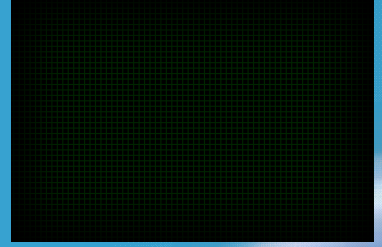
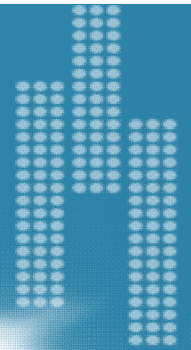


人体 心电图描记

Electrocardiogram, ECG



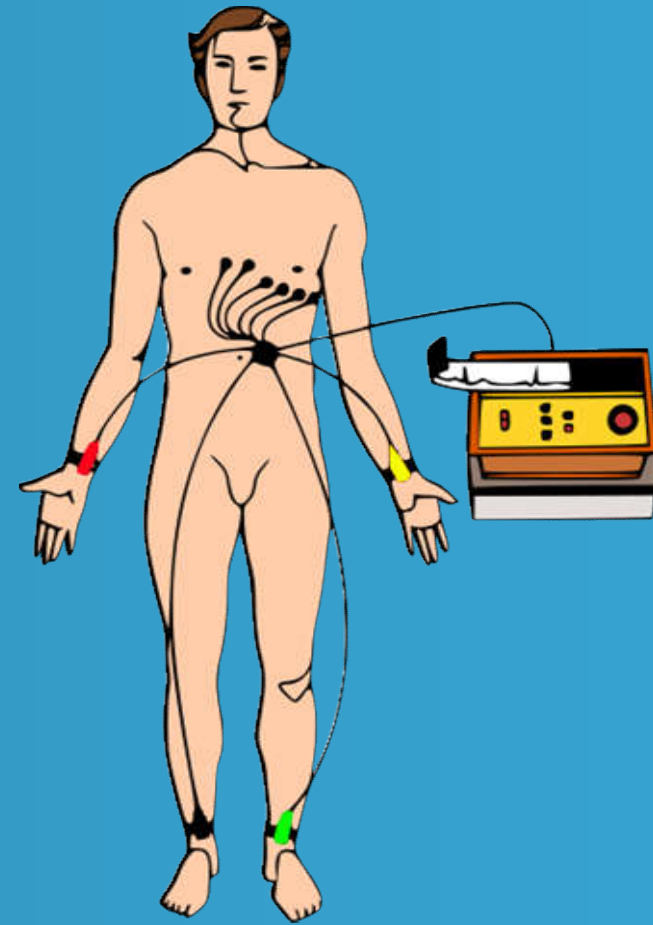
实验教学管理中心



人体心电图描记 **Electro**Cardio**G**raphy



1. 什么是 ECG?
2. 如何记录 ECG?
3. 如何分析 ECG?



1. 心肌细胞特性

① 兴奋性

- 动作电位AP（右上图）

② 自律性

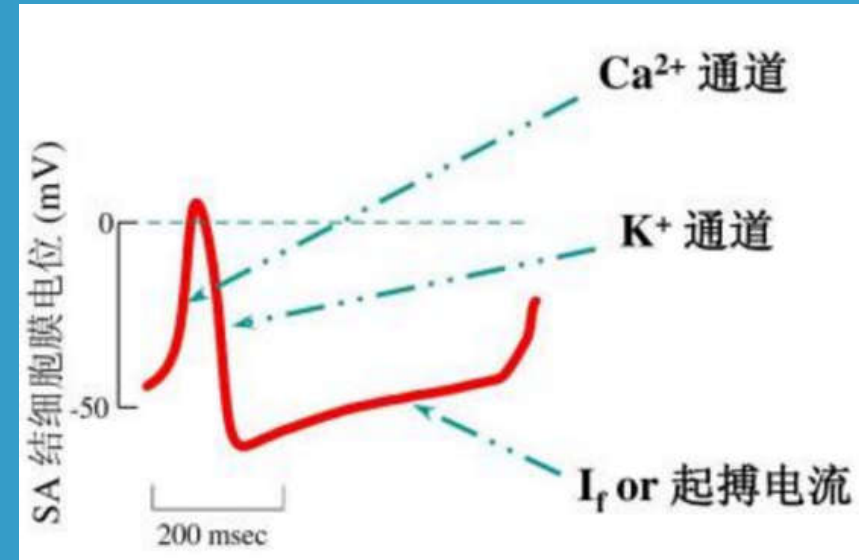
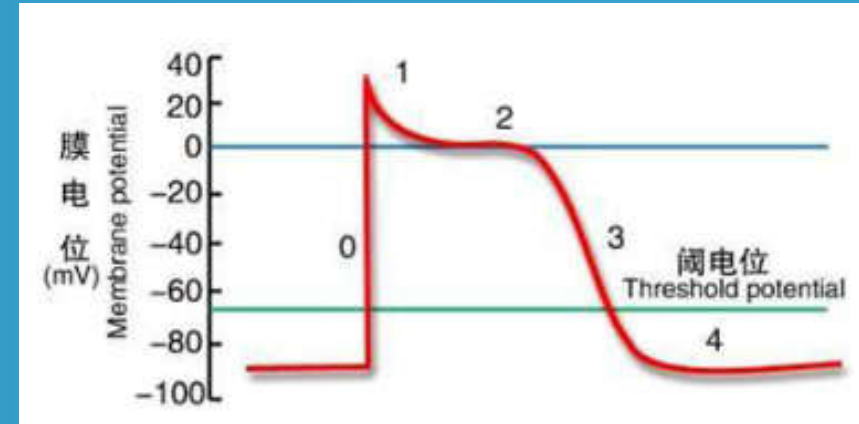
- 窦房结、房室束、浦肯耶纤维等特殊心肌细胞（非工作细胞）等
- 机制：AP 第4期自动去极化

