19. Screening for Diabetes Mellitus

RECOMMENDATION

There is insufficient evidence to recommend for or against routine screening for diabetes mellitus in asymptomatic adults. There is also insufficient evidence to recommend for or against universal screening for gestational diabetes. Although the benefit of early detection has not been established for any group, clinicians may decide to screen selected persons at high risk of diabetes on other grounds (see ***Clinical Intervention***). Screening with immune markers to identify persons at risk for developing insulin-dependent diabetes is not recommended in the general population.

Burden of Suffering

Approximately 14 million persons in the U.S. have diabetes mellitus.[1] Non-insulin-dependent diabetes mellitus (NIDDM) or Type II diabetes accounts for 90–95% of all cases of diabetes in the U.S., while insulin-dependent diabetes mellitus (IDDM) or Type I diabetes accounts for the remaining 5–10%.[1–4] An estimated half of all persons with diabetes (primarily patients with NIDDM) are currently unaware of their diagnosis.[2] Diabetes may cause life-threatening metabolic complications, and is the seventh leading cause of death in the U.S., contributing to roughly 160,000 deaths each year.[1,3] It is also an important risk factor for other leading causes of death such as coronary heart disease and cerebrovascular disease.[4] Diabetes is the most common cause of polyneuropathy, with approximately 50% of diabetics affected within 25 years of diagnosis,[5] and is responsible for over 50% of the 120,000 annual nontraumatic amputations in the U.S.[6] Diabetic nephropathy is now the leading cause of end-stage renal disease in the U.S.[7] and, if current trends continue, will soon account for 50% of all patients with renal failure.[8] Diabetes is the leading cause of blindness in adults ages 20–74 and accounts for over 8,000 new cases of blindness each year.[9] Infants born of diabetic women are at increased risk of fetal malformation, prematurity, spontaneous abortion, macrosomia, and metabolic derangements.[10,11] Compared to persons without diabetes, diabetic patients have a higher hospitalization rate, longer hospital stays, and increased ambulatory

care visits.[3,12] The total annual economic burden of diabetes is believed to approach $100 billion in the U.S.[13]

The onset of NIDDM is usually after age 30, and the prevalence steadily increases with advancing age. It is estimated that nearly 20% of the U.S. population aged 65–74 has diabetes.[2] The prevalence of NIDDM is markedly increased in Native Americans and is also higher among black and Hispanic populations.[3] The prevalence of NIDDM is greater than 70% in Pima Indians 55 years of age and older.[14] Other risk factors for diabetes include family history, obesity, and a previous history of gestational diabetes or impaired glucose tolerance. IDDM has an earlier onset (usually before age 30), a much shorter asymptomatic period, and a more severe clinical course than NIDDM.

Gestational diabetes mellitus (GDM), the development of glucose intolerance during pregnancy, occurs in 3–5% of all pregnancies and is the most common medical problem of pregnancy.[3,15] Risk factors for GDM include obesity, increased maternal age, hypertension, glucosuria, a family history of diabetes, and a history of a macrosomic, stillborn, or congenitally malformed infant. GDM is a risk factor for fetal macrosomia and is associated with other neonatal complications, such as hyperbilirubinemia and hypoglycemia. Macrosomia—most commonly defined as birth weight above 4,000 or 4,500 g—is not itself a morbid condition but is associated with increased risk of operative delivery (cesarean section or vacuum or forceps delivery) and birth trauma (e.g., clavicular fracture, shoulder dystocia, and peripheral nerve injury).[16–19] In some series, the incidence of shoulder dystocia in infants over 4,000 g is close to 2%.[20] Women with a history of GDM are also at increased risk for developing NIDDM later in life.[21]

Accuracy of Screening Tests

The diagnosis of diabetes in many nonpregnant patients is based on typical symptoms (polyuria, polydypsia) in association with clear elevation of glucose (fasting plasma glucose > 140 mg/dL [7.8 mM]). Many asymptomatic persons, however, may have abnormal glucose metabolism and be at increased risk for complications of diabetes.

