12 Lead EKG Interpretation

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Technology is advancing in EMS:

Pulse ox's
EID's
New drugs
Monitors that really monitor
Capnography

12-lead EKG interpretation
is a relative newcomer
in the field evaluation
of the emergency patient

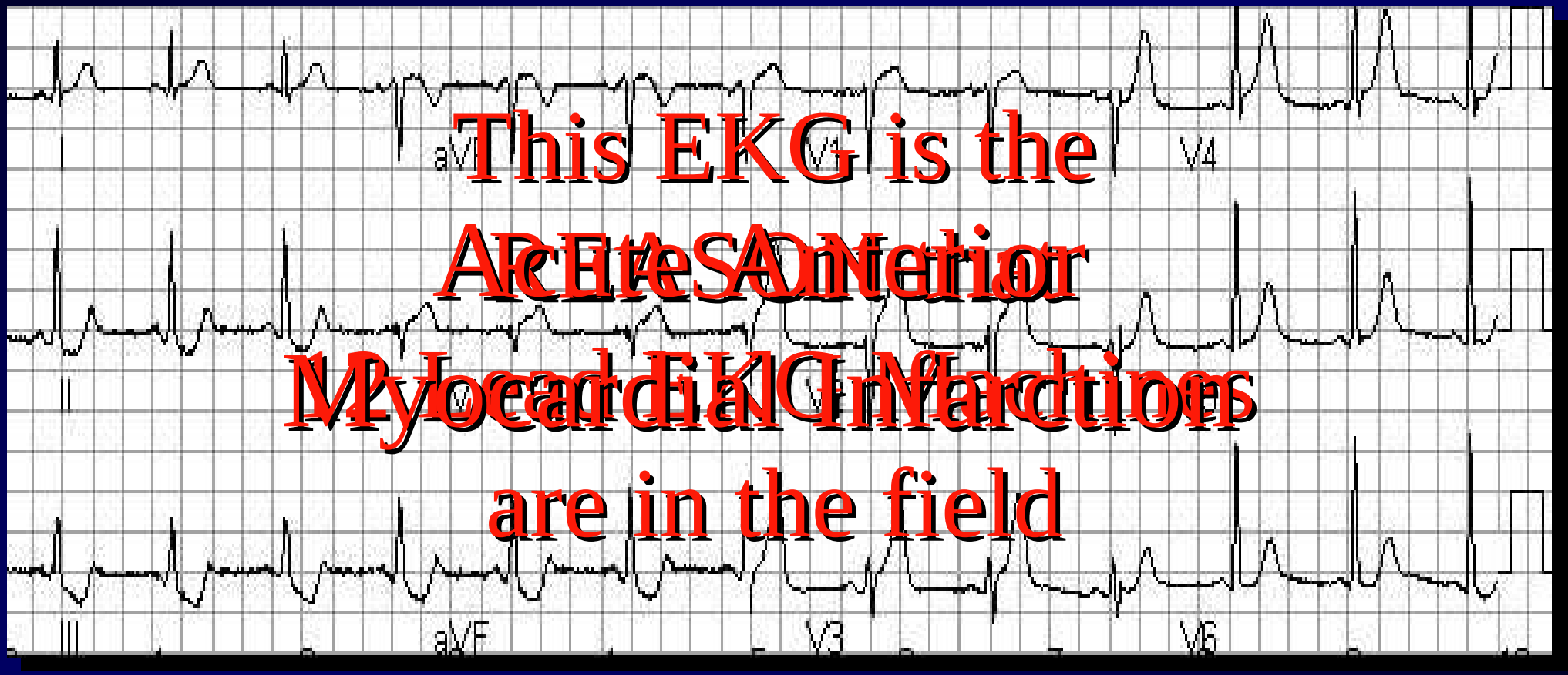
Many, perhaps most providers
are not adept
at 12 lead EKG interpretation

WHY?????

Because most EKG courses
are too long,
too boring,
and teach absolutely unnecessary
and unrememberable stuff
to medics
who will never use
that information

What am I NOT talking about?

Advanced rhythm assessment
Ventricular tachycardia assessment
Vtach vs. SVT assessment
Block



This EKG is the

Acute Anterior

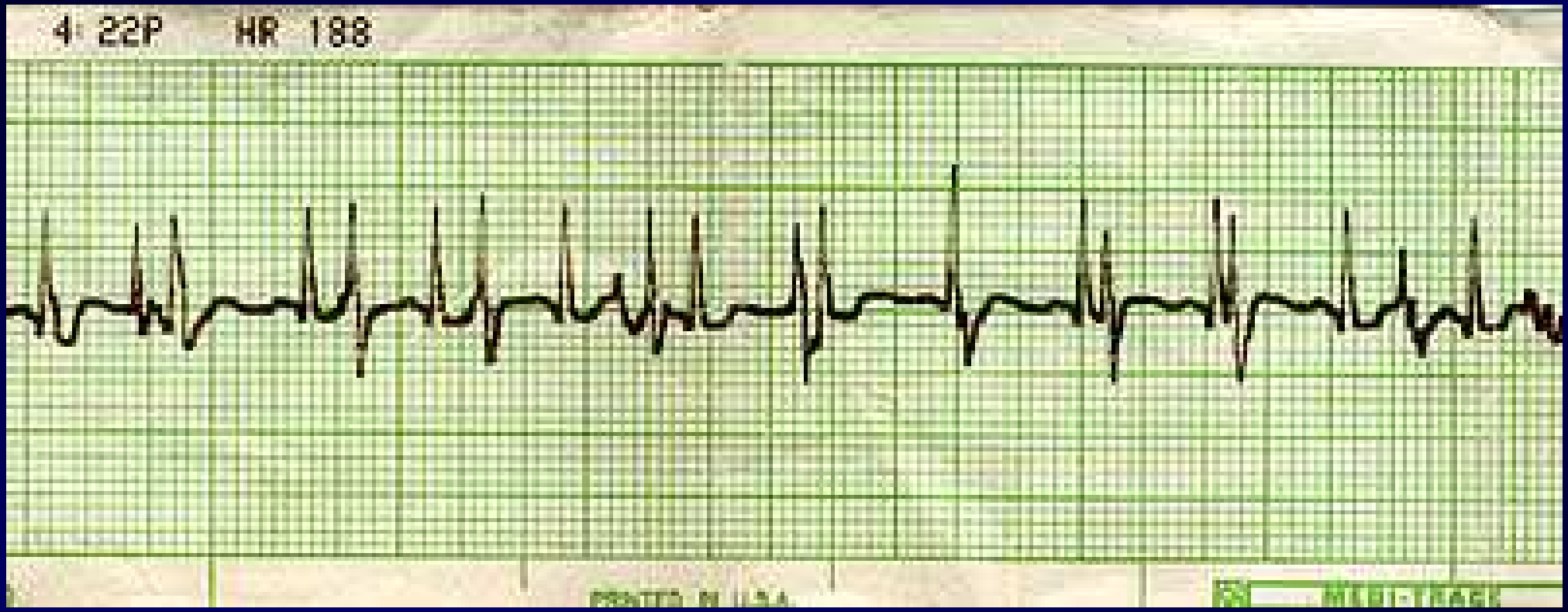
Myocardial Infarctions

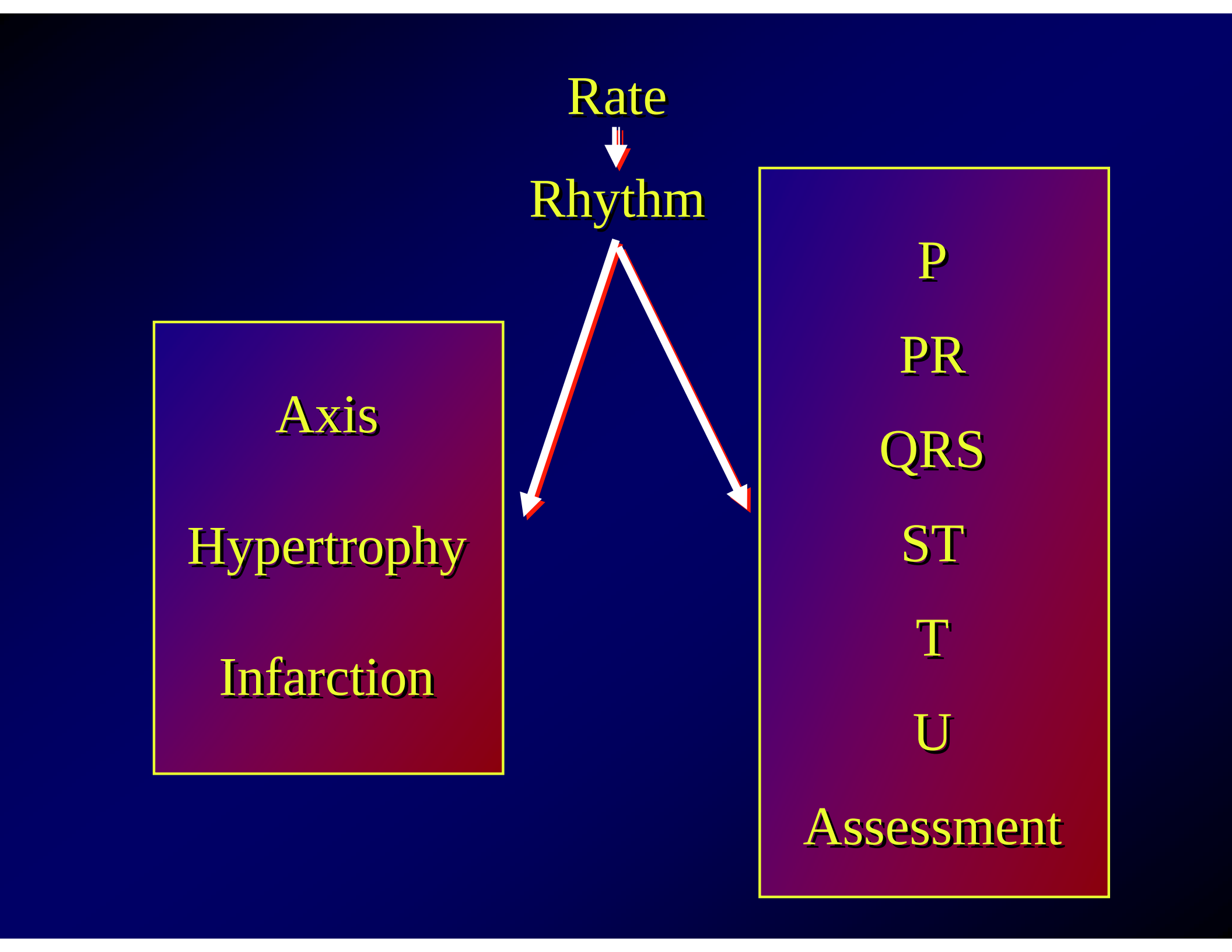
are in the field

Rhythm strip interpretation
has been a standard
since almost the beginning of EMS

Basic Rhythm Strip Interpretation

- Rate
- Rhythm
- P Waves
- PR Interval
- QRS Complex
- ST Segment
- T Wave
- U Wave
- Summary


4: 22P HR 188


Rate
Rhythm
Axis
Hypertrophy
Infarction
P
PR
QRS
ST
T
U
Assessment

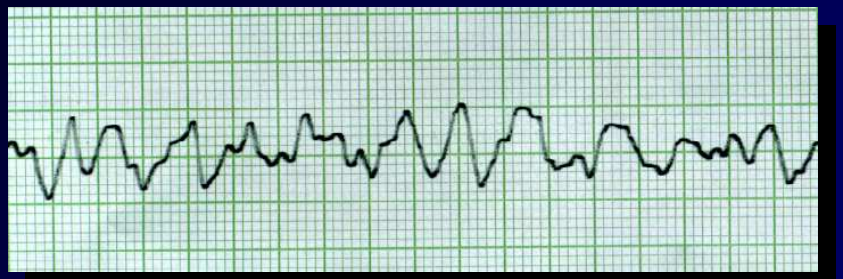
Since serious rhythm disturbances are the most important issue (like VF, VT, asystole), then if you see a serious rhythm disturbance proceed with rhythm strip interpretation

FIRST!!!

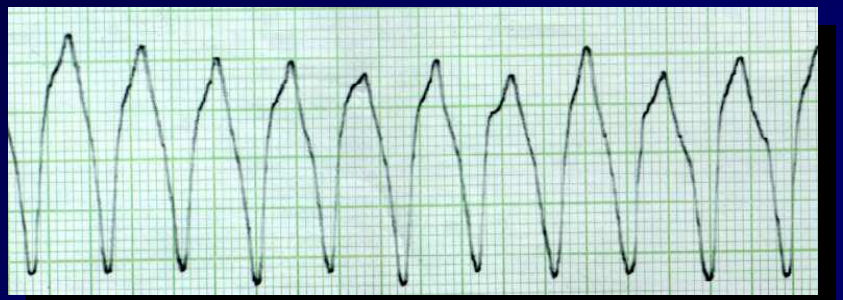
Fowler's Prime Directive of Cardiac Emergencies:

Some systole is better than no systole at all

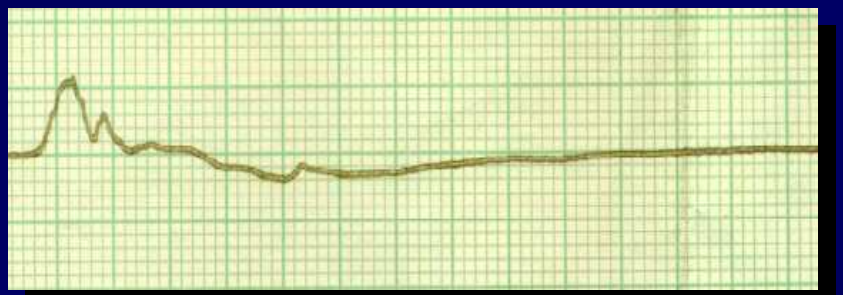
Pulseless Rhythms



Shock x 3, Intubate with CPR, Epi q 3, Shock, Amio or Lidocaine then ??



Shock x 3, Intubate with CPR, Epi q 3, Shock, Amio or Lidocaine then ??



Intubate, IV, Epi q 3, Consider Atropine, Look for cause

Second point:

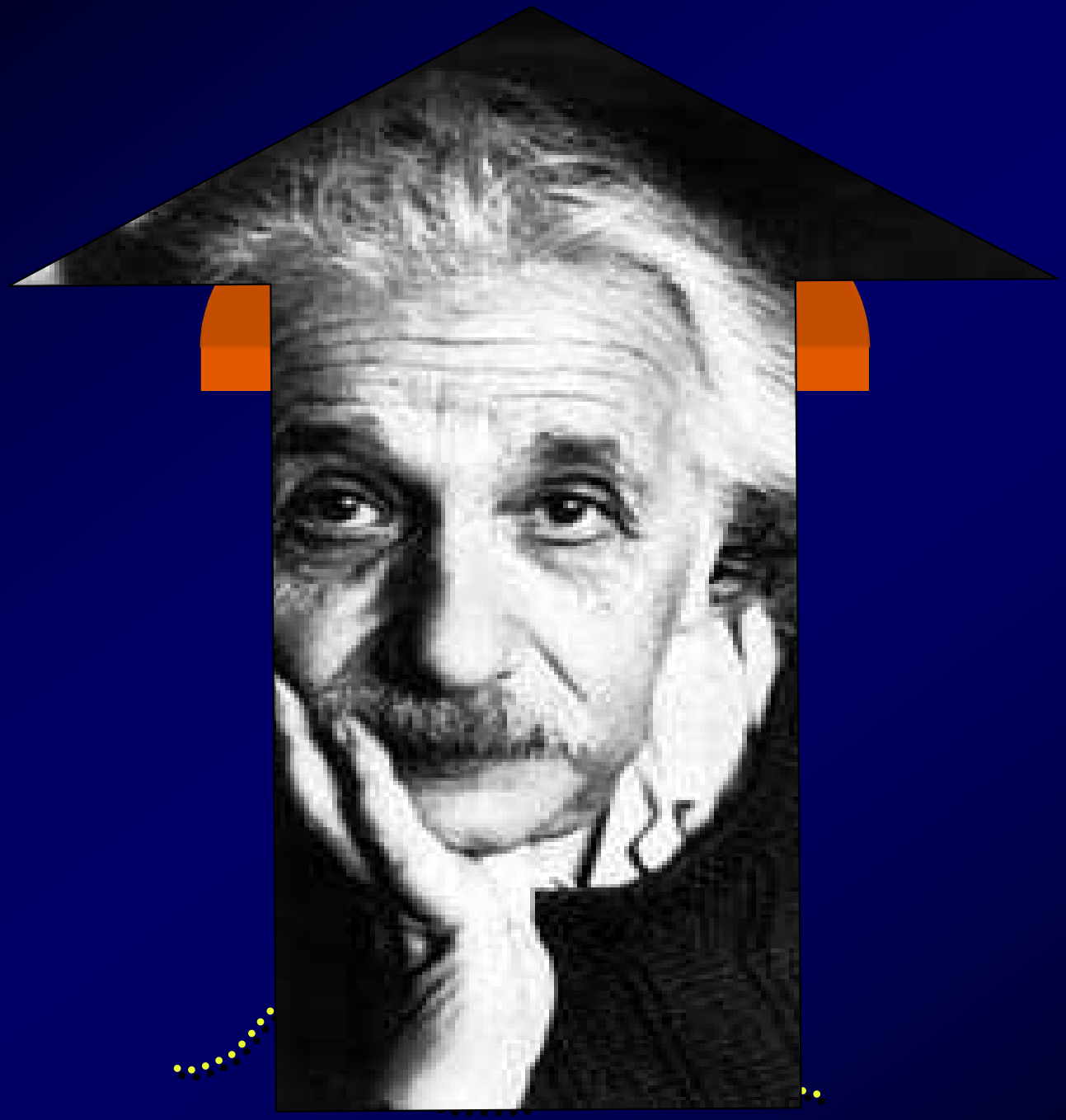
Much of what we call
"12 lead interpretation"
is in fact actually
rhythm strip interpretation.

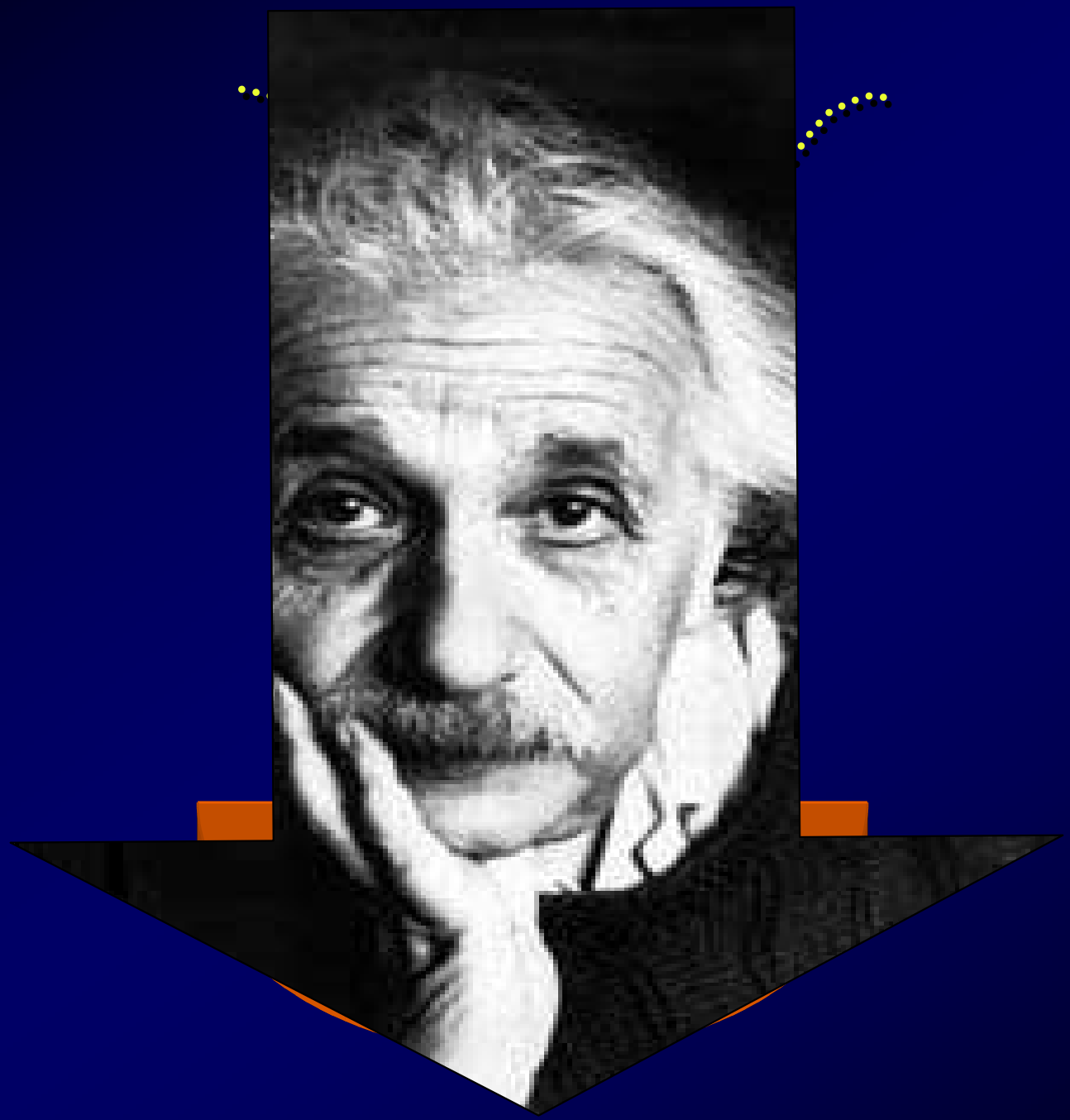
….such as, for example, the evaluation of AV block,
which can usually be done in one,
or at most, two leads

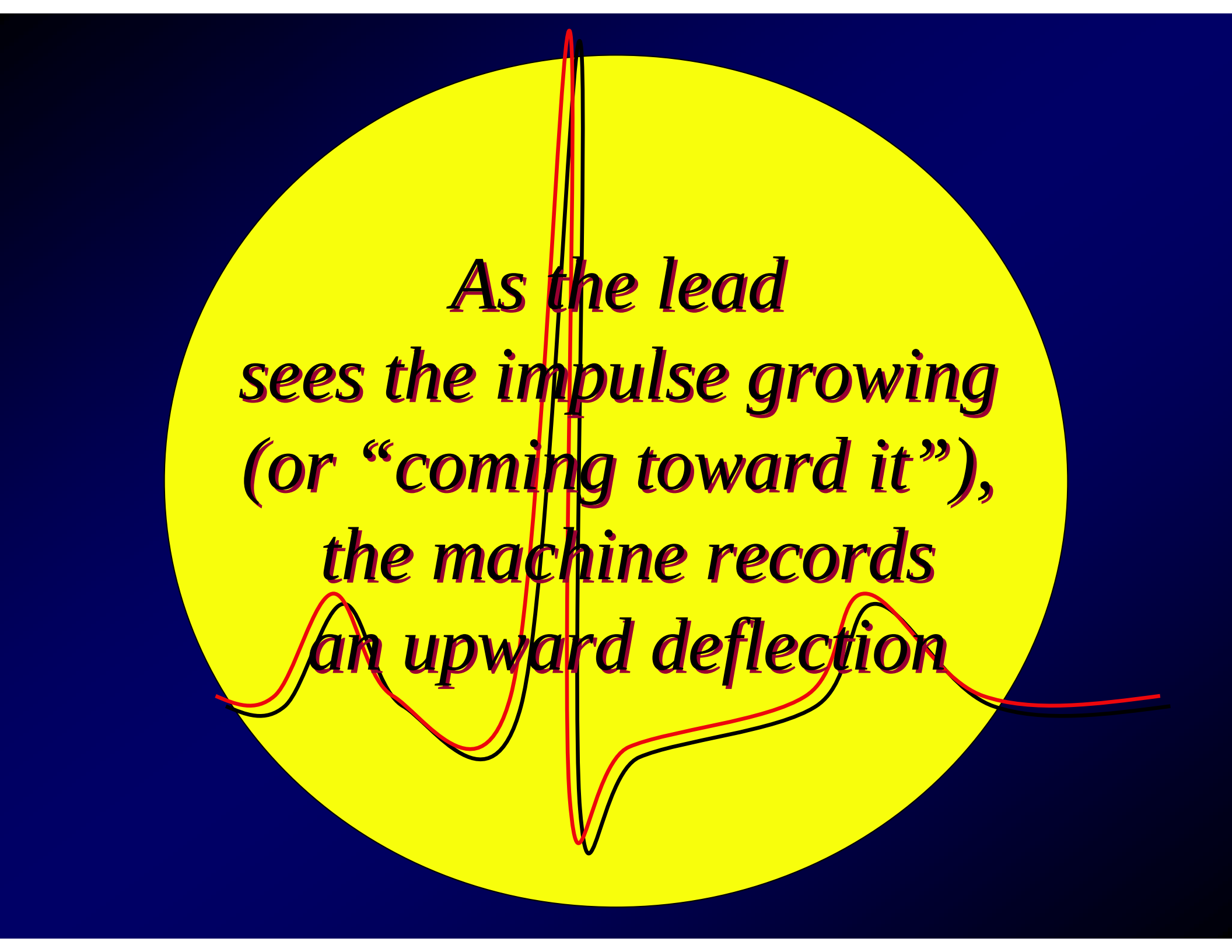
Third point:

AXIS INTERPRETATION
IS BORING!!

Hence, I will make it VERY short!

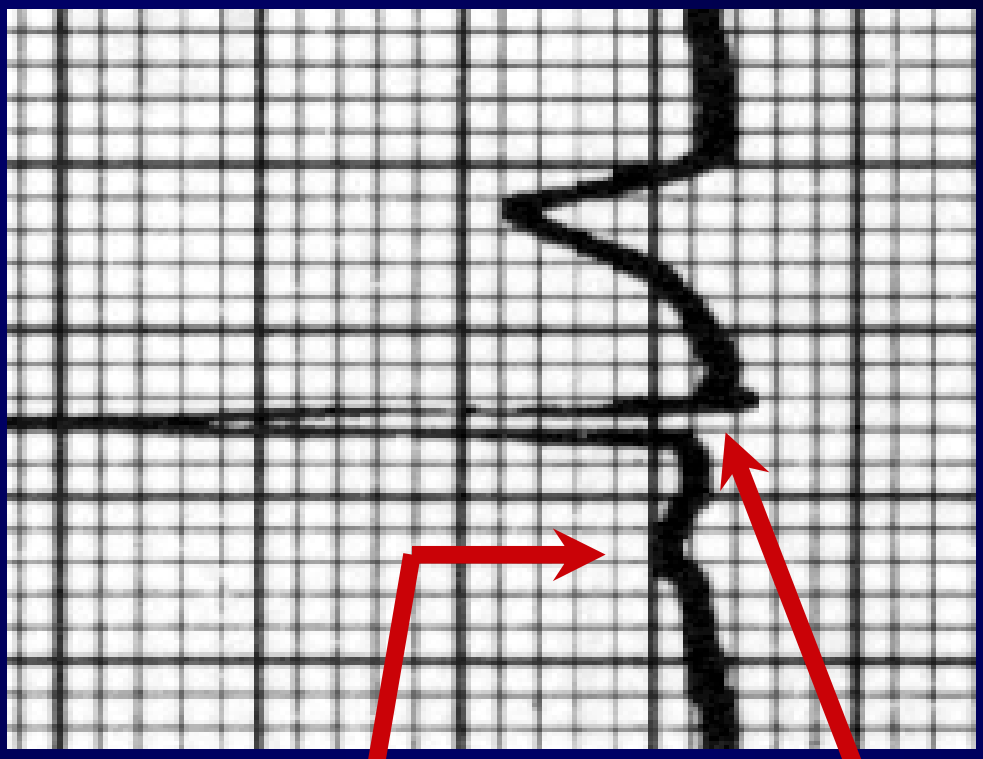


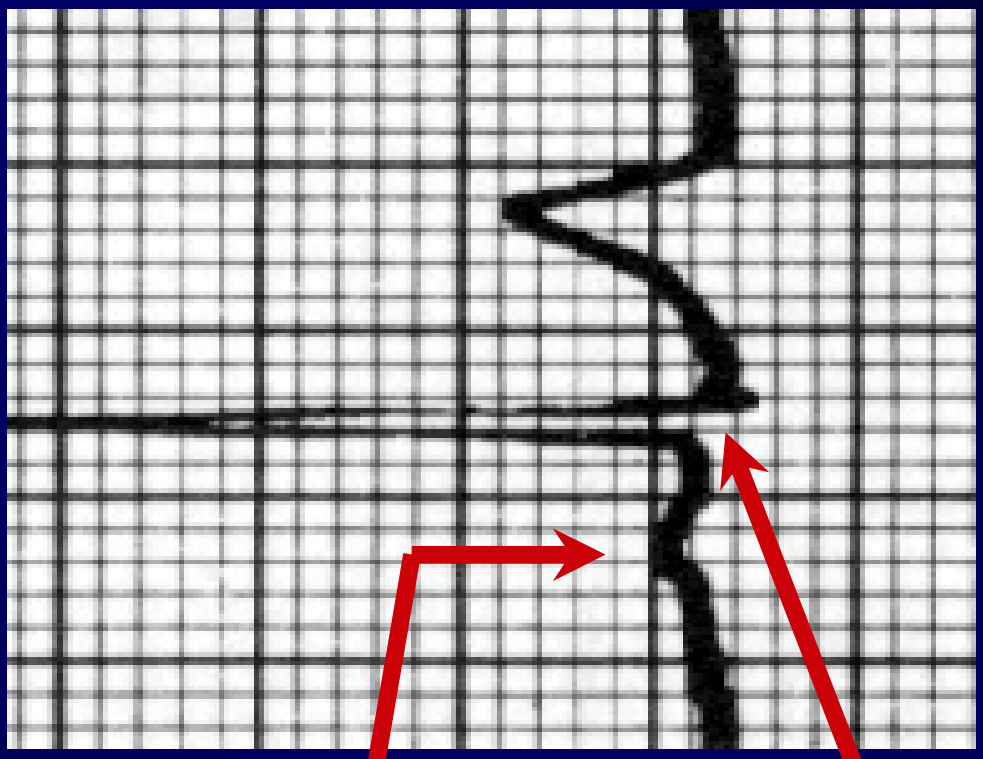



As the lead
sees the impulse growing
(or “coming toward it”),
the machine records
an upward deflection

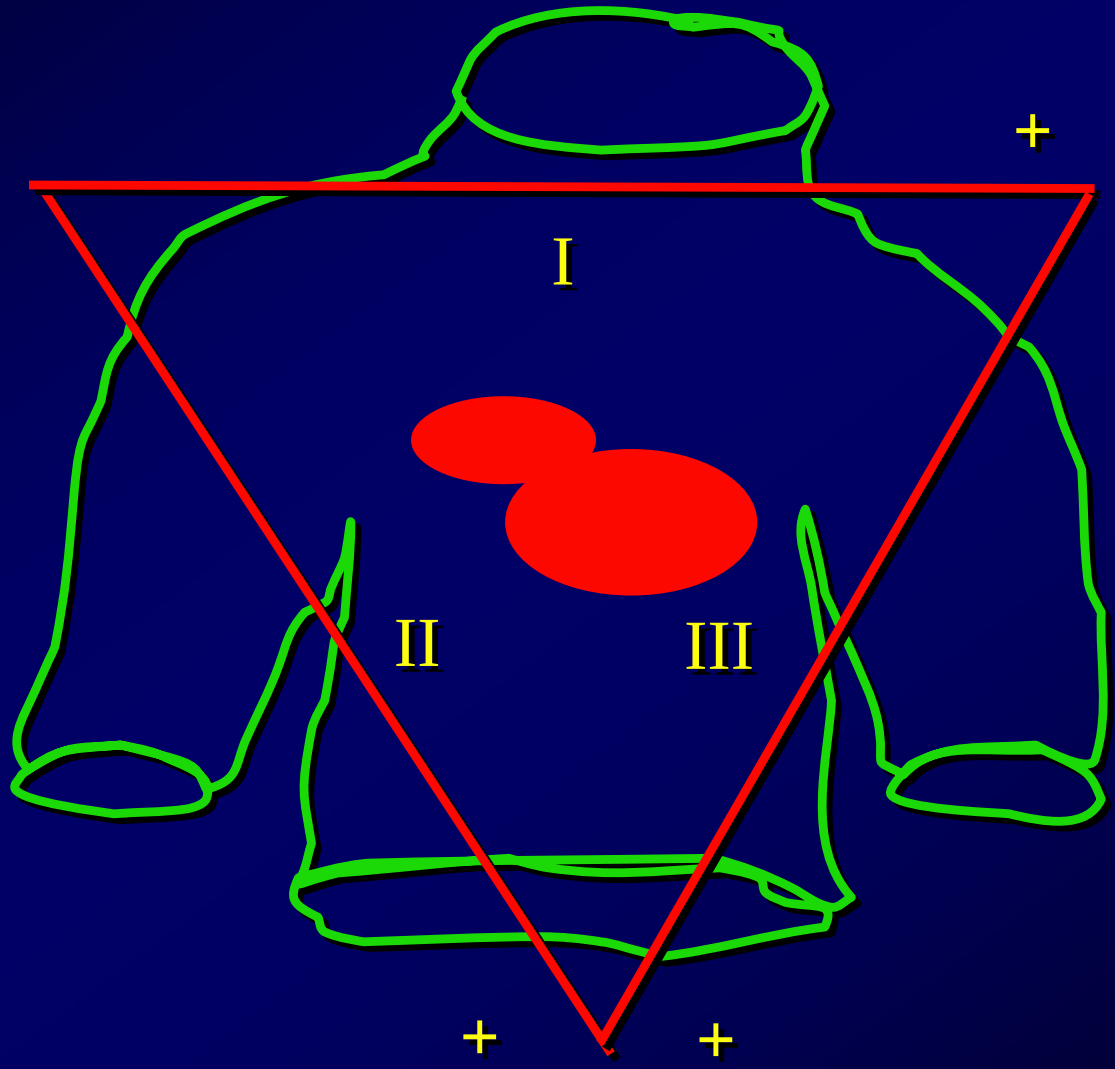
As the lead sees the impulse coming then going (or "going by the lead"), the machine records an isoelectric deflection

As the lead sees the impulse coming then going (or "going by the lead"), the machine records an isoelectric deflection

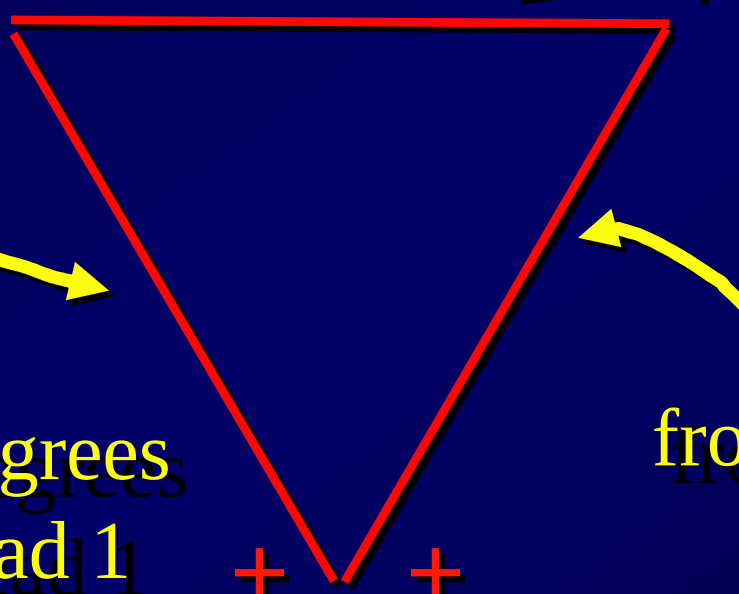




The EKG Basic Limb Leads



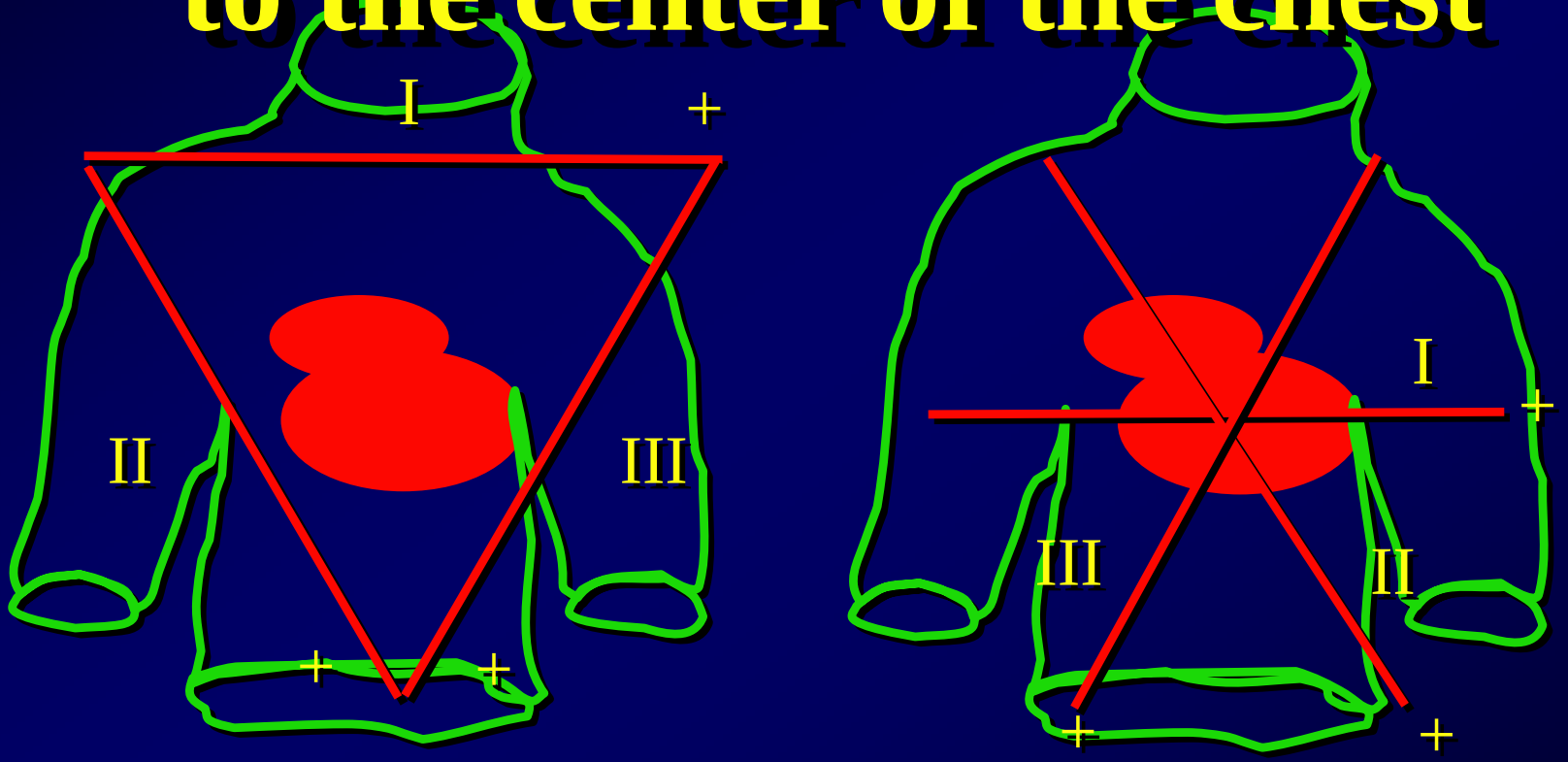
Lead I is “horizontal”, and is arbitrarily established at “0 Degrees”



