لجان الدفعات

PATHOPHYSIOLOGY

MORPHINE ACADEMY

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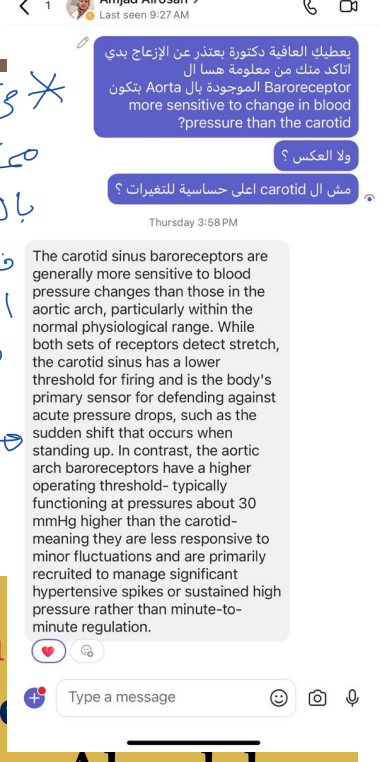
يعطيكم العافية
حاولت اكتب حكي الدكتوره بمكانه ع السلايدات و ال Overview الي بتعطيه الدكتوره اول محاضره هيو بصفحات لحالهم
ان شاء الله انه كامل بالتوفيق و سامحوني لو غلط
في أشياء كان بدهم توضيح او معلومات من الفسيو كتبتهم حتنتبهوا لهم و بتقدروا تسكبوها إذا بدكم



Pathophysiology-Hypertension

Faculty of Pharmaceutical Science

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we have 3 receptor (β_1, β_2, α_1)
When they activition? with SNS
β_1 in the Heart → contractility ↑, CO ↑, HR ↑
β_2 in the lungs → vasodilation (Bronchodilation)
α_1 in the BV → vasoconstriction predinally ↓ بشتغل على [tunic media] [In the smooth muscle]
What we do in hypertension?
α_1 Blockers → vasodilation for BV → يقلل الضغط
β_1 Blockers → HR↓, CO↓, BP↓

What is the ANP?
Atrial Natriuretic peptide
بشتغل وقت يكون BP↑
يفرغ الجسم من السوائل ويخفض
الضغط يفرز من الـ atrium
والـ BNP بشتغل نفس
ويفرز من الـ ventricles

بشتغلوا وقت يكون في Hypertension

What dose the complication of HT?
MI, angina? Bec the BP↑ → workload↑
Where is the Baroreceptor?
2 place
→ in the arch of aorta
→ in the carotid sinus
ميين من الاماكن اكثر حساسية؟
aorta? ⇒ just a change about 30
it will be active in the carotid
it need the double → 60 to be active

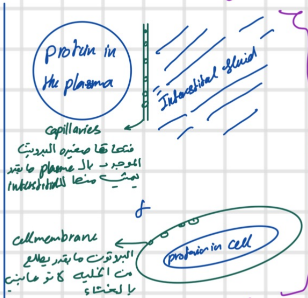
ما بعمل خلال يومين الضغط المرتفع بصير بالنسبة الهم هو الضغط الطبيعي

1. تعريف الـ hypertension فخضاغط بأدم بالسلايد تاعة موضع المنر
2. طبقات الـ BV → tunica intima – media – externa
3. endothelial dysfunction (make) → smooth blood flow ↑ (normal make)
baroreceptors, Chemoreceptors, RAAS, ANH, ANP
3. coagulation / anticoagulation, Vasodilation
4. inflammation, anti-inflammation
4. اهم مصطلح مهم
5. BP = contraction = systolic, relaxation = diastolic
6. metabolic syndrome ⇐ diabetes + pressure
7. ليش بنبعد عن الـ salt؟
↑BV ⇐ ↑chloride + ↑Na+ ← ↑salt
8. اي receptor رح بشتغل؟
BV ما بدهم يزودوا الـ ✗ RAAS + ANH
✓ BNP + ANP بعملوا عكس
↓BV ⇐ Ca + Na ✓ بساعدوا على اخراج الـ
الجسم بتصرف كالعادة بدون هرمونات (دوا)
9. chemoreceptors + Baroreceptors
in the temporary HT ⇒ they active
in the sustained HT ⇒ بتأقلموا مع الـ HT
بشتغل الـ RAAS "مصيبة"
10. قانون الـ mean pressure = $\frac{1}{3}$ (diastolic + systolic) = 100 (normal)
CO = SV * HR
11. ضغط + مقاومة = علاقة طردية
انا ضيقت الفتحة او القطر
⇐ مقاومة اكثر
أضيق الدم رح يضرب على الجدران اكثر
BP اكثر
12. BP + BV = علاقة عكسية
بالاطراف ⇐ BV بتحتوي اكثر المساحة
انتشار الدم اكثر فما رح يخبط بالجدران
فـ ↓BP

Where the hypertension effect?
the Hypertension effect on the systemic circulation
not the pulmonary, so the Blood in the center ↑
and in the peripheral organic ↓
نفس عمل الـ SNS
What is the medication?
Sympathetic blocker / antagonist ضد الـ HT عكس الـ SNS
Bec I want peripheral vasodilation
What is the side effect of β_1 Blocker?
bradycardia → HR → 70↓ which more server than tachycardia
What is the chain reaction?
1. Venous Return = دم من الجسم للقلب كل ما كان ↑
كمية الدم بالـ Rb ↑ وبالـ RV ↑ اعلى
2. preload = End diastolic Volume ← زادت
3. Stroke Volume ↑ SV = EDV - ESV
كمية الدم الي بضخها الـ ventricle بالنبضة الواحدة
CO = SV * HR
بس الـ CO يزيد الدم رح يضغط على جدار الشريان
→ BP ↑
4. After load ⇒ المقاومة الي لازم يتغلب عليها القلب
ليفتح الصمامات ويضخ الدم لبرا بتزيد
بينما الـ HR اكثر فالـ HR بتزيد

الـ BV مع الـ BP
central
بتكون طردية
اما peripheral
بتدخل الـ resistance
بسبب تنوع الـ BV
فـ BP + مقاومة
طردية
BP + BV عكسية

SNS What is do?
vasodilation centrally
vasoconstriction peripherally
The total peripheral resistance rely to?
TPR ↑
→ vasoconstriction peripheral — بخلي الدم يرجع للقلب
→ venous return ↑
→ preload ↑
→ diastolic ↑
التعبئة — diastolic hypertension ⇒ بدواء vasodilators
→ ACE Inhibitors
Cardic output ↑?
systolic hypertension — الضخ ⇒ بدواء يقلل قوة ضربات القلب زي NH / β-Blocker



مواد صارلها تسمم حمل &
1. HT → destruction for kidneys tubules
proteinuria...
2. Factor يفرز من المشيمة بخزب
الشعيرات الدموية في جدار الاوعية
بصير ضعيف وخرم فـ البروتين
الموجود بالدم بطلع للـ Interstitial fluid
Edema
Secretion of water ← البروتين بجلب معه

BP = CO * TPR

الاستنتاج الـ Vasodilation جداً ممتاز لمرض الـ HT

Blood Pressure (BP) Regulation

(Hypertension HTN)

Hypertension

❖ **What do Blood Pressure Numbers Mean?**

- **Top number (Systolic) while the bottom number (Diastolic).**
- **Normal Blood Pressure: Blood Pressure of < 140/ 90.**
- **Blood Pressure of 130 to 139/ 85 to 89 should be closely watched.**

- **High Blood Pressure: Blood Pressure > 140/ 90. Usually NO SYMPTOMS! "The Silent Killer". May have headache, blurry vision, chest pain, and frequent urination at night.**