Diagnosis of Diabetes in Asymptomatic Persons. The National Diabetes Data Group (NDDG)[22] and World Health Organization (WHO)[23] have issued similar criteria for diagnosing diabetes in asymptomatic persons, based on elevated fasting plasma glucose (>140 mg/dL) or an abnormal plasma or serum glucose using a 2-hour 75 g oral glucose tolerance test (OGTT). NDDG criteria for a positive OGTT (> 200 mg/dL at 2 hours and before 2 hours) differ slightly from WHO criteria (glucose > 200 mg/dL at 2 hours alone). Abnormal glucose measurements on more than one occasion are required for a diagnosis of diabetes.[22,23] The complex diagnostic criteria

reflect both the difficulty in distinguishing diabetic from nondiabetic patients on the basis of a single measurement, and the substantial test-retest variability of the OGTT. The coefficient of variation for OGTT ranges from 20% to 35%.[24,25] To improve reliability of the OGTT in nonpregnant adults, the American Diabetes Association (ADA) recommends that patients eat an unrestricted diet for 3 days preceding the test and fast overnight before the test.[26]

Both the NDDG and WHO recognize an intermediate form of disordered glucose metabolism, impaired glucose tolerance (IGT), based on intermediate results of the OGTT (140–200 mg/dL).[22,23] Patients with IGT are at increased risk of developing frank diabetes, but rates of progression are highly variable. IGT is also a risk factor for cardiovascular disease.[25] A significant number of individuals diagnosed with IGT revert to normal on repeat testing,[25] and the treatment implications of IGT alone are uncertain.

Diagnosis of Gestational Diabetes. The diagnosis of GDM is traditionally based on two or more abnormal values during a 3-hour glucose tolerance test using 100 g glucose.[22,27] NDDG diagnostic criteria are based on extrapolations from standards for whole blood glucose originally derived by O'Sullivan[28] to identify mothers at risk of developing diabetes in long-term follow-up. The conversion factor used to develop criteria for plasma glucose measurements may have been incorrect, however,[29] and others have proposed modified criteria with lower thresholds as more sensitive predictors of adverse pregnancy outcomes.[30] Outside of North America, the diagnosis of GDM is usually based on WHO criteria using a 2-hour 75 g glucose tolerance test.[23] The prevalence of GDM varies considerably depending on whether WHO, NDDG, or modified criteria of Carpenter and Coustan[30] are used.[15,31] In addition to poorly standardized criteria for a positive OGTT in pregnancy, the lack of studies on the reproducibility of the 100 g glucose tolerance test contributes to ongoing controversy over the diagnosis of GDM.[32–34]

Because diagnostic glucose tolerance testing is too time-consuming and expensive for routine screening, various blood or urine tests have been examined for their ability to identify three distinct at-risk populations among asymptomatic persons: persons with undiagnosed NIDDM, pregnant women with GDM, and individuals at high risk of developing IDDM.

Screening for Non-Insulin-Dependent Diabetes. The most commonly used screening tests for NIDDM include measurement of serum or plasma glucose in fasting or postprandial specimens, measurement of glycosylated proteins in blood, and detection of glucose in urine. The sensitivity and specificity of the fasting plasma glucose (compared to diagnostic oral glucose tolerance testing) depends on the threshold set to define an abnor-

mal screening result. A single fasting glucose above 140 mg/dL is specific for diabetes (>99%) but sensitivity varies widely among different populations (21–75%).[35–40] Using a lower threshold (>123 mg/dL) improves sensitivity (40–88%), while maintaining reasonably high specificity (97–99%).[35–40] A random (i.e., nonfasting) plasma glucose greater than 140 mg/dL has a sensitivity of 45% and a specificity of 86%.[41] The ADA recommends that a fasting plasma glucose greater than 115 mg/dL, or a random glucose greater than 160 mg/dL, be considered a positive screen to be confirmed with OGTT.[26]

The nonenzymatic attachment of glucose to circulating proteins, primarily hemoglobin and albumin, reflects overall metabolic control in diabetic populations. A number of studies have evaluated hemoglobin A1c (HbA1c) and serum fructosamine as screening tests for diabetes.[40,42–45] Test characteristics are more variable than fasting plasma glucose, with sensitivity ranging from 15% to 93% and specificity from 84% to 99%.

