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CAN ADULT CARDIOLOGISTS PLAY A ROLE IN THE PREVENTION OF HEART DISEASE BEGINNING IN CHILDHOOD?

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Foreword

For 38 years, Dr. Gerald Berenson, through his Bogalusa Heart Study, has meticulously and scientifically proven that atherosclerosis has its origin in early life. These lesions may accelerate in adulthood, but they begin much earlier and therefore prevention must begin in childhood. The Bogalusa Heart Study has not only documented these facts but also has implemented these findings into a cohesive program that can be implemented by physicians, teachers, and children — our future patients. We as physicians mend but often fail to prevent disease. This study, second in longevity only to the Framingham Study, has spawned staggering data, producing more than 1,000 publications and 4 books. It has been recognized appropriately not only nationally but internationally as well.

At 88 years of age, Dr. Gerald “Pops” Berenson is only getting started. He has been a source of great pride to me as well as a professional inspiration and challenge. His lifetime of hard work has and will continue to improve the quality of life for all future generations.

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Background

When Dr. William Winters, editor of this journal, asked if I would write an article on prevention, I was both honored and very pleased. I have respected Dr. Winters for years, beginning with an association in the American College of Cardiology (ACC). I was aware of his leadership role in the ACC and certainly in Houston; in fact, I have a picture of him and Dr. Suzanne Knobel giving me an award at an ACC meeting years ago, only to be beaten out by an award to Dr. DeBakey and his colleagues for research on aneurism repair. It is also an honor to be able to write an article for this journal since Dr. DeBakey was a graduate from Tulane; I used to see him visiting Dr. George Burch, for whom I was working as a fellow, beginning in 1948 when I got out of the Navy. Dr. DeBakey traveled through New Orleans in his military uniform on his way to Houston. And it

was Dr. Burch’s assistant, Lois DeBakey, sister of Dr. DeBakey, who helped keep us fellows in line and who edited our manuscript to make them as good as possible. Her training has stood the test of time in my career. I am grateful to her.

Introduction

As I view it, preventive cardiology, as important as it is, is a hard sell. For the past 2 decades, we have been advocating prevention beginning in childhood, and some aspects are just catching on due to the epidemic of obesity in both children and adults and the horrible increase in type 2 diabetes mellitus.¹ The diabetologists are now emphasizing cardiovascular risk factors, while the cardiologists are recognizing the impact of diabetes on cardiovascular-renal disease and the need for controlling hypertension as much as controlling glucose

levels. Further, prevention, both primary and secondary, has expanded tremendously with the availability of numerous drugs directed to specific risk factors, like hypertension or dyslipidemia, and new technologies and instrumentation to diagnose and treat heart disease patients. It should be noted, however, that much of this is directed towards advanced cardiovascular disease in middle-aged and older individuals.

An initial leap forward for cardiologists came with the pioneering work of Goldstein and Brown,² which led to the statins and subsequent clinical trials showing the effect of lowering low-density lipoprotein cholesterol (LDL-C) on related morbidity and mortality. The Coronary Drug Project's use of niacin along with clofibrate⁽³⁾ much earlier set a background for focusing attention on triglycerides, very low-density lipoproteins (VLDL-C), and low high-density lipoprotein (HDL-C). All of these lipoproteins are now considered an integral part of the cardiometabolic syndrome — a cluster of interrelated risk factors that emphasize obesity and insulin resistance as the underlying features. Now we understand better that central (visceral) fat tissue is an active endocrine organ involved in dysregulation of inflammatory, metabolic, and hemodynamic processes.

Equally impressive advances have been made in the management of hypertension and heart failure with a vast array of drugs. The Framingham Heart Study, which showed the importance of controlling systolic hypertension especially in the aged, changed the old concept that high levels of blood pressure are needed for blood flow through rigid arteries. The early Cooperative Veterans Administration Study on Hypertension, lead by Edward Fries, was a landmark study showing the effectiveness of lowering blood pressure levels.⁴ Now, the dramatic clinical picture of "malignant" hypertension is seldom seen. The evolution of progressively lowering the threshold levels of blood pressure indicated for treatment by the Joint National Commission underscores the progress. The current concepts of prehypertension and the stages of hypertension provide new guidelines for drug intervention.⁵ However, an erroneous focus on prehypertension as a precursor of the disease process shows a lack of emphasis on beginning early prevention, even when "silent" changes of the cardiovascular system are already present^{6,7} and can be detected by noninvasive studies of vascular stiffness and compliance.

