

Prevention of Complications in Diabetes is Possible with Screening



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Abstract

Screening represents the preliminary detection of previously unrecognized health disorders in the phase when there are no visible signs of the disease, but the pathological process has already begun. The goal of such early detection of the disease is to increase the possibility of timely action, to modify and redirect the natural course of the disease, and to act on the outcome of the disease itself. Diabetes is sometimes discovered quite by accident during a blood test due to suspicion of another disease or during a routine systematic examination. Sometimes the doctor and the patient suspect diabetes and perform targeted tests. There are several ways to detect elevated blood sugar levels.

Keywords: Diabetes; Screening; Prediabetes; Detection; Health

Abbreviations: NSC: National Screening Committee; ACR: Albumin Creatinine Ratio; IDF: International Diabetes Federation; ADA: American Diabetes Association; OGTT: Oral Glucose Tolerance Test; BG: Blood Glucose; ISF: Interstitial Fluid; CGM: Continuous Glucose Monitoring; HbA1C: Hemoglobin A1c; MODY: Maturity-Onset Diabetes of the Young; HNF: Hepatocyte Nuclear Factor; IPF: Insulin Promoter Factor; UKPDS: UK Prospective Diabetes Study; DCCT: Diabetes Control and Complications Trial

Introduction

The goals of diabetes management are, in the beginning glance, easily established [1]. The extra mortality related to diabetes is predominantly because of macrovascular disorder, despite the fact that greater lately there may be developing information to indicate that most cancers is a developing reason of mortality in human beings with diabetes. The morbidity because of diabetes effects from each macrovascular and microvascular disorder. The purpose of remedy is to normalize extra mortality and morbidity, so remedy has to be geared toward chance elements for each macrovascular and microvascular diseases. Modifiable chance elements for macrovascular disorder are hypertension, hypercholesterolemia, weight problems, smoking, and hyperglycemia. Risk elements for microvascular disorder are in large part identical, however predominantly hyperglycemia and hypertension. Since many sufferers with type 2 diabetes have an aggregate of those chance elements, many sufferers would require an aggregate of medicine to manipulate their diabetes. In type 1 diabetes, insulin remedy is obligatory as soon as insulin dependence is installed, and in those sufferers the point of interest is a whole lot greater on control of glycemia, as those sufferers

are normally more youthful and feature fewer modifiable chance elements than sufferers with type 2 diabetes.

Aim

Screening objectives to perceive healthful people who can be at accelerated chance of a disorder or situation [2]. In a health care context, it's miles described as "a manner of figuring out reputedly healthful folks who can be at accelerated chance of a disorder or situation. They can then be supplied statistics, similarly, checks and suitable remedy to lessen their chance and/or any headaches bobbing up from the disorder or situation." Screening is distinct to diagnosis; in a screening programme people may also get hold of a diagnostic take a look at, the important thing distinction is why the man or woman gets the take a look at. In a screening programme people are asymptomatic in place of a man or woman who offers to a clinician with signs and symptoms which can be then investigated. In phrases of T2DM and PDM, the purpose could be to perceive folks who both have PDM or are in a preclinical asymptomatic section of T2DM. The UK National Screening Committee (NSC) describes screening as a sieve, in

which maximum human beings pass through, that means that they're at low chance of getting the situation being screened for. "Captured" people are at excessive chance and have to get hold of similarly investigations or a confirmatory take a look at. In concept screening have to perceive disorder in advance than it was without screening, or it have to perceive 'excessive chance' people who may be supplied an intervention to lessen the chance of growing a selected disorder. Most screening checks aren't ideal and consequently there may be a chance that human beings might be both falsely reassured and instructed they're low chance whilst certainly they have got the disorder or will broaden it withinside the future, or human beings can get hold of a fake superb end result, i.e. instructed they're excessive chance after they don't have the disorder or are at low chance of growing it withinside the future.

