Comparison of Short-term MUFA and PUFA—Rich Diets on Blood Lipid Levels in NG Tube-Fed Elderly Patients

Pei-Chun Chao¹, Chi-Hua Yen², Chien-Ning Huang³, Chin-Kun Wang⁴

Abstract

Blood lipid disorder or dyslipidemia is a key component for the medical care of patients with cardiovascular disease (CVD). Dietary lipids on the risk of CVD have traditionally been revealed by their effects on low density lipoprotein cholesterol (LDL-C). This is a cross-over study to evaluate the effects on the blood lipids of nasogastric tube-fed elderly patients of a two-week administration of dietary lipids with either polyunsaturated fatty acids (PUFA) or monounsaturated fatty acids (MUFA). Ten elderly patients (4 men and 6 women, mean age 74.0±2.0, body mass index 18.3±1.5 kg/m²) were involved in this study and supplemented with 1,800 kcal diet of 45% carbohydrates, 12% protein and 43% lipids every day. The diet supply contained 43% energy of fats, with either rich PUFA (52% of Fat) or MUFA (42% of Fat). The two diets reported similar effects on patients in terms of total cholesterol (TC), LDL-C, high density lipoprotein cholesterol (HDL-C), triglyceride (TG), apolipoprotein A-1 and B levels. This study found that isocaloric diets rich in MUFA or PUFA made no difference on cardiovascular risk factors for NG-fed elderly patients in the two-week duration. However, as compared to their counterparts treated with PUFA rich diet, subjects of MUFA rich diet reported lower TC, LDL-C, TG, and apolipoprotein B levels and a higher apolipoprotein A-1 level on blood lipids. In addition, subjects of PUFA rich diet showed lower systolic and diastolic blood pressure.

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Keywords: MUFA, PUFA, blood lipid, CVD, cross-over study

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Introduction

The population aged 65 years and older has exceeded 7.0% in Taiwan since 1994[1]. Therefore, it is timely to look at the health and the disease profile of the elderly people in this country. Coronary heart disease is the most important cause of death in the industrialized Western countries[2,3]. While decreasing in certain areas, the incidence of coronary artery disease has been on the rise in several countries, notably Soviet Union[4], People’s Republic of China[5] and Taiwan[6].

Many studies have identified plasma LDL-C as one of the most important factors related to atherosclerotic disease. Relatively high levels of LDL-C are associated with the intake of large quantities of dietary lipids. High carbohydrate, low fat diets are well known to decrease the concentration of plasma LDL-C, helping reduce the risk for developing CVD[7]. However, low-fat diets can also increase plasma TG levels and decrease HDL-C concentration, contributing thereby to a higher risk for CVD[8]. The hypertriglyceridemic effects could be attributed to large quantity of carbohydrate intake [9].

Dietary saturated fatty acids (SFA) could induce hypercholesterolemic action [10], but polyunsaturated fatty acids (PUFA) have a hypocholesterolemic effect[8]. However, epidemiological studies have shown that intake of high monounsaturated fatty acids (MUFA) could lower the incidence of CVD in the Mediterranean area[11].

The present cross-over study aims to evaluate the effects on the blood lipids of nasogastric tube-fed elderly of two diets with identical carbohydrate and protein content, one rich in MUFA and the other rich in PUFA.

Subjects and methods

1. Subjects

Fourteen NG-fed patients were screened for participation in this study. All had access to NG-feeding diet. Two volunteers dropped out of the study because of inability to comply with the intervention diets (eg, severe prolonged diarrhea), and two subjects dropped out for reasons unrelated to the study (eg, hospitalization). Ten subjects (4 men and 6 women) participated in the study; their baseline characteristics are summarized in Table 1. For the purpose of this study, “elderly” is defined as someone who is sixty-five years of age or older. The subjects had an average age of 74.0 ± 2.0 (mean ± s.d.) years and were underweight (body mass index: 18.3 ± 1.5 Kg/m²). All
participants were normolipidaemic. None of the subjects had clinical evidence of endocrine, diabetes, renal, hematologic, or hepatic dysfunction; no history of myocardial infarction; and no current treatment with lipid-lowering drugs. Eight of the participants were hypertensive with six of them treated with antihypertensive medication during the experiment. The remaining two participants reported normal blood pressure. The study had obtained approval from the local ethical committee of Chung Shan Medical University Hospital, and all subjects gave their informed consent.