③ 传导性

- 窦房结→房室束→房室结→希氏束→左右、束支→浦肯耶纤维
- 心肌细胞间（什么结构？）

④ 收缩性（非工作细胞无）

- AP 触发
- Ca^{2+} 参与的兴奋-收缩偶联

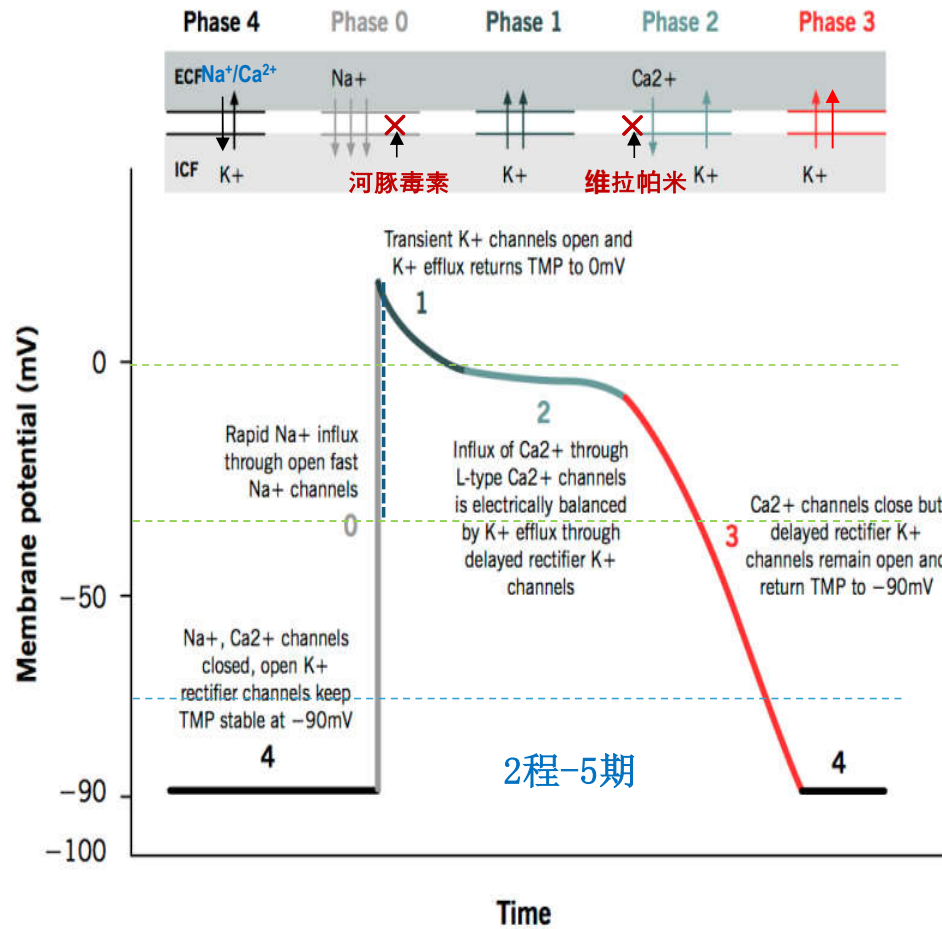


1. 心肌细胞特性——动作电位



Action potential of cardiac muscles

Grigoriy Ikonnikov and Eric Wong



▶ Ca^{2+}

↓↑

▶ Na^+

↓↑

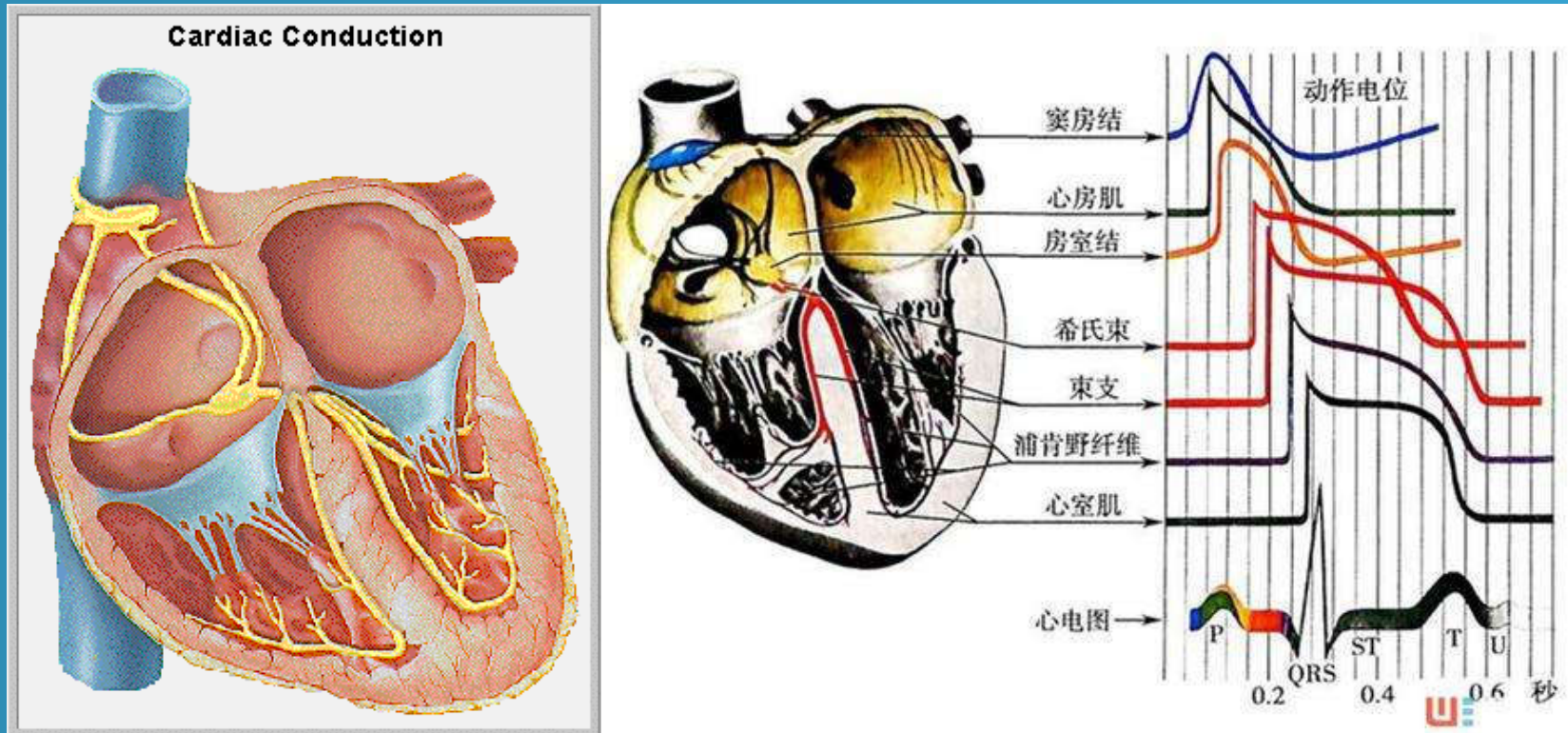
▶ K^+ ★

▶ 跨膜运输方式?

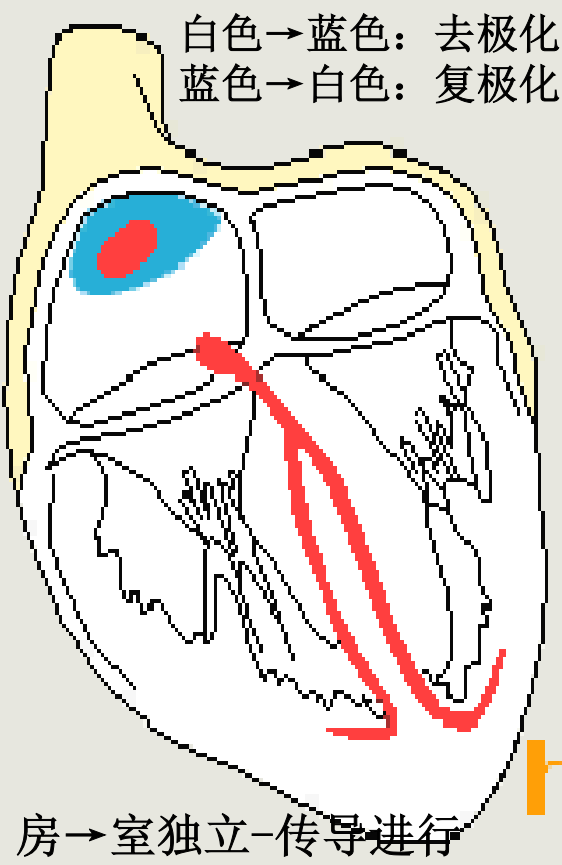
1. 心肌细胞特性 $\sum (AP)_n \rightarrow ECG$



Overall electrical activity of the heart \rightarrow ECG



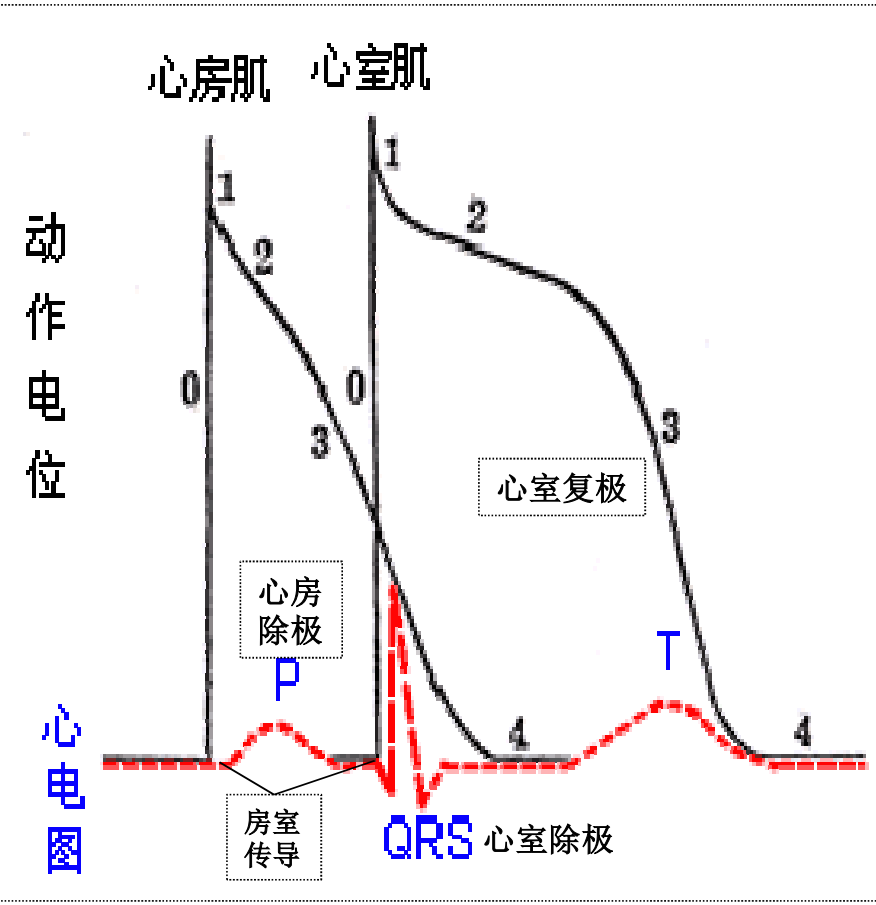
Principles



P波: 心房除极; PR间期: 房室传导时间; QRS波: 心室除极;