There are statistical measures which may be used to evaluate the overall performance of a screening programme. To check a screening programme, the effects of the programme want to be in comparison to a gold standard (now and again referred to as a reference standard). This will be the take a look at mechanically used to diagnose the situation in medical practice (for instance OGTT or HbA1c for this setting) or it can be primarily based totally on medical evaluation in which no take a look at exists. Sensitivity measures the cap potential of a screening programme to effectively perceive human beings with the situation of interest and is calculated with the aid of using dividing the quantity of authentic positives with the aid of using the quantity of human beings with the situation. A screening programme with 100% sensitivity could effectively perceive all people with the situation. A screening programme with 80% sensitivity could stumble on 80% of people with the situation (authentic positives) however 20% with the situation move undetected (fake negatives). A screening programme with 100% sensitivity won't be ideal, as many human beings without the situation may also were given a superb screening take a look at the end result. Therefore, we additionally want to evaluate the cap potential of the screening take a look at to perceive human beings without the disorder/situation effectively. Specificity is the cap potential of the screening programme to effectively perceive individuals who do now no longer have the situation (quantity of authentic negatives divided with the aid of using the quantity of people without the situation). An ideal take a look at could have a 100% sensitivity and a 100% specificity, however this isn't generally visible and consequently we want to recall what constitutes an appropriate overall performance of a screening take a look at. The stage of sensitivity and specificity which can be applicable for a selected programme will depend upon the character of the situation being detected. The superb predictive price is a clinically beneficial measure because it offers information on how in all likelihood and man or woman with a superb screening end result is to have the situation (quantity of authentic positives divided with the aid of using the overall quantity of superb effects). The terrible predictive price of a screening programme solutions the question:

"How in all likelihood is it that this man or woman does now no longer have the situation for the reason that the end result is terrible?" (Quantity of authentic negatives divided with the aid of using the overall quantity of negatives).

Detection

Detection of the earliest signs of diabetic complications is a vital requirement of diabetes care main to early preventive and remedy techniques that could abort development of a number of the maximum severe consequences [3].

Screening is preferably completed as an established provider undertaken with the aid of using nurses and technicians out of doors the manner of expert consultation, which have to be knowledgeable with the aid of using revealed effects from the screening programme. Screening has to be completed at onset after which annually, from the onset of diabetes in all diabetic sufferers. Complications in Type 1 diabetes, however, are not likely to broaden throughout the primary 5 years after prognosis, in order that the whole annual screening protocol may be deferred for a brief time. The screening programme may be completed anyplace suitable centers exist. Once headaches are gifted and installed, greater common screening or remedies, or each can be needed.

Eye screening calls for expert devices and is regularly undertaken as a network responsibility, and there are robust representations that there have to be a countrywide screening programme. Detection and prevention of foot troubles connected to shipping of good enough network podiatry offerings is likewise critical and quite powerful in stopping severe foot disorders.

The annual complications screening programme This comprises:

- a) Weight (height): body mass index
- b) Blood pressure
- c) Eye examination (visible acuity, funduscopy, and photography)
- d) Foot examination: test for deformities, abrasions and ulcers sensation (monofilament checks, and different sensory modalities if to be had
- e) Blood tests: HbA1c; lipid profile; creatinine
- f) Urine tests: strip tests for proteinuria or microalbuminuria (if both of those are superb, total 24hour proteinuria or the albumin creatinine ratio (ACR) have to be measured, ideally on an early morning urine sample)
- g) Evaluation of smoking status

Prediabetes

The quantity of people with prediabetes is predicted to upward thrust extensively and is expected to have an effect on

417.3 million human beings with the aid of using 2030 and 486.1 million with the aid of using 2045 in step with the projections of IDF (International Diabetes Federation) [4]. This exponential boom in numbers is likewise because of the growing charges of weight problems considering the fact that a raised BMI is a famous chance thing for growing diabetes.

