Third week

By: Nadine Allaam

Resting membrane potential (RMP)

RMP: potential difference between the sides of the membrane

= −70 mV in nerves

= −90 mV in muscles

* RMP occurs in exitable tissues (muscles and nerves) more than other tissues

ions distribution

ions	inside	outside
Na^+	14	140
k^+	140	4

} in polarized state (+ on one side and − in the other side)

* the reasons behind the negativity of the inner side: proteins, phosphate, sulfate

* the reason behind the positivity of the outer side: Na^+

Causes of RMP:

1- selective permiability 93% −65.1mV
2- (K - Na) pump 7% −4.9 mV

} these make inside more negative and out side more positive

selective permiability:-

* k^+ go out more than Na^+ go inside, this is because:

1- Concentration gradient for k^+ is more than Na^+

2- k^+ leak channels are more than Na^+ leak channels

3- Na^+ channels are guarded by Ca^{+2}

4- Na^+ and K^+ are covered by a jacket of water, but Na^+ is thicker.

* negative ions inside remain inside

Action Potential

1- **Latent period** the period between stimulation and starting of Depolarization

2- **Depolarization** → (−70 → −55): Slow depolarization: opening few Na^+ voltage channels

because of opening Na^+ Channels

- (−55): firing level: opening all Na^+ voltage channels
- (0): isopotential depolarization: no potential difference between the sides of the membrane
- (0 → +35): reversal of polarity: inside becomes (+) and outside negative
- −55 → +35 rapid depolarization

** at +35 Na^+ channels are closed

3- **Repolarization**: Rapid repolarization is 70% of curve

* rapid depolarization and rapid repolarization are called spike potential

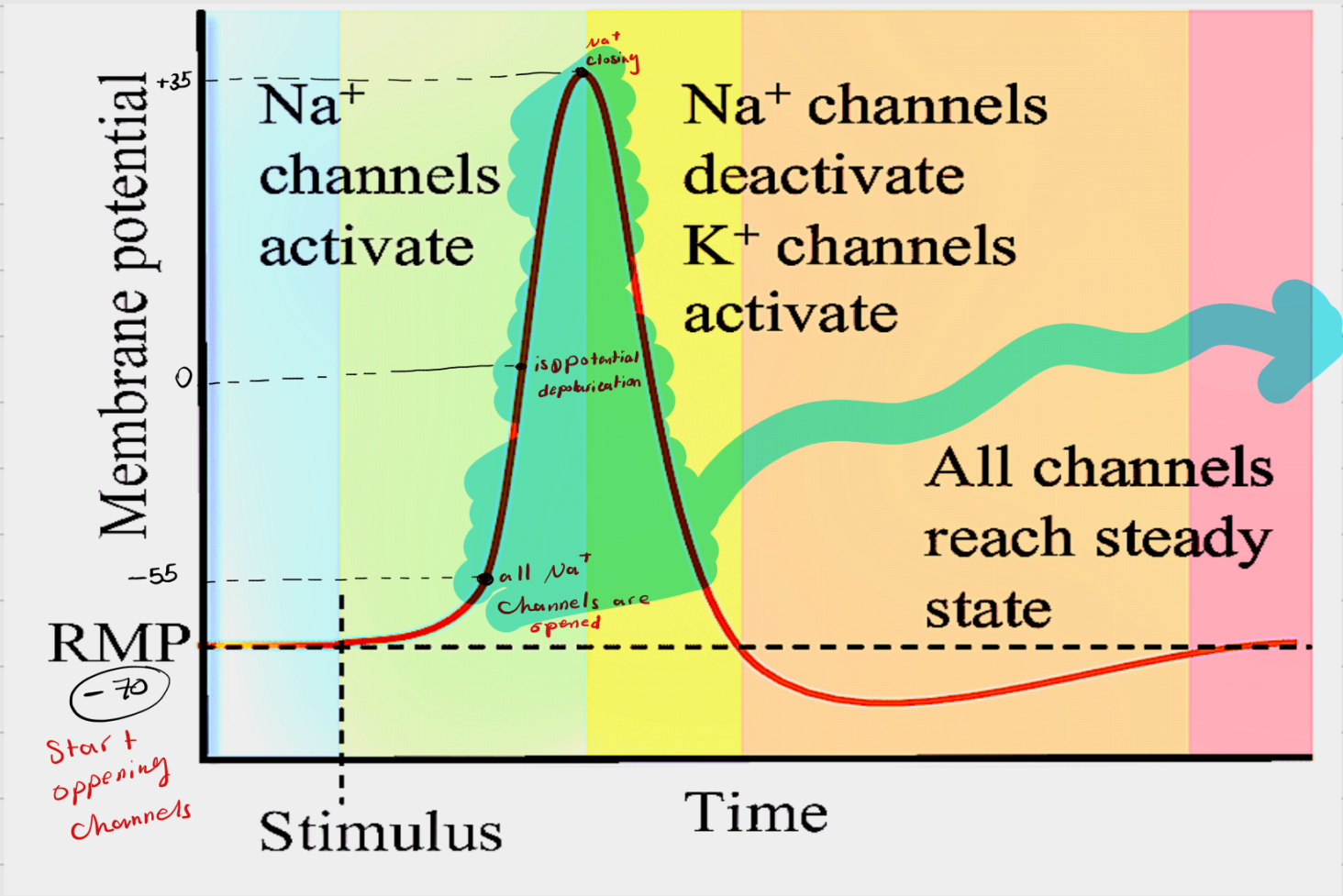
causes: closing Na^+ channels and increase K^+ outflow