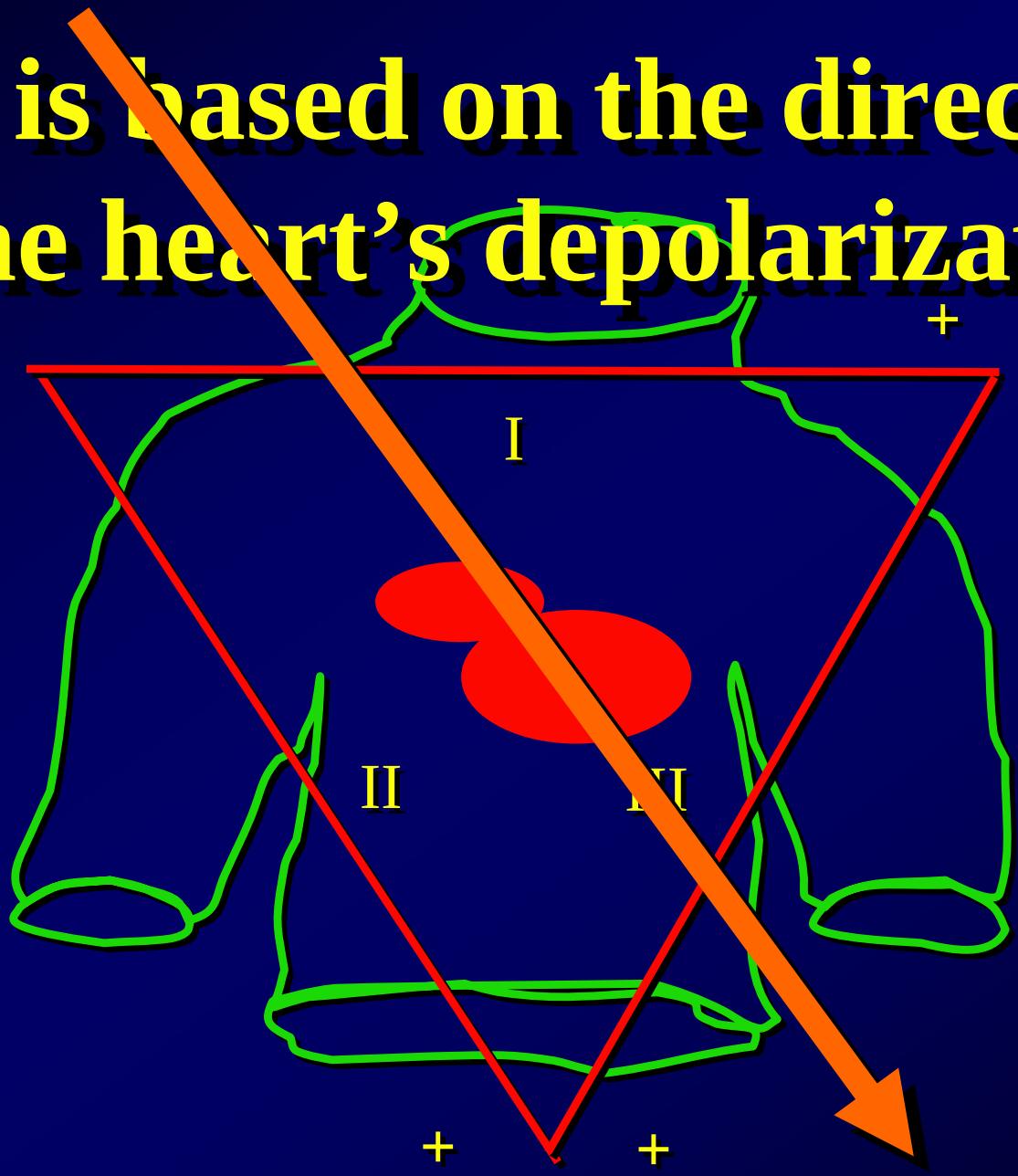
Lead II is 60 degrees down from Lead 1 and is arbitrarily established at “Positive 60 Degrees”

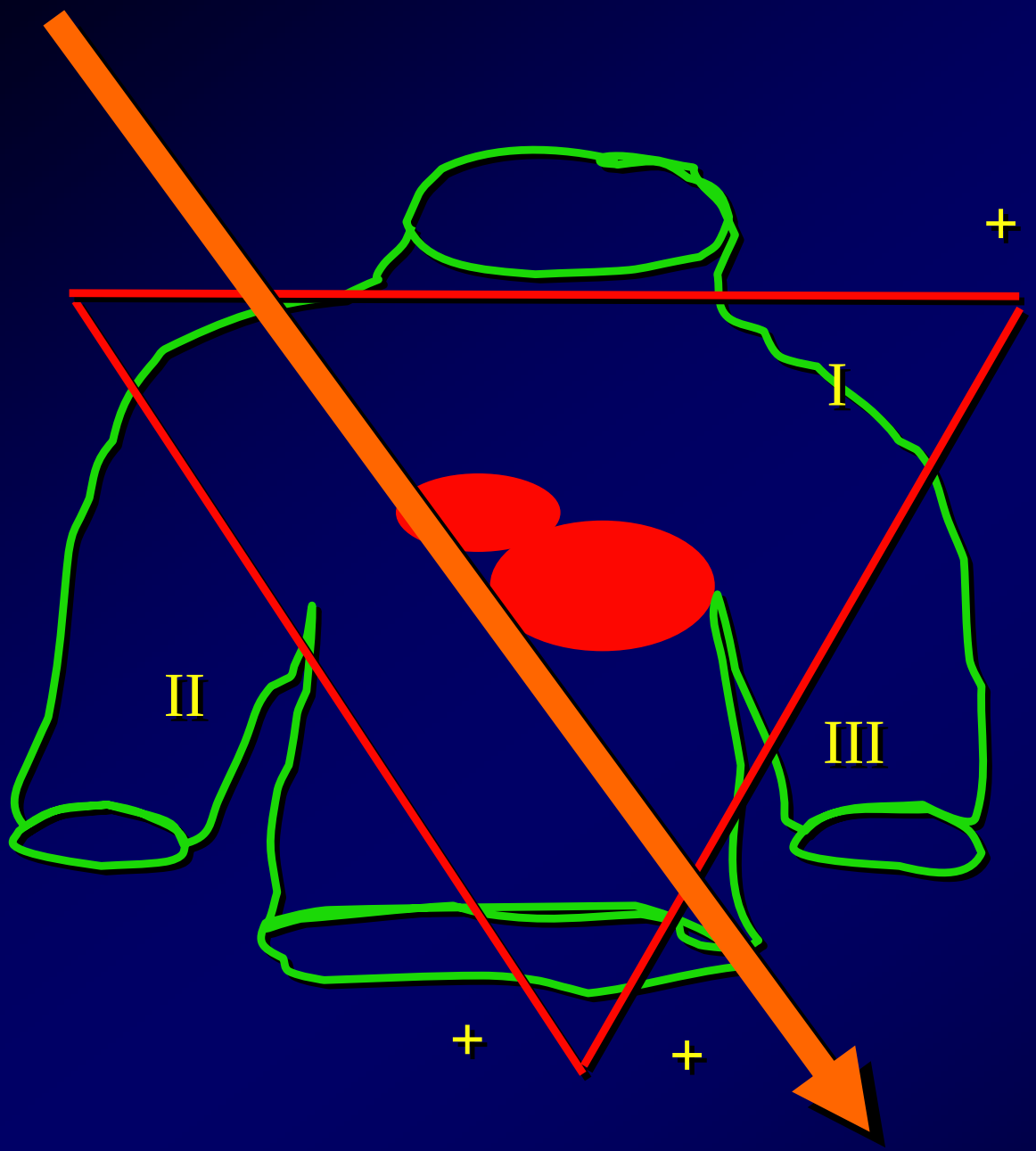
Lead III is 120 degrees from Lead I, and is arbitrarily established at “Positive 120 Degrees”

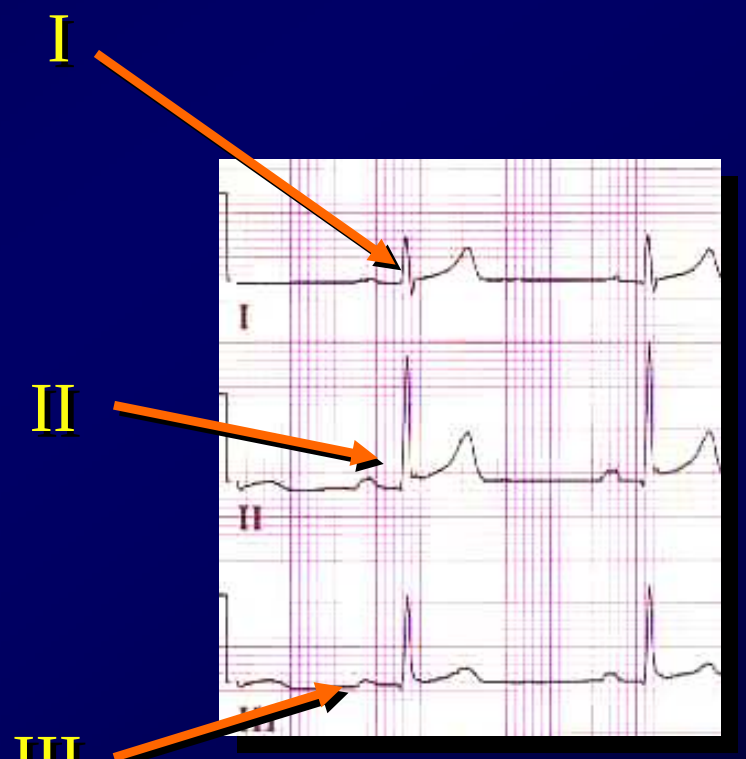
The Leads may be moved to the center of the chest

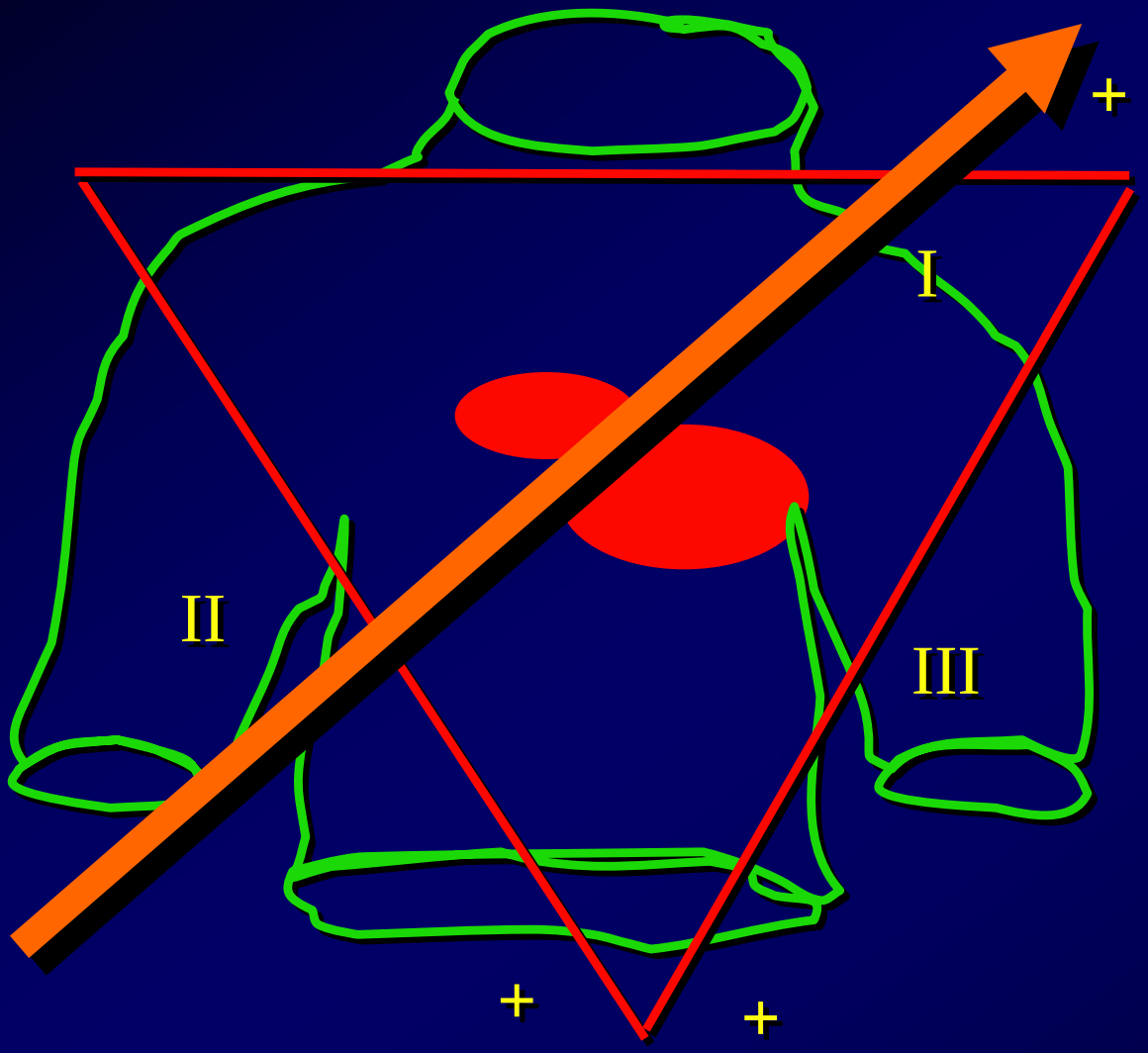


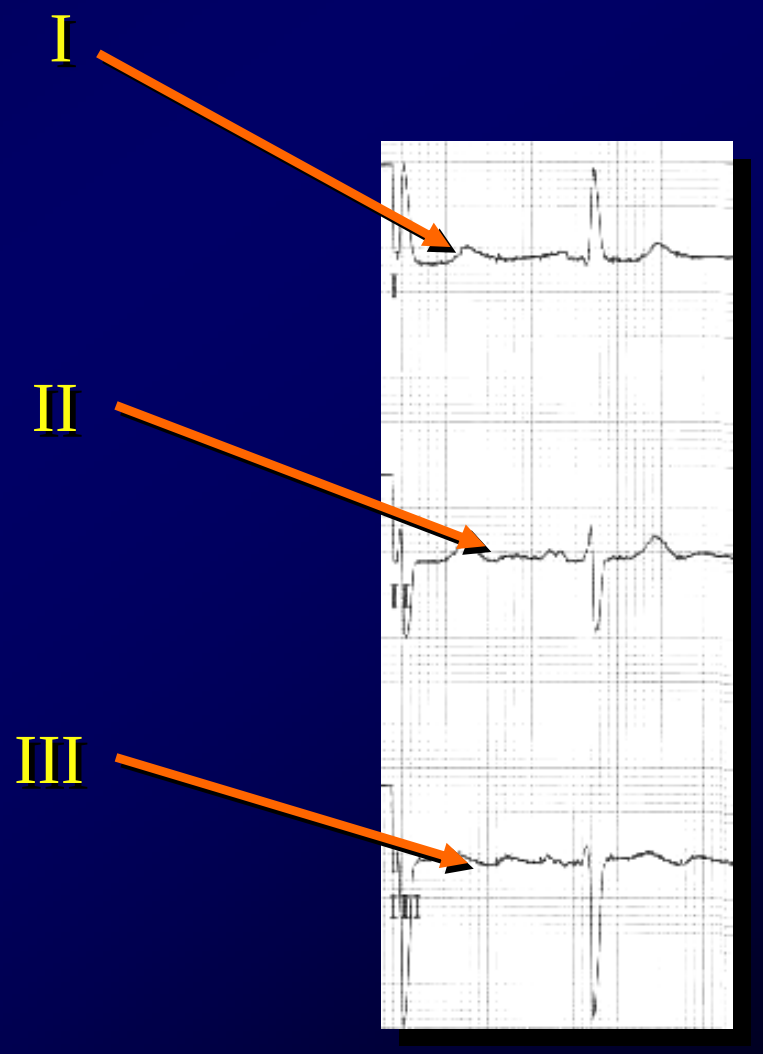
Axis is based on the direction of the heart's depolarization

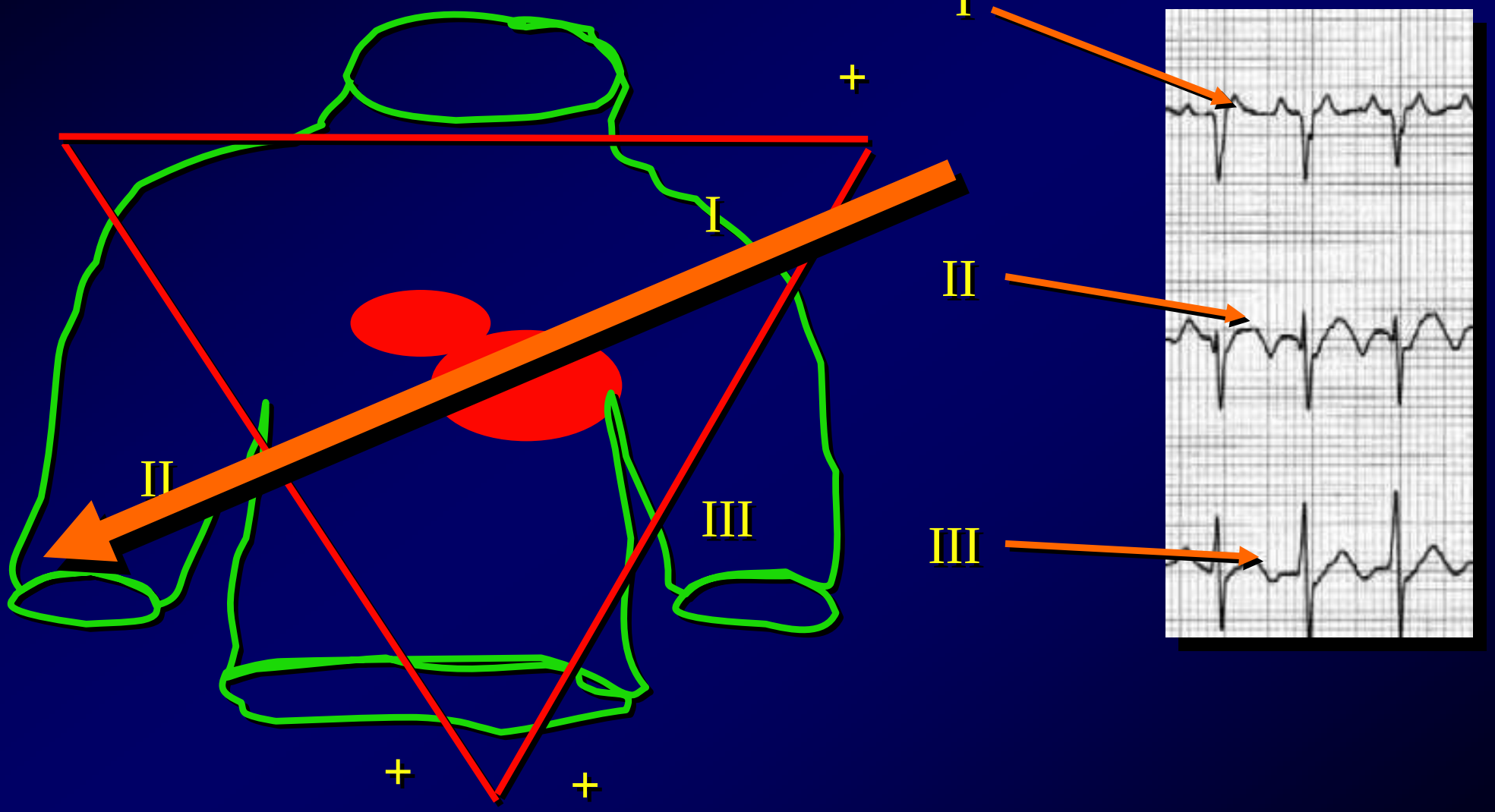



+
I
II
III
+
+

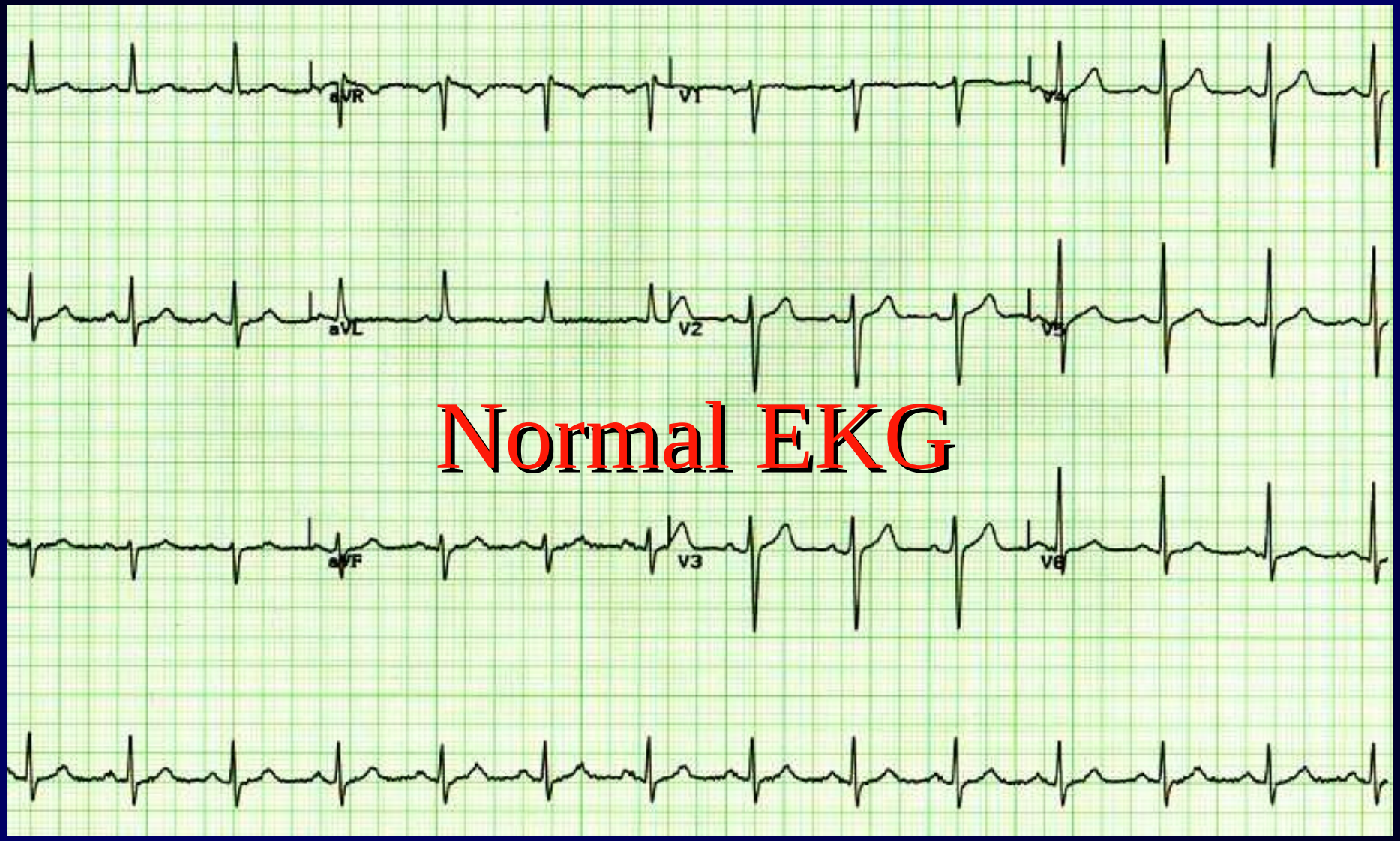

I
II
III


+
I
II
III
+
+


I
II
III

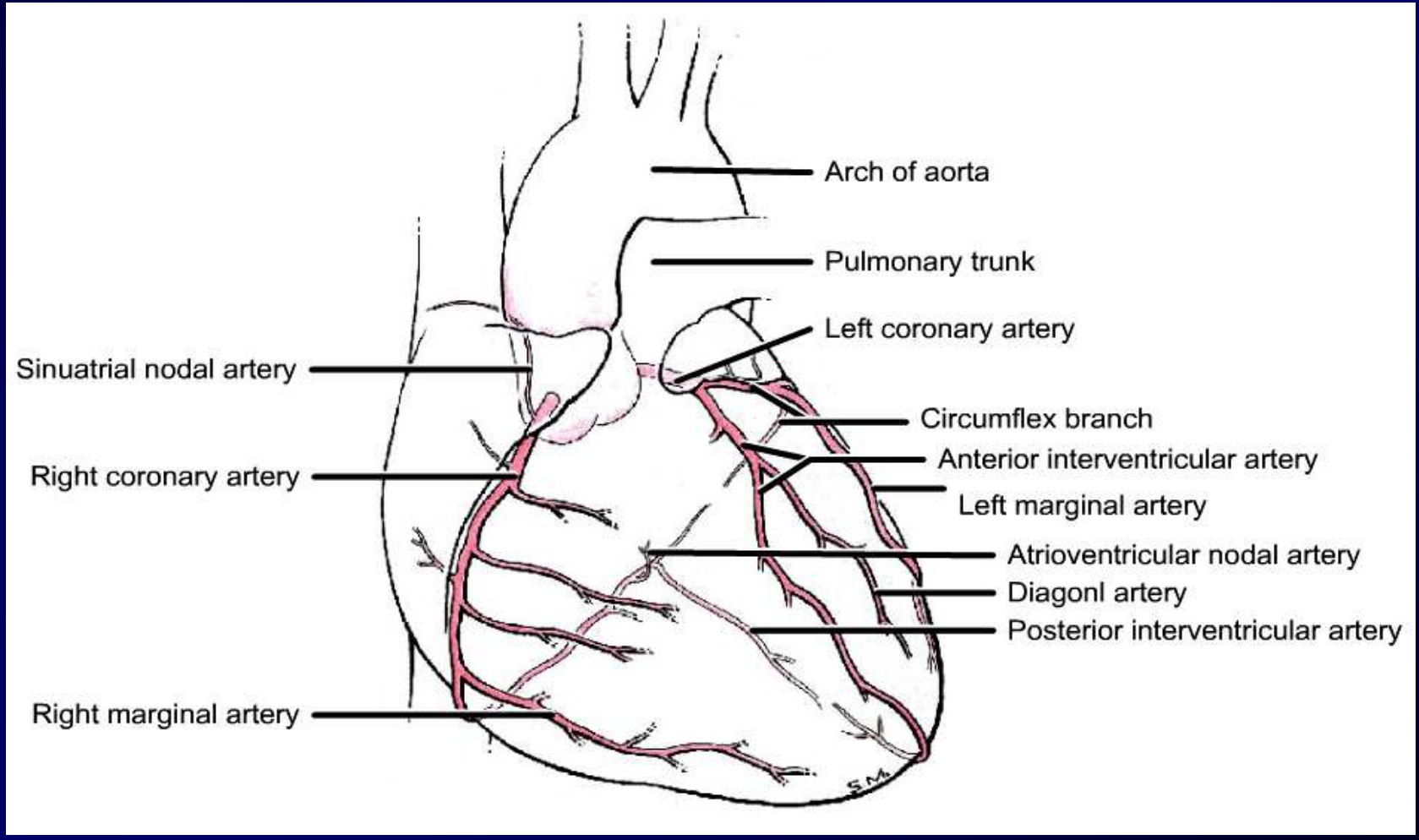

+
I
II
III
+
+
I
II
III

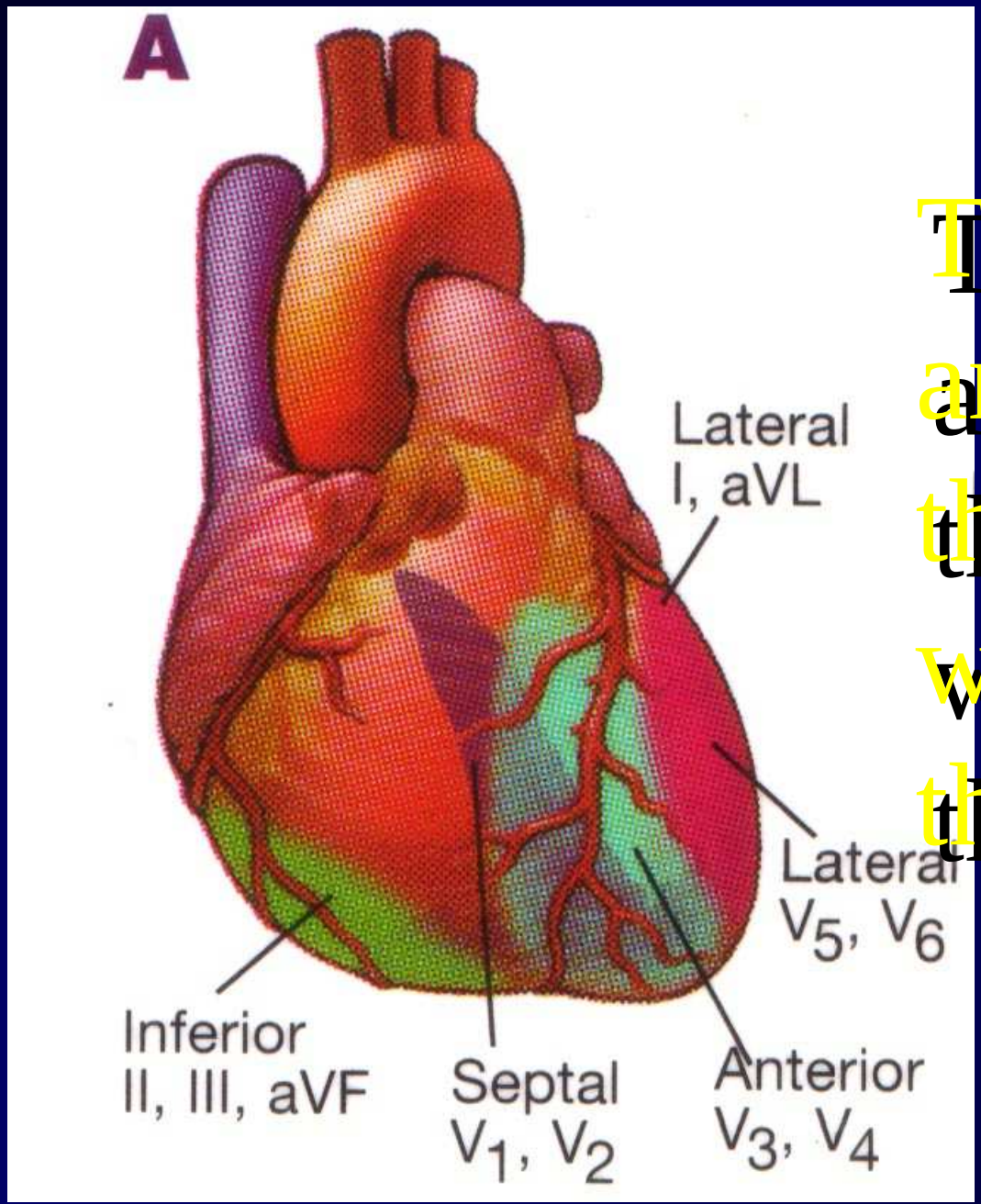
"I think this means no candy."