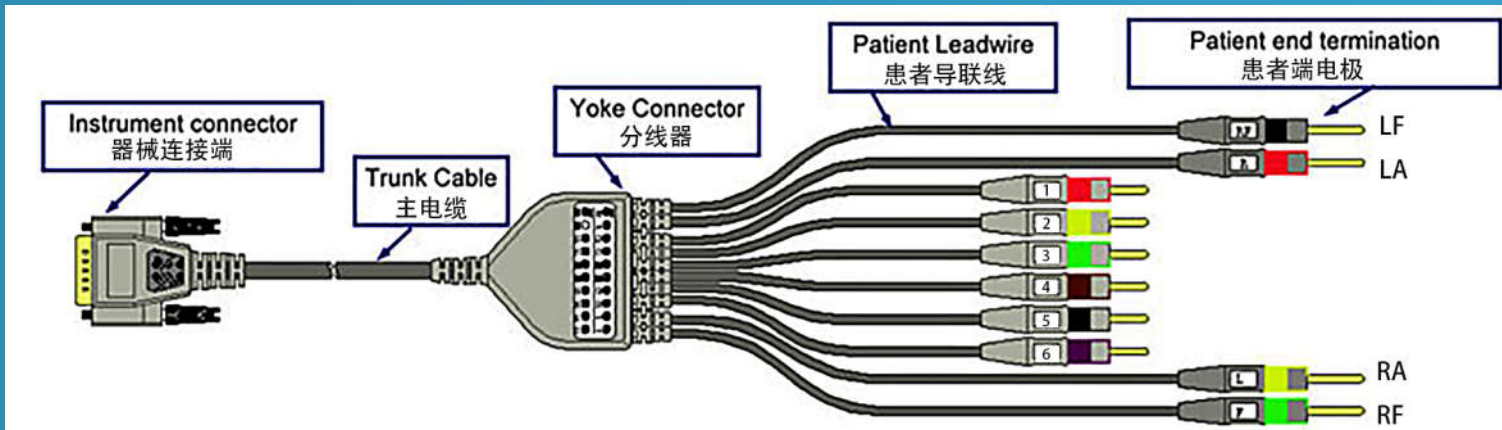
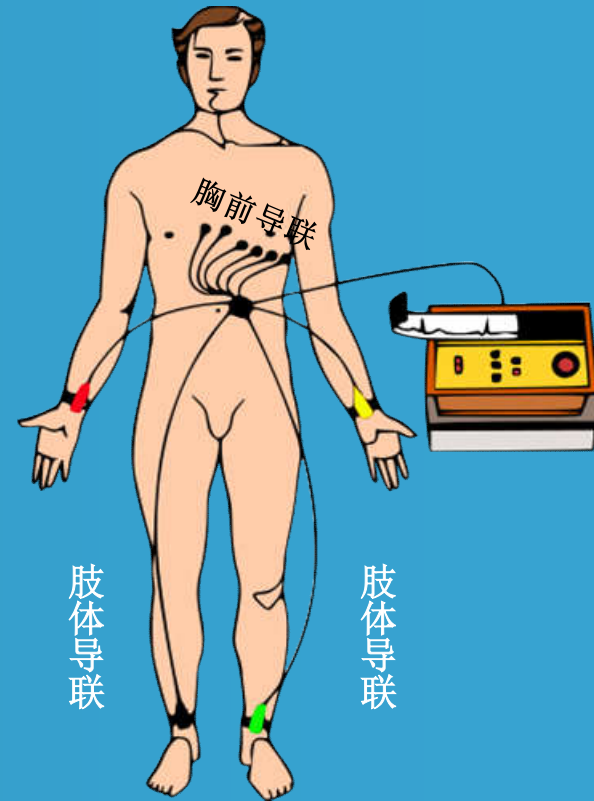
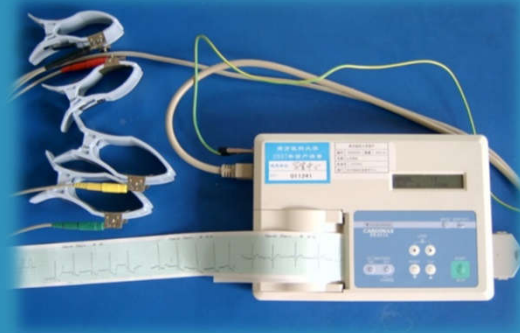
T波: 心室复极; QT间期: 心室兴奋时间。
记录电极



P波: 心房除极; PR间期: 房室传导时间; QRS波: 心室除极; T波: 心室复极; QT间期: 心室兴奋时间。
AP是单个心肌细胞的电位变化曲线; ECG则是整个心脏的电位变化。

2. 如何记录 ECG?

1. 心电图仪
2. 连线
3. 电极
4. 电极-人体连接
5. 打印纸



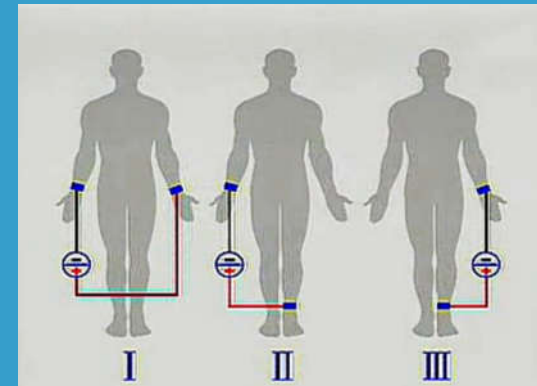
2. 如何记录ECG —— 如何连接?



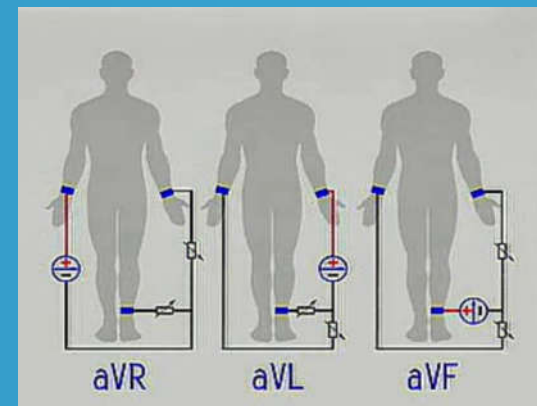
▶ 肢体导联 Limb Leads

- ✓ 双极肢体导联 bipolar limb leads: I, II, III
- ✓ 加压单极肢体导联 augmented unipolar limb leads: avR, avL, avF
- ✓ 反映心脏冠状面情况 Frontal plane axis

LEADS	LIMBS	+ LEAD
I	Left arm + Right arm	Left arm
II	Left foot + Right arm	Left foot
III	Left foot + Left arm	Left foot
aVR	Left arm + Right arm + Left foot	Right arm
aVL	Left arm + Right arm + Left foot	Left arm
aVF	Left arm + Right arm + Left Foot	Left Foot

