

تفريغ فارما ١

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Distribution

- After ^{absorption} reaching plasma, drug has to leave it to be distributed into the interstitial and intracellular fluids

سائل ما بين الخلايا

السائل داخل الخلية

اشي منهم منهم قبل ما تنزل تحت : معنا حجم الماء في الجسم تقريباً 49 لتر ، و 4 منهم بين الخلايا في الدم ، والباقى (38L) في الأنسجة ،
فلو كان عندها صابون الا شوي صابون فارح يدخل متحرك وينتشر بين الخلايا فقط ، اصالو بده أكثر من 4L صابون فارح يتوزع بين
الأنسجة ويا هذا كل الماء ، علماً إنه في أدوية بدها أكثر من 500L ، من وين بدنا نجيبها والجسم ما فيه إلا 49L

كله رح نفهمه تحت في ذن الله



- “Distribution is the dispersion of the drug among the various organs or compartments within the body”

DISTRIBUTION OF DRUGS

- After absorption, drug distributes to

➤ Interstitial fluid سائل ما بين الخلايا

➤ Intracellular fluid داخل الخلايا

❖ liver, kidney, brain, and other well-perfused organs receive most of the drug, whereas delivery to muscle, most viscera, skin, and fat is slower

➤ The **rate** of delivery and potential **amount** of drug distributed into tissues depend on : يعتمد توزيع الدواء في الأنسجة على :

- Cardiac output
- Regional blood flow
- Capillary permeability
- Degree of binding to plasma and tissues protein albumin protein
- Relative lipophilicity of the drug

تحمية الدواء في ارتباطه ببروتين الدم
صارح يتركها تأثير ولا يغيرها distribution
الطبيباني يميل (rate) والارتباط قوى أو
منفصل حسب الدواء
• الدواء الذي يميل إلى الارتباط
من non polar drugs

- هنا الأعضاء هي الأكثر تفرغها أدوية
- Well perfused organs (liver, kidney, brain) initially receive most of the drug
- Less perfused organs: (muscles ,most viscera, skin, and fat) initially receive less drug

كيف بدنا نفهم إي ذا الدواء روح يضاهج بين حجم
الحماة إي من الدم (٧ L) ولا بدو أكثر ولازم
بدخل ولا نسجه؟ عن طريقه صلب V_d

Volume of distribution (V_d)

- Fluid volume that is required to contain the entire drug in the body at the same concentration measured in the plasma at time zero.

حكيًا مجموع الحماة من الحجم
٧ L صبح! طيب حجم ماد
الدم = ٧ L، والباقي داخل الأنسجة

- Importance : it can be useful to compare the distribution of a drug within the volumes of the water compartments in the body

طيب لو حسينا V_d وطلعنا رقم
صغير ← يعني الدواء صابهاج
إلا إنه يكون في الدم، تمام!
أما بمارا كانت رقم كبير يعني
ماد الدم صابكفيه، في بدخل
للانسجة لأنه عندها كثير.

← تم أخذ حماة قبل المريف

$$V_d = \frac{\text{total amount of drug (mg)}}{\text{plasma concentration (mg/L)}}$$

نفسها صبح:

عمية تم سحبها من المريف
بعد مدة عن أخذ البقرة

← النتائج بوحدة اللتر (L)

مثال

مثال سريع: لو أخذ المريض دواء 500 mg وبمعدلة أخذ معينة من دمه (plasma) وكان
 الناتج 5 mg/L ؟ لو صا علينا برز نفرض انه فرغ كبير بين إلى أخذ مادتين إلى جوده
 بالتالي نعرف انه دخل للأ نسبه و عشانه نتأكد من صحة تركيزه بنحسب

$$V_d = \frac{500 \text{ mg}}{5 \text{ mg/L}}$$

$$= 100 \text{ L}$$

وهذا كبير
 يعني الدواء وصل للأقل
 الأنسجة مما نري

blood brain barrier

اختراق

Example of BBB drug penetration importance

خصائص الأدوية التي لها القدرة على اختراق حاجز الدماغ؟

- uncharged =
- unionized
- highly lipophilic
- unbound

more lipophilic → صعب ومنسحب
 للنفس أكثر
 Old generation
 Antihistamines: Diphenhydramine, causes
more sedation due to central
blocking of H1 receptor