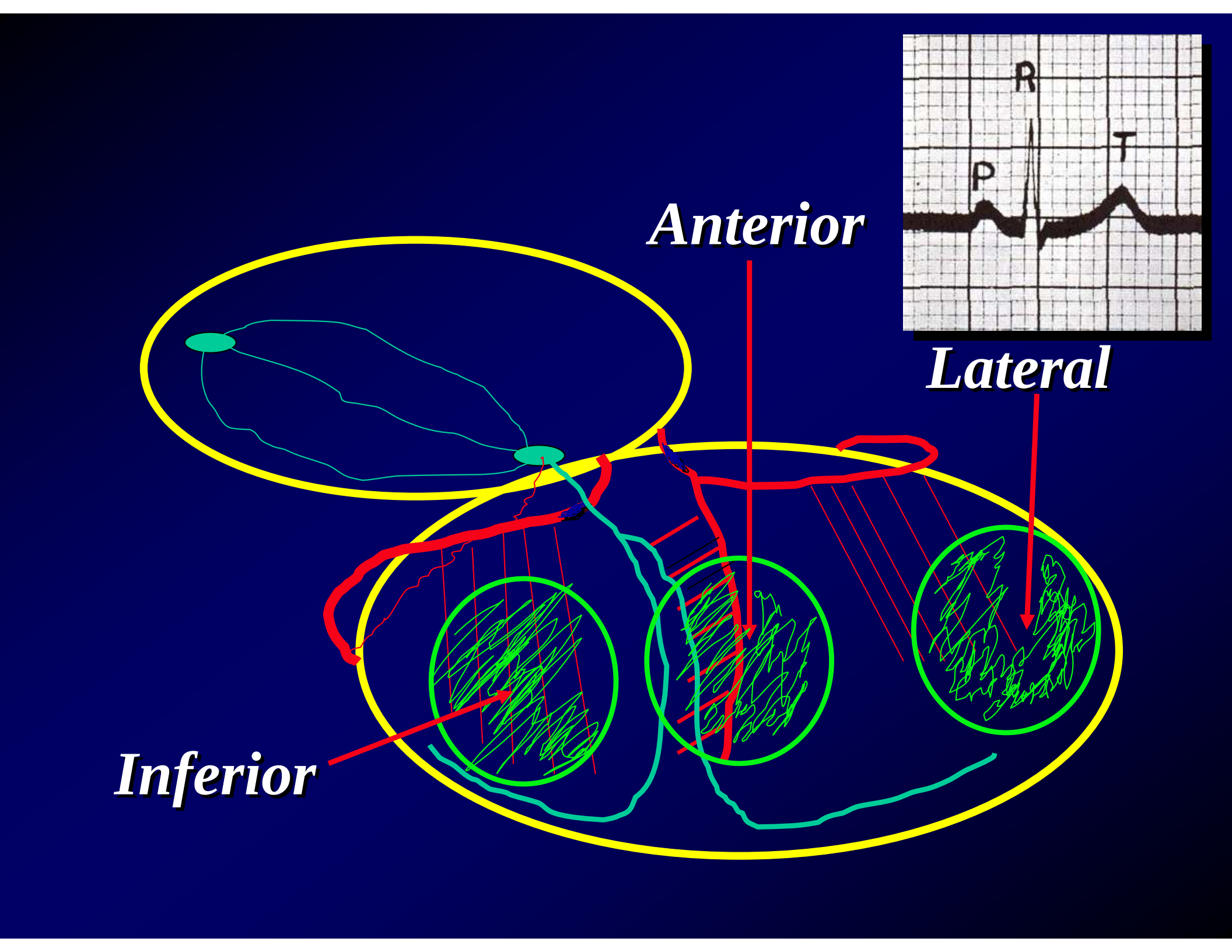
Normal EKG

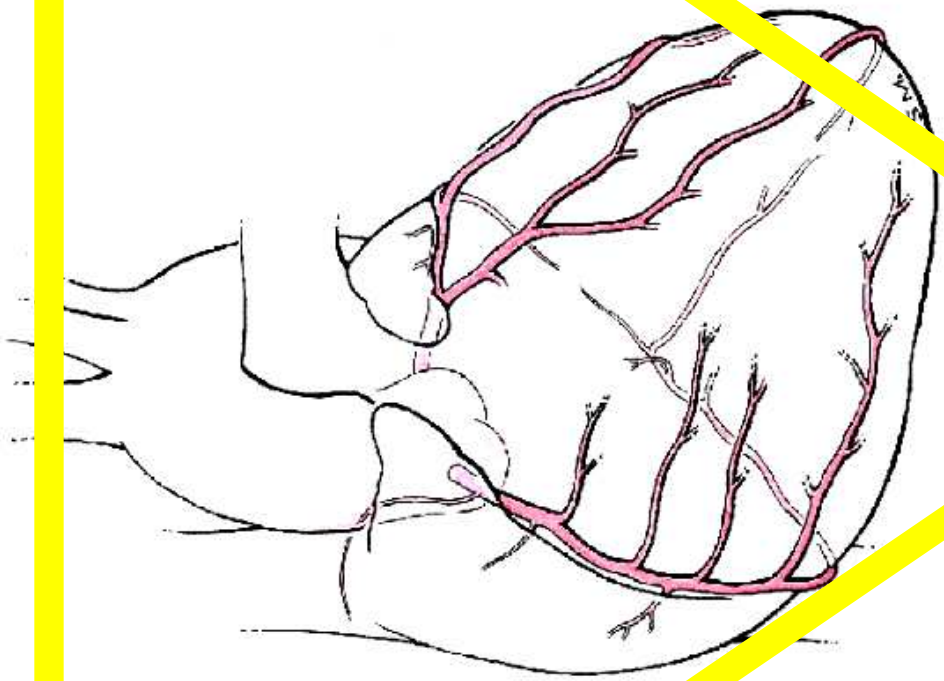
The coronary circulation

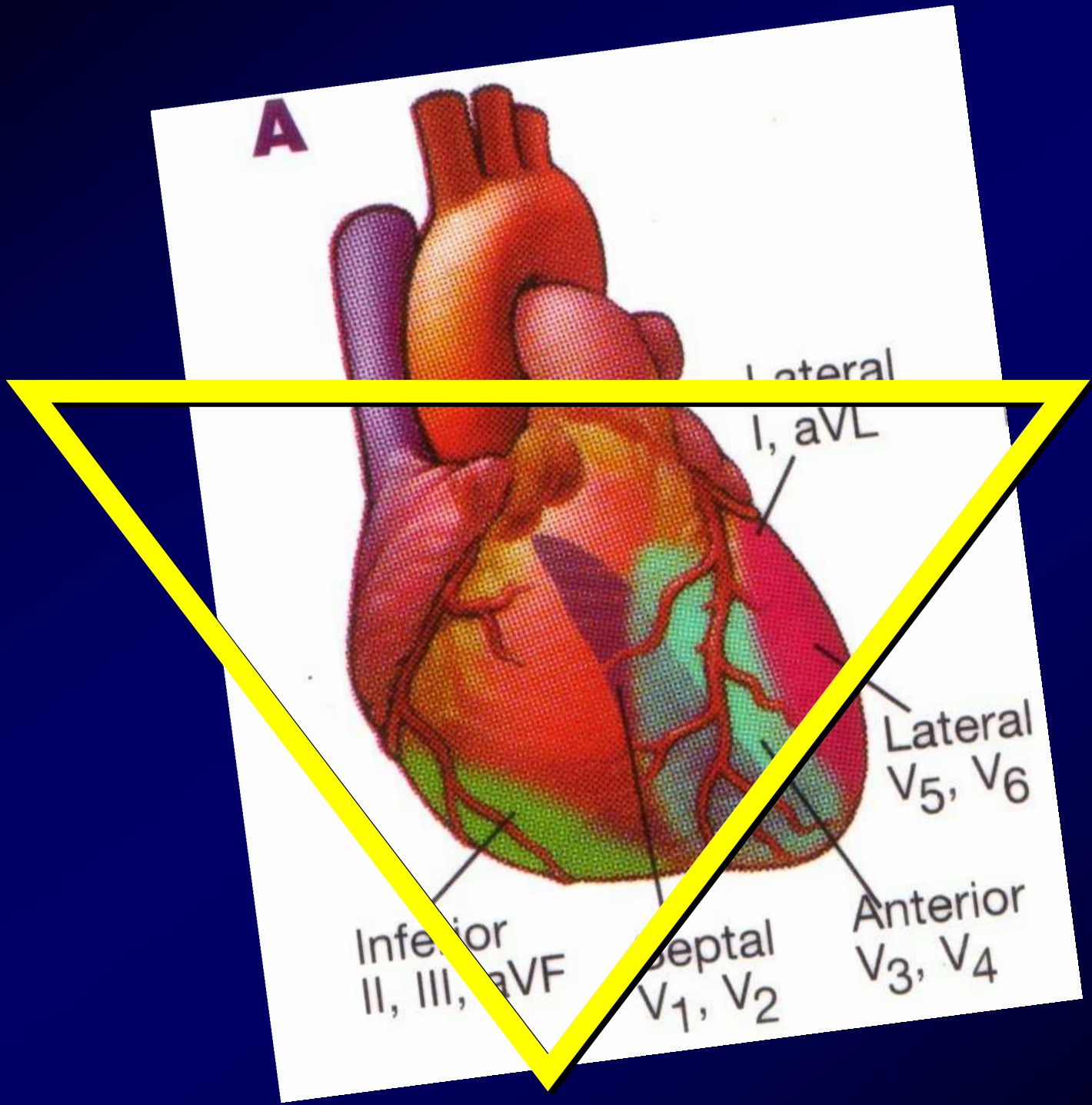


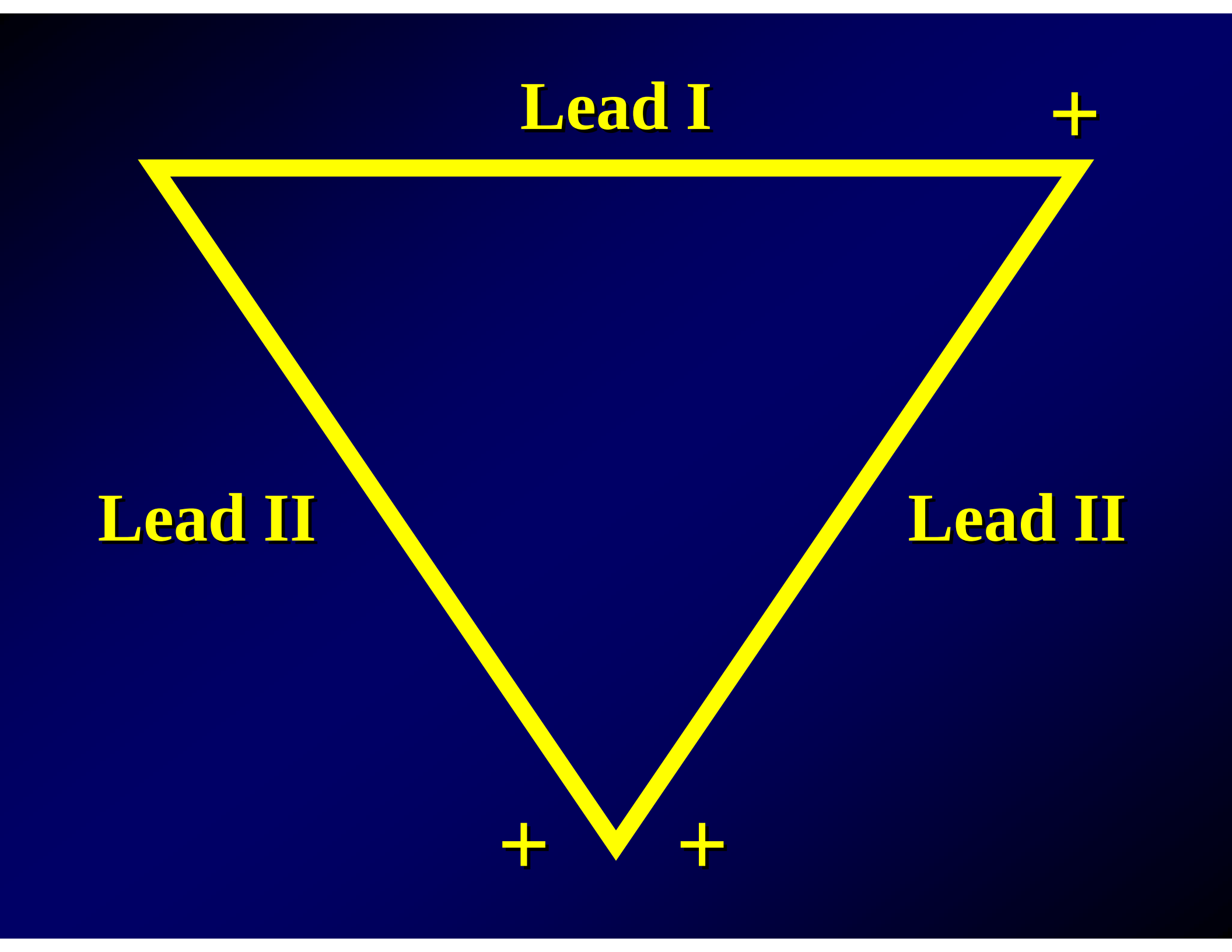


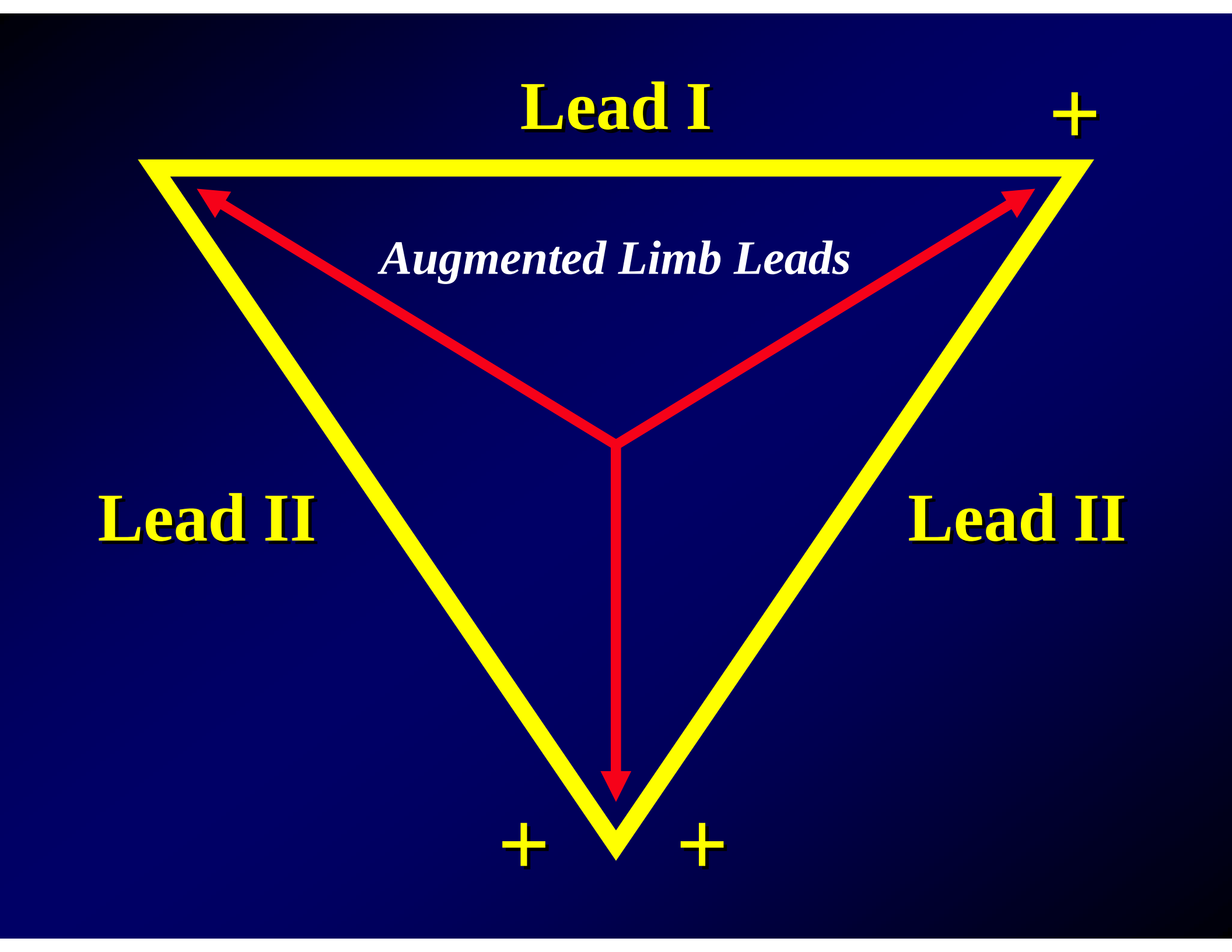
The coronary arteries supply the three main walls of the heart

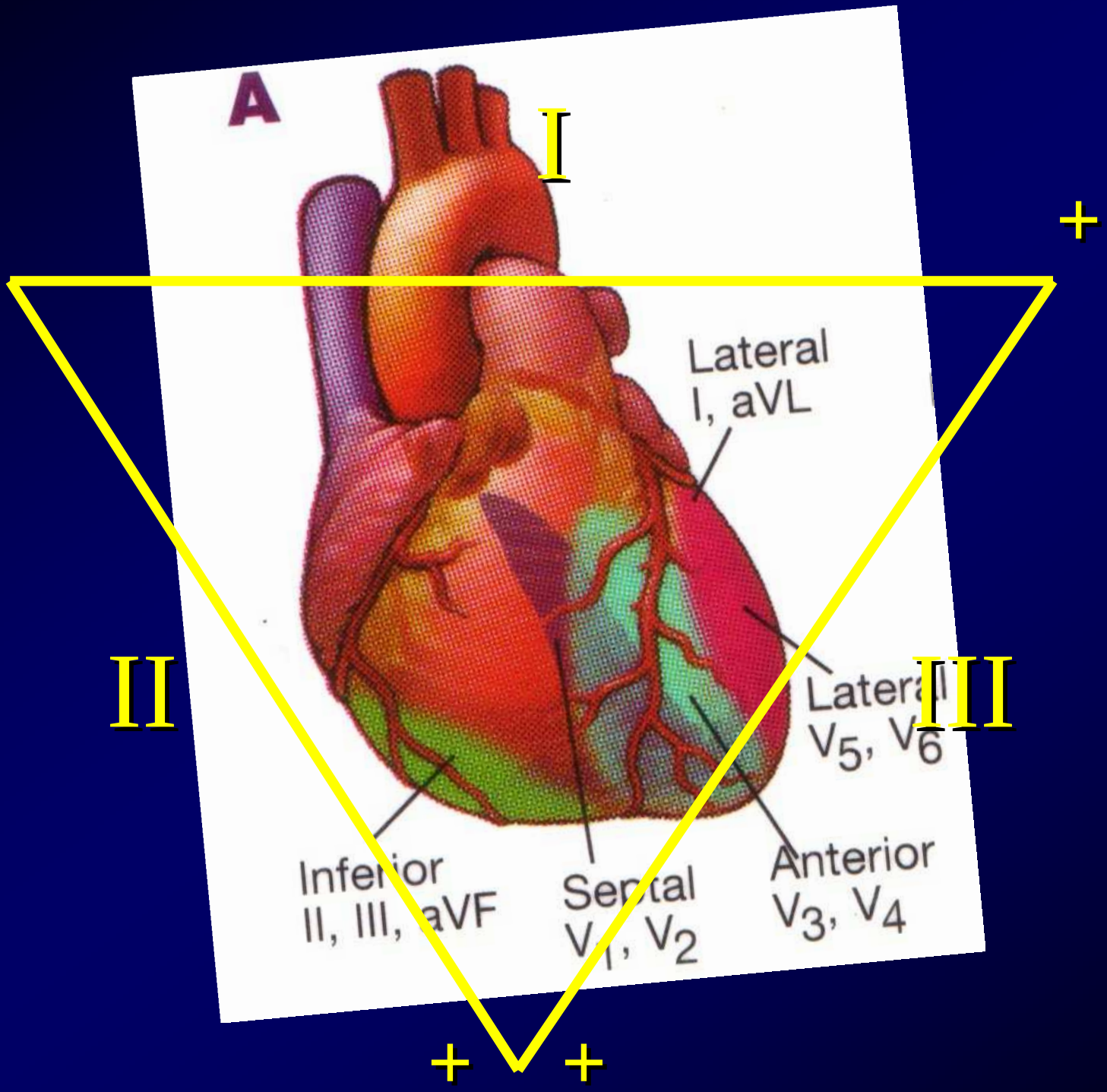

R
P
T
Anterior
Lateral
Inferior

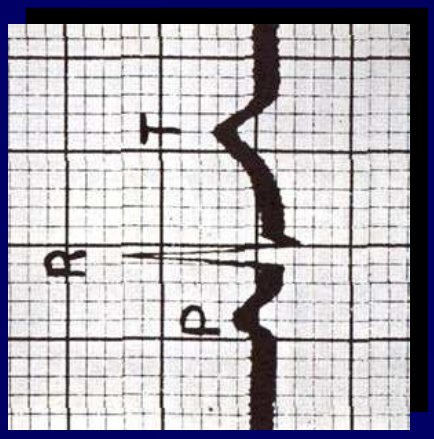


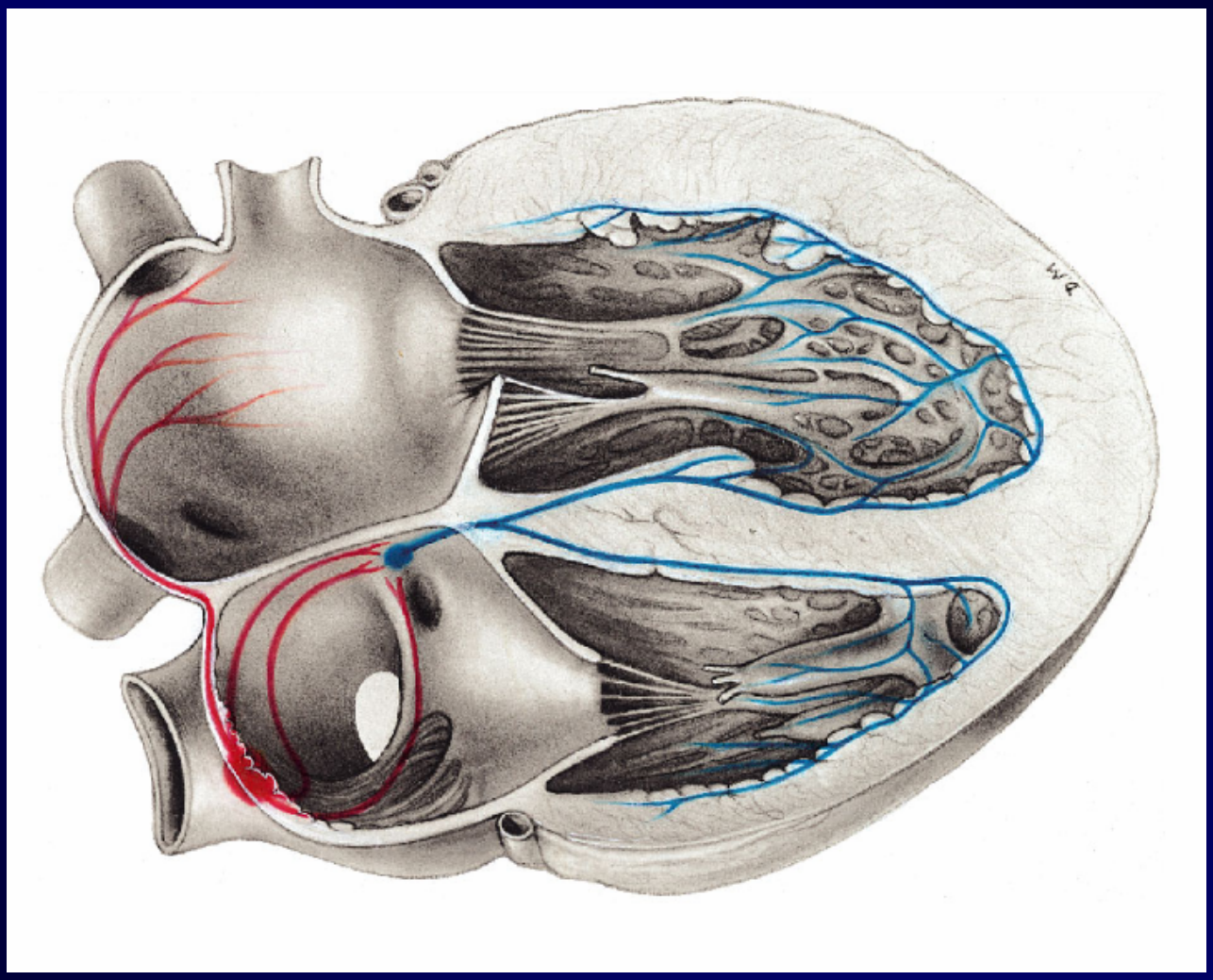

A
I, aVL
Lateral
V5, V6
Anterior
V3, V4
Septal
V1, V2
Inferior
II, III, aVF

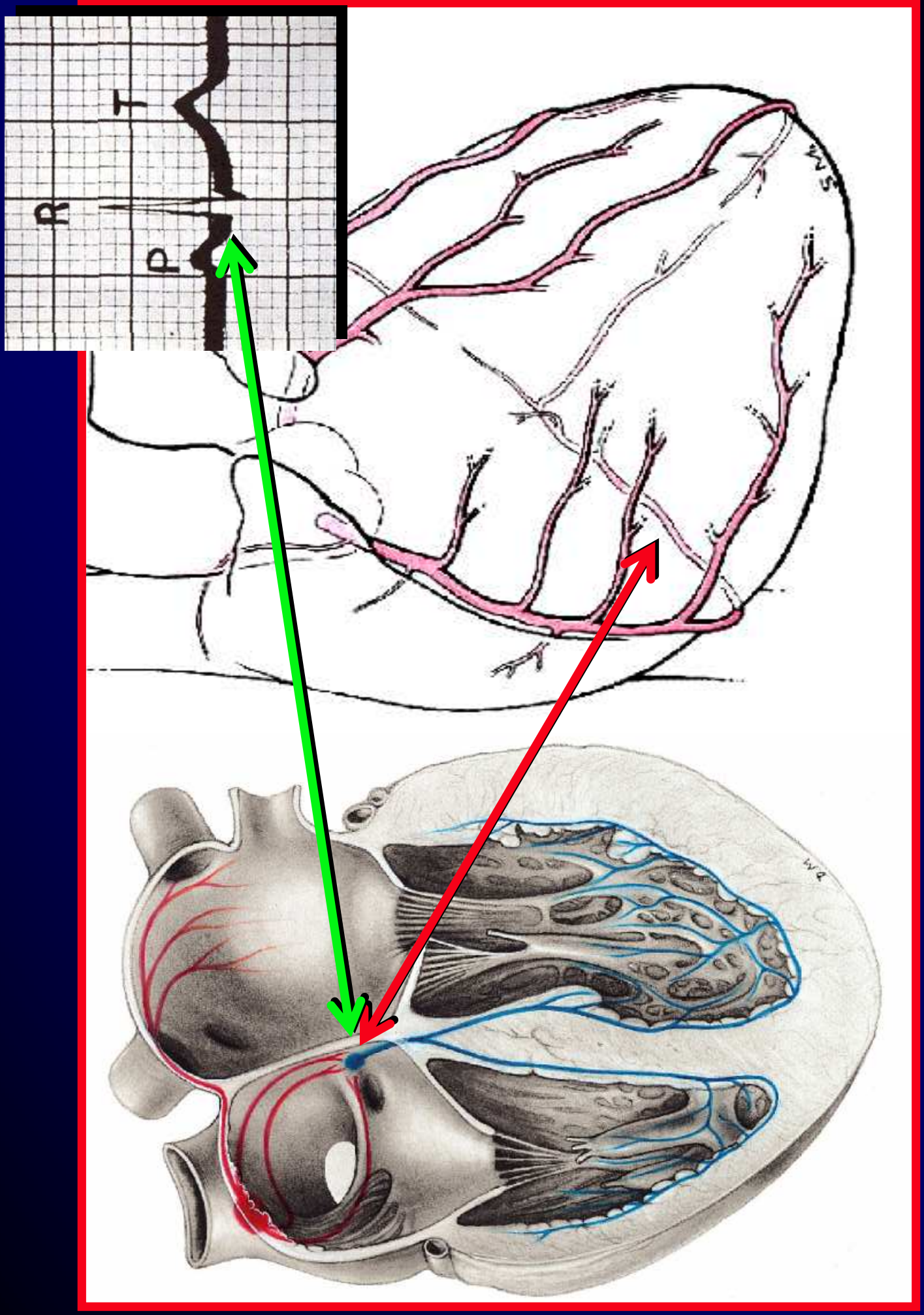

Lead I
+
Lead II
Lead II
+
+


Lead I
+
Augmented Limb Leads
Lead II
Lead II
+
+

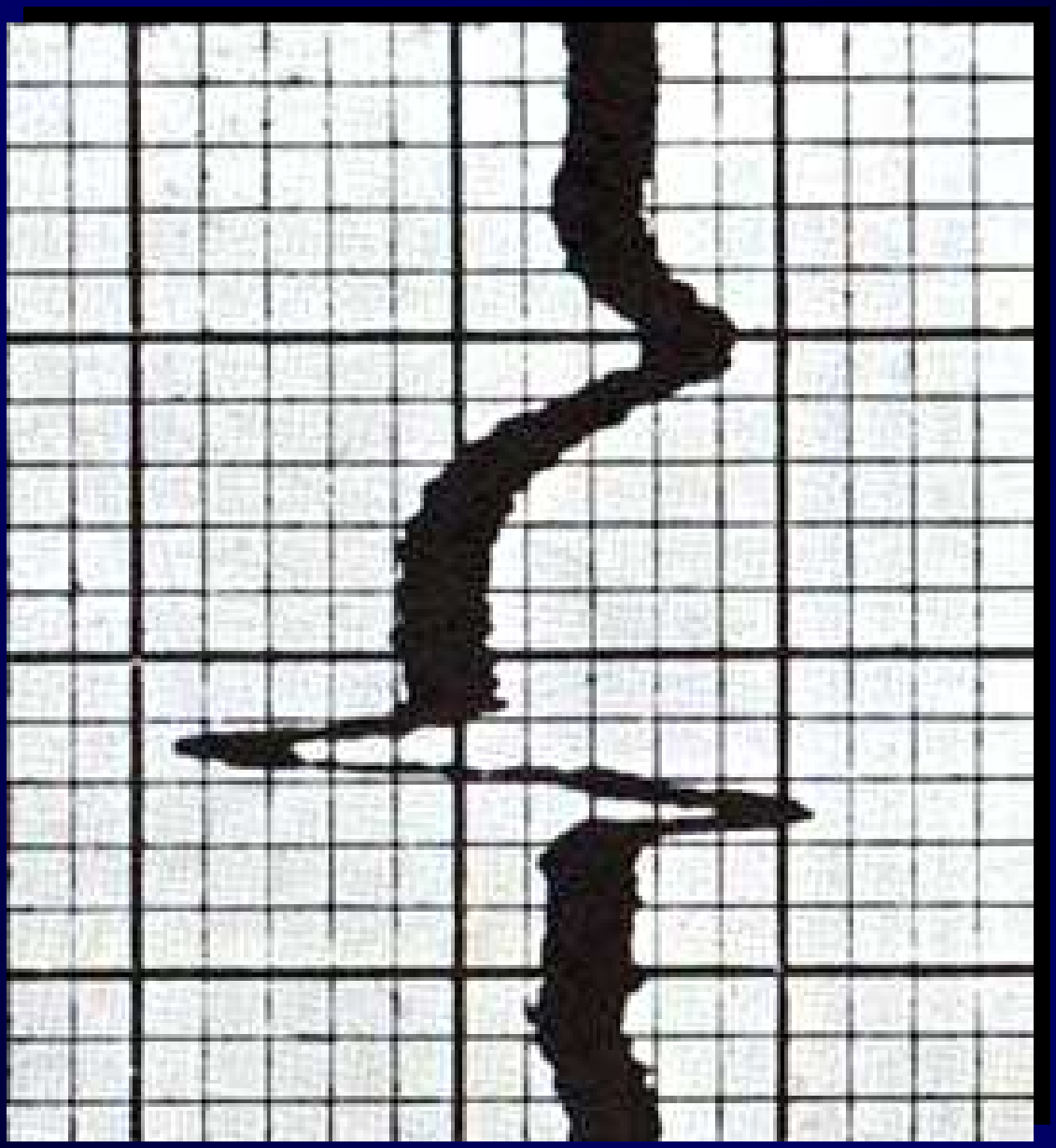

A
I
+
II
III
Lateral
I, aVL
Lateral
V5, V6
Inferior
II, III, aVF
Septal
V1, V2
Anterior
V3, V4
+
+

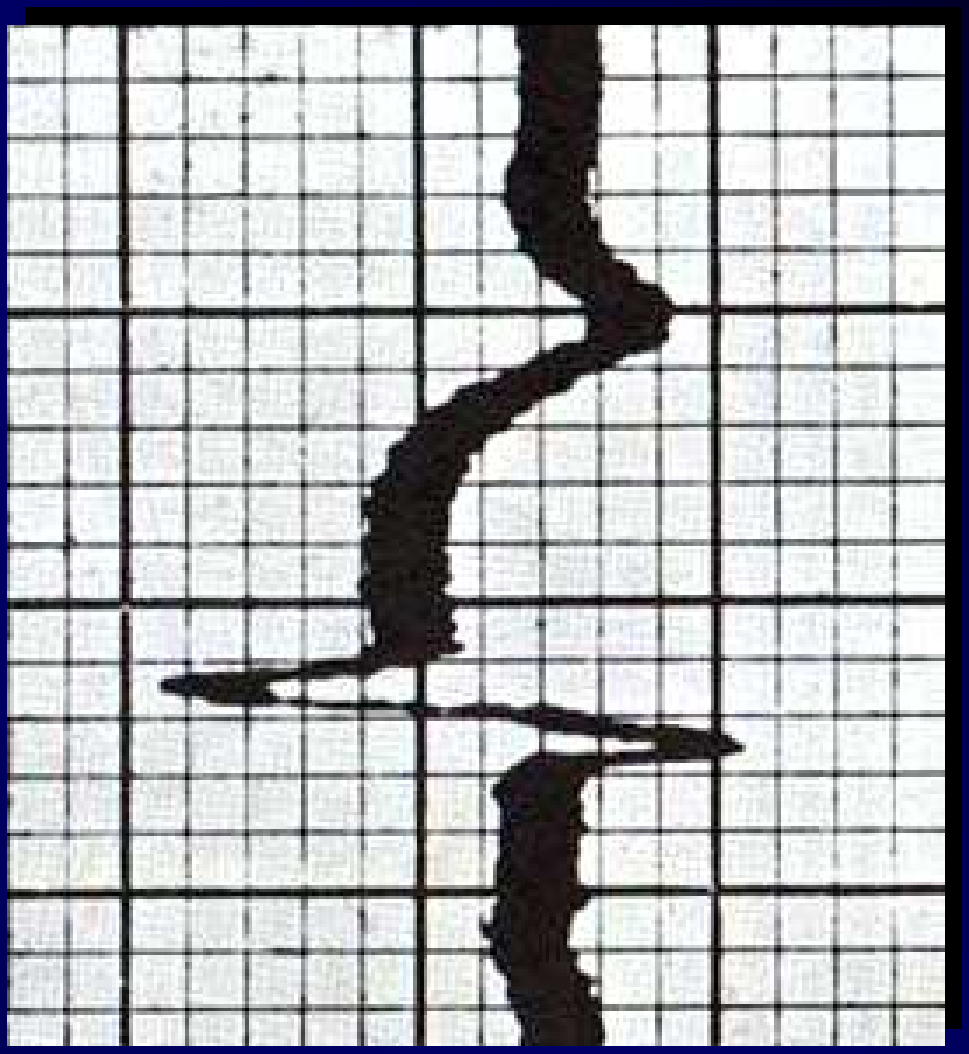

T
R
P

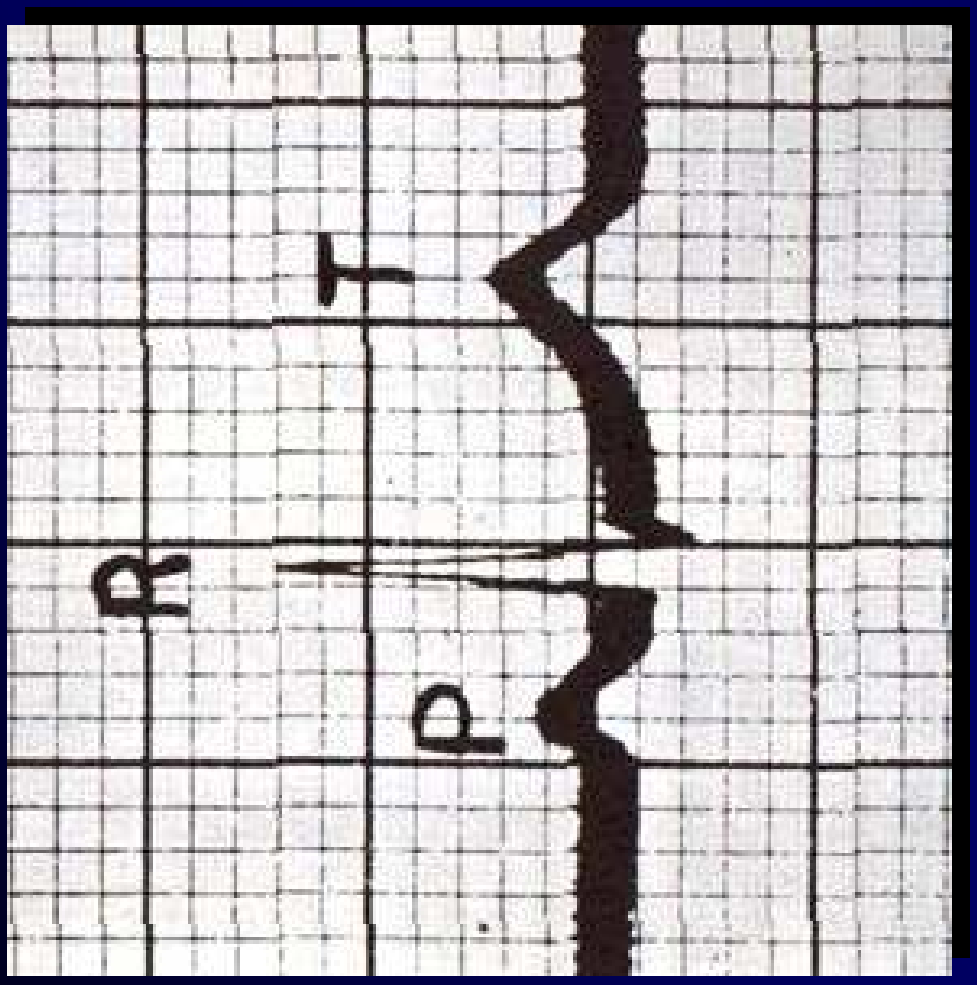


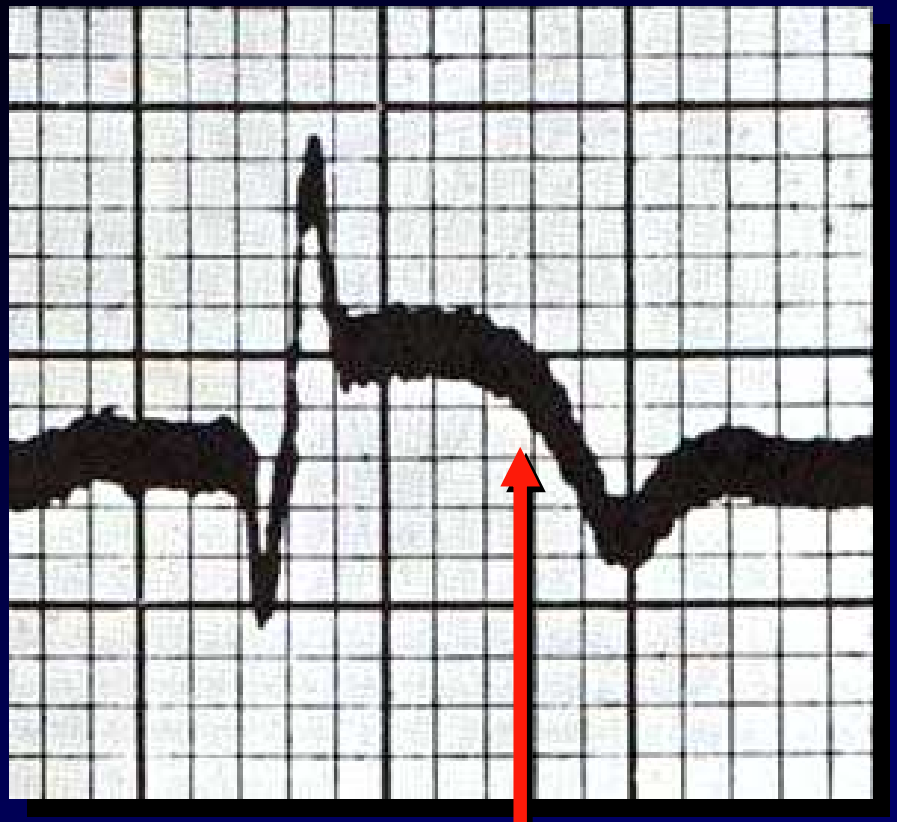

T
R
P

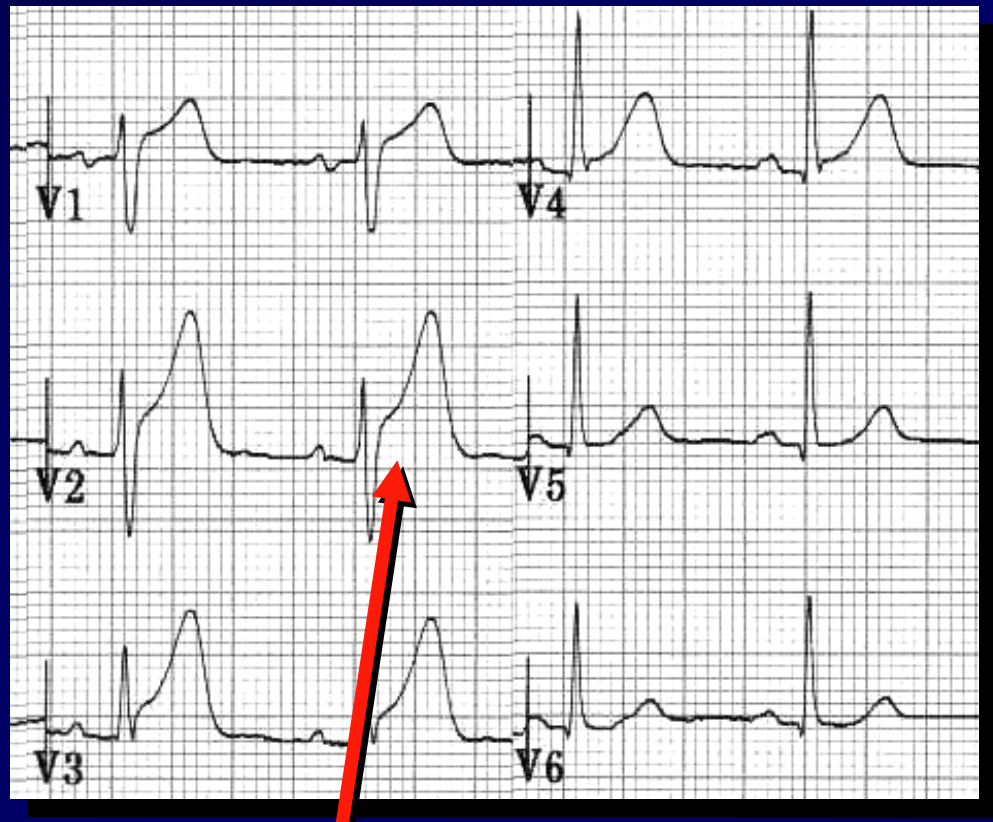

The EKG leads
that are positive
closest to the
site of the infarction
will show
ST segment elevation






