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Effect of Therapeutic Plasma Exchange on Lipid Profile in Patients with Treatment-Resistant Severe Hypertriglyceridemia: A Retrospective Single-Center Experience

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Abstract

Aim:

Current pharmacological approaches (statins, fibrates, and omega-3 fatty acids) may be insufficient to reduce elevated triglyceride levels and improve clinical outcomes. This study aimed to evaluate the acute effect of therapeutic plasma exchange (TPE) on lipid profile and its clinical success in patients with treatment-resistant severe hypertriglyceridemia.

Materials and Methods:

This single-center retrospective cohort study included 28 patients with severe hypertriglyceridemia who underwent TPE at the Endocrinology Clinic of Malatya Turgut Özal University Training and Research Hospital between 2024 and 2026. Patients' demographic data, comorbidities, indications for plasmapheresis, number of sessions, and complications observed during the procedure were retrospectively reviewed and recorded. The efficacy and safety of therapeutic plasma exchange were evaluated.

Results:

The mean age of the 28 patients included in the study was 46.07 ± 12.93 years, and 60.7% of the patients were male. The most common indication for plasmapheresis was resistance to conventional drug therapy (82.1%), followed by acute pancreatitis (14.3%) and pregnancy (3.6%). A single session of TPE was performed in 53.6% of the patients, whereas two sessions were performed in 46.4%. Evaluation of post-procedural outcomes revealed an 89.3% reduction in serum triglyceride (TG) levels and a 36.9% reduction in total cholesterol levels. Despite this lipid clearance, a significant increase in HDL cholesterol levels and a marked decrease in C-reactive protein (CRP) levels were observed ($p = 0.001$). When the effects of TPE on hemostatic and metabolic balance were examined, the procedure was found to have a favorable safety profile. In contrast to the substantial reduction in lipid levels, decreases in hemoglobin and calcium levels remained clinically minimal. None of the patients required red blood cell suspension replacement. In addition, no statistically significant changes were observed in hematocrit, albumin, platelet count, or coagulation parameters, including PT, INR, and fibrinogen, before and after the procedure ($p > 0.05$). During the procedure, only one patient (3.6%) developed a mild allergic reaction, while no complications were observed in the other patients.

Conclusion:

Therapeutic plasma exchange is a highly clinically effective method that rapidly and markedly reduces triglyceride and total cholesterol levels in patients with severe hypertriglyceridemia, thereby minimizing

the risk of acute complications.

Introduction

Hypertriglyceridemia (HTG) is a lipid metabolism disorder that develops as a result of increased dietary intake, enhanced hepatic synthesis, impaired triglyceride (TG) metabolism, or a combination of these factors (1). Plasma TG levels between 150 and 499 mg/dL are defined as mild-to-moderate HTG, whereas values above 880 mg/dL are classified as severe HTG (2). Severe HTG is a clinically significant risk factor responsible for approximately 10% of acute pancreatitis cases. In addition, the incidence of pancreatitis during pregnancy may reach up to 56% (3, 4, 5).

Although standard pharmacological approaches such as statins, fibrates, and omega-3 fatty acids reduce cardiovascular risk in the management of HTG, they may be insufficient to achieve adequate TG reduction, particularly in severe and genetic forms (2). The limited availability of pharmacological options represents a major challenge in clinical conditions that are resistant to conventional treatments or in which rapid reduction of TG levels is critically important, such as pregnancy and acute pancreatitis (6). Treatments such as insulin and heparin, which are used to increase lipoprotein lipase activity, may have limited efficacy and may yield inadequate results in some cases. Therefore, alternative treatment approaches capable of providing a faster and more effective reduction in triglyceride levels are needed, particularly in severe and refractory cases (7). Therapeutic plasma exchange (TPE) is a method that can reduce TG levels by 50–80% within a short period by removing triglyceride-rich lipoproteins and inflammatory mediators from plasma. However, it is still classified as a Category III indication by the American Society for Apheresis (ASFA). This classification emphasizes that the method should be applied in selected patient groups and that clinical decision-making should be individualized (8). The fact that the available literature is largely based on case series and small cohorts indicates the need for stronger evidence regarding the efficacy of TPE and its impact on clinical outcomes (9).

Recent studies have shown that TPE rapidly reduces triglyceride levels; however, its effect on clinical outcomes may be more limited and dependent on patient selection (7, 10). This highlights the need to clarify which patient groups may benefit most from TPE. In the present study, we aimed to evaluate the acute effects of TPE on lipid profile and clinical outcomes in patients followed up with a diagnosis of treatment-resistant severe hypertriglyceridemia.

