

تفریغ کلینکال



المحاضرة:
Regulation of
Parathyroid gland

الصيدلانية: ياسمين خليل



لجان التّفعّلات

بسم الله الرحمن الرحيم

Regulation of Parathyroid gland Calcium, Magnesium and Phosphate

اللهم علمنا ما ينفعنا وانفعنا بما علمنا وزدنا علما

ناتئات Ca^{2+} في جسم الإنسان ناتج من النوع Ca^{2+} free Ca^{2+} unionized Ca^{2+} لا كما يخدم جزءه الـ Ca^{2+} free Ca^{2+} في ذلك ارتباطه و يسمى هو Ca^{2+} free و Ca^{2+} unionized

Calcium

- The ionized/free calcium is essential for myocardial contraction whereas protein bound and citrate-bound calcium had no effect

زی الیسومن

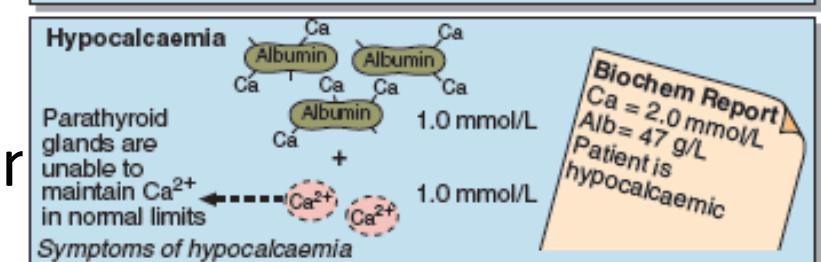
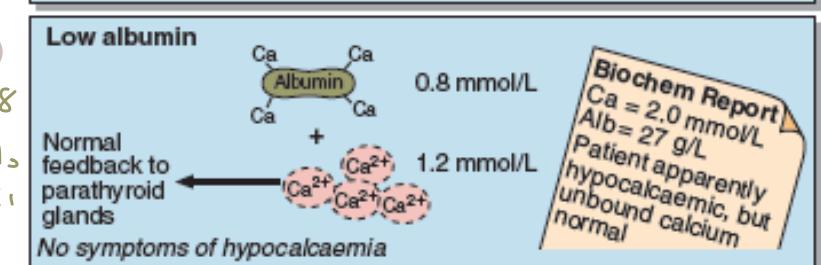
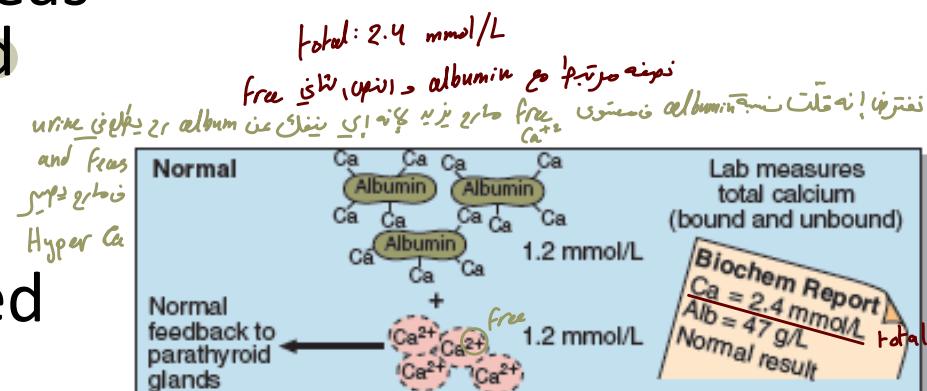
- It is important to maintain ionized calcium at a near normal concentration during surgery and in critically ill patients.

عزم نقل مراقبين (أ) المريضين حبذاً أو المرضى
أفضل الممارسة الجراحية، كإنه مستوى الاستثناء والبروتوكول (يُرجى مراجعتها) المعايير مع تطبيق حبذاً على جميع (أ)
لكربيدات وزيزيمات دفلوكوبـ (Diflucobut) / ionized free في بعسـ (Hypo) فـ بهمـ تـ تشـ بـ جـات

- Decreased ionized Ca conc. in blood can cause neuromuscular irritability which may become clinically apparent as irregular muscle spasms, called tetany.

تَسْجِيْل

• لما ينخل 99% من انتقالات الأيونات من الماء إلى خلايا العظام، فإن 99% من الأيونات تكون ملتصقة بالمواد العضوية، بينما 1% فقط تكون ملتصقة بالمواد المائية.



Regulation of Calcium

cholecalciferol
= vit D

Three hormones, PTH, vitamin D, and calcitonin, are known to regulate serum calcium by altering their secretion rate in response to changes in ionized calcium

لیم من bound کننے ہو ابی عمل تائیش ات خدا

PTH secretion in blood is stimulated by a decrease in ionized calcium and, conversely PTH secretion is stopped by an increase in ionized calcium.

تثبيط كالسيتونين ممتعي Ca عالي في البول due to calcitonin

□ PTH exerts three major effects on both:

□ Bone: activates bone resorption, break down osteoclast and release Ca to ECF

نخر الصمام ٨٪ منها مخازن

bone cells

2

- ❑ Kidney: conserves calcium by increasing tubular reabsorption of calcium ions and stimulates renal production of active vitamin D.

٦) **vit D₃ بجهز ال activational مرتين** : مرّة في الكبد عن طريق 25-Hydroxylation و الثانية في الكلى عن طريق 1-Hydroxylation

الله ارحم زميلنا أiéهم واغفر له وعافه واجمعه وأهله وال المسلمين في الجنة

Regulation of Calcium

vit D \leftarrow ^{sun light}
_{food}

- Vitamin D3, a **cholecalciferol**, is obtained from the **diet** or exposure of skin to **sunlight**, **hydroxylated** in liver to **25-OH-** (inactive form), activated in the kidney by **1- α -hydroxylase** to form **(1,25-OH)2-D3**, the biologically active form which will:

↑ اكتبي
↑ اكتبي
↑ اكتبي
↑ اكتبي
↑ اكتبي

- **Increase calcium absorption in the intestine and**
- **Enhance the effect of PTH on bone resorption.**

يُحسن من نخر PTH للنظام (osteoclasts)

