

ORIGINAL RESEARCH

Lipoprotein (a) Screening, and What's Next?

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ABSTRACT

Lipoprotein (a) (Lp(a)) is a low-density lipoprotein (LDL) in which the apolipoprotein B100 molecule is bound to a highly polymorphic, plasminogen-like apolipoprotein (a). The concentration of Lp(a) is predominantly genetically determined, governed by the expression of the LPA gene, and remains relatively stable from early adulthood. The physiological function of Lp(a) is unknown. Lp(a) is recognized as a main carrier of oxidized phospholipids and has strong atherogenic, prothrombotic, and pro-inflammatory properties. Elevated levels of Lp(a) above 75 nmol/l (30 mg/dl) are an independent risk factor for cardiovascular diseases. According to the recommendations of the Polish Lipid Association, Lp(a) should be measured once in a lifetime. This study presents an analysis of the results of Lp(a) screening among adult patients from southeastern Poland (Nowy Sącz county) and evaluates further diagnostic and therapeutic measures for patients with elevated Lp(a) levels. Among the 231 patients screened, 48 individuals (20.8%) had increased Lp(a) levels above 75 nmol/l. Patients with elevated Lp(a) concentration were invited to participate in a survey, in which 31 individuals ultimately took part. Of these, 4 individuals were classified into the moderate risk group, 25 into the high-risk group, and 2 into the very high-risk group for cardiovascular diseases. The pharmacotherapy directly targeting the reduction of Lp(a) is currently undergoing clinical trials. Its effectiveness in decreasing Lp(a) concentrations, along with demonstrating desirable and positive effects on cardiovascular disease outcomes, requires further investigation due to the lack of conclusive evidence. Diet and physical activity have limited impact on Lp(a) concentration. It is recommended to expand preventive programs, including for younger populations, which could help identify patients with genetically determined cardiovascular risk. Additionally, there is a necessity to educate the medical personnel and patients about the significance of Lp(a) and the implementation of guidelines for managing patients with elevated Lp(a) levels.

Keywords: lipoprotein (a), apolipoprotein (a), cardiovascular diseases, atherosclerosis, lipid disorders

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INTRODUCTION

LP(A): STRUCTURE, GENETIC BACKGROUND, PRODUCTION, AND DEGRADATION

Lipoprotein (a) (Lp(a)) was discovered in 1963 by Norwegian geneticist Kåre Berg. Lp(a) is a variant of low-density lipoprotein (LDL).¹ It is composed of apolipoprotein

B-100 (apoB100) and apolipoprotein (a) (apo(a)), covalently linked by a disulfide bridge.² The protein components constitute about 30% of the total molecular mass, combined with cholesterol esters (35%), phospholipids (20%), free cholesterol (8%), cholesterol (5%), and triglycerides (2%).³

Apo(a) is encoded by the LPA gene located at positions 26 and 27 on the long arm of chromosome 6

(6q26–27). The LPA gene evolved through modifications of the plasminogen-encoding gene.³ The high structural diversity of apo(a) is directly related to the protein domain called ‘kringle’ (K). Apo(a) consists of a single kringle V (KV), an inactive serine protease-like domain (P), and 10 subtypes of kringle IV (KIV1–KIV10). The second kringle IV subtype (KIV2) occurs in varying copy numbers (from 13 to over 50). These multiplied KIV2 copies directly account for the heterogeneity of apo(a) isoforms (depending on their size), which is inversely related to the concentration of Lp(a).⁴ Higher concentrations of smaller Lp(a) isoforms, containing only a few KIV2 copies, are associated with an increased risk of cardiovascular diseases.⁵

Apo(a) is synthesized and released from liver hepatocytes in three stages: transcription of the gene encoding apo(a), translation, and post-translational modifications.³ The liver is also the site of Lp(a) catabolism, although some studies indicate the possibility of partial elimination of Lp(a) by the kidneys.⁴

Due to its unique structure, Lp(a) can interact with various types of receptors, such as LDL receptors (LDLR), very low-density lipoprotein (VLDL) receptors (VLDLR), LRP1 and LRP2 receptors, toll-like receptors, scavenger receptors, and plasminogen receptors.^{4,6}

