

ASSESSMENT OF A FIXED-DOSE THERAPEUTIC DUO IN MANAGING ELEVATED BLOOD PRESSURE AND LIPID IMBALANCE

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SUMMARY –

This prospective observational study aimed to evaluate the results of using a combined daily dose of atorvastatin and amlodipine in patients diagnosed with both high blood pressure and abnormal blood lipid profiles, who were considered to have a moderate to high risk for cardiovascular events. The study enrolled 243 individuals with an average age of 63, all of whom were treated with one of four fixed-dose regimens (10/5 mg, 10/10 mg, 20/5 mg, or 20/10 mg). Over a three-month period, systolic and diastolic blood pressure readings at baseline (approximately 156/92 mm Hg) dropped to around 137/81 mm Hg by the end of the trial.

Alongside blood pressure improvement, favorable shifts were also seen in cholesterol levels: total cholesterol fell from 6.6 to 5.1 mmol/L, and low-density lipoprotein (LDL) dropped from 4.4 to 2.9 mmol/L. Only a small portion of participants (3.7%) discontinued the medication due to adverse effects. These findings suggest that a single-pill approach combining antihypertensive and lipid-lowering agents can be an efficient, well-tolerated strategy for patients facing multiple cardiovascular risks, potentially simplifying long-term disease management.

Key words: *Hypertension; Dyslipidemias; Cardiovascular diseases; Antihypertensive agents*

Introduction

Arterial hypertension (HTN) and dyslipidemias are the most significant risk factors (RF) for cardiovascular (CV) complications worldwide¹⁻⁴. HTN affects ~22% of the world population (30%-45% in Europe and North America) and dyslipidemias ~39% of the population aged ≥25 years (54% of the Europeans)¹⁻⁵.

In a number of epidemiological studies, elevated blood pressure (BP) and cholesterol have been identified as strong RF for coronary heart disease, cerebro-

vascular disease, peripheral arterial disease, etc.⁶⁻⁷. Regardless of the existing pharmacological and non-pharmacological options, control of these RF is unsatisfactory. At least 50% of patients with HTN and/or hypercholesterolemia in many countries of Europe, North America and Asia maintain BP and/or low-density lipoprotein cholesterol (LDL-C) and/or total cholesterol (TC) levels above the target ones^{1,2,7}. Each year ~8 million hypertensives die and another ~60 million develop severe debilitating complications as a consequence of uncontrolled HTN⁵. Another 2.6 million patients with dyslipidemia die yearly and about 30 million are seriously disabled due to untreated or not effectively treated hypercholesterolemia⁸.

The contemporary combination antihypertensive and lipid-lowering strategies are based mostly on the

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level of CV risk of the individual patient on the one hand, and on the BP, LDL-C and TC values (baseline and target ones) on the other hand^{5,8,9}. Where possible, single-pill combinations (SPC) are widely recommended because of the certain advantages over free combinations, i.e. standardized dose of the ingredients, facilitated treatment regimen with less tablets and often more affordable price^{5,8,11}. These features improve patient adherence to the prescribed treatment, and thus to HTN and dyslipidemia control¹¹⁻¹³.

The SPC of atorvastatin/amlodipine in various proportions is one of the most reasonable options for combination treatment in patients with HTN and hypercholesterolemia. Its pharmacokinetic and pharmacodynamic features, as well as the proven clinical benefits of each of the active components gave us grounds for conducting a prospective clinical study among outpatients¹⁴⁻¹⁶.

Patients and Methods

A prospective, open-label study, conducted from March to August, 2014, included 243 consecutive outpatients with HTN and dyslipidemia (128 (52.7% males) from 20 Bulgarian cities, towns and villages, mean age 63.3±9.8 (range, 40-91) years. The study conductance was in accordance with ethical standards of the institutional or regional responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 1983. A written informed consent was obtained from all patients before their enrolment in the study and an approval of the study was obtained from the local ethics committee.