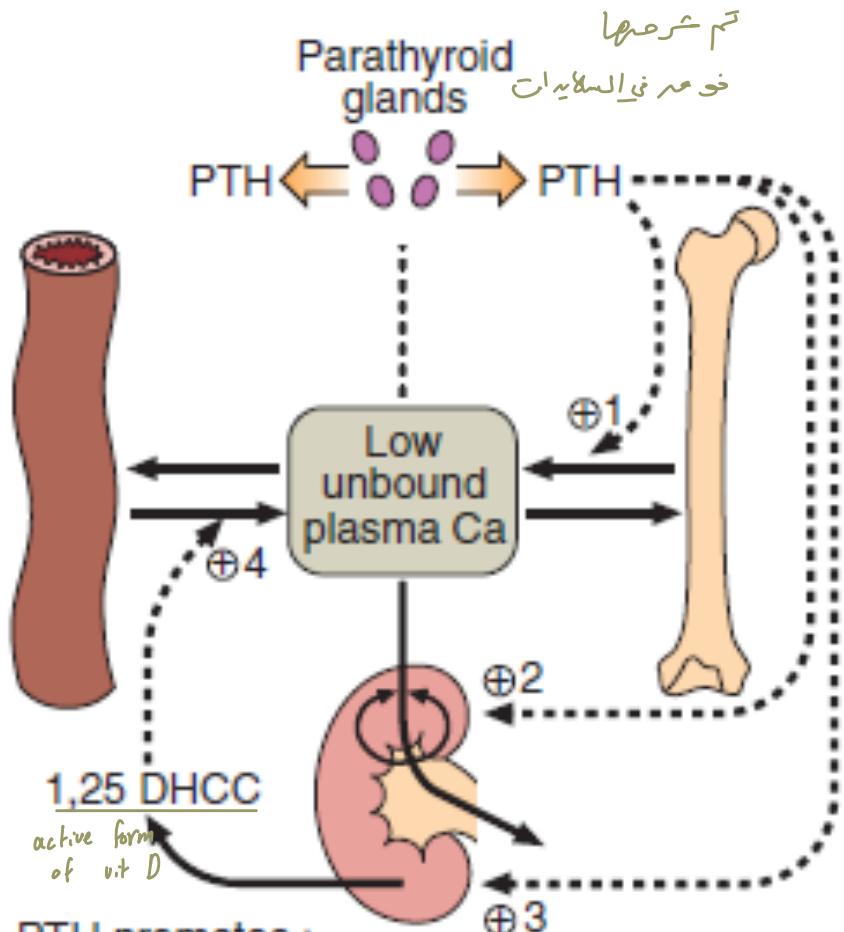
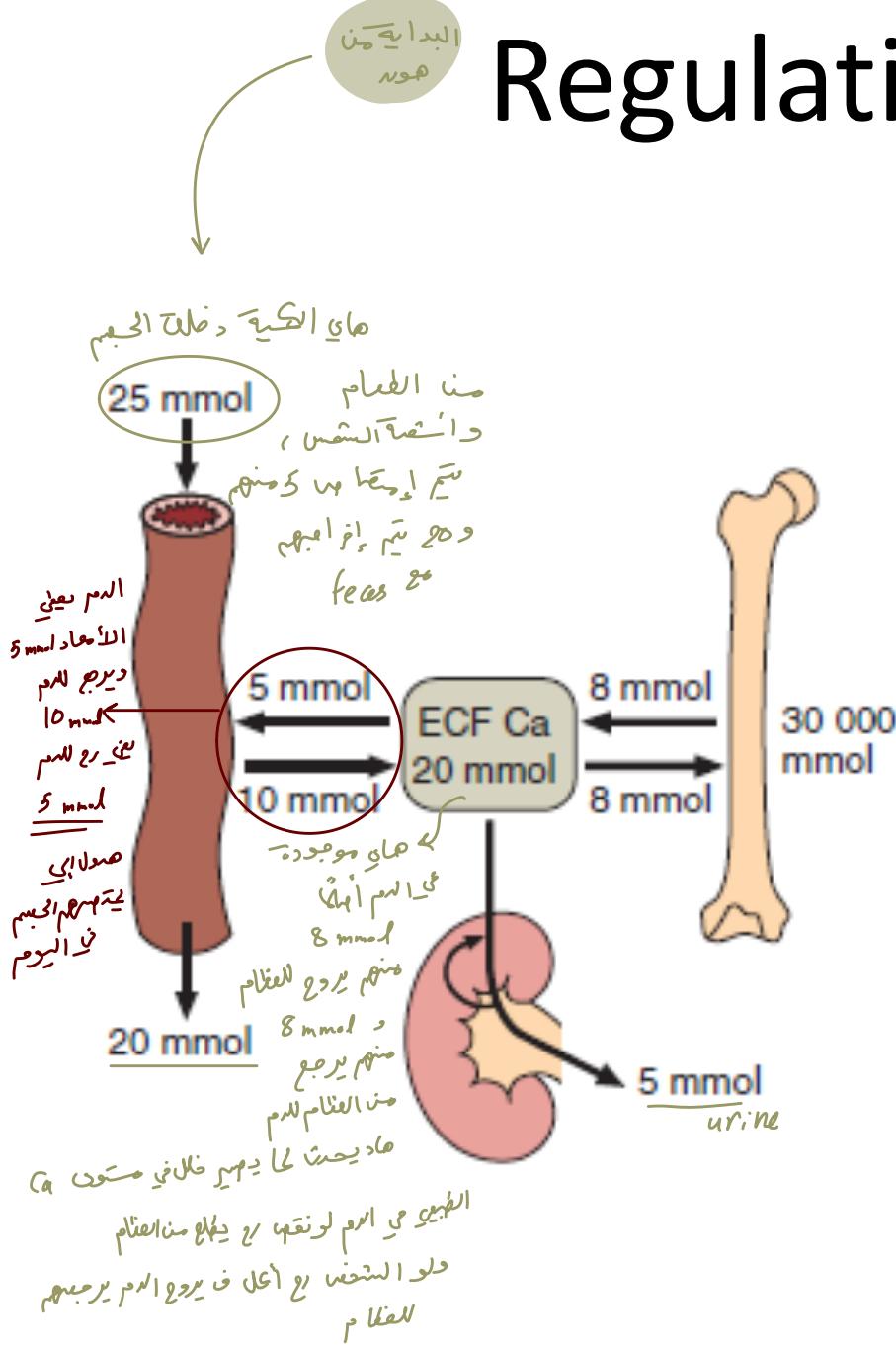
- **Calcitonin**, which originates in the medullary cells of the thyroid gland, is secreted when the concentration of Ca in blood increases (not at normal levels)

عندما يرتفع تركيز Ca في الدم \rightarrow على فبييل تنشيط الـ PTH
عندما يوقف نخر العظام ويتوقف ارتفاع مستوى Ca أكثر من المعيار

- Calcitonin reduces Ca by inhibiting the actions of both PTH and vitamin D

vit D = PTH \neq calcitonin

Regulation of calcium



PTH promotes:

- 1 Bone resorption
- 2 Renal tubular reabsorption
- 3 1,25 DHCC synthesis
- 4 Calcium absorption from gut

Distribution

and 1% in the blood

- About 99% of calcium in the body is part of bone.

ionized unionized

CF. Little is
cardiac
smooth
عَسَارٌ نَحَافَةٌ فَزِيمٌ
الْمَرْكِبُ

- The remaining 1% is mostly in the blood and other ECF. Little is in the cytosol of most cells.
عَنْهُمْ فَخَافَفَ عَلَى فَرَمَةِ اِنْتِرْकَيْنِزِ
- The concentration of ionized calcium in blood is 5,000-10,000 times higher than in the cytosol of cardiac or smooth muscle cells.