* maximum K^+ channels opening occur when Na^+ channels closing * (at +35)

* after potential: slow (30% of curve)

- negative after potential: after depolarization: outer surface becomes less positive than in resting because diffusion of K^+ is decreased due to concentration, electric gradient
- positive after potential: after hyperpolarization: outer surface become positive more than in resting because of slow closer of K^+ channels

RMP re-established again by Na^+ - K^+ pump



Local Anesthetic

such as lidocaine and procaine

bind to receptor site on Na^+ voltage channels and block ions movement

So ... Ap is stopped and signals can't reach CNS

↳ central nervous system

properties of cardic muscle

① Exitability

RMP = -90mV

the outside of the membrane is + due to Na^+, Ca^{+2}

the inside of the membrane is − due to phosphate, sulfate, protein

AP ⟶ 5 stages

0 1 2 3 4

- Stage 0 : (-90 ⟶ +20)

rapid Depolarization: due to rapid influx of Na^+ through Na^+ voltage channels

- Stage 1 : (+20 ⟶ +10)

initial repolarization : due to inactivating for Na^+ Channels and K^+ efflux

- stage 2 : (+10 ⟶ 0) platue

due to balance between Ca^{+2} influx and K^+ efflux

it makes action potential time longer ⟶

it makes long absolute refractory period (ARP)

★ importance of ARP:

1- Prevent tetanic contraction

2- Prevent the fatigue

- Stage 3 : (0 ⟶ -90)

Repolarization : due to stopping Ca^{+2} influx because the Ca^{+2} channels are closed, and K^+ efflux through slow voltage K^+ channel

- Stage 4 : (at -90)

complete repolarization by K^+ efflux

** RMP is restored by Na-K pump

② Autorythmicity:

myogenic nerve supply can control rythmicity

SA node :	90 - 105
AV node :	60 - 90
atrial muscle :	30 - 40
ventricular muscle :	30 - 40

SAnode : the peace maker because of its high rythmicity

* it has the highest rythmicity due to its rapid recovery from AP

vagal tone : continous inhibitory effect by vagi on the heart during rest

SAN 105 ⟹ 70 (vagal tone)

③ contractility : ability to contract

factors affecting on it :-

1- All or non : the cardic muscle contract maximaly or doesn't contract - - - this is because the ventricles act as one and the atrias act as one.