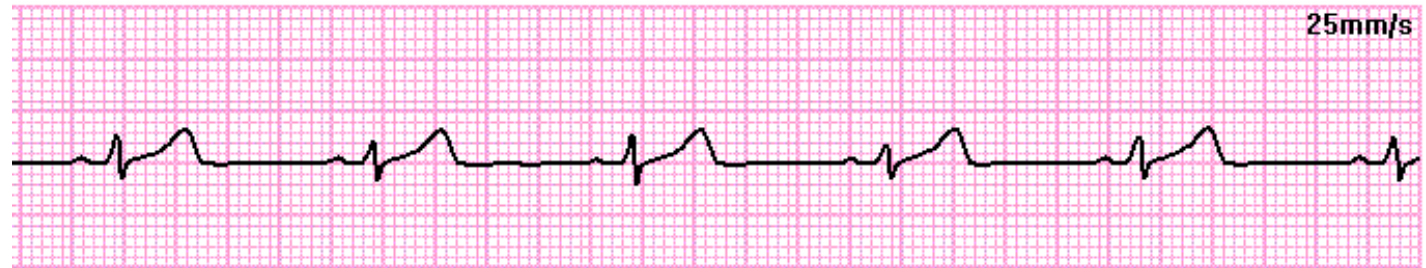


1. Red: RA
2. Black: RF
3. Yellow: LA
4. Green: LF



any name

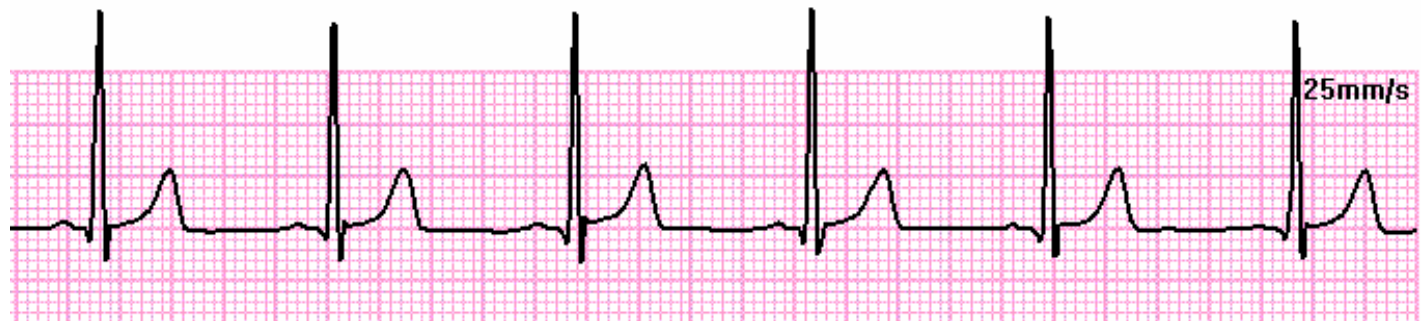
LEAD I



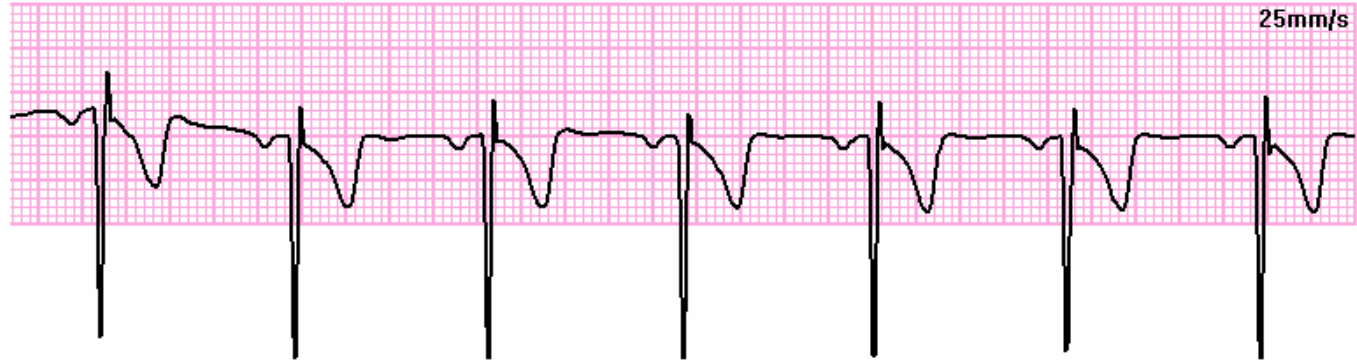
LEAD II



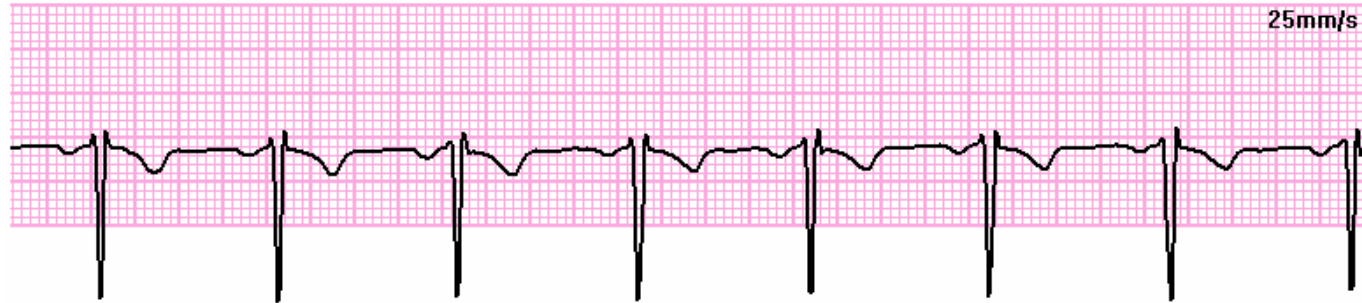
LEAD III



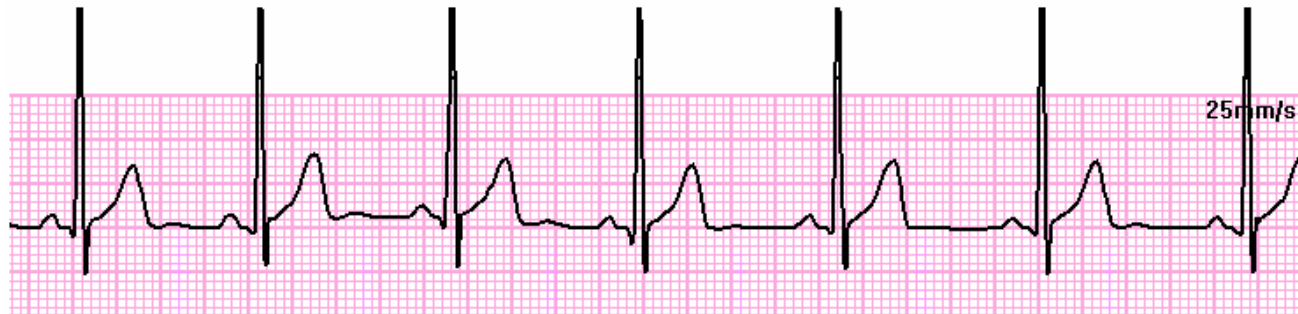
aVR



aVL



aVF

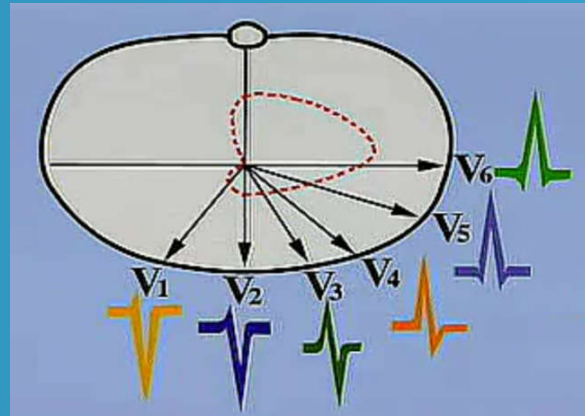


Standard 12-lead System

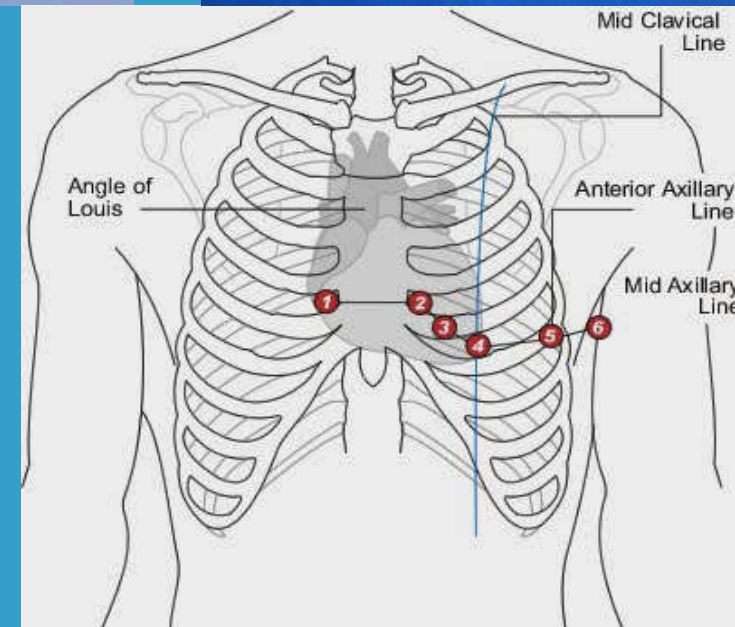


▶ 胸(前)导联 Chest Leads

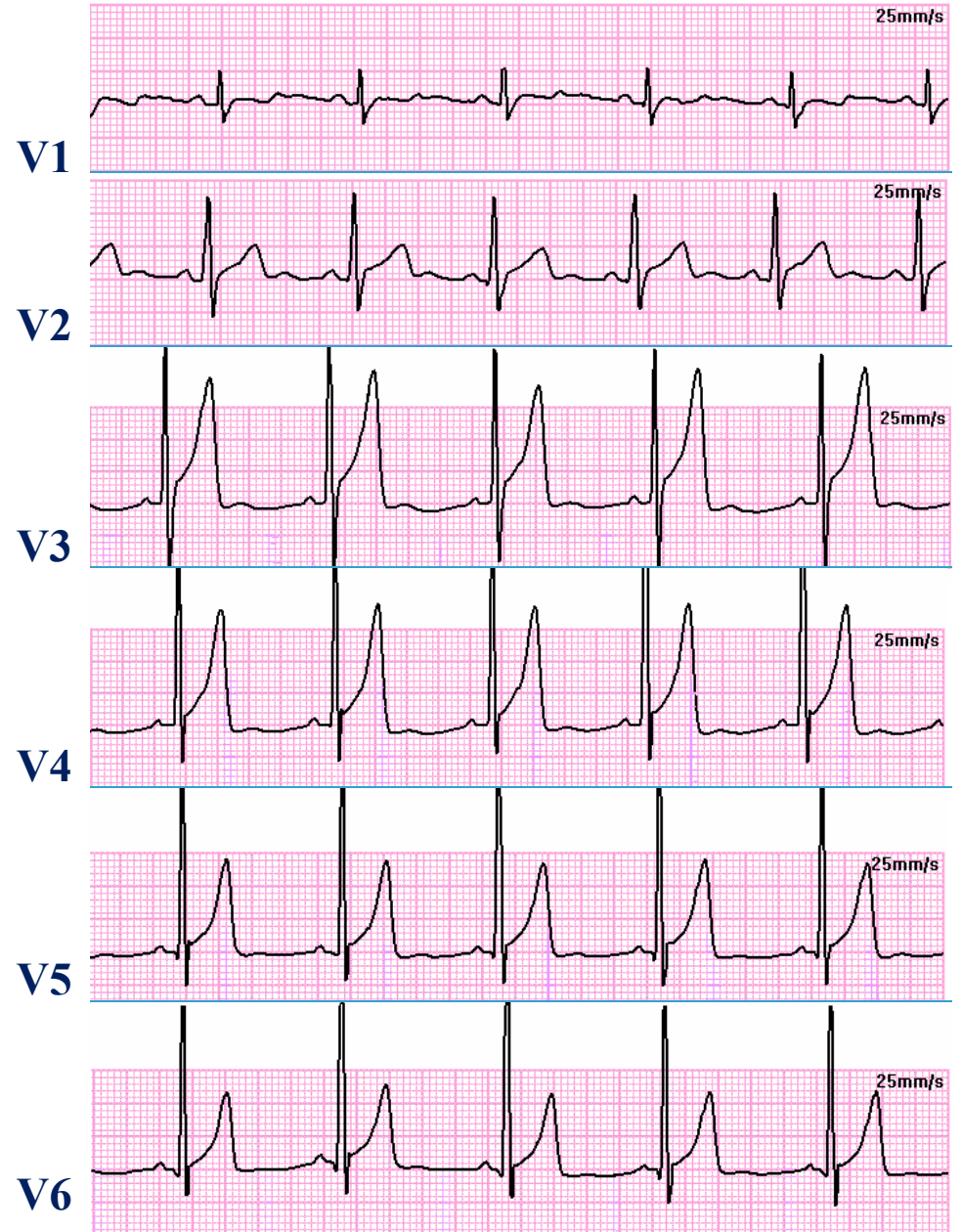
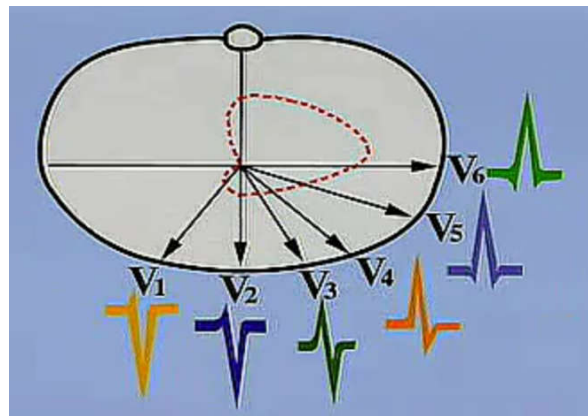
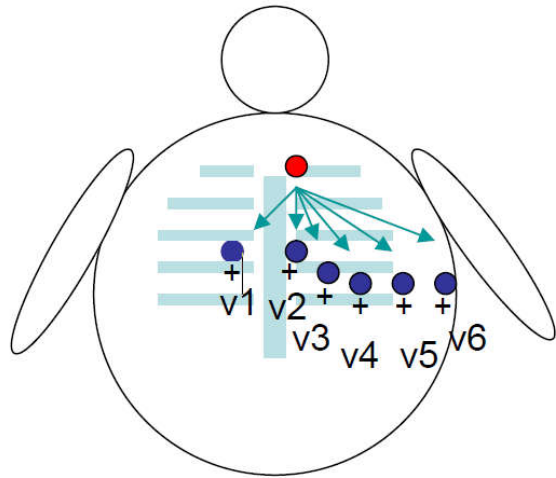
- ✓ V₁, V₂, V₃, V₄, V₅, V₆
- ✓ 反映心脏水平面情况
- ✓ horizontal axis



