Relation Between Obesity and the Attainment of Optimal Blood Pressure and Lipid Targets in High Vascular Risk Outpatients

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Obesity is associated with hypertension, dyslipidemia, and diabetes, but it is also an independent cardiovascular risk factor. We sought to evaluate the differences in treatment patterns and attainment of guideline-recommended targets among high-risk vascular outpatients in relation to their body mass index (BMI). The prospective Vascular Protection and Guideline Orientated Approach to Lipid Lowering Registries recruited 7,357 high-risk vascular outpatients in Canada from 2001 to 2004. We stratified the patient population into 3 groups according to their BMI: normal weight (BMI <24.9 kg/m\textsuperscript{2}), overweight (BMI 25 to 29.9 kg/m\textsuperscript{2}), and obese (BMI >30 kg/m\textsuperscript{2}). We evaluated the rates of attainment for contemporary guideline targets of blood pressure (<140/90 or <130/80 mm Hg in the presence of diabetes) and lipids (low-density lipoprotein [LDL] <2.5 mmol/L [96.7 mg/dl] and total cholesterol [TC]/high-density lipoprotein [HDL] ratio <4.0). Of the 7,357 patients, 1,305 (17.7\%) were normal weight, 2,791 (37.9\%) overweight, and 3,261 (44.4\%) obese, as determined by the BMI. Obese patients were younger and more likely to have hypertension and diabetes (all p <0.001 for trend). Obese patients had higher baseline blood pressure, TC, LDL cholesterol, triglyceride levels and TC/HDL ratio, and lower HDL cholesterol. Obese patients were more likely to be treated with antihypertensive agents (p = 0.002), angiotensin-converting enzyme inhibitors (p = 0.024), angiotensin receptor blockers (p <0.001), and high-dose statin therapy (p = 0.001). On multivariable analyses, obese patients were less likely to attain the blood pressure (odds ratio 0.77, 95\% confidence interval 0.66 to 0.90, p = 0.001) and TC/HDL ratio (odds ratio 0.48, 95\% confidence interval 0.42 to 0.55, p <0.001) targets but not the LDL targets (odds ratio 0.89, 95\% confidence interval 0.78 to 1.03, p = 0.11). In conclusion, only a minority ambulatory patients at high cardiovascular risk achieved both guideline-recommended blood pressure and lipid targets, and this significant treatment gap was more pronounced among obese patients. Our findings underscore the opportunity to optimize the treatment of these high-risk patients. © 2010 Elsevier Inc. All rights reserved. (Am J Cardiol 2010;106:1270–1276)
Table 1
Demographics and clinical characteristics stratified by body mass index