Hypertension

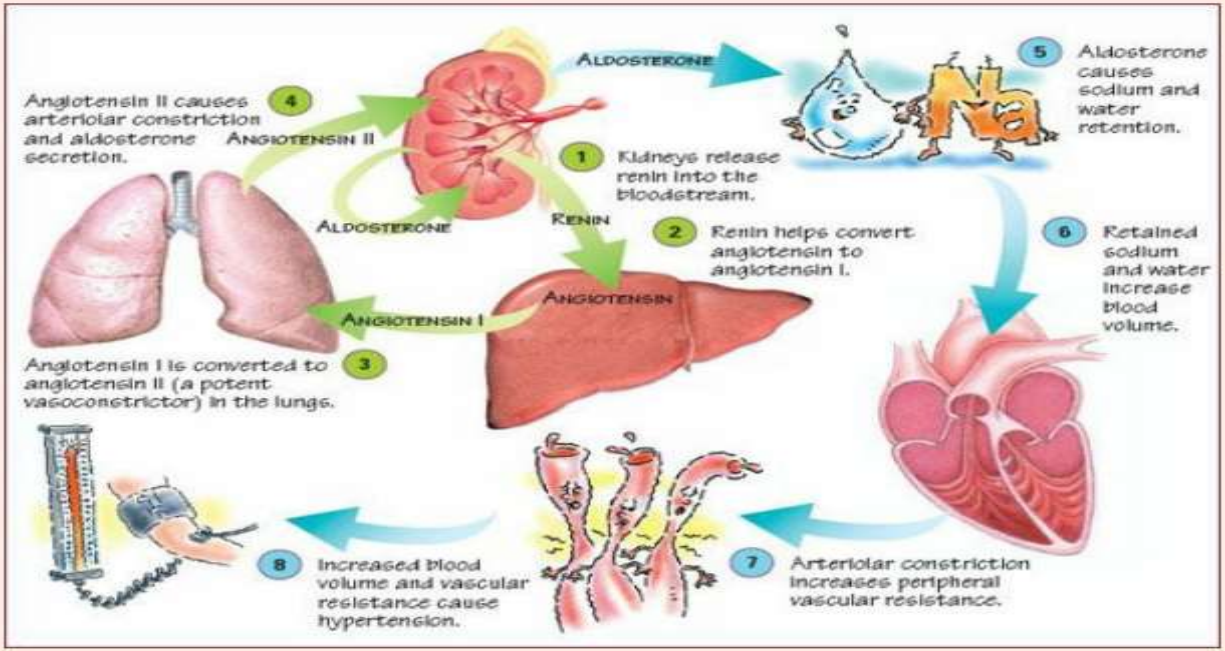
- **Hypertension is an intermittent or sustained elevation of diastolic or systolic blood pressure. Generally, a sustained systolic blood pressure of 139 mm Hg or higher or a diastolic blood pressure of 89 mm Hg or higher indicates hypertension.**
- Increased blood pressure is the most common health problem in adults and the leading risk factor in CVD.
- It affects about 1 billion people worldwide.
- Hypertension increases with age.
- Males more than females until menopause. More in blacks compared to whites.

American Heart Association Recommended Blood Pressure Levels

BP Category	Systolic (mmHg)		Diastolic (mmHg)	Follow-up
Optimal	< 120	and	< 80	Recheck 2 years
Normal	< 130	and	< 85	Recheck 2 years
High Normal	130-139	or	85-89	Recheck 1 year

American Heart Association Recommended Blood Pressure Levels

BP Category	Systolic (mmHg)		Diastolic (mmHg)	Follow-up
Stage 1 (mild HTN)	140-159	or	90-99	Confirm within months
Stage 2 (moderate HTN)	160-179	or	100-109	Evaluate within 1 month
Stage 3 (severe HTN)	180 or >	or	110 or >	Evaluate immediately


ALDOSTERONE
5 Aldosterone causes sodium and water retention.
Na
Angiotensin II causes arteriolar constriction and aldosterone secretion.
4
ANGIOTENSIN II
1 Kidneys release renin into the bloodstream.
ALDOSTERONE
RENIN
2 Renin helps convert angiotensin to angiotensin I.
6 Retained sodium and water increase blood volume.
ANGIOTENSIN
ANGIOTENSIN I
Angiotensin I is converted to angiotensin II (a potent vasoconstrictor) in the lungs.
3
8 Increased blood volume and vascular resistance cause hypertension.
7 Arteriolar constriction increases peripheral vascular resistance.

Chronic disease ⇐ Hypertension

- **Divided into two categories:**
  - **Primary or idiopathic hypertension:**
    - Chronic elevation of blood pressure without evidence of other diseases.
    - Affect 90-95% of hypertensive patients. ⟹ from stress
  - **Secondary hypertension**: caused by other diseases like kidney disease (if it's related to a systemic disease that raises peripheral vascular resistance or cardiac output.).

Secondary hypertension

Secondary hypertension may be caused by:

- Renal hypertension.
- Adrenocortical hormone as:
  - Primary hyperaldosteronism.
  - Excess corticosteroids (Cushing's syndrome).
- Adrenal gland abnormalities: Pheochromocytoma (rare catecholamine–secreting tumor of adrenal chromaffin cells it produces adrenaline & noradrenaline, and they cause hypertension), characterized by episodes of headache, excessive sweating, and palpitation.

Secondary hypertension

Secondary hypertension may be caused by:

- Coarctation of the aorta (narrowing or constriction of the aorta).
- Oral contraceptive drugs.
- Drugs as cocaine, amphetamine, and erythropoietin.
- Obstructive sleep apnea.
- Diabetes mellitus.
- Dysfunction of the thyroid, pituitary, or parathyroid gland.
- Pregnancy (gestational hypertension. which is part of the preeclamptic toxemia that is characterized by edema, hypertension, and proteinuria (protein in urine).
- Neurologic disorders.

Hypertension

❖ Controllable Risk Factors:

- Increased salt intake.
- Obesity (Lectin works fine in non-obese people, but when an adipose tissue (fat) increases in the body, the sensor gets damaged).
- Alcohol.
- Stress.
- Lack of exercise.

❖ Uncontrollable Risk Factors:

- Heredity.
- Age.
- ✓ Men between age 35 and 50.
- ✓ Women after menopause.
- Race:
- ✓ 1 out of every 3 African Americans.
- ✓ Higher incidence in non-Hispanic blacks and Mexican Americans.

Hypertension

- **Women and High Blood Pressure:**
  - Birth Control Pill. (oral contraceptives drug)
  - Pregnancy.
  - Overweight.
  - After Menopause.
  - African Americans.

Hypertension

What does High Blood Pressure do to my body?:

- Stroke.
- Congestive heart failure.
- Kidney failure.
- Heart attack.
- Heart rhythm problems.
- Aneurysm,

- High blood pressure adds to the workload of the heart.
- The heart must pump harder.
- If high blood pressure continues for a long time, the heart and arteries may not function appropriately.
- The heart may at first thicken and then dilate and weaken causing heart failure.
- Other body organs may also be affected.

Regulation of hypotension

→ short term (Baroreceptor / Chemo)

→ long term (RAAS / ANP / BNP / ADH / EP / NEP)

How the chemo active?

① indirect detection

② PH / H^+ ← active لما يصير في change نتيجة ال

$BV\uparrow \rightarrow O_2\uparrow \rightarrow CO_2\downarrow \rightarrow PH\uparrow$ (alkalinity)

$CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H^+ + HCO_3^-$

$BV\downarrow \rightarrow O_2\downarrow \rightarrow CO_2\uparrow \rightarrow PH\downarrow$ (acidity)

Hypoxia — Hypercapnia

We have vasomotor center

→ vasoconstrictor area

→ vasodilator area

→ sensory area ← ① اول اشي بجي بحكي (عون / او / هون)

glass / vags عبر ال AP بستقبل ال

tractus solitarius ← nucleus بحتوي على ال

cell body for interneuron → داخل ال CNS يستقبل الاشارة / ايعازها

يقرر شو يصير منها ويبعثها لل motor → هي اللي بتعمل ال integration لل AP اي رد فعل

3 type of neuron:

- sensory → ينقل من الجسم لل CNS
- motor → من ال CNS للعضلات

When I saw vaso → the effect in the vessels

But when I saw

Cardiac muscle & Sympathetic → Contraction

Blood vessels & center & dilation

peripherally & vasoconstriction

ترجمو و بس عنا ال cardio خاص بالدماغ "Respiratory centers"

خاص بالـ Sympathetic بعمل → active / inhibition

* لا نو الـ sympathetic رح يأثر بأعضاء ال lungs & Heart → dilation / ↑ contraction

وبالـ para بعمل العكس

* Chemo & Baro جنبها؟ ion chanal (for open = active)

How they open? → indirect / direct

2 type of receptor:

- ionotropic * اوتوماتيكيا بترجع ion chanal ال
- Metabotropic * اوتوماتيكيا بتعمل فتح ال ion chanal ب ...

resting membrane potential قبل بكون بال

graded potential

open Na^+ chanal

باخلايا العادية → -70 * احنا كنا

باخلايا القلبية → -90

Threshold (-55) (for -50)

depolarization

كيف صار open for Na^+ chanal?

for → AP

from BP↑ — from BP↓

We have center inside the brain

- Cardiostimulatory
- Cardioinhibitory

Parasympathetic (Sensory information) * vagus nerve → to brain

Sympathetic (Sensory information) * Glossopharyngeal → to brain

Chang in BP → active for chem / Baro → generation of action potential → تنتقل عبر ال nerve

Cardioinhibitory → Vasoconstr / Vasodilation (central / peripheral) ← ال fibers تأكد صار بعملوا

vasoconstrictor area → يعمل vasoconstr peripherally → central vasodilation يبدي → vasodilation area