Inclusion criteria

The study inclusion criteria were as follows: 1) patients with essential HTN and dyslipidemia (according to the current European guidelines for diagnosis and treatment of these diseases); 2) patients on outpatient antihypertensive and lipid-lowering therapy, not achieving the target BP and/or LDL-C values according to the current European guidelines^{5,8} at ≥1 month of treatment initiation; 3) patients requiring antihypertensive and lipid-lowering therapy according to the current European guidelines, but not receiving medication therapy before inclusion in the study; 4) feasible follow-up in the course of 3 months after initiation of

atorvastatin/amlodipine treatment; and 5) an informed consent from the patient to participate in the study.

Exclusion criteria

Exclusion criteria were as follows: 1) known secondary hypertension and/or dyslipidemia; 2) target BP and/or lipid levels achieved by the ongoing therapy; 3) known adverse effects from previous experience or present contraindications to any of the atorvastatin/amlodipine SPC components; 4) patients already on maximal daily dose of amlodipine (10 mg) and/or atorvastatin (80 mg), not achieving the target BP and/or lipid levels; 5) patient's refusal to be treated with the atorvastatin/amlodipine SPC; and 6) impossibility of patient follow-up in the course of 3 months for whatever reason.

Among all patients, 231 (95.1%) had antihypertensive treatment, but had not achieved the target BP values despite combination therapy with 2 to 3 drugs in most of them (218 of 231, 94.4%). An angiotensin-converting enzyme inhibitor had been included in therapy of 118 (48.6%) patients, a calcium channel blocker was taken by 81 (33.3%), an angiotensin II-receptor blocker by 88 (36.2%), a beta-blocker by 152 (62.6%), a thiazide diuretic by 19 (7.8%), and other BP-lowering drugs by 28 (11.5%) patients. The mean number of antihypertensive tablets received by the hypertensive patients was 3.0±1.5 (0-8): 2 tablets by 48 (22.0%), 3 tablets by 77 (35.3%), 4 tablets by 39 (17.9%) and 5 tablets by 25 (10.3%) patients.

Sixty-seven (27.6%) patients had been on statin treatment before inclusion in the study, and 31 (46.3%) of them had received atorvastatin.

All patients were evaluated for CV risk. The Systematic COronary Risk Evaluation (SCORE) model^{15,8} was used to assess the absolute 10-year risk of fatal cardiac event in asymptomatic patients with cardiovascular RF. The added CV risk was assessed in hypertensives with RF and/or subclinical target organ damage or overt CV or non-cardiac complications. The risk was found to be moderate in 70 (39.3%) and high in 173 (59.7%) patients.

All patients enrolled in our study started treatment with one of the following doses of the SPC atorvastatin/amlodipine (Gedeon Richter Plc., Hungary): 10/5, 10/10, 20/5 or 20/10 mg daily with up-titration at visit 1 when necessary. The dosage was determined

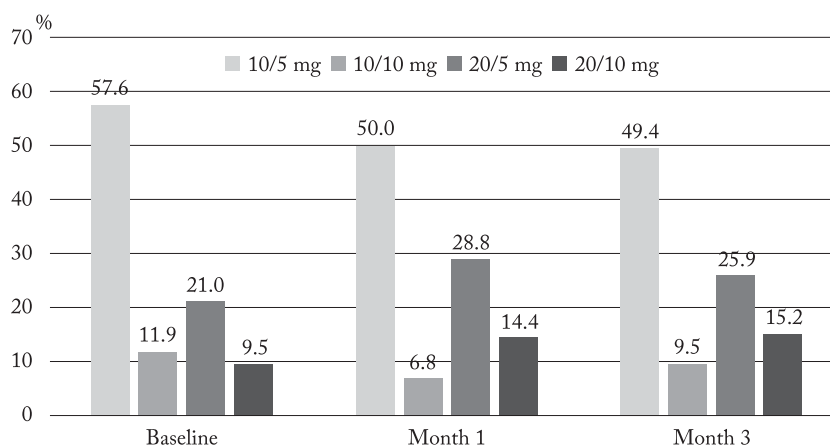


Fig. 1. Prescription of different atorvastatin/amlodipine combinations to study population at baseline, month 1 and month 3.