Presence of glucose in the urine is fairly specific but less sensitive than most blood tests for NIDDM. In population-based screening using semiquantitative urine dipstick, a "trace positive" dipstick result or greater has a reported sensitivity of 23–64% and specificity of 98–99%.[40,46] In a high-risk population, quantitative assays of urine glucose achieved high sensitivity (81%) with high specificity (98%), comparable to both fasting plasma glucose and glycosylated protein assays.[40]

Sensitivity of all screening tests increases with the severity of hyperglycemia among the diabetic population.[40] Both the sensitivity and positive predictive value of screening tests will be highest in high-risk populations such as Native Americans and African Americans, where undiagnosed diabetes and severe hyperglycemia are more prevalent.[40] In the asymptomatic general population, where the prevalence of undiagnosed diabetes is only 1–3%, a greater proportion of diabetic patients may be missed by screening, and many persons with a positive screening test will not have diabetes. Screening asymptomatic persons may have some harmful effects, including an increase in false-positive diagnoses; in a review of 112 patients being treated for diabetes in a general practice, nine (8%) patients, all without classic symptoms, were found not to have diabetes on further evaluation.[47] Even a true-positive diagnosis could have adverse consequences for an asymptomatic person if it causes "labeling" effects[48] or difficulty obtaining insurance.

Screening for GDM. The Third International Workshop Conference on Gestational Diabetes has recommended screening pregnant women at 24–28 weeks of gestation with a 50 g 1-hour oral glucose challenge test, performed in fasting or nonfasting state.[27] Patients with plasma glucose of 140 mg/dL (7.8 mM) or greater at 1 hour should undergo a diagnostic 3-

hour OGTT. There is no single threshold that accurately separates normal from abnormal results on the glucose challenge test, however.[27] Estimates of sensitivity of screening under this protocol range from 71% to 83% with a specificity of 78%–87%.[30,49,50] Sensitivity is increased by using a lower threshold for a positive screen[30,51] and by testing in the fasting state.[49] A large prospective study of nearly 4,300 pregnant women reported that using higher cutpoints (142–149 mg/dL) and adjusting for time since last meal could reduce the misclassification of patients based on initial screening tests.[52] Reproducibility of the 1 hour glucose challenge test is only fair,[53] but it improves with advancing gestational age.[54] In an unselected pregnant population (prevalence of GDM approximately 3%), fewer than one in five women with a positive glucose challenge test will meet criteria for gestational diabetes on a full OGTT.[52]

The elevations in plasma glucose in GDM are less pronounced than in IDDM or NIDDM. As a result, neither serum glycosylated proteins[51,55–58] nor urine glucose[34] are sufficiently sensitive for detecting GDM. In addition, glucosuria is common among nondiabetic pregnant women. Random blood glucose has been advocated as a simpler and less costly screening test for GDM[59,60] but its test performance has not been fully evaluated. A large prospective study is comparing fasting and random plasma glucose to oral glucose challenge for detecting GDM and for predicting adverse perinatal outcomes.[52]

Screening for Patients at Risk for IDDM. A growing body of evidence indicates that IDDM is a genetically linked autoimmune disorder, in which progressive destruction of insulin-producing pancreatic islet cells eventually leads to complete dependence on exogenous insulin.[61] Islet cell autoantibodies and insulin autoantibodies are present in the majority of patients with newly diagnosed IDDM,[62] and may precede the onset of clinical symptoms by months to years. Immunoassays for islet cell antibodies remain difficult to standardize,[63] however, and appear to be of limited value for screening in the general population. In individuals without a family history of IDDM, the prevalence of islet cell autoantibodies ranges from 0.3% to 4.0% and the chance of developing IDDM in antibody-positive individuals is estimated to be less than 10%.[64] The potential value of immune markers is greater in high-risk individuals (i.e., first-degree relatives of affected patients). Several studies report that a combination of immune markers and measures of insulin responsiveness can identify a population at very high risk (up to 70%) of developing IDDM.[62,63,65] This high risk may make such persons appropriate candidates for experimental interventions to reduce the risk of progression to IDDM. Only 10% of all cases of IDDM, however, occur in persons with a positive family history.