R
P

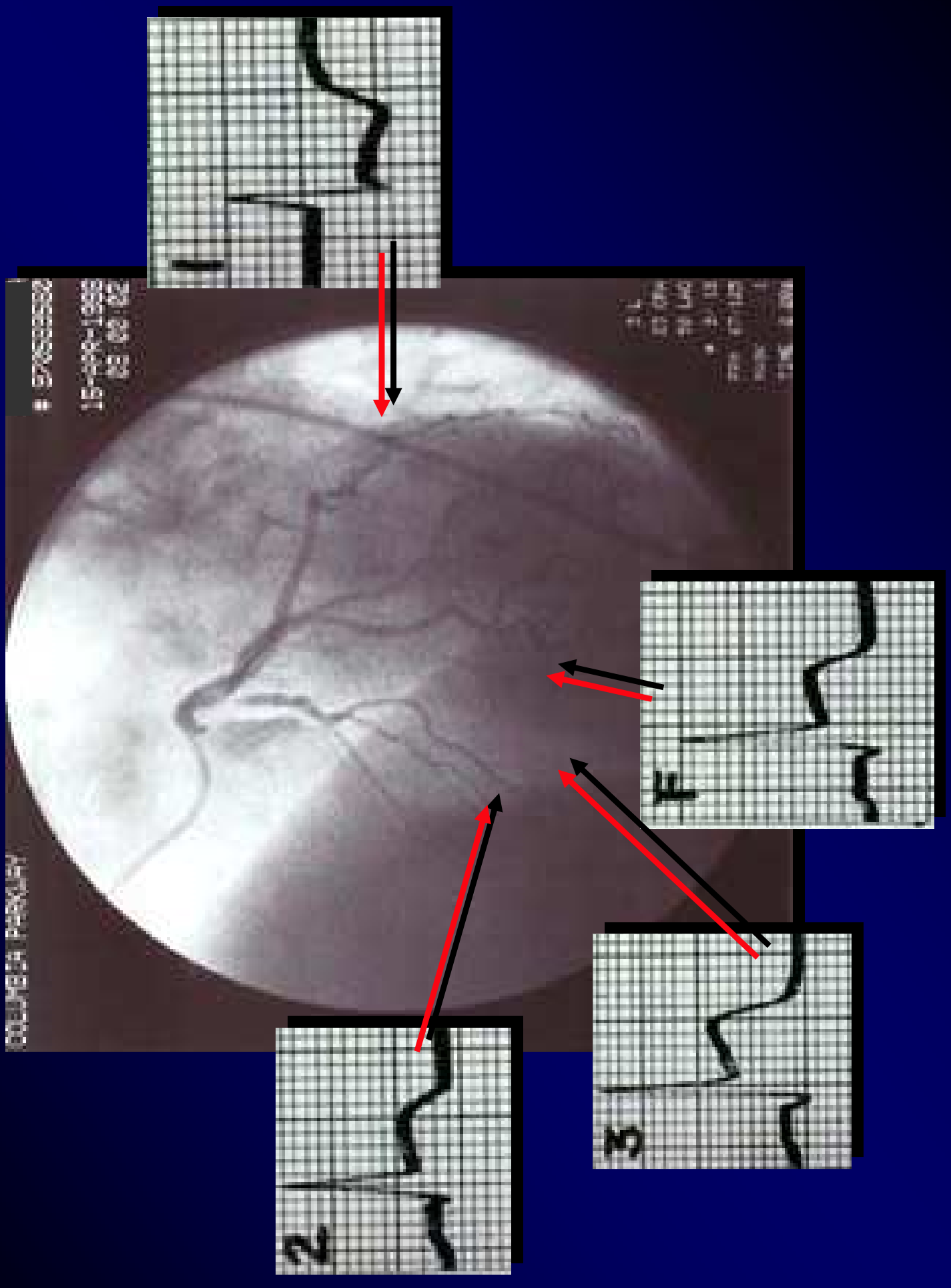




Convex upwards is an injury pattern, meaning infarction

Concave upwards is probably early repolarization

The EKG leads
that are positive
on the other side of the
heart from the infarction
will show reciprocal
ST segment depression

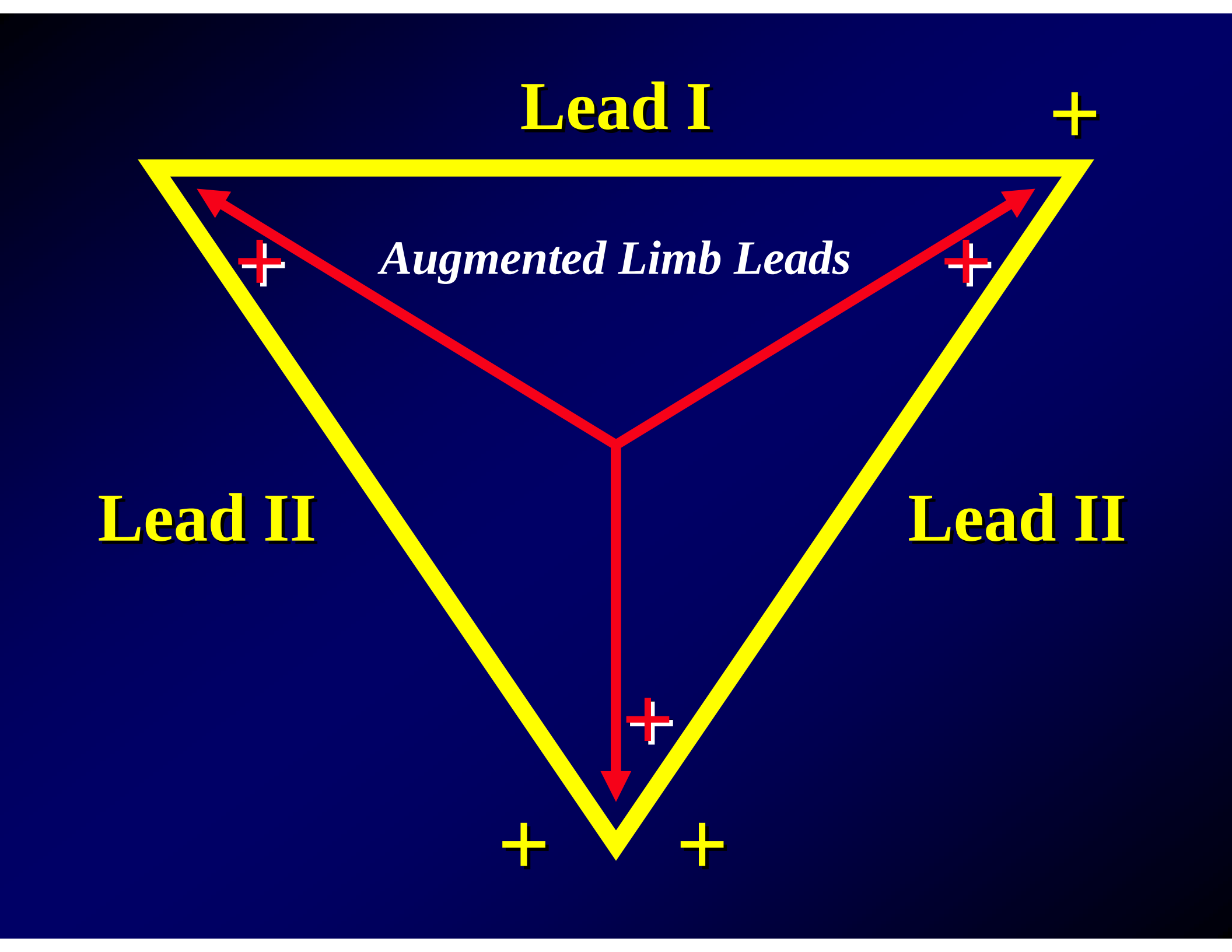

1
2
3
4
5

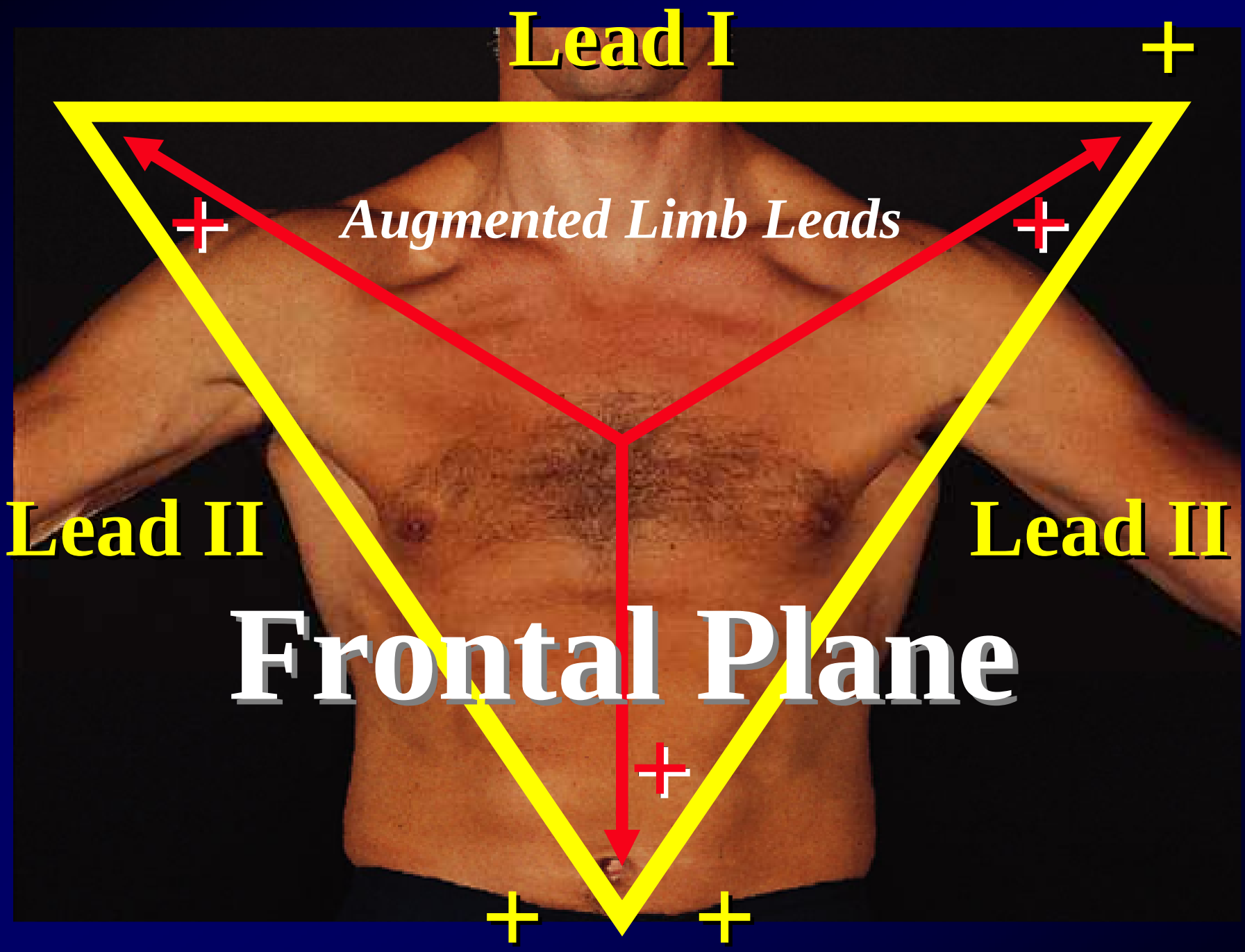
The Basic Fundamental of 12 Lead EKG Interpretation

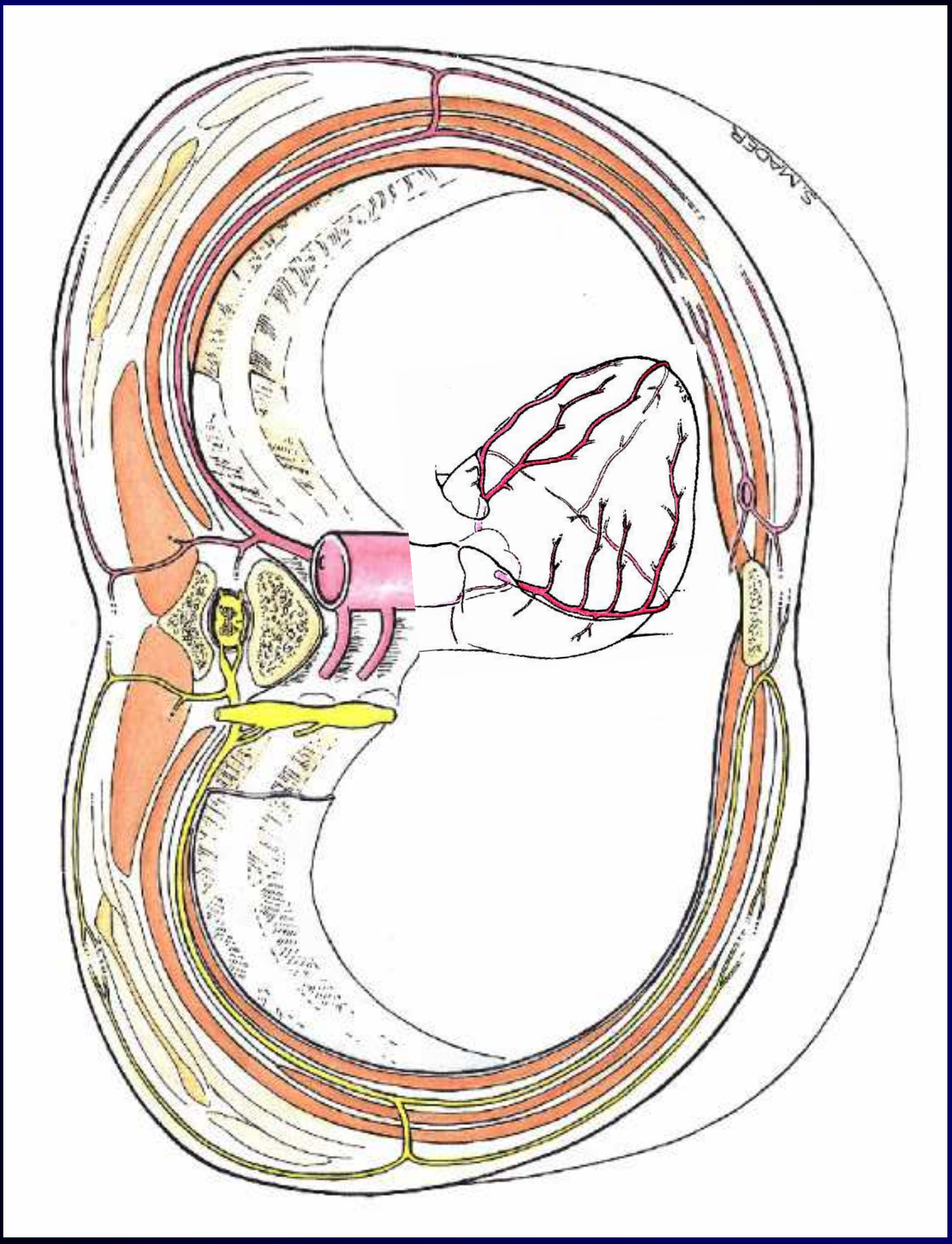
You CAN'T understand 12 leads without understanding the concept of "Grouped Leads"

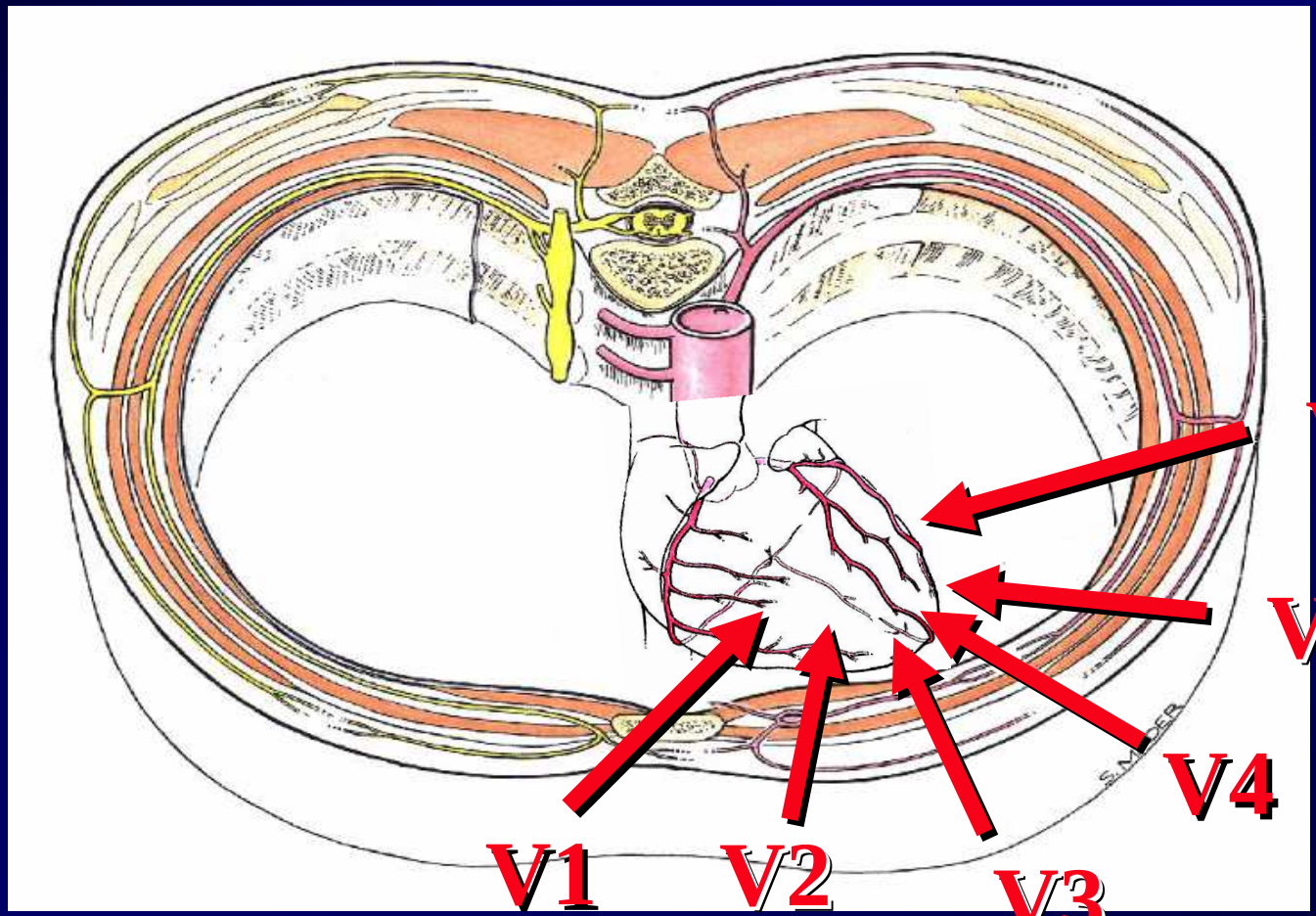
Grouped Leads Relate DIRECTLY to Cardiac Anatomy

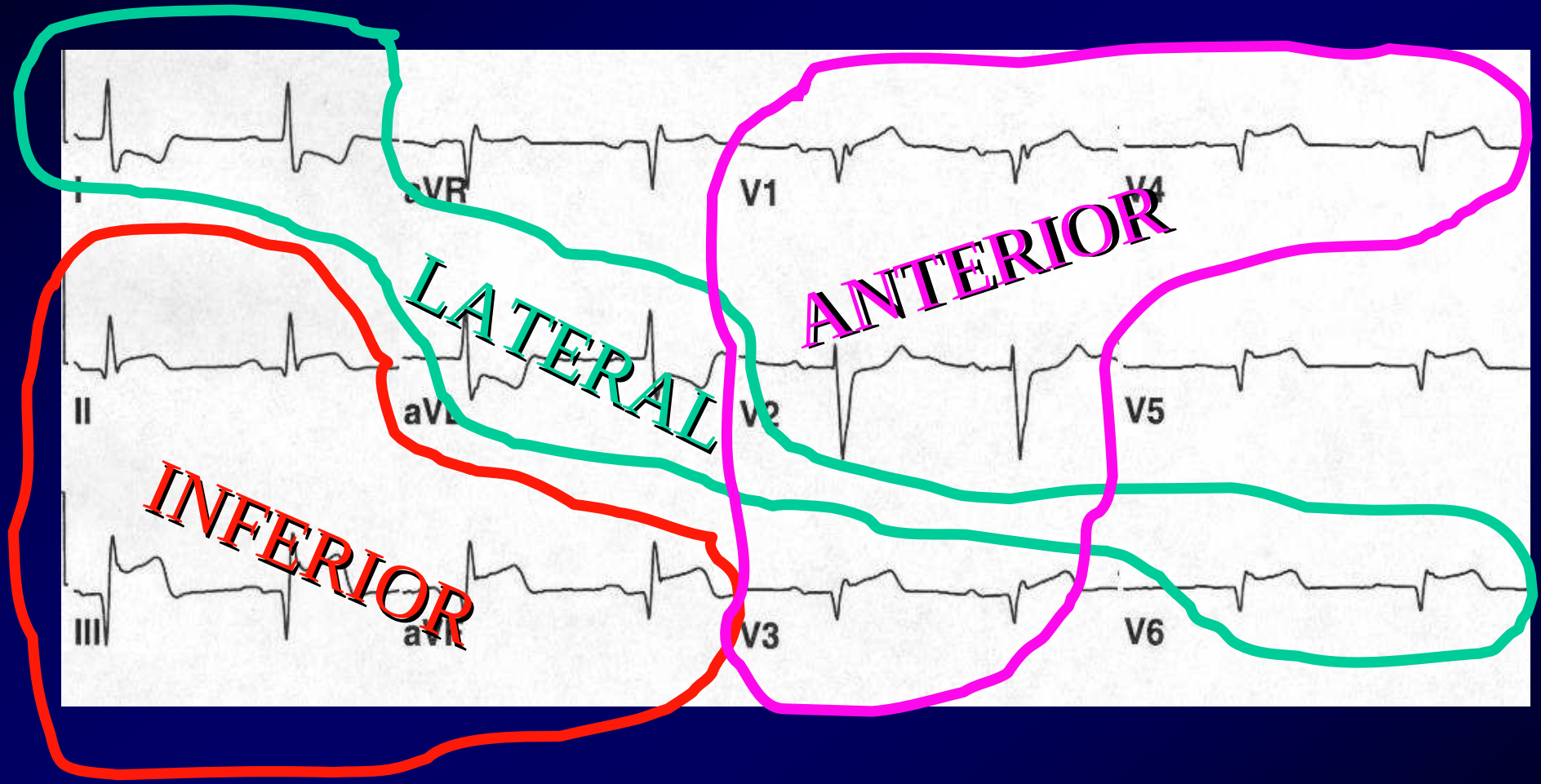
So, if you understand the anatomy, you can quickly look at a 12 lead and understand it immediately!