الحقيقة انا رح يصير عندي واحد يشتغل و واحد يطفي مو الاثنين يشتغلن

هاد ال Blood vessel ع ... يصير

* صار عندي vasodilation ال fibers تأعطيها رح تعمل dilation ... inhibition للـ vasoconstr

* لحن بالاعضاء زي ال Cardiomus رح يصير ↑ contraction ↓ contraction

inhibited & vasodilator / active & vasoconstriction & sympathetic فال

بيروح لل Cardiostimulatory center (اعصاب ال vasomotor)

Autonomic Centers

([Medulla oblongata]

├── Cardiac Center ❤️ (مسؤول عن ال cardio)
│ ├── Cardio-stimulatory (Sympathetic) ↑ HR
│ └── Cardio-inhibitory (Parasympathetic) ↓ HR
│
├── Vasomotor Center 🩸 (مسؤول عن الاوعية)
│ ├── Sensory Area
│ │ ([Nucleus tractus solitarius]
│ └── Output Areas:
│ ├── Vasoconstrictor (↑ BP)
│ └── Vasodilator (↓ BP)
│
└── Respiratory Center 🫁
 ├── Controls rate
 ├── Controls depth
 └── Works with:
 ([Pons]

وين هما ال sympathetic nerves peripherally؟

- * autonomic لا ارادي
- * enteric جهاز
- * somatic ارادي حركي

ال cranial وال spinal رح نتوزع عليها

الاعصاب اي طالعه من الدماغ والحبل الشوكي — بتعمل وظيفه من دون ...

ليش ال sympathetic اكثر و اوسع تأثير؟

* اكثر مصدر ← NEP / EP من ال sympathetic adrenal medulla

* توزيع الاعصاب ال sympathetic اكبر من ال para

* ال Ach تاع ال para بتكسر بسرعه بواسطة ال Ach E اما ال NEP / EP بتكسر بواسطة MAO ← تكسر بطيء = تأثير لفترة اطول

يشجع ال heart لل Contraction ويثبط ال cardio inhibitor Center

Arterial Blood Pressure Regulation

Short term regulation of blood pressure:

- A regulation of blood pressure due to a change in position.
- Baroreceptor reflex (Immediate rapid mechanism). This is done/regulated by baroreceptors, which are responsible for regulating blood pressure from moment to moment. Baroreceptors prevent fluctuating BP.
- Baroreceptors are neurons (collection of nuclei) located in the arch of the aorta and large blood vessels of the chest.
- These baroreceptors are sensitive to either increase or decrease in blood flow.

Arterial Blood Pressure Regulation

- **Short term regulation of blood pressure:**
  - In the case of decreasing blood flow (hypotension), these receptors will send an impulse through the glossopharyngeal nerve to the vasomotor center, which is located in the medulla oblongata (have a collection of nuclei which are called tractus solitarius).
  - The vasomotor center (tractus solitarius) will stimulate the sympathetic nervous system, increasing contractility, and cardiac output. It also enhances the release of epinephrine & norepinephrine from the medulla of the adrenal gland which leads to central vasodilation and peripheral vasoconstriction; so, BP will return to normal.

Arterial Blood Pressure Regulation

- **Short term regulation of blood pressure:**
  - In the case of an increase in blood flow, the impulse will be sent to the vasomotor center (tractus solitaries). It will block the sympathetic nervous system rather than stimulate the parasympathetic nervous system. Thus, contractility and cardiac output will be decreased, vasodilation peripherally will occur, and BP will return to normal.

Nervous Regulation of the Circulation

Nervous control of the circulation mainly affects more global functions (e.g., redistribution of blood flow, cardiac contractility, and rapid control of arterial blood pressure).

Autonomic Nervous System

- **Sympathetic Nervous System** (Norepinephrine is the neurotransmitter substance): It stimulates vasoconstriction by activation of alpha adrenoceptors on vascular smooth muscle.

Nervous Regulation of the Circulation

Autonomic Nervous System

- **Sympathetic Nervous System:**
  - Vasoconstriction of arterioles results in increased vascular resistance and redistribution of blood flow.
  - Vasoconstriction of veins results in increased circulating blood volume, increased venous return, which subsequently leads to increased ventricular filling and stroke volume.
  - Increase in the activity of the heart (heart rate and contractility ↑).

Nervous Regulation of the Circulation

Autonomic Nervous System

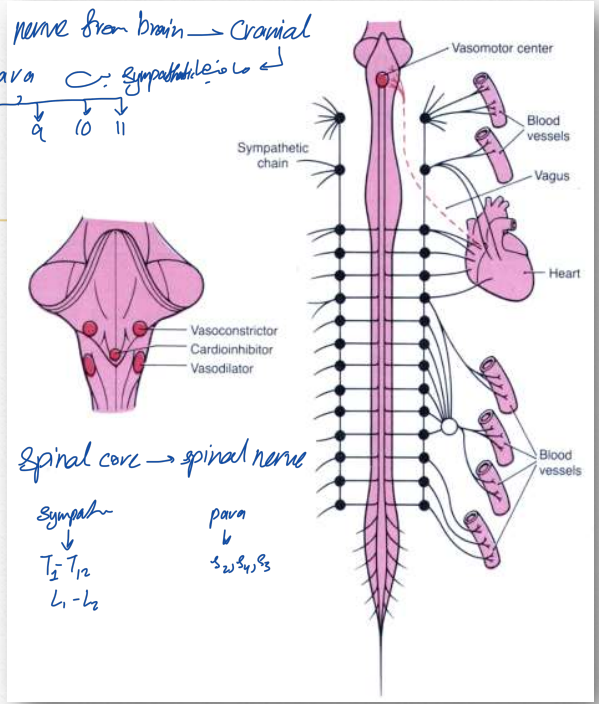
- **Parasympathetic system:** → ما الك دخل بالموضوع؟

Plays a minor role in the regulation of circulation. Its important function relates to its control of the heart rate (stimulation of *vagus nerves* results in a decrease in heart rate and contractility).

Anatomy of the Sympathetic Nervous Control of the Circulation

Nerves leave the spinal cord through thoracic and lumbar spinal nerves, pass into the sympathetic chain, and then into the circulation through:

- Specific sympathetic nerves innervate the vasculature of the internal viscera and the heart.
- The spinal nerves innervate mainly the vasculature of the peripheral metarterioles.



The Sympathetic Vasoconstrictor System and its Control by the Central Nervous System

- **The distribution of vasoconstrictor fibers varies:**
  - Greater distribution in the kidneys, gut, spleen, and the skin.
  - Less potent in the skeletal muscle and brain.
- **Vasomotor center:**
  - Located in the brain (reticular substance of the medulla and lower pons).
  - transmits impulses through the spinal cord and hence sympathetic vasoconstrictor fibers to almost all blood vessels of the body for blood pressure control.

Areas of the Vasomotor Center:

1. Vasoconstrictor Area:

Neurons secrete norepinephrine which stimulates the vasoconstrictor neurons of the sympathetic nervous system.

2. Vasodilator Area:

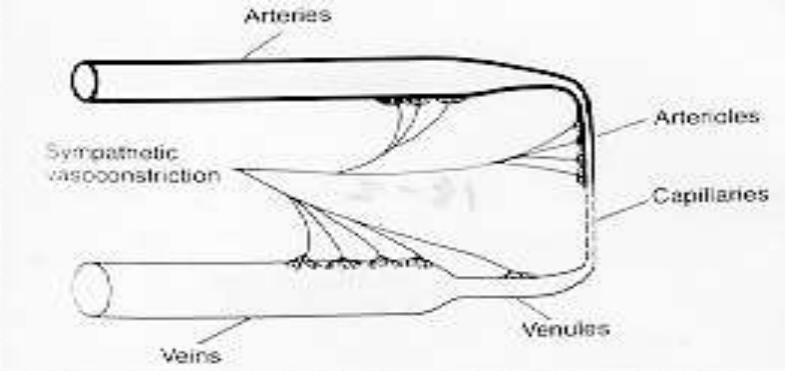
Fibers from neurons in this area project upward to the vasoconstrictor area and inhibit vasoconstrictor activity.

3. Sensory Area:

* يستقبل معلومات الضغط
* يقرر يشغل تضييق أو يخففه
* يعمل reflex لضبط الضغط

Receives sensory nerve signals from the vagus and glossopharyngeal nerves and the output signals from this sensory area then help to control the activities of both the vasoconstrictor and vasodilator areas, thus providing "reflex" control of many circulatory functions (e.g., **baroreceptor reflex** for blood pressure control).