Effectiveness of Early Detection

Asymptomatic NIDDM. Up to 20% of patients with newly diagnosed NIDDM already have early retinopathy, suggesting that the onset of diabetes may be many years (estimated 9–12 years) before clinical diagnosis, and that the microvascular changes may precede overt symptoms in many patients.[66] Earlier detection through screening might provide an opportunity to reduce the progression of microvascular or macrovascular disease due to asymptomatic hyperglycemia. Animal models of diabetes suggest that hyperglycemia is the underlying cause of microvascular complications,[67] and numerous epidemiologic studies confirm that the degree of hyperglycemia and duration of disease are associated with microvascular complications such as nephropathy, retinopathy, and neuropathy.[5,68–72] Direct evidence that improving glucose control reduces the incidence of these complications has only recently become available, and only for patients with IDDM. In the Diabetes Control and Complications Trial (DCCT), over 1,400 subjects with IDDM were randomized to intensive insulin therapy versus conventional treatment. Intensive insulin therapy improved average blood glucose, significantly reduced progression of existing retinopathy, and significantly lowered the incidence of retinopathy, neuropathy, and nephropathy in all patients.[73,74]

The DCCT study is generally regarded as providing strong evidence of the role of hyperglycemia in diabetic microvascular disease, but questions remain about extrapolating its results to the management of patients with NIDDM.[75] The incidence of microvascular complications is lower in NIDDM than IDDM, and the largest controlled trial to date of treatment of NIDDM (the University Group Diabetes Program study) found no effect of improved glucose control with insulin or drug therapy on retinopathy.[76] More definitive results may come from the U.K. Prospective Diabetes Study (UKPDS), which randomized 2,520 patients with newly diagnosed NIDDM controlled with diet to diet alone, or additional therapy with chlorpropamide, glibenclamide, metformin, or insulin.[77] Three-year results indicated that patients receiving drug or insulin therapy had significantly better glucose control but greater weight gain and more frequent episodes of hypoglycemia.[78] Data on other clinical outcomes are not yet available.

Patients with diabetes are at significantly increased risk for coronary heart disease, stroke, and peripheral vascular disease; cardiovascular diseases combined account for the majority of deaths in diabetic patients. The risk of cardiovascular disease, however, is not clearly associated with either disease duration or degree of glycemic control. The rate of increase in coronary heart disease risk over time is similar in patients with NIDDM and in nondiabetic patients.[79,80] In 8-year follow-up of almost 500 diabetic men and women, disease duration was associated with risk of ischemic heart disease in patients with IDDM but not in those with NIDDM,[81] and

there was no correlation between cerebrovascular and peripheral vascular events and diabetes duration. Detecting such an association may be complicated by difficulty in accurately ascertaining the onset of diabetes in patients with NIDDM. Insulin resistance and hyperinsulinemia may be more important determinants of macrovascular complications than degree of glucose control.[79,82] In the UGDP study, neither cardiovascular disease nor mortality was reduced by improved glucose control in the intervention groups,[76] but the interpretation of these findings has been criticized.[83] Drug therapy for NIDDM carries the risk of hypoglycemia. In the UKPDS study, the annual incidence of hypoglycemia was 28% for patients on glibenclamide, and 33% for those on insulin; episodes requiring medical therapy occurred in 1.4% of subjects each year.[78]