10/5 mg: $p=0.03$ for baseline *vs.* month 1 and month 3; $p=NS$ for month 1 *vs.* month 3;
 10/10 mg: $p=0.01$ for baseline *vs.* month 1 and $p=0.04$ *vs.* month 3, $p=0.03$ for month 1 *vs.* month 3;
 20/5 mg: $p<0.0001$ for baseline *vs.* month 1 and month 3; $p=NS$ for month 1 *vs.* month 3;
 20/10 mg: $p=0.02$ for baseline *vs.* month 1 and month 3; $p=NS$ for month 1 *vs.* month 3.
 NS = nonsignificant; p = level of statistical significance

by the treating physician based on the BP and LDL-C values and the level of individual CV risk as well.

The concomitant medication was continued unless it was a calcium channel blocker or statin. The period of patient follow-up was 3 months with clinical visits at the end of months 1 and 3 after initiation of SPC atorvastatin/amlodipine treatment. At baseline and at each follow-up visit, office BP measurement was performed after 10-min rest in sitting position, twice at the non-dominant arm with 1-min interval between the measurements. During follow-up visits, detailed medical history was taken about treatment regimen, home BP control and presence of adverse effects (AE). In patients not achieving the target BP and/or LDL-C levels recommended by the current Guidelines of the European Society of Cardiology, an increase in the dose of the researched combination was considered.

At baseline and at month 3, the following lipid parameters were examined: TC, LDL-C, high-density lipoprotein cholesterol (HDL-C) and triglycerides (TG).

Statistics

Statistical analysis was carried out with SPSS statistical package, version 16.0 (SPSS Inc, Chicago, IL, USA). Data were expressed by frequencies and percentages for categorical variables, and by minimal,

maximal, mean values and standard deviation for continuous variables. Comparisons were made by using the independent χ^2 -test, t-test, and ANOVA. The level of statistical significance was set at $p<0.05$.

Results

Figure 1 shows the prescription rate of the analyzed 4 dose combinations of atorvastatin/amlodipine at baseline, month 1 and month 3.

The mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) values of the analyzed group of patients at baseline and at the end of month 1 and 3 are shown in Table 1, whereas Figure 2 illustrates the dynamics of BP during the follow-up period.

The normalization rate of BP, defined for our study as SBP <140 and DBP <90 mm Hg (<85 mm Hg for diabetic patients) in accordance with the current 2013 ESC Guidelines for treatment of arterial hypertension⁵ was as follows:

- at month 1: SPB <140 mm Hg was achieved by 147 (60.5%) and DBP <90 mm Hg by 183 (75.3%) patients; $p<0.0001$ *vs.* baseline;
- at month 3: SPB <140 mm Hg was achieved by 175 (72.1%) and DBP <90 mm Hg by 221 (91.0%) patients; $p<0.0001$ *vs.* baseline and month 1.

Table 1. Systolic and diastolic blood pressure values in study population at baseline and at follow-up visits during the treatment period

Blood pressure	Minimal value (mm Hg)	Maximal value (mm Hg)	Mean value (mm Hg)	Standard deviation
Baseline SBP	146	200	155.67	16.21
Baseline DBP	90	118	92.03	9.23
SBP – month 1	107	183	140.69	13.59
DBP – month 1	70	105	83.41	6.32
SBP – month 3	112	148	136.88	26.97
DBP – month 3	65	90	80.64	5.07