فتق، ترکيز خارج دا داھل اکالیوم هم که کایه سیر علیه تجاج ۵۰
تیدر اکالیوم تیورک و فیر مکانه، کانه لو عکه خارج = داھل خارج یکووه فی حرکه اکالیوم
فی الھامات ایه تجاج منھا تی Ca^{2+} نزی افراز الستونین - ۱۱۰ تا ۱۱۵

- Calcium in blood: 45% circulates as free calcium ions (ionized calcium), 40% is bound to albumin, and 15% is bound to anions (bicarbonate, citrate, phosphate, and lactate)

- Distribution can change in disease as conc. Of citrate, bicarbonate, lactate, phosphate and albumin can change dramatically during surgery or critical care. This calcium cannot be reliably calculated from **total calcium** measurement (acutely ill patients) مكتباً عنها فحص الحرمي داناسن المعايير التشخيصية التي تميز لهم

total = free + bound on protein only

$$\text{Corrected } \text{Ca}^+ = \text{total } \text{Ca}^+ + 0.8 \text{ (4-albumin)}$$

normal (8.6-10)

Ques: if total = 8.9

album = 3.2 Then the corrected range is? = 8.84 mmol (normal)

Causes of hypocalcemia

ارتفاع مستوى إنزيم catalase يؤدي إلى زيادة ارتباط Cu في الأمعاء وكمّيّة أمّهابه للدم
ناتجة عن الأمعاء وذلل مع Fe(III) داهتفع مستوى هاد وإنزيم catalase في الــ Fe(III) يزيد

- **Acute pancreatitis:** the cause appears to be a result of increased intestinal binding of calcium as increased intestinal lipase activity occurs

أَسْتَغْفِرُكَ رَبِّي وَأَتُوبُ إِلَيْكَ

- ☐ **Vitamin D deficiency** and **malabsorption** can cause decreased absorption, which leads to increased PTH production or **secondary hyperparathyroidism**.

الا يزور متن باللغة - نصفها
هي غالباً شفالة - بين متن طلاقية - شغل كثير كارثة عند الشخص - حوة (مقدمة) و نصف (D with)

Renal disease (Altered concentrations of calcium, phosphate, albumin, magnesium and hydrogen ion (pH): مَرَاجِعُ الْمَكَلَّمِ تَوَدِّدُ إِلَيْكُمْ ارْتِقَاعُ الْغُوْسَفَانَ ①

- In chronic renal disease, secondary hyperparathyroidism frequently develops as the body tries to compensate for hypocalcemia caused either by hyperphosphatemia (phosphate binds and lowers ionized calcium) or altered vitamin D metabolism

Causes of hypocalcemia

أ) ميكاله صنفي الغدة بلى في استجابة لها (receptors) ولو أفرزت كثير PTH

وراثي

الجسم

سيجبي

Pseudohypoparathyroidism: a rare hereditary disorder in which PTH target tissue response is decreased (end organ resistance)

PTH production responds normally to loss of calcium, however, without normal response (decreased cAMP (Adenosine 3',5'-cyclic phosphate) production), calcium is lost in the urine or remains in the bone storage pool

مسنوناً عن إرسال الاشارات للستيبلان
فتقعه رغبة في الخلايا ماقررها انه خواص ارتباط على
ستيبلانها يعني لها تعاون

صيفاً وبرد
دفول Ca
العنام

آن ما يقدر يطلع منها ما يصنفه صنف انت عادي
ف العقم يغير نحو بالعربي من الطول وما فيه نزف حجم العقم

بريم
دعاي صناديق
الستيبلان اليه
Pseudo PTH

Patients often have common physical features, including short stature, obesity. Shortened metacarpals and metatarsals, and abnormal calcification.

حوادث دبابارات كسرت اذنها

Rhabdomyolysis: as with major crush injury and muscle damage, may cause hypocalcemia as a result of increased phosphate release from the cells, which binds to calcium ions.

من اول المسبب العذر سنار هو ^{intraacellular anion} كا تسكر ايليا
ويطلع الفرز سنار الدم في يصعب مع كيلان Ca^{2+} كبير ويرتبط مع كا فوج و المونون PO_4^{2-} سبب في كل كيلان Ca^{2+} ف ينبع مع المونون Ca^{2+}

Surgical and intensive care

- Controlling calcium concentrations may be critical in **open heart surgery** when the heart is restarted and during **liver transplantation** because large volumes of **citrated blood** are given.

حوالی یعنی کوئہ استجابة آئیں
کا انتشار و انتقام (a) تجوہ علی انسانہ والمرتبہ صابہ نازنی

Ionized Ca measurements are the measurement of greatest clinical value.

فِي الْحَرَمَةِ يَقْعُدُ الْمُتَحَفِّظُ الْوَانِلِ إِلَيْهِ تَهْلِكُ مِنْهُ بُرُوسِيَّاتٍ وَأَيُّونَاتٍ

- Hypocalcemia occurs commonly in critically ill patients, that is, those with sepsis, thermal burns, renal failure, or ^{lactate} ^{bound} cardiopulmonary insufficiency (abnormalities of acid-base regulation and losses of protein and albumin)

Neonatal monitoring

نحو ٢٠٪ من مستوى ٢٠٪ عند مولود في أسبوع أو أقل ينخفض لمستوى أعلى من الطبيعي (التحفظ بالغ) بحوالي .

- Typically blood-ionized calcium concentrations in neonates are high at birth and then rapidly decline by 10-20% after 1-3 days. After about 1 week, ionized calcium concentrations in the neonate stabilize at levels slightly higher than in adults.
- The concentration of ionized calcium may decrease rapidly in the early neonatal period because the infant may lose calcium rapidly and not readily reabsorb it. 10-20٪ ينخفض بـ ٣-٤ أيام في نزول
كما عناه صلين مهمن زراعته المحتوى عاليه لوحضر كثير بجعل سرعه مهبل به بين نعمه .
- Several possible etiologies have been suggested: abnormal PTH and vitamin D metabolism, hypercholesterolemia, عاليه جبيه, hyperphosphatemia, and hypomagnesemia. عاليه إلى قبل اما ابلاعه مكرر

Symptoms of hypocalcemia

- Neuromuscular irritability and cardiac irregularities are the primary groups of symptoms that occur with hypocalcemia. *Cardiac + skeletal.* *if total is lower than 7.5 mmol*
- Neuromuscular symptoms include paresthesia, muscle cramps, tetany, and seizures.
- Cardiac symptoms may include **arrhythmia** or heart block. *→ Hyperkalemia + Hypokalemia + acidosis + Alkalosis + hypo Ca* *لحد الـ 5 أسباب بعده arrhythm*
- Symptoms usually occur with severe hypocalcemia, in which total calcium levels are below 1.88 mmol/L (7.5 mg/dL).

