Management of Elevated Serum Cholesterol in a University-Based Family Practice

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Hypercholesterolemia is a well-known risk factor of coronary heart disease. This study was designed to determine whether a group of family physicians in an academic medical center followed recent recommendations in the recognition and treatment of young patients with elevated cholesterol levels.

Patient charts were reviewed retrospectively in 94.1 percent of the 1,129 patients aged between 30 and 39 years seen in the University of California at Los Angeles (UCLA) Family Health Center over a one-year period. Only 346, or 32.6 percent, of the charts reviewed contained the patient's cholesterol values. Ninety-nine patients had serum cholesterol levels greater than the recommended treatment level of 5.70 mmol/L (220 mg/dL). Of patients with elevated cholesterol levels, only 34.1 percent were treated. There was no difference in the treatment rates of faculty members' patients as compared with residents' patients. The incidence of treatment increased linearly with respect to rising cholesterol values.

This study identified the relative infrequency with which cholesterol levels appear in the charts of patients aged 30 to 39 years. It also illustrated that significantly more physician effort is required to meet suggested treatment guidelines for patients with elevated cholesterol levels. The cholesterol "normal ranges" that are reported on laboratory result sheets, which are not age-specific, may be misleading, and consequently affect patient care.

Coronary heart disease continues to be the major cause of death and disability in the United States. Several risk factors have been found to be associated with an increased risk of coronary heart disease, including cigarette smoking, high blood pressure, elevated serum cholesterol levels, male sex, increasing age, family history of coronary heart disease, obesity, diabetes mellitus, physical inactivity, and certain behavior patterns.

The Lipid Research Clinics Coronary Primary Prevention Trial (CPPT) provided conclusive evidence that the risk of coronary heart disease could be reduced by lowering elevated serum cholesterol levels.[1,2] The CPPT was a multicenter, randomized, double-blind study that followed 3,806 men, aged 35 to 59 years, with initial serum cholesterol levels greater than 6.85 mmol/L (265 mg/dL) and type II hyperlipoproteinemia. Individuals were assigned randomly to either a cholestyramine treatment group or to a placebo-control group for an average of 7.4 years. Both groups followed a moderate cholesterol-lowering diet.

The cholestyramine-treated group developed a 19 percent reduction in the risk of coronary heart disease ($P < .05$), defined as sudden cardiac death or nonfatal myocardial infarction, with average reductions in total cholesterol of 8 percent and reductions in low-density lipoprotein cholesterol of 12 percent. The latter is the lipoprotein subfraction most often associated with an increased risk of coronary heart disease. Additionally, a continuing linear relationship was noted between higher doses of cholestyramine and reductions in total cholesterol, low-density cholesterol, and coronary heart disease.

In December 1984, the National Institutes of Health held a Consensus Development Conference to develop physician guidelines for lowering blood cholesterol to help prevent heart disease.[3] They recommended that individuals with "high-risk cholesterol levels" (greater than the 90th percentile for age) be treated initially with intensive dietary therapy; if the cholesterol-reduction response is inadequate, appropriate lipid-lowering drugs should then

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be added. For individuals with "moderate risk cholesterol levels" (75th to 90th percentile for age), intensive dietary therapy should be sufficient, but drugs may be necessary. Cholesterol reference values and percentiles were derived from the Lipid Research Clinics Program in 1983.[4]

This study investigated men and women in the 30- to 39-year age group for whom the "moderate risk" cholesterol level (75th percentile) is 5.70 mmol/L (220 mg/dL), and the "high risk" level (90th percentile) is 6.20 mmol/L (240 mg/dL).[3,4] Cholesterol values exceeding 5.70 mmol/L (220 mg/dL) were considered elevated. The following questions regarding the recognition and management of patients with elevated cholesterol levels were investigated in this study:

1. What proportion of patient charts contained recently obtained normal and elevated cholesterol levels?
2. What proportion of patients with known elevated cholesterol levels are counseled or treated by faculty, fellows, and residents?
3. What were the mean cholesterol values at which patients were and were not treated by faculty, fellows, and residents?
4. Did the proportion of patients counseled or treated by their physicians increase with higher cholesterol values?
5. Did inappropriately high laboratory report sheet "normal ranges" appear to affect patient treatment?
6. What types of treatment were prescribed?
7. How often was hypercholesterolemia added to the patient chart problem list for patients with elevated cholesterol levels?
8. Which cholesterol level did surveyed physicians consider to be the optimal level to initiate treatment?