DBP = diastolic blood pressure; SBP = systolic blood pressure

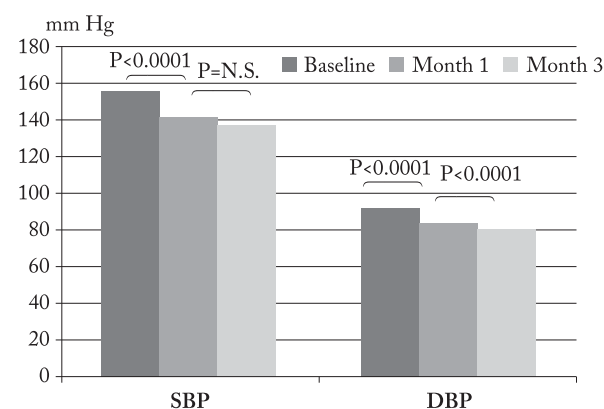


Fig. 2. Dynamics of systolic and diastolic blood pressure in study population after initiation of treatment with atorvastatin/amlodipine.

DBP = diastolic blood pressure; SBP = systolic blood pressure; NS = nonsignificant; p = level of statistical significance

The mean SBP and DBP values of patients treated with the most frequently prescribed dosage of 10/5 mg of the SPC of atorvastatin/amlodipine are shown in Table 2, whereas Figure 3 illustrates the dynamics of their BP during the follow-up period.

The normalization rate of BP of the patients treated with atorvastatin/amlodipine 10/5 mg was as follows:

- at month 1: SPB <140 mm Hg was achieved by 64 (45.7%) and DBP <90 mm Hg by 116 (82.6%) patients; $p < 0.0001$ *vs.* baseline;

Table 2. Systolic and diastolic blood pressure values in study patients treated with the lowest dose of atorvastatin/amlodipine (10/5 mg)

Blood pressure	Minimal value (mm Hg)	Maximal value (mm Hg)	Mean value (mm Hg)	Standard deviation
Baseline SBP	146	197	153.17	15.03
Baseline DBP	90	110	90.81	9.02
SBP – month 1	108	182	138.55	12.80
DBP – month 1	70	95	82.71	5.59
SBP – month 3	116	167	130.36	12.99
DBP – month 3	65	90	80.59	5.47

DBP = diastolic blood pressure; SBP = systolic blood pressure

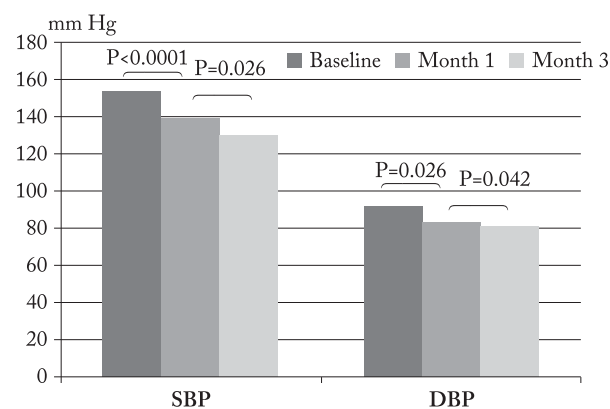


Fig. 3. Dynamics of systolic and diastolic blood pressure in patients treated with 10/5 mg atorvastatin/amlodipine.

DBP = diastolic blood pressure; SBP = systolic blood pressure; p = level of statistical significance

- at month 3: SPB <140 mm Hg was achieved by 108 (76.9%) and DBP <90 mm Hg by 127 (90.6%) patients, $p < 0.0001$ *vs.* baseline and month 1.

The mean values of the lipid parameters at baseline and at month 3 are shown in Table 3, whereas the dynamics of TC and LDL-C are illustrated in Figure 4.