Materials and Methods

Study Design

In this retrospective cohort study, the records of 28 patients with hypertriglyceridemia (HTG) who underwent therapeutic plasma exchange (TPE) in the Endocrinology Department of Turgut Özal University Faculty of Medicine between 2024 and 2026 were retrospectively evaluated. Adult patients aged 20–70 years who had serum triglyceride levels above 1000 mg/dL, failed to achieve adequate

biochemical control despite lipid-lowering therapy, and underwent therapeutic plasmapheresis for hypertriglyceridemia were included in the study.

Therapeutic plasma exchange (TPE) was performed in these patients to rapidly control triglyceride levels. Demographic characteristics, including age and sex, and clinical variables, including the presence of chronic comorbidities, indication for plasmapheresis, and number of treatment sessions, were obtained from the hospital electronic medical record system.

Ethical approval

for this study was obtained from the Non-Interventional Clinical Research Ethics Committee of Malatya Turgut Özal University on April 2, 2026 (Decision No: 2026/144).

Sample Size

The sample size of the study was determined according to the number of cases that met the inclusion criteria during the study period and had complete pre- and post-procedural laboratory data. Accordingly, a total of 28 cases were included in the analysis.

In the power analysis performed for triglyceride levels, the mean difference between paired measurements was calculated as 2281.04 mg/dL, and the standard deviation of the differences was 1602.20. Based on these values, the effect size for paired measurements was calculated as dz = 1.42. Under the assumptions of $\alpha = 0.05$ and a two-tailed test, the current sample size was determined to have a statistical power of more than 90% to detect changes in triglyceride levels.

Inclusion Criteria

Patients were included in the study if they met the following criteria:

- Age between 20 and 70 years;
- Serum triglyceride level above 1000 mg/dL;
- Failure to achieve adequate biochemical control despite lipid-lowering therapy;
- Undergoing therapeutic plasma exchange/plasmapheresis due to hypertriglyceridemia;
- Availability of demographic and clinical data in the hospital electronic medical record system.

Exclusion Criteria

Patients were excluded from the study if they met any of the following criteria:

- Hemodynamic instability, including severe hypotension or drug intolerance developing during the procedure, sepsis, or coagulation disorder;

- Diagnosis of hypertriglyceridemia accompanied by hypocalcemia;
- Age younger than 20 years or older than 70 years;
- Undergoing therapeutic apheresis for indications other than hypertriglyceridemia.

Therapeutic Plasma Exchange

The choice of venous access was determined according to the indication for fresh frozen plasma (FFP), the planned number of sessions, the patient's clinical condition, and the suitability of the peripheral veins of the upper extremities. For dialysis catheters placed in the jugular or subclavian region under ultrasound guidance, chest radiography was systematically performed to confirm correct catheter positioning and to ensure that no complications, such as pneumothorax, had occurred.

Therapeutic plasma exchange procedures were performed using the COM.TEC cell separator system (Fresenius Kabi AG, Bad Homburg, Germany), which operates on a continuous-flow principle. The maximum centrifuge speed of the device is 2200 rpm, and its maximum load capacity is 3.0 kg. Standard apheresis protocols were applied in each procedure, and an exchange of approximately 1–1.5 plasma volumes per procedure was targeted. Fresh frozen plasma (FFP) was used as the replacement fluid in all procedures.

Anticoagulation of the extracorporeal circuit was achieved using acid citrate dextrose solution A (ACD-A). The total volume of ACD-A used during the procedure and the volume returned to the patient were automatically calculated by the centrifuge system of the device. Hypocalcemia was prevented by continuous calcium infusion during the FFP procedure; the amount of calcium administered was determined according to pre-procedural ionized calcium levels and the type of replacement fluid used. In general, calcium chloride was infused at a dose of 2 g per hour during FFP use.

All plasmapheresis procedures were performed by an experienced apheresis team in accordance with the institution's standard clinical protocols. Vital signs were recorded at the beginning and end of each procedure, and patients were closely monitored for possible adverse events throughout the procedure. Before apheresis, all patients were informed in detail about the potential risks of the procedure, and written informed consent was obtained. Each apheresis session lasted approximately 2.5–3 hours. TPE was performed every other day until serum TG levels decreased below 500 mg/dL.