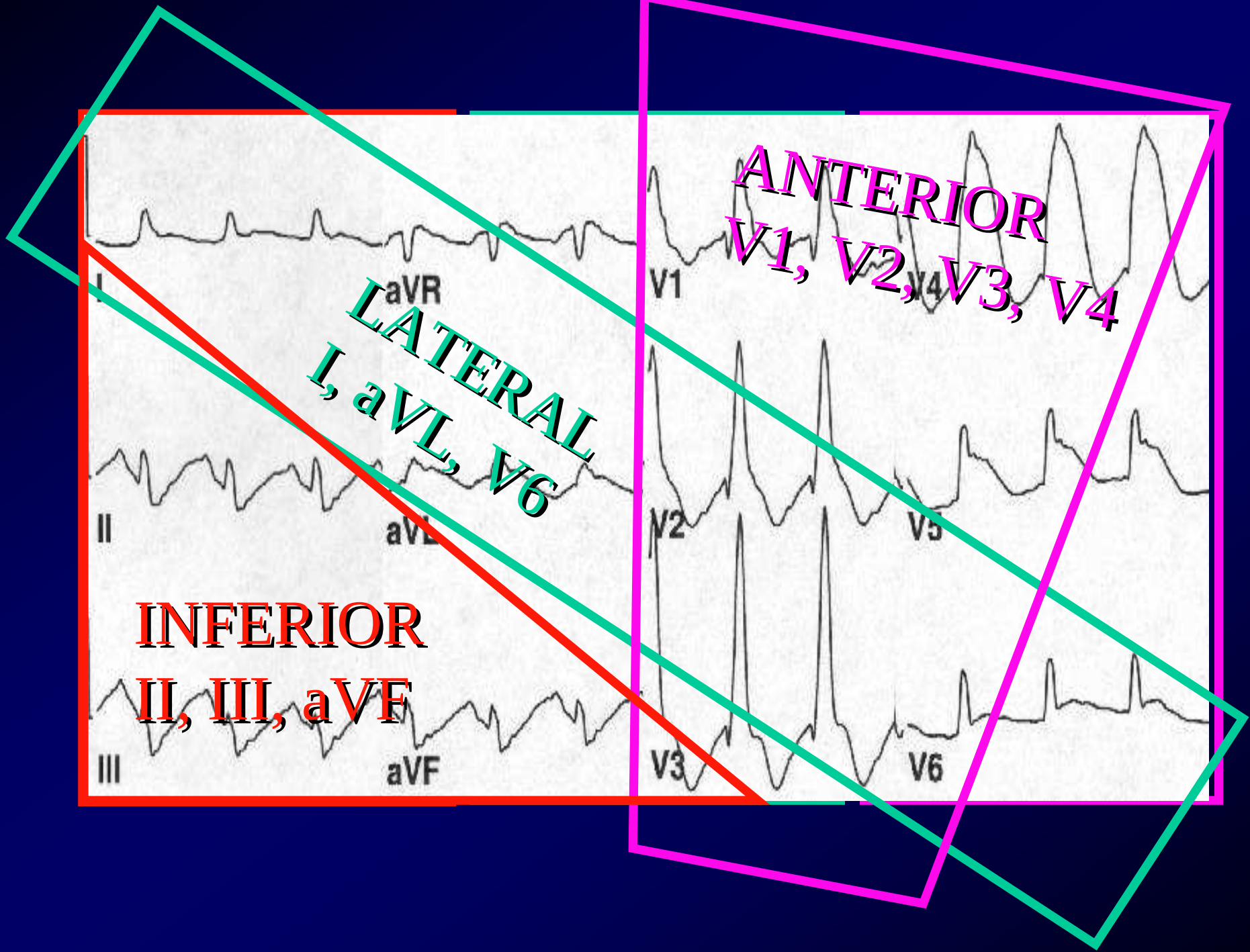

Lead I
+
Augmented Limb Leads
+
+
Lead II
Lead II
+
+
+

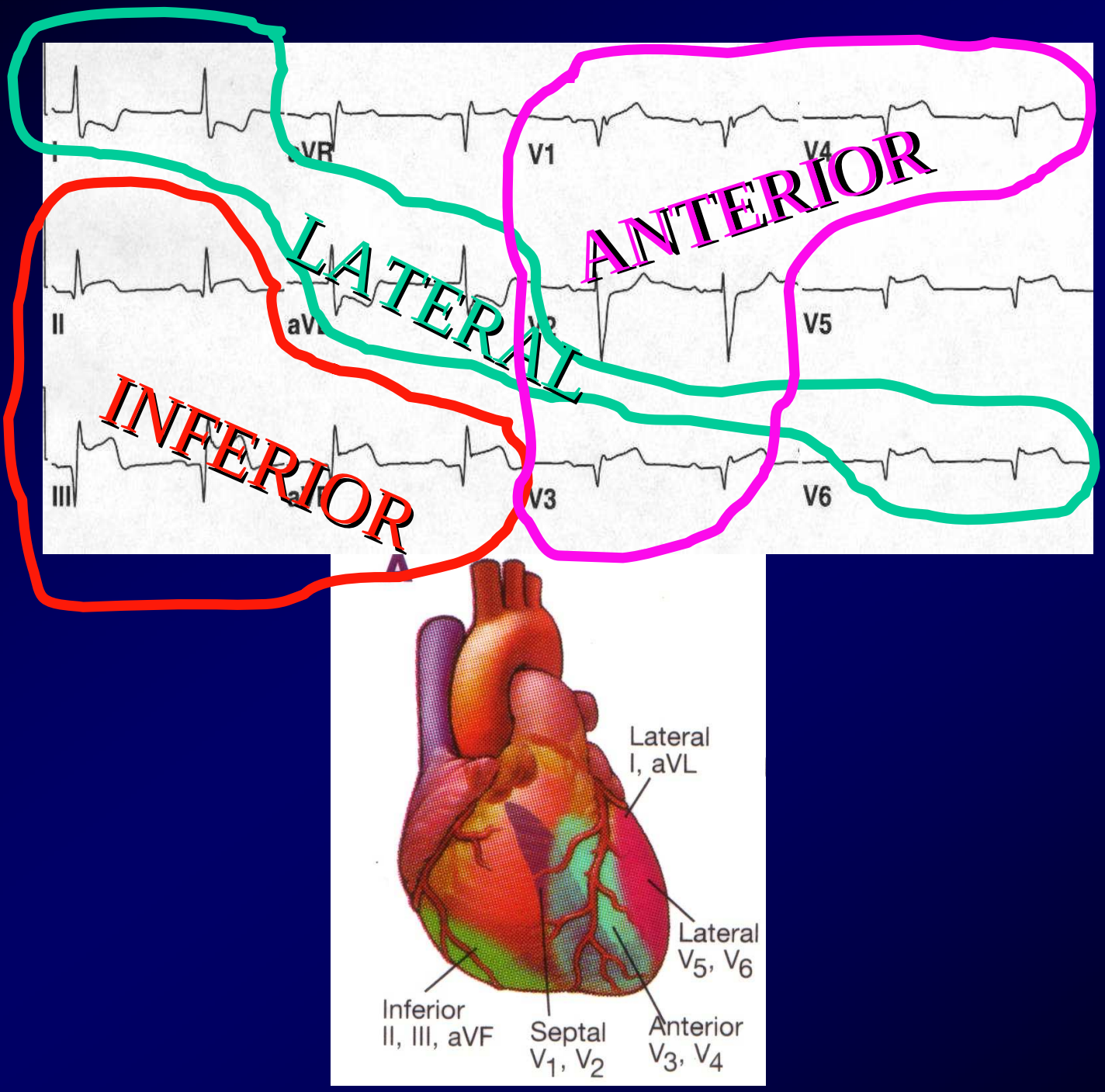

Lead I
+
+
Augmented Limb Leads
+
Lead II
Lead II
Frontal Plane
+
+
+

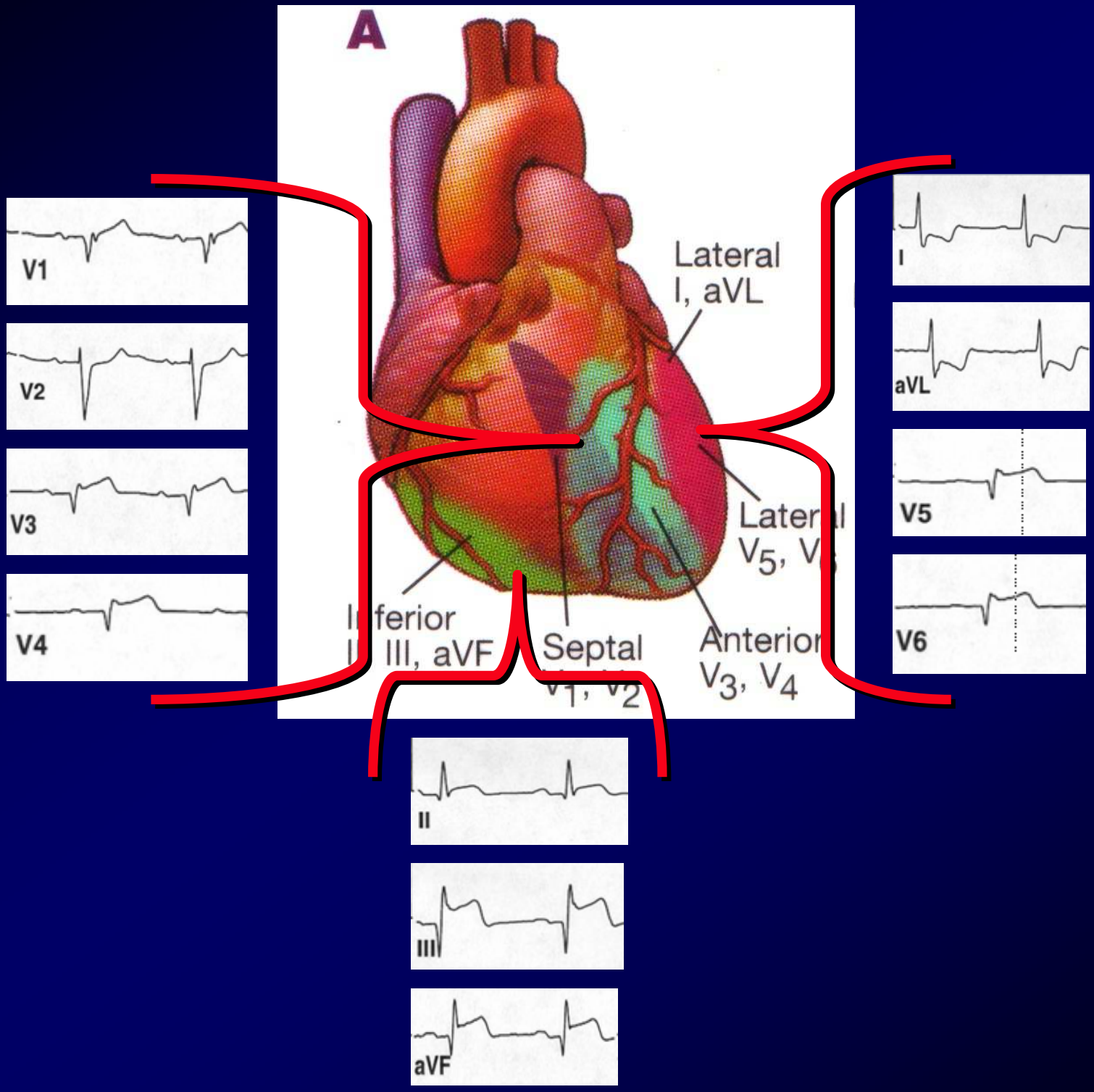

S.MADER

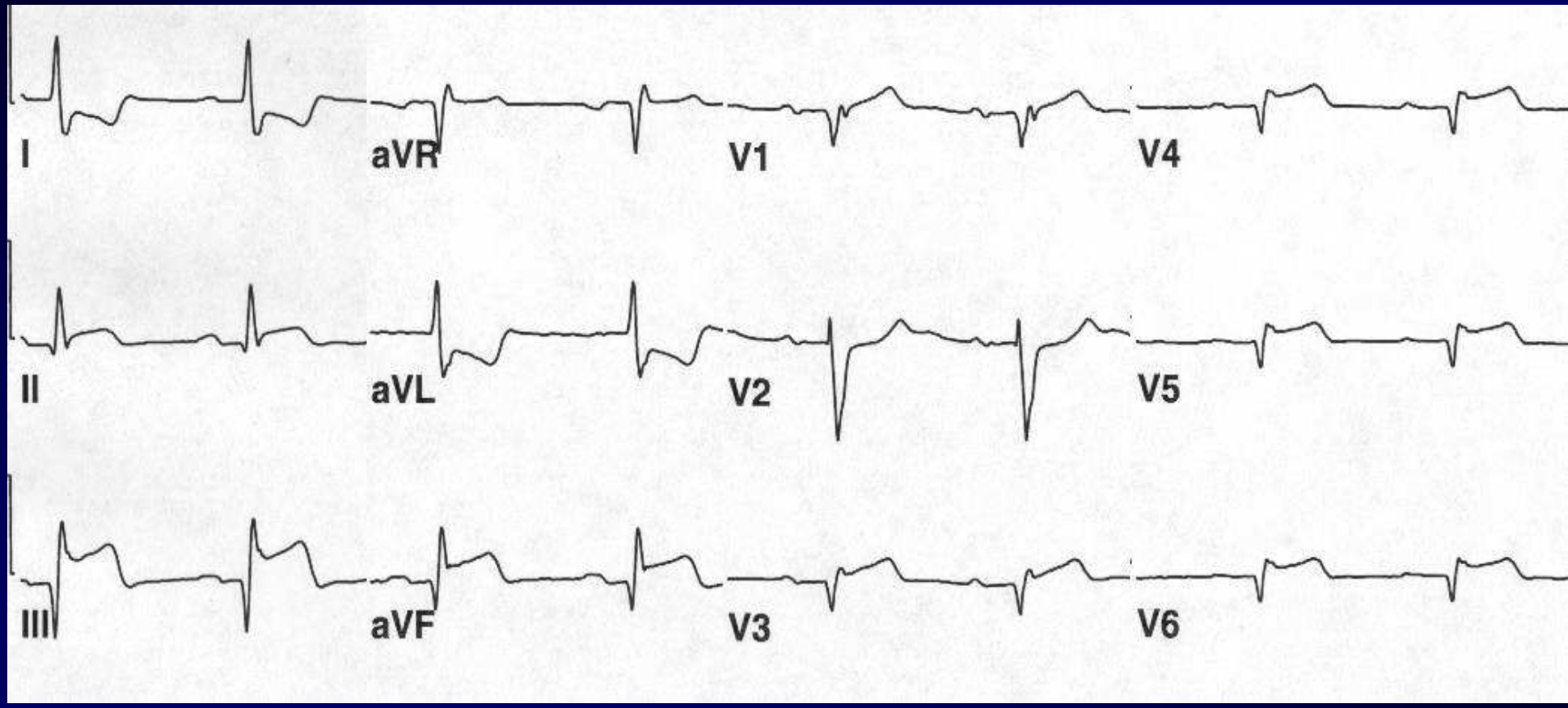

V6
V5
V4
V1
V2
V3

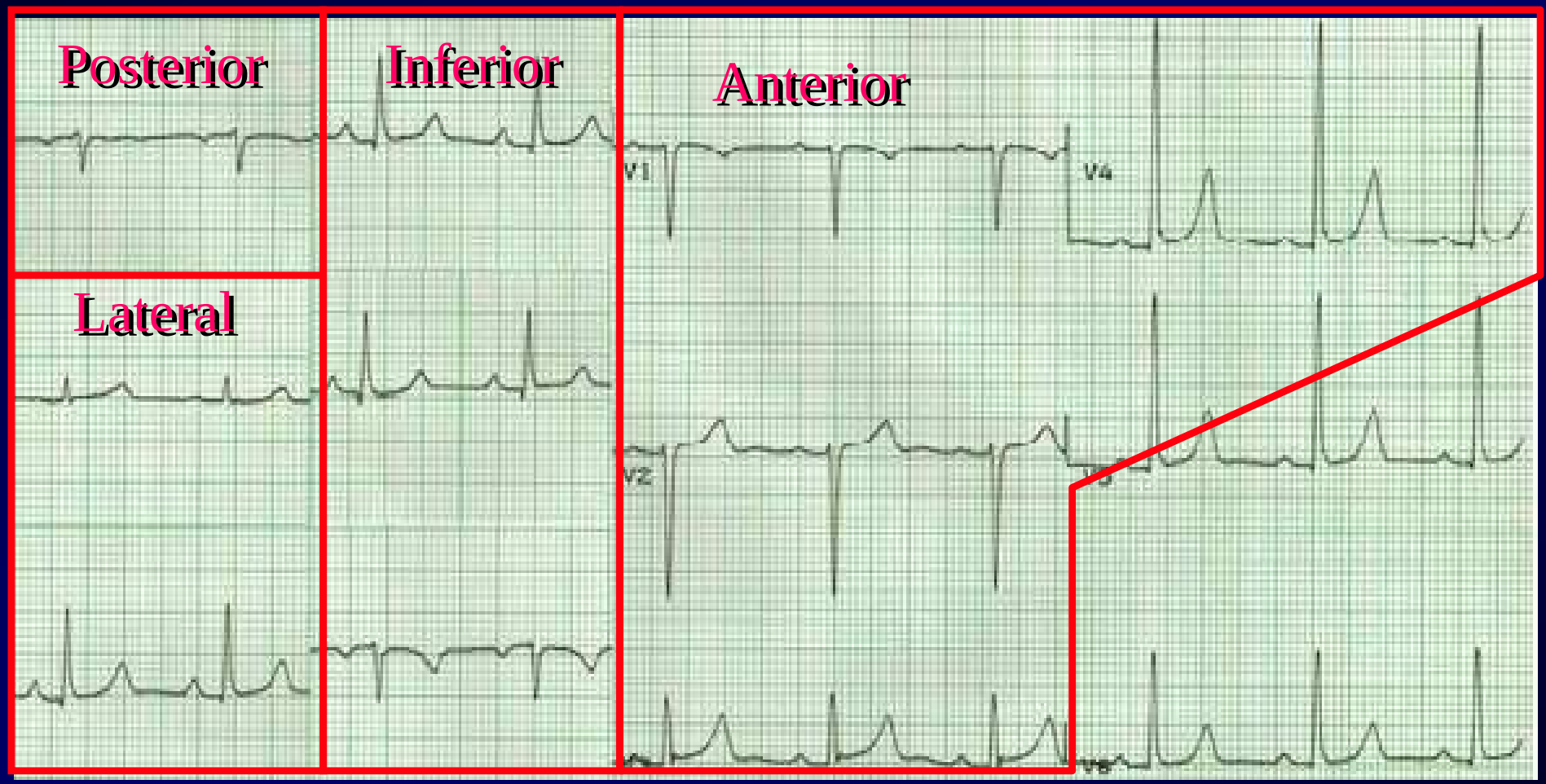

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
LATERAL
ANTERIOR
INFERIOR

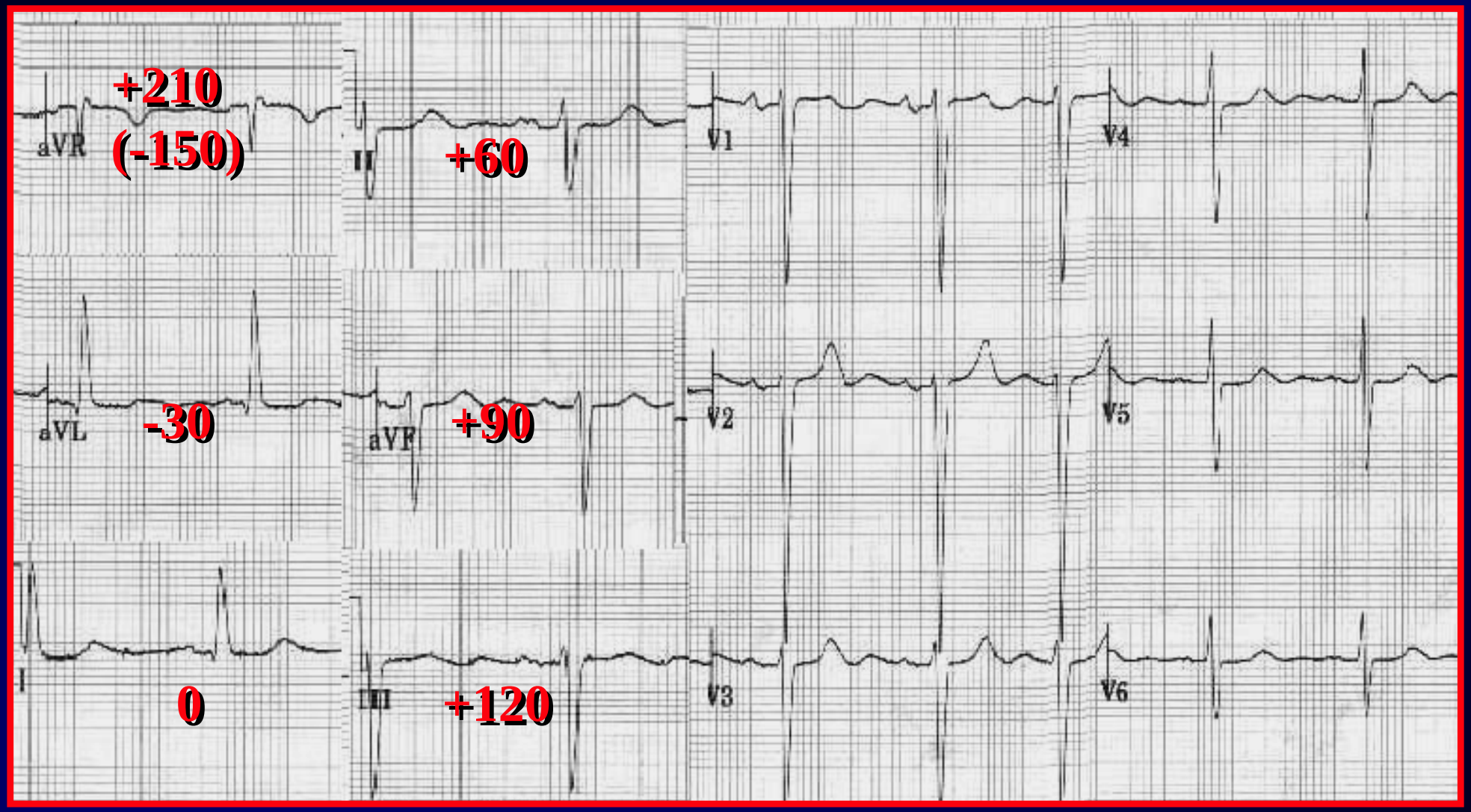

ANTERIOR
V1, V2, V3, V4
LATERAL
I, aVL, V6
INFERIOR
II, III, aVF
I
aVR
V1
V4
II
V2
V5
III
aVF
V3
V6


I
aVR
V1
V4
II
aVL
V5
III
V3
V6
LATERAL
ANTERIOR
INFERIOR
Lateral
I, aVL
Lateral
V5, V6
Inferior
II, III, aVF
Septal
V1, V2
Anterior
V3, V4


A
V1
V2
V3
V4
Lateral
I, aVL
I
aVL
V5
V6
Septal
Anterior
V_3, V_4
II
III
aVF


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

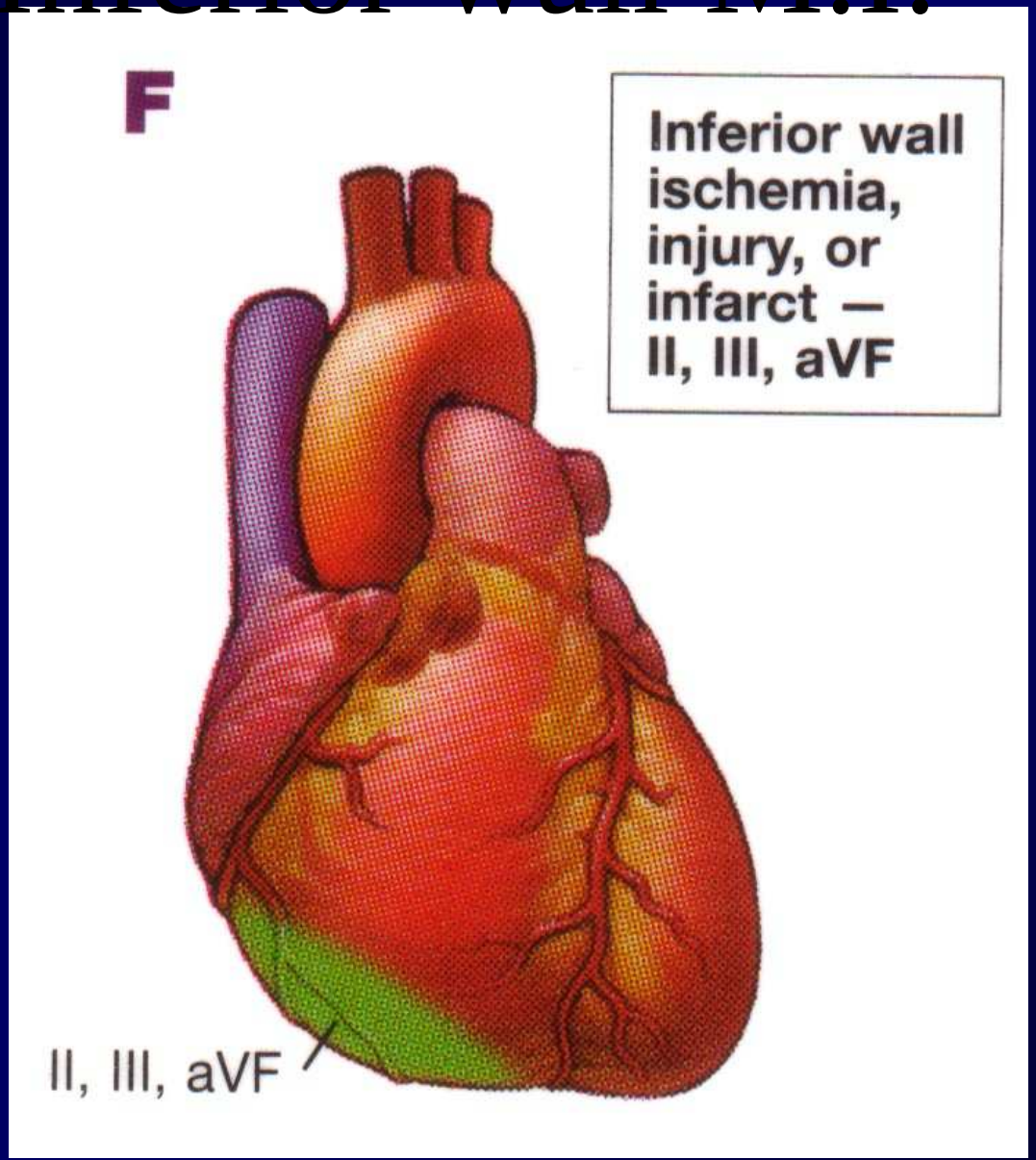

Posterior
Inferior
Anterior
Lateral
V1
V4
V2


+210
aVR
(-150)
II
+60
V1
V4
aVL
-30
aVF
+90
V2
V5
I
0
III
+120
V3
V6

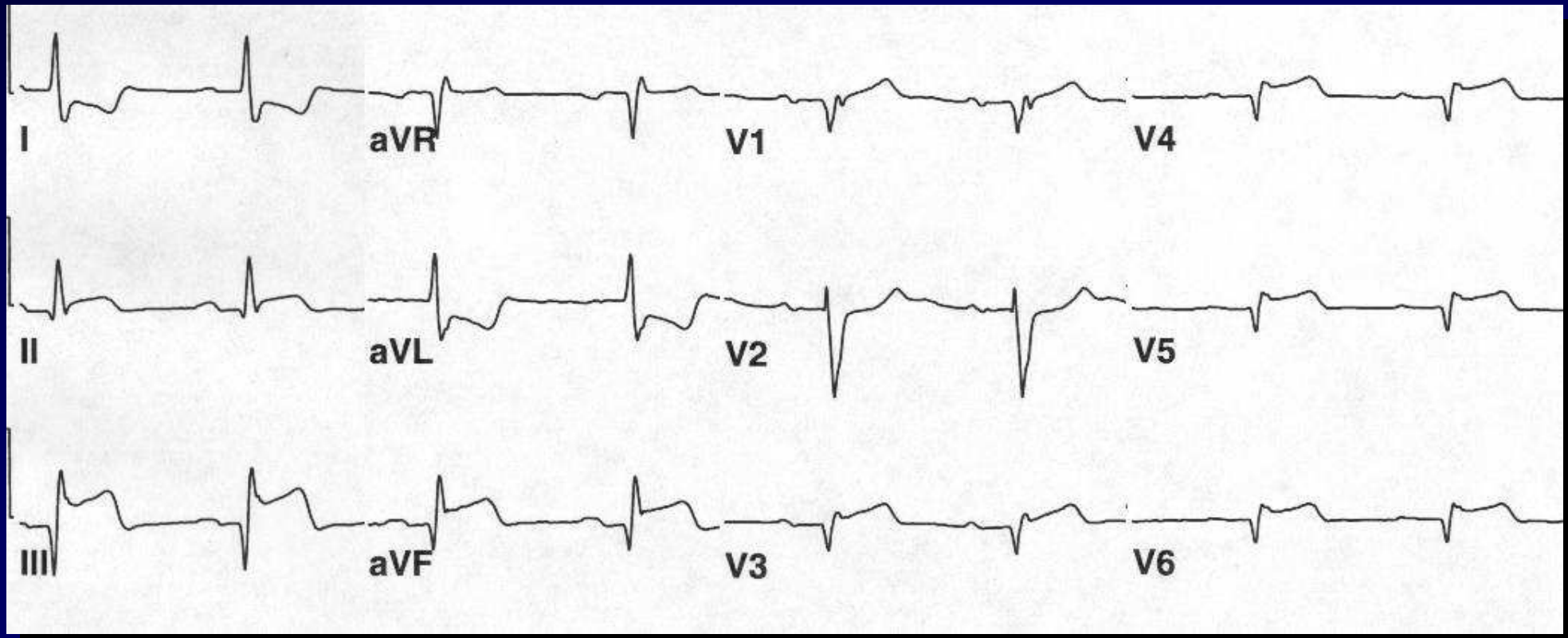
Inferior wall M.I. ≡
Right Coronary
infarction (usually)

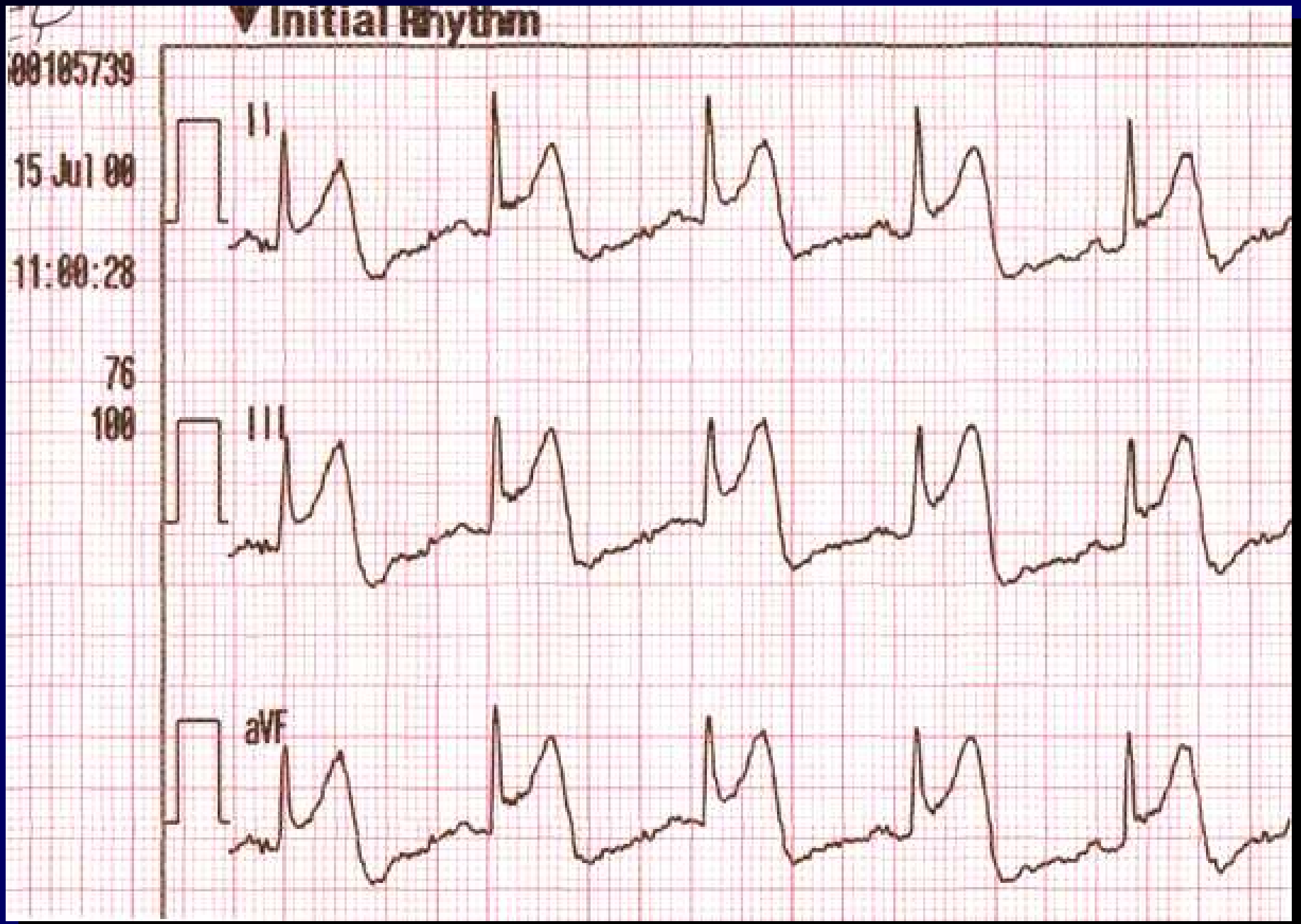
Elevated ST segments
in II, III, and avF, with
reciprocal depression
in I, avL, and the chest leads

Inferior wall M.I. =



Acute Inferior Wall Myocardial Infarction

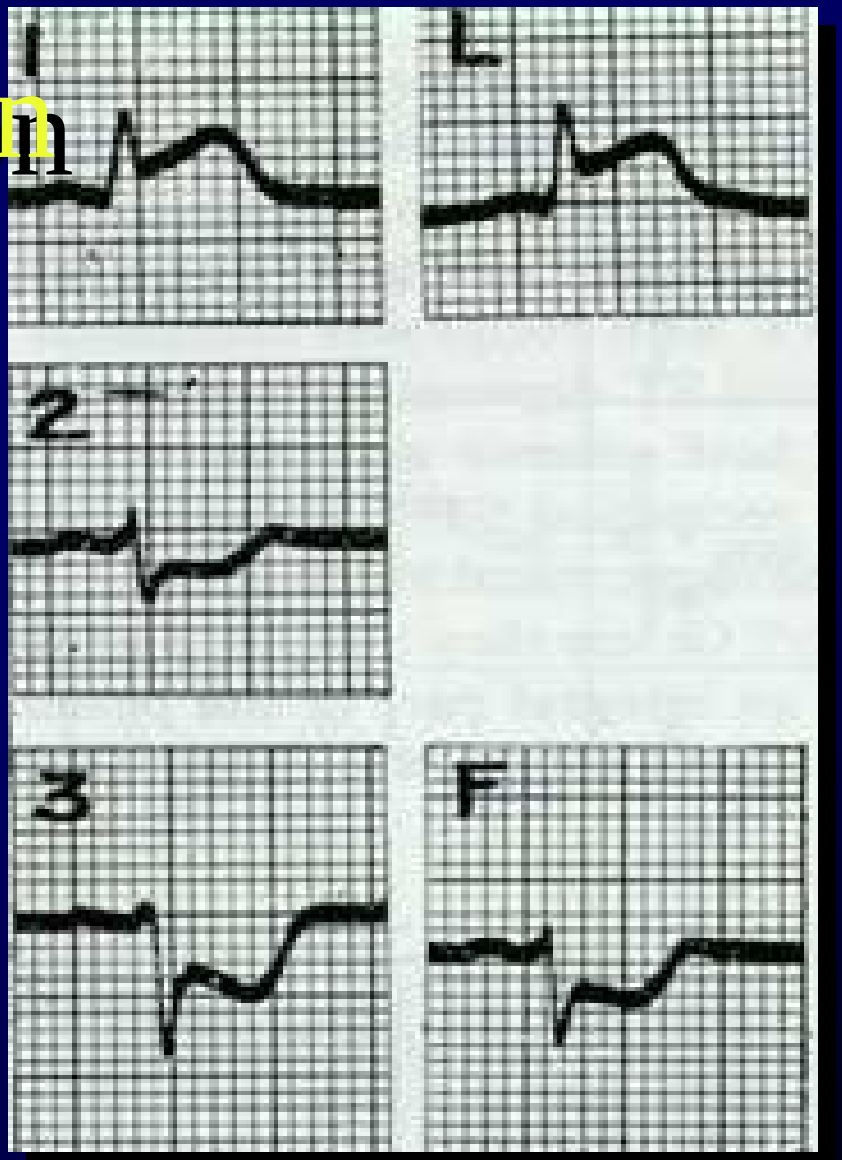



Initial Rhythm
00185739
15 Jul 00
11:00:28
76
100
II
III
aVF

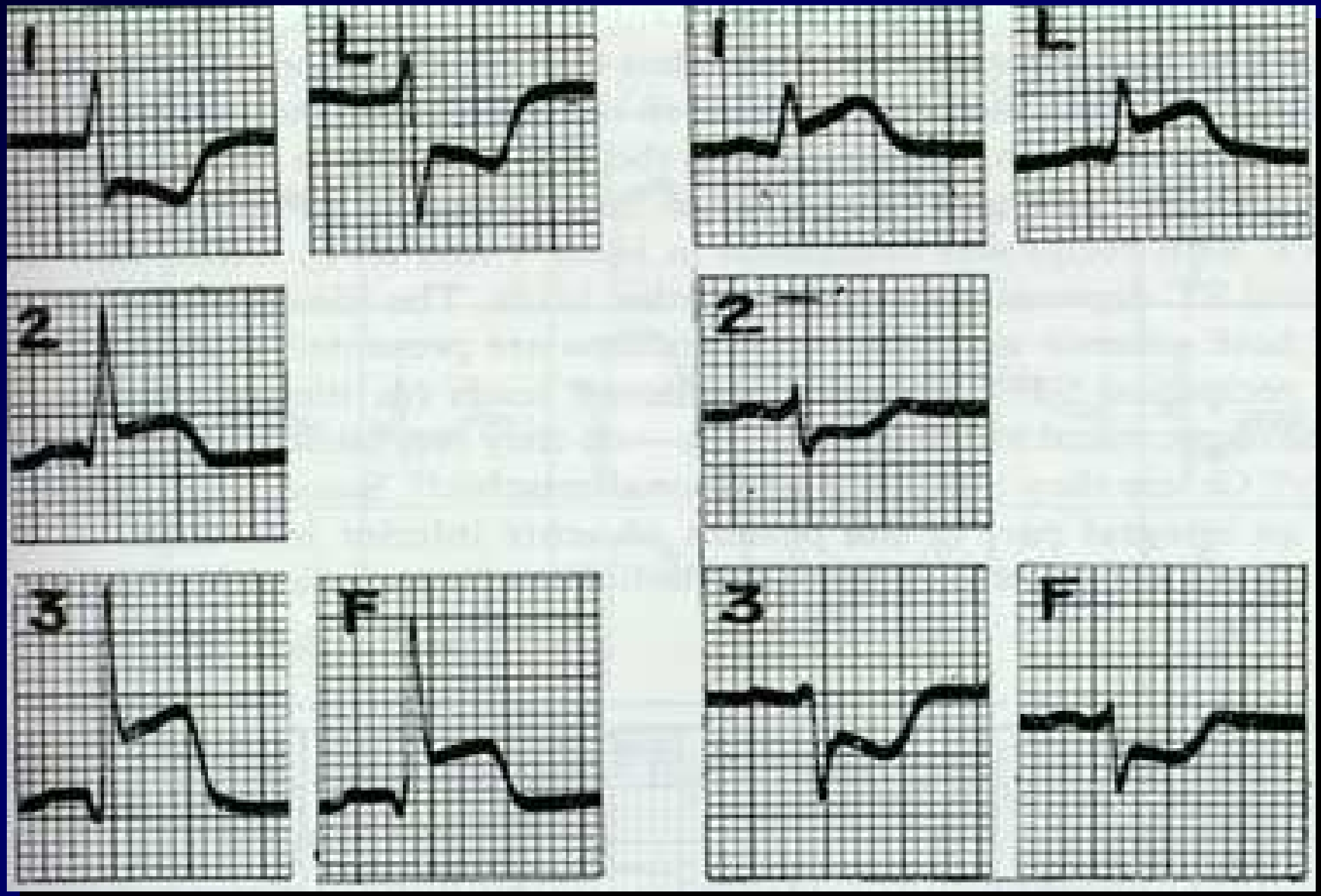
Lateral wall M.I. ≡ Left Circumflex Coronary infarction

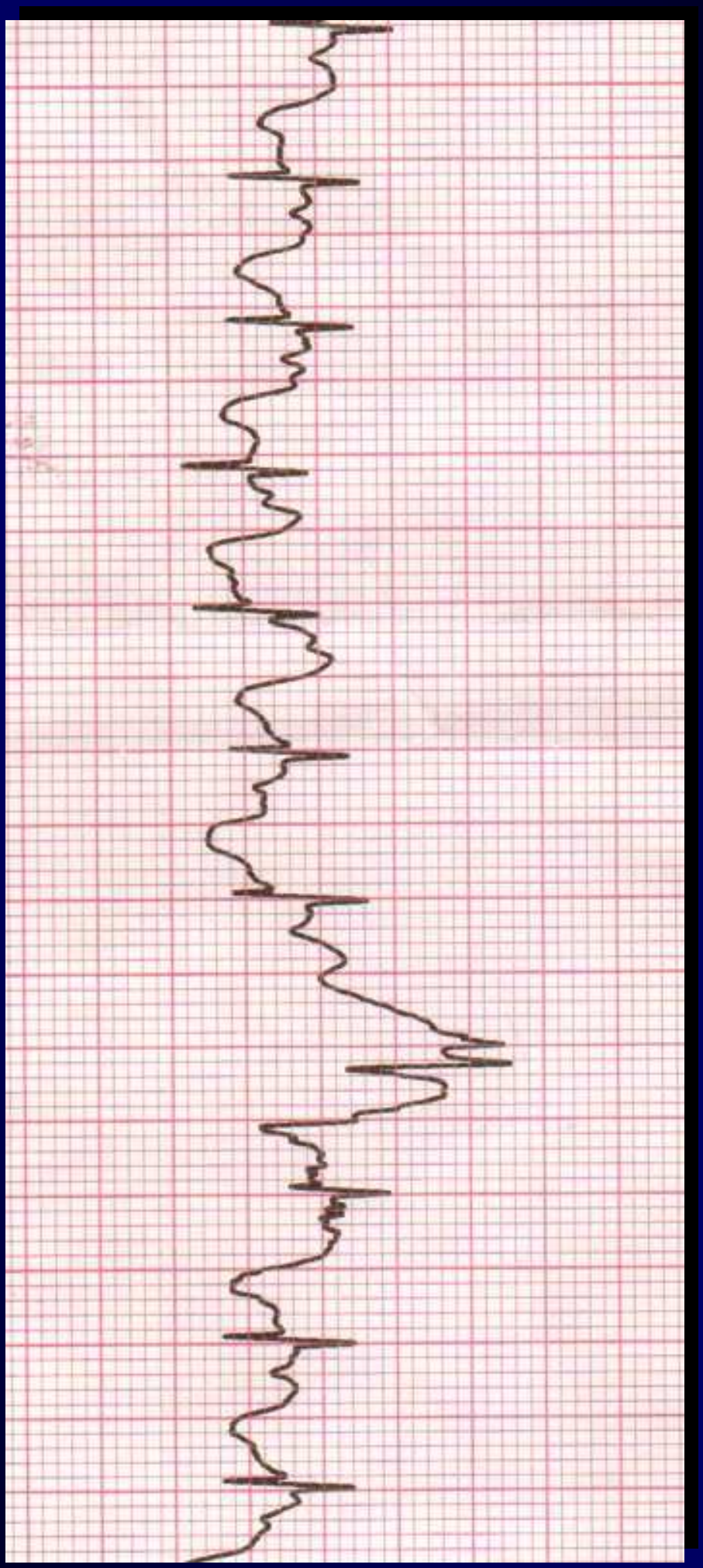
Elevated ST segment in I, L, and V6 with reciprocal depression in II, III, and avF

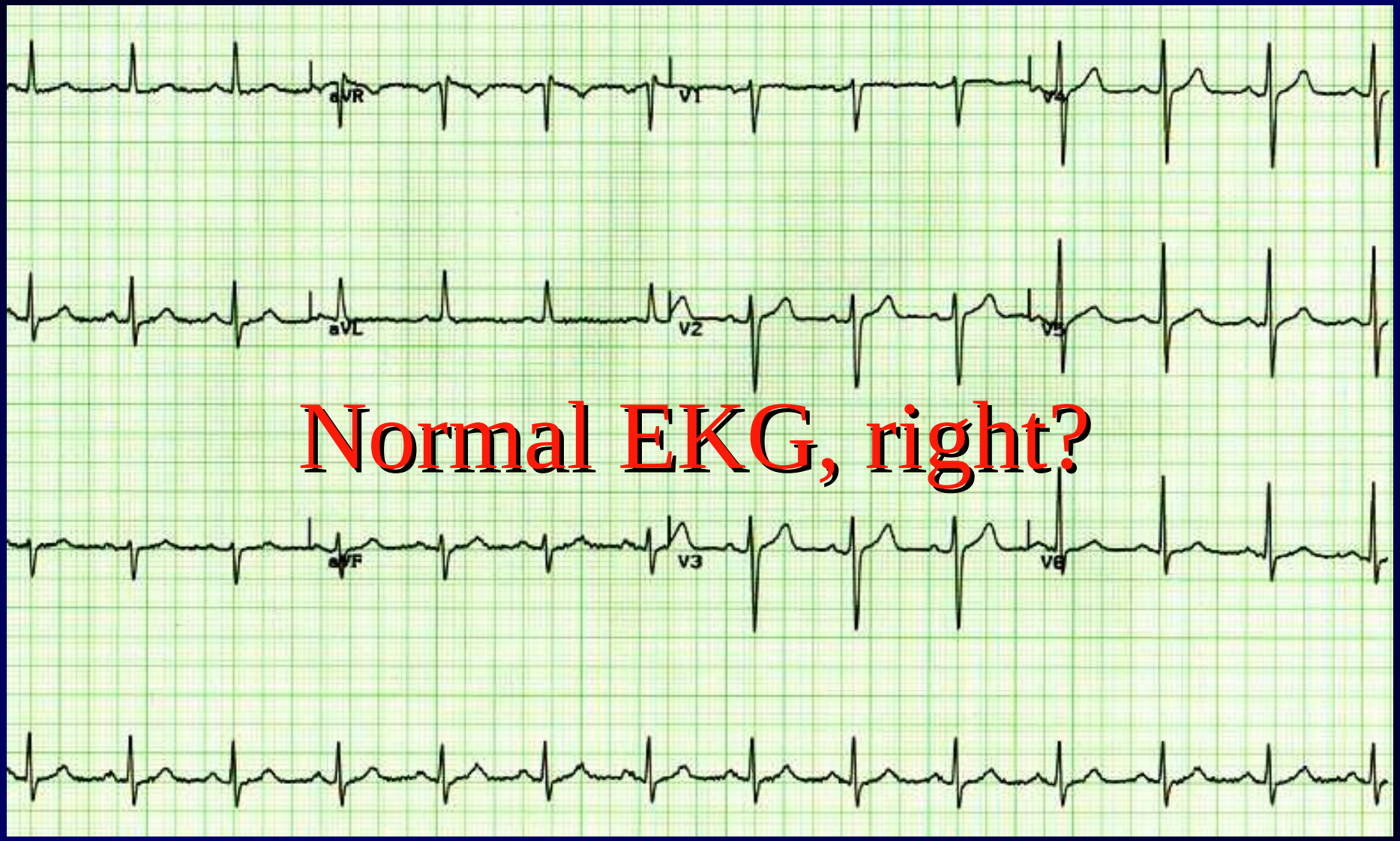
Acute Lateral Wall Myocardial Infarction



Inferior Wall M.I. vs. Lateral Wall M.I.

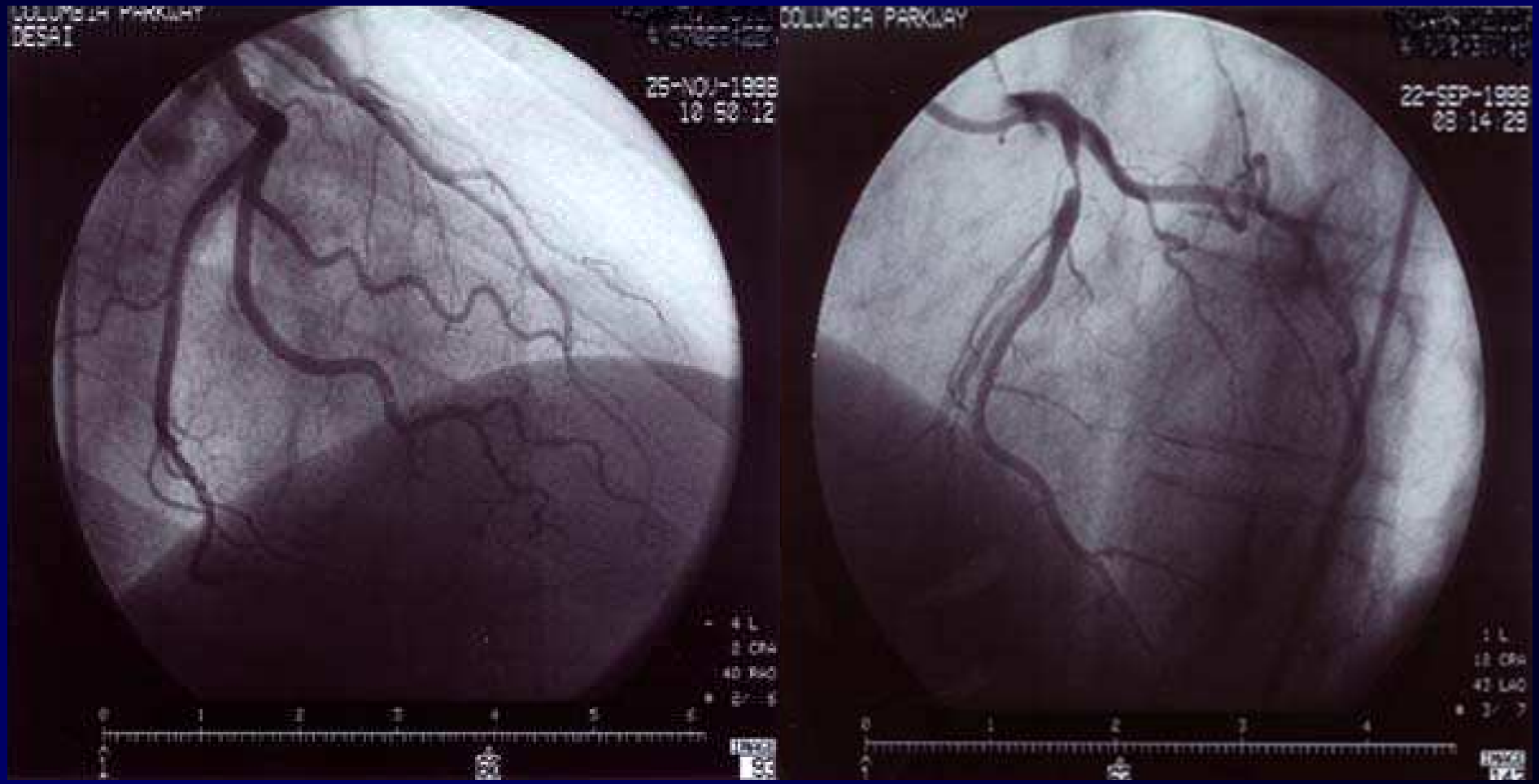




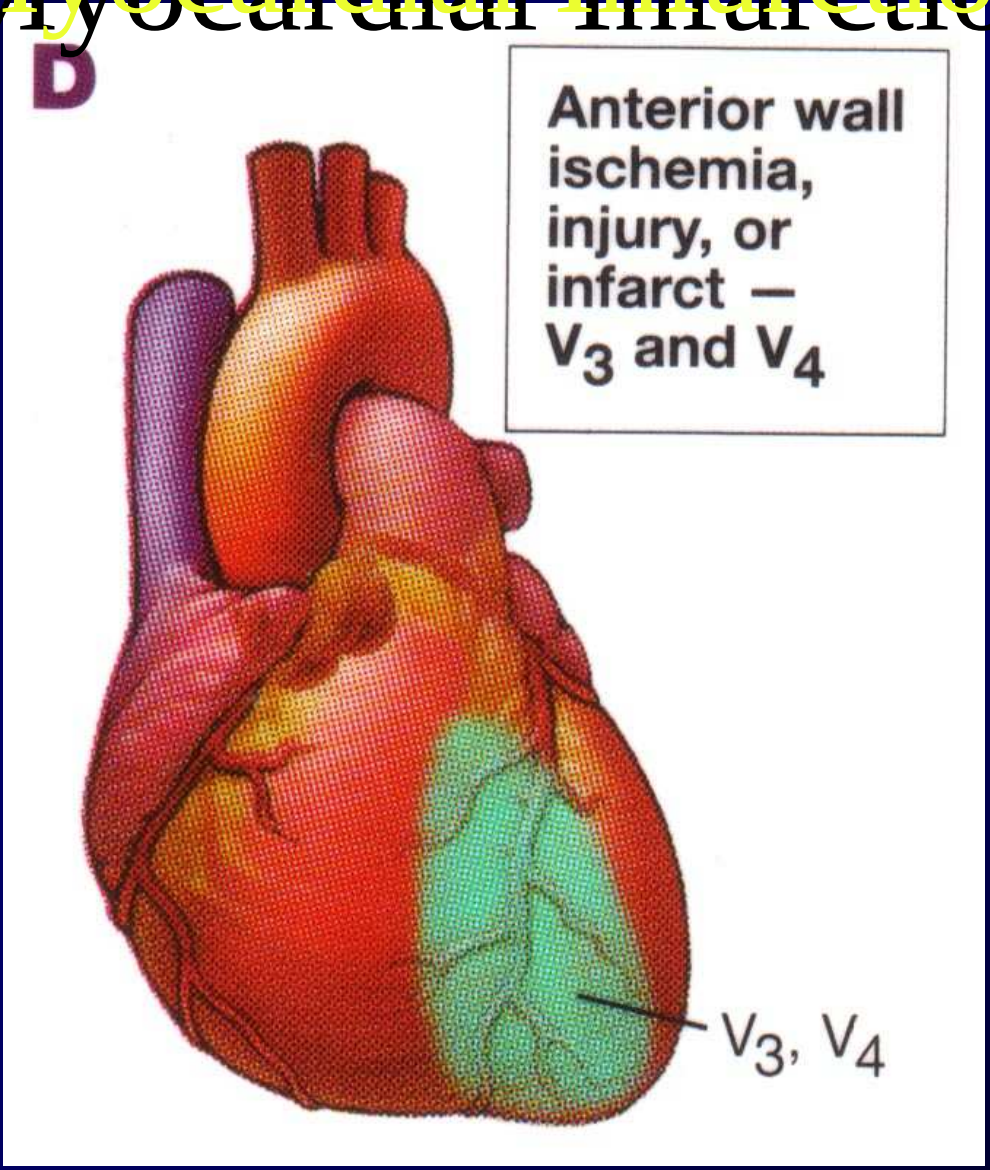

aVR
V1
aVL
V2
aVF
V3
V6
Normal EKG, right?