Target values of the analyzed lipid parameters (according to the recommendations of the current

Table 3. Values of lipid parameters in study population

Lipid parameter (mmol/L)	Minimal value	Maximal value	Mean value	Standard deviation
Baseline TC	5.4	10.3	6.6	1.2
Baseline LDL-C	3.5	7.9	4.4	1.1
Baseline HDL-C	0.5	2.2	1.3	0.5
Baseline TG	0.6	6.0	2.1	0.8
TC – month 3	2.9	6.4	5.1	0.9
LDL-C – month 3	0.8	4.6	2.9	1.0
HDL-C – month 3	0.8	2.5	1.4	0.5
TG – month 3	0.6	4.6	1.6	0.7

HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; TC = total cholesterol; TG = triglycerides

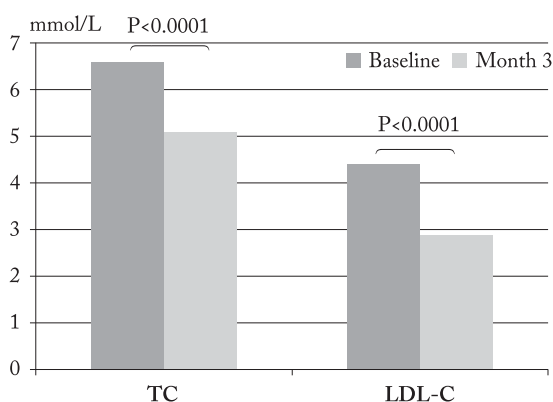


Fig. 4. Dynamics of total cholesterol and low-density lipoprotein cholesterol in study population.

TC = total cholesterol; LDL-C = low-density lipoprotein cholesterol; p = level of statistical significance

ESC Guidelines for cardiovascular prevention)⁸ were achieved at month 3 as follows:

- patients at moderate CV risk: LDL-C <3.0 mmol/L in 52 (74.3%) and TC <5.0 mmol/L in 55 (78.6%) patients; $p < 0.0001$ *vs.* baseline;
- patients at high CV risk: LDL-C <2.5 mmol/L in 108 (62.4%) and TC values <4.5 mmol/L in 114 (65.9%) patients; $p < 0.0001$ *vs.* baseline.

The values of lipid parameters in patients treated with the most frequently prescribed dosage of 10/5 mg

Table 4. Values of lipid parameters in patients treated with the lowest dose of atorvastatin/amlodipine (10/5 mg)

Lipid parameter (mmol/L)	Minimal value	Maximal value	Mean value	Standard deviation
Baseline TC	5.4	9.7	6.3	1.2
Baseline LDL-C	3.5	7.9	4.3	1.2
Baseline HDL-C	0.5	1.9	1.3	0.4
Baseline TG	0.6	3.5	1.9	0.7
TC – month 3	3.3	6.4	5.2	1.0
LDL-C – month 3	1.0	5.7	3.1	1.0
HDL-C – month 3	0.8	2.1	1.3	0.4
TG – month 3	0.6	4.4	1.7	0.7

HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; TC = total cholesterol; TG = triglycerides

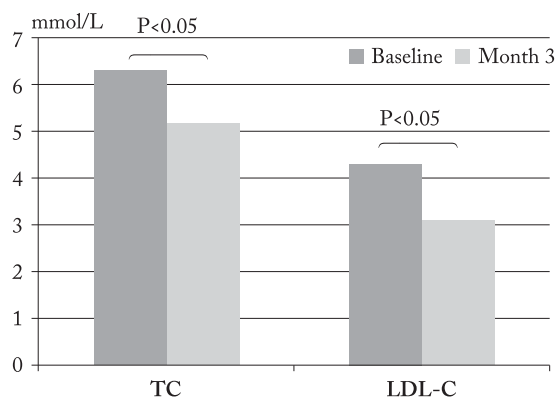


Fig. 5. Dynamics of total cholesterol and low-density lipoprotein cholesterol in patients treated with 10/5 mg atorvastatin/amlodipine.

TC = total cholesterol; LDL-C = low-density lipoprotein cholesterol; p = level of statistical significance

of the SPC of atorvastatin/amlodipine are shown in Table 4, whereas Figure 5 shows the dynamics of TC and LDL-C.