Newer generation
 Antihistamines: Loratidine,
 less sedative effect

Diphenhydramine (old)
 lipophilicity
 Loratidine (new)

More lipophilic
 more sedative
 → صعب للنفس
 صعب

Less lipophilic
 less sedative

Placental Transfer of Drugs

- Lipid solubility *high*
- Extent of plasma binding *low*
- Degree of ionization of weak acids and bases
= unionized ✓

Administration Routes

- Oral
- Sublingual
- Rectal
- Intravenous
- Subcutaneous
- Intramuscular
- Intra-arterial
- Intrathecal and epidural
- Pulmonary absorption

through the mouth

عن طريق الشرج

IV

تحت الجلد

IM

داخل الشرايين

من الفقار

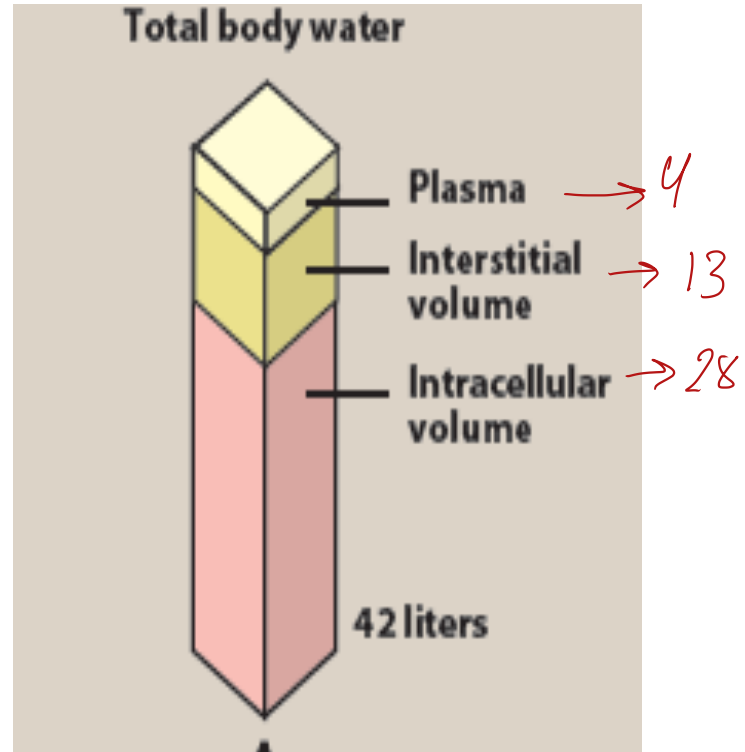
استعصا من رئوس

Parenteral

حجم الماء Water presence in various body compartments :

intra cellular > interstitial > plasma

Schematic representation of body water in a 70kg adult. A total of 42 L. Intracellular volume 28L, Interstitial 13 L and plasma about 4L



V_d

that taken by the patient

- $V_d = \text{Dose} / C_p$ plasma concentration

- Water soluble drugs will reside in the blood, and fat soluble drugs will reside in cell membranes, adipose tissue and other fat-rich areas.
- Drugs distributed mainly in plasma will have lower V_d values compared to drugs distributed mainly in tissues

← أكيد، لأننا نأخذ جميع المواد في النسبة كـ مقارنة بالدم

→

- Volume of Distribution also relates to whether a drug is Free / protein bound
- Drugs that are charged tend to bind to serum proteins.
- Protein bound drugs form macromolecular complexes that cannot cross biological membranes and remain confined to the bloodstream.

تم ترشحها نمی شود
⑤

Plasma Proteins

- ✓ ^{موجود في الدم} Albumin is a major carrier for acidic drugs
- ✓ α 1- acid glycoprotein binds basic drugs
- ✓ Plasma protein acts as a reservoir

- ✓ ^{الرّابطة بين الدواء والبروتين} The binding is usually reversible and non specific Therefore many drugs may compete on Albumin binding, resulting in a noticeable displacement of one drug by another (warfarin)

- ✓ Protein binding affect drug excretion through the kidneys, its transport and metabolism