(HEY, FOWLER,
lighten up and tell ‘em
about the
three-legged pig!)

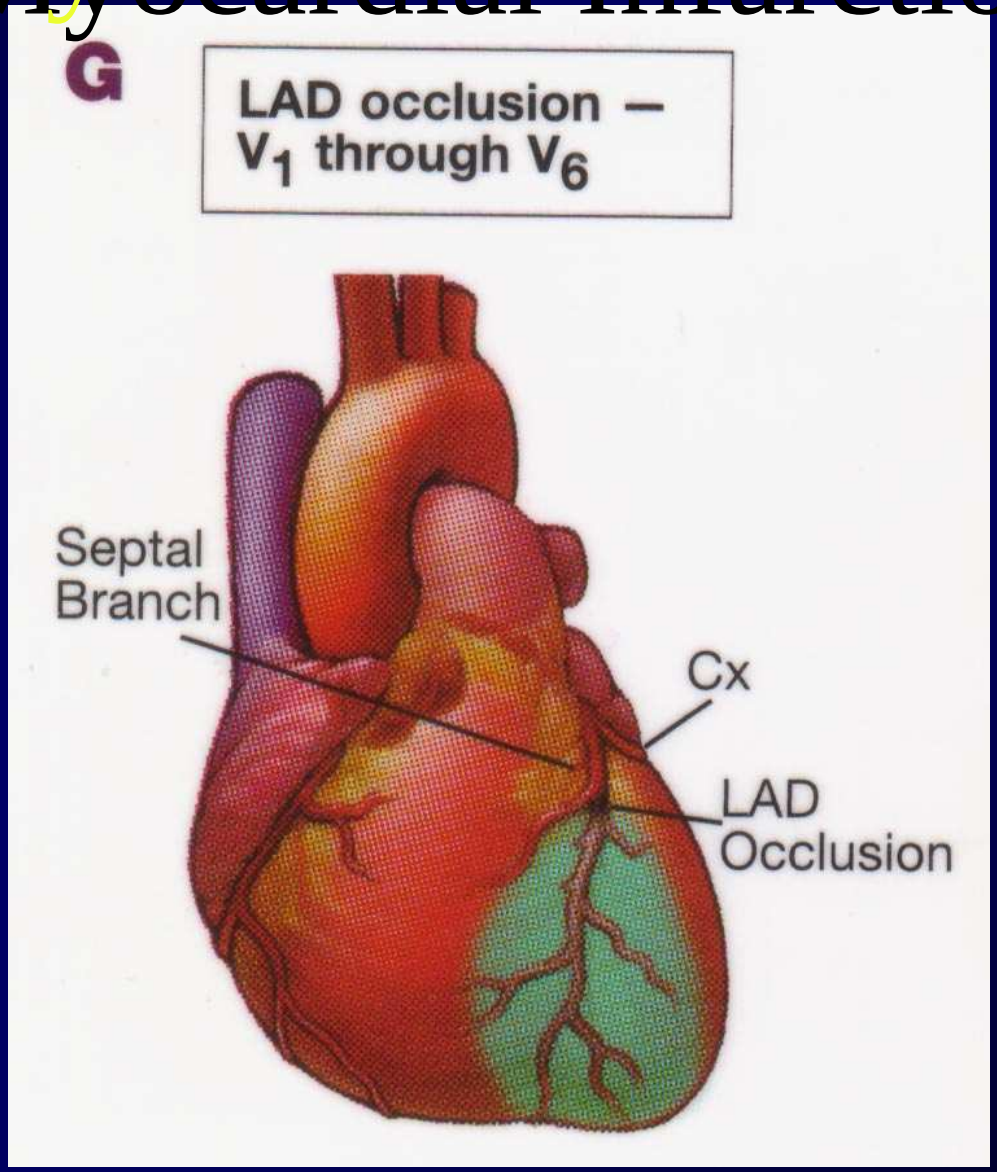
Normal vs. abnormal Left Coronary Artery



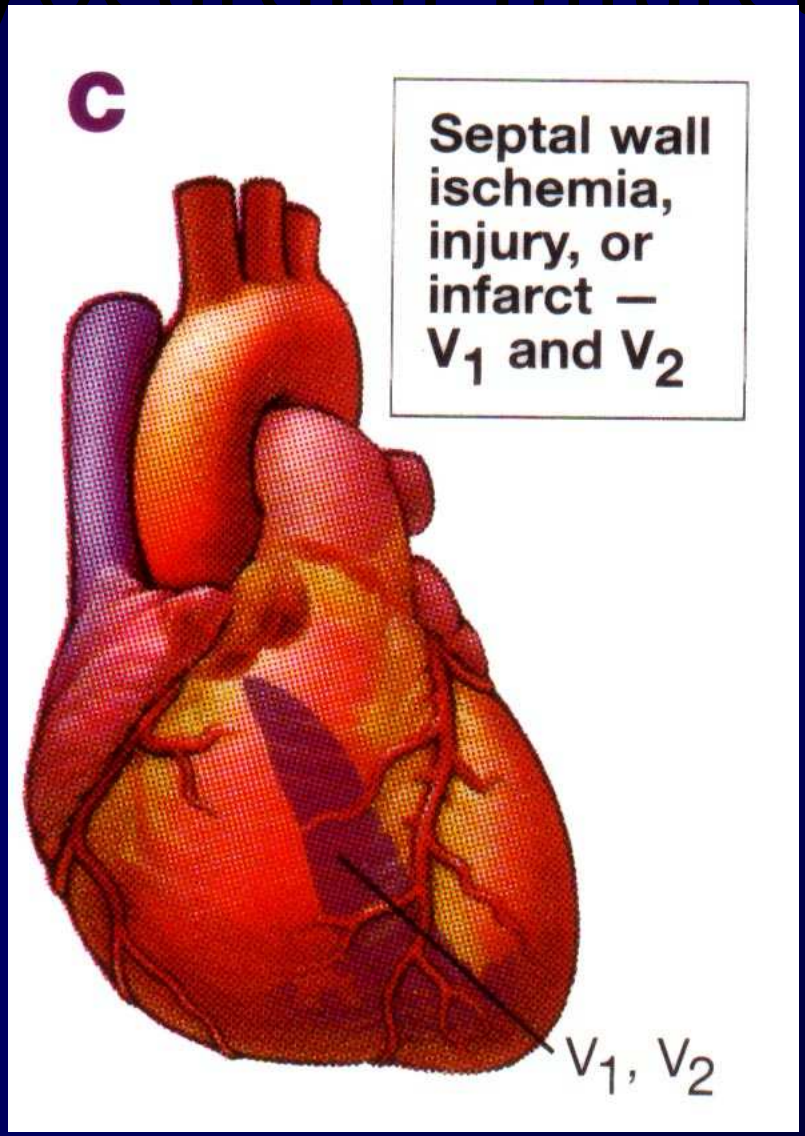
Acute Anterior Wall Myocardial Infarction



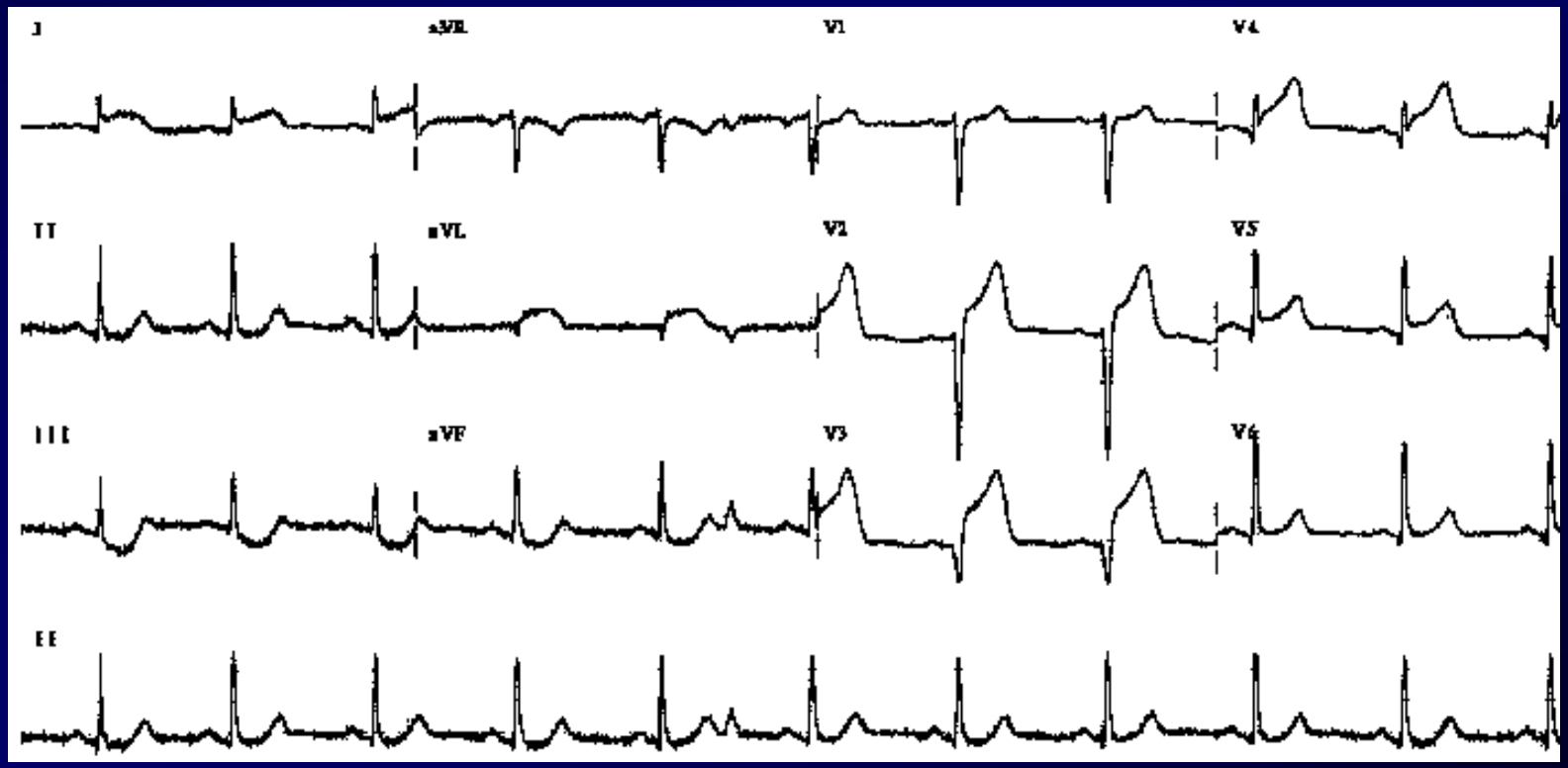
Acute Anterior Wall Myocardial Infarction



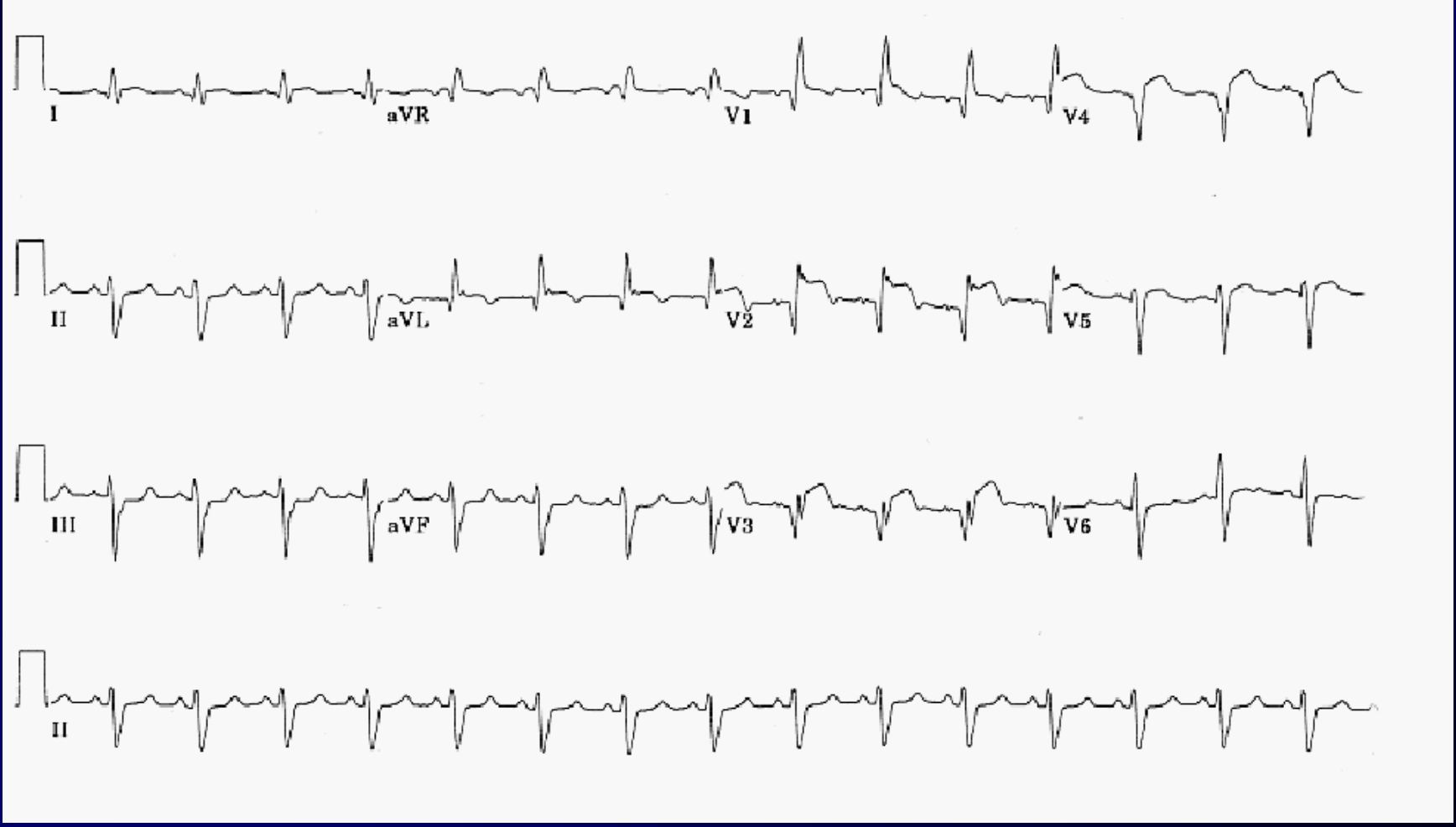
Acute Anterior Wall Myocardial Infarction



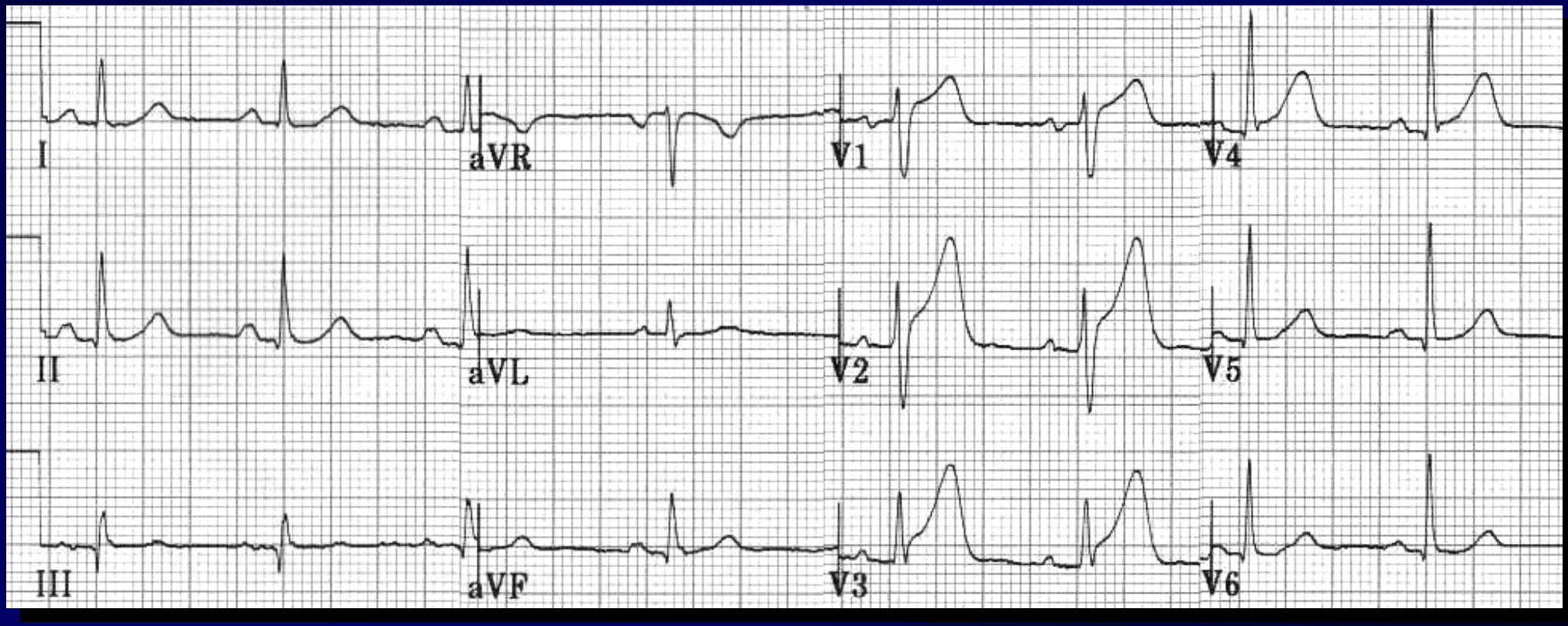
Acute Anterior Wall Myocardial Infarction



Acute Anterior Wall Myocardial Infarction



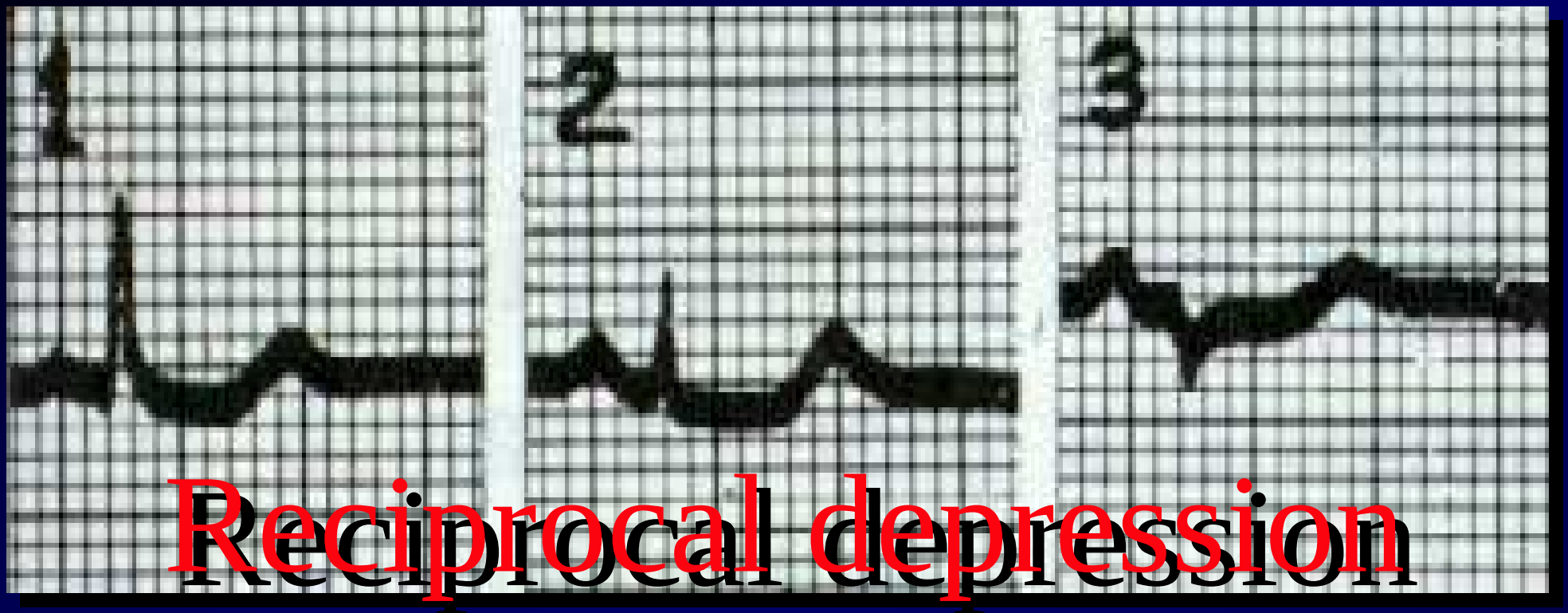
Early Repolarization Pattern



Okay, smarty pants:

What exactly
would leads I, II, and III
show in the case
of an
anterior (LAD) infarction?

HMMMMM????

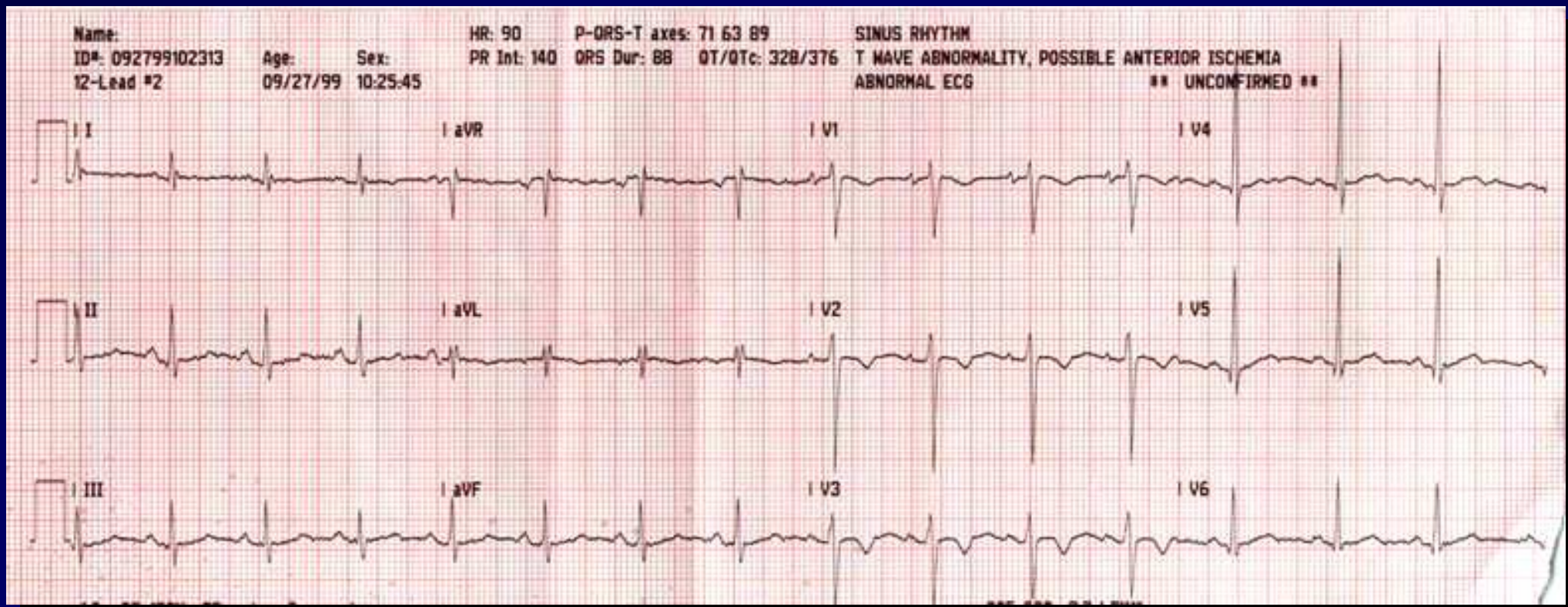


Reciprocal depression

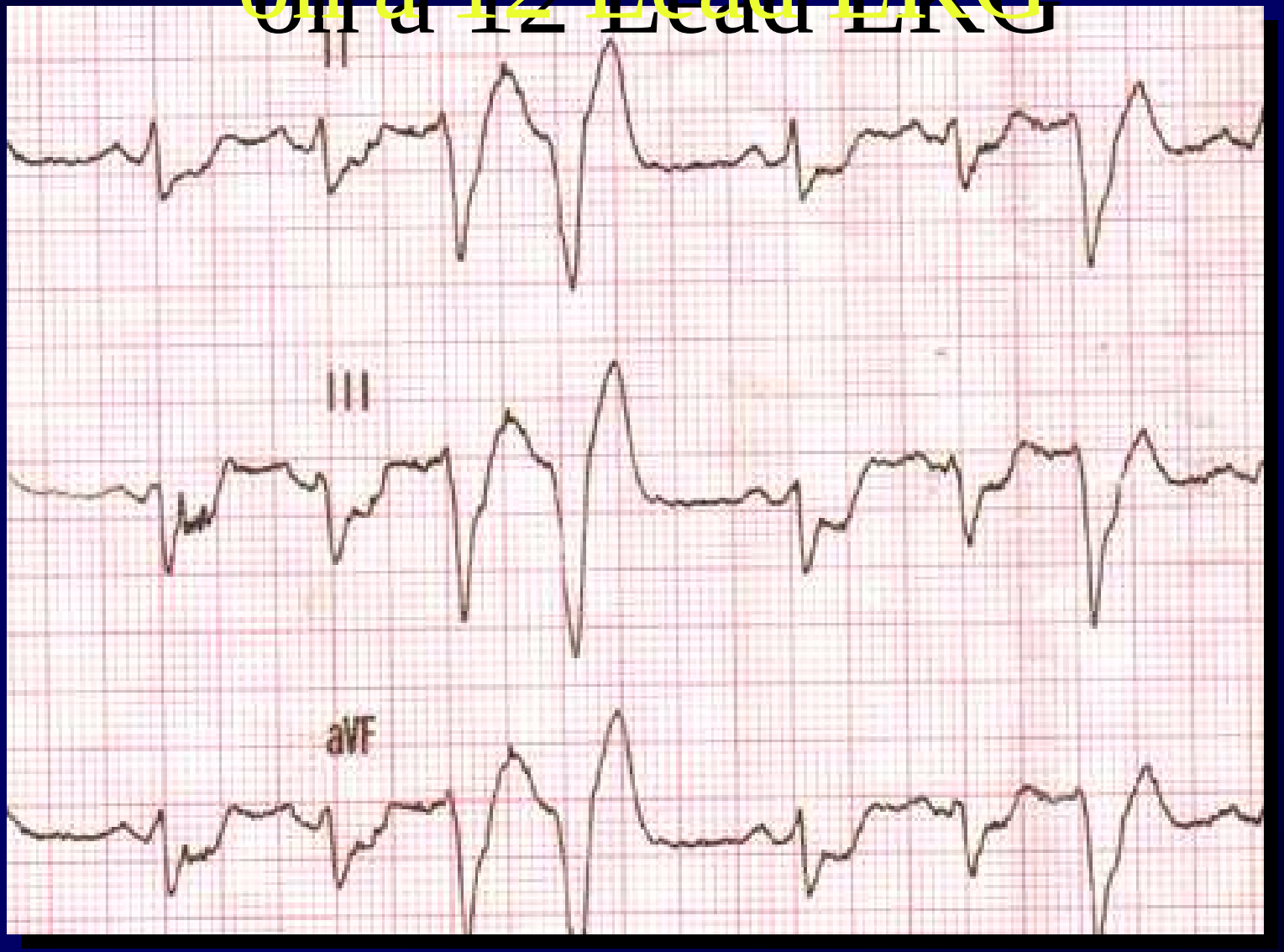
in all three leads!!

All three leads are on the other side of the heart from the infarction!

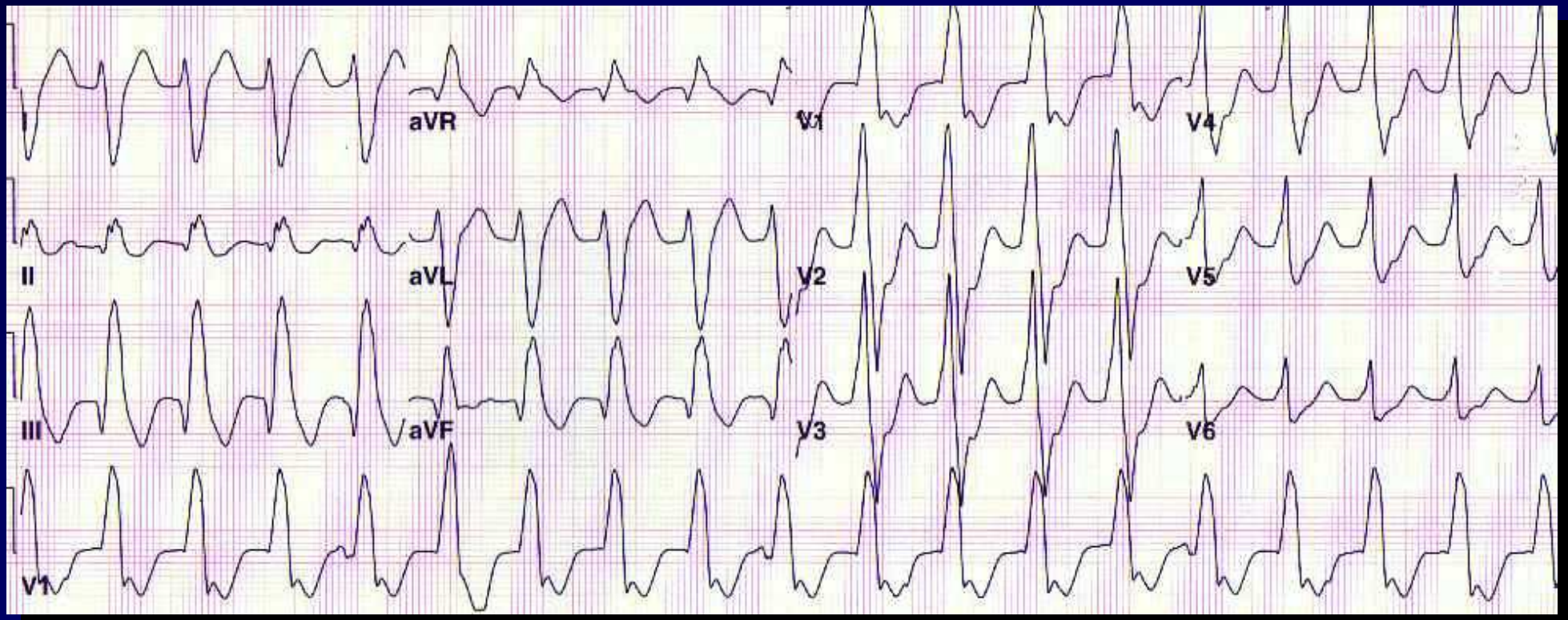
Having a 12 lead machine around to keep an eye on the tracings is a good idea sometimes....



Monitoring For Ectopy on a 12 Lead EKG

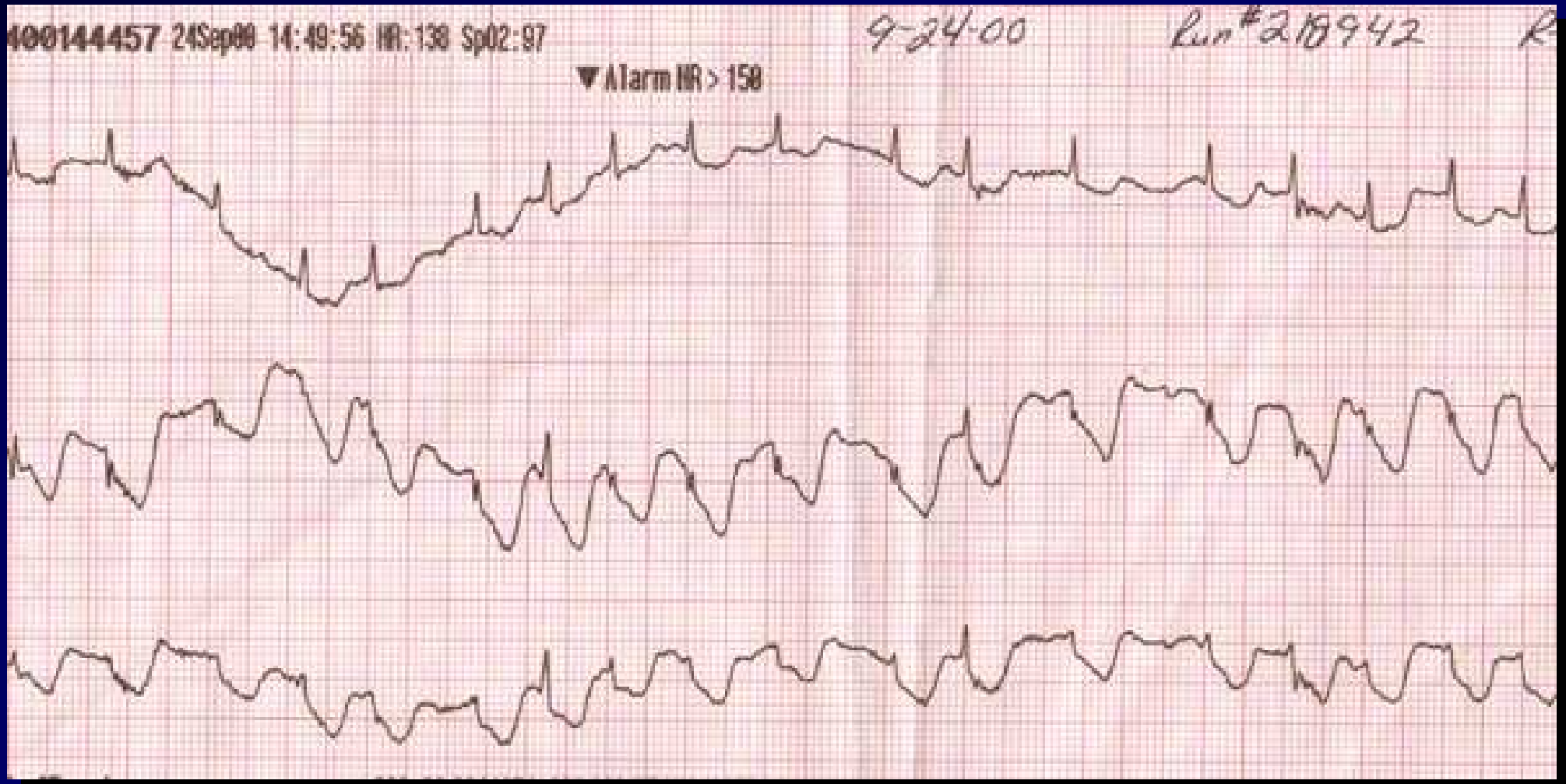


Sometimes the tracings can be quite hard to interpret

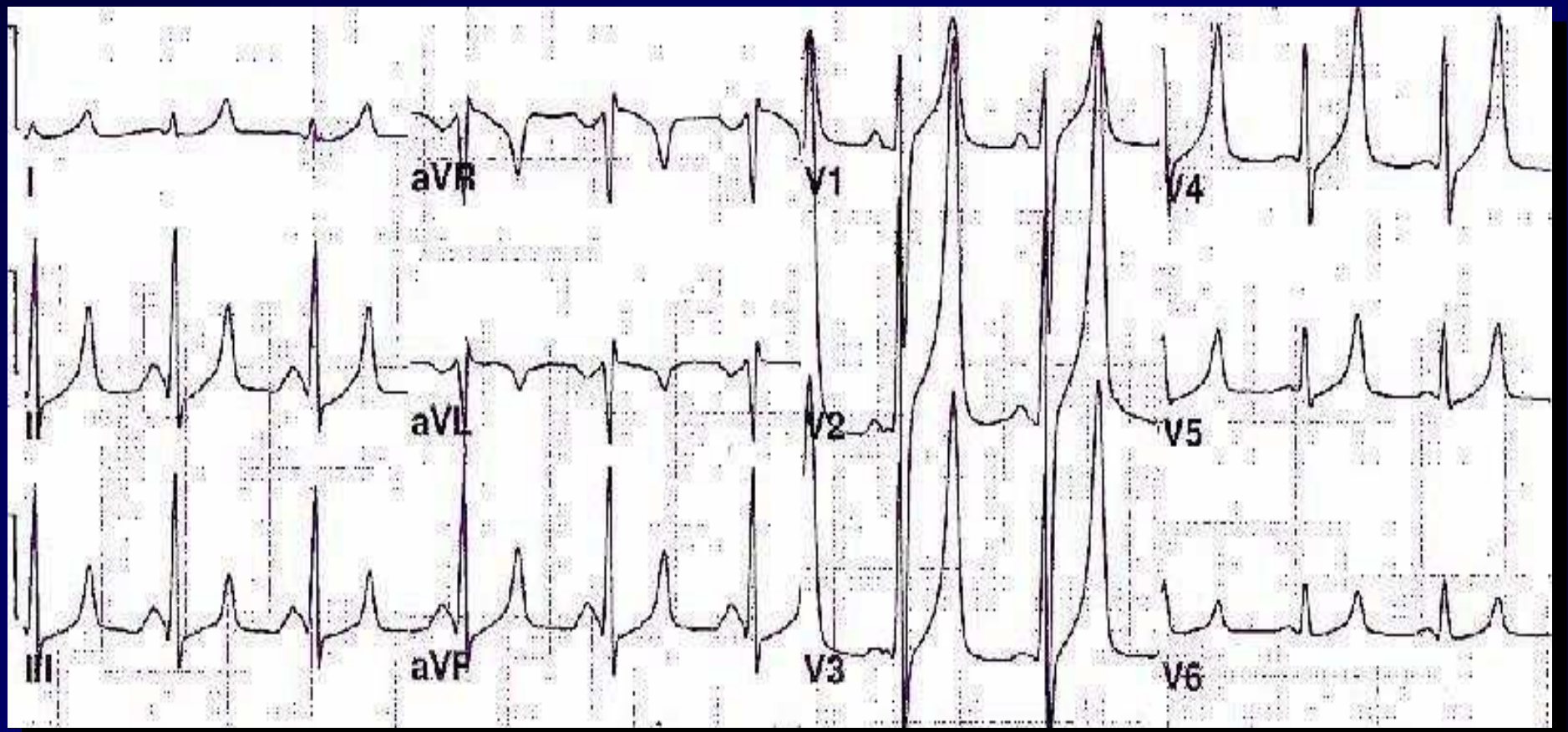


….and sometimes almost worthless....

