How Genomics Will Ensure Risk-free & Beneficial Treatment

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In today's world, modern medications and treatment save millions of lives every year. However, any one prescription probably won't work for you, regardless of whether it works for others. Moreover, there might be a case where it causes severe side effects for you but not for someone else. There are several factors like your age, lifestyle, health etc. that influence your reaction to medications along with which one of the main factors are your genes. Pharmacogenomics is the study of how an individual's distinctive genetic makeup influences their reaction to medications.

What is precision medicine?

The aim of precision medicine is to tailor health care, with decisions and treatments customised to everyone in every way possible. Pharmacogenomics is an integral part of precision medicine.

Although genetic testing is still a relatively new development in drug treatment, but this field is rapidly expanding considering the value proposition it provides. At present, there are over 200 drugs that have been labeled as pharmacogenomic biomarkers. These biomarkers are quantifiable or specific genetic information that can be used to individualise the use of a specific drug.

Why is genomic information helpful for medication and treatment?

Whenever a medication is taken, certain processing occurs in the body which is important for the drug action and response. In case of some drugs, an active drug is made inactive (or less active) through metabolism whereas in other cases, an inactive (or less active) drug is made more active through metabolism. It is important that the active form of a drug stays in the body for a specific period to do its work properly. In some people, the drug is metabolised too quickly or too slowly or not at all. This may mean that either the drug may not produce its intended effect, or it may remain in body for a long time which may lead to side effects or adverse drug reactions (ADRs). Such people may thus respond differently than others to the same medications or may experience different side effects from drugs. Therefore, a drug that is effective for one person may be less effective for another or that a drug that is safe for one person may be less safe for another person—even at the same dosage. This variability in the drug response may be due to the difference in genetic constitutions of individuals, along with various other factors like age, gender, comorbidities, lifestyle, etc. that impact the drug response. Genetic variants that occur in genes that code for drug-metabolising enzymes, drug targets, drug transporters, or proteins involved in immune response may influence the processing of most drugs in the body.

How does pharmacogenomics work in practice?

For example, Clopidogrel is an oral antiplatelet agent which belongs to a class of medicines called platelet inhibitors. It is used to inhibit blood clot formation in coronary artery disease, peripheral vascular disease, and cerebrovascular disease. It helps to prevent heart attacks and strokes in persons at high risk and prevent blood clots after certain procedures such as percutaneous coronary intervention (angioplasty; coronary stent) or coronary artery bypass grafting (CABG). Clopidogrel works by stopping the platelets from sticking together and thus inhibiting platelet activation and aggregation.

Like any other drug, taking clopidogrel at right dosage is important. Clopidogrel will not work properly if you take less of it and taking more than directed may increase the chance of side effects. The main side effect of clopidogrel is bleeding more easily than normal. This includes nosebleeds, heavier periods (in females), bleeding gums or bruising. Doctor may prescribe an initial loading dose of up to 300mg or 600mg to acute coronary syndrome patients followed by maintenance dose of 75mg per day. For prevention of heart attack or stroke in patients with a history of heart attack, stroke, or peripheral arterial disease, a dose of 75mg once a day is normally prescribed.

Clopidogrel is a prodrug that must be metabolised to its active form by enzymes in the liver (particularly governed by the CYP2C19). There are several factors which affects clopidogrel metabolism and efficacy which can be categorised into non-genetic factors (like age, gender, BMI, tobacco consumption, comorbidities, etc.) and genetic factors including polymorphisms in CYP2C19 gene.

Genetic variants in CYP2C19 gene can also affect the metabolism of clopidogrel and depending on the genetic make-up of an individual, they can be either a normal, poor, intermediate, rapid or ultrarapid metaboliser of clopidogrel. Individuals who are genetically determined as poor or intermediate metaboliser may have lower response to clopidogrel. Therefore, they will not be able to prevent blood clot formation efficiently which can eventually increase the risk of heart attack and stroke. This means that clopidogrel is not a suitable drug for these individuals and must be replaced with appropriate alternative drugs.

The future of pharmacogenomics

Although pharmacogenomics is new in Indian medical ecosystem, but it has made a great progress globally. In India, it has shown a promising future that will help in transforming the preventive healthcare and overall treatment process.

While pharmacogenomic testing is currently used for only a few drugs, the field is growing very quickly. Improved understanding of how pharmacogenomics can protect your health and improve your treatment will be increasingly important. Consult with your healthcare provider about what pharmacogenomics might mean for your health.