نحو المحتلة من السبب تبع المحتلة

Treatment of hypocalcemia

severe hypo \rightarrow Ca injections
mild \rightarrow oral
will cause constipation

- Oral or parenteral calcium therapy may occur, depending on the severity of the decreased level and the cause.

Ca injection
Ca oral
will cause constipation

vit D
vit D
vit D

- Vitamin D may sometimes be administered in addition to oral calcium to increase absorption.
- If hypomagnesemia is a concurrent disorder, magnesium therapy should also be provided

ارتباط (a) یعنی انتشار free (a) no green

پسندیده ایون های خارجی Ca^{2+} را **extracellular calcium free** می نویسند.

Hypercal

Hypercalcemia

حکایت هم خطیران

- Although either total or ionized calcium measurements are elevated in serious cases, ionized calcium is more frequently elevated in asymptomatic hyperparathyroidism.

Causes of hypercalcemia

Primary hyperparathyroidism (in old women)-adenoma or glandular hyperplasia خربطة هرمونات عند النساء-adenoma خربطة هرمونات عند النساء-الاكتياء



- ❑ hyperthyroidism, because of the proximity of the parathyroid gland to the thyroid gland, hyperthyroidism can sometimes cause hyperparathyroidism. 

عکس مقدارهای کلی از این میکروبلوک های $20\text{mm}\times 5\text{mm}$ (کلیکلی) می باشد.

Benign familial hypocalciuria

البروتينات تتبع α -مطابق PTH related peptide

□ **Malignancy:** هو بيتدى سبب في اشغال PTH فاعلة قدرة على الارتباط \rightarrow دتحفيز حواص ارتباط PTH ولكنها تفعلاً بالشخص PTH لا يدركها مساعدة جسمها

Ca is sole biochemical marker for many tumors.

- Many tumors produce PTH-related peptide (PTH-rP), which binds to normal PTH receptors and causes increased calcium levels 

- ❑ Assays to measure PTH-rP are available because this abnormal protein is not detected by most PTH assays

Causes of hypercalcemia

- ① يُقلِّلُ مُسْتَوِيَّ Ca^{++}
- ② يُرْفِعُ مُسْتَوِيَّ Na^{+}
- ③ يُؤثِّرُ عَلَى الْإِلْكْرُولِيْتُوْمُ (electrolyte balance)
- ④ يُرْفِعُ مُسْتَوِيَّ Ca^{++}

□ Thiazide diuretics increase calcium reabsorption

قلة الحركة تزيد من نزف العظام (مثل تهدر رأس مناعصه، أو نساخ عنوانعه، ...)

□ Prolonged immobilization may cause increased bone resorption. This cause is further compounded by renal insufficiency

هاد اشهر خلا على تضرر عضوي ذي إلى عدم حركة

□ Multiple myeloma

سرطاً سُفْرِيًّا
أنواع بروتينات الدم

□ Increased vitamin D

جداً ضعافاً كاستخف فندر \rightarrow
عند نقص D_{3} يرجح بذراً يأخذ D_{3} supplements
وهو أصلically مستوى D_{3} عند منيغ ف يغير عند خادفها
أذ أنه يتم هنا \rightarrow sunlight كثير ويرتفع مستوى vit D
واليوم ما يحلق الزلادة كأنه خيالهين هنا فنتناهياً \rightarrow ADEK (lipid soluble)

Symptoms of hypercalcemia

normal range 24 mmol/L

بين نبض أنواعه يتربّح ما: أخير

- A mild hypercalcemia (2.62-3.00 mmol/L) is often **asymptomatic**.
أعراضه تتبع الجهاز العصبي، الأعصاب، الكلى ...
- Moderate or severe calcium elevations include:
 - Neurologic symptoms: mild drowsiness or weakness, lethargy, and coma depression,
ارتفاع في التردد، منهاج الرئيسي، معنـى لا يرتفع مـنـواه يـحـقـزـ إـفـازـ g~astri~ وـ H~Clـ فـ زـادـتـ حـوـمةـ الـأـعـصـيـ وـ دـمـكـةـ تـرـددـةـ.
 - GI: constipation, nausea, vomiting, anorexia, and peptic ulcer disease.
Same as Hypo
 - Hypercalcemia may cause renal symptoms of nephrolithiasis and nephrocalcinosis
نـفـسـ مـشـبـبـ الـرـيـفـنـ سـوـالـ عـشـيرـ حـصـوانـ
- Hypercalciuria can result in nephrogenic diabetes insipidus, which causes polyuria and results in hypovolemia, which further aggravates the hypercalcemia.
قللتـ السـوـالـ خـارـجـ تـرـكـيزـ Ca^{++}
- Hypercalcemia can also cause symptoms of digitalis toxicity.
... bradycardia : digoxin أعراضه تسمم

حدوث كثرة بـلـوـا
polyuria
كانـاـ فـيـ تـحـابـيـرـ الـرـئـيـفـنـ

Treatment of hypercalcemia

Depends on the level of hypercalcemia and the cause.

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ ۖ

- Often people with primary hyperparathyroidism are asymptomatic. Postmenopausal women with primary hyperparathyroidism may have estrogen deficiency \rightarrow estrogen replacement therapy (بروتوكول هرمون الاستروجين)
Hyper PTH (الهرمون المفرط)
نحو ٣٠٪ من النساء يعانون من نقص هرمون الاستروجين

ency \rightarrow estrogen replacement therapy (استrogen فارجي)

نقص الاستروجين عن النساء Hyper PTH صبغة كبيرة عن Hyper PTH ١٠ و ممارسة قلائل عن ما تحتوي estrogen كافية لانقشع الهرمون

Parathyroidectomy may be necessary in some hyperparathyroidic patients

استئصال جزء من الغدة أو الفدمة كالمبا لو كان المرض متقدماً

- Often, estrogen replacement therapy reduces calcium levels.

تغیل مسَوی Ca^{+2} نیز تیل PTH (علمه PTH estrogen) را می‌کند.