METHODS

The study site was the University of California at Los Angeles Family Health Center (UCLA-FHC), which is the outpatient medical clinic used in the UCLA Medical Center family medicine residency training program. Medical care at the UCLA-FHC is provided by family medicine faculty, fellows, and residents. A computer-generated list of all patients aged 30 to 39 years seen in the UCLA-FHC between September 1, 1985, and August 30, 1986, was used to select charts for audit. Each patient chart that could be located was examined for the notation of serum cholesterol levels obtained within the preceding three years. Those patients with elevated levels (greater than 5.70 mmol/L or 220 mg/dL) were studied further. Data collected from each patient chart included serum cholesterol level, patient age, sex, whether counseling or treatment was prescribed by the physician for the elevated cholesterol level, the type(s) of treatment prescribed, and whether hypercholesterolemia was added to the patient chart problem list.

To provide physicians with ample time to follow up on recently elevated values, patient charts were excluded from the study if cholesterol values were obtained within three months of the audit. Charts with cholesterol values that had not been obtained within three years were also excluded, as this study was designed to investigate current physician practice.

Serum cholesterol determinations may be ordered by the physician individually, as part of a lipid profile, or as a component of an automated chemistry panel. All measurements were determined in the UCLA clinical laboratory. Cholesterol results are received by physicians for review within three days of testing.

After chart data collection was completed, each physician was asked to answer the following question: "Given an otherwise healthy 35-year-old male or female patient seen in the UCLA-FHC for a routine medical problem, at which cholesterol level would you feel that dietary or drug therapy is indicated?"

The statistical analyses included determining the frequencies of treatment for patients with elevated cholesterol levels overall and within subgroups of different degrees of cholesterol elevation. Statistically significant differences between treatment rates were tested with chi-square analysis. A regression line and coefficient were created to compare patient treatment rates at different degrees of cholesterol elevation. Additionally, computations of the mean cholesterol levels of treated and untreated patients were tested for statistically significant differences by the use of Student's *t* test with determination of P values.

RESULTS

There were 1,129 30- to 39-year-old patients seen in the UCLA-FHC between September 1, 1985, and August 30, 1986. Of this group 1,062 charts (94.1 percent) were reviewed for cholesterol values obtained within three years. Three hundred forty-six (32.6 percent) charts contained cholesterol values, of which 99 (28.6 percent) were greater than or equal to 5.70 mmol/L (220 mg/dL). Eighty-eight charts met the criteria for inclusion in the study.

The number and percentage of patient charts with elevated cholesterol levels (greater than 5.70 mmol/L or 220 mg/dL) in which there was an indication that the physician prescribed cholesterol-lowering treatment is displayed in Table 1. Faculty and residents had identical overall treatment rates of 33.3 percent, while fellows treated 50 percent of patients with elevated cholesterol levels. No statistically significant differences existed in treatment rates between faculty, fellows, and residents.

Cholesterol values were subdivided into groups at 0.50-

TABLE 1. TREATMENT FREQUENCY FOR PATIENTS WITH ELEVATED CHOLESTEROL LEVELS (>5.70 mmol/L or >220 mg/dL)

Care Provider	Treatment Prescribed? Yes No. (%)	No No. (%)	Total No. (%)
Faculty	12 (33.3)	24 (66.7)	36 (100)
Residents	16 (33.3)	32 (66.7)	48 (100)
Fellows	2 (50)	2 (50)	2 (100)
All physicians	30 (34.1)	58 (65.9)	88 (100)

mmol/L (20 mg/dL) increments to compare treatment rates at different levels of cholesterol elevation. These values produce a near-linear relationship (Figure 1). A regression line was created with a slope of m = 0.511 and a correlation coefficient of $r = 0.835$.