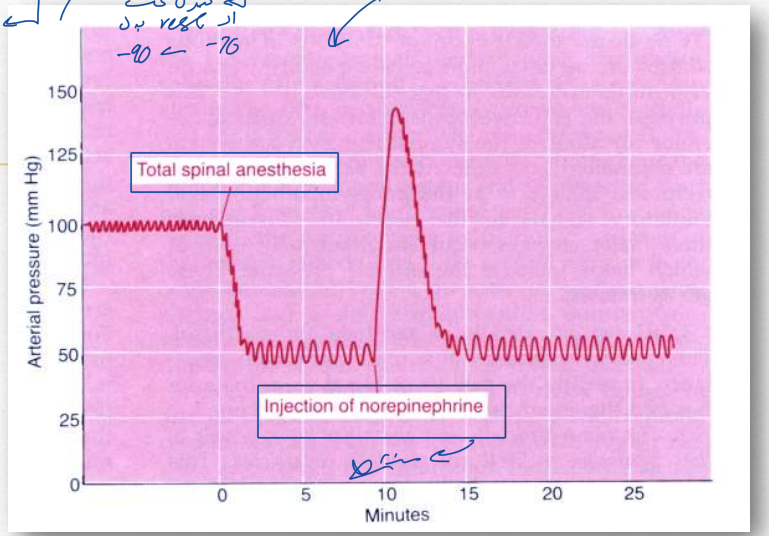
All vessels except capillaries, pre-capillary sphincters, and most metarterioles are innervated. Small arteries and arterioles when stimulated will increase resistance to flow and decrease the flow of blood to the tissues. Innervation of large vessels (e.g., veins) decreases the volume of the veins and alters the volume of the venous side of the circulation, so the volume is transferred to the arterial side. (Again, "reservoir function")



Sympathetic carry mostly vasoconstrictor fibers and a lot are present in the kidney, gut, spleen, skin, and *less are in* the skeletal muscle and brain.

Sympathetic Vasoconstrictor Tone

Under normal conditions, the vasoconstrictor area transmits signals continuously (0.5-2 impulses/sec). These impulses maintain a partial state of contraction in vascular smooth muscle (**vasomotor tone**).



Effect of total spinal anesthesia on arterial blood pressure

- **Control of Heart Activity by the Vasomotor Center:**

  Sympathetic nerve fibers to the heart increase heart rate and contractility when stimulated, whereas impulses from the vagus nerve (parasympathetic nerve fibers) decrease heart rate.

- **Control of Heart Activity by Higher Nervous Centers:**

  Reticular substance

  Hypothalamus can either excite or inhibit the vasomotor center

  Cerebral Cortex

- **The Adrenal Medullae:**

  Excitation of sympathetic fibers to the adrenal medullae cause the secretion of epinephrine and norepinephrine into the circulation.

Role of the Nervous System for Rapid Control of Arterial Pressure

The entire vasoconstrictor and cardioaccelerator functions of the SNS are stimulated as a unit. At the same time, there is reciprocal inhibition of the normal parasympathetic vagal inhibitory signals. As a result, 3 changes occur, each of which contributes to increasing arterial blood pressure: arteriolar constriction and large vessel constriction (especially veins) increases circulating blood volume and venous return, increased cardiac contractility and stroke volume, and increase in arterial pressure. Direct stimulation of the heart (HR increases up to 3-fold and contractility is increased).

These effects can double arterial pressure within 10-15 sec. Sudden inhibition can decrease pressure by half within 10-40 sec.

Increased Arterial Pressure during Exercise:

During exercise, active muscles require greatly increased blood flow.

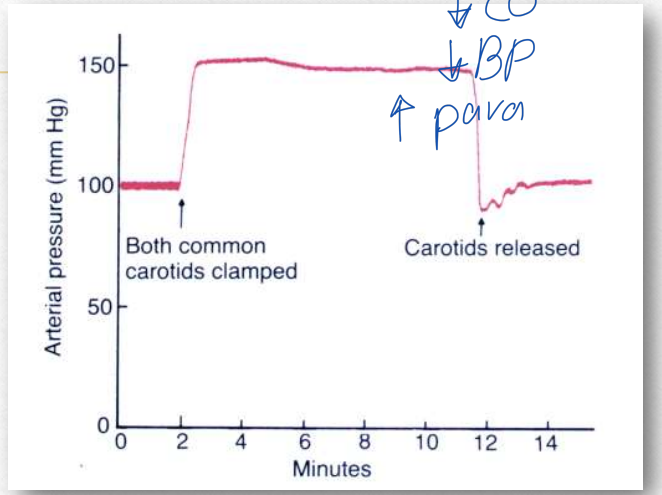
- Local vasodilatory mechanisms.
- Elevation of arterial blood pressure (an increase of 30-40% can increase blood flow by 2-fold).

Exercise is initiated by activation of the motor areas of nervous system. At the same time these areas are activated to initiate exercise, the reticular activating system of the brain stem is also activated (incl. stimulation of the vasoconstrictor and cardioaccelerator areas of the vasomotor center). These raise arterial pressure instantaneously to keep pace with the increase in muscle activity. This occurs with many other types of stress (e.g., fight or flight reaction).

The Baroreceptor Reflex

Once signals have entered the medulla secondary signals inhibit the vasoconstrictor center and excite the vagal center. This results in vasodilation of the veins and arterioles throughout the systemic circulation and decreased heart rate and contractility.

Therefore, stimulation of the baroreceptor reflex reduces blood pressure through a decrease in peripheral resistance and a decrease in cardiac output. Low pressure has the opposite effect.



Typical Carotid Sinus Reflex on Arterial Pressure Caused by Clamping Both Common Carotids

The Baroreceptor Reflex

Function during changes in body posture:

When going from laying down to standing up there is a decrease in a stretch of the baroreceptors which respond immediately to increase pressure by removal of inhibition on the vasoconstrictor center.

Mechanisms for Maintaining Normal Arterial Pressure

- **Arterial Baroreceptor Control System:**

Receptor: Spray-type nerve endings

Location: in the wall of large arterial vessels (internal carotid artery and the wall of aortic arch; (baroreceptor, pressoreceptors)