99%

bind with
blood protein

1%

free

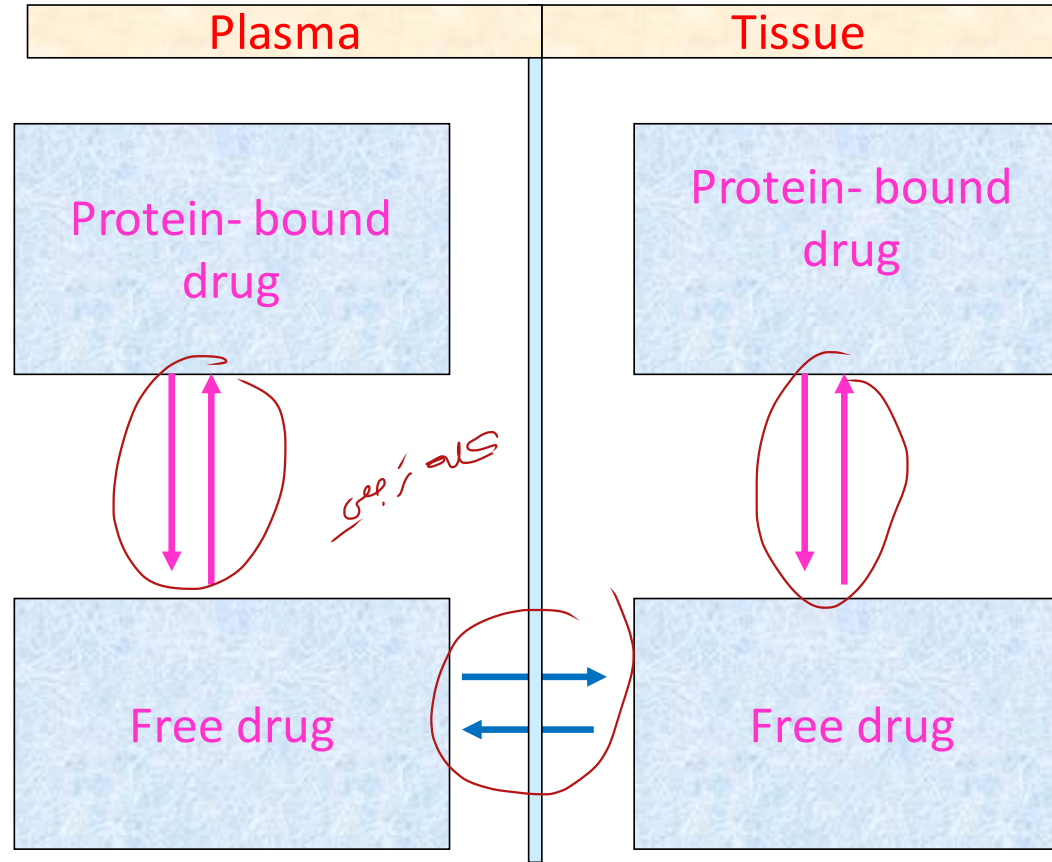
دليلًا على

أنّ تعطي المنعول

المطلوب ، جرعة

محددة بدقّة.

Reversible drug binding to albumin is critical to effective drug distribution



The free drug concentration gradient drives transport across the membrane.

- A large variety of drugs ranging from weak acids and weak bases bind to plasma proteins.

- Binding to other plasma proteins (e.g., lipoproteins and globulins) occurs to a much smaller extent.

albumin انجمن پروتین

Protein Displacement

- For example, displacement of unconjugated bilirubin from binding to albumin by the sulfonamides and other organic anions is known to increase the risk of bilirubin encephalopathy in the newborn

صغار الأطفال

- ❑ Note that drugs are active in the unbound form.

Tissue Binding

بیراچم

- Many drugs accumulate in tissues at higher concentrations than those in the extracellular fluids and blood as in (Azithromycin) (10days effect)

لما الدواء بیراچم بترکیز عالیه فی الأنسجه، فانه هادو الاشی بقیه مفعول الدواء

بیروم وقفه طویل، کانه یطهره شوی شوی صنه و هیل بقیه عندی دایمیا نری محذوف

- Tissue binding can serve as depot (Reservoir), allowing sustained drug release into the circulation
- Tissue binding of drugs usually occurs with cellular constituents such as proteins, phospholipids, or nuclear proteins and generally is reversible

Fat As a Reservoir

- In obese persons, the fat content of the body may be as high as 50%, however, in lean individuals it constitutes 10% of body weight.
- 70% of the highly lipid-soluble barbiturate *thiopental* may be present in body fat 3 hours after administration
- Fat is a rather stable reservoir because it has a relatively low blood flow

الدهون تعتبر مستودع أفضل، لأن تدفق الدم عندها قليل وبالتالي استهلاك الدواء عندها أقل،
أي لا يدخل عندها لفترة طويلة

Bone

- Bone can become a reservoir for the slow release of toxic agents such as radium into the blood
- Tetracycline bone adsorption .