The mean cholesterol levels at which treatment was and was not prescribed by faculty, residents, and fellows is shown in Table 2. The mean cholesterol level at which faculty patients were "treated" was 7.00 ± 1.45 mmol/L (270 ± 56 mg/dL), and the level of those who were "not treated" was 6.15 ± 0.40 mmol/L (237 ± 15 mg/dL). For residents, the corresponding cholesterol values were 7.20 ± 1.25 mmol/L (278 ± 48 mg/dL) and 6.25 ± 0.45 mmol/L (242 ± 18 mg/dL). For fellows, the values were 7.70 ± 2.85 mmol/L (298 ± 49 mg/dL) and 5.75 ± 0.10 mmol/L (223 ± 3 mg/dL), respectively. The mean cholesterol values of patients who were "treated" differed significantly from those who were "not treated" for the patients of faculty ($P < .05$), residents ($P < .01$), and fellows ($P < .05$). The mean cholesterol level at which all physicians combined "treated" patients was 7.15 ± 1.30 mmol/L (276 ± 50 mg/dL), while the mean cholesterol value of patients who were "not treated" was 6.10 ± 0.40 mmol/L (236 ± 15 mg/dL). These two values also differ significantly ($P < .01$).

The UCLA clinical laboratory result sheet reported the normal cholesterol range as 3.60 to 7.00 mmol/L (140 to 270 mg/dL). Treatment rates of patients with elevated cholesterol values greater than and less than or equal to 7.00 mmol/L (270 mg/dL) are compared in Table 3. Overall, the treatment rate for elevated values exceeding 7.00 mmol/L (270 mg/dL) was 75 percent, while for those patients with values less than or equal to 7.00 mmol/L, only 25 percent were treated. These treatment rates differ significantly ($P < .001$). The corresponding treatment rates for the patients of faculty members were 25 and 80 percent, and the rates for residents' patients were 70 and 23.7 percent, respectively.

The types of treatment prescribed by physicians are presented in Table 4. Dietary counseling was prescribed in 86.7 percent of treatment plans and was provided by the physician or dietician. Weight loss, repeat tests of cholesterol levels, exercise, and lipid-lowering drugs were used less frequently in treatment plans.

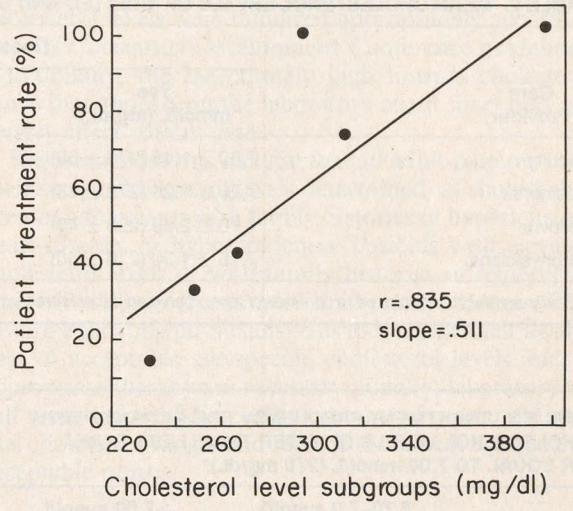

Figure 1. Patient treatment frequencies at different levels of cholesterol elevation (at 0.50-mmol/L or 20-mg/dL increments)

Hypercholesterolemia was seldom recorded (15.5 percent) in the patient chart problem list of patients with cholesterol elevations. Of patients treated, hypercholesterolemia was noted on 43.3 percent of their problem lists. The mean cholesterol level at which hypercholesterolemia was added to the problem list was 7.55 ± 1.65 mmol/L (292 ± 64 mg/dL) for all physicians combined, 8.40 ± 2.30 mmol/L (325 ± 89 mg/dL) for faculty only, and 7.20 ± 0.45 mmol/L (282 ± 17 mg/dL) for residents only.

