardiographic end-point (b) in the green tea patient group (GT, *n* = 11, left). Same measurements in the historic control group (HC, *n* = 22, right) conducted at first diagnosis (a) and at the next echocardiographic control after 3–6 months under conventional therapy. GT versus HC, \**P* = 0.013



**Fig. 2** Left ventricular mass indexed to body surface area at examination before start of green tea consumption (a) and at the echocardiographic end-point (b) in the green tea patient group (GT,  $n = 11$ , left). Same measurements in the historic control group (HC,  $n = 22$ , right) conducted at first diagnosis (a) and at the next echocardiographic control after 3–6 months under conventional therapy. GT versus HC,  $*P = 0.006$



Values were compatible with a severe impairment of left ventricular long axis function. No significant changes could be determined in each group, nor at any examination time. Similar findings could be observed concerning diastolic function, as assessed with the parameters  $E/E'$  and left ventricular end-diastolic pressure [15]. A high prevalence of severe diastolic dysfunction, as suggested in the former guideline ( $E/E' > 15$ ), could be documented in both groups (GT 45.5 vs. HC 45.3%,  $P = ns$ ), but no significant change could be observed in the follow-up examination.

Pulmonary artery systolic pressure (PASP) at rest at first examination was elevated, i.e.,  $>30$  mmHg, up to almost half of the patients (GT 45.5 vs. HC 22.7%,  $P = ns$ ). A decreasing trend in PASP at rest could be seen at the follow-up examination in the GT group. Moreover, when comparing second examinations of both groups, a significant decrease in PASP could be found in the GT group, 30 (23, 35) versus HC group, 35 (30, 41)%,  $P = 0.041$  (Table 3). At follow-up examination, prevalence of patients with pulmonary hypertension at rest in the GP group was unchanged. However, a significant increase could be observed in the HC group (22.7–54.5%,  $P = 0.030$ ).

#### Cardiac biomarkers

NT-proBNP, a sensitive marker for myocardial dysfunction was massively elevated in both groups at first assessment, with no significant change at the follow-up examination. Serum cardiac troponin T (cTnT), a marker for myocardial damage was mildly elevated and only slightly higher in the GT group, showing a trend in lower values at the follow-up examination (Table 3).

#### Discussion

This is the first longitudinal observation in a group of patients with AL amyloidosis receiving current therapy

options, who in addition started a daily EGCG consumption from green tea after available information of a first case in the literature [4]. A significant decrease in left ventricular wall thickness and mass, as well as an improvement in NYHA functional classification and left ventricular ejection fraction could be assessed in the green tea drinking group, confirming the former original observation.

Concentric wall thickening due to infiltration of the heart by extracellular deposition from insoluble protein deposits, i.e.,  $\beta$ -amyloid fibrils, with subsequent myocardial disarray and necrosis, posterior local and/or diffuse fibrosis, constitute the complex leading to architectural changes and functional impairment. Thus, treatment targets are both, reduce the production, as well as disaggregate “seeds” of  $\beta$ -pleaded amyloid fibrils.

Reduction in left ventricular wall thickness under chemotherapy is reported in only one former study, where in 3 of 20 of patients with cardiac response a reduction in septal or mean left ventricular wall thickness could be found [24]. In our observation, all patients showed a wall thickness reduction of at least 2 mm, despite a more severe phenotype than the historical group. In this group, a higher proportion of patients were eligible for autologous stem cell transplantation, since a better clinical stratification for reduction treatment-related mortality was aimed [25]. Furthermore, 4 patients in the GT group came to the next routine follow-up examination and showed further reduction in LV wall thickness with a median of 5 (5, 7) mm. The patient of the first case published [4, 13], not included in this report, has a constant interventricular septal thickness of 12 mm since the last 22 months, showing a total reduction of almost 5 mm, under daily therapy with EGCG. Last administered chemotherapy was 36 months ago and no further cardiac/hematological medication was administered since that time. These clinical findings are supported by structural and molecular biology results on the effects of EGCG on amyloid formation [11, 12].

The improvement in wall thickness in patients of the GT group was accompanied with functional changes, such as an increase in left ventricular ejection fraction. This may be due to one or more of the following factors: a decrease in  $\beta$ -amyloid infiltration of the heart caused by EGCG [11], an EGCG calcium-dependent positive inotropic effect [9], and/or a modulation of contraction through a binding of EGCG to a cardiac myofilament, cTnC [26].

Severe impairment of diastolic function (restrictive pattern) did not change significantly during follow-up in the GT group, similar findings in patients with advanced cardiac involvement and severe left ventricular diastolic dysfunction at the first examination were reported before [22]. Restrictive filling pattern in cardiac amyloidosis is possibly due to amyloid infiltration itself [27], but also alterations in cardiomyocyte metabolism, cellular edema, intracellular calcium handling, myocardial necrosis due to excessive extracellular mechanically induced architectural disarray and remodeling of the cardiac matrix and fibrosis. Although it has been shown that EGCG inhibits proliferation of cardiac fibroblasts in vivo and in vitro, thus preventing myocardial fibrosis in cardiac hypertrophy [28], this action may not play a significant role in well established cardiac amyloidosis.

Pulmonary artery systolic pressure (PASP) estimated through tricuspid regurgitation velocity was not severely elevated in all patients, despite severe impairment of diastolic left ventricular function. PASP can show normal values at rest, but an excessive hypertensive response to exercise even in individuals without dyspnea on exertion [29]. However, an assessment of PASP under exercise was not part of the routine examinations in these patients. The trend in decrease of PASP at rest in the GT group as assessed in follow-up examinations, as well as a significant decrease compared to the HC group, are in agreement with other signs of improvement in left ventricular hemodynamics.

Although cardiac biomarkers were markedly elevated (NT-proBNP), multiple mechanisms may lead to their elevation in blood, e.g., chronic renal failure. A trend in decrease of values of cardiac troponin T in the GT group suggests a reduction in myocardial damage in these patients.

#### Limitations

Since serum EGCG levels were not assessed in these patients, it was not possible to determine the percentage of “non responders” in this cohort, a very important fact, since the effect of EGCG from green tea occurs a dose-dependent way [11] and the bioavailability of EGCG is very limited [30, 31].

#### Conclusions

In this longitudinal observation, new-onset daily green tea polyphenol EGCG consumption in patients with AL amyloidosis and cardiac involvement, under current standard therapy options, causes a significant decrease in left ventricular wall thickness and mass, as well as an improvement in NYHA functional classification and left ventricular ejection fraction. Prospective clinical studies are needed to assess effect, define doses and possible side effects of EGCG in the therapy of AL amyloidosis.

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