Outcome Variables

The outcome variables of the study consisted of triglyceride, total cholesterol, HDL cholesterol, CRP, hemoglobin, white blood cell count, APTT, albumin, calcium, corrected calcium, PT, INR, fibrinogen, hematocrit, and platelet levels. These variables were compared between pre- and post-TPE measurements.

All parameters were reported in standard units: triglyceride, mg/dL; total cholesterol, mg/dL; HDL cholesterol, mg/dL; CRP, mg/L; albumin, g/L; calcium and corrected calcium, mg/dL; white blood cell and platelet counts, $10^3/\mu L$; hemoglobin, g/dL; hematocrit, %; APTT and PT, seconds; and fibrinogen, mg/dL.

Statistical Analysis

Categorical variables were summarized as numbers and percentages, whereas numerical variables were summarized as mean ± standard deviation or median (Q1, Q3), as appropriate. The normality of continuous variables was assessed using the Shapiro–Wilk test, and distributional characteristics were additionally evaluated by examining skewness and kurtosis values.

The paired-samples t-test was used to compare normally distributed paired numerical measurements. The Wilcoxon signed-rank test was used to compare two paired numerical measurements that did not show a normal distribution. Statistical analyses were performed using IBM SPSS Statistics version 20.0. A p value of < 0.05 was considered statistically significant.

Results

The distributions and descriptive statistics of the patients' clinical and demographic characteristics are presented in Tables 1 and 2. In our study, 39.3% of the patients were female (n = 11), and 60.7% were male (n = 17).

Among the 28 patients included in the study, 50.0% had diabetes mellitus alone (n = 14), 10.7% had diabetes mellitus and coronary artery disease (n = 3), 10.7% had diabetes mellitus and hypertension (n = 3), and 3.6% had hyperthyroidism (n = 1), whereas 25.0% had no chronic disease (n = 7). When evaluated according to smoking status, 71.4% of the patients were smokers (n = 20), whereas 28.6% were non-smokers (n = 8). The most common indication for plasmapheresis was drug resistance, and plasmapheresis was performed for this reason in 82.1% of the patients (n = 23). Other indications for plasmapheresis were pancreatitis in 14.3% of patients (n = 4) and pregnancy in 3.6% (n = 1). A single session of plasmapheresis was performed in 53.6% of the patients (n = 15), whereas two sessions were performed in 46.4% (n = 13). No adverse effects were observed in the vast majority of patients after the procedure (96.4%; n = 27), while an allergic reaction developed in only one patient (3.6%).

Evaluation of the medications used showed that the most frequently used drug was fenofibrate (89.3%; n = 25), followed by the combination of fenofibrate and atorvastatin (7.1%; n = 2) and rosuvastatin (3.6%; n = 1).

Table 1
Distribution of Patients' Clinical and Demographic Characteristics

Sex		**n**	**%**
	Female	**11**	**39,3**
	Male	17	60,7
Comorbidity	Absent	7	25,0
	Present	21	75,0
Smoking Status	Non-smoker	8	28,6
	Smoker	20	71,4
Indication for plasmapheresis	Drug resistance	23	82,1
	Pregnancy	1	3,6
	Pancreatitis	4	14,3
Number of sessions	1,00	15	53,6
	2,00	13	46,4
Adverse effect	None observed	27	96,4
	Allergic reaction	1	3,6
Medication	Fenofibrate	25	89,3
	Rosuvastatin	1	3,6
	Fenofibrate+atorvastatin	2	7,1

The mean age was 46.07 ± 12.93 years. The median smoking exposure was 12.50 pack-years (Q1–Q3: 10.00–20.00), and the median amount of fresh frozen plasma administered was 18.00 units (Q1–Q3: 15.50–27.00). The median duration of fenofibrate/statin use was 4.00 months (Q1–Q3: 3.00–6.50).

Table 2
Descriptive Statistics of Patients' Clinical and Demographic Characteristics

Age	**Mean ± SD**	**Median (Q1–Q3)**
	46,07 ± 12,93	**47,00 (37,00–59,00)**
Smoking exposure, pack-years	14,20 ± 6,44	12,50 (10,00–20,00)
Amount of FFP administered	21,61 ± 7,44	18,00 (15,50–27,00)
Duration of fenofibrate/statin use, months	6,50 ± 10,68	4,00 (3,00–6,50)

SD:standard deviation; Q1–Q3:first and third quartiles; FFP:fresh frozen plasma.