<table>
<thead>
<tr>
<th></th>
<th>All Patients (n = 7,357)</th>
<th>BMI (kg/m²)</th>
<th>p Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;24.9 (n = 1,305)</td>
<td>25–29.9 (n = 2,791)</td>
<td>&gt;30 (n = 3,261)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>65 ± 11</td>
<td>68 ± 11</td>
<td>66 ± 11</td>
</tr>
<tr>
<td>Women</td>
<td>35.1%</td>
<td>39.2%</td>
<td>28.7%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>62.5%</td>
<td>52.5%</td>
<td>57.7%</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>57.8%</td>
<td>42.8%</td>
<td>50.8%</td>
</tr>
<tr>
<td>Family history</td>
<td>34.5%</td>
<td>33.2%</td>
<td>34.5%</td>
</tr>
<tr>
<td>Smoker</td>
<td>15.1%</td>
<td>18.7%</td>
<td>14.1%</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>52.4%</td>
<td>58.5%</td>
<td>58.0%</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>29.4%</td>
<td>32.7%</td>
<td>33.1%</td>
</tr>
<tr>
<td>Coronary artery bypass</td>
<td>16.3%</td>
<td>18.2%</td>
<td>18.7%</td>
</tr>
<tr>
<td>Percutaneous coronary intervention</td>
<td>12.8%</td>
<td>15.2%</td>
<td>14.3%</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>10.8%</td>
<td>15.4%</td>
<td>11.4%</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>13.3%</td>
<td>16%</td>
<td>14.3%</td>
</tr>
<tr>
<td>Heart failure</td>
<td>7.9%</td>
<td>8.9%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Creatinine (µmol/L)</td>
<td>92 ± 31</td>
<td>94 ± 35</td>
<td>93 ± 28</td>
</tr>
<tr>
<td>Alcohol use (drinks/wk)</td>
<td>None</td>
<td>49.7%</td>
<td>55.6%</td>
</tr>
<tr>
<td></td>
<td>Light, &lt;5</td>
<td>37.5%</td>
<td>33.5%</td>
</tr>
<tr>
<td></td>
<td>Moderate, 6–10</td>
<td>9.7%</td>
<td>7.8%</td>
</tr>
<tr>
<td></td>
<td>Heavy, &gt;10</td>
<td>3.1%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>81.8 (70.9, 93.6)</td>
<td>63.6 (57.3, 70)</td>
<td>78 (70.9, 84.6)</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>101 (92, 110)</td>
<td>87 (81, 92)</td>
<td>97 (92, 103)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>168 (160, 174)</td>
<td>167 (159, 173)</td>
<td>169 (161, 175)</td>
</tr>
<tr>
<td>Heart rate (beats/min)</td>
<td>72 (66.78)</td>
<td>71 (64.76)</td>
<td>71 (64.76)</td>
</tr>
<tr>
<td>Systolic blood pressure (mm Hg)</td>
<td>132 (120, 140)</td>
<td>130 (120, 140)</td>
<td>131 (120, 140)</td>
</tr>
<tr>
<td>Diastolic blood pressure (mm Hg)</td>
<td>76 (70, 80)</td>
<td>74 (70, 80)</td>
<td>76 (70, 80)</td>
</tr>
</tbody>
</table>

Data are presented as mean ± SD or median (twenty-fifth, seventy-fifth percentile).

* p for trend.

in ambulatory patients stratified by body mass index (BMI); (2) treatment patterns in relation to BMI in two Canadian high vascular risk patient registries.

Methods

The present study was a cross-sectional analysis of the prospective observational Guidelines Orientated Approach to Lipid Lowering (GOALL) and Vascular Protection (VP) registries. The objectives of these registries were to examine clinical management practices and identify gaps between the patient care recommended in guidelines and that delivered in the “real world.” Overall, 278 physicians participated in the VP registry and 254 in the GOALL registry. The registries had no exclusion criteria, and the physicians were encouraged to enroll consecutive patients. The present study included only those patients with established cardiovascular disease or diabetes.

The participating physicians collected all data using standardized case report forms. The data collected included patient demographics, cardiovascular risk factors, history of atherosclerotic disease, medication use, height, weight, heart rate, blood pressure, routine blood work values, and medication use.

Plasma lipid measurements were performed in commercial laboratories, as part of routine clinical practice. Fasting plasma glucose and a complete lipid profile, including TC, low-density lipoprotein (LDL) cholesterol, HDL-C, and triglycerides (TG), were collected within 6 months of study entry. Patients with familial hypercholesterolemia (TC >9.4 mmol/L [363.5 mg/dl], LDL cholesterol >6.8 mmol/L [263 mg/dl], and/or TG >4.5 mmol/L [394 mg/dl]) were excluded from the present analysis, because it would have precluded calculation of LDL cholesterol using the Friedewald formula. Blood pressure, waist circumference, and height and weight measurements were recorded by the phy-
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The present analysis, the primary outcome measure was the attainment of the guideline-recommended lipid LDL cholesterol goal (<2.5 mmol/L [97 mg/dl]) and blood pressure targets (<140/90 mm Hg or <130/80 mm Hg for diabetic patients). Secondary outcome measures included a TC/HDL cholesterol ratio <4.0, TG <2.0 mmol/L (177 mg/dl), and the use of antiplatelet, antihypertensive, and lipid-modifying agents.