The UCLA-FHC physicians were surveyed regarding the cholesterol level at which they would treat an otherwise healthy 35-year-old male or female patient. The optimal mean cholesterol level at which physicians felt that treatment should be initiated was 5.95 ± 0.55 mmol/L (230 ± 21 mg/dL) overall, 5.70 ± 0.45 mmol/L (220 ± 18 mg/dL) for faculty, and 6.20 ± 0.50 mmol/L (240 ± 20 mg/dL) for residents.

DISCUSSION

Hypercholesterolemia is a well-documented risk factor for the development of atherosclerotic coronary heart disease.[5-8] By identifying patients with elevated cholesterol levels at an early age, physicians may more effectively delay the progression of atherosclerosis. The American

TABLE 2. MEAN CHOLESTEROL LEVELS OF TREATED AND UNTREATED PATIENTS

Care Provider	Treatment Prescribed? Yes mmol/L (mg/dL)	No mmol/L (mg/dL)	*P* Value*
Faculty	7.00 ± 1.45 (270 ± 56)	6.15 ± 0.40 (237 ± 15)	<.05
Residents	7.20 ± 1.25 (278 ± 48)	6.25 ± 0.45 (242 ± 18)	<.01
Fellows	7.70 ± 2.85 (298 ± 49)	5.75 ± 0.10 (223 ± 3)	<.05
All physicians	7.15 ± 1.30 (276 ± 50)	6.10 ± 0.40 (236 ± 15)	<.01

** P values refer to differences in cholesterol levels between patients treated and not treated within each physician subgroup*

TABLE 3. TREATMENT FREQUENCY FOR PATIENTS WITH CHOLESTEROL LEVELS GREATER THAN, LESS THAN, OR EQUAL TO 7.00 mmol/L (270 mg/dL)*

	5.70–7.0 mmol/L (220–270 mg/dL) Treatment Prescribed?		>7.00 mmol/L (>270 mg/dL) Treatment Prescribed?	
Care Provider	Yes No. (%)	No No. (%)	Yes No. (%)	No No. (%)
Faculty	8 (25.8)	23 (74.2)	4 (80)	1 (20)
Residents	9 (23.7)	29 (76.3)	7 (70)	3 (30)
Fellows	1 (33.3)	2 (66.7)	1 (100)	0 (0)
All physicians	18 (25)**	54 (75)	12 (75)**	4 (25)

** Represents the laboratory's reported upper limit of normal*
*** Values differ significantly, P < .001*

TABLE 4. TYPE(S) OF TREATMENT PRESCRIBED FOR ELEVATED CHOLESTEROL LEVELS

Treatment	Number	Percent
Dietary therapy	26	86.7
Physician only	(10)	(38.5)
Dietician only	(4)	(15.4)
Physician and dietician	(12)	(46.2)
Weight loss	17	56.7
Repeat cholesterol level	11	36.7
Lipid subfractionation	11	36.7
Exercise	10	33.3
Lipid-lowering drugs	3	10

Heart Association has recommended that all healthy American children with known family histories of hyperlipidemia, hypertension, or premature vascular disease have their plasma lipids measured.[9] A 1984 NIH Consensus Development Conference on lowering blood cholesterol to prevent heart disease recommended that physicians measure the serum cholesterol levels of every adult patient when that patient is first seen.[3]

This study examined a group of young adults who could potentially benefit from reductions in elevated cholesterol levels. Of patient charts audited, only 32.6 percent contained serum cholesterol values, suggesting that as many as 67.4 percent of 30- to 39-year-old UCLA-FHC patients may have unknown cholesterol levels. Recommendations from the NIH Consensus Development Conference concluded that patients with serum cholesterol levels above the 75th percentile for their age group be given dietary or drug treatment. Thus, an estimated 25 percent of the 716 patients in this study with unknown cholesterol values (179 patients) may have elevated cholesterol levels that are not being treated. In addition, many patients with known elevated cholesterol levels did not receive treatment, as the chart review documented treatment in only 34.1 percent of such patients. Thus an additional 58 patients with elevated cholesterol levels were apparently not treated.