The comparison of laboratory measurements before and after plasmapheresis is presented in Table 3. A marked and statistically significant decrease was observed in the median triglyceride level. The median triglyceride level decreased from 1975.00 (1339.50–3385.00) before the procedure to 211.50 (163.00–299.50) after the procedure ($p < 0.001$). Similarly, the median total cholesterol level decreased from 267.00 (208.00–301.00) before the procedure to 168.50 (152.25–194.50) after the procedure, and this reduction was statistically significant ($p < 0.001$).

The median HDL cholesterol level increased significantly after the procedure, from 22.75 (17.53–26.75) before the procedure to 34.45 (26.30–41.10) after the procedure ($p = 0.001$). The median CRP level was 0.50 (0.50–6.38) before the procedure and 0.50 (0.50–0.50) after the procedure. Although the median CRP value did not change, CRP levels decreased in 13 patients, remained unchanged in 15 patients, and did not increase in any patient. Therefore, a significant post-procedural decrease in CRP levels was observed ($p = 0.001$).

The median hemoglobin level was 14.00 (11.83–15.13) before the procedure and 13.75 (12.10–14.93) after the procedure, and this decrease was statistically significant ($p = 0.033$). No significant difference was observed in the median white blood cell count before and after the procedure; the pre- and post-procedural median values were 8.90 (7.71–10.79) and 8.90 (7.71–10.79), respectively ($p = 0.374$). The median APTT value was 25.70 (24.53–27.08) before the procedure and 26.20 (24.73–26.80) after the procedure, with no significant change observed ($p = 0.666$).

The mean albumin level was 3.79 ± 0.28 before the procedure and 3.78 ± 0.25 after the procedure, with no significant difference detected ($p = 0.914$). The mean calcium level decreased from 9.20 ± 0.49 before the procedure to 9.02 ± 0.42 after the procedure, and this decrease was statistically significant ($p = 0.046$). The mean corrected calcium level also showed a significant decrease, from 9.37 ± 0.43 before the procedure to 9.19 ± 0.37 after the procedure ($p = 0.020$).

The mean PT value was 11.98 ± 1.01 before the procedure and 12.14 ± 0.69 after the procedure ($p = 0.501$). The INR values were 0.99 ± 0.08 and 0.98 ± 0.07, respectively ($p = 0.570$). The fibrinogen level was 270.40 ± 56.56 before the procedure and 258.95 ± 56.03 after the procedure ($p = 0.435$). The hematocrit level was 40.56 ± 5.66 before the procedure and 40.81 ± 5.33 after the procedure ($p = 0.752$). The platelet count was 255.21 ± 81.68 before the procedure and 237.36 ± 71.13 after the procedure, and this change was not statistically significant ($p = 0.184$).

Table 3
Comparison of Laboratory Measurements Before and After Plasmapheresis

Triglyceride (mg/dL)	**Before**	**After**	**p**
	Median(Q1–Q3)	**Median(Q1–Q3)**	
	1975,00 (1339,50–3385,00)	**211,50 (163,00–299,50)**	**< 0,001**
White blood cell count (10^3/uL)	8,90 (7,71–10,79)	8,90 (7,71–10,79)	0,374
Total cholesterol (mg/dL)	267,00 (208,00–301,00)	168,50 (152,25–194,50)	< 0,001
HDL cholesterol (mg/dL)	22,75 (17,53–26,75)	34,45 (26,30–41,10)	0,001
CRP (mg/L)	0,50 (0,50–6,38)	0,50 (0,50–0,50)	0,001
APTT (seconds)	25,70 (24,53–27,08)	26,20 (24,73–26,80)	0,666
Hemoglobin	14,00 (11,83–15,13)	13,75 (12,10–14,93)	0,033
	Before Mean ± SD	After Mean ± SD	
Albumin (g/L)	3,79 ± 0,28	3,78 ± 0,25	0,914
Calcium (mg/dL)	9,20 ± 0,49	9,02 ± 0,42	0,046
Corrected calcium (mg/dL)	9,37 ± 0,43	9,19 ± 0,37	0,020
PT (seconds)	11,98 ± 1,01	12,14 ± 0,69	0,501
INR	0,99 ± 0,08	0,98 ± 0,07	0,570
Fibrinogen (mg/dL)	270,40 ± 56,56	258,95 ± 56,03	0,435
Hematocrit (%)	40,56 ± 5,66	40,81 ± 5,33	0,752
Platelet count 10^3/uL	255,21 ± 81,68	237,36 ± 71,13	0,184

CRP, C-reactive protein; APTT, activated partial thromboplastin time; PT, prothrombin time; INR, international normalized ratio; HDL, high-density lipoprotein; SD, standard deviation; Q1–Q3, first and third quartiles.