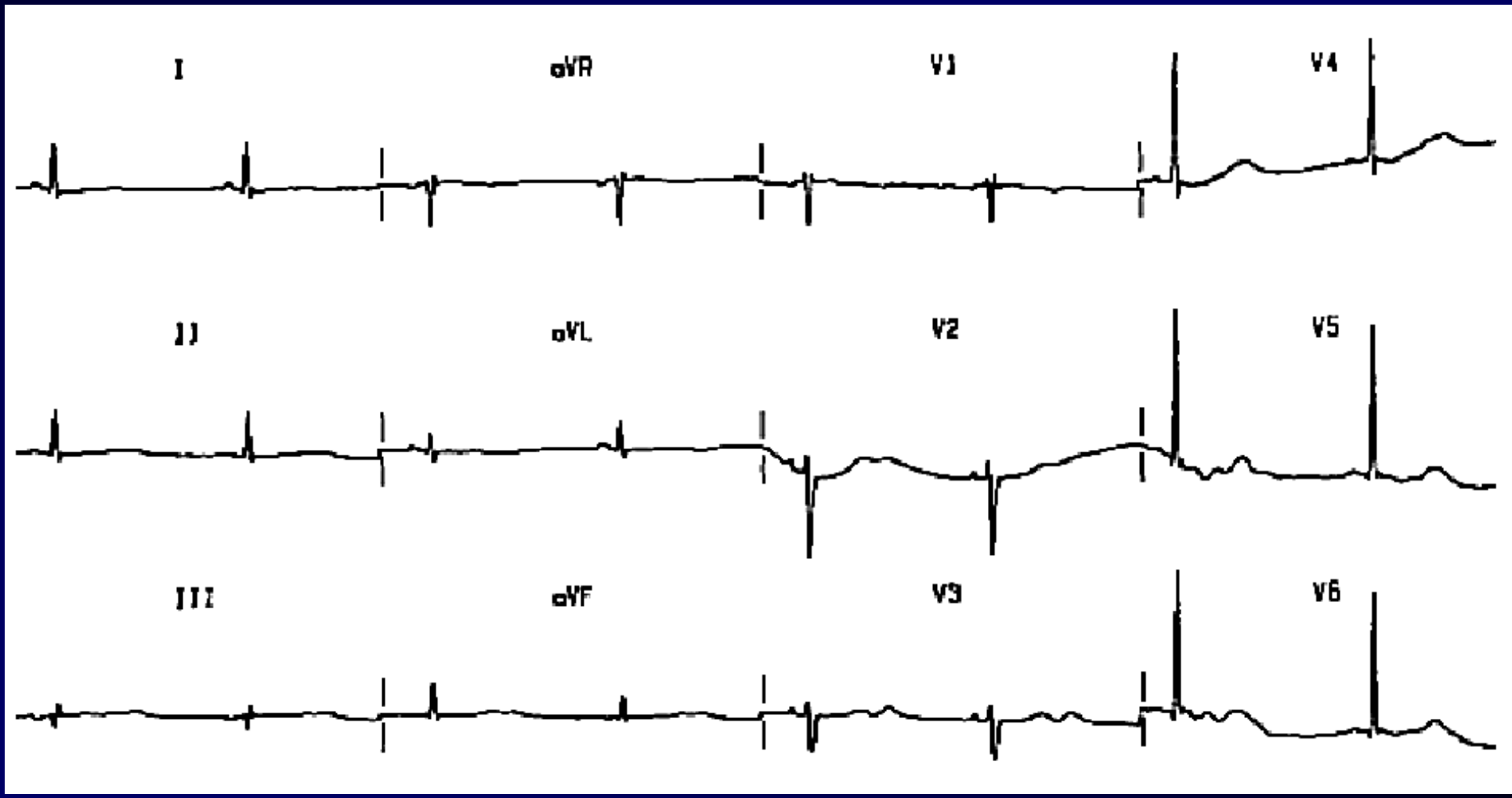
….sometimes VERY interesting....

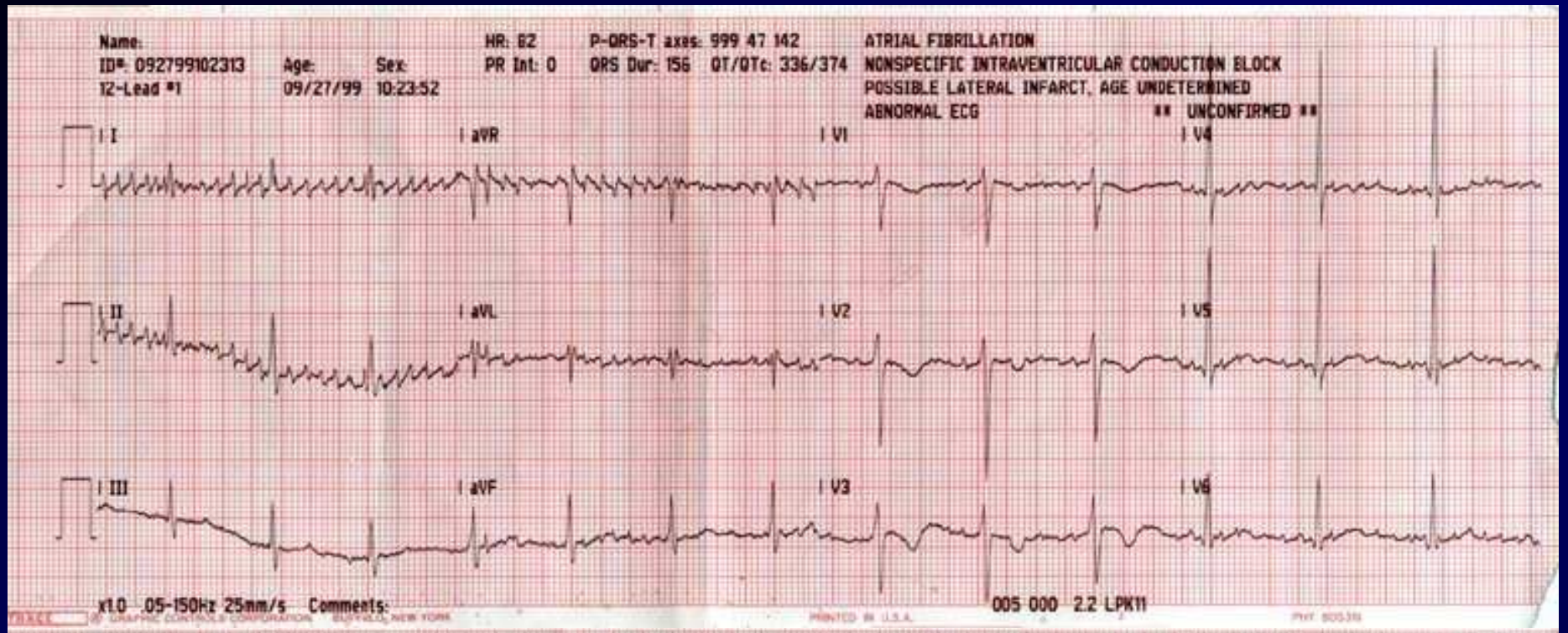


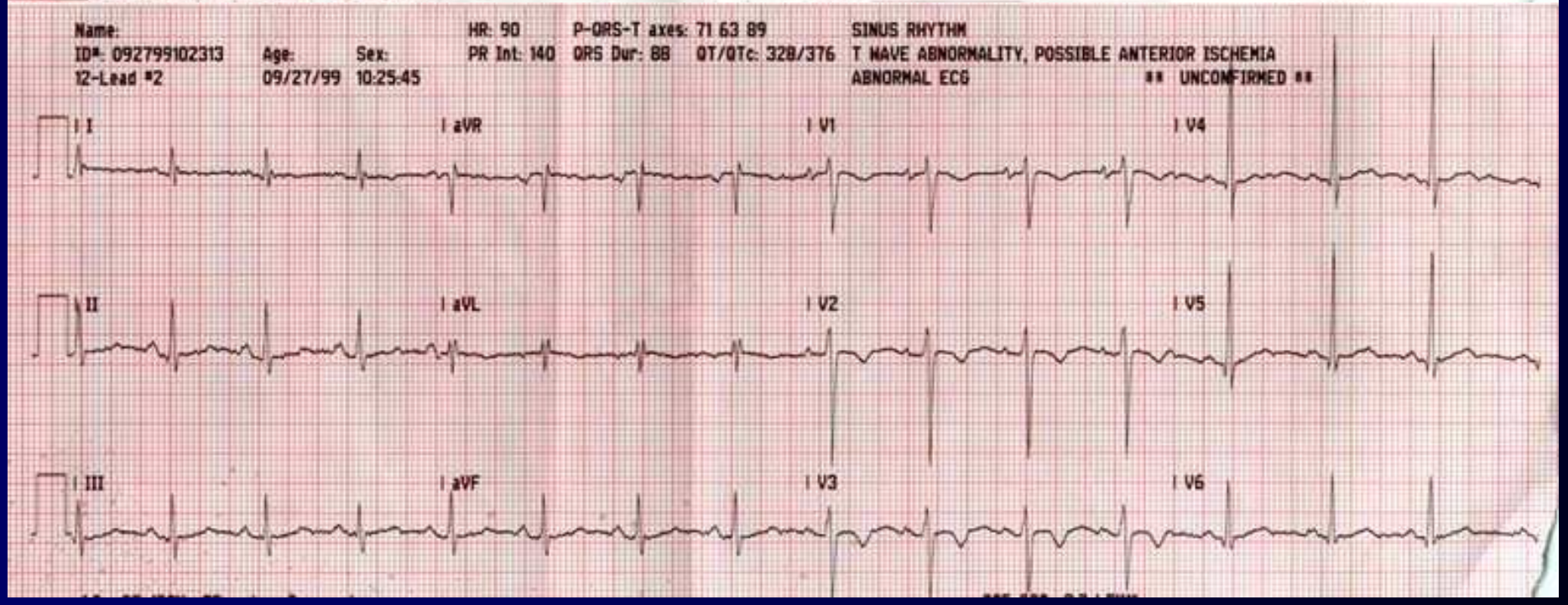
Acute Hyperkalemia



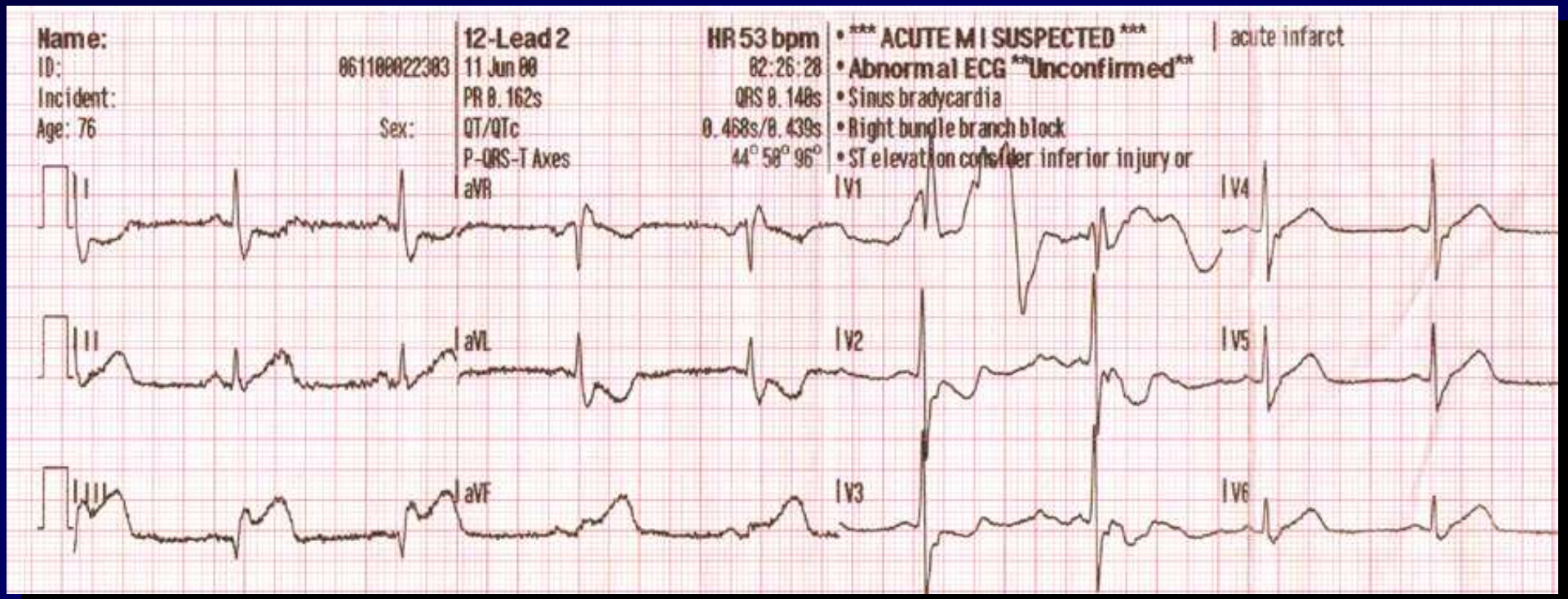
Acute Hypokalemia




Name:
ID#: 092799102313
12-Lead #1
Age:
09/27/99
Sex:
10:23:52
HR: 62
PR Int: 0
P-QRS-T axes: 999 47 142
QRS Dur: 156
QT/QTc: 336/374
ATRIAL FIBRILLATION
NONSPECIFIC INTRAVENTRICULAR CONDUCTION BLOCK
POSSIBLE LATERAL INFARCT, AGE UNDETERMINED
ABNORMAL ECG
** UNCONFIRMED **
I I
I aVR
I V1
I V4
II
I aVL
I V2
I V5
III
I aVF
I V3
I V6
x1.0 05-150Hz 25mm/s Comments:
005 000 2.2 LPK11


Name:
ID#: 092799102313
12-Lead #2
Age:
09/27/99
Sex:
10:25:45
HR: 90
PR Int: 140
P-QRS-T axes: 71 63 89
QRS Dur: 88
QT/QTc: 328/376
SINUS RHYTHM
T WAVE ABNORMALITY, POSSIBLE ANTERIOR ISCHEMIA
ABNORMAL ECG
** UNCONFIRMED **
I I
I aVR
I V1
I V4
II
I aVL
I V2
I V5
III
I aVF
I V3
I V6

….but sometimes the machine can be RIGHT!!!



00001 02-Mar-1999 11:56:06 AM test, HQ J & J EMS SERVICES UNLIMITED

50 Years Male 145 lbs Blood Pressure: 100/60

Rate	71
PR	164
QRSD	136
QT	345
QTc	375

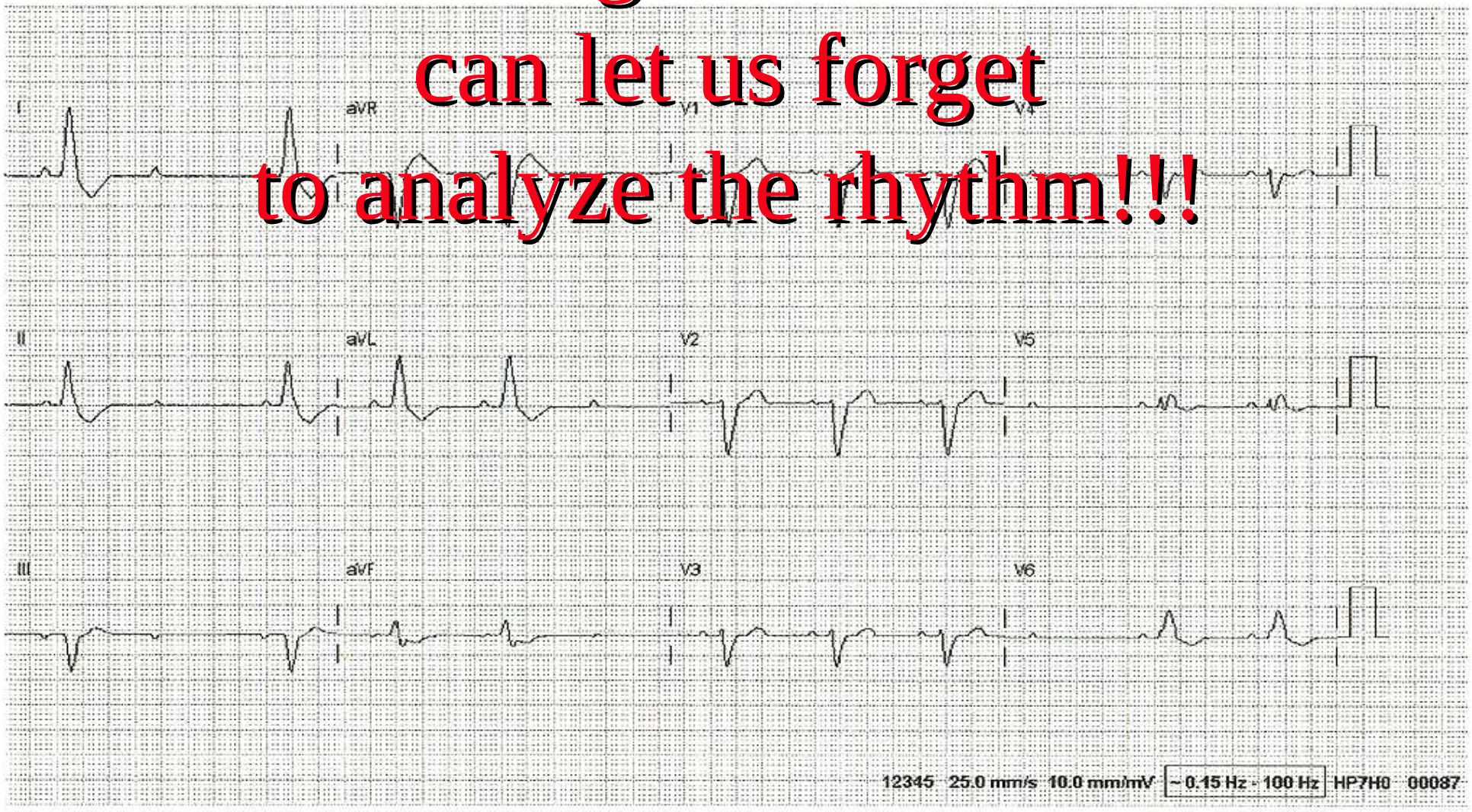
. Patient's ECG DOES NOT meet ST criteria for acute MI or ECG DOES NOT meet inclusion criteria for TPI analysis.
. ... QRS duration detected is > 130 ms
. ... LBBB Detected
. Time since acute ischemic symptom: 20 Min.; Hx: Diabetes, Hypertension

smoker
y

Requested by:

Axis	
P	-2
QRS	3
T	193

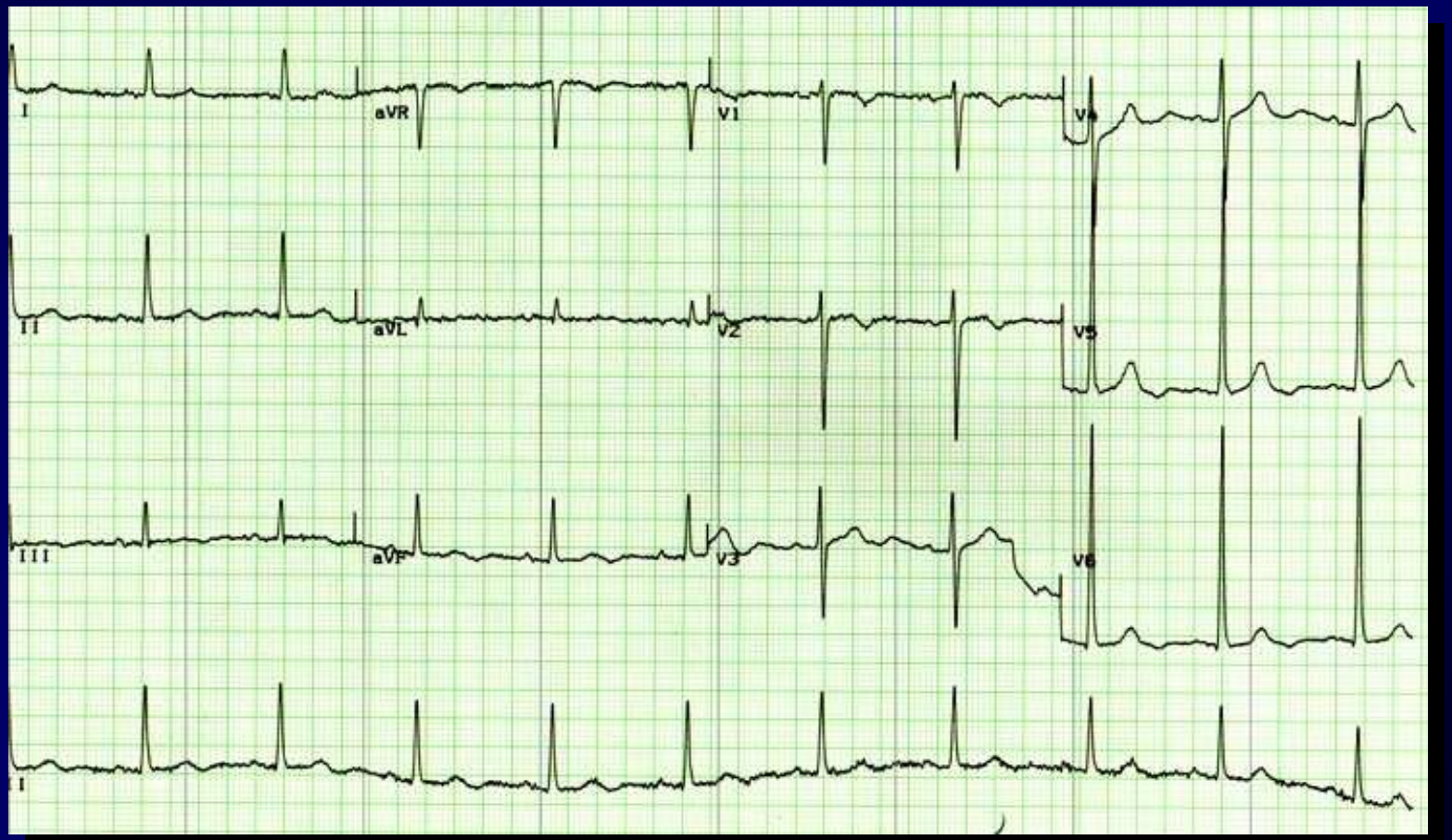
Don't forget that 12 leads can let us forget to analyze the rhythm!!!



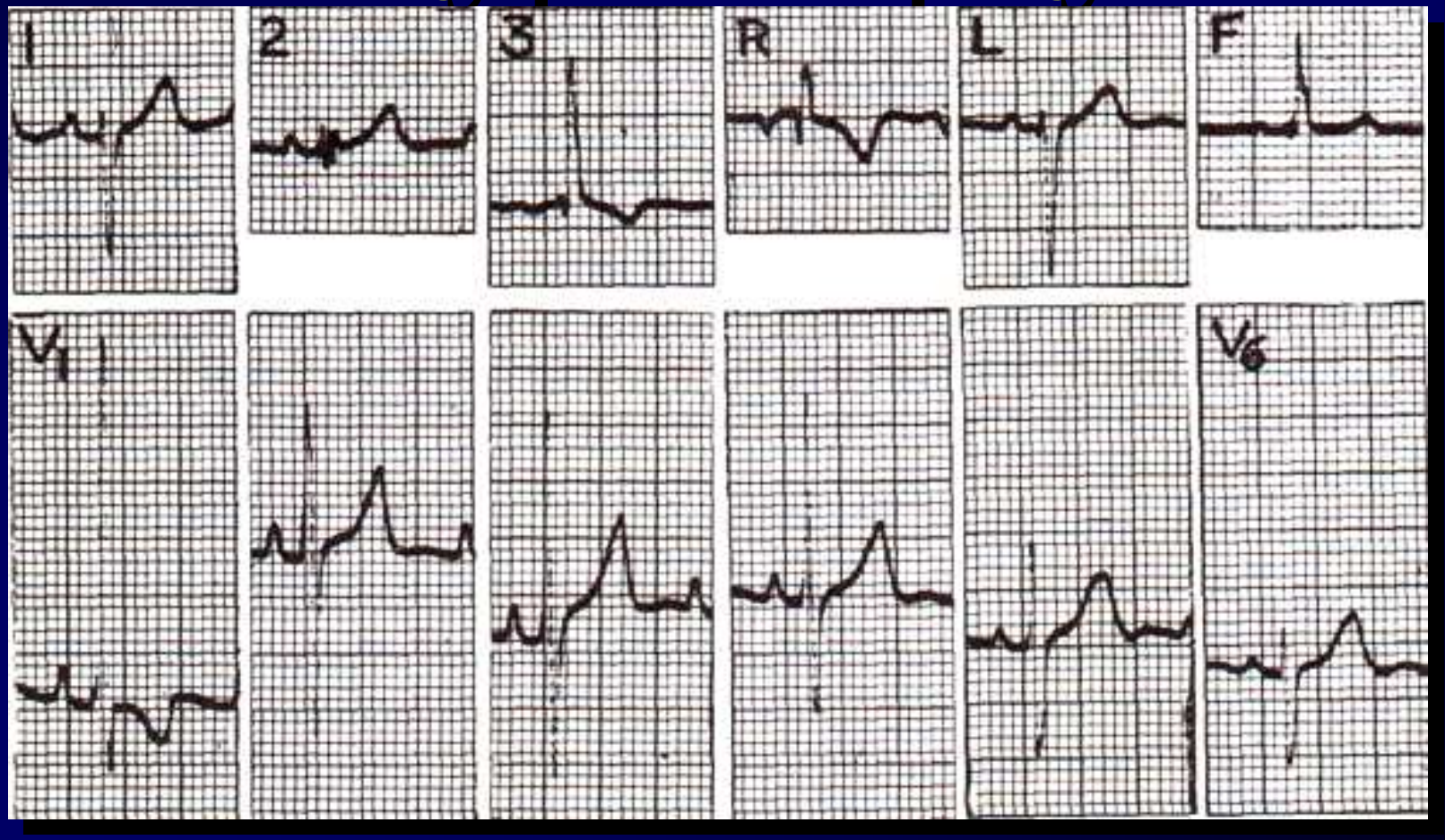
Ventricular Hypertrophy

Enlargement of ventricles

Left Ventricular Hypertrophy



Right Ventricular Hypertrophy



Finding Ventricular Hypertrophy

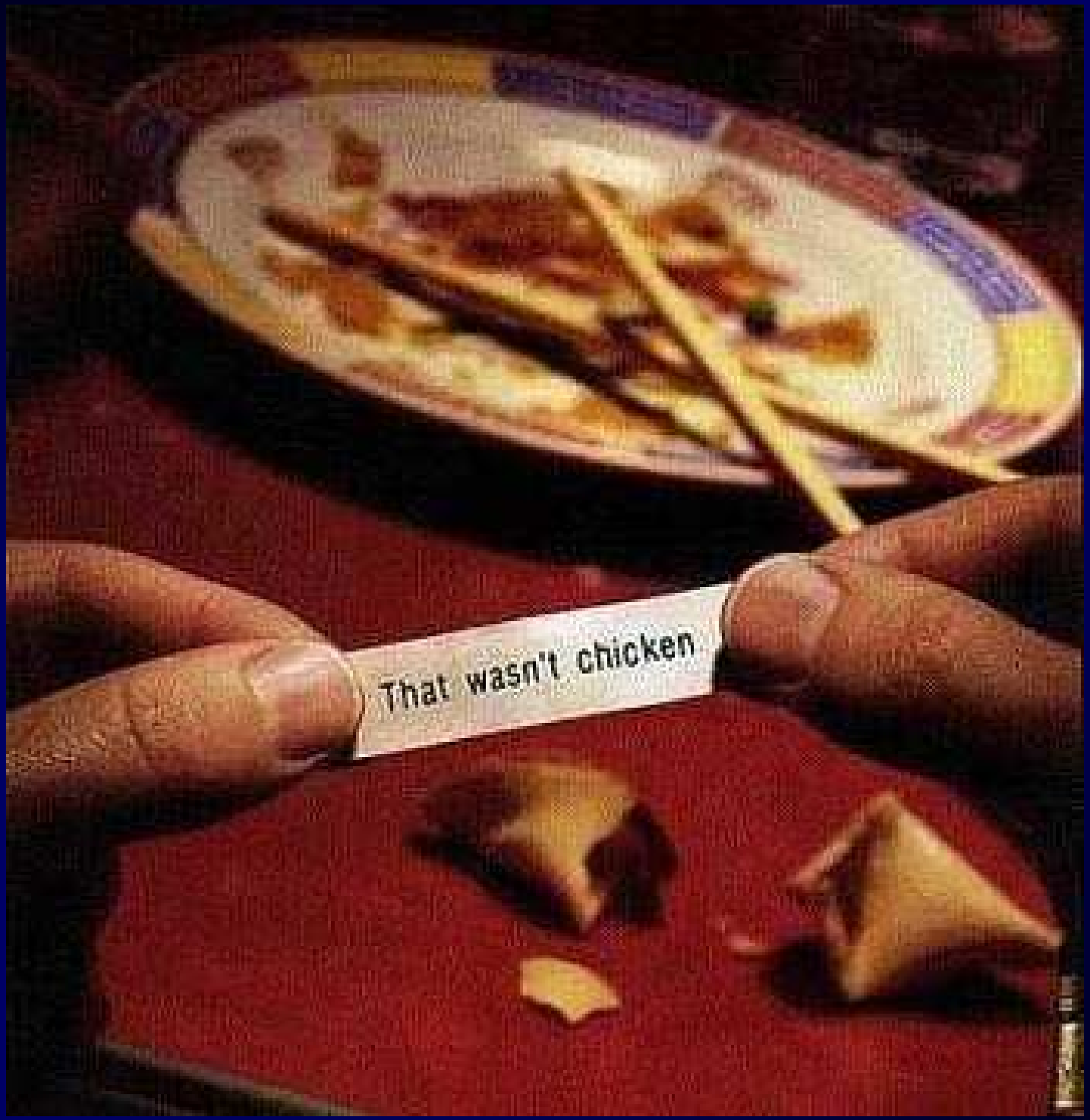
Always look at V1

Finding Ventricular Hypertrophy

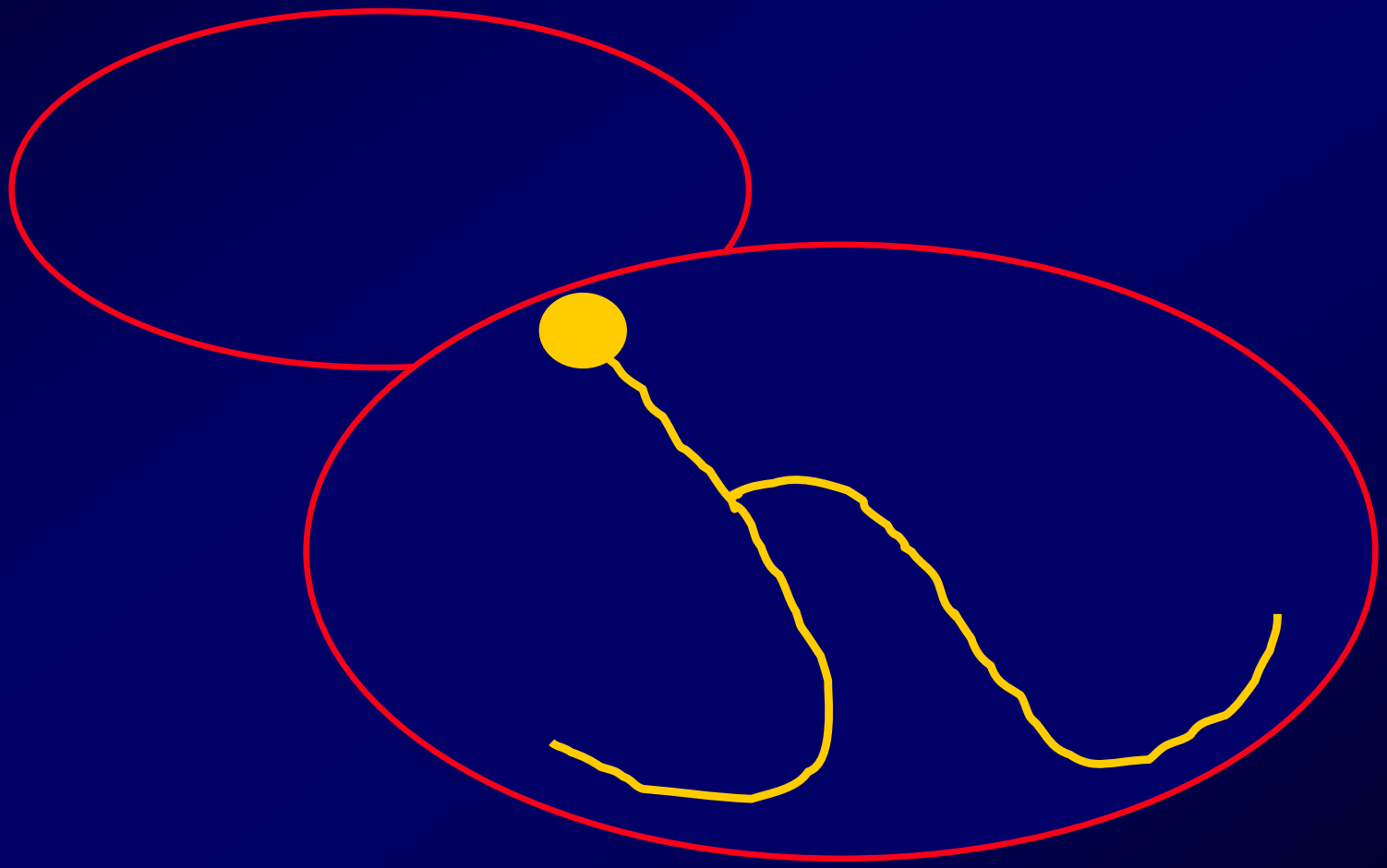
Large R wave in V1 = RVH

Deep S wave in V1 = LVH

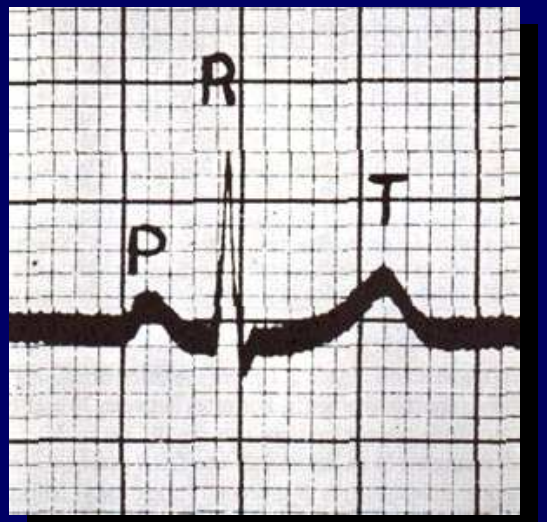
Corollary: If the complex is wider than 0.12 seconds, this is probably a bundle branch block and not ventricular hypertrophy