Overall, an estimated 237 study group patients may have been inadequately treated, while only 30 patients were known to have been appropriately treated, giving an estimated treatment rate of only 11.2 percent of patients with elevated cholesterol values. At the very least, this chart audit suggests that UCLA family physicians are not adequately identifying and treating patients with elevated serum cholesterol levels.

No treatment frequency differences were noted between the patients of faculty and residents with elevated cholesterol levels. Conclusions regarding the management behavior of the two groups of physicians are difficult to make, however, as differences in the respective patient groups could have influenced treatment incidences.

The mean cholesterol levels at which treatment was and was not prescribed differed significantly. As could be expected, a near-linear relationship was found to exist in which greater elevations of cholesterol led to higher patient treatment rates.

The normal range that appears on laboratory result sheets may influence physician behavior, as an elevated

value (greater than the upper limit of normal) is highlighted to bring it to the physician's attention. In this study, 75 percent of patients with cholesterol values above 7.00 mmol/L (270 mg/dL), the laboratory's upper limit of normal, were treated by their physicians; however, only 25 percent of patients with elevated levels of less than 7.00 mmol/L (270 mg/dL) were treated. The laboratory result sheet's normal reference range of 3.60 to 5.70 mmol/L (140 to 270 mg/dL) is inappropriately broad and not age specific. The laboratory should replace this inaccurate laboratory normal range with age-specific guidelines of acceptable cholesterol levels.

Dietary therapy was the most commonly prescribed treatment for hypercholesterolemia and should be the first line of therapy for any patient with an elevated cholesterol level. Physicians should familiarize themselves with the following general dietary treatment guidelines: (1) all Americans over 2 years of age should limit their fat intake to no more than 30 percent of total calories, (2) saturated fat intake should be less than 10 percent of total calories, (3) polyunsaturated fat intake should be increased but to no more than 10 percent of total calories, and (4) the total daily intake of cholesterol should be no more than 300 mg.[3]

A relatively small proportion of patients with elevated cholesterol levels had hypercholesterolemia added to their patient chart problem lists. This finding may reflect that physicians place inadequate emphasis on hypercholesterolemia as representing a significant medical problem. By increasing physician awareness of the condition, better patient care may result.

The survey results of UCLA-FHC physicians regarding optimal cholesterol treatment levels indicated a good physician understanding of appropriate treatment levels. A discrepancy exists, however, between what physicians considered to be optimal care and how actual patient care was charted. Previous studies have documented poor physician recognition and management of elevated cholesterol levels.[10,11]

A potential limitation of this retrospective chart review is that results are dependent on accurate physician charting. It also assumed that laboratory determinations of cholesterol levels are accurate, even though recent studies demonstrated wide variations in cholesterol level determinations using different laboratories or laboratory instruments.[12,13] Another potential study limitation is that patients may have had cholesterol levels previously determined elsewhere, or may have sought treatment elsewhere. Finally, this study assumed that the NIH Consensus Development Conference treatment guidelines are reasonable standards of optimal patient care.

In conclusion, this study revealed that a large proportion of young patients seen in an academic, hospital-based family medicine residency training clinic had no cholesterol levels recorded on their patient charts. It also demonstrated that relatively few patients with known elevated cholesterol levels were managed appropriately according to NIH Consensus Development Conference guidelines. Additionally, the inaccurately high normal cholesterol range that appears on the laboratory result sheet may adversely affect patient care.

Recommendations include that all adult patients have their serum cholesterol levels determined, as should children or adolescents with family histories of hypertension, heart disease, or hyperlipidemia. Patients with elevated cholesterol levels or with family histories of hyperlipidemia should have fractionated lipid profiles. Better efforts toward educating physicians so as to increase their awareness of acceptable age-specific cholesterol levels and of appropriate therapy are necessary. Finally, laboratory result reports should discontinue the use of inaccurate normal cholesterol ranges and replace those with age-specific acceptable ranges.

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