PATHOPHYSIOLOGICAL SIGNIFICANCE OF LP(A)

Although the physiological role of Lp(a) is still not completely understood, it is suggested that it has a significant role in tissue regeneration processes, including wound healing. However, its importance is based on its involvement in the pathophysiology of atherosclerotic disorders.⁷ Lp(a) takes part in the development of atherosclerosis due to the homology of this molecule to plasminogen and LDL.³ Lp(a) participates in three processes: atherogenesis, thrombosis, and inflammation (Table 1).⁴

The impact of Lp(a) on the development of atherosclerotic lesions is associated with its infiltration into the arterial intima, stimulation of monocyte and macrophage chemotaxis, and smooth muscle cell proliferation. Lp(a), associated with macrophages through endocytosis (via the VLDL receptor), facilitates foam cell formation and cholesterol deposition.⁸ Moreover, Lp(a) is the major carrier of oxidized phospholipids in plasma.⁹ These participate in the process of monocyte migration to the arterial wall and the release of pro-inflammatory cytokines.³ Therefore, the pro-atherogenic properties of Lp(a) are related to the pro-inflammatory effect of oxidized phospholipids.¹⁰ Additionally, macrophages stimulated by apo(a) release IL-8, monocyte chemotactic protein, and tumor necrosis factor α (TNF- α).¹¹

The pro-thrombotic properties of Lp(a) mainly result from its homology to plasminogen. Lp(a) binds to fibrin, blocking the attachment of plasminogen and thus limiting the fibrinolysis process.¹⁰ Apo(a) inhibits the activation of tissue plasminogen activator and increases platelet activity, leading to thrombosis.¹²

FACTORS DETERMINING LP(A) LEVELS

Ethnic origin

The blood concentration of Lp(a) is primarily regulated genetically (through the LPA gene), associated with ethnic origin and related isoform size of Lp(a). Carriers of genetic variants associated with elevated Lp(a) levels present a significantly increased risk of cardiovascular events.¹³ Approximately 20% of the Caucasian population has Lp(a) levels >125 nmol/l (>50 mg/dl), with the highest levels observed among Black African, African American, and subsequently South Asian, Latino, and East Asian populations. Lp(a) results should be referenced to appropriate cut-off values specific to different ethnic groups.

TABLE 1. Pro-atherogenic and prothrombotic mechanisms of Lp(a)⁴

Pro-atherogenic and pro-inflammatory properties of Lp(a)	Prothrombotic properties of Lp(a)
↑ oxidized phospholipids ↑ foam cell formation ↑ endothelial dysfunction ↑ smooth muscle cell proliferation ↑ monocyte chemotaxis ↑ arterial wall inflammation (IL-8, monocyte chemotactic protein, TNF-α)	↓ plasminogen activation ↓ fibrinolysis ↓ tissue factor pathway inhibitor ↓ clot stability ↑ platelet response ↑ plasminogen activator inhibitor-1 (PAI-1)

TABLE 2. The factors that influence Lp(a) levels^{2,3,15–17}

Factors increasing Lp(a) levels	Factors decreasing Lp(a) levels
• Ethnic origin (Black African, African American) • Pregnancy (Lp(a) level returns to normal values after delivery) • Acute inflammatory states (Lp(a) level normalizes with recovery) • Kidney function impairment (from the early stages) • Antiviral treatment (hepatitis C) • Growth hormone replacement therapy • Diet based on unsaturated fats or carbohydrates	• Impaired liver function (hepatocyte damage) • Postmenopausal hormone replacement therapy • Treatment of overt and subclinical hypothyroidism • Diet based on low-carbohydrate and high-saturated fat products • Flaxseed and walnuts in the diet

Factors modulating Lp(a) levels

Despite the predominant role of genetic factors in individual Lp(a) levels, other factors have also been observed to influence its levels to a limited extent (Table 2).