Rationale for Preventive Cardiology

Based on currently available information, cardiologists should assume a leadership role and responsibility in prevention approaches. Cardiologists best under-

stand the outcome from heart disease and the need for prevention, both medically and socially; they see end-stage CV disease and the ravages from heart disease. Yet there is still a lack of emphasis on prevention beginning at a younger age, when underlying CV disease is asymptomatic and progressively developing. The studies on carotid intima-media thickness, coronary calcification, and coronary atherosclerosis by noninvasive procedures have clearly shown asymptomatic atherosclerosis and vascular disease to be quite prevalent at a young age in our society. Our cardiology literature abounds with this information.

There are now 3 large, ongoing, long-term studies beginning in childhood and extending into young adulthood and middle age.⁸⁻¹⁰ These studies have provided data clearly showing that risk factors can be identified in childhood and are predictive of adult levels and related to CV system changes. Importantly, autopsy studies dramatically show evidence of coronary artery disease and hypertension changes of the vascular system in young soldiers killed in the Korean and Vietnamese wars.^{11, 12} The majority, perhaps 70%, of young soldiers showed significant atherosclerosis of coronary arteries occurring in the third decade of life. Two later autopsy studies, the Bogalusa Heart Study (BHS)¹³ and the Pathologic Determinants of Atherosclerosis in Youth (PDAY),^{14, 15} have shown a strong relation between risk factors and actual lesions in the CV system. In the BHS, a strong and highly significant correlation was noted between the acceleration and severity of coronary and aorta atherosclerosis and the increasing numbers of risk factors.^{16, 17} Some of the other germane findings from the BHS can be summarized to emphasize the need to begin prevention in early life. Risk factors change with age, growth, and maturation of children. They differ by race and sex and should be treated as a continuum with no threshold effect. Any thresholds for abnormalities need to be age, race, sex, and specific population, perhaps percentiles, rather than cutpoints that have mostly been taken from adult experience and are difficult to extrapolate to childhood levels. Two examples are "prehypertension" in the range of 135/80 or an LDL-C of 130, now lowered to 100 or even 70 mg/dL for adults. The average serum total cholesterol level at the childhood age is 165 mg/dL, and this level will increase 40–50 mg/dL as individuals become adults.

In childhood just as in adulthood, risk factors occur in constellation — a condition called metabolic syndrome.^{18, 19} Obesity and insulin are the driving forces of the myriad variables associated with body fatness, and that obesity is productive of an inflammatory response. Our long-term studies on children show that obesity

precedes hyperinsulinemia/insulin resistance,²⁰ and childhood obesity, rather than insulin resistance, predicts metabolic syndrome in adulthood.²¹ Obesity in childhood is the most consistent risk factor predictive of adult CV system changes — cardiac enlargement and evidence of vascular stiffness.^{22, 23} Coupled with hypertension, obesity in childhood is predictive of increased ventricular end-diastolic diameter and early heart failure.²⁴ Further, obesity is strongly related to carotid intima-media thickness, a surrogate measure of coronary artery disease.²⁵

Adulthood prediabetes and type 2 diabetes can be predicted from childhood fasting glucose levels in the upper normoglycemic range, especially with a parental history of diabetes.²⁶ Blacks have more progressive CV disease beginning in childhood, starting with higher blood pressure levels; after puberty, a profound degree of obesity occurs in black girls. Electrolyte handling, lower renin, and less urinary potassium excretion in blacks are noted as interesting racial contrasts important to prevention and management of hypertension.²⁷ Dietary studies even show a relation between certain types of food intake and the cardiometabolic syndrome.²⁸ Perhaps lifestyle behavior is even more important in terms of heart disease, and changes should begin in early life.²⁹

There are other risk-factor findings of interest to adult clinical medicine, but the above observations demonstrate the need to begin prevention in childhood and potential areas to address prevention. For the most successful outcomes from prevention of adult CV disease, prevention has to be “primordial” — before risk factors evolve and have a chance to adversely affect the CV system and lead to later CV events.³⁰ This admonition comes from Rose’s statement of “sick individuals and sick populations.”³¹

Current Approaches to Preventive Cardiology

The above background and considerations — and the evolution of treatment with a variety of drugs, medical, and surgical advances — have provided cardiologists and surgical colleagues with some comfort of practicing prevention. Despite the advances outlined, the urgency to expand prevention has been limited since it doesn’t pay. Even though many clinical trials have shown the value of primary (control of risk factors) and secondary (intervention on individuals with overt cardiac disease) prevention, the trials remain the area of emphasis, especially secondary prevention by cardiologists.

