Basic Biopharmaceutics

Introduction

All pharmaceuticals, from the generic analgesic tablet in the community pharmacy to the immunotherapy in specialized hospitals, undergo extensive research and development prior to approval by the FDA.

The physicochemical characteristics of the API, or drug substance, the dosage form or the drug, and the route of administration are critical determinants of the ***in-vivo*** performance, safety and efficacy of the drug product.

The properties of the drug and its dosage form are carefully engineered and tested to produce a stable drug product that upon administration provides the desired therapeutic response in the patient.

Both the pharmacist and the pharmaceutical scientist must understand these complex relationships to comprehend the proper use and development of pharmaceuticals.

The importance of the drug substance and the drug formulation on absorption, and distribution of the drug to the site of action

A sequence of events are precede elicitation of a drug's therapeutic effect.

First, the drug in its dosage form is taken by the patient either by an oral, IV, SC, transdermal, etc., route of administration.

Next, the drug is released from the dosage form in a predictable and characterizable manner.

The importance of the drug substance and the drug formulation on absorption, and distribution of the drug to the site of action

Then, some fraction of the drug is absorbed from the site of administration into either the surrounding tissue, into the body (as with oral dosage forms), or both.

Finally, the drug reaches the site of action.

If the drug concentration at the site of action exceeds the ***minimum effective concentration*** (MEC), a pharmacologic response results.

The importance of the drug substance and the drug formulation on absorption, and distribution of the drug to the site of action

The actual dosing regimen (dose, dosage form, dosing interval) was carefully determined in clinical trials to provide the correct drug concentrations at the site of action.

This sequence of events is profoundly affected by the design of the dosage form, the drug itself, or both.

Pharmaceutical scientists have evaluated the relative drug availability to the body ***in vivo*** after giving a drug product to an animal or human, and then comparing specific pharmacologic, clinical, or possible toxic responses.

e.g. A drug such as isoproterenol causes an increase in heart rate when given intravenously but has no observable effect on the heart when given orally at the same dose level.

In addition, the ***bioavailability*** may differ from one drug product to another containing the same drug, even for the same route of administration.

The difference in drug bioavailability may be manifested by observing the difference in the therapeutic effectiveness of the drug products.

The nature of the drug molecule

The route of delivery

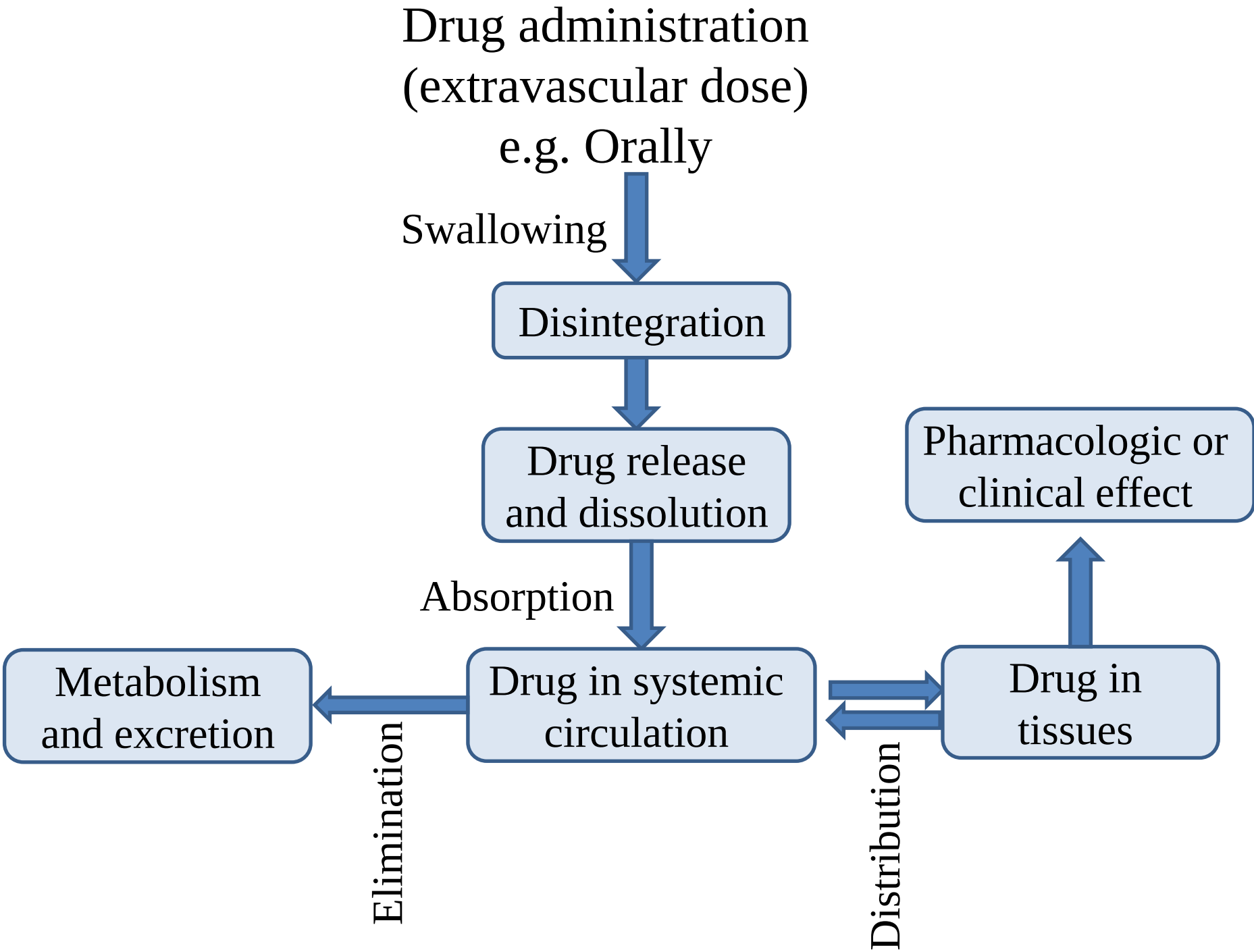
The formulation of the dosage form

Determine whether an administered drug is therapeutically effective, toxic, or has no apparent effect at all.

Biopharmaceutics is the science that examines this interrelationship of the physicochemical properties of the drug, the dosage form in which the drug is given, and the route of administration on the rate and extent of systemic drug absorption.

Biopharmaceutics involves factors that influence

1- The stability of the drug within the drug product
2- The release of the drug from the drug product
3- The rate of dissolution/release of the drug at the absorption site
4- The systemic absorption of the drug.


Drug administration
(extravascular dose)
e.g. Orally
Swallowing
Disintegration
Drug release
and dissolution
Absorption
Drug in systemic
circulation
Metabolism
and excretion
Elimination
Distribution
Drug in
tissues
Pharmacologic or
clinical effect

The study of biopharmaceutics is based on fundamental scientific principles and experimental methodology.

Studies in biopharmaceutics use both ***in-vitro*** and ***in-vivo*** methods.

In-vitro methods are procedures employing test apparatus and equipment without involving laboratory animals or humans.

In-vivo methods are more complex studies involving human subjects or laboratory animals.

These methods must be able to assess the impact of the physical and chemical properties of the drug, drug stability, and large-scale production of the drug and drug product on the biologic performance of the drug.

Biopharmaceutics also considers the properties of the drug and dosage form in a physiologic environment, the drug's intended therapeutic use, and the route of administration.