SPECIFIC USES OF BIOCHEMICAL TESTS

Diagnosis

It has been said that diagnosis in medicine is an art, not a science. Clinical diagnosis is based on the patient's history and clinical examination. Taking general and hospital practice together, it has been estimated that in more than 80% of cases, a confident diagnosis can be made on the basis of the history or the history and clinical findings alone. The ideal diagnostic test would be 100% sensitive and 100% specific. In practice, the capacity of biochemical tests to provide precise diagnostic information is extremely variable.

Molecular genetic analysis is a special case of the use of biochemical tests for diagnosis. It is used to detect the presence of a mutation responsible for a specific disease. Even when possession of a mutation does not inevitably result in the development of a disease» it can indicate increased susceptibility to a condition.

The capacity of a biochemical test to provide diagnostic information can be quantified by the calculation of a mathematical function known as the predictive value. The predictive value of a diagnostic test depends on the prevalence of the condition in the group of people to whom the test is applied. If a diagnostic test is used indiscriminately, its predictive value will be low.

The majority of biochemical tests made for diagnostic purposes involve analysis of plasma or serum.

Most biochemical tests are quantitative and the more abnormal a result is, the greater is likely to be the pathological disturbance causing it.

Prognosis

Prognosis is a medical term for predicting the likely or expected development of a disease, including whether the signs and symptoms will improve or worsen or remain stable over time. The likely outcome or course of a disease; the chance of recovery or recurrence.

Screening

Screening for disease implies attempting to detect disease before it becomes manifest through the development of a clinical disturbance. Screening can involve clinical assessment, laboratory and other tests. A screening lest on its own should not usually be regarded as being diagnostic. When the prevalence of a condition in the population being screened is low, the predictive value of a positive result is often lower than is generally supposed. Diagnoses made on the basis of screening tests must always be confirmed by further investigation.

Screening may be applied to a population, to groups within a population sharing a common characteristic or to individuals. According to the nature of the condition in question, screening may be carried out antenatally, shortly after birth, during childhood or during adult Life.

1. Population screening: Population screening is **the process of assessing the prevalence of a particular trait in the entire population or in a subgroup of the population**. Genetic testing or other means are used to determine the presence of biomarkers or genetic characteristics.
2. Selective screening: s**creening of selected groups of people in high-risk categories**, for example, genetic screening of people with a strong family history of breast cancer.
3. Individual screening: Examples of individual screening include antenatal screening of a fetus for an inherited disease when a previous child of the parents has been found to have the condition or when there is a strong family history of the condition.

The acquisition of biochemical data

Biochemical test/parameter:

- Core Biochemical test
- Specialized Biochemical test (hormone, vitamin, trace elements, PCR, micro array)

FACTORS AFFECTING TEST RESULTS

• **Preanalytical**: that is, either outside or within the laboratory but before the analysis is performed;

• **Analytical**

• **Postanalytical:** that is, during data processing or transmission, or in relation to the interpretation of the data.

Preanalytical Factors: Preanalytical factors fall into two categories: those which relate directly to the patient (biological factors) and those which relate to the specimen obtained for analysis (technical factors).

- Technical factors
    - correct identification of the patient
    - appropriate preparation of the patient
    - collection of the sample required into a container
    - accurate labelling of the specimen container
    - secure transport to the laboratory
- Biological factors
    - Age
    - Sex
    - Body mass
    - Time
    - Stress

- Posture
- Food intake
- Drugs

Analytical Factors:

- Staff must be properly trained
- reagents and calibration materials prepared correctly
- instruments maintained and calibrated according to the manufacturer's instruction
- precision accuracy
- quality assurance
- Tests must be performed in strict accordance with written protocols.
- Specificity
- Sensitivity

POSTANALYTICAL FACTORS

Errors can still arise even after an analysis has been performed, for example if calculations are required or if results have to be transferred manually either directly from an analyser to a report or entered into a computer database. Even computers are not immune to error.

Data interpretation

NORMAL AND ABNORMAL

When a test is performed for the first time on an individual, the result must be assessed against what is expected. Usually, it is assessed specifically against what is expected in a healthy individual, although it might be more relevant to assess it against what is expected in a comparable patient suffering from the same condition. The range of values expected in healthy individuals has been often been termed the 'normal range* but for various reasons, the term 'reference range' is now preferred.

Reference values

A reference value is defined as the value for an analyte obtained by measurement in an individual precisely selected using detuned criteria such as sex, age, state of health or other relevant characteristics.

THE PREDICTIVE VALUE OF TESTS

The concept of predictive values is that disease or freedom from that disease can be defined absolutely that there is a test which can be regarded as the 'gold standard'.

If all the member» of a population consisting of people with and without a particular disease are subjected to a particular test, it will be divided into four categories:

- **true positives (TP)** - individuals with disease, who test positive;
- **false positives (FP)** - individuals free of disease, who test positive;
- **true negatives (TN)** - individuals free of disease, who test negative;
- **false negatives (FN)** - individuals with disease, who test negative.

The total number of positive tests is (TP+FP) and the total number of negative tests is (TN+FN).

These data can conveniently be arranged in a matrix. It is then easy to derive the other important parameters relating to test performance, that is, prevalence, sensitivity, specificity, predictive value and efficiency.

Prevalence: The prevalence of a disease is the number of individuals with the disease expressed as a fraction of the population. Thus:

$$\text{Prevalence} = \frac{TP+FN}{TP+FP+TN+FN} \times 100\%$$

Sensitivity: The sensitivity of a diagnostic test is defined as the number of true positives in all individuals with disease. Thus:

$$\text{Sensitivity} = \frac{TP}{TP+FN} \times 100\%$$

Specificity: The specificity of a diagnostic test is defined as the number of true negatives in all individuals without disease. Thus:

$$\text{Specificity} = \frac{TN}{TN+FP} \times 100\%$$

The predictive value: The predictive value of a test is a measure of its ability to allocate individuals correctly to cither the disease or non-disease category. Thus, the predictive value of a positive test is given by:

$$\text{PV(+)} = \frac{TP}{TP+FP} \times 100\%$$

and the predictive value of a negative test by:

$$\text{PV(-)} = \frac{TN}{TN+FN} \times 100\%$$

Efficiency: The efficiency of a test is a measure of its ability correctly to assign people to both the disease and the non-disease category. Thus:

$$\text{Efficiency} = \frac{TP+TN}{TP+FP+TN+FN} \times 100\%$$