The patient population was stratified into 3 groups according to their BMI: normal weight (BMI ≤24.9 kg/m²), overweight (BMI 25.0 to 29.9 kg/m²), and obese (BMI ≥30 kg/m²). To determine whether our results would be different using other anthropometric measures of obesity, we repeated our analysis using the waist circumference. The population was stratified into 3 groups: normal (waist circumference <93.9 cm for men and 79.9 cm for women), overweight (waist circumference 94 to 101.9 cm for men and 88 cm for women), and obese (waist circumference >102 cm for men and 88 cm for women). The statin dose was classified as low, standard, and high using previously published criteria.

Continuous variables are summarized as medians with the twenty-fifth and seventy-fifth percentiles (or means ± standard deviation for normally distributed data), and group comparisons were made using the t test or analysis of variance. Categorical variables are presented as percentages and were compared using the chi-square test. We used Kendall’s tau-b and chi-square test for trend for the contin-
uous and categorical variables, respectively. We performed multivariable logistic regression analysis to determine the factors associated with attainment of the blood pressure and lipid targets. From the results of previous studies and bivariate analyses, the predictor variables considered in the models were age, gender, alcohol use, smoking, diabetes, previous coronary revascularization, history of coronary artery disease, history of heart failure, and use of antihypertensive, statin, and other lipid-modifying drugs. We report the adjusted odds ratios with 95% confidence intervals. We performed statistical analyses using the Statistical Package for Social Sciences, version 12.0 (SPSS, Chicago, Illinois). A 2-sided probability value of <0.05 was considered statistically significant.

Results

Of the 7,357 patients in the present study, 1,305 (17.7%) were normal weight, 2,791 (37.9%) overweight, and 3,261 (44.4%) obese based on BMI. The patient demographics and clinical characteristics are summarized in Table 1. Compared to the normal weight and overweight groups, the obese patients were younger and more likely to have a history of hypertension and diabetes (p < 0.001). In contrast, the obese patients were less likely to have a history of coronary artery disease, peripheral vascular disease, or cerebrovascular disease (p < 0.001). Obese patients had higher resting heart rate, systolic and diastolic blood pressure.

The medication use and lipid profiles for the 3 groups are summarized in Table 2. Obese patients had higher TC, LDL cholesterol, TG, TC/HDL cholesterol and lower HDL cholesterol. Obese patients were significantly less likely to have received treatment with any antplatelet agent (p = 0.011). No significant difference was found among the 3 groups with respect to treatment with any lipid-modifying medication or statins. The obese patients were more likely to be treated with nonstatin lipid-modifying therapy (p < 0.001). Of those patients treated with statins, the obese patients were significantly more likely to be treated with a high dose. Obese patients were also more likely to be treated with antihypertensive medications (p = 0.002), angiotensin-converting enzyme inhibitors and angiotensin receptor blockers (p < 0.001) but less likely to be treated with β blockers (p = 0.006).

Overall, only 46.6% of patients achieved the target LDL cholesterol goal of <2.5 mmol/L (97 mg/dl) and 42.4% attained the blood pressure target of <140/90 mm Hg (<130/80 mm Hg for diabetic patients). Figures 1 and 2 show the percentages of patients attaining the targets in the 3 groups. Obese patients were less likely to achieve the target LDL cholesterol (p = 0.021), TG (p < 0.001), TC/HDL cholesterol ratio <4.0 (p < 0.001), and blood pressure

Table 3

Multivariable analysis: factors associated with attainment of blood pressure <140/90 mm Hg (130/80 mm Hg for diabetic patients)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted OR (95% CI)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;65 Referent group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65–75</td>
<td>0.90 (0.79–1.02)</td>
<td>0.11</td>
</tr>
<tr>
<td>&gt;75</td>
<td>0.80 (0.69–0.94)</td>
<td>0.05</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25 Referent group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25–29.9</td>
<td>0.91 (0.78–1.07)</td>
<td>0.25</td>
</tr>
<tr>
<td>&gt;30</td>
<td>0.77 (0.66–0.90)</td>
<td>0.001</td>
</tr>
<tr>
<td>Antihypertensive agents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None Referent group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1.41 (1.17–1.70)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2</td>
<td>1.46 (1.21–1.77)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>≥3</td>
<td>1.20 (0.98–1.48)</td>
<td>0.08</td>
</tr>
<tr>
<td>Heart failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.90 (1.54–2.34)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.17 (0.16–0.20)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.36 (0.32–0.41)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
</tbody>
</table>