The majority of individuals in the U.S. who have disordered glucose metabolism have IGT.[84] Untreated, most persons with IGT do not develop diabetes, but the reported cumulative incidence of diabetes at 10 years has varied from 15% to 61%.[25] Progression to diabetes is highest in some Native American populations.[85] There is little direct evidence of a benefit of detecting and treating IGT.[86,87] Prospective studies of interventions to prevent progression to frank diabetes in patients with IGT have produced conflicting results. One trial of dietary and pharmacologic treatment[88] and a nonrandomized trial of diet and physical activity training[89] each reported a reduced incidence of diabetes, whereas other prospective studies have reported no effect on the rate of progression to diabetes.[90–92]

Gestational Diabetes. GDM is associated with increased risk of fetal macrosomia, birth trauma, neonatal hypoglycemia, and perinatal mortality.[93–96] No properly controlled trial has examined the benefit of universal or selective screening compared to routine care without screening. In two retrospective analyses, no significant difference in macrosomia or in birth trauma was found in women screened for GDM compared to unscreened control populations.[97,98] Because women screened for GDM are more likely to be at high risk, such studies cannot reliably exclude a benefit of screening.[98]

The clearest benefit of screening is the potential for treatment to reduce the incidence of fetal macrosomia in women with GDM. Although modified diet can reduce hyperglycemia in GDM, only one controlled trial has examined the effect of dietary therapy on clinical outcomes in GDM.[99] A total of 158 women with mild GDM (positive by NDDG criteria but not WHO criteria) were randomized to diet treatment or no therapy; there were no significant differences in perinatal outcomes, although slightly fewer infants over 4,000 g were born to diet-treated mothers (3 vs. 5).[100] Several randomized controlled trials have demonstrated that diet and insulin (compared to diet alone) results in improved glucose control and re-

duced incidence of macrosomia in women with GDM.[94,101,102] Macrosomia was not significantly reduced in a fourth trial, but 15% of the women assigned to diet therapy received insulin because glucose control was inadequate.[103] An overview of four randomized trials estimated that treatment of GDM with diet and insulin, compared to diet alone, reduced the incidence of macrosomia by two thirds (6% vs. 17%).[104] Despite a reduction in macrosomia, there were no significant differences in rates of cesarean section, forceps delivery, or birth trauma between treated and control groups in any of the prospective trials, however. There was only one reported instance of shoulder dystocia among 140 births in the two trials reporting this outcome.[101,104] In a retrospective analysis of 445 gestational diabetics, women who received both insulin and dietary treatment had significantly lower rates of birth trauma and operative delivery than women who received dietary treatment alone or no intervention.[96] Since treatment was not randomly assigned, factors other than treatment may have contributed to the differences in outcomes.

The benefit of improved glucose control on other outcomes in GDM, including perinatal mortality, remains uncertain. Although several case series have reported marked improvements in perinatal death rates with treatment of GDM,[95,97,105–107] none of these studies employed an appropriate control group. The use of historical controls (i.e., outcomes of prior pregnancies) or general population controls is likely to exaggerate the apparent benefits of treatment. In an overview of five randomized trials, there was no significant difference in perinatal mortality among women treated with diet and insulin (2.7%) and those treated with diet alone (3.2%).[104] Moreover, in trials conducted after 1975, there were no perinatal deaths in treated or control groups.[100,104] In one trial, insulin treatment was associated with lower rates of neonatal jaundice and nonsignificant reductions in admissions to the neonatal ICU.[108] At the same time, treatment of GDM may have adverse effects for some women. In one retrospective analysis, women with GDM who maintained tight glucose control (mean glucose < 87 mg/dL) had a higher incidence of small-for-gestational age infants than nondiabetic controls.[109]

Degrees of hyperglycemia more subtle than in GDM may result in increased maternal and neonatal complication rates.[110–112] The incidence of macrosomia and preeclampsia/eclampsia is higher in women who demonstrate at least one abnormal result among the four measurements in a glucose tolerance test. The prevalence of mildly hyperglycemic pregnant women who do not meet the criteria for GDM but are at increased risk during pregnancy is unknown.