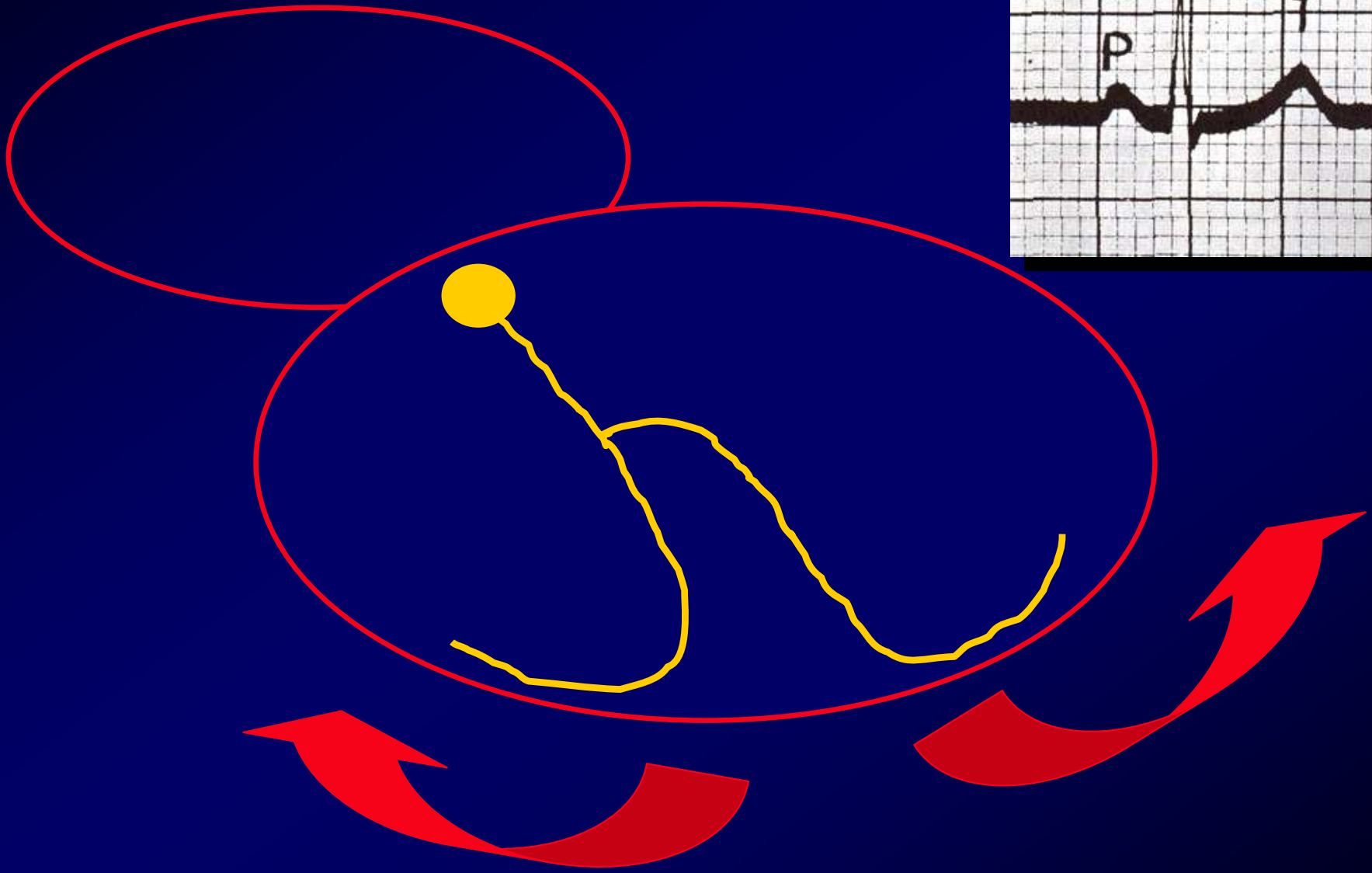

That wasn't chicken

Bundle Branch Block

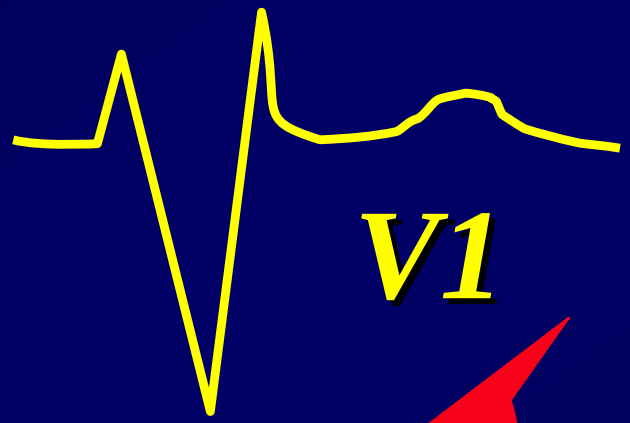


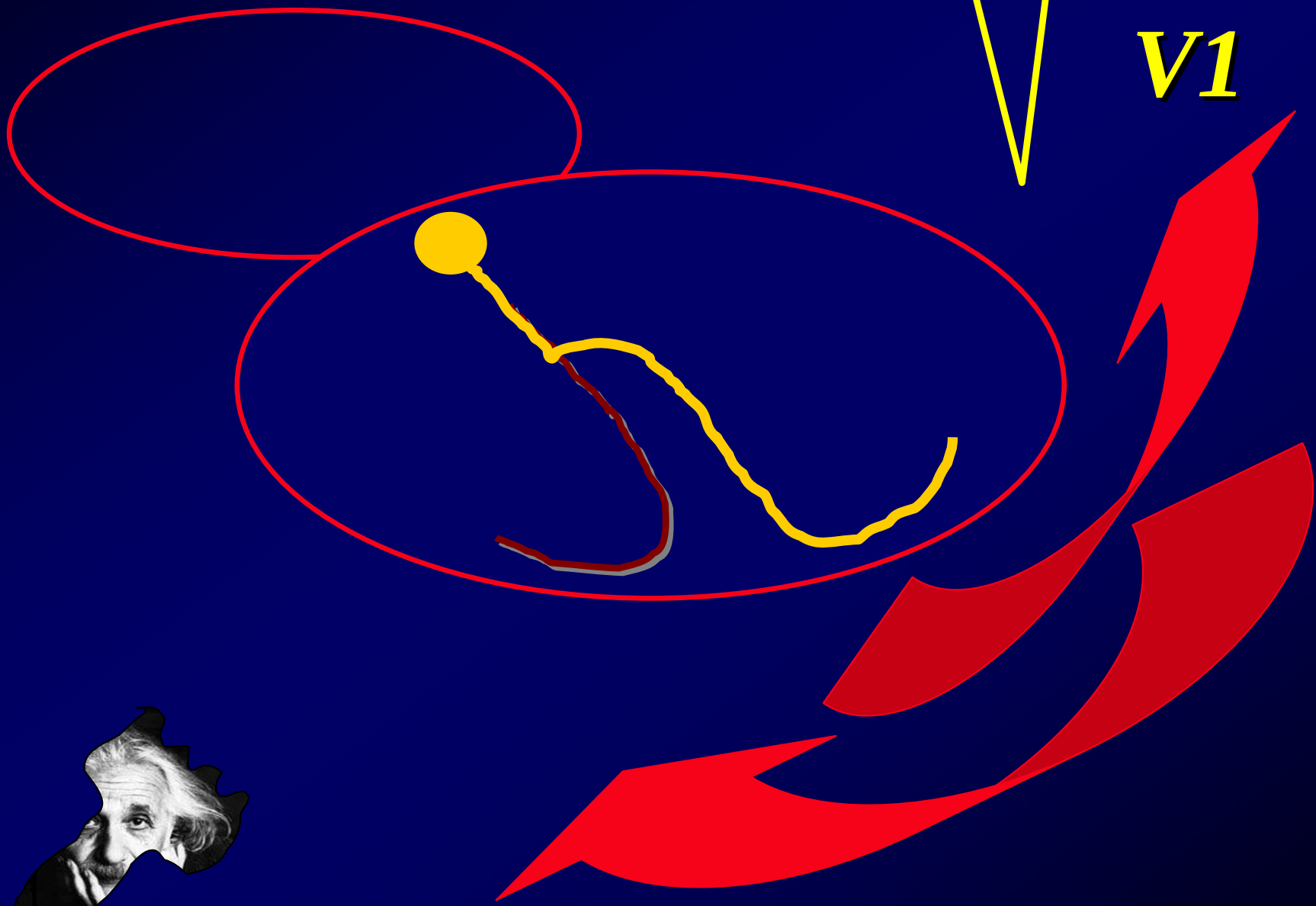
Normal Conduction

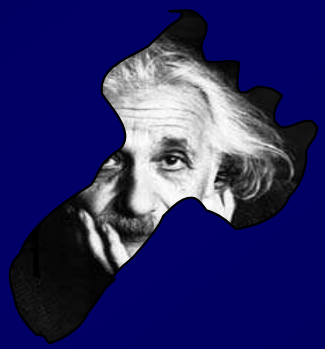




Right Bundle Branch Block



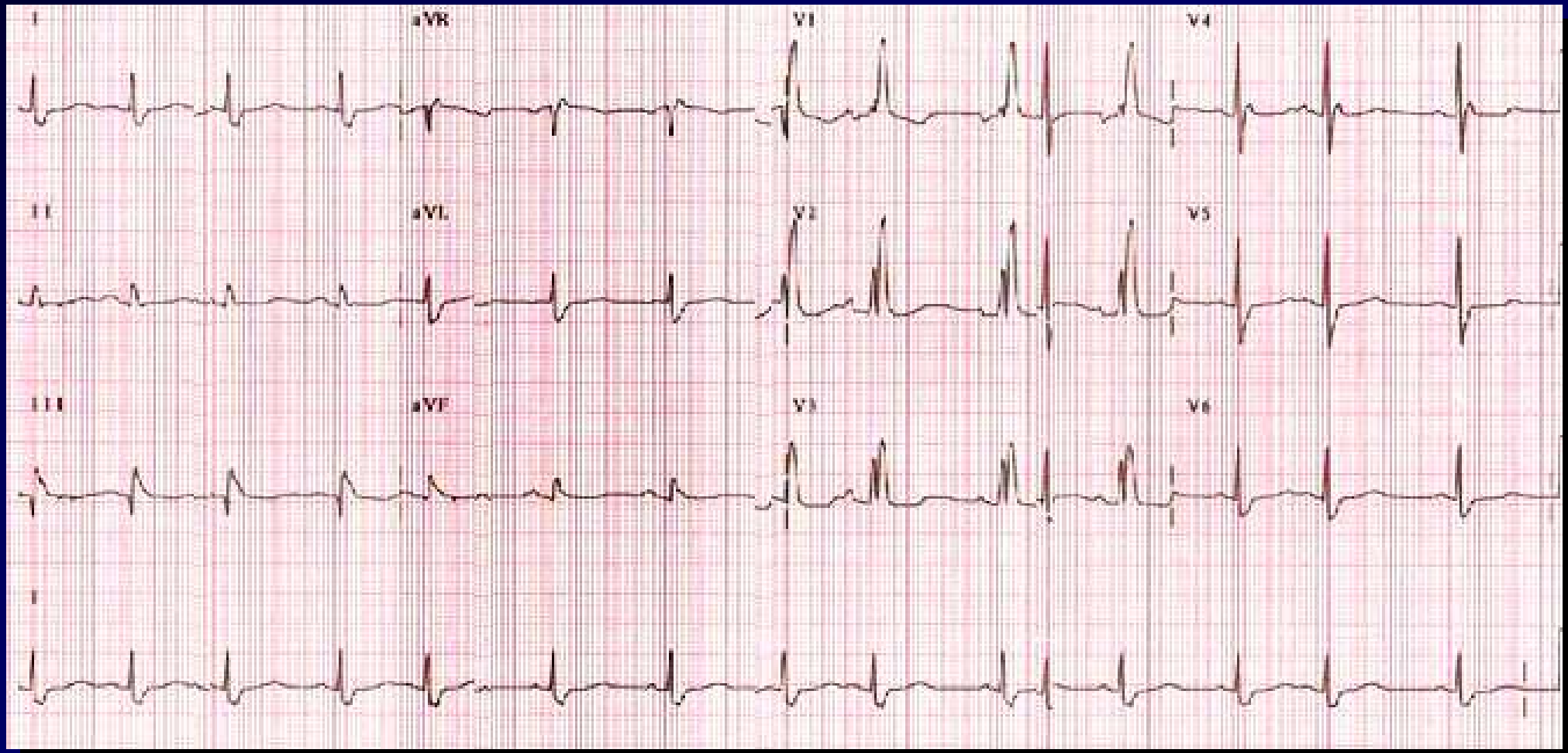




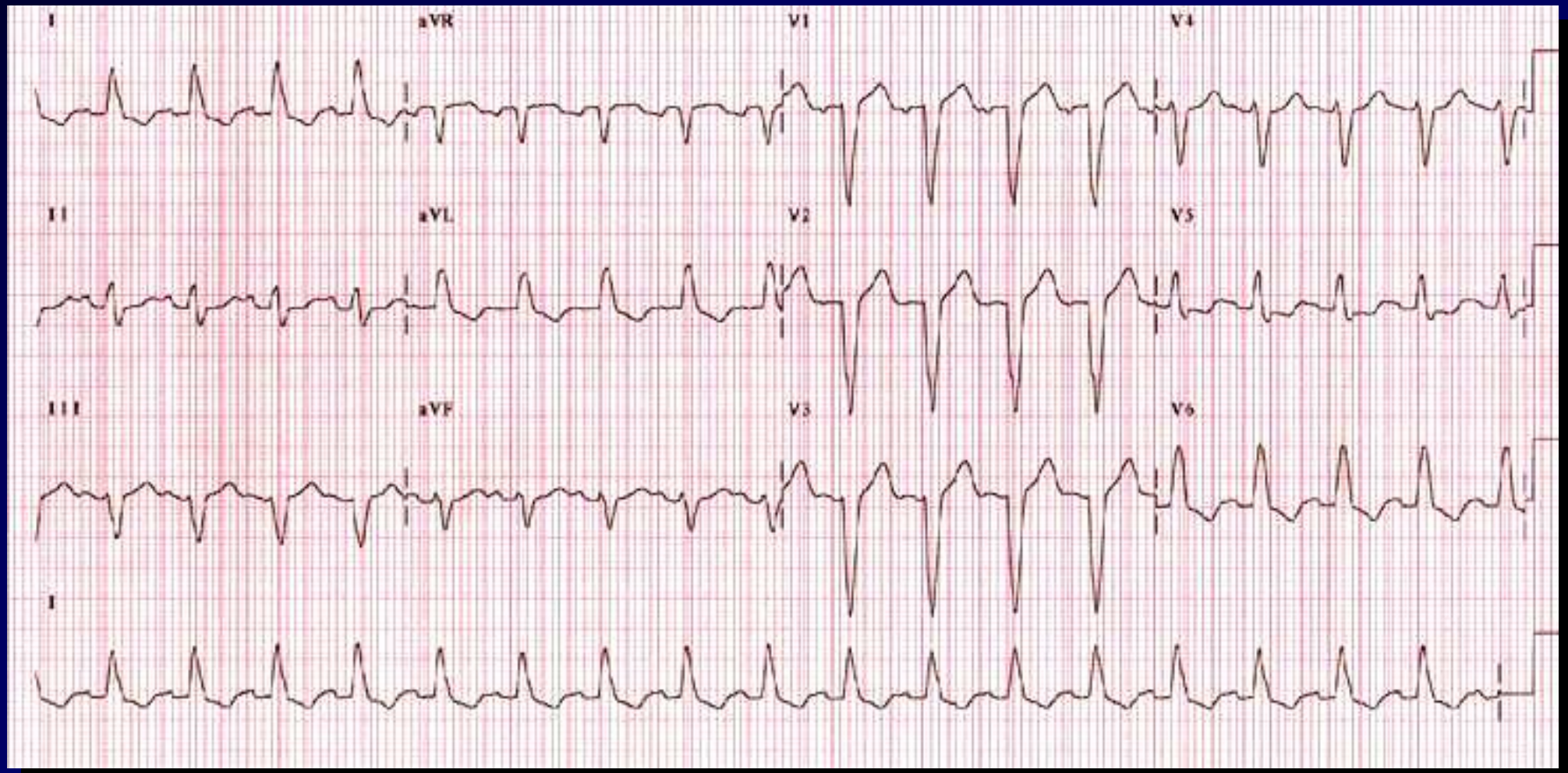
Bundle Branch Block

Positive Deflection Rabbit Ears in V1 with wide complex	Positive Deflection in V6 with wide complex
Right Bundle Branch Block	Left Bundle Branch Block

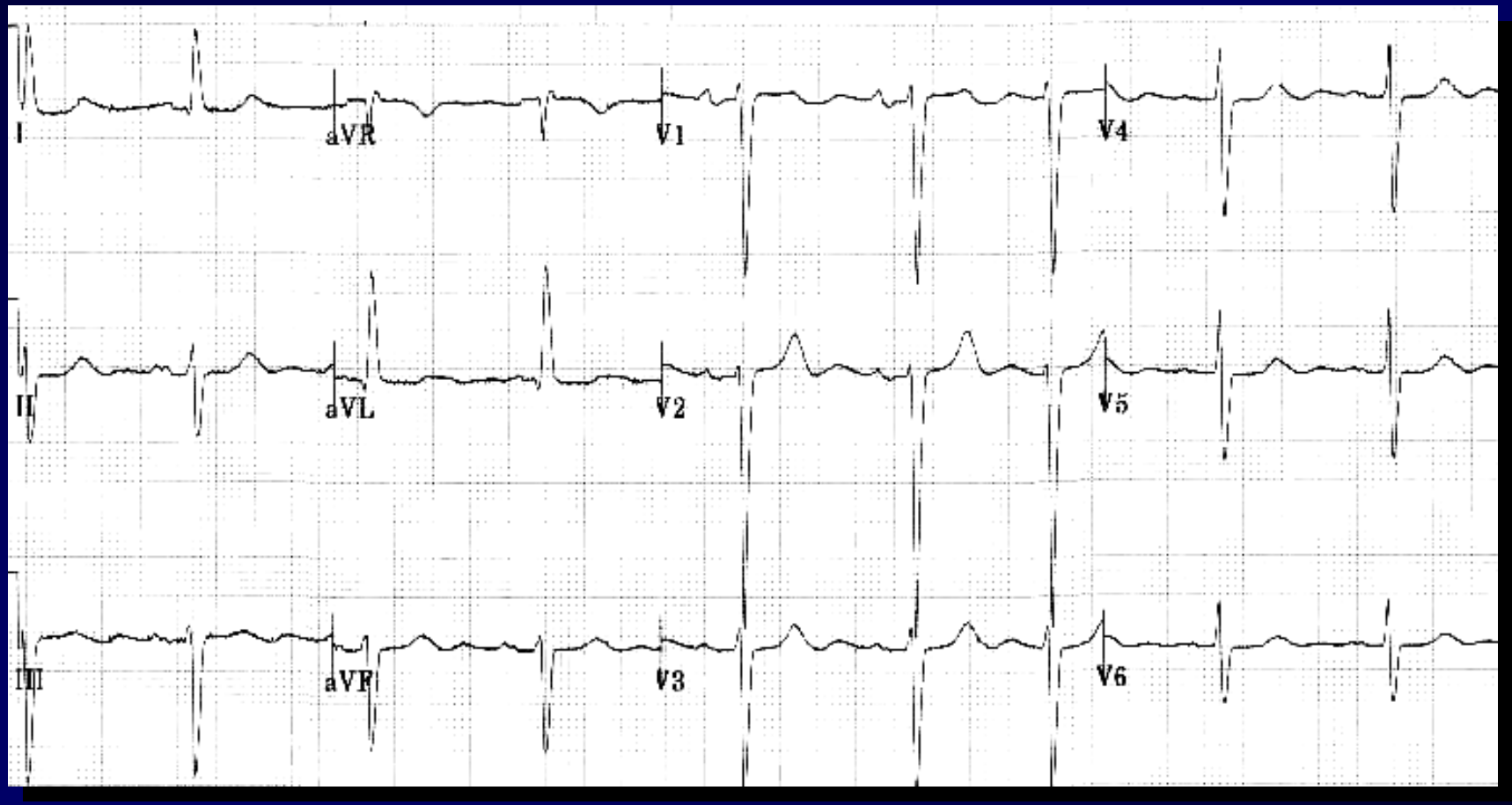
Right Bundle Branch Block



Left Bundle Branch Block

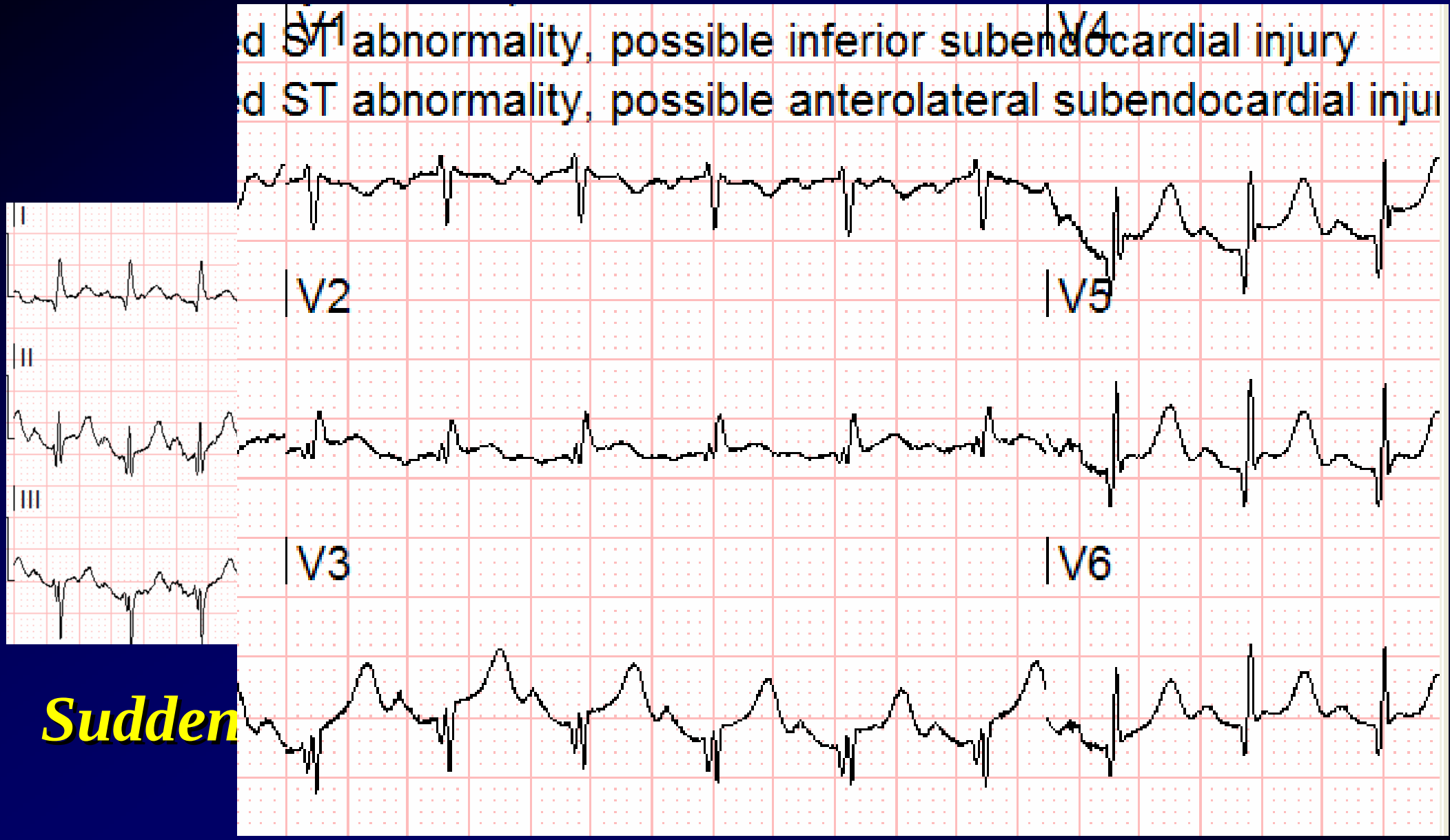


Left Anterior Hemiblock

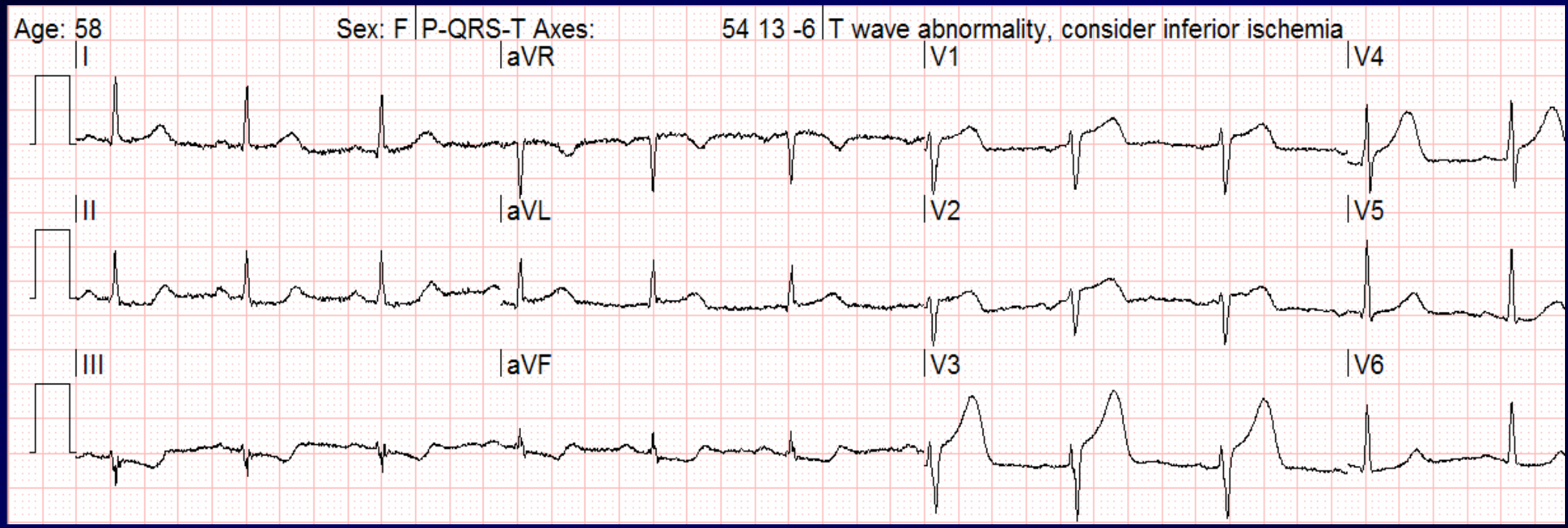


Now, kiddies…

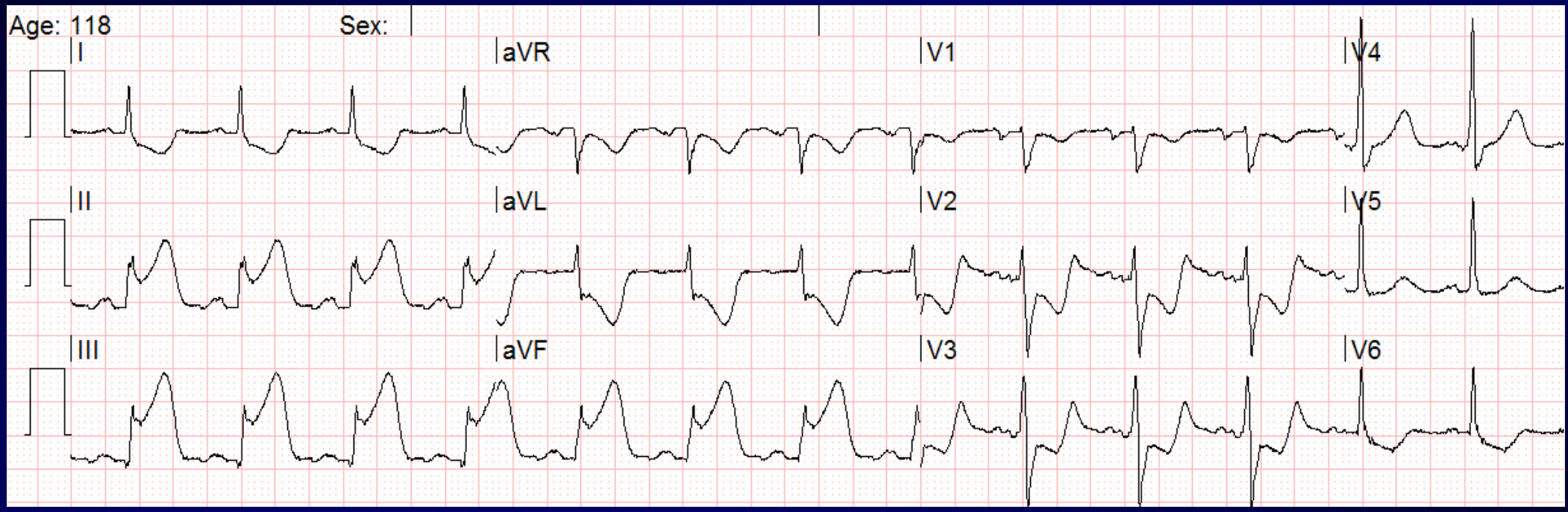
IT'S EXAM TIME!!


d ST abnormality, possible inferior subendocardial injury
d ST abnormality, possible anterolateral subendocardial injur
I
II
III
V1
V2
V3
V4
V5
V6

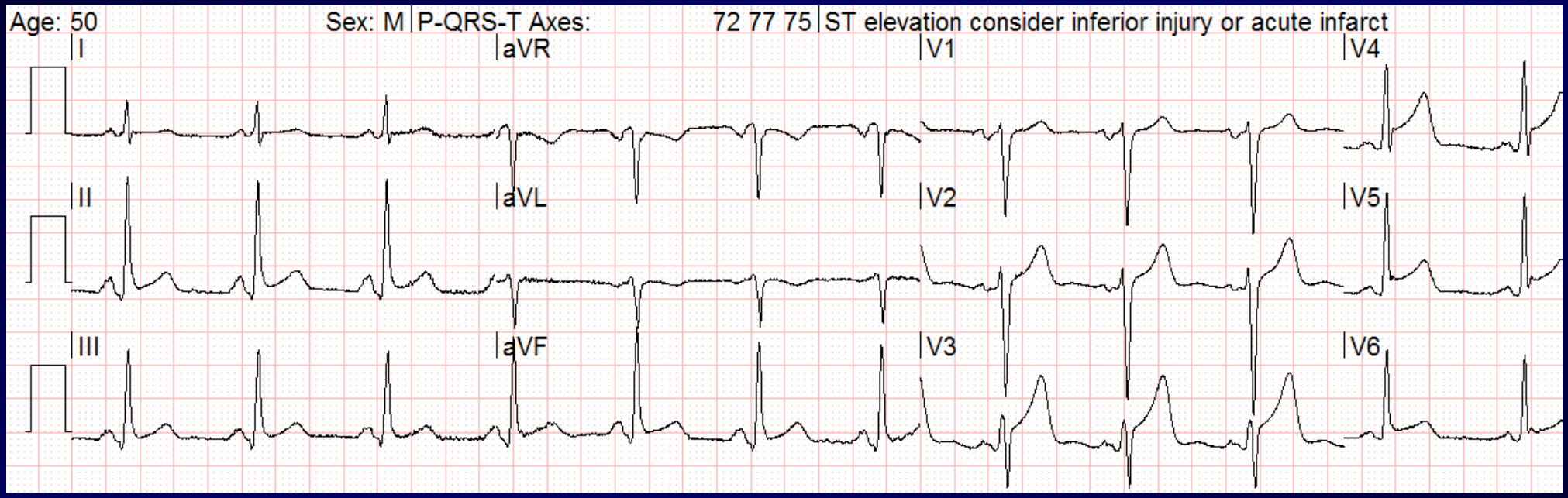
Sudden



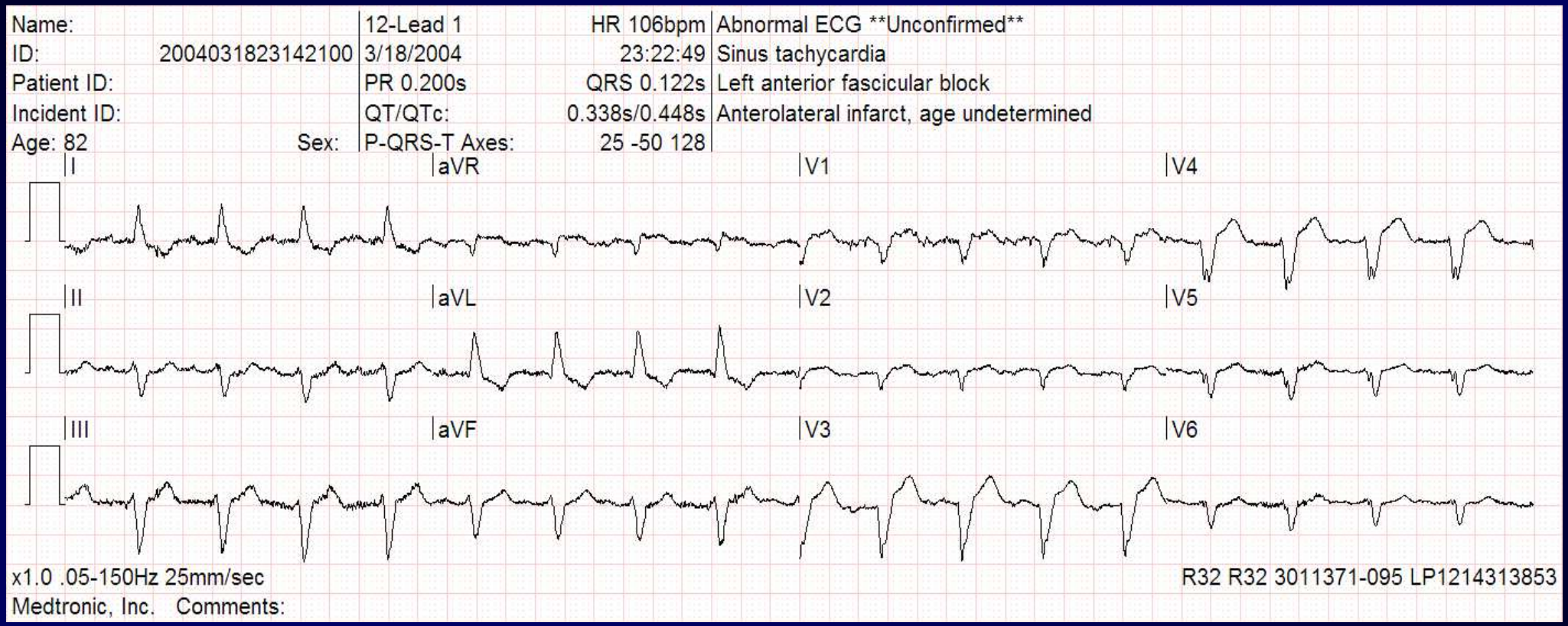
Crushing Chest Pain with Diaphoresis 58 y/o



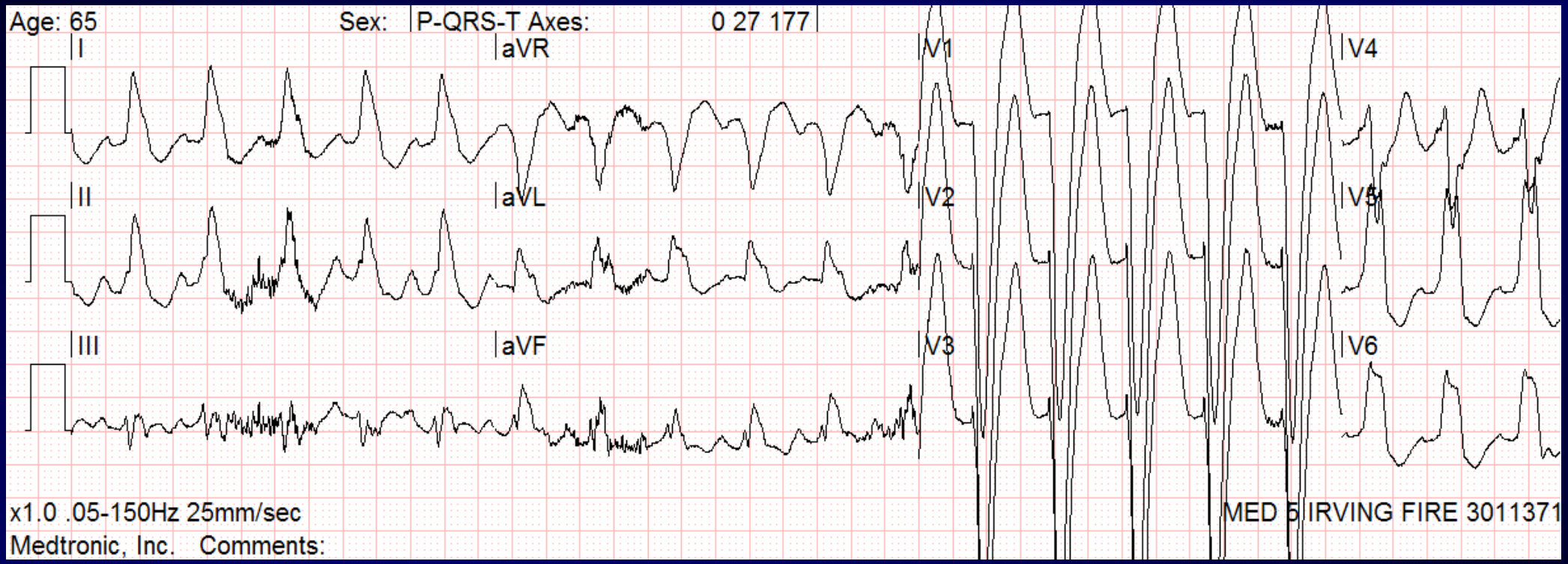
Acute Chest Pain in 118 Year Old Patient