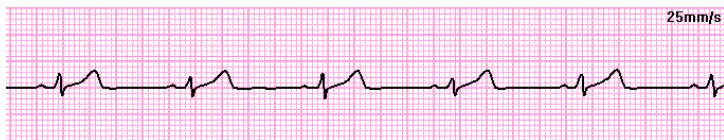
V1	4 th intercostal space-right sternum
V2	4 th intercostal space-left sternum
V3	midpoint between V ₂ and V ₄
V4	5 th intercostal space-left mid clavical line
V5	line of the 5 th intercostal space-anterior axillary line
V6	line of the 5 th intercostal space-mid axillary line



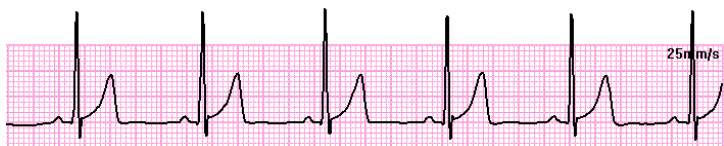
胸前导联 Chest Leads



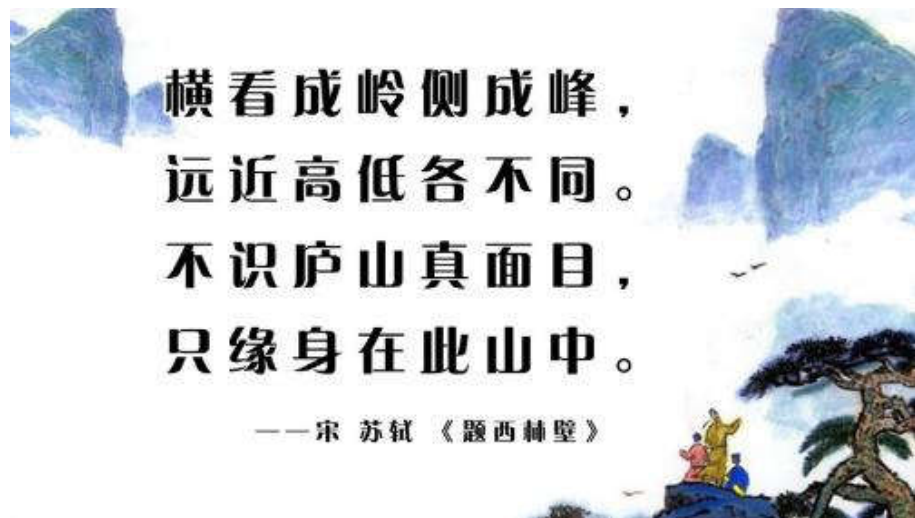
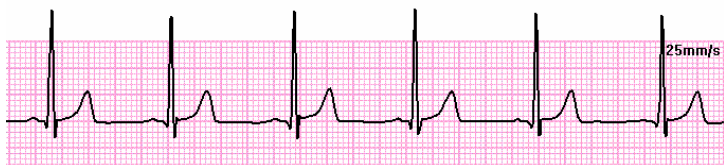
LEAD I



LEAD II



LEAD III



为何不同导联心电图形状不同？

V1



V2



V3



V4



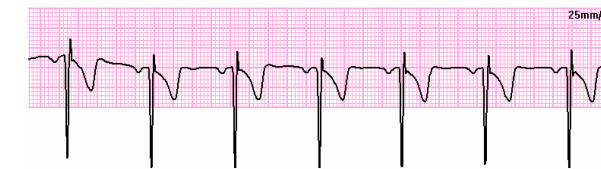
V5



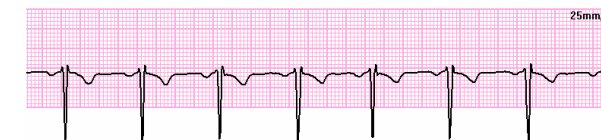
V6



aVR



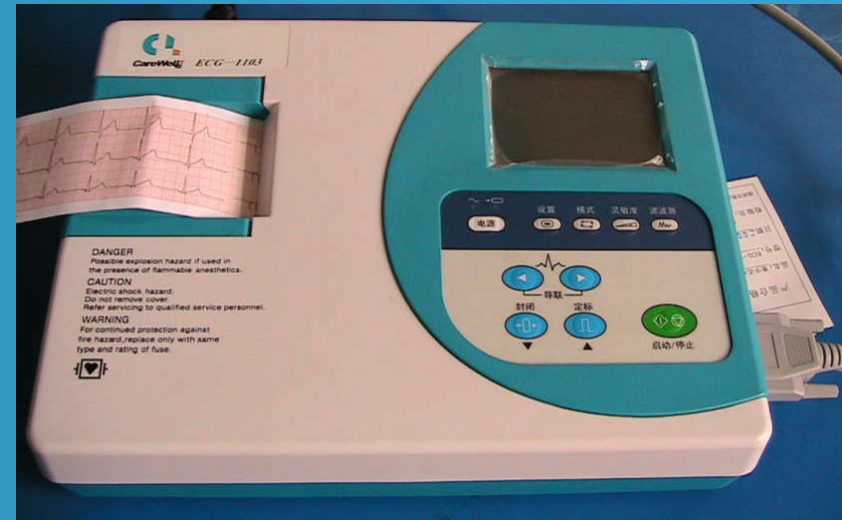
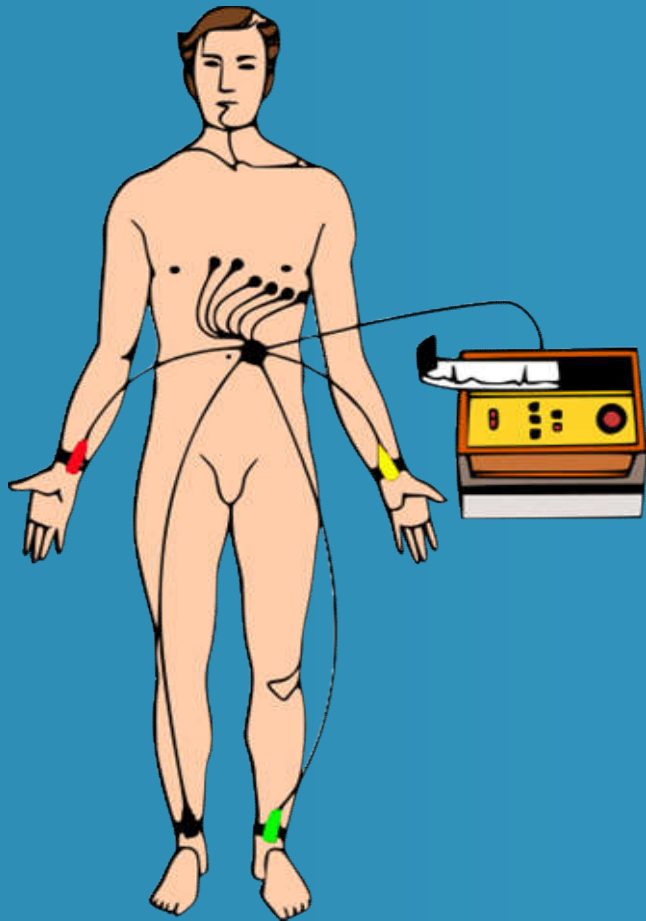
aVL



aVF

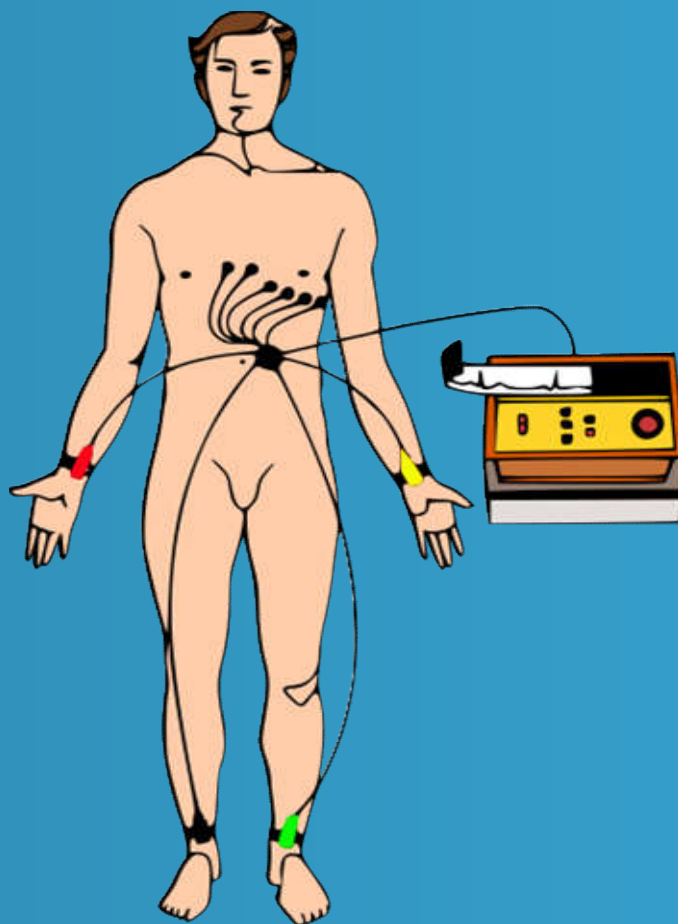


ECG 描记: 操作



1. **Machine preparation:** lead wires, power on 3-5min in advance
2. **Patients preparation:** Lie on the back and relax. Exposure of the left-right wrist, left-right ankle & chest.
3. **Apply conductive paste** (or alcohol wipes), leads placement, scaling ($1\text{mm}^2=0.1\text{mV}\times 0.04\text{s}$), 25mm/s.