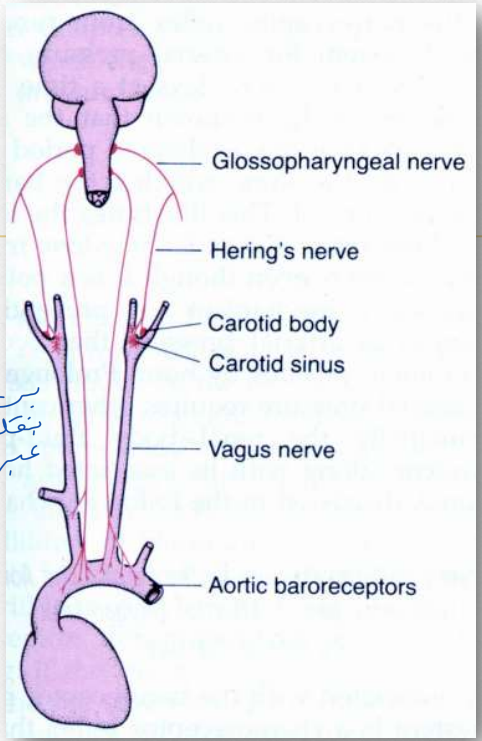
Stimulus: Stretch

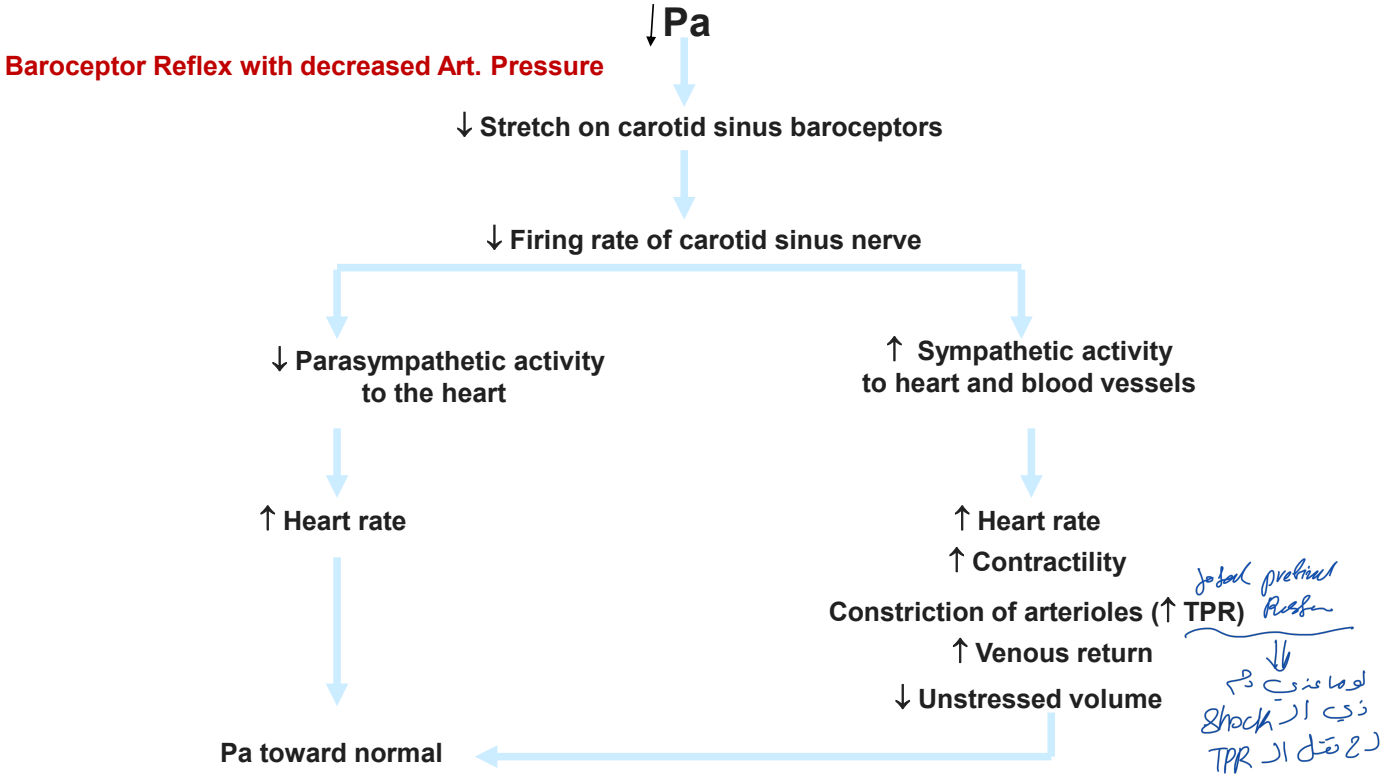
Normally, the carotid baroreceptors are not stimulated by pressures between 0-60 mmHg. Above 60 mmHg they respond progressively more and more rapidly and reach a maximum at about 180 mmHg. **The aortic baroreceptors behave similarly but operate at pressures 30 mmHg higher than the carotid**. Respond very rapidly to changes in pressure, with the rate of impulse firing increasing during systole and decreasing during diastole.

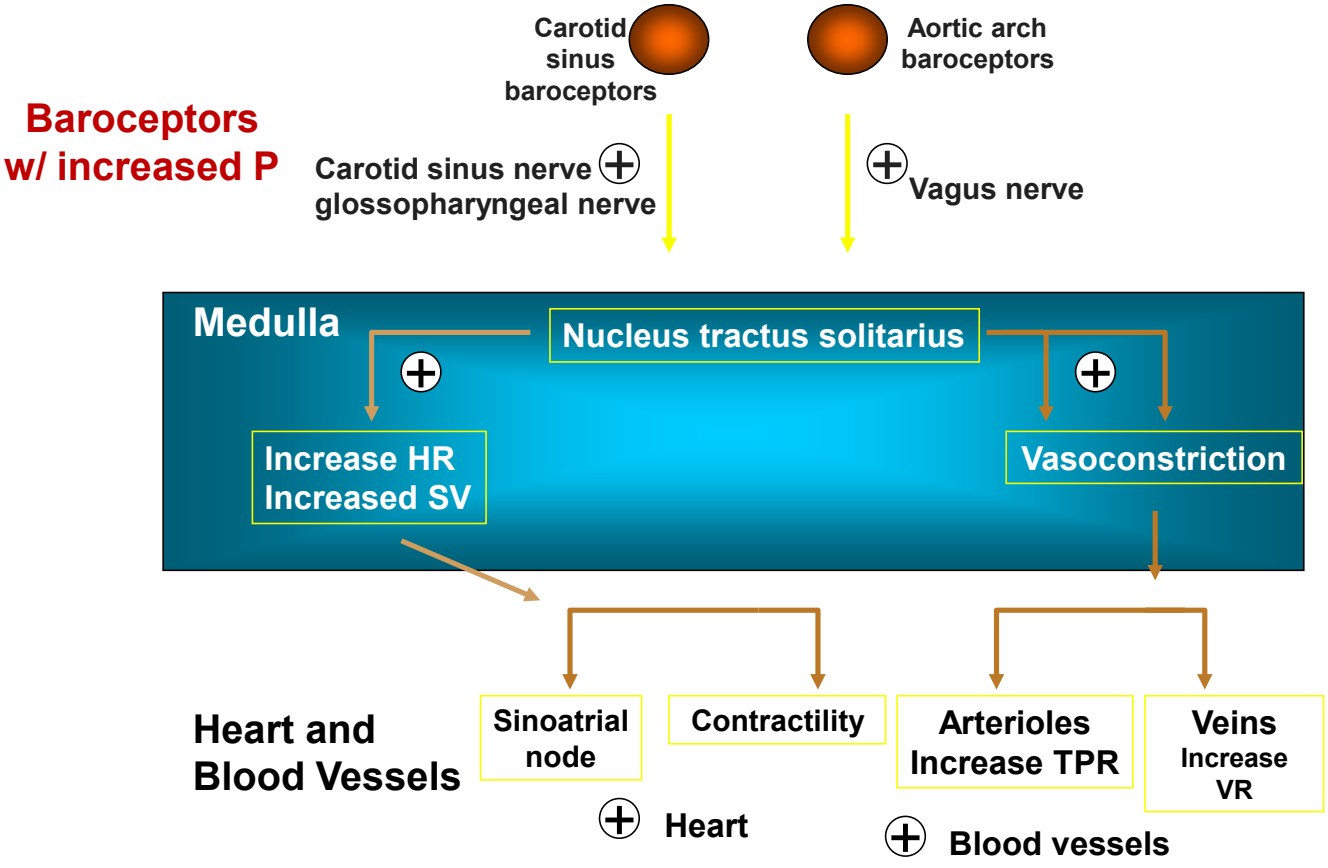
Arterial Baroreceptor Control System:

- Pathway: Internal carotid transmits impulses through Herring's nerve to the glossopharyngeal nerve and hence to the tractus solitarius in the medulla.

- Signals from the aortic arch are transmitted through the vagus nerves also into this area of the medulla.




Baroceptor Reflex with decreased Art. Pressure
↓ Pa
↓ Stretch on carotid sinus baroceptors
↓ Firing rate of carotid sinus nerve
↓ Parasympathetic activity to the heart
↑ Sympathetic activity to heart and blood vessels
↑ Heart rate
↑ Heart rate
↑ Contractility
Constriction of arterioles (↑ TPR)
↑ Venous return
↓ Unstressed volume
Pa toward normal


Carotid sinus baroceptors
Aortic arch baroceptors
Baroceptors w/ increased P
Carotid sinus nerve
glossopharyngeal nerve
Vagus nerve
Medulla
Nucleus tractus solitarius
Increase HR
Increased SV
Vasoconstriction
Heart and Blood Vessels
Sinoatrial node
Contractility
Arterioles
Increase TPR
Veins
Increase VR
Heart
Blood vessels

- **Carotid and Aortic Chemoreceptors:**
  - Closely associated with the baroreceptors.
  - Stimulus: lack of O_2, excess of CO_2, or excess of H^+
  - Receptor: located in several small organs (1-2 mm in size), carotid, and aortic bodies.

Each body has close contact with the arterial blood. Low pressure stimulates the chemoreceptors because diminished blood flow reduces oxygen and increases carbon dioxide and hydrogen ions. These receptors are not strongly stimulated until systolic pressure falls below 80 mmHg.

- Pathway: same as Baroreceptor.
- The Reflex: The signals transmitted from the chemoreceptors into the vasomotor center EXCITE the vasomotor center and increase arterial pressure.