Patients with moderate to severe hypercalcemia are treated by:

Encouraging salt and water intake to increase calcium excretion and avoid dehydration تقویت ماء و ملح (لوراد) کاہر ہے جو دمپتھے فری ابھول کرنے مطلع ہے تاہم یہ نہیں بالکل وکالتہ بخوبی ہے ①

لوازمه مدراء نویسندگان

Thiazide diuretics should be discontinued.

Biphosphonate (a derivative of pyrophosphate) are the main drug class used to lower calcium levels by preventing bone resorption, achieved by its binding action to bone. MOA ↗

MOA ↗

Determination of Calcium

For total calcium determinations is either **serum or lithium heparin plasma** collected without venous stasis.

وَسَاهَةً أَنْشَدَ عَلَىٰ بَلْهَرِيَّةِ بَنْ بَنْجَبِي
عَسَابَةً مَاتَسْلِسَ الْلَّاَيَا وَتَلَمَّلَ حَمْوَلَرَهَا مَنْ
فَوْ سَنَاتٍ ، كَالْكَنَّيْتِ ... تَرِيَتِهَا مَوْهَبَتِي دَيْبِينِ إِنْ
مَسْتَوْ تَهَمَّعَتِ الْعَرَدِهَا مَنْفَعَهَا (underestimation)

- Anticoagulant such as **EDTA** or **oxalate** bind calcium tightly and interfere with the measurement, so, their use should be avoided

تحتاج بروتينات الميكروبات إلى CO_2 من العينة للبقاء فاعلة في تفكيك سائلها عادةً، مما يزيد من احتمال إصابة العينة في خروق غير مرئية.

- The proper collection of samples for ionized calcium measurements requires greater care. Because loss of CO₂ will increase pH, samples must be collected anaerobically.

Although heparinized whole blood is the preferred sample, serum from **sealed** evacuated blood collection tubes may be used if clotting and centrifugation are done quickly (<30 minutes) and at room temperature.

- ② rapid measurement
- ③ room temperature

Determination of Calcium

نحوه مانعيل الماء في التيترايشن
Solid heparin يحيط Ca^{2+}

- No liquid heparin products should be used. Most heparin anticoagulants (sodium, lithium) partially bind to calcium and lower ionized calcium concentrations

كم تر صهم قبل

- Dry heparin products are available titrated with small amounts of Ca or Zn ions that essentially eliminates the interference by heparin.

اما الفحص في البول:

- For analysis of calcium in **urine**, an accurately timed urine collection is preferred, acidified with approximately 1 ml of HCl (6M) for each 100 ml of urine

نسبة العينة يتحقق صدر من لونه الأعلى ويدها زئيف حبيبات HCl ، تكون فزابول مع كبريتاتها هو أنتي ، ثانية
فهي albumin في ذلك حاد الارتفاع من الحمض وبروير free وآمنية بدقة

Method

- The two commonly used methods for **total calcium** analysis are:

- Use of **ortho-cresolphthalein complexone (CPC)** or **arsenzo III dye** to form a complex with calcium.

- Prior to the dye binding reaction, calcium is released from its protein carrier and complexes by acidification of the sample HCl
- The CPC method uses **8-hydroxyquinoline** to prevent magnesium interference

ion selective electrodes

يرتبط مع Mg^{2+} و تجنب صاد الضرر نهضي للعينة صاد Ca^{2+} (CPC)

- Use **ISEs**: for **ionized**

- Use membranes impregnated with special molecules that selectively, but reversibly, bind **calcium ion** Ca^{2+} / **ionized**

صاد الضرر لتناسب زرمه أنتاج Ca^{2+} مع أقطاب
الجهاز 8-نـ Ca^{2+} متضمن بصفة موية

- As calcium ions bind to these membranes, an electric potential develops across the membrane that is **proportional to the ionized calcium concentration**.

كلما زاد فرق الجهد بين الأقطاب وطرفتها electrodes كلما زادت كثافة Ca^{2+} المرتبط

- AAS remains the reference method for **total calcium**

atomic absorption
spectroscopy to calculate

← 15s من مواد في كل اختبارات في كابري أنتاج ionized
يقيس عادي Ca^{2+} من أمبيره total دققيس كثافة albumin
ويطرد من سيفون يعطي Ca^{2+} ionized / pre

Reference Ranges

مِنْ مَفَقَ الْأَرْعَام

TOTAL CALCIUM (SERUM, PLASMA)

Child 2.20–2.70 mmol/L (8.8–10.8 mg/dL)

Adult 2.15–2.50 mmol/L (8.6–10.0 mg/dL)

IONIZED CALCIUM (SERUM)

مِنْ مَفَقَ الْأَرْعَام *upper limit*

Neonate 1.20–1.48 mmol/L (4.8–5.9 mg/dL)

Child 1.20–1.38 mmol/L (4.8–5.5 mg/dL)

Adult 1.16–1.32 mmol/L (4.6–5.3 mg/dL)

Urine (24-hour) 2.50–7.50 mmol/day (100–300
mg/day), varies with diet

Magnesium

تشابهات Mg مع Ca
إنه كالسيوم Ca + صوبدين في العظام
يشترط على الجسم الجزء الحر $free$ من حجم الـ $2/3$
وبرنحو 140 مللي متر يزيد من Ca في Mg زائد
إعادة انتظام من الأعلى

- The average human body (70 kg) contains 1 mole (distributed as 24 g) of magnesium
 - 53% in bone ✓
نحو 53% في العظام، إنه الصيغة المطلوبة
 - 46% in muscle and other organs and soft tissue ✓
 - less than 1% in serum and RBC's (1/3 bound to albumin) ✓
 $2/3$ *free*
- Similar to calcium, it is the free ion that is physiologically active in the body
- The role magnesium in the body is:
 - It is an essential cofactor of more than 300 enzymes
 - The most significant findings are the relationship between abnormal serum magnesium levels and cardiovascular, metabolic, and neuromuscular disorders. Although serum levels may not reflect total body stores of Mg, serum level is useful in determining acute changes in the ion
• كثرة افقيس Mg بطيئية - تغيره متواتر في الجسم \Rightarrow افقيس Mg في $free$ و $total$ من Mg

Regulation

الحكم الرئيسي في مستوى

مكتننة قبل أنه إلى يربع نعيم (استهلاك) الالكترولوجيا العادفة هو نعيم (استهلاك) H_2O

Regulation

مستوى العتبة إلى على أن تحدد الكلمة في تفه أو زلادة مستوى My

Hypomagnesemia

أغلى حالات انتفاذه My هي إيلان المستشن (الإلكترونية الجديدة)، أول بثٍ ساخنةٍ وافتراضيةٍ.