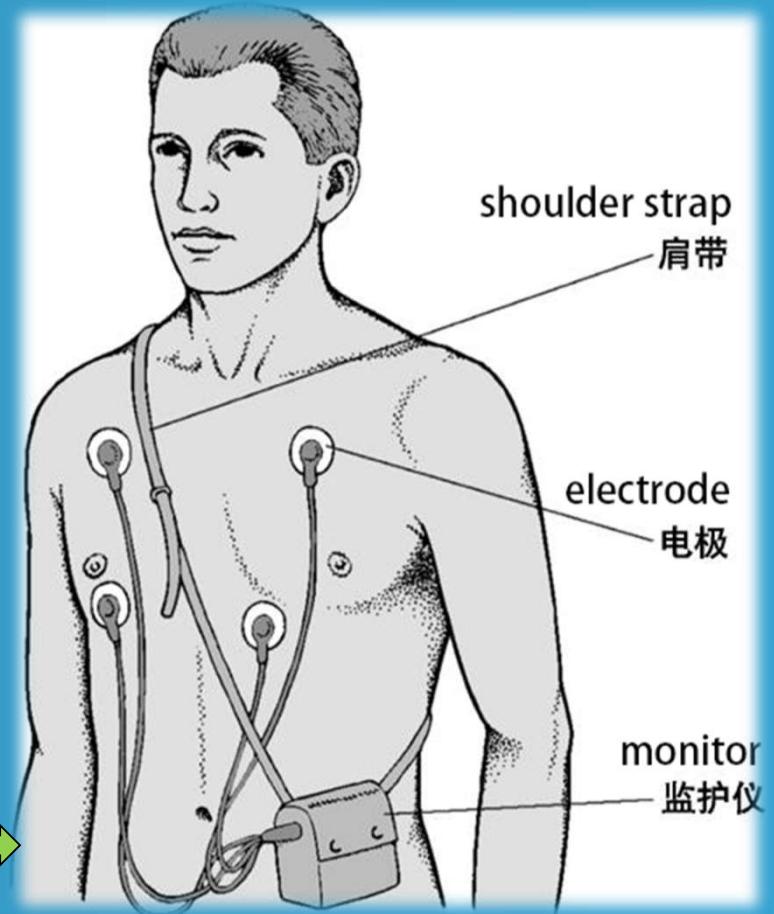
ECG 描记：操作（肢体导联 vs 颜色的关联）



临床新进展 New Advances in Clinics



ECG
Treadmill
Exercise
← Test



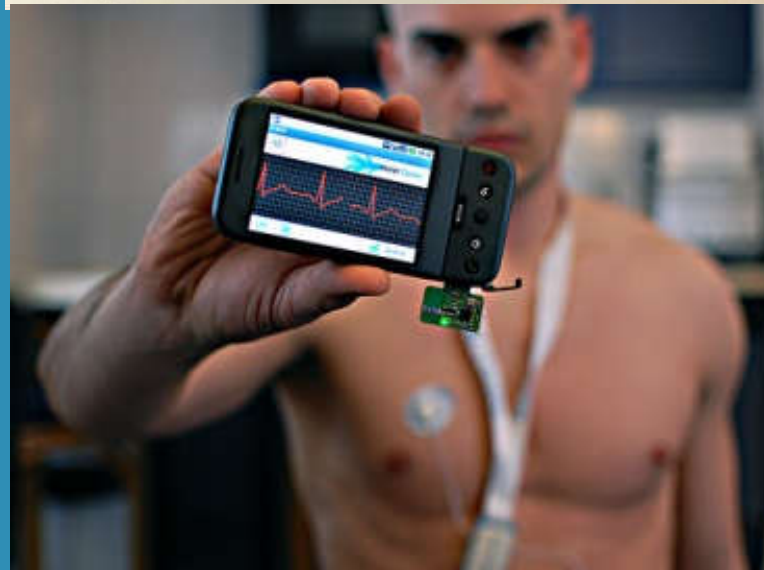
Holter
Monitor →

Company name

临床新进展 New Advances in Clinics



Wireless iOS bluetooth ECG machine



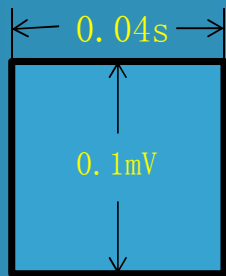
Wireless
Devices to
monitor
and to
show ECG

Company name

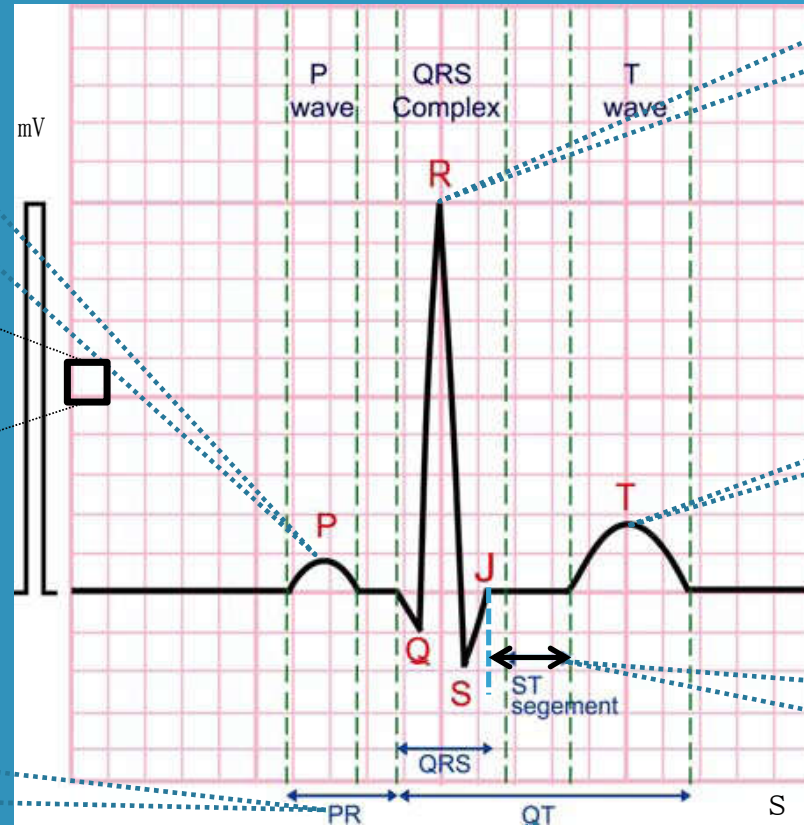
组成&分析 ECG Components & Analysis



心房去极化, $t \leq 0.12s$
 $v \leq 0.25 \text{ mV}$
 超过: 心房肥大?