CI = confidence interval; OR = odds ratio.
Table 4
Multivariable analysis: factors associated with attainment of total cholesterol/high-density lipoprotein (TC/HDL) cholesterol ratio <4.0

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted OR (95% CI)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;65 Referent group</td>
<td>1.49 (1.34–1.67)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>65–75</td>
<td>1.75 (1.53–2.00)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25 Referent group</td>
<td>0.88 (0.79–0.98)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>25–29.9</td>
<td>0.91 (0.81–1.02)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>≥30</td>
<td>1.11 (1.01–1.22)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Statin dose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None Referent group</td>
<td>1.47 (1.30–1.67)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Low dose</td>
<td>1.94 (1.76–2.15)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Standard dose</td>
<td>2.44 (2.19–2.74)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>High dose</td>
<td>3.05 (2.81–3.32)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Nonstatin medications</td>
<td>0.70 (0.62–0.80)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Women</td>
<td>1.56 (1.40–1.74)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Previous coronary artery bypass grafting</td>
<td>1.26 (1.12–1.41)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>or percutaneous coronary intervention</td>
<td>1.26 (1.12–1.41)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol use</td>
<td>1.23 (1.14–1.33)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Current smoker</td>
<td>1.09 (1.02–1.17)</td>
<td>0.007</td>
</tr>
</tbody>
</table>

Abbreviations as in Table 3.

Table 5
Multivariable analysis: factors associated with attainment of low-density lipoprotein (LDL) cholesterol <2.5 mmol/L

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted OR (95% CI)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;65 Referent group</td>
<td>1.23 (1.10–1.37)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>65–75</td>
<td>1.23 (1.10–1.37)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25 Referent group</td>
<td>0.95 (0.83–1.09)</td>
<td>0.45</td>
</tr>
<tr>
<td>25–29.9</td>
<td>0.90 (0.78–1.03)</td>
<td>0.11</td>
</tr>
<tr>
<td>≥30</td>
<td>1.19 (1.10–1.30)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Statin dose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None Referent group</td>
<td>1.15 (1.05–1.26)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Low dose</td>
<td>1.41 (1.27–1.67)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Standard dose</td>
<td>2.17 (1.96–2.41)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>High dose</td>
<td>2.71 (2.38–3.09)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Women</td>
<td>0.78 (0.70–0.86)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1.59 (1.42–1.78)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Previous coronary artery bypass grafting</td>
<td>1.45 (1.27–1.66)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>or percutaneous coronary intervention</td>
<td>1.45 (1.27–1.66)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>1.14 (1.02–1.28)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Abbreviations as in Table 3.

Discussion

Overall, fewer than half of the 7,357 high vascular risk ambulatory patients achieved the contemporary guideline-recommended blood pressure and lipid targets in these large, prospective registries. Obese patients were less likely to achieve these targets than the normal and overweight patients. After adjustment for other confounders, the obese patients remained less likely to attain the blood pressure and TC/HDL cholesterol but not LDL cholesterol targets. To the best of our knowledge, the present study is the first to show that obese high vascular risk patients are less likely to achieve guideline-recommended lipid and blood pressure targets.

Current obesity treatment guidelines have emphasized control of cardiac risk factors. However, no studies to date have examined obesity in relation to the attainment of recommended targets in a high vascular risk population. Our study has provided new information regarding the “real world” treatment of these outpatients. Molenaar et al13 found that the prevalence of hypertension, dyslipidemia, and diabetes increased with obesity in patients without known cardiovascular disease. Obese patients were more likely to be treated for hypertension and dyslipidemia but did not differ in the attainment of guideline-recommended targets. Our study showed a similar trend toward a greater prevalence of diabetes, hypertension, and dyslipidemia in obese patients, albeit at greater rates than seen in previous studies.20 However, our observation that obese patients were less likely to have a history of cardiovascular disease likely reflects a selection bias owing to the inclusion criteria of the registries, which required either the presence of cardiovascular disease and/or diabetes, which is strongly associated with obesity. The latter inclusion criterion might have led to selective enrollment of more obese diabetic patients without known cardiovascular disease.