2- Franc starling law : with limits, this is direct propotion between initial Long of fibers and contraction

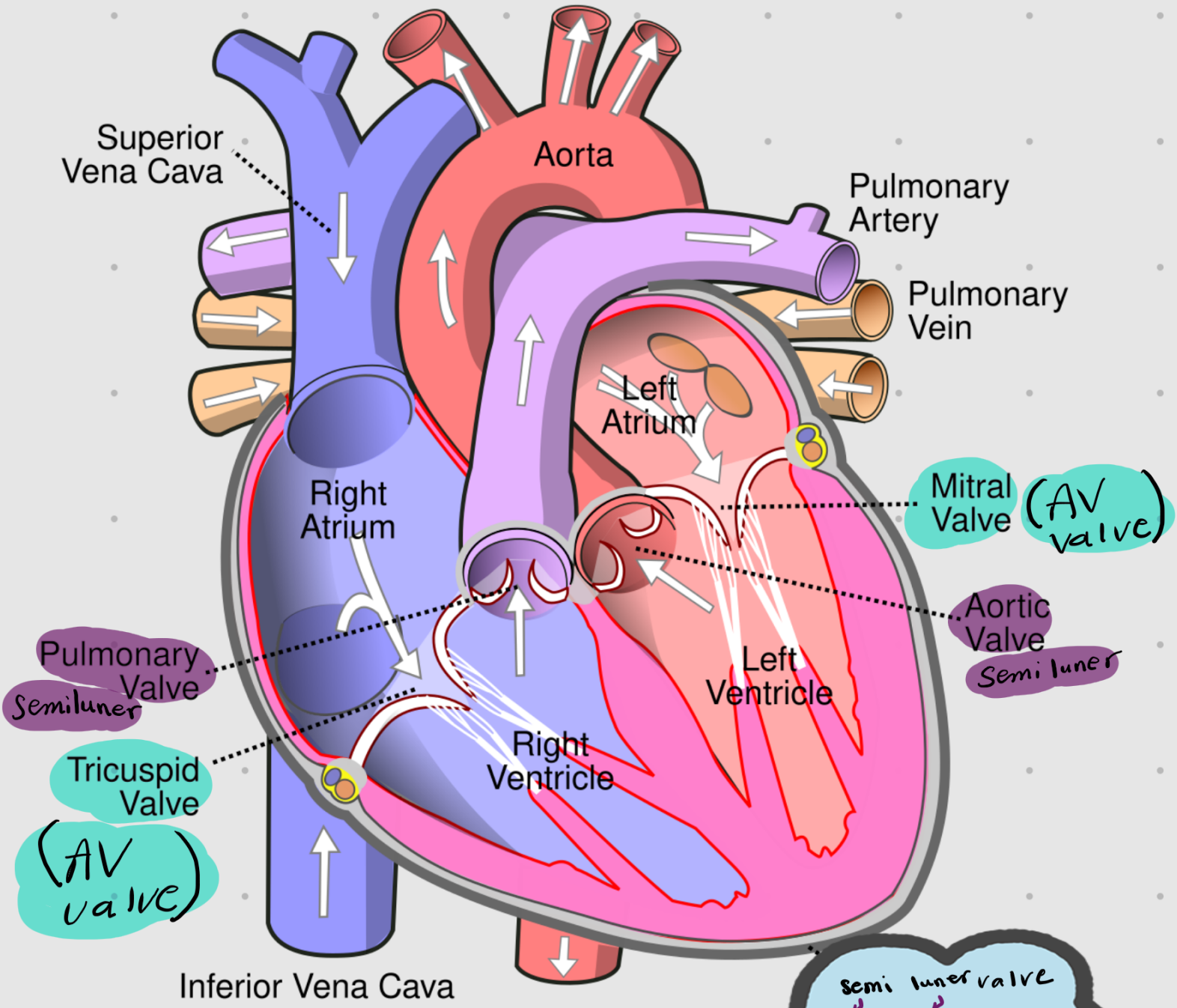
Limitation : over strech decrease force

Because of intercalate discs

④ conductivity : the ability of cardic muscle to transmit exitation wave from part to another