心房去极化并传导至心肌细胞, $0.12-0.2s$
 过长: 房室传导阻滞



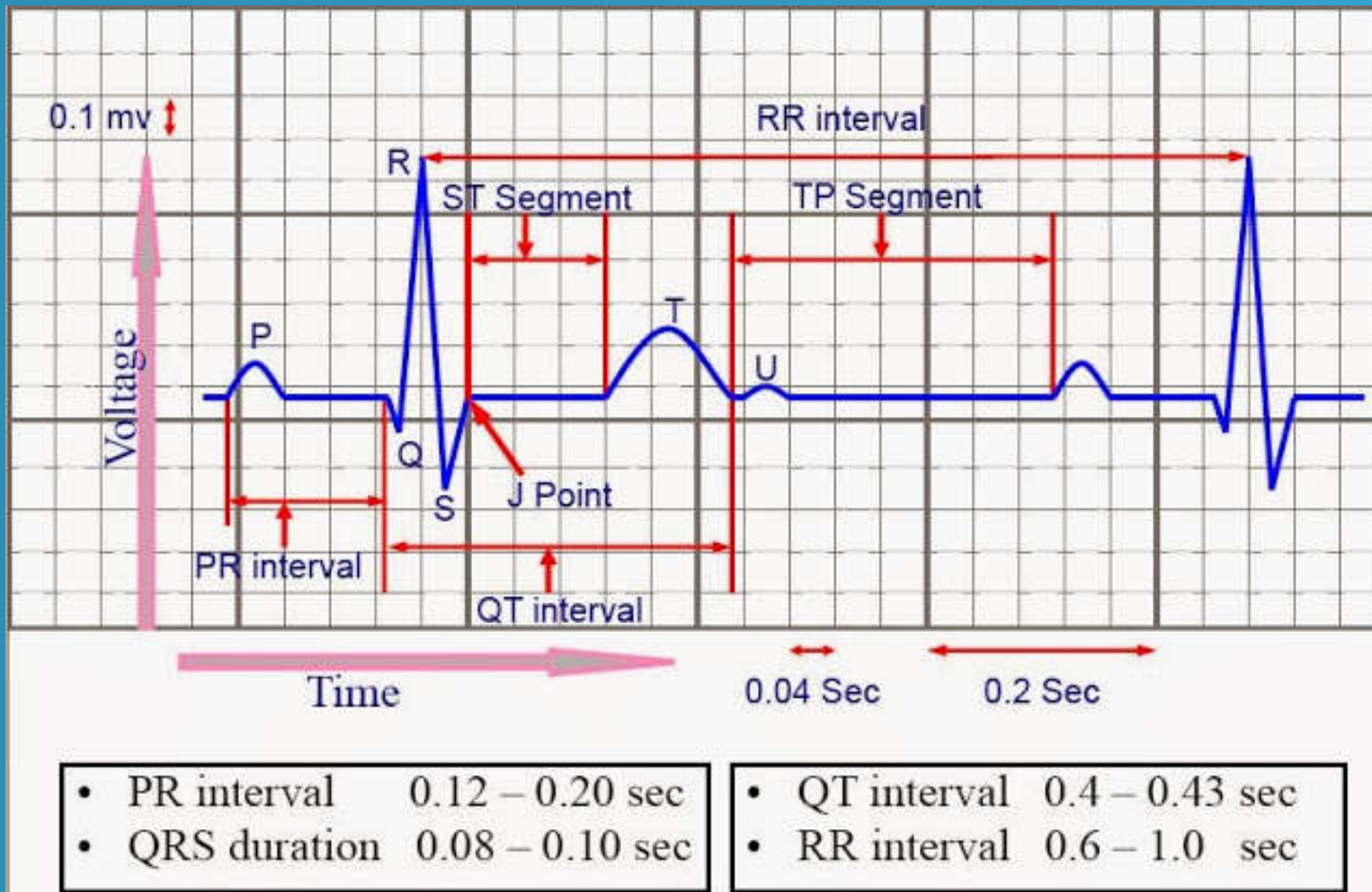
心室去极化, $0.08-0.12s$
 QRS 过长: 束支传导阻滞

心室复极化, AP 2末-3期;
 高耸或倒置有意义

心室复极化, AP平台期;
 抬高或降低有意义

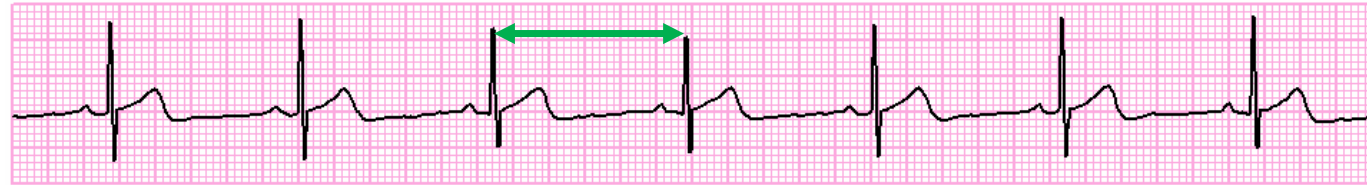
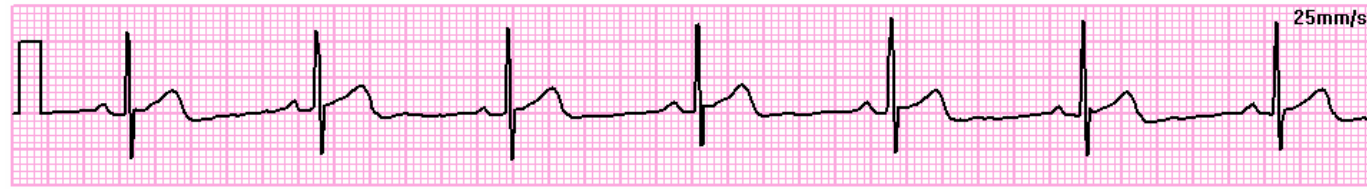
心室去极化+复极化时间
 $0.4-0.43s$

组成&分析 ECG Components & Analysis



心电图分析

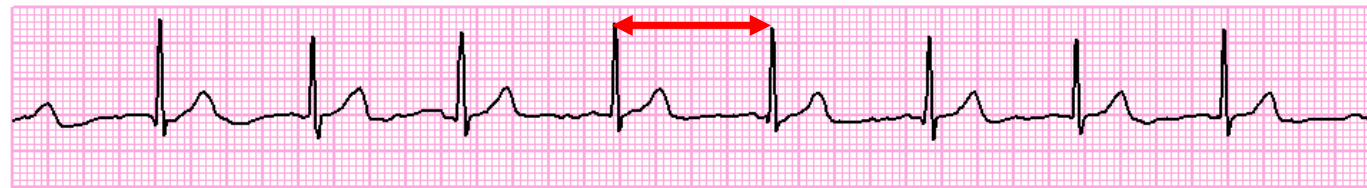
sinus
bradycardia:
normal
waves,
HR<60



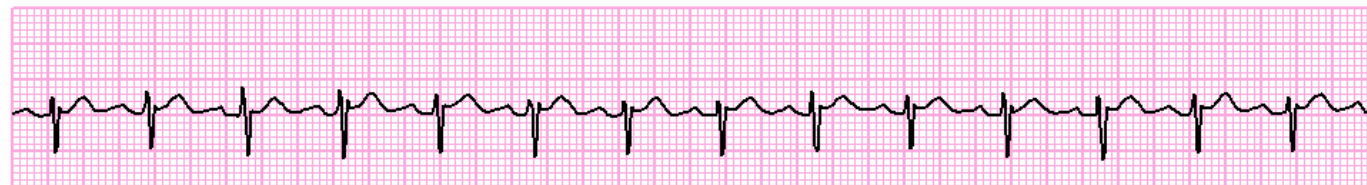
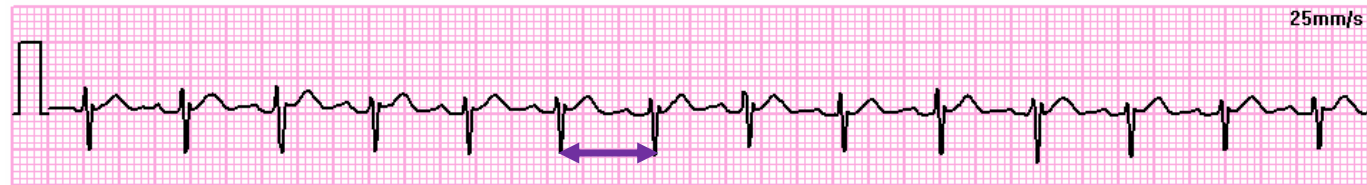
normal sinus
rhythm:
normal
waves,
HR=60~100



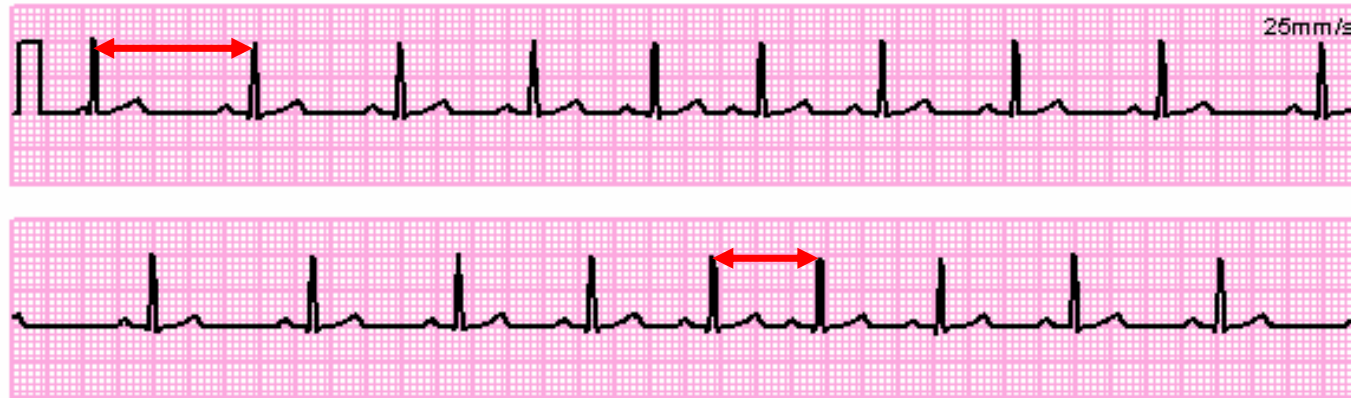
How to calculate heart rate?