- Most frequently observed in hospitalized individuals in intensive care units of those receiving diuretic therapy or digitalis therapy

اما میان این اجنبیهایی که با بحث اخراج سنتیشن های نادر^{۱۰} ما به مرکز های انتخابی این فرستاده می باشد

Hypomagnesemia is rare in nonhospitalized individuals

There are many causes of hypomagnesemia

Reduced intake Poor diet/starvation, Prolonged magnesium-deficient IV therapy, chronic alcoholism

جـمـاعـةـ الـإـنـادـيـ زـيـ أـمـلـ العـاـسـرـ \rightarrow
دـعـزـةـ اللـهـ يـحـمـمـ مـنـ حـارـجـةـ

سُوْدَ الْمَقْدِيَّةِ أَوِ الْأَسْتَقْبَاهِ دَائِيَّ يَهُولِيَّ مُسْتَوْيَاتِ أَهْمَمِ عَنَمِ الْجَبَسِ نَازِلَةً -

سُبْحَانَ رَبِّ الْعَالَمِينَ

فتحات الاتفاقيات والمواثيق

my titles

أزانة جزء من \downarrow
 Small intestine
 تقل انتهاها إلى اثنين من بسبعين \downarrow
 كم يرتفع نسبة إنزيم lipase
 وستزيد على الأنسجة لثالثة
 من البنكرياس (زيادة ٣٠٪) \downarrow

- Decreased absorption: due to GI disorders as malabsorption syndrome, surgical resection of the small intestine, nasogastric suction, pancreatitis, prolonged vomiting, diarrhea, laxative abuse, neonatal (due to surgical procedure), primary (due to selective malabsorption of the ion), congenital (autosomal recessive disorder)

A chronic congenital hypomagnesemia with secondary hypocalcemia occurs due to specific transport protein defect in the intestine

آلام أسباب Hypo/Hyper Uterus Hypoga

Causes of hypomagnesemia

لعنى الكل محب السبي

□ Increased Excretion

□ Renal: Tubular disorder, Glomerulonephritis, Pyelonephritis

← هو ارتفاع تصل 4.5 mmol/L يعود إلى انتفاخنا Mg دارئنا Ca دهان Ca ضطاً بالجلبة بما إننا مكتننا بقل شوي !
تاً Mg ، Ca ، دين الفكرة إن الفخذ تستعمل Mg دين Ca بينفس Ca في لسان ينتقل في إعداد إيمان Ca برو بيز لاصنون Mg
وهي صون مستر اها المطبي Ca تحافظ عليهم Ca دين Ca مكتننا تأثير على إنما Ca ←
e: Hyperparathyroidism (increased calcium) ←
ecteropians (increases of Mg excretion and water)

Endocrine: Hyperparathyroidism (increased calcium)

(Hyperaldosteronism (increase of Mg excretion and water retention (pseudohypomagnesemia), hyperthyroidism (increase excretion cause intracellular shift of ions), hypercalcemia, diabetic ketoacidosis (increase renal loss due to glycosuria) *decrease the reabsorption of Mg and increase excretion polyuria*)

Drug induced (increase renal loss of Mg): diuretics, antibiotics (gentamicin), cyclosporine, and cisplatin (nephrotoxic), digitalis (interfere with Mg reabsorption)

□ **Miscellaneous:** Excess lactation (loss in milk)), Pregnancy (may cause a hyperexcitable uterus, anxiety and insomnia)

الجزء السادس

Symptoms of hypomagnesemia

- A patient who is hypomagnesemic may be **asymptomatic** until serum levels fall below 0.5 mmol/L.
مما يزيد عن 0.5 ممоль لتر ماء بين 0.5 و 0.63
- A variety of symptoms can occur. The most frequent involve cardiovascular, neuromuscular, psychiatric, and metabolic abnormalities

لَا حُوْلَ وَلَا قُوَّةَ إِلَّا بِاللَّهِ

Cardiovascular	Psychiatric
Hypo or Hyper Mg	
Arrhythmia ✓	Depression ↘
Hypertension ✓	Agitation ↘
Digitalis toxicity ✓	Psychosis ↘
Neuromuscular	Metabolic → Hypo Mg و Hypo K
Weakness	Hypokalemia
Cramps	Hypocalcemia
Ataxia ↘	Hypophosphatemia
Tremor ↘	Hyponatremia
Seizure	
Tetany	
Paralysis ↘	
Coma	

Symptoms of hypomagnesemia

Cardiac:

- Symptoms result primarily from the ATPase enzyme's Mg. requirement for Mg
- Mg loss leads to decreased intracellular K levels because of a faulty NaK pump (ATPase)
- This change in cellular RMP causes increased excitability that may lead to cardiac arrhythmia and digitalis toxicity

Normal nerve and muscle cell stimulation:

- Requires magnesium and ATPase for normal calcium uptake following contraction
عَسَارُ العَضَلَةِ تَبَسُّطُ بَعْدَ الْتَنْبِيَاهُ بِمُحْرَكِ الْمُخْرَجِ Mg^{2+} دُولَمَيْدَرْ مُحْرَكِ الْمُخْرَجِ
- Requires magnesium to assist with the regulation of acetylcholine, a potent neurotransmitter

Metabolic disorders:

- Mg deficiency can impair PTH release and target tissue response, resulting in hypocalcemia. Mg therapy alone may restore both ions levels to normal
- Serum levels of the ions must be monitored during treatment.

Treatment of hypomagnesemia

- The preferred treatment of hypomagnesemia by oral intake is Mg-lactate, Mg oxide, MgCl or an antacid that contains Mg.
- In severely ill patients, a MgSO₄ solution is given parenterally
- Before initiation of therapy; renal function must be evaluated to avoid inducing hypermagnesemia during treatment

Mg Sulfate → injections for severe hypomg

*كم انتوك من زنك اركون شفاف صناعي تناوله اعده المريض على زلاده
مع مل شفاف خادره على افراده من اصحاب*

Hypermagnesemia and its causes

□ less frequently than hypomagnesemia

□ The most common cause is renal failure (GFR <30 severe elevations are usually a result of the combine effects of decreased renal function and increased intake of commonly prescribed magnesium-containing medication, such as antacid, enemas, or cathartics.

□ Nursing home patients are at greatest risk for this occurrence.