2. Experimental protocol

A cross-over study design was chosen. After a one-week run-in period taking the baseline diet, the NG-fed patients were randomly allocated to two-week treatment with either a high monounsaturated fatty acid (MUFA) diet or a high polyunsaturated fatty acid (PUFA) diet. After a two-week wash-out period on the baseline diet, the participants received the alternative diet for two weeks (Fig 1).

Table 1. Demographic and anthropometric characteristics of subjects

<table>
<thead>
<tr>
<th></th>
<th>Baseline (n=10)</th>
<th>MUFA diet (n=20)</th>
<th>PUFA diet (n=20)</th>
</tr>
</thead>
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<tr>
<td>Sex (Male/Female)</td>
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<td>4/6</td>
<td>4/6</td>
</tr>
<tr>
<td>Age (y)</td>
<td>74.0±2.0</td>
<td>74.0±2.0</td>
<td>74.0±2.0</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>155.3±3.1</td>
<td>155.3±3.1</td>
<td>155.3±3.1</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>45.1±2.9</td>
<td>45.6±3.5</td>
<td>45.4±3.0</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>18.3±1.5</td>
<td>18.6±2.2</td>
<td>18.5±2.0</td>
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Fig 1. Experimental protocol

The table and figure are from the article "Comparison of Short-term MUFA and PUFA–Rich Diets on Blood Lipid Levels in NG Tube-Fed Elderly Patients." The study compared the effects of short-term high monounsaturated fatty acid (MUFA) and high polyunsaturated fatty acid (PUFA) diets on blood lipid levels in NG tube-fed elderly patients. The participants were normolipidaemic and did not have medical conditions that could affect the results. The study was conducted in a cross-over design, with participants randomized to either the MUFA or PUFA diet for two weeks each, with a two-week wash-out period in between. The energy requirements of each patient were calculated using the Harris-Benedict equation corrected for stress and activity. The table presents demographic and anthropometric characteristics of the subjects, including sex, age, height, weight, and BMI. The results were expressed as mean ± standard deviation. The study was approved by the local ethical committee, and all subjects provided informed consent.
amount of food consumed was documented on charts completed by the nursing staff, and the energy intake was calculated by the dietitian. For each patient the two diets were isocaloric with a mean energy content of 1,800 Kcal/day. Blood pressure, lipids and lipoproteins were measured before and on the last day of the two diet periods. The study was carried out on a convalescent hospital.

3. Dietary intervention

The patients were fed through nasogastric tube with high-fiber (Sentosa CBF) enteral formula as the baseline diet, and extra Sunflower oil (SAFA 11%, MUFA 20%, PUFA 69%; Quaker, Taiwan) was added as the PUFA source in the PUFA diet, and unsaturated-Sunflower oil (SFA 9%, MUFA 65%, PUFA 26%; Quaker, Taiwan) was added as the MUFA source in the MUFA diet. The nutrient composition is given in Table 2. All food was prepared in the convalescent hospital, and six meals (300 Kcal/ 300cc/ meal) were offered daily to the participants during all intervention periods.

The patients’ diagnosis and relevant medical details were documented at the start of the feeding period. Tolerance of each feeding method was monitored for incidence of complications, including nausea, diarrhea, vomiting, inadequate gastric emptying and abdominal distension. Severe distension and diarrhea, repeated vomiting, and high gastric residual (> 200 cc/shift) were considered poor tolerance. At times, feeding was withheld for a few hours if these symptoms or signs were severe. The number of patients who managed to achieve more than 80% of their estimated energy and fat requirements were recorded.

4. Statistical methods

The results were expressed as mean ±
S.D. As all the data presented were consistent with the hypothesis of normality, a paired *t*-test and Tukey’s test were used for statistical analysis (SPSS Exact Tests 10.0). *p* < 0.05 was considered statistically significant.