In newborns, Lp(a) values remain low due to incomplete LPA gene expression. During growth, Lp(a) levels fluctuate (probably due to hormonal changes) and stabilize in young adults.¹⁴ Although many studies have reported the lack of gender-related differences in Lp(a) levels, some have observed higher concentrations in women.¹⁵ Pregnancy promotes an increase in Lp(a) levels (one to twofold), but they return to normal values after delivery.⁴ Postmenopausal hormone replacement therapy has been observed to decrease Lp(a) levels by 20–25%.¹⁵ Treatment of overt and subclinical hypothyroidism lowers Lp(a) by 5–20%, whereas growth hormone replacement therapy increases its concentration by 25–100%.²

Acute inflammatory states cause an increase in Lp(a) along with CRP, IL-6, and α_1 -antitrypsin,³ but its level normalizes with recovery. Lp(a) levels also increase from the early stages of kidney function impairment.¹⁵ Kidney transplantation restores Lp(a) levels to baseline.¹⁶ Impaired liver function (mainly due to hepatocyte damage) is associated with a decrease in Lp(a) levels, depending on the severity of the disease. Antiviral treatment (in the case of hepatitis C) results in about a twofold increase in Lp(a) levels.¹⁷ Physical activity does not directly affect Lp(a) levels.¹⁵

MEASUREMENT OF LP(A), CUT-OFF VALUES, AND RECOMMENDATIONS FOR MEASUREMENT

The measurement of Lp(a) levels and their interpretation are not straightforward. This is partly due to the significant heterogeneity in Lp(a) particle sizes, related to the varying number of KIV2 repeats in apo(a). Cross-reactivity of anti-

apo(a) antibodies with repetitive KIV2 has been observed. As a result, individuals with larger Lp(a) isoforms receive falsely elevated results using certain methods.¹⁸ The main aspects of Lp(a) measurement involve the sensitivity of the measurement system to isoform size, the selection of appropriate calibrators, and the type of antibodies used in the assay.¹⁹ Most Lp(a) measurement kits use five-point calibration.

Lp(a) levels can be expressed in mass units (mg/dl) or in the recommended molar units (nmol/l), which better indicate the number of particles. Conversion between these units is not recommended due to possible mistakes.⁸ Methods insensitive to the size of Lp(a) isoforms, with appropriately selected specific antibodies and calibrators consistent with World Health Organization or International Federation of Clinical Chemistry and Laboratory Medicine reference materials, should be used.⁸ The gold standard for Lp(a) measurement is an assay based on anti-KIV9 antibodies, a unique and non-repetitive subtype of kringle IV in apo(a).³

In accordance with the 2021 guidelines of the Polish Lipid Association, it is recommended to measure Lp(a) concentration once in a lifetime for every adult to identify patients with heightened Lp(a) levels (>75 nmol/l) and with a higher risk of cardiovascular diseases. Similar recommendations have been developed by the American Heart Association, the American College of Cardiology, the European Society of Cardiology, and the British HEART UK consensus (Table 3).^{7,8}

Although the significance of Lp(a) in cardiovascular disease risk stratification is well-established, its measurement remains rare. The clinical utility of this parameter may be underestimated by physicians, partly due to the lack of specific recommendations for pharmacological and non-pharmacological management of high Lp(a) levels. The aim of this study was to analyze the results of Lp(a) screening in adult patients from southeastern Poland (Nowy Sącz county). Addition-

TABLE 3. Lp(a) cut-off values according to different guidelines

Recommendation	Lp(a) cut-off values
Polish Lipid Association 2021 ²⁰	• <75 nmol/l – optimal Lp(a) level • 75–125 nmol/l – moderate cardiovascular risk • >125–450 nmol/l – high cardiovascular risk • >450 nmol/l – very high cardiovascular risk
HEART UK consensus 2019 ⁸	• 32–90 nmol/l – low risk of cardiovascular disease • 90–200 nmol/l – modest risk • 200–400 nmol/l – high risk • >400 nmol/l – very high risk
European Society of Cardiology/ European Atherosclerosis Society 2019 ⁷	• <75 nmol/l – optimal Lp(a) level • >75 nmol/l – progressive risk • >125 nmol/l – significantly increased risk • > 430 nmol/l – high risk

ally, the study evaluated the subsequent diagnostic and therapeutic management of patients with elevated Lp(a) levels.