🧠 مقارنة Baroreceptor vs Chemoreceptor Reflex

الخاصية	🩸 Baroreceptor reflex	🧪 Chemoreceptor reflex
الهدف	تنظيم ضغط الدم الطبيعي بسرعة	إنقاذ الجسم عند نقص O_2 أو زيادة H^+ / CO_2
المستقبلات	Baroreceptors	Chemoreceptors
الموقع	Carotid sinus + Aortic arch	Carotid bodies + Aortic bodies
المحفز	Stretch (ضغط الدم)	$\downarrow O_2$ $\uparrow CO_2$ $\uparrow H^+$
يشتغل عند	أي تغير بالضغط (حتى الطبيعي)	غالبًا في **hypotension الشديد (mmHg 80>)**
المسار	CN IX + CN X → NTS	نفس المسار (IX + X → NTS)
التأثير الأساسي	↓ أو ↑ ضغط حسب الحالة	↑ ضغط (تقريبًا دائمًا)
Sympathetic	يزيد أو يقل حسب الضغط	↑↑ قوي
Parasympathetic	قوي ومهم	ضعيف/ثانوي
النتيجة	يرجّع الضغط للطبيعي	يرفع الضغط لإنقاذ الجسم

Arterial Blood Pressure Regulation

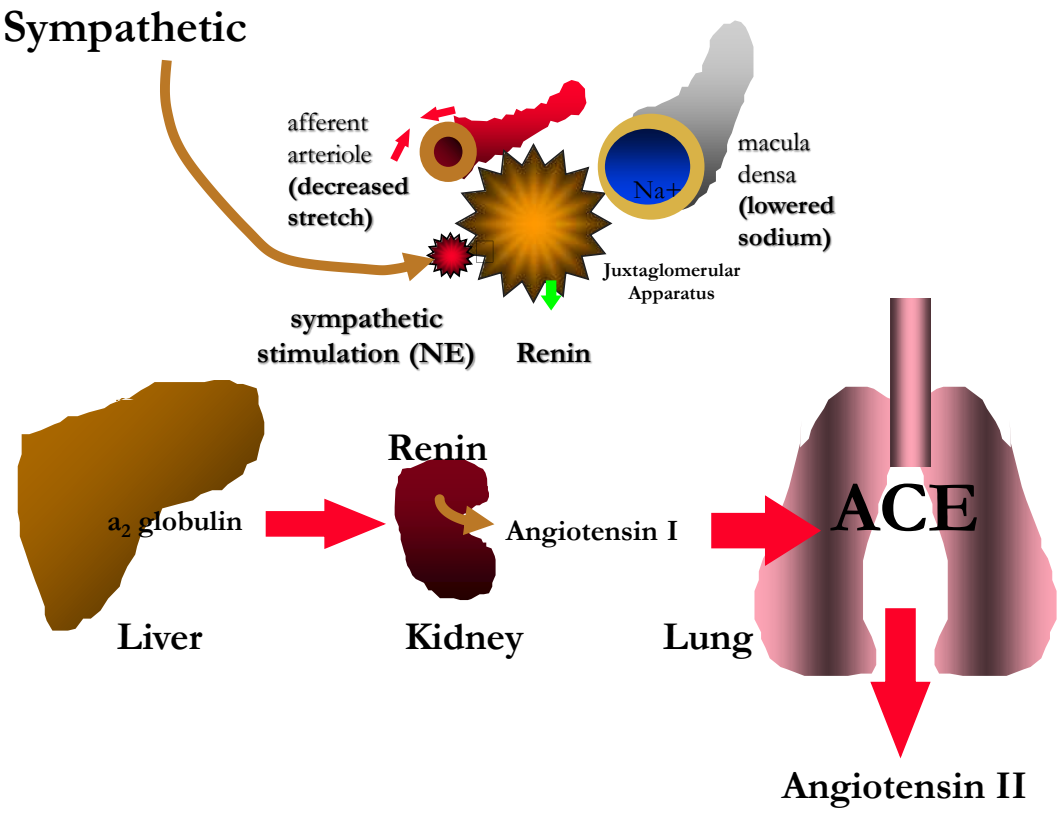
Long-Term Control

- It is done through the Renin-Angiotensin-Aldosterone System [RAS].
- When cardiac output decreases, it decreases CO in all the body including the kidneys.
- When the globular filtration rate or the renal perfusion decreases, the kidneys will respond to this by increasing renin production.

Baroceptors in long term AP regulation

ضغط عالي لديه سين بتتعود

However, if BP is maintained for 1 to 2 days, the baroceptors will reset at this 'new' level of 160 mmHg. Therefore, baroceptors are not as important, in long-term regulation.


Sympathetic
afferent
arteriole
(decreased
stretch)
macula
densa
(lowered
sodium)
Na+
Juxtaglomerular
Apparatus
sympathetic
stimulation (NE)
Renin
Renin
a2 globulin
Angiotensin I
ACE
Liver
Kidney
Lung
Angiotensin II

* Strong stimulation for sympathetic → Very vasoconstriction in afferent, Efferent ← اقل
GFR↓

* moderate stimulation for sympathetic → afferent ≤ Efferent (vasocon)

GFR → يوصف السائل اي صار له فلترة من كبسولة الكلية

↑GFR ← ↑Blood

Angiotensin 2 → ↓GFR لأنه بعمل Vasoconst على الـ afferent
→ Blood↓

How the autoregulation of GFR happend?

we have cell in the distal tubule (Macula densa)

← حساسة للتغير بالـ Na+

active for osmoreceptor that in densa ← ↓BV

بتنتج ↓ vasoconstrictor → vasodilation for afferent / or vasoconst for afferent → تحسين GFR

* once we have sever hypotension or hypertension → لأنه الـ sympathetic بصير dominant على الـ autoregulation (المطلوب)

↓

Vasoconstriction / vasodilation for Afferent / Efferent

↓

Angiotensin II more constriction for afferent than efferent

↓

GFR↓

ANP
↓
GFR↑ → مناطق بدها يصير لها امتصاص لكن من الدم ماصير لها وهاد المطلوب
↓
بزيد من افراز الصوديوم والماء
↓
Vasodilation for Afferent
↓
BP↓

☆ Natriuresis = urine بالصوديوم طلع

☆ diuresis = urine بالـ water طلع

واحد عنده ↓BV لأنه مثلا بينزف
active for long term ←
↓
لأنه كمية الدم اللي راح للـ kidney قليلة
↓

- **الكبد:** يقوم بإفراز مادة تسمى **أنجيوتنسينوجين (Angiotensinogen)**.
- **الكلية:** عندما تشعر بنقص التروية، تفرز إنزيم **الرينين (Renin)**.
- **التفاعل:** يقوم الرينين بتحويل "الأنجيوتنسينوجين" إلى **أنجيوتنسين 1**.
- **تحويل الأنجيوتنسين (ACE):** يفرز الكبد (والرئتان) إنزيم ACE الذي يحول "أنجيوتنسين 1" إلى **أنجيوتنسين 2** وهو المادة النشطة والقوية جداً [25، 26].

↓
وهذا نفسه

prdn ؟ vasoconstriction ↑
vasodilation ↓

زيادة افراز الالدستيرون بعمل للـ Na reabsorption والـ water
collecting duct ← from → late distal CT
بعمل للـ Na reabsorption والـ water من الـ proximal CT

* Vasoconst → TPR↑

🔴 Severe hypotension:
* sympathetic قوي
* afferent constriction ↑↑
* ↓ GFR
🟡 Mild/moderate hypotension:
* angiotensin II
* efferent constriction ↑
* يحافظ على GFR

Renin

- **Renin is a protease that cleaves angiotensinogen to angiotensin I. Then angiotensin 1 is converted to angiotensin 2 by the angiotensin-converting enzymes (ACE) in the lungs.**

- Renin is secreted by the juxtaglomerular apparatus in response to a reflexive sympathetic activity or beta receptor stimulation, decreased central volume of blood or decreased plasma Na+.

Angiotensin II

- **One of the most potent vasoconstrictors known.**
- Octapeptide (8 amino acids).
- Constricts principally arteriolar smooth muscle to increase resistance.
- Stimulates the vasomotor center of the brain.
- **Stimulates the release of *Aldosterone* (steroid hormone) by the adrenal medulla.**
- Inactivated by angiotensinase enzyme.

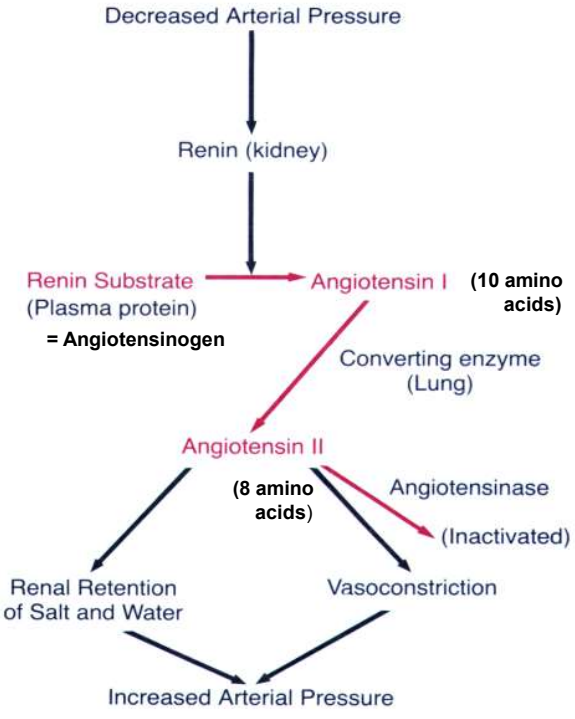
Effect of Angiotensin to Cause Retention of Salt and Water

- **Direct Renal Effect** (can decrease urinary output 4-6 fold):
  - ✓ Enhances the reabsorption of Na ions from the proximal tubule (Na reabsorption = water retention = increase in volume… vasoconstriction).
- **Stimulation of Aldosterone Secretion** from the adrenal glands
  - ✓ Increase in salt reabsorption by the kidney tubules, increase in extracellular fluid sodium, and water retention.
- **Blocks bradykinin,** which is a local mediator of vasodilation:
  - ✓ So, blocking it causes vasoconstriction.