□ Decreased excretion: acute or chronic renal failure, hypothyroidism, hypoaldosteronism, hypopituitarism (IGH)

□ Increased intake: Antacids, enemas, cathartics, therapeutic-eclampsia, cardiac arrhythmia

□ Miscellaneous: dehydration (pseudohypermagnesemia, corrected by rehydration), bone carcinoma, bone metastases (high Mg due to bone loss)

Causes of hypomagnesemia

- **Endocrine disorders:** Thyroxine and growth hormone cause a decrease in tubular reabsorption of Mg and of either hormone may cause a moderate elevation in serum Mg. *نحو ترمون تنددي بالتنبيه إما هرمونا*
tubules via Mg uptake
- **Adrenal insufficiency** may cause a mild elevation as a result of decreased renal excretion of Mg *دكثير استرا، منير Mg*
- MgSO₄ may be used therapeutically with preeclampsia, cardiac arrhythmia, or myocardial infarction *صدول ايجابي لـ MgSO₄ ضد اضطرابات عن المزدوج*
ـ Hyper Mg بـ Hypo Mg
- Mg is a vasodilator, and can decrease uterine hyperactivity in eclampsic states and increase uterine blood flow (maternal hypermagnesemia) *ـ اوكلي على دفع الـ electrolytes في محاذاة فـ regulation*
- Neonatal hypermagnesemia due to the immature kidney of the newborn (Premature infants are at great risk) *ـ هو عرض اكتر سبب اـ انتاج*

Symptoms of hypermagnesemia

- Hypermagnesemia typically do not occur until the serum level exceeds 1.5 mmol/L.

لَا يَدْعُوا مَا لَمْ يُكُنْ مَحْدُودٌ بِزَرْعٍ
كُلَّيَّاتٍ، لَمْ يَلْعُمْ دَارِمَةَ الْجَدَافِ بِجَمِيعِ
الْمُتَحَقِّقِ اَعْرُدْ حَرَارَةَ مَرْتَعَةَ بَلْزَنْ
عَنْدَهُ مَلَى عَلَى

عِرْقَاتِهَا

- Most frequent symptoms involve cardiovascular, dermatological, GI, neurologic, neuromuscular, metabolic, and hemostatic abnormalities.

مُتَابِعَاتِ الْمَمْعَلِ تَخَرِّجُ الْمَخْتَرِيَّاتِ بِهَا Mg^{2+} فِي كَيْلَيْتِيَّاتِ
الْكَبِيرَةِ لَعْنَ تَخَرِّجِهَا بِهَا Ca^{2+} وَهُوَ مَا يَعْلَمُ سَقَلَهُ فِي الْمَخْتَرِيَّاتِ

تَنَوُّعُهُ الْأَوْدِيَّةِ لَمَوْيَةِ فِي بَهْرَمِيِّ $Hypotension$ وَبَيْهِ (الْأَنْجَابِ بِهِ يَعْوِزُونِ)
بِهِيَّهِ مَلَى مَلَى
عَصَمَاتِهِ يَسْقُلُهُ مَلَى وَلَيْكَهُ
صَلَفَهُ حَيَّةَ مَيْنَةَ فِي
بِهْرَمِيِّ $bradycardia$

- Mild to moderate symptoms may occur when serum levels are 1.5-2.5mmol/L: hypotension, bradycardia, skin flushing, increased skin temperature, nausea, vomiting, and lethargy

- Life-threatening symptoms, such as ECG changes, heart block, asystole, sedation, coma, respiratory depression or arrest and paralysis, can occur when serum levels reach 5.0mmol/L

كَيْلَيْتِيَّاتِ

Symptoms of hypermagnesemia

both Hypo/Hyper Mg will cause Hypo Ca⁺
because they inhibit PTH

- Elevated Mg levels may inhibit PTH release and target tissue response. This may lead to hypocalcemia and hypercalciuria
- Normal hemostasis is a calcium-dependent process that may be inhibited as a result of competition between increased levels of magnesium and calcium ions. Thrombin generation and platelet adhesion are two processes in which interference may occur.

Treatment of hypermagnesemia

- If Mg excess associated with increased intake one should discontinue the source of Mg.
إذا كان الماء يأخذ ماء معدني فيجب إيقافه أو يتحقق ادراكه
- Severe symptomatic hypermagnesemia requires immediate supportive therapy for cardiac, neuromuscular, respiratory or neurologic abnormalities.
 $GFR < 30 \text{ ml/min}$
- Patients with renal failure require hemodialysis.
- Patients with normal renal function may be treated with a diuretic and IV fluids
إذا كان ارتفاع الماء معدني مترافق مع ارتفاع الكرياتينين
أو حفاف في الحالات التي يتعذر تخلصه من الماء

Determination of magnesium

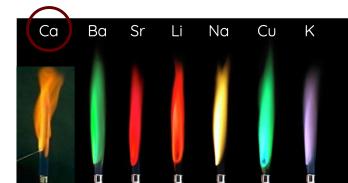
- Specimen:**
- Nonhemolyzed serum or lithium heparin plasma may be analyzed.

نَسْرَمٌ نَّسْبَهُ مُوْهَنٌ مَّعَ الْأَلْبَرٌ عَنْهُمَا دُطْلُمٌ حَمَرَاهَمٌ وَلَمْ دِيرَقَعْ سَبَهُ تَجَلَّلَ عَادِيٌّ
- Mg is intracellular cation so hemolysis should be avoided and the serum should be separated from the cells as soon as possible
- Oxalate, citrate, and EDTA anticoagulants are unacceptable because they will bind with magnesium.
- A 24-hour urine is preferred for analysis and must be acidified with HCl to avoid precipitation

Same as Ca^{+2}

Method

- The three most common methods for measuring total serum Mg are colorimetric: *All depend on spectrometer*
 - Calmagite: Mg binds with calmagite to form a reddish-violet complex that is read at 532 nm
 - Formazen dye: Mg binds with the dye to form a colored complex that is read at 660 nm
 - Methylthymol blue: Mg binds with the chromogen to form a colored complex
- Most methods use a calcium shelter to prohibit interference from Ca.
مما يحول الماء من مسحوم إلى ماء يحول Mg^{2+} إلى ماء يحول Ca^{2+} إلى ماء يحول Mg^{2+} إلى ماء يحول
- The reference method for measuring magnesium is AAS.



Method	Principle	Wavelength (nm)
Calmagite	Mg binds with calmagite to form a reddish-violet complex	532 nm
Formazen dye	Mg binds with formazan dye forming a colored complex	660 nm
Methylthymol blue	Mg binds with methylthymol blue to form a colored complex	Specific wavelength (depends on method)

اللهم قنا عذابك يوم تبعث عبادك

Limitations of Mg determination

- Although the measurement of total Mg conc in serum remains the usual diagnostic test for the detection of magnesium abnormalities, it has limitations:

1 Because approximately 25% of magnesium is protein bound, total magnesium may not reflect the physiologically active free ionized magnesium.