Central Nervous System and Cerebrospinal Fluid

- ❖ The distribution of drugs into the CNS from the blood is unique
- ❖ The unique characteristics of brain capillary endothelial cells which constitute the blood-brain barrier
- ❖ the brain capillary endothelial cells have continuous tight junctions

- The lipid solubility of the nonionized and unbound species of a drug is therefore important factors for BBB penetration
- The more lipophilic, the more Centrally absorbed hence the greater the effect will be.

Administration routes :Oral route

- Most common method of administration, safest and most convenient and economical
- Disadvantages include limited absorption for some drugs, emesis and GE upset, destruction of some drugs by gastric enzymes and always needs patient cooperation.
- Absorption is governed by :
 - Drug factors: pH, ionization, etc..
 - Blood flow to the area of absorption
- * Entering coating for acid labile drugs
- * Controlled release preparations (increase compliance)

Sublingual route :

Despite the small surface area, however its significant for some medication with high lipid solubility thus ensuring very fast absorption

(Nitroglycerine in angina)

Rectal route:

Used when oral route is precluded (patient is unconscious).

Mainly used for children . Almost 50% of the dose will bypass liver metabolism , irregular absorption rate, and may cause irritation

Parenteral injection

- **Intravenous** :BA is complete and rapid. Used in cases such as general anesthesia, also used for irritating drugs because they will be diluted in blood. however unpleasant action may happen, so there is a need of slow infusion and clinical supervision when using this route.

- **Intramuscular :**

- Drugs in aqueous solutions have rapid absorption or specialised depots via this route depending on the blood flow rate.
- Absorption in females is slower due to different adipose tissue distribution. Also absorption pattern is unpredictable with obese patients.

- **Intra arterial:**

occasionally some drugs are injected into arteries to localize the effect such as in head and neck cancer.

- **Intrathecal :**

mainly used when drugs cant cross BBB or CSF

- **Pulmonary absorption :**

used for volatile drugs and gases, ensures rapid and high absorption due to the large surface area of lungs. Such as Aerosols as inhalation.

“Advantages are mainly bypass liver , and this route is ideal for lung diseases such as asthma because the site of administration is the site of action”.

- **Subcutaneous :**

Used only for drugs that are not tissue irritating, otherwise it causes severe pain and necrosis .Insulin and heparin administration is a good example of this route .

Unsuitable for drugs which are administered with large volume.

Topical application

1) **Mucous membranes :**

Drugs applied to such membranes as, conjunctiva, nasopharynx, oropharynx, vagina

2) **Skin :**

few drugs can penetrate intact skin!!! Penetration depends on the surface area of application and on the lipid solubility. However , systemic absorption occurs in cases of wounds and burns.

• اللهم اغفر لي ولوالدي والمسلمين والمسلمات الأحياء والأموات

• اللهم إنا نسألك الجنة ونعوذ بك من النار وما قرب إليها من قول أو عمل

• اللهم انصر الإسلام والمسلمين، وزلزل الأرض تحت أعداء الإسلام وأخوانهم وأخوانهم

• اللهم اجمعنا وأهلنا والمسلمين عند حوض رسولك الكريم صلى الله عليه وسلم

• اللهم ارحم أئمتهم اغفرهم وأدخلهم الجنة بغير حساب ولا عذاب واجمعهم وأهلهم في الفردوس الأعلى آمين

• رَبِّ إِنِّي لَمَّا أَنْزَلْتَ إِلَيَّ مِنْ صُفْرٍ فَقِيرٌ

• اللهم ادخلنا مدخلهم ، واخرجنا صفيهم ، واجعل من لدنا سلطاناً نصيراً

• سبحان الله ، الحمد لله ، لا إله إلا الله ، الله أكبر ، اللهم ارزقني وارحمني واغفر لي وأسر مني بيوت الدنيا والآخرة