MATERIAL AND METHODS

The study was conducted on a group of 231 adult patients residing in the Nowy Sącz region (Lesser Poland Voivodeship), who participated in a preventive health program aimed at determining their lipid profile, including Lp(a) levels. The program was dedicated to individuals over 40 years of age and was funded by the Nowy Sącz City Office. The tests were conducted in the Diagmed medical laboratory.

Blood samples were collected from the patients, and Lp(a) levels in serum samples were determined using the second-generation Tina-quant Lipoprotein (a) assay (Roche) (immunoturbidimetric method with latex particles) on a Cobas 6000 analyzer (Roche Diagnostics).

Patients with elevated Lp(a) levels were encouraged to present their laboratory results to their primary care physician. Those with Lp(a) levels above 75 nmol/l were surveyed by telephone by a healthcare worker after their follow-up visit. The survey inquired whether the patient was informed by their physician about the significance of elevated Lp(a) levels for their health and whether any therapeutic or diagnostic actions were taken to reduce cardiovascular disease risk.

STATISTICS

Descriptive statistical methods supported by Microsoft Excel (Microsoft) software were applied in the data analysis. Categorical variables were presented as counts and percentages; continuous variables were expressed as a median and interquartile range (IQR). Normality was

tested by the Shapiro–Wilk test. The correlation between laboratory results and age was evaluated by the Pearson's correlation test. The significance level in all analyses was set to $\alpha = 0.05$.

RESULTS

GENERAL CHARACTERISTICS OF THE STUDY GROUP

The study group consisted of a total of 231 adult patients (162 women and 69 men) aged between 40 and 80 years. The median age of the patients was 61 years (IQR, 51–67). The median Lp(a) concentration in the study group was 16.0 nmol/l (IQR, 11.0–52.0).

The detailed distribution of patients by age category and sex is shown in Figure 1. The distribution of Lp(a) concentrations by age is shown in Figure 2 ($r = 0.001$).

The median Lp(a) level was 17.1 nmol/l (IQR, 11.2–79.4) in the 40–49 years age group, 21.5 nmol/l (IQR, 11.2–63.5) in the 50–59 years age group, 16.0 nmol/l (IQR, 11.0–46.1) in the 60–69 years age group, and 12.1 nmol/l (IQR, 7.9–53.5) in the 70–80 years age group.

Among the 231 patients, 48 (20.8%) had elevated Lp(a) levels above 75 nmol/l. Heightened values were observed in 32 women (19.8% of the total number of women studied) and 16 men (23.2% of the total number of men studied). Women constituted 66.7% of this group.

Among patients with elevated Lp(a) levels, 10 patients (20.7%) had Lp(a) levels in the range of 75–125 nmol/l (moderate cardiovascular risk), 35 patients (72.8%) had Lp(a) levels in the range of 125–450 nmol/l (high cardiovascular risk), and 3 patients (6.5%) had Lp(a) levels of >450 nmol/l (very high cardiovascular risk) (Figure 3).

All patients with increased Lp(a) levels were planned to be surveyed by phone to collect information on how phy-