Treatment with the lowest dose of 10/5 mg of the SPC of atorvastatin/amlodipine achieved target values of the analyzed lipid parameters at month 3 as follows:

- patients at moderate CV risk: LDL-C values <3.0 mmol/L in 37 (63.8%) and TC values <5.0 mmol/L in 39 (67.2%) patients; $p < 0.0001$ *vs.* baseline;
- patients at high CV risk: LDL-C <2.5 mmol/L in 24 (38.7%) and TC values <4.5 mmol/L in 28 (45.2%) patients; $p < 0.0001$ *vs.* baseline.

On clinical visits at months 1 and 3, we recorded the following adverse events (AE) that could be attributed to the treatment with the SPC of atorvastatin/amlodipine:

- mild to moderate facial flush: 2 (1.1%) patients at month 1 and 1 (0.6%) patient at month 3;
- mild to moderate swelling edema of lower extremities: 6 (3.4%) patients at month 1 and month 3 each;
- mild to moderate headache: 3 (1.7%) patients at month 1, whereas none of the patients complained of headache at month 3;
- mild to moderate myalgia: 2 (1.1%) patients at month 1 and month 3 each.

Treatment with the investigated SPC of atorvastatin/amlodipine was discontinued in nine (3.7%) patients because of AE (swelling edema and/or headache); three of them stopped treatment at week 2, four patients at month 1 and two patients at month 2.

Discussion

In our study, treatment of patients with the SPC of atorvastatin and amlodipine led to significant reduction of both blood pressure and LDL-C as important indicators of CV risk. The mean reduction of BP across all dose regimens used (from 10/5 mg to 20/10 mg) was ~12% for SBP and DBP each. The percentage of patients achieving the target BP values at the end of the study was high (72.1% and 91.0% for SBP and DBP, respectively).

Our results were comparable to those published by Kékes¹⁷. In their study, 2606 patients with HTN and dyslipidemia were treated with an SPC of atorvastatin and amlodipine. All dosage regimens from 10/5 to 20/10 mg were analyzed. The mean baseline SBP and DBP values were 155.9 and 90.2 mm Hg and they were reduced at month 3 to 136.9 and 83.6 mm Hg, respectively. At the end of the study, 86.5% of the patients reached the target BP levels (<140/90 mm Hg)¹⁷.

In our study, the analyzed SPCs also demonstrated a statistically significant lipid-lowering effect; the values of TC and LDL-C were reduced by ~23% and 34%, respectively, compared to baseline values. In the study performed by Kékes *et al.*, LDL-cholesterol was reduced from the mean value of 3.45 mmol/L to 2.49 mmol/L after 3 months of treatment and 76.4% of the patients reached the target LDL-C levels at the end of the study¹⁷.

In more than half of our patients, the lowest dosage of the SPC of atorvastatin/amlodipine was prescribed at inclusion in the study (individual decision of the treating physician) and this regimen was maintained until the end of the study in 49% of patients. This dosage achieved 15% additional SBP and 11% DBP reduction when added to the ongoing antihypertensive therapy. The mean reduction of the analyzed lipid parameters by this dosage of atorvastatin/amlodipine was by ~18% for TC and by ~28% for LDL-C. Reduction of LDL-C <3.0 mmol/L was achieved by 46.5% of the patients treated with the 10/5 mg SPC of atorvastatin/amlodipine. It means that the low-dose combination of atorvastatin/amlodipine could be a reasonable choice for a large number of patients with moderate to high CV risk and mild to moderate elevation of BP and LDL-C.

Our results could also be compared with the results from several other studies. In the Gemini Study (1220 patients with uncontrolled HTN and dyslipidemia included), eight dosage regimens of an SPC of amlodipine/atorvastatin (from 5/10 to 10/80 mg) were electively titrated to improve blood pressure and lipid control¹⁸. At baseline, the mean BP was 146.6/87.9 mm Hg and mean LDL-C was 152.9 mg/dL. At the end of the study, 57.7% of patients achieved both their BP and LDL-C goals. The mean dose of the study medication at the end point was amlodipine component 7.1 mg and atorvastatin component 26.2 mg¹⁸.

