Introduction to Biomarkers

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Introduction

• In this section we will discuss...
• What are biomarkers
• History
• What is a good biomarker
• Types of biomarkers
• Nature of biomarkers
• Biomarker validation
• Role of BMs in health care system
Introduction

• Biomarker
  • Defined as a characteristic that can be objectively measured and evaluated as an indicator of a physiological or a pathological process or pharmacological response to a therapeutic intervention

• Classical biomarkers being blood pressure, glucose....
Introduction

• History

Table 1.1 Historical landmarks in discovery and development of biomarkers

<table>
<thead>
<tr>
<th>Year</th>
<th>Landmark</th>
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<tbody>
<tr>
<td>1847</td>
<td>The first laboratory test for a protein cancer biomarker, the Bence Jones protein in urine</td>
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<td>1954</td>
<td>Test for the measurement of transaminases in myocardial infarction (Karmen et al. 1954)</td>
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<td>1960s</td>
<td>The term “biomarker” started to appear in the literature in connection with metabolites and biochemical abnormalities associated with several diseases</td>
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<td>1967</td>
<td>An improved test for myocardial infarction based on a biomarker – serum creatine phosphokinase (Rosalki 1967)</td>
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<td>1971</td>
<td>Report of carcinoembryonic antigen (CEA) as biomarker of cancer (Moore et al. 1971)</td>
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<td>1987</td>
<td>Troponin I as a biomarker for myocardial infarction (Cummins et al. 1987)</td>
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<td>Early 1990s</td>
<td>Accelerator mass spectrometry used for analysis of biological samples for biomarkers</td>
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<td>1995</td>
<td>Applications of proteomics for discovery of biomarkers and use in molecular diagnostics</td>
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<tr>
<td>1999</td>
<td>Emergence of metabolomics for study of biomarkers</td>
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<td>2000</td>
<td>Sequencing of the human genome completed opening the way for discovery of gene biomarkers</td>
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<td>2005</td>
<td>Discovery and application of biomarkers becomes a major activity in biotechnology and biopharmaceutical industries</td>
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Introduction

• What is a good BM
• Ideal BM must be specifically associated with a particular disease or disease state and should be able to differentiate between similar physiological conditions
• Standard biological sources like serum or urine can be used for identification
• Should have an accurate, simple and cost effective measurement method
• Must have base line reference point
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• Types of biomarkers
• Predisposition BMs
  • Helpful in identifying likeliness of getting disease
• Screening BMs
  • Helpful in screening who is suffering the disease
• Staging BMs
  • Helpful in categorizing disease severity
• Prognostic BMs
  • Helpful in assessing disease progression
• Prediction BMs
  • Helpful in predicting the course of the disease
• Recurrence monitoring BMs
  • Helpful in identifying recurrence of the disease
Introduction

- Nature of Biomarkers
- Nature of BMs can be as simple as metabolites like glucose, steroids, lipids… and also can be complex such as T cells, auto-antibodies….
- Classically they can be
  - A piece of DNA – gene – genomics
  - RNA – transcriptomics
  - Any protein – proteomics
  - Any metabolite – metabolomics
  - Protein interactions - interactome
Introduction

- Biomarker validation
  - Is the process of assessing the assay or measurement performance characteristics

- Biomarker qualification
  - Is the process of providing evidence to link a BM with biology and clinical end points
Introduction

• Role of BMs in health care
  • Knowledge of BMs can be used by translational medicine (transfer of research findings to clinical applications)
  • BMs play important role if not central
  • Helpful in inventing diagnostic kits ultimately leading to drug development
  • Aid in developing personalized medicine which is the future of health care

• Limitations
Introduction

• Relationship of BMs to health care
Introduction

• Next class…..
• BMs of general tissue functions