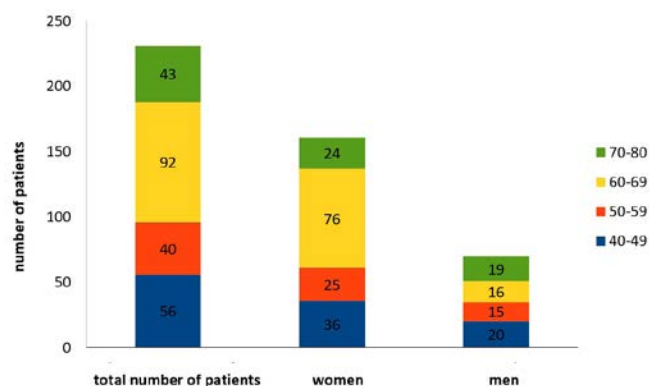


FIGURE 1. The detailed distribution of patients by age category and sex

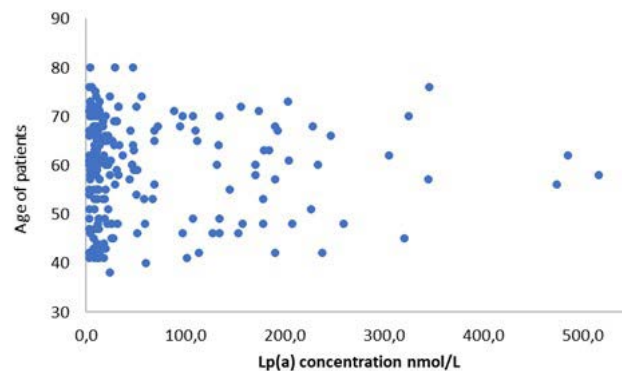


FIGURE 2. The distribution of Lp(a) concentrations by age

sicians used the pathological results of this lipoprotein. Eventually, responses were obtained from 31 individuals (Figure 4). Among them, 4 individuals could be classified according to the 2021 guidelines of the Polish Lipid Association [20] into the moderate cardiovascular risk group (Lp(a) 75–125 nmol/l), 25 into the high cardiovascular risk group (Lp(a) 125–450 nmol/l), and 2 individuals into the very high cardiovascular risk group (Lp(a) >450 nmol/l).

As a result of the conducted discussions, it was established that only two individuals, qualified based on their Lp(a) concentration to the very high cardiovascular risk group, were informed by their doctor about the significance of this test and the possible health consequences of elevated Lp(a) levels. These patients reported being under the care of a specialist (cardiologist) and undergoing regular lipid profile monitoring. None of the surveyed patients received information regarding the possibilities of lowering high Lp(a) levels.

The remaining 29 patients (25 qualified to the high cardiovascular risk group and 4 to the moderate cardio-

vascular risk group based on their Lp(a) levels) reported a general discussion of the results with their doctor, without detailed interpretation. In this group, patients were not informed about the obtained elevated Lp(a) levels or its diagnostic significance. Fourteen individuals from this group received recommendations for regular lipid profile monitoring. These 14 patients indicated that they are under the care of a specialist (mainly a cardiologist).

DISCUSSION

The pro-atherogenic, pro-inflammatory, and prothrombotic properties of Lp(a) are at the source of the pathogenesis of many diseases, primarily those of the cardiovascular system. Elevated plasma levels of Lp(a), starting from values above 75 nmol/l (30 mg/dl), are associated with an increased risk of cardiovascular diseases, including myocardial infarction, stroke, heart failure, peripheral artery disease, and aortic valve stenosis (related to its calcification).¹³ The relationship between elevated Lp(a) lev-

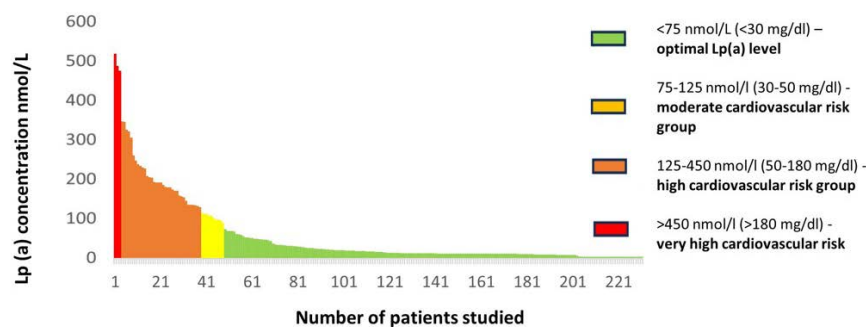


FIGURE 3. Results of Lp(a) concentration measurements in the studied population (divided into cardiovascular disease risk groups according to the 2021 guidelines of the Polish Lipid Association)