Current pointers from the American Diabetes Association (ADA) for screening are nearly completely centered on adults who're obese (BMIkg 25kg/m²) or obese (BMI 30kg/m²), as a minimum as much as forty-five years of age, whilst screening is suggested to everyone. This technique can compromise the detection of this pathology in healthful and ordinary-weight human beings. Also, prediabetes and T2D can be absolutely symptomless, which, blended with the reality that it's miles normally not possible to decide the precise time of the onset of this situation, ends in an in-depth pre-diagnostic duration. The loss of everyday screening for prediabetes and early ranges of diabetes ends in glucose intolerance development going unnoticed, and lots of human beings emerge as with early diabetes complications and a better cardiovascular disorder chance whilst their situation is in the end diagnosed. In the years earlier than diabetes is diagnosed, there may be an upward thrust in cardiovascular disorder events, health resources, and costs. Therefore, the improvement of powerful and correct strategies for diagnosing prediabetes is needed to lessen the chance of this situation progressing to diabetes with complications associated.

The screening and detection of diabetes within the early ranges of the herbal disorder route are vital for preventive control via techniques that presently can encompass lifestyle changes and pharmacological therapeutics. Several predictive models were examined within the look for the maximum particular technique to stumble on undiagnosed diabetes. These processes encompass combos of affected person-pronounced questionnaires with goal measures, inclusive of however now no longer restricted to age, body mass index (BMI), glucose, and glycated hemoglobin.

ADA Recommendations

The American Diabetes Association (ADA) has precise suggestions approximately who have to get screened for diabetes, at what age screening have to start, and what checks have to be used [5].

- a. Start screening at the age of forty-five. If the take a look at is ordinary, repeat every 3 years.
- b. Screen adults more youthful than forty-five if they're obese and feature one or greater of the subsequent chance elements:
 - c. Have a parent, sibling, or child with diabetes
 - d. Are bodily inactive
 - e. Belong to an ethnic organization wherein there may be better chance for diabetes (African American, Latino, Native

American, Asian-American, and Pacific Islander)

- f. Had diabetes throughout being pregnant or added a child weighing greater than 9 pounds
- g. Blood pressure readings are 140/90 or higher
- h. Have an abnormal lipid profile with a low stage of HDL cholesterol (much less than 35mg/dl) and/or an excessive stage of triglycerides (greater than 250mg/dl). A lipid panel or profile is a blood take a look at for stages of cholesterol, triglycerides, HDL cholesterol, and LDL cholesterol.
- i. Have a medical situation referred to as polycystic ovary syndrome (PCOS)
- j. Have had previous blood glucose checking out that indicated the presence of prediabetes
- k. Have circulatory problems

There are screening checks for diabetes, and both is applicable:

- a. A fasting glucose stage after an in a single day rapid
- b. An oral glucose tolerance test (OGTT), in which you drink seventy-five grams of glucose after an in a single day rapid and your glucose stage is measured hours later

The ADA recommends that docs use the fasting glucose take a look at due to the fact it's miles less difficult to do. If the fasting glucose stage is abnormal, however now no longer squarely within the diabetes variety, your health practitioner may fit directly to do an OGTT.

Risk Factors

Patients with type 2 diabetes have an accelerated mortality (as much as 4 instances that of the nondiabetic populace) attributed especially to macrovascular disease, considerably cardiovascular disease [1]. In excessive-earnings countries, diabetes is the most typical unmarried reason of limb amputations, the most typical reason of blindness in running existence, and the most typical reason of end-stage renal failure. The macrovascular disorder chance is related to smoking, loss of exercise, hypertension, weight problems, dyslipidemia, and hyperglycemia. This community of chance elements, whilst it happens concurrently, is referred to as metabolic or insulin-resistance syndrome, considering the fact that these kinds of elements are related to insulin resistance and may precede type 2 diabetes. Metabolic syndrome can be found in as much as 25% of the non-diabetic populace and, in grownup existence, approximately 2–12% in line with 12 months of those people development to diabetes.