Recommended Strategies Of Prevention

We have had the opportunity to develop 2 strategies of prevention. The first is a public health model for health promotion for children called “The Health Ahead/Heart Smart program,” a K–6 comprehensive health education program for school children.³²⁻³⁵ The program addresses all components of the school environment and includes the health of teachers and parents as role models. It advocates involvement of doctors, the community, and medical institutions. The second strategy is a clinical model for high-risk individuals called the “Family Health Promotion Program.” Families are identified from individuals with known cardiac disease or identified with abnormal risk factors.^{36, 37} It is especially important to identify children of parents who have had heart attacks by age 60 or have hypertension, diabetes, or other risk factors.³⁸ The application of the education program for children in schools has now successfully been applied to an entire geographic area, a parish (county) in Louisiana representing approximately 5,000 children, even helping to control obesity and improving one-quarter mile run times.³⁹

The Role of Adult Cardiologists

One might ask, “Why should adult cardiologists be involved in primordial prevention?” The answer is that they have the knowledge and background. The appropriate question is “How can the adult cardiologist help with ‘primordial’ prevention beginning in childhood?” Through their leadership, they can encourage schools to incorporate health education into the general curriculum where their children or grandchildren go to school. Cardiologists can help with in-service training of teachers on risk factors and discuss the importance of healthy lifestyle and heart disease in our society. The message of the Bogalusa Heart Study is that heart disease begins in childhood. The comprehensive health education of elementary school children beginning in kindergarten that addresses social and medical problems (i.e., obesity, smoking, dropout, and teen pregnancy as well as nutrition and physical activity) can be successful.⁴⁰

Perhaps a more direct role is through their patients. Adult cardiologists need to encourage the spouses of their patients and their families, including children, to have risk factor profiles performed and enter into a prevention program. Since prevention clinics are not economically productive and may be lacking, cardiologists could encourage development of a prevention clinic incorporated into the section of adult cardiology with cooperation from pediatricians and primary care physicians. Clinics are being promoted by paraprofes-

sionals for specific and limited areas such as obesity and exercise, but these need to be more general and under medical care. If necessary, vascular noninvasive methodologies need to be incorporated to relate to both a Framingham score and a vascular score.⁴¹

Our Family Health Promotion model uses a cardiologist or nurse oriented in CV disease to lead a team of nutritionists, exercise specialists, and behavioral-oriented professionals.^{36,37} We find it important to have a multidisciplinary team address families or groups of families together, using a “Weight Watchers” or “Alcoholics Anonymous” group style. Family members are addressed by the team weekly over a period of 10–12 weeks. All members have a risk factor profile, including children. A physician discusses risk factors with the group and individually as needed, and sessions are provided on diet, food purchasing, menu planning, and other lifestyle modifications. The importance of physical activity and appropriate exercise, tobacco use, side stream smoke, the effects of alcohol on blood pressure, etc., are also part of the training program. Repeated observations of family members help to determine easily recognizable changes, such as weight, blood pressure, and lifestyle. Cardiologists can play a major role by referring their patients and families into such a program.

Both models have been fully developed by our group and have been shown to be successful in having an effect on obesity, hypertension, and tobacco use. Marked dyslipidemia, risk factors related to diabetes, and severe hypertension, although aided by improved lifestyles, require usual medical management. The intensity and thoroughness of applying the interventions as described over time have an impact on the effectiveness of the program.

Conclusion

The message of the BHS is that heart disease, atherosclerosis, hypertension, and diabetes begin in childhood. Lifestyles and behaviors that influence heart disease also begin in childhood. Some of the energy directed toward drugs and cardiac intervention, while critically important in caring for patients with advanced heart disease, needs to be directed toward asymptomatic individuals and children who are also at risk. As long as heart disease remains the major cause of mortality and economic burden to our society, it is incumbent upon cardiologists to provide leadership in educating the population, especially children, on prevention.

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