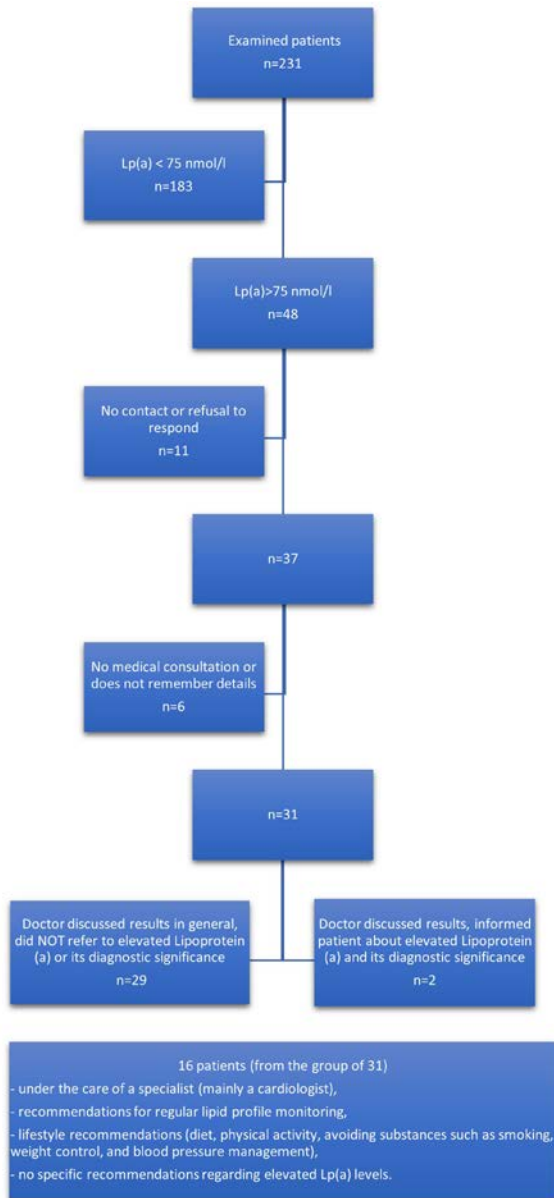


FIGURE 4. Results of the survey of patients with Lp(a) > 75 nmol/l (>30 mg/dl)

els and these diseases has been confirmed by numerous epidemiological studies, such as British studies involving over 460,000 patients,²⁴ meta-analyses concerning coronary artery disease, cerebrovascular stroke, and atrial fibrillation (studies including over 126,000 patients²⁵), and genetic studies.^{13,26,27}

According to the recommendations of the Polish Lipid Association from 2021,²⁰ it is recommended to measure plasma or serum Lp(a) concentration once in a lifetime for every adult, to identify patients with elevated Lp(a) levels indicating a higher risk of cardiovascular diseases. Specific indications for Lp(a) measurement include premature onset of cardiovascular disease, lack of expected

effect from statin treatment, and the need for better risk stratification in individuals at borderline risk between moderate and high. The measurement of Lp(a) can also be considered for patients at very high cardiovascular risk with atherosclerotic cardiovascular disease, patients with familial hypercholesterolemia, and pregnant women as a preventive measure for preeclampsia, miscarriage, recurrent pregnancy loss, and intrauterine growth restriction.²¹

We found elevated Lp(a) levels of ≥ 75 nmol/l (increased risk of cardiovascular incidents, according to Polish and other recommendations, Table 3) in 20.8% of the examined individuals (48 patients). These results are consistent with earlier observations, which found that about 20% of Caucasians have elevated Lp(a) levels.¹³

Some of the research involving populations from different continents (Europe, Africa, Asia) did not show significant differences in Lp(a) levels based on sex. Some studies indicate higher levels among women.^{15,28} In the present study, elevated Lp(a) levels were observed in 19.8% of all examined women (32 patients), whereas increased Lp(a) levels were found in 23.2% of all examined men (16 patients). The exact relationships between Lp(a) levels and sex-related cardiovascular disease risk require further study, especially given that hormone replacement therapy in postmenopausal women reduces Lp(a) levels by 20–25%.^{15,29}

The results of the telephone surveys conducted with patients with heightened Lp(a) levels indicated that most patients (29 out of 31) had not discussed this parameter and its diagnostic significance with their doctor. Consequently, patients were unaware of the importance of Lp(a) testing and the associated genetic risk of cardiovascular diseases. Only two patients from the very high-risk group (Lp(a) >450 nmol/l) received full information regarding Lp(a) levels, their elevated concentrations, and their implications for cardiovascular risk. This highlights the need for the development of appropriate, detailed guidelines encompassing routine Lp(a) measurement and subsequent management in case of elevated values.