Body Fluids

Blood has lengthy been diagnosed because the maximum not unusual place physical substance that human beings use for measurements and medical tests [6]. BG (blood glucose) stages are generally measured in a droplet of capillary blood on the

fingertips. Capillary glucose stages intently suit systemic arterial BG stages. Other to be had frame fluids suitable for checking out encompass urine, interstitial fluid (ISF), sweat, ocular fluid, and saliva for non-invasive screening. Urine is a non-invasive and without problems to be had fluid utilized in diagnosing diabetes. Urine is made of numerous metabolites, such as glucose, proteins, salts, and nitrates, and is the reason why the pH of urine fluctuates among acidic (pH 4.8) and basic (pH 8). During hyperglycemic events, glucose may be excreted and measured within the urine. Since urine is transient, it can't be used for non-stop glucose tracking.

ISF is a skinny film of fluid that encloses the frame's cells. It consists of water, carbohydrates, salts, fatty acids, amino acids, hormones, leukocytes, neurotransmitters, coenzymes, and cell byproducts. ISF glucose stages range from BG stages, and correlation measurements are needed. The bloodstream is the frame's shipping machine for transporting materials like glucose on a systemic stage. At the identical time, the ISF is the compartment in which materials like glucose diffuse into tissues and cells locally. Accordingly, blood collects glucose absorbed from the gastrointestinal tract or launched from glucose stores, flowing via capillary partitions into the ISF. In different words, BG awareness is a measure of the general quantity of glucose gift within the blood. In contrast, the awareness of glucose within the ISF relies upon nearby elements, inclusive of nearby diffusion from the blood and metabolism with the aid of using surrounding tissues. ISF is without problems accessed from subcutaneous tissue. Minimally invasive microneedles were conceived to acquire ISF. They are implemented to the pores and skin with an adhesive film for up to 2 weeks, permitting continuous glucose monitoring (CGM).

Sweat is a thermoregulatory substance that serves to govern frame temperature. It is secreted with the aid of using sweat glands all around the frame, making it the maximum to be had physical fluid. Sweat is mildly acidic (pH 5.5–6.5) and on the whole includes water, electrolytes, and urea. Sweat additionally incorporates low glucose, antibodies, and cytokines. Glucose stages in sweat have been related to BG stages, however they lag with the aid of using around eight min from BG stages. Saliva is a flexible fluid that consists of more than one analyte excreted from the blood which could have an impact on a man or woman's hormonal, mental, dietary, and metabolic situation. Saliva can be used as a non-invasive glucose sensing sample. Salivary glucose stages variety among 0.23 and 0.38mM in healthful people, even in sufferers with diabetes, salivary glucose stages fall among 0.55 and 1.77mM.

Diagnosis

In medical observation, the prognosis of diabetes is normally triggered with the aid of using numerous signs and symptoms like accelerated urine volume, thirst, recurrent infections, unexpected lack of weight, and, in intense cases, drowsiness and coma [7]. In

trendy blood/plasma glucose analysis (fasting plasma glucose, random plasma glucose, 2-h plasma glucose), oral glucose tolerance takes a look at (OGTT), or estimation of hemoglobin A1c (HbA1C) is used to stumble on DM. Diagnostic standards range amongst extraordinary organizations. Determination of blood glucose stage remains taken into consideration as a key marker for the prognosis of diabetes. Usually, the not unusual place and broadly used standards to diagnose DM and prediabetes have been advised with the aid of using WHO (World Health Organization) and ADA. The plasma glucose stage remains a key criterion for the prognosis of diabetes.

In undiagnosed diabetes, by myself fasting plasma glucose fails to perceive almost 30% cases; OGTT is then beneficial to discover the disturbed glucose tolerance in asymptomatic human beings. Estimation of A1C is a fundamental marker for evaluation of diabetes, which additionally plays a key position in tracking DM. Estimation of HbA1C is reflecting a median stage of blood glucose over a duration of 2–3 months.