5. Analytical methods

Blood samples were drawn after an overnight fast at approximately 8.00 a.m. All blood samples were collected according to a standardized protocol. Triglyceride was measured by GPO-PAP method, enzymatic color test for clinical chemistry analyzers (Cat.-No.: OSR6133, Olympus System Reagent). Plasma total cholesterol was measured by enzymatic color test, cholesterol reagent OSR6516 for use on the AU2700 and AU5400 systems only (Olympus Analyzers). Cholesterol in the high-density lipoprotein (HDL) fraction of serum is known as HDL cholesterol. The study used quantitative determination of HDL cholesterol in serum. In our assay system, only HDL was solubilized by a special detergent. After HDL was selectively disrupted, HDL cholesterol was measured enzymatically, using commercial kits (Cholestest N HDL). Moreover, a homogeneous method based on an innovative detergent technology was used for quantitative determination of LDL cholesterol in serum. The following example is for a Hitachi-747 (7250) automated analyzer, using commercial kits (Cholestest LDL). Apolipoprotein A-1 is the major protein constituent of high-density lipoproteins (HDL), and apolipoprotein B is the major constituent of LDL. Analyses of apolipoprotein A-1 and B were based on the measurement of immunoturbidimetrics which were determined turbidimetrically at 340 nm.

Results

All subjects followed the protocol and had no problem eating either diet as judged by the dietitian. The participants succeeded well concerning the change in diets during both periods (Table 2). On both diets the patients had similar weight gain averaging 0.5 kg on the MUFA diet vs. 0.4 kg on the PUFA diet (*p* = 0.55), i.e. on average less than 1% from baseline (Table 1).

1. Resting blood pressure

All participants had normal blood pressure. The MUFA and PUFA diets seemed to have similar neutral impact on the resting blood pressure levels (Table 3). However, both the systolic pressure and the diastolic pressure tended to be lower in the PUFA group.
2. Lipids and lipoproteins

In Table 4 the lipid and lipoprotein levels at the start and end of each intervention period are given. There was no significant effect of the two intervention diets. Neither was difference observed in the LDL/HDL ratio and total CHO/HDL ratio at the end of the two diet periods (Table 5).

Discussion

In this study, we examined the metabolic effects of high-MUFA and high-PUFA diets on normolipidemic NG-fed elderly patients. Our purpose was to investigate the impacts of high fat diet (43% of Fat) on elderly patients’ blood lipid. The research using normolipidemic patients as experiment subjects aimed to observe how feeding high fat diet during a short-term (two-week) period could impact cardiovascular influence factors. The study was a randomized crossover study, and statistical analyses were done with
within-person comparison to secure a higher degree of statistical power.

Cardiovascular disease occurs at exponentially increasing rates with advancing age. Coronary artery disease is the leading cause of death in people aged 65 years and above (National Center for Health Statistics, NCHS). And more and more elderly citizens are living at nursing homes. It is therefore important to consider the quality of care, including diet treatment, received by elderly nursing home residents with NG-feeding.

The primary focus in the early years was on decreasing the intake of total fat, especially saturated fat, in the diet. More recently, for lowering blood cholesterol concentration, the Step I and Step II diets created by the National Cholesterol Education Program and endorsed by American Heart Association are typically recommended [13]. The primary objective of these two diets is to reduce saturated fat (8-10% and <7% of energy, respectively), cholesterol (300 or 200 mg/dl), and total fat (<30% of energy). Typically, a Step I diet lowers total cholesterol and LDL cholesterol by 5-7% [13,14]. A Step II diet is capable of reducing total cholesterol and LDL cholesterol an additional 3-7% [13, 15]. In these diets, saturated fat energy is replaced by carbohydrate, resulting in a low-fat, high-carbohydrate diet. Although these diets have beneficial effects on total cholesterol and LDL cholesterol, they increase plasma triacylglycerol concentrations and decrease HDL-cholesterol concentrations, thereby potentially and adversely affecting CVD risk. This has caused some to question whether the NCEP Step I and Step II diets are ideal for maximally reducing CVD risk [16].

In contrast to the NCEP Step I or Step II diet, a high-MUFA diet neither raises triacylglyceride nor lowers HDL-cholesterol concentrations. The finding that a high-MUFA diet favorably affects LDL-cholesterol as well as HDL-cholesterol and triacylglycerol concentrations [17] has important public health implications. Moreover, meta-analysis of many published studies indicates that dietary SFAs increase serum cholesterol while dietary PUFAs decrease serum cholesterol [18]. MUFAs and PUFAs are reported to decrease total cholesterol, LDL cholesterol, and HDL cholesterol by several mechanisms, including reducing LDL apolipoprotein B production rates and increasing HDL apolipoprotein A1 catabolism in monkeys [19]. Recently, the dietary guidelines by the Nutrition Committee of American Heart Association recommend replacing
SFAs by unsaturated fat, whether PUFAs or MUFAs [20] and limiting the intake of saturated fat to < 7% of energy, and cholesterol to < 300 mg per day by choosing lean meats and vegetable alternatives [21]. For this reason, this study evaluates the short-term effects of supplementation of poly- and monounsaturated fatty acids on the lipidemic metabolism of NG-fed elderly patient.