Aldosterone

- *Steroid hormone* secreted by the adrenal medulla in response to angiotensin II formation.
- Increases blood volume by promoting the reabsorption of sodium and water.
- Takes hours to be effective in raising blood pressure and volume because it requires protein synthesis.

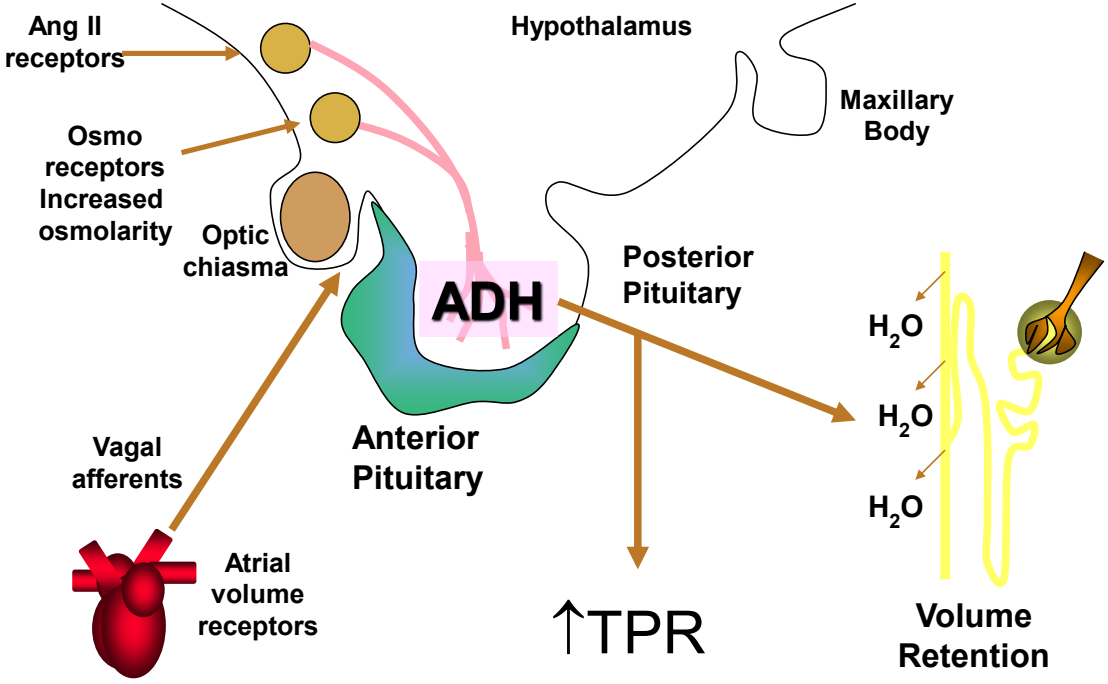
The Role of the Renin-Angiotensin System in Regulating Arterial Pressure



Antidiuretic Hormone (ADH, Vasopressin)

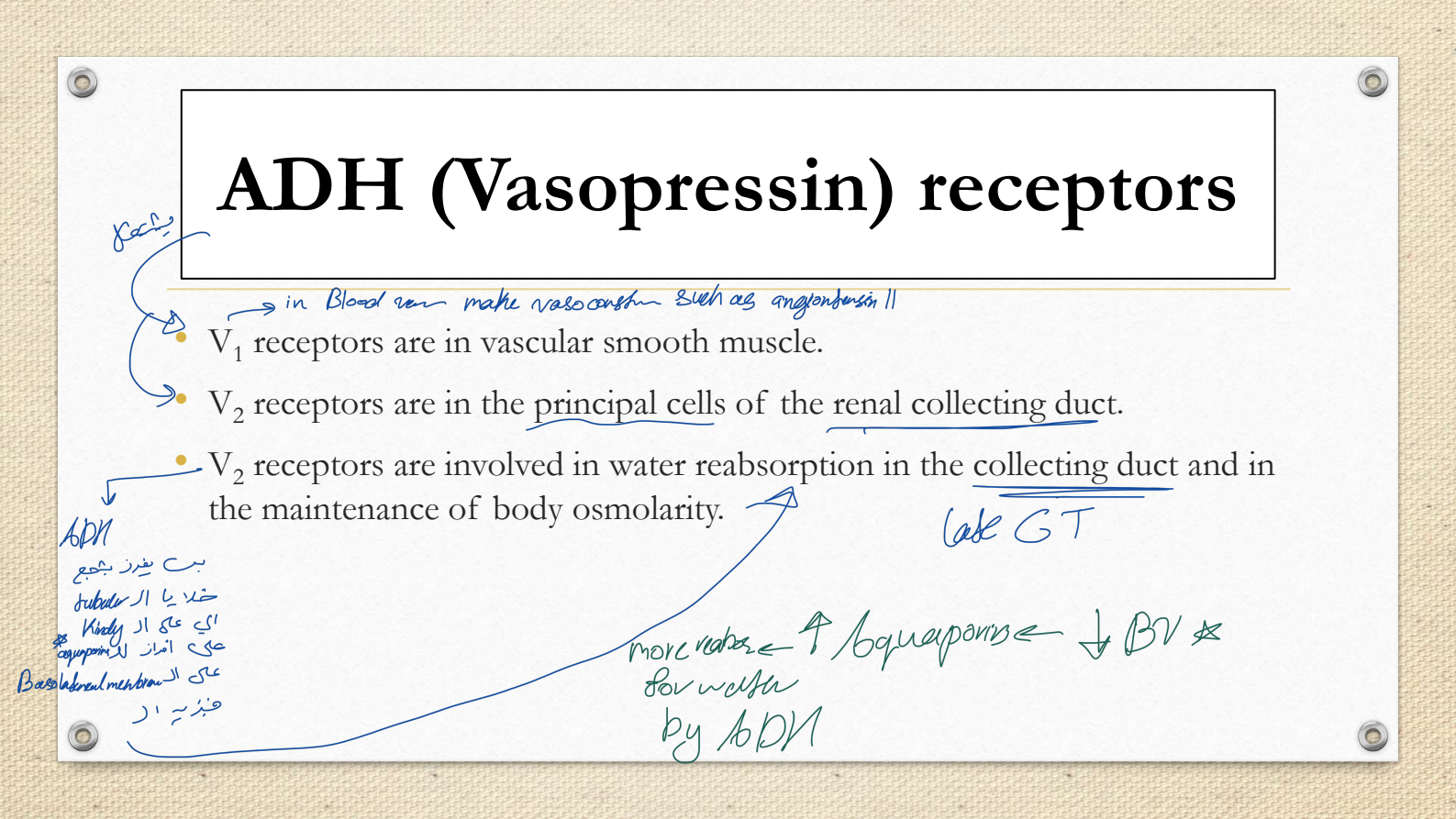
1. ADH is an oligopeptide that is synthesized in the hypothalamus and stored in the posterior pituitary before it is released into the bloodstream.
2. ADH release is stimulated by *osmoreceptors* in the anterior pituitary, triggers ADH and thirst (2% osmolarity) change is enough.
3. These hormones prevent diuresis (loss of water in urine) in case of dehydration and hypovolemia.

ADH (Vasopressin) and Blood Volume



ADH (Vasopressin) receptors

- V_1 receptors are in vascular smooth muscle.
- V_2 receptors are in the principal cells of the renal collecting duct.
- V_2 receptors are involved in water reabsorption in the collecting duct and in the maintenance of body osmolarity.



The Renal-Body Fluid System for Long Term Control of Arterial Pressure:

When the body contains too much extracellular fluid, arterial pressure rises. This increase in pressure causes the kidneys to excrete the excess fluid until pressure returns to normal (pressure diuresis).