لتوزع على العظام ، الحمایا
البریتانیا ... فوأنا بنی العادم من سرور
عادم يسر عن الحکیمة أکثیر

2 Because magnesium is primarily an intracellular ion, serum concentration will not necessarily reflect the status of intracellular magnesium (depletion of 20% of cellular Mg, serum magnesium concentrations may remain normal)

مِنْ دَفَّيْهِ

TABLE 13-15. REFERENCE RANGE FOR MAGNESIUM

Serum, plasma 0.63–1.0 mmol/L (1.2–2.1 mEq/L)

Phosphate

- Found everywhere in living cells: DNA, RNA, in most coenzymes as NAD⁺
- The most important reservoirs of biochemical energy are ATP, creatine, phosphate, and phosphoenolpyruvate.
مقدار كالوري مقدار طاقة الجسم
- Phosphate deficiency can lead to ATP depletion, which is ultimately responsible for many of the clinical symptoms observed
أعصاب أعراض نقص الغلوغان يتجه معتبر بـ ATP هي تهمني من فحص ملخص المريض
- Alteration in the concentration of 2,3-bisphosphoglycerate (2,3-BPG) in red blood cells affect the affinity of hemoglobin for oxygen, the concentration of inorganic phosphate indirectly affects the release of oxygen from hemoglobin
مقدار الغلوغان يزيد من امداد الأكسجين لـ Hb ويزيد في دماغه
- Transcellular shifts of phosphate are a major cause of hypophosphatemia in blood. Once phosphate is taken up by the cell, it will be used in the synthesis of phosphorylated compounds. As these phosphate compounds are metabolized, Pi slowly leaks into the blood, where it is regulated principally by the kidney
تستخرج الأنيونات حارق الغلوغان لتخفيض مقدار الالاتنة ويسقط على مقدار الأنيون وترعرع بنظام الغلوغان دينور مقدار الأنيون يجيء بسيطة و المفهول هي نجارة ولكن

Regulation

- Phosphate in blood may be absorbed in the intestine from dietary sources, released from cells into blood and lost from bones. In healthy individuals, all these processes are relatively constant and easily regulated by renal excretion or reabsorption of phosphate عند استهلاك المغذي (أي سليمة) ①

- Many factors can alter phosphate concentrations in the blood:
 - The loss of regulation by the kidneys will have the most profound effect
 - The most important factor is PTH, which overall lowers blood conc. By increasing renal excretion PTH يمكن تزوير المغذي أو تناهيه ولكن بكميات كبيرة
 - Vitamin D acts to increase phosphate in the blood by increasing both phosphate absorption in the intestine and phosphate reabsorption in the kidney.
 - Growth hormone, which helps regulate skeletal growth, can affect circulating concentration of phosphate
 - Excessive secretion or administration of growth hormone, phosphate concentrations in the blood may increase because of decreased renal excretion of phosphate.
 - Calcitonin, acid-base status, can also affect renal regulation of Phosphate

المغذيات هو دام
buffer systems

PTH

GH
يرفع من مستوي
المغذيات

يزيل من باز ايج المغذيات

المغذيات

تقليل

المغذيات

تناهيه

إدفافه

المغذيات

Distribution

- Although the concentration of all phosphate compounds in blood is about 12 mg/dl (3.9 mmol/L), only about 3-4 mg/dL is inorganic phosphate.
ذرة الفوسفات هي من مركبات فوسفات
غير بروتيني مثل امتحان Ca^+ ، Al^+ ، Mg^{2+}
- Phosphate is the predominant intracellular anion, with variable concentrations depending on the type of cell.
MIA
major intracellular
anion is
phosphate
- About 80% of the total body pool of phosphate is contained in bone, 20% in soft tissues, and less than 1% is active in the serum/plasma.
في العظام
في الأنسجة
فري

Hypophosphatemia

كلسنو تيائز عندهم

- Hypophosphatemia occurs in about 1-5% of hospitalized patients.
- The incidence of hypophosphatemia increases to 20-40% in patients with:
 - الانسوتن إلى يانده المرض يدخل العروقان = غير المرض
- diabetic ketoacidosis, chronic obstructive pulmonary disease (COPD), asthma, malignancy, long-term treatment with total parenteral nutrition (TPN), inflammatory bowel disease, anorexia nervosa, and alcoholism.
 - الانسوتن إلى المرض يدخل العروقان = غير المرض
 - انفاس مرضية = غير المرض
- The incidence increases to 60-80% in:
 - ICU patients with sepsis. دخترية الحال موجودة = غير المرض
 - increased renal excretion
 - Hyperparathyroidism
 - Decreased intestinal absorption
 - vitamin D deficiency
 - Antacid use → بالتناول إلى تناول البيكربونات
- Although most cases are moderate and seldom cause problems
severe hypophosphatemia (<1mg/dl or 0.3 mmol/L) requires
monitoring and possible replacement therapy

Hyperphosphatemia

- ❑ Patients at greatest risk for hyperphosphatemia are those with acute or chronic renal failure ناترايوم الفوسفات زياده
- ❑ An increased intake of phosphate or increased release of cellular phosphate may also cause hyperphosphatemia لوراء اضطراب انتقال الفوسفات في موضع نسبه
- ❑ Neonates: not developed mature PTH and vitamin D metabolism, hyperphosphatemia is caused by increased intake such as from cow's milk or laxatives. منهم كبار السن
- ❑ Increased breakdown of the cells as with severe infections, intensive exercise, neoplastic disorders, or intravascular hemolysis استress انتقال خروج النسغ
- ❑ Because immature lymphoblasts have about 4 times the phosphate content of mature lymphocytes, patients with lymphoplastic leukemia are especially susceptible to hyperphosphatemia. بعض بويه وبيه بـ 4 أضعاف كبع النسغ مقارنة بـ 1 المـ نـ بـ 1

Determination of inorganic phosphorus fru

- Specimen.** Serum or lithium heparin plasma is acceptable for analysis.
as Ca + Mg
- Oxalate, citrate, or EDTA anticoagulants should not be used because they interfere with the analytic method.
- Hemolysis should be avoided because of the higher concentrations inside the red cells
- Circulating phosphate levels are subject to circadian rhythm, with highest levels in late morning and lowest in the evening.
النحوتة
من الصالح
مسنونات
الصبايا
النافذة
Urine analysis for phosphate requires a 24-hour sample collection because of significant diurnal variations.

Methods and reference ranges

- Phosphorus determination methods involve the formation of an ammonium phosphomolybdate complex. This colorless complex can be measured by ultraviolet absorption at 340 nm or can be reduced to form molybdenum blue, a stable blue chromophore, which is read between 600 and 700 nm.

λ_{max} is shift \rightarrow 600
Colorless is nontoxic
blue \rightarrow

- Normal ranges:

SERUM, PLASMA

Neonate	1.45–2.91 mmol/L (4.5–9.0 mg/dL)
Child	1.45–1.78 mmol/L (4.5–5.5 mg/dL)
Adult	0.87–1.45 mmol/L (2.7–4.5 mg/dL)
Urine (24-hour)	13–42 mmol/day (0.4–1.3 g/day)