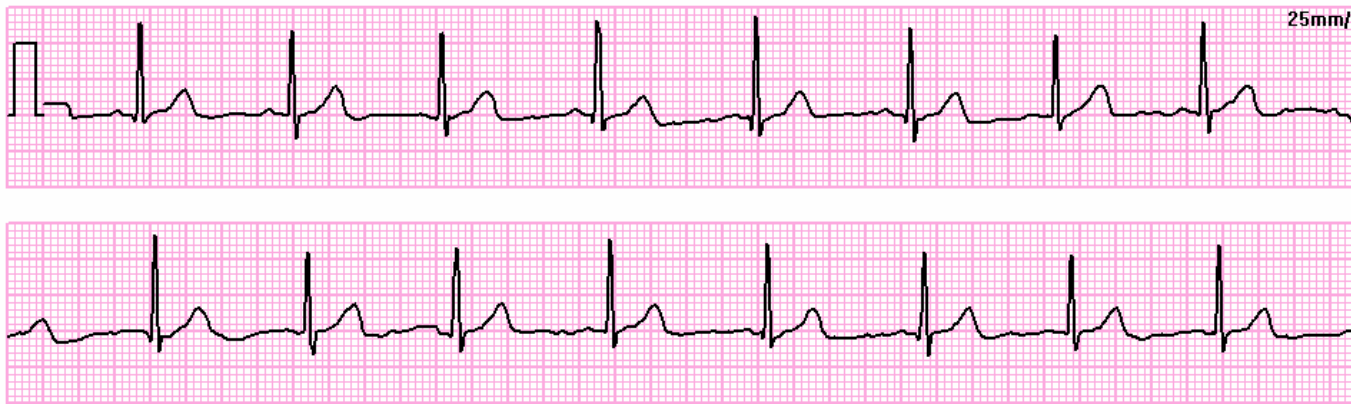
sinus
tachycardia:
normal
waves,
HR>100



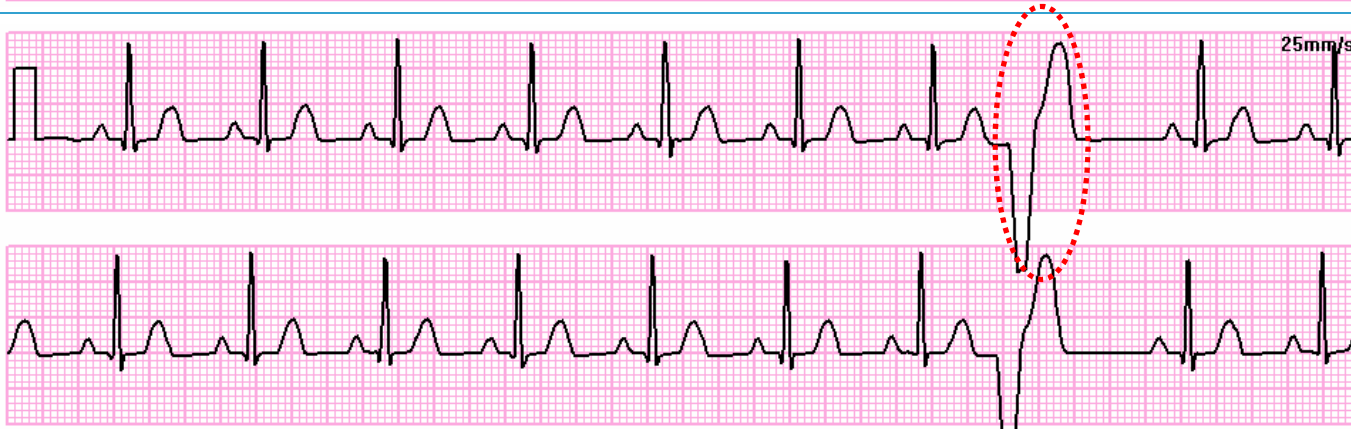
sinus arrhythmia:
normal waves,
HR=60~100
R-R varies.



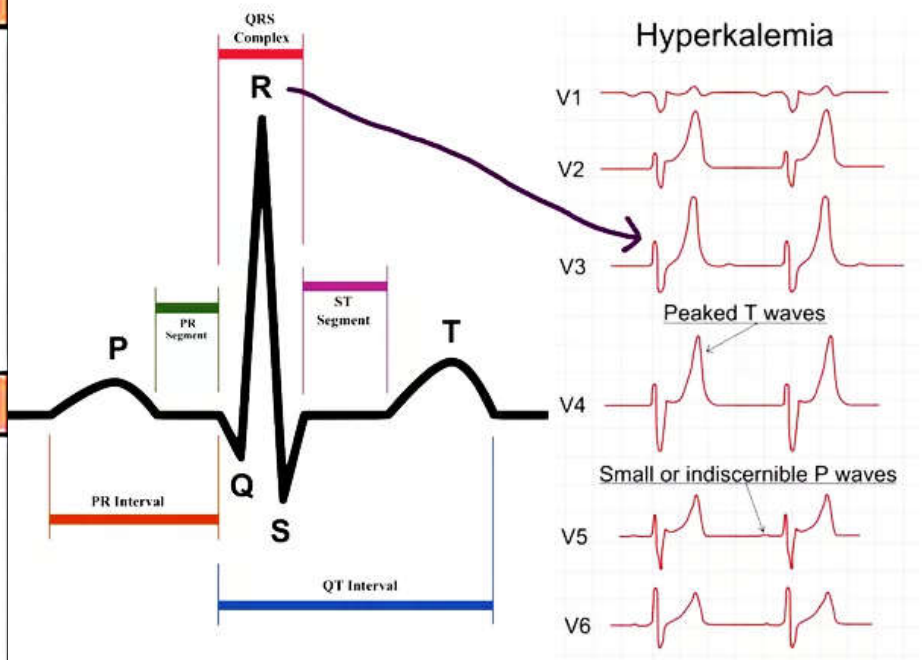
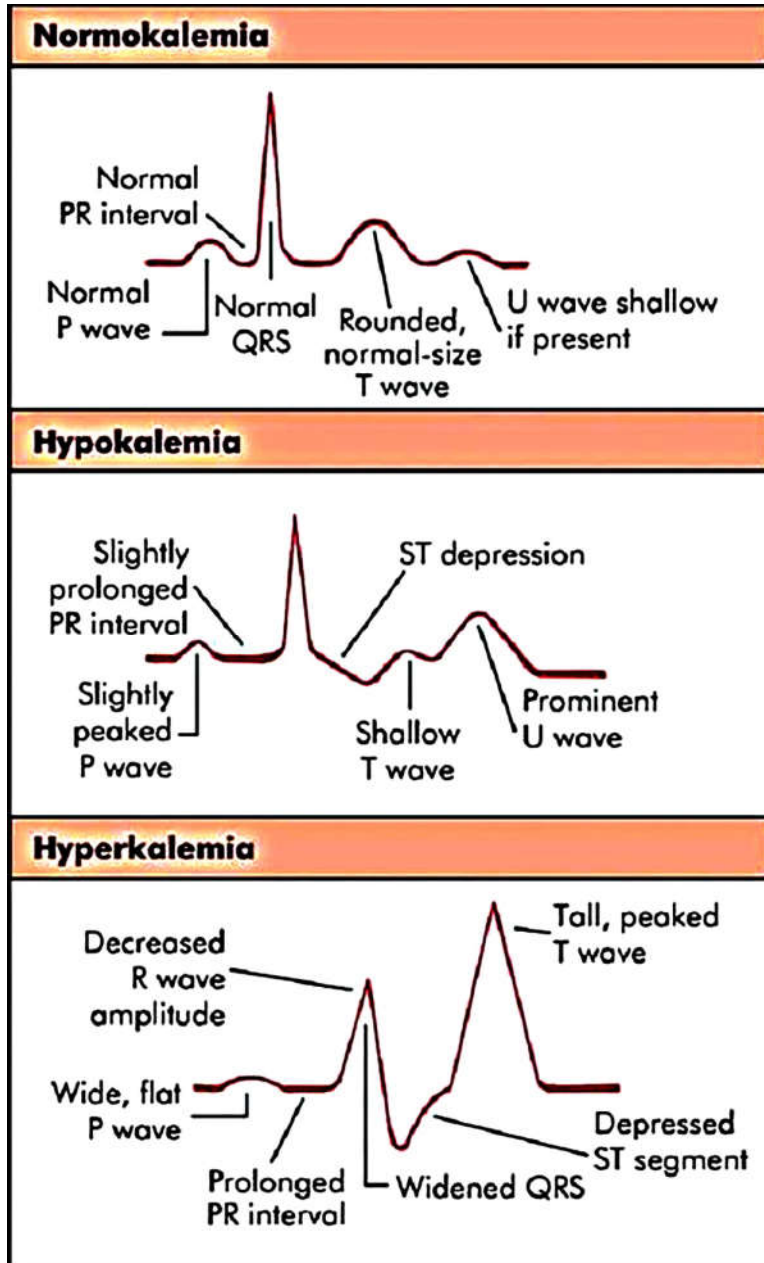
normal sinus rhythm:
normal waves,
HR=60-100



premature ventricular contraction:
no P, wide inverted QRS,
compensatory pause



ECG&血钾 ECG Varies in Different Potassium levels



welcome



国家级医学形态学虚拟仿真实验教学中心

基础医学形态学 病理学理论 数字医学影像学 临床解剖学 临床影像学 3D打印

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博學篤行，尚德濟世

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用户名: [input type="text"] 密码: [input type="password"] 登录

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 - 全国基础医学实验教学示范中心在渝召开第三次理事会
 - 南方医科大学医学形态学虚拟仿真实验教学中心网站上线

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2014级实验中心会议 南方医科大学 实验医学中心

虚拟生命博物馆 3D打印实验室

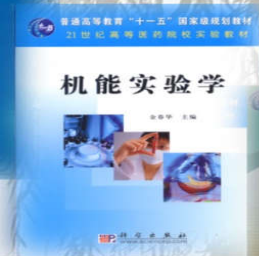
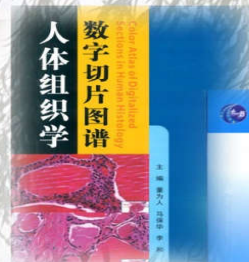
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National Virtual Simulation Experimental Teaching Center

国家级实验教学示范中心
National Experimental Teaching Demonstration Center

医学形态学虚拟仿真实验教学中心
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中华人民共和国教育部
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异想天开，小心求证 科学思维，工匠精神



為中華之崛起而讀書