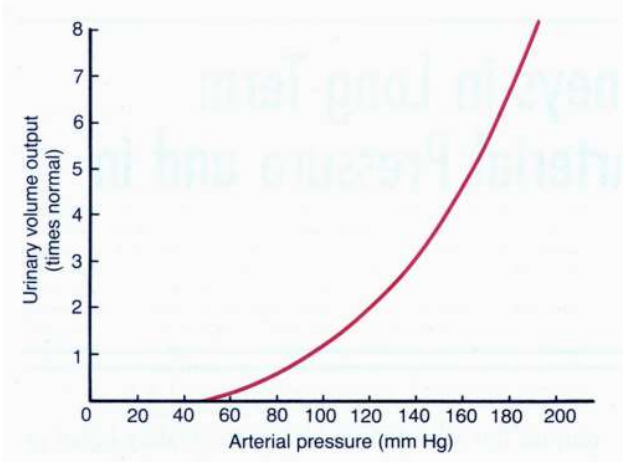
Quantification of pressure diuresis using renal function curves

As pressure increases urinary volume, there is an equal effect on the urinary output of salt (pressure natriuresis),

i.e. the relationship is similar for sodium excretion

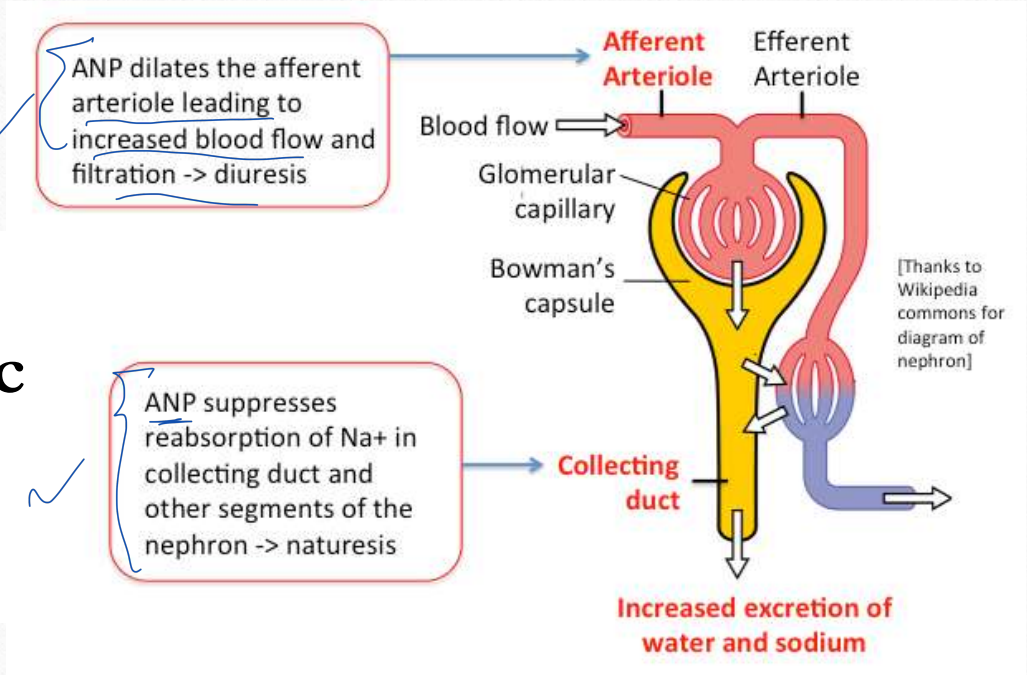
↑ BP = ↑ urine output = ↑ Na excretion = ↑ water loss

الآلية	النتيجة
Pressure diuresis	↑ BP → ↑ ماء بالبول
Pressure natriuresis	↑ BP → ↑ صوديوم بالبول
V1 (ADH)	vasoconstriction
V2 (ADH)	water retention

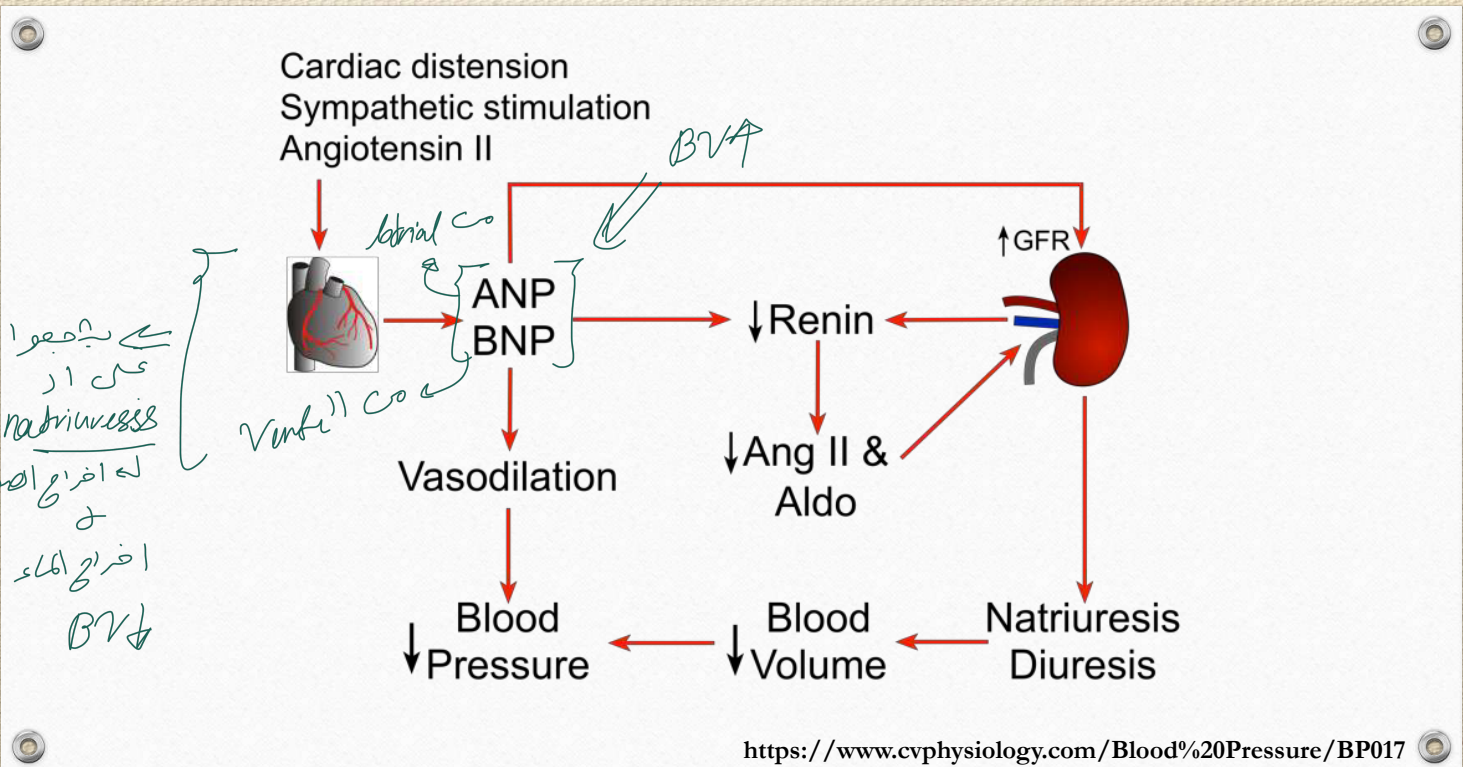


Typical Renal Output Curve Measured in an Isolated Perfused Kidney

Atrial Natriuretic Peptide (ANP)



http://www.vivo.colostate.edu/hbooks/pathphys/endocrine/otherendo/anp.html



https://www.cvphysiology.com/Blood%20Pressure/BP017

❑What Can I Do?

- High blood pressure is a lifelong disease.
- Blood pressure can be controlled not cured.
- Controlling blood pressure will reduce the risk of stroke, heart attack, heart failure, and kidney disease.

❑What Can I Do?

- Loose weight if your overweight.
- Get regular physical activity.
- Avoid excessive alcohol.
- Stop smoking.
- Manage your stress.
- Decrease salt intake.
- Eat for heart health.
- Discuss the use of oral contraceptives with your doctor.
- Discuss the use of some medications with your doctor.

Commandments for Blood Pressure Control:

-Know your blood pressure

- Have it checked regularly

-Know what your weight should be

- Keep it at that level or below

-Don't use excessive salt in cooking or at meals

- Avoid salty foods

-Eat a low-fat diet

- According to AHA regulations

-Don't smoke cigarettes

- Or use tobacco products

-Take your medicine exactly as prescribed

- Don't run out of pills even for a single day

-Keep your appointments with the doctor

-Follow your doctor's advice about exercise

Main medication for HTN

- ***Diuretics:***
  - Rid the body of excess fluids and salt
- ***Beta-blockers:***
  - Reduce the heart rate and the work of the heart
- ***Calcium antagonists:***
  - Reduce heart rate and relax blood vessels
- ***Angiotensin II receptor blockers (ACE):***
  - Interfere with the bodies production of angiotensin, a chemical that causes the arteries to constrict (narrow)
- ***Vasodilators:***
  - Cause the muscle in the wall of the blood vessels to relax, allowing the vessel to dilate (widen).

Thank You