The human beings who've a few problems like undue tiredness, burning feet, pruritis, recurrent infection, tingling and numberless, behind schedule and nonhealing wound, balanitis, impotency, and untimely cataract additionally have to go through DM screening as those may also arise because of undetected DM.

Self-Care

Screening for diabetes is suggested as a minimum at 3-12 months periods for adults over forty-five years of age, however screening frequency periods precise to the older grownup in superior years aren't addressed [8]. In the future, because the older populace keeps expanding, new screening standards may also want to be explored for prognosis of diabetes. To conclude, there are numerous physiological elements and boundaries contributing to behind schedule prognosis of diabetes in older adults. Once diagnosed, the older grownup with diabetes is concept to be greater susceptible to persistent complications (in comparison to more youthful adults) in prevalence and at a greater improved rate. Clinicians in number one care and diabetes care may also want to devise for beyond regular time for diabetes control evaluation, for the reason that man or woman will in all likelihood have a couple of health situation to cope with throughout the visit. Symptoms of hyperglycemia, inclusive of reviews of accelerated urination from an older grownup, may also have numerous feasible reasons apart from diabetes, such as age-associated urinary incontinence, urinary tract infections, flawed use of prescribed medications, and different genito-urinary problems.

Older adults have a number of health worries and court cases because of physical modifications and dealing with persistent conditions. Common physical struggles related to growing old encompass modifications in imaginative and prescient, hearing, mobility, dexterity, and cognitive modifications. Chronic disorder control for a couple of situation offers remedy demanding

situations for the man or woman, inclusive of polypharmacy, problems with sports of every day residing, health care machine navigation, and economic burdens. Older adults can also be handling lack of a spouse, lack of friends, modifications in independence and residing conditions, economic instability, and lack of identity, which have an effect on their cap potential to offer self-care. Because diabetes control is on the whole everyday self-care, health care experts want to be touchy to the style of problems probably obstructing care. Health care experts want to recall the particular desires of this populace for medical evaluation, remedy, schooling, and persevering scientific care.

Typical self-care responsibilities the use of syringes, lancet devices, domestic blood glucose tracking devices, and measuring cups may be bold to the older grownup with bad imaginative and prescient and/or dexterity problems. Adaptive gear inclusive of magnifiers, insulin pens, remedy reminder aids, and adaptive device for the kitchen are to be had. Instructional strategies may also want to be changed due to the visible or cognitive modifications on this populace. An occupational therapist may be an aid for health care and lifestyle aid for impartial residing.

Once diagnosed, a complete evaluation has to take location. The older grownup's health care group/company will want to be knowledgeable of the affected person's cap potential to carry out different self-care responsibilities inclusive of physical activity, domestic blood glucose tracking, remedy administration, and different non-public health care activities. An included remedy plan with collaboration of a multidisciplinary health care group such as the affected person and his or her caregivers can be the high-quality method to acquire appropriate outcomes.

Mody

Several varieties of diabetes are related to monogenetic defects in b-cell function [9]. These varieties of diabetes are often characterized with the aid of using onset of hyperglycaemia at an early age (normally earlier than age 25 years). They are known as maturity-onset diabetes of the young (MODY) and are characterized with the aid of using impaired insulin secretion with minimum or no defects in insulin action. They are inherited in an autosomal dominant pattern. Abnormalities at over six genetic loci on extraordinary chromosomes were diagnosed to date. The maximum not unusual place shape is related to mutations on chromosome 12 in a hepatic transcription thing known as hepatocyte nuclear factor (HNF)-1a; MODY3 debts for 70% of the MODY populace A 2nd shape is related to mutations withinside the glucokinase gene on chromosome 7p and effects in a faulty glucokinase molecule. Glucokinase converts glucose to glucose 6-phosphate, the metabolism of which, in turn, stimulates insulin secretion with the aid of using the b-cell. Thus, glucokinase serves because it is the 'glucose sensor' for the b-cell. Because of defects withinside the glucokinase gene, accelerated plasma stages of glucose are vital to elicit ordinary stages of insulin secretion. Patients with MODY2 present with a much less intense shape of