In none of the identified cases of patients with elevated Lp(a) levels did doctors recommend therapeutic actions directly aimed at reducing these levels. Currently, there are no targeted pharmacotherapies approved for widespread use. Therapies directly aimed at reducing Lp(a) levels without lowering other lipoprotein concentrations are in clinical trial phases. These include therapies using antisense oligonucleotides (e.g., pelacarsen³⁰) or small interfering RNA (siRNA) (e.g., olpasiran³¹). By targeting apolipoprotein (a), the main protein of the Lp(a) particle, these drugs reduce Lp(a) levels by up to 90%. The

final results of ongoing studies will determine the validity of using these targeted therapies in clinical practice if they not only lower Lp(a) levels but also reduce cardiovascular events.¹³

In the case of patients with very high cardiovascular risk, doctors may consider LDL apheresis (also related to simultaneous Lp(a) apheresis). This is the most effective method among non-specific therapies.^{32,33} Patients qualifying for this procedure must meet the criteria outlined in the recommendations of the Polish Lipid Association, as per the Polish Nephrology Association Working Group on Apheresis.²⁰ LDL apheresis can be considered an adjunctive therapy for patients with homozygous familial hypercholesterolemia. It should also be considered in patients not meeting the criteria for PCSK9 inhibitor treatment under drug programs (currently for heterozygous familial hypercholesterolemia and secondary prevention) and with further progression of clinically symptomatic atherosclerosis despite maximum tolerated lipid-lowering treatment. Apheresis is also recommended for patients with high Lp(a) levels and features of rapid atherosclerosis progression. The procedure is performed every 1–2 weeks and takes about 3–4 h. It can reduce Lp(a) levels by 50–85% and LDL levels by 60–85%,³⁴ which reduces the risk of cardiovascular incidents. However, it is a highly effective, though costly and time-consuming method available in only a few centers in Poland. None of the surveyed patients, including those with very high Lp(a) levels (from the very high cardiovascular risk group), were suggested Lp(a) apheresis.

Non-specific therapies that result in Lp(a) reduction (by 20–30%) are primarily aimed at lowering LDL cholesterol. Anti-PCSK9 antibodies (inhibitors of proprotein convertase subtilisin/kexin type 9) are used. Drugs such as evolocumab or alirocumab show a reduction in Lp(a) levels by approximately 29% and 23%, respectively, thereby reducing cardiovascular risk.^{35,36} Inclirisan, based on siRNA, inhibits hepatic PCSK9 synthesis. It mainly lowers LDL levels and slightly (by about 20%) Lp(a) levels, without showing a reduction in cardiovascular events.³⁷ Studies on the impact of statins on lowering Lp(a) levels do not confirm their effectiveness in this regard. However, in our study, 16 patients were taking statins for medical reasons. Statin therapy lowers elevated LDL cholesterol levels, thereby reducing the number of cardiovascular incidents and overall cardiovascular risk.²² A drug that reduces Lp(a) levels is niacin. Niacin can lower Lp(a) levels by about 40%, but its effectiveness in reducing cardiovascular episodes has not been observed. Additionally, combining niacin therapy with statins can result in numerous side effects (such as infections or bleeding).³⁸