Discussion

Therapeutic plasma exchange (TPE) is an apheresis procedure that involves the extracorporeal separation of plasma from cellular blood components and its replacement with appropriate replacement fluids (11). TPE provides an important clinical benefit by facilitating the rapid reduction of triglyceride (TG) levels and inflammatory cytokines. During TPE, fresh frozen plasma (FFP), 5% human albumin solution, colloid solutions, and crystalloid fluids are most commonly used for replacement. The type of replacement fluid, as well as the duration and intensity of treatment, varies according to the

characteristics and clinical severity of the underlying disease. When plasma is used as the replacement fluid, it may potentially replace deficient lipoprotein lipase (LPL). The use of FFP as the replacement fluid has a theoretical advantage over albumin because it provides LPL and apolipoproteins required for TG hydrolysis (10).

Although the current guidelines of the American Society for Apheresis (ASFA) define the replacement fluids recommended for different clinical indications, a substantial proportion of these recommendations are based on low-quality evidence, with grades ranging from 2B to 2C. This indicates that current data on the efficacy and safety profiles of different replacement fluids remain limited (12).

The present study aimed to evaluate the efficacy and safety of TPE in patients with severe hypertriglyceridemia (HTG) who were resistant to lipid-lowering therapies or required rapid triglyceride reduction. TPE demonstrated high clinical efficacy in the rapid optimization of the lipid profile. Among the 28 patients who underwent TPE, the most common indication for plasmapheresis was resistance to conventional drug therapy, observed in 82.1% of patients, followed by acute pancreatitis (14.3%) and pregnancy (3.6%). After TPE, serum triglyceride (TG) levels decreased markedly by 89.3%, from 1975.00 to 211.50 mg/dL ($p < 0.001$), and total cholesterol levels decreased by 36.9%, from 267.00 to 168.50 mg/dL ($p < 0.001$). In contrast, HDL cholesterol levels increased significantly, from 22.75 to 34.45 mg/dL ($p = 0.001$), and CRP levels decreased markedly ($p = 0.001$). Despite this substantial improvement in the lipid profile, the decreases in hemoglobin, from 14.00 to 13.75 g/dL ($p = 0.033$), and calcium, from 9.20 to 9.02 mg/dL ($p = 0.046$), remained clinically minimal. In addition, none of the patients required red blood cell suspension replacement, and no significant changes were observed in hematocrit, albumin, platelet count, or coagulation parameters, including PT, INR, and fibrinogen, before and after the procedure ($p > 0.05$).

Şimşir et al. (9) reported a 69.7% reduction in TG levels after TPE in a Turkish series of 31 cases. In our study, this reduction was 89.3% among 28 patients. Similarly, in the multicenter study by Stefanutti et al. (13), which included 17 patients, the mean triglyceride level decreased from 1929 mg/dL to 762 mg/dL after TPE, and the total cholesterol level decreased from 510 mg/dL to 227 mg/dL. In our series, the triglyceride level decreased from 1975 mg/dL to 211.5 mg/dL, and the total cholesterol level decreased from 267 mg/dL to 168.5 mg/dL; these differences were statistically significant. Compared with similar studies, our findings are generally consistent, although the proportional reduction in TG levels was somewhat higher.

Kandemir et al. (14), in a series of 33 patients, reported a 54.4% reduction in TG levels and a 52.1% reduction in total cholesterol levels. In our study, a greater reduction in TG levels was observed (89.3%), whereas the decrease in total cholesterol levels (36.9%) was lower than that reported by Kandemir et al. These differences may be attributable to variations in baseline lipid profiles and clinical characteristics of the patient populations.

When evaluated in terms of treatment safety, in the randomized study by Gubenšek et al. (15), which included 22 patients, the TPE procedure was terminated early in one of the 11 patients who underwent

TPE because of an allergic reaction characterized by urticaria and hypotension toward the end of the procedure. In our study, only one patient developed mild urticaria that did not require discontinuation of TPE. Similarly, Araz et al. (16) reported two minor transfusion reactions during TPE sessions performed in 19 patients. In addition, serious systemic complications, such as acute kidney injury in four patients and altered mental status in seven patients, as well as local complications including splenic vein thrombosis, abscess, and pseudocyst, were observed in the apheresis group. In our study, no adverse effects were observed in 96.4% of patients (n = 27), and only one patient (3.6%) developed a mild allergic reaction, including erythema and pruritus. These findings suggest that TPE may be a safe treatment modality when performed with appropriate patient selection and close monitoring.