Although treatment of GDM can reduce macrosomia, the impact of widespread screening and treatment on the overall incidence of macrosomia and dystocia may be quite small. The reported incidence of macroso-

mia in the general population varies from 1% to 8%,[93,113] and most macrosomic infants are born to women without GDM.[114] Gestational diabetes was responsible for only 5% of infants over 4,500 g in one study,[115] and it is estimated to account for only 5% of shoulder dystocia cases in this country.[116] Other factors such as maternal obesity, gestational weight gain, and maternal age may be more important determinants of macrosomia and adverse outcomes.[117] In a prospective study of GDM controlled with diet, the only significant predictor of birth weight was maternal weight at delivery; plasma glucose levels were poor predictors of birth weight.[118]

Persons at Risk for IDDM. Earlier diagnosis of IDDM could be of considerable benefit if treatment could arrest the disease process before severe insulinopenia and hyperglycemia had developed. A number of recent trials have examined whether immunosuppressive agents can delay disease progression in patients with new-onset IDDM.[61] Although some patients have experienced prolonged remissions, the benefit has not been sustained in most patients, and the serious adverse effects of immunosuppressive agents are likely to preclude their use in completely asymptomatic persons. There have been several promising small trials of other interventions to prevent IDDM in high-risk asymptomatic persons, enrolling individuals identified by autoantibodies levels and other physiologic measures.[63,119,120] Multicenter randomized clinical trials are currently underway to determine whether prophylactic regimens of insulin or nicotinamide can prevent progression to IDDM in such high-risk subjects.[61]

Recommendations of Other Groups

The Canadian Task Force on the Periodic Health Examination (CTF),[121] the American College of Physicians (ACP),[122] and the American Academy of Family Physicians[123] recommend against routine screening for diabetes among asymptomatic nonpregnant adults; each of these organizations concluded that selective screening may be reasonable among individuals at high risk of developing diabetes (e.g., older obese persons, those with a strong family history). AAFP policy is currently under review. The ADA recommends screening all individuals with a careful history and measuring fasting glucose on those with identified risk factors for developing diabetes, including obesity, family history, history of GDM, selected medical conditions, or selected ethnic background.[124] A 1994 report of the WHO concluded that population screening for NIDDM was not justified, but that opportunistic screening of high-risk persons may be useful to permit earlier intervention.[125]

The ACP,[122] the ADA,[124] and the Third International Workshop Conference on Gestational Diabetes[27] recommend universal screening for GDM in pregnant women between weeks 24 and 28 using a 1-hour glucose

tolerance test. The American College of Obstetricians and Gynecologists and the American Academy of Pediatrics do not recommend universal screening in pregnancy but strongly recommend screening pregnant women in certain high-prevalence populations (e.g., Native Americans) and those with specific risk factors (age over 30, family history of diabetes, previous macrosomia, malformed or stillborn infants, hypertension, or glucosuria).[126,127] The CTF concluded that there was insufficient evidence to recommend for or against universal screening for GDM, but suggested close monitoring of women with risk factors for GDM.[121]

Discussion

Screening for diabetes in asymptomatic adults suffers from two important limitations: the lack of a practical screening test that is both sensitive and specific, and insufficient evidence that detection of diabetes in the asymptomatic period significantly improves long-term outcomes. Even if improving glucose control can reduce long-term complications of NIDDM, many other factors must be considered in determining the likely benefits and risks of screening in asymptomatic persons: efficacy of diet or medications in reducing glucose levels; compliance of asymptomatic persons with lifestyle advice; possible risks of drug or insulin therapy; inconvenience and costs of screening, follow-up, and treatment; and the potential adverse effects of screening (false-positive diagnoses, "labeling" of asymptomatic persons). Targeting screening to high-risk groups (certain ethnic populations, older overweight subjects) and emphasizing interventions that are inexpensive and safe (exercise, prudent diet, and weight loss) are likely to minimize the potential adverse effects of screening. Since most of these interventions are recommended for all adults, the additional benefit of screening to promote lifestyle interventions remains uncertain. If the ongoing UKPDS trial demonstrates important clinical benefits from more intensive interventions (i.e., drug or insulin therapy) in patients with minimally symptomatic NIDDM, this would provide stronger support for screening for diabetes among asymptomatic adults.