SA node ⟶ AV node ⟶ AV bundle ⟶ purkinje fibers

lecture 9



semi luner valve
half moon
AV valve
atrium ventricular

two atrial contract and relax together,
two ventricles contract and relax together

systole = blood flows out (ejection) (contraction)

diastole = blood flows in (filling) (relaxation

ventricular systole + atrial diastole → occur together
ventricular diastole + atrial systole → occur together

Cardiac cycle (.8 sec)

events from the beggining of one beat to the beggining of the next beat

= events in one beat

phases

- ventricular systole (atrial diastole)
- ventricular diastole (atrial systole)

* right side of the heart has deoxygenated blood

* left side of the heart has oxygenated blood

* 2 atria → بيشتغلوا مع بعض
2 ventricles → بيشتغلوا مع بعض
عند انقباض atria بتنبسط ventricles والعكس صحيح

ventricle contraction (systole) → pressure increase, volume increase

1- isometric contraction

١- تغلق كل الأبواب فيتحول الventricle إلى حجرة مغلقة

- values are closed
- Blood volume is constant (ventricular volume) (لا يزاد ولا يقل)
- Ventricular pressure increased
- aortic pressure decreased

2- Rapid ejection

semilunar valve is open

ventricles contract maximaly ,
semilunar valves open
٢ - نبدأ نفتح الأبواب اللي تحت حتى يتم خروج الدم
Left → aorta
right → palmonary
عند فتح الأبواب تندفع كمية كبيرة من الدم rapid ejection → 70%
تستمر هذه المرحلة

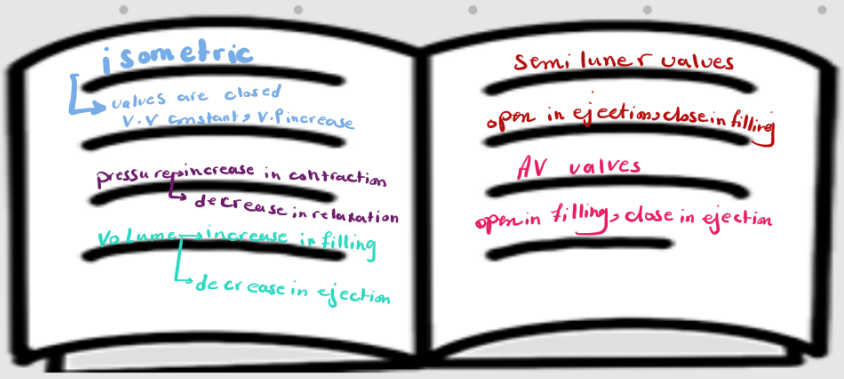
- ventricular pressure greater increased
- ventricular volume greater decreased
- semilunar valves open → AV valves closed

3- slow ejection

semilunar valve is open

المرحلة التي بعدها (بعد فتح الأبواب بقترب) تكون أضعف → 30%
Slow ejection
{filling} بعدها يتم إغلاق الأبواب ويبدأ القلب باستقبال الدم
(Blood flow with force less than the previous phase)

- ventricular pressure starts to decrease
- ventricular volume decreased
- semilunar valves open → AV valves closed



ventricle relaxation → pressure decrease, volume increase

1- isometric relaxation

ventricles relax without change in fibers length

١- تغلق كل الأبواب فيتحول الventricle إلى حجرة مغلقة

- values are closed
- Blood volume is constant (لا يزاد ولا يقل)
- Ventricular pressure decreased
- atrial pressure increased

2- Rapid filling

AV valve is open

semilunar valve يبقى مغلق بينما AV valve تفتح
rapid filling يحدث → 60%
slow filling يحدث → 10%

* atria are relaxed
* ventricular pressure decreased
* ventricular volume gradually increased

3- slow filling

AV valve is open

* ventricular pressure greater increased
* ventricular volume greater increased

4- Atrial systole 30%

contraction of atria → atrial systole
الكمية المتبقية من الدم تنزل بـ from atrium to ventricles

* atrial pressure increased
* ventricular pressure slightly increase
* ventricular volume increase

لجنة طب الأسنان