Changes in calcium levels are also clinically important. During TPE, citrate-containing anticoagulation may bind ionized calcium and lead to symptoms such as paresthesia, muscle cramps, hypotension, or arrhythmia. Calcium supplementation is widely used during TPE to prevent citrate-induced hypocalcemia; however, practices vary across centers. In some centers, calcium support is provided only when symptoms of hypocalcemia develop (17). In our center, all patients undergoing TPE with citrate anticoagulation received continuous intravenous calcium infusion at a diluted concentration through the return line.

In the study by Jin et al. (17), which included 42 patients undergoing TPE, hypocalcemia was defined as a total corrected calcium level below the lower limit of normal, that is, total calcium < 8.5 mg/dL, and post-procedural hypocalcemia was detected in 35 patients (83%). Although total calcium levels improved in most participants during follow-up evaluations, persistent hypocalcemia was reported in 10 patients (24%). In our study, the mean corrected calcium level was 9.37 ± 0.43 mg/dL before the procedure and 9.19 ± 0.37 mg/dL after the procedure ($p = 0.020$). No patient developed hypocalcemia or symptoms related to hypocalcemia.

In our literature review, we did not identify any study investigating anemia after TPE performed for hypertriglyceridemia. A distinctive aspect of our study in terms of safety is that changes in hemoglobin and calcium levels were analyzed separately. Although a mean decrease of 0.33 g/dL was observed in hemoglobin levels, no clinical complication such as bleeding requiring red blood cell suspension replacement occurred.

Therefore, safety assessment should not be limited to the presence or absence of complications alone; rather, it should include the combined monitoring of hemoglobin, calcium, and hemodynamic parameters.

Pregnancy represents a special patient group that requires greater caution when deciding to perform TPE. Nguyen et al. reported that severe hypertriglyceridemia could be managed with high-dose omega-3 therapy and plasmapheresis in two pregnant women with HTG (6). Başar et al. also demonstrated that therapeutic apheresis could be used in two cases of severe hypertriglyceridemia during pregnancy (18). Our series included one pregnant patient, who achieved the target triglyceride level after the procedure. Her TG level decreased from 3428 mg/dL before TPE to 280 mg/dL after two sessions with 24 units of

FFP. Because this finding is based on a single patient, it does not allow a strong conclusion specific to pregnancy. However, this case is important in demonstrating that TPE can also be applied in special clinical conditions within our center's experience.

Therapeutic plasma exchange rapidly reduces triglyceride levels; however, the decision to perform the procedure should not be made independently of clinical evaluation. Particularly in treatment-resistant patients, in those with persistently high triglyceride levels despite medical therapy, and in cases accompanied by pancreatitis or at risk of clinical deterioration, TPE may be considered a strong option for achieving biochemical targets. In addition, our findings regarding hemoglobin and calcium monitoring indicate that safety follow-up is as important as treatment efficacy.

Conclusion and Recommendations

In our series of 28 patients who underwent TPE for treatment-resistant severe hypertriglyceridemia, therapeutic plasmapheresis rapidly and markedly reduced triglyceride levels, and the post-procedural target of < 500 mg/dL was achieved in all patients. The mean triglyceride reduction was 89.3%, which is comparable to or higher than the rates reported in many TPE series in the literature. A significant decrease in total cholesterol and a significant increase in HDL cholesterol were also observed. These findings support the role of TPE as a preventive treatment approach against serious future complications, such as acute pancreatitis and atherosclerotic cardiovascular disease.

Although the decreases observed in hemoglobin, total calcium, and corrected calcium levels were limited in absolute terms, they are important for safety monitoring. The most commonly reported complications of TPE include urticaria, paresthesia, headache, hypotension, muscle cramps, and catheter-related problems. Such complications can be readily prevented through sterile technique, continuous observation, and appropriate monitoring of patients by highly trained medical personnel. Overall, our findings indicate that TPE is an effective biochemical intervention in selected and treatment-resistant cases. However, larger, prospective, and comparative studies are needed to evaluate its effects on clinical outcomes.

Declarations

Conflict of Interest:

The authors declare that they have no conflicts of interest related to this manuscript.

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Ethical Approval:

Ethical approval for this study was obtained from the Non-Interventional Clinical Research Ethics Committee of Malatya Turgut Özal University on April 2, 2026 (Decision No: 2026/144).

Clinical trial number

not applicable

Note

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Author Contribution

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