Elevated Lp(a) levels obtained during the preventive screening program should be interpreted individually for each patient. This is an additional test component included in the guidelines of the Polish Lipid Association and should be skillfully analyzed by doctors. Limited direct intervention options for Lp(a) levels do not make this parameter insignificant. On the contrary, elevated Lp(a) levels should be treated as a warning sign, prompting extended diagnostics to assess cardiovascular risk. A lipid profile test, which includes total cholesterol, LDL cholesterol, triglycerides, HDL cholesterol, non-HDL cholesterol, and apolipoprotein B levels as indicated, should be performed. In individuals with increased cardiovascular risk resulting from elevated Lp(a) levels, these parameters demand regular monitoring. Using a cardiovascular risk calculator that includes Lp(a) levels, such as the one proposed by B. Ference, allows for better risk stratification for the patient.³⁹ An individualized approach to the lipid profile of a given patient, maintaining appropriate LDL cholesterol levels and proper systolic blood pressure values, is recommended to compensate for the increased risk for the patient resulting from elevated Lp(a) levels.⁴⁰ Sixteen out of 31 surveyed patients with elevated Lp(a) (2 from the very high-risk group, 10 from the high-risk group, and 4 from the moderate cardiovascular risk group) reported regular lipid profile tests.

Noninvasive coronary CT angiography is a valuable diagnostic tool for patients with elevated Lp(a) concentrations, aiding in the diagnosis of coronary artery disease and assessment of myocardial infarction risk, now included in the tests that can be requested by primary care physicians. Consideration should also be given to conducting tests to confirm or exclude diseases affecting Lp(a) levels. Elevated Lp(a) values are associated with impaired kidney function from early stages (Lp(a) levels are inversely proportional to kidney function).¹⁵ Growth hormone therapy also stimulates Lp(a) levels (increasing by 25% to even 100%),² as do acute inflammatory conditions accompanied by increases in CRP, IL-6, or α -1-antitrypsin.³ Treatment of overt or subclinical hypothyroidism reduces Lp(a) levels by approximately 5–20%.² Patients undergoing antiviral treatment (HCV) may experience a twofold increase in Lp(a) levels.¹⁷ A detailed medical history enables determination of additional tests required.

Lp(a) can also be considered a prognostic factor when assessed in young adults, allowing for timely implementation of appropriate preventive measures. A diet based on unsaturated fats or carbohydrates can increase Lp(a) levels by 8–20%,¹¹ whereas consuming low-carbohydrate and high-saturated fat products is associated with a decrease in Lp(a) levels by approximately 15%.²⁰ Similar ef-

fects are seen with the inclusion of flaxseed and walnut in the diet.^{11,41} Although lifestyle factors and diet have minimal impact on Lp(a) levels, lifestyle changes remain a key aspect of lipid disorder prevention and treatment. In addition to pharmacotherapy, promoting a healthy lifestyle — physical activity and adapted diet based on cardiovascular risk determined by Lp(a) levels or avoiding substances (i.e., cigarette smoking) in young adults — is crucial for maintaining an appropriate lipid profile and reducing cardiovascular risk in the future.

CONCLUSIONS

It is essential to educate patients and medical personnel regarding the significance of increased Lp(a) as a cardiovascular risk factor. Research conducted in a cohort of patients from the Nowy Sącz region showed elevated Lp(a) levels in nearly 21% of individuals. This finding supports the indication for the dissemination of similar preventive programs, which can help identify patients with genetically predisposed cardiovascular disease risk and enable further appropriate diagnostic and therapeutic actions.

Consideration should be given to measuring Lp(a) levels in young adults in the future, dedicating preventive screening programs to younger social groups as well. Incorporating Lp(a) into routine diagnostics, measured in young adults, with appropriate dietary prophylaxis and promotion of a healthy lifestyle, has the potential to effectively reduce the percentage of hazardous cardiovascular events in the later life of patients.

Lp(a) testing in middle-aged and older individuals, if classified into a risk group based on elevated Lp(a) levels, requires monitoring of lipid parameters and medical interventions aimed at reducing cardiovascular risk. Urgent recommendations are needed regarding further management of patients with elevated Lp(a) levels depending on age and other lipid parameter results.

CONFLICT OF INTEREST

Nothing to declare.

ETHICAL APPROVAL

The study and the survey received approval from the Ethics Committee for Scientific Research at Jagiellonian University – Collegium Medicum (approval number 118.6120.210.2023/15.02.2024).

CONSENT TO PARTICIPATE

All study participants provided written informed consent before being included in the study.

FUNDING

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