In the CAPABLE clinical trial (499 patients with HTN and dyslipidemia included), the SPC of amlodipine/atorvastatin was also administered in one of the 8 dosage regimens available (from 5/10 to 10/80 mg), with the dose being titrated according to the intermediate results¹⁹. At the end point, 48.3% of patients reached both their BP and LDL-C goals; 56.8% reached BP goals and 73.7% reached LDL-C goals¹⁹.

Two other open-label studies conducted in 122 study centers across the United Kingdom and Canada

(JEWEL 1) and 113 centers across 11 European countries (JEWEL 2) evaluated the clinical utility of the SPC of amlodipine plus atorvastatin to help patients across Europe and Canada achieve country-specific targets for BP and LDL-C²⁰. The treatment period was 16 weeks. Among 2245 patients enrolled in these studies, 62.9% in JEWEL 1 and 50.6% in JEWEL 2 reached both country-specific BP and LDL-C goals. BP was reduced by 20.4/10.7 and 21.8/12.6 mm Hg in JEWEL 1 and JEWEL 2, respectively, and reductions in LDL-C were 0.90 mmol/L and 1.09 mmol/L, respectively²⁰.

Our results and the reports of other clinical studies presented above are quite important. Epidemiologic data have suggested that, on average, less than 10% of patients with concomitant hypertension and dyslipidemia are at target levels for both conditions^{7,21}. The large benefits that can result from simultaneous treatment of hypertension and dyslipidemia and the current suboptimal management of these conditions worldwide demonstrate that novel solutions are needed to treat the growing number of patients who have both of these important CV risk factors. The SPC of amlodipine/atorvastatin therapy represents such a solution. Usage of single-pill combinations is associated with 24% lower risk of the lack of compliance to treatment²². A retrospective cohort study in a large managed-care population (n=8406) showed that patients who initiated therapy with both antihypertensive and lipid-lowering drugs within 30 days apart were more likely to be adherent to both drug regimens over time^{23,24}. It has been proven that the high level of patient compliance to treatment is related to 50% reduction of CV events^{24,25}.

Treatment with the SPC of atorvastatin/amlodipine was generally well tolerated by our patients. Only nine of 243 (3.7%) patients discontinued treatment, mostly for AE which were relatively rare, mildly to moderately manifested, and often transient. Swelling of lower extremities was the most common one, but compared to other studies with amlodipine its frequency was lower^{18-20,26-28}. In the Gemini study, 4.8% of patients discontinued therapy due to AE^{18,26}. In JEWEL 1 and 2 studies, the most common ones were peripheral edema (11.0%), joint swelling (2.9%) and headache (2.9%), but only edema was linked to study treatment²⁰. Similarly, in the CAPABLE clinical trial including 499 patients receiving drug therapy, com-

mon treatment-related AE were peripheral edema (3.4%) and headache (2.2%), rarely myalgia and constipation (2.0%)¹⁹.

It could be suggested that the lower rate of AE in our study was because of the use of amlodipine 5 mg in the vast majority of patients (78.6%), as well as the concomitant treatment with angiotensin-converting enzyme inhibitor or angiotensin II-receptor blocker (up to 84.8%).

The main limitations of our study were as follows: 1) our research was designed as a prospective but not randomized and blinded study; 2) control group was not included – the effectiveness of the study medication was not compared to a placebo and/or other drug combination (free or SPC); and 3) the follow-up period was 3 months and conclusions on long-term efficacy and safety of the investigated SPC of atorvastatin/amlodipine could not be drawn.

In conclusion, treatment with the SPC of atorvastatin/amlodipine in our study was effective in reducing both blood pressure and lipid levels and generally well tolerated by patients with moderate to high risk.

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