The finding that <1/2 the patients in our study attained the blood pressure and lipid targets is significant and signifies important treatment gaps. Other investigators have reported similar findings.10,20,21 Nevertheless, none of these studies specifically examined whether obese patients were more or less likely to achieve the lipid and blood pressure targets. In our study, only 21.4% of patients attained both LDL cholesterol and blood pressure targets. This obvious treatment gap was more pronounced in obese patients, with only 17.3% attaining both targets. Treatment differences alone could not account for this gap, because the obese patients in our study were more likely to be treated with antihypertensive agents, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, and nonstatin lipid-modifying agents. That fewer obese patients attained the targets of therapy for blood pressure and the TC/HDL cholesterol ratio likely reflects the difficulty in managing the risk factors in these patients, who are often resistant to therapy and might require combined drug therapy, as well as lifestyle interventions. Obese patients were more likely to receive treatment with high-dose statin therapy. This more
intensive treatment in obese patients could also reflect the difficulty physicians encountered in enabling obese patients to attain their lipid targets. This is supported by the multivariable analysis, which actually showed that treatment with the highest statin dose resulted in a similar odds ratio for achieving the target LDL cholesterol compared to the medium doses. The same association was seen for hypertension.

Our results do not seem to support the notion that obese patients are more aggressively treated than normal weight patients. The “obesity paradox” has been documented in a number of clinical settings. Many of these studies postulated more aggressive treatment as an explanation for the paradox. In the present study, the obese patients were more likely to be treated with antihypertensive agents, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, and nonstatin lipid-modifying agents. However, no difference was seen in the treatment with aspirin or statin medications, and obese patients were less likely to be treated with β blockers.

A number of recent studies have suggested that the waist circumference or waist/hip ratio might be a more accurate measure of visceral obesity than the BMI. INTERHEART, which included 27,098 participants in a case-control study of patients worldwide, demonstrated that the association between BMI and myocardial infarction was attenuated after adjustment for the waist/hip ratio and other factors. In contrast, the associations between both the waist/hip ratio and the waist circumference with myocardial infarction were still significant after adjustment for BMI and other confounders. Another study documented that the waist/hip ratio and waist circumference, but not the BMI, were predictors of cardiovascular mortality after adjustment for Framingham risk scores. Our sensitivity analysis indicated that obese patients (classified according to the waist circumference) were also less likely to achieve the optimal target blood pressure and TC/HDL cholesterol ratio, but not LDL cholesterol, than were nonobese patients.

The present study had several limitations. First, the participating physicians were not randomly selected, and a selection bias might have been present because of the inclusion criteria for patients in these registries. To address this concern, the inclusion criteria were broad, and the physicians were encouraged to enroll consecutive patients. Second, lipid profiles and the measurements of blood pressure, height, weight, and waist circumference were based on individual physician reporting. Although these measurements were not validated using a standardized method, they did reflect routine clinical practice. Third, we did not have information regarding the implementation of lifestyle modifications. Patients’ diet and level of physical activity might have confounded the effect of obesity on the attainment of targets. Finally, we did not collect data on the duration of treatment or adherence to medications.

Our results have demonstrated that obesity appears to be an independent risk factor for the failure to attain the target blood pressure and TC/HDL cholesterol ratio targets. With the increasing prevalence of obesity, strategies at eliminating this treatment gap are imperative. Additional studies should elucidate the factors that underlie the link between obesity and the failure to achieve the targets. Obese patients might inherently have more severe hypertension, dyslipidemia, and diabetes that are more difficult to control. However, more aggressive treatment with pharmacologic agents might not be adequate. Although causality could not be established in our observational study, it appears that a combination of pharmacologic and lifestyle therapies might be the best approach to narrow this treatment gap. Our results suggest that quality improvement projects should be directed at high vascular risk outliers, particularly those who are obese, to eliminate the existing treatment gaps.

Acknowledgment: We thank Sue Francis for her secretarial assistance, and all the patients and investigators who participated in the GOALL and VP registries.


