A review on nanotech microchip for diabetes mellitus

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Abstract
Diabetes mellitus is an metabolic disorder with multiple etiology characterized by hyperglycemia, disturbances of carbohydrate, fat and protein metabolism and resulting from inadequate insulin secretion, inadequate insulin supply and both. Type 1 diabetes (T1D) is an autoimmune disease, whereas Type 2 diabetes (T2D) results from insulin resistance and beta cell dysfunction. Previously, the onset of these two separate diseases was easily distinguished, with children being most at risk for T1D and T2D occurring in overweight adults. However, the dramatic rise in obesity, coupled with the notable increase in T1D, has created a large overlap in these previously discrete patient populations. Delayed diagnosis of T1D can result in severe illness or death especially chronic complication like nephropathy, neuropathy, high blood pressure, stroke, gastroparesis, diabetic keto acidosis (DKA), foot, eye and skin complications and rapid diagnosis of T1D is critical for the efficacy of emerging therapies. However, attempts to apply next-generation platforms have been unsuccessful for detecting diabetes biomarkers. The plasmonic gold microchip for near-infrared fluorescence–enhanced (NIR-FE) detection of islet cell–targeting autoantibodies. These microchips are now using when compare to RIA and ELISA for detection of diabetes and that to microchips are less expensive and less time consuming with early detection.

Keywords: T1D, T2D, Nephropathy, Neuropathy, High blood pressure, Stroke, Gastroparesis, Diabetic keto acidosis.

INTRODUCTION
The most common form of diabetes is sometimes referred to as metabolic diabetes, which is the diabetes most people are very familiar with, type 2 diabetes. This form of diabetes is most prevalent in people that are overweight or obese. Historically, it has been confined to adults or older patients but it has been on the rise as the global obesity problem has continued to worsen.

The second most common form is type 1 diabetes, which used to be referred to as juvenile diabetes. Type 1 diabetes is not caused by obesity or other metabolic issues and is an autoimmune disease (Fig 1).

Autoimmune disease refers to when the body’s immune system has, for some erroneous reason, recognized a piece of itself as being foreign and started to attack it. In this case, that piece of the self is the pancreas, the organ that makes insulin.

Type 1 diabetes and type 2 diabetes are therefore very different diseases, but they both present with an elevated blood sugar level. In type 2 diabetes, this is because the body has become resistant to insulin, meaning the insulin is ineffective, whereas in type 1 diabetes, the body stops producing insulin altogether because the pancreas is under attack.

The fact that type 1 diabetes is an autoimmune disease means that we can sometimes detect the problems in the immune system before symptoms.
have manifested, whereas in type 2 diabetes, these immune signs do not occur. We can therefore define biomarkers in the blood that are predictive of type 1 diabetes that are not found in type 2 diabetes.

OLD DIAGNOSIS FOR THE DETECTION OF DIABETES MELLITUS
1. The old test is decades old and it’s called radioimmunoassay or RIA for short. RIA is very labor-intensive and expensive, as well as being a biohazard because radioactivity is needed to detect the antibodies.
2. Many people have tried to evolve the platform from RIA to traditional next-generation platforms, which would be similar to an ELISA plate. However, for some reasons that are known and some that are unknown, the testing for these particular autoantibodies is recalcitrant to traditional platforms and trying to move away from RIA really didn’t achieve the sensitivity and specificity required for this type of diagnostic. We’ve therefore been stuck with this very expensive and labor-intensive RIA procedure.

NEW DIAGNOSIS FOR THE DETECTION OF DIABETES MELLITUS
Right now, scientists have found Plasmonic nanotech microchips for early detection of diabetes. The test is performed on top of a glass slide with relatively state-of-the-art surface chemistry. One of the key features is Plasmonic resonance, which we use to amplify the signal of the autoantibodies. One of the reasons the traditional ELISA plates and other next-generation techniques have been unsuccessful is because they fail to preserve this regular structure of these sensitive antigens. Scientists built that into the surface chemistry of our chip. The plasmonics are also so powerful at amplifying the signal that we can measure the autoantibodies using just one drop of blood. This is quite a contrast to the millilitres of blood required for RIA.
Another important feature of nanotech microchips is simple test procedure that to compare to RIA is so less cost with less consuming time may be 2-5 hrs and technically challenging.

Fig 2. A Plasmonic Microchip for biomarker discovery and diagnosis of type 1 diabetes

Schematic depicting the spatial relationship of the platform’s PEG layer, the islet-specific antigens, the primary autoantibodies (Abs) from diluted human serum or blood and the detection antibodies conjugated with a fluorophore signal.

IMPORTANT OF DETECTION OF TYPE 1 DIABETES
Currently, there is a need to make sure we find the adults that have type 1 diabetes and don’t lose them in the sea of adults with type 2 diabetes. For children, we need to protect the ones that don’t necessarily need to start on insulin and cater the therapy to their specific needs.
Knowing somebody’s diagnosis from the outset allows you to provide patient-specific care. The care that’s provided right now really does not cater for the individual’s needs in the way that it could do if we have this information more rapidly.
In the future, next-generation therapies that are coming online will really demand that we improve the speed at which we obtain this information, in order to provide the most effective care.

USE OF NANOTECH MICROCHIP
Type-1 diabetes is an autoimmune disease caused by an inappropriate immune-system attack on healthy tissue. As a result, Patients’ bodies stop making insulin, a hormone that plays a key role in processing sugar, “the scientists said. “The disease begins when a person’s own antibodies attack the insulin-producing cells in the pancreas.”
“The auto-antibodies are present in people with type-1 but not those with type-2, which is how tests distinguish between them,” it added. “A growing body of evidence suggests that rapid detection of,
and aggressive new therapies for, type-1 diabetes benefit patients in the long run, possibly halting the autoimmune attack on the pancreas and preserving some of the body’s ability to make insulin.”

Scientists are discovering increasing amounts of evidence that by rapidly detecting and aggressively treating type-1 Diabetes. Doctors can help stop the autoimmune attack on the pancreas, thus helping the body preserve some of the body’s ability to produce insulin.

The old testing method used radioactive materials to detect the auto-antibodies – a process which took multiple days, cost several hundreds of dollars per patient and had to be performed by highly-trained professionals. Conversely, the new method does not use radioactivity, takes only a few minutes, requires little training to administer and is expected to cost approximately 20 dollars for a chip that can be used for as many as 15 tests.

The microchip also uses far less blood than the older test, requiring just a finger prick instead of a laboratory-based blood draw, and relies on a fluorescent-based method of antibody detection. Nanoparticle-sized gold coats the base of each chip, intensifying the fluorescent signal and allow the antibodies to be detected. They are currently petitioning the US Food and Drug Administration (FDA) for approval of the device.

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Nil.

CONFLICT OF INTEREST
Not interest.

REFERENCES