The value of widespread screening for GDM is also unproven. Important questions remain about the diagnostic gold standard, the optimal screening test, and the appropriate management of GDM. Although there is good evidence that insulin treatment can reduce the incidence of macrosomia in GDM, evidence of an effect on clinically important perinatal outcomes (birth trauma, operative delivery, neonatal metabolic derangements, or perinatal mortality) is much weaker. The high risk associated with GDM in earlier cohorts primarily reflects adverse outcomes in women who were older, overweight, or otherwise at increased risk. Universal screening is likely to have only a small impact on the overall incidence of macrosomia and birth trauma and may subject many low-risk

women to the inconvenience, costs and possible risks of follow-up testing, dietary restriction, or insulin management. A 1988 study estimated that universal screening would cost $8,000 per case of macrosomia prevented.[122] By one estimate, however, up to 10,000 women would need to be screened to prevent 50 cases of macrosomia, 6 cases of shoulder dystocia, and 1 case of shoulder girdle injury (few of which cause lasting problems).[128] Targeting screening to women with risk factors for GDM (including older age), with emphasis on dietary management of GDM, is likely to minimize the adverse effects and costs of screening. Direct evidence of a benefit of screening on important clinical outcomes is not available for any group, however.

Immune markers are not sufficiently specific to recommend their use in the general population at this time. Screening persons with a family history of IDDM using immune markers and physiologic measurements can identify a small number of persons at very high risk of developing IDDM. Patients with a family history account for only 10% of all cases of IDDM, however, and trials of interventions to prevent IDDM in high-risk patients have not yet been completed.

Primary prevention may be a more effective means to reduce diabetes-associated morbidity than widespread screening. Diet, exercise, and weight reduction can safely improve glucose tolerance and are likely to have independent benefits on other important chronic diseases (see Chapters 55 and 56). Whether diabetes screening improves compliance with generally recommended lifestyle interventions has not been determined.

CLINICAL INTERVENTION

There is insufficient evidence to recommend for or against routine screening for NIDDM in nonpregnant adults (“C” recommendation). Although evidence of a benefit of early detection is not available for any group, clinicians may decide to screen selected persons at high risk of NIDDM on other grounds, including the increased predictive value of a positive test in individuals with risk factors and the potential (although unproven) benefits of reducing asymptomatic hyperglycemia through diet and exercise. Individuals at higher risk of diabetes include obese men and women over 40, patients with a strong family history of diabetes, and members of certain ethnic groups (Native Americans, Hispanics, African Americans). In persons without risk factors, screening for asymptomatic disease is much less likely to be of benefit, due to the low burden of disease and the poor predictive value of screening tests in low-risk persons. Measurement of fasting plasma glucose is recommended by experts as the screening test of choice; the frequency of screening is left to clinical discretion.

There is also insufficient evidence to recommend for or against routine screening for GDM (“C” recommendation). Although a beneficial ef-

fect of screening on perinatal morbidity has not been clearly demonstrated for any group, clinicians may decide to screen high-risk pregnant women on other grounds, including the higher burden of disease, and the potential clinical benefits from reducing macrosomia due to GDM. Risk factors for GDM include obesity, older maternal age, a family history of diabetes, and a history of macrosomia, fetal malformation, or fetal death. The 1-hour 50 g glucose challenge test, with confirmation of abnormal results with a 3-hour 100 g oral glucose tolerance test, is the screening test recommended by expert panels in the U.S.

Screening with immune markers to identify asymptomatic individuals at risk for developing IDDM is not recommended in the general population ("D" recommendation).

The draft update of this chapter was prepared for the U.S. Preventive Services Task Force by M. Carrington Reid, MD, PhD, Harold C. Sox, Jr., MD, Richard Comi, MD, and David Atkins, MD, MPH.

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