People at risk of cardiovascular disease should have their plasma concentrations of total and LDL cholesterol reduced. Controlled clinical trials have shown that a 1% reduction in total and LDL-cholesterol concentrations may lead to an approximately 1.5% decrease in the incidence of CVD [22,23]. Moreover, the risk of CVD is increased by 2-3% for every 0.026-mmol/L (1mg/dL) decrease in HDL cholesterol [24]. In addition, a 1-mmol/L increase in triacylglycerol is associated with a 14% increase in CVD risk in men and a 37% increase in women [25].

This study indicates that no significant differences became apparent as to the short-term (2-week) impact of different diets on blood lipidemic metabolism. Though the differences are not significant, when compared to the PUFA diet, the MUFA diet could induce lower triacylglyceride, total-cholesterol, LDL-cholesterol, and Apo B-1 levels, and higher HDL-cholesterol and Apo A-1 levels (Table 4). This suggests that a two-week feeding period may be too short to observe changes in plasma lipid fatty acid composition. The ratio of HDL-total plasma cholesterol in our study (Table 5) showed no significant difference between the two dietary oils, whereas in other studies with hamsters this ratio was found to be higher with olive oil [26]. This study observes that the MUFA diet and the PUFA diet seemed to have similar neutral impact on the resting blood pressure levels (Table 3) while the systolic pressure and the diastolic pressure appeared to be lower in the PUFA group. Several studies have indicated that PUFA is able to lower BP in humans, but issues of study design often hampers data interpretation [27].

In summary, the length of this study is restricted to two weeks, and the results obtained only allow for conclusions regarding to the effects observed during the time of the study. More lengthy intervention studies may be useful for assessment of the long-term efficacy of MUFA and PUFA.

Acknowledgement

The high PUFA sunflower oil and
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References:


25. Austin MA, Hokanson HE, Edwards


短期高含量單元或多元不飽和脂肪酸飲食之介入
對管灌老人脂質代謝的影響

趙佩君 1 顏啟華 2 黃建寧 3 王進崑 4

摘   要
血脂的異常或代謝障礙，是心血管疾病重要的醫療照護指標，飲食中脂肪的攝取量與種類，則會影響脂質之代謝，其與心血管疾病有極大之關連。本研究以交叉試驗設計進行，在插鼻胃管餵食的老年人隨機分成兩組，分別給予短期二週的高含量之單元不飽和脂肪酸及多元不飽和脂肪酸飲食，共有10位志願者（4位男性和6位女性，平均年齡為 74±2.0，體重指數 18.3±1.5 kg/m^2）參與本研究，每日個別接受1,800 大卡熱量。本研究介入飲食的脂質含量占總熱量的43%；其中一組給予高含量多元不飽和脂肪酸，占脂質含量的52%；另一組給予高含量單元不飽和脂肪酸，占脂質含量的42%；之後再交叉供應。結果顯示，經二週的飲食介入後，其血漿中總膽固醇、低密度脂蛋白膽固醇、高密度脂蛋白膽固醇、三酸甘油酯、高密度脂蛋白元A1及低密度脂蛋白元B等含量變化，無顯著性差異。顯示當給予相同熱量、相同脂肪攝取量時，高含量單元或高含量多元不飽和脂肪酸飲食的介入，對於管灌老人血脂的代謝並無顯著影響與差異。但是，在高含量單元不飽和脂肪酸的飲食介入組，血漿中有較低的總膽固醇、三酸甘油酯、低密度脂蛋白膽固醇、低密度脂蛋白元B和較高的高密度脂蛋白元A1濃度的趨勢；另外，在高含量多元不飽和脂肪酸的飲食介入組，則有較低的收縮壓和舒張壓之血壓值趨勢。
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關鍵詞: 單元不飽和脂肪酸、多元不飽和脂肪酸、交叉試驗、血脂質、心血管疾病