hyperglycaemia that may be controlled with scientific nutrients remedy alone. The much less not unusual place bureaucracy end result from mutations in different transcription elements, such as HNF-4a, HNF-1b, insulin promoter factor (IPF)-1 and NeuroD1. Up to 15% of sufferers with MODY present with medical traits of MODY, however do now no longer have any acknowledged mutation and are labeled as MODY-X till similarly genetic loci were explored.

Knowledge of the genotype withinside the unaffected child of an affected person with this syndrome gives the opportunity of a corporation prognosis or, importantly, exclusion of the opportunity of diabetes in later existence. If the genetic checking out is terrible, no screening might be vital and people and their households may be reassured. If an unaffected offspring is discovered to have a MODY2 mutation, then annual checking out of fasting plasma glucose and, for females, focus of the significance of terrific glycaemic manage earlier than idea and throughout being pregnant are required. Identification of a MODY1 or MODY3 genotype necessitates greater rigorous, everyday screening via childhood, early life and early grownup existence to stumble on the improvement of diabetes, as pharmacological remedy, such as insulin, is in all likelihood to show vital. Such checking out increases moral problems and it's been advised that it has to be supplied best after suitable genetic counselling. Whether such understanding will in the long run permit intervention to prevent or retard the arrival of diabetes is presently uncertain.

Point mutations in mitochondrial DNA were discovered to be related to diabetes mellitus and deafness. The maximum not unusual place mutation happens at function 3243 withinside the tRNA leucine gene, main to an A-to-G transition. The same lesion happens withinside the MELAS (mitochondrial myopathy, encephalopathy, lactic acidosis and stroke-like) syndrome; however, diabetes isn't a part of this syndrome, suggesting extraordinary phenotypic expressions of this genetic lesion.

Genetic abnormalities that bring about the incapacity to transform proinsulin to insulin were diagnosed in some households, and such tendencies are inherited in an autosomal dominant pattern. The resultant glucose intolerance is mild. Similarly, the manufacturing of mutant insulin molecules with resultant impaired receptor binding has additionally been diagnosed in some households. It is related to an autosomal inheritance and best mildly impaired or maybe ordinary glucose metabolism.

Management

The control of type 2 diabetes is complicated and the health practitioner will ought to recall the interaction among the psychosocial background, numerous chance elements, and numerous healing dealers earlier than choosing a routine suitable to the affected person. In sensible phrases the remedy for type 2 diabetes includes a trade-off among what's appropriate and

what's nearly feasible [1]. There is robust proof that patient focused schooling early withinside the prognosis of diabetes can significantly enhance outcomes. Different research of remedies, such as the UKPDS (UK Prospective Diabetes Study) and DCCT (Diabetes Control and Complications Trial), illustrate the substantial advantages that can be carried out with the aid of using suitable remedy. Cost/benefit tests suggest that advanced diabetes care compares favorably with different installed healthcare programs, inclusive of breast most cancers screening. Newer healing dealers have proven substantial advantages in phrases of cardiovascular and renal outcomes, and their location in remedy of type 2 diabetes is expanding.

Conclusion

Diabetes is a chronic, sometimes asymptomatic disease, a disease without symptoms and signs, but most often complications are the first sign that the patient sees a family medicine doctor for. This means that the disease lasted for some time and that it irreversibly damaged certain organs of the human body. Prevention of complications is the goal of early detection of diabetes, and this is possible with screening. In the USA, for every hundred known diabetics, there are 150 undetected. Only preventive examinations can detect unrecognized patients and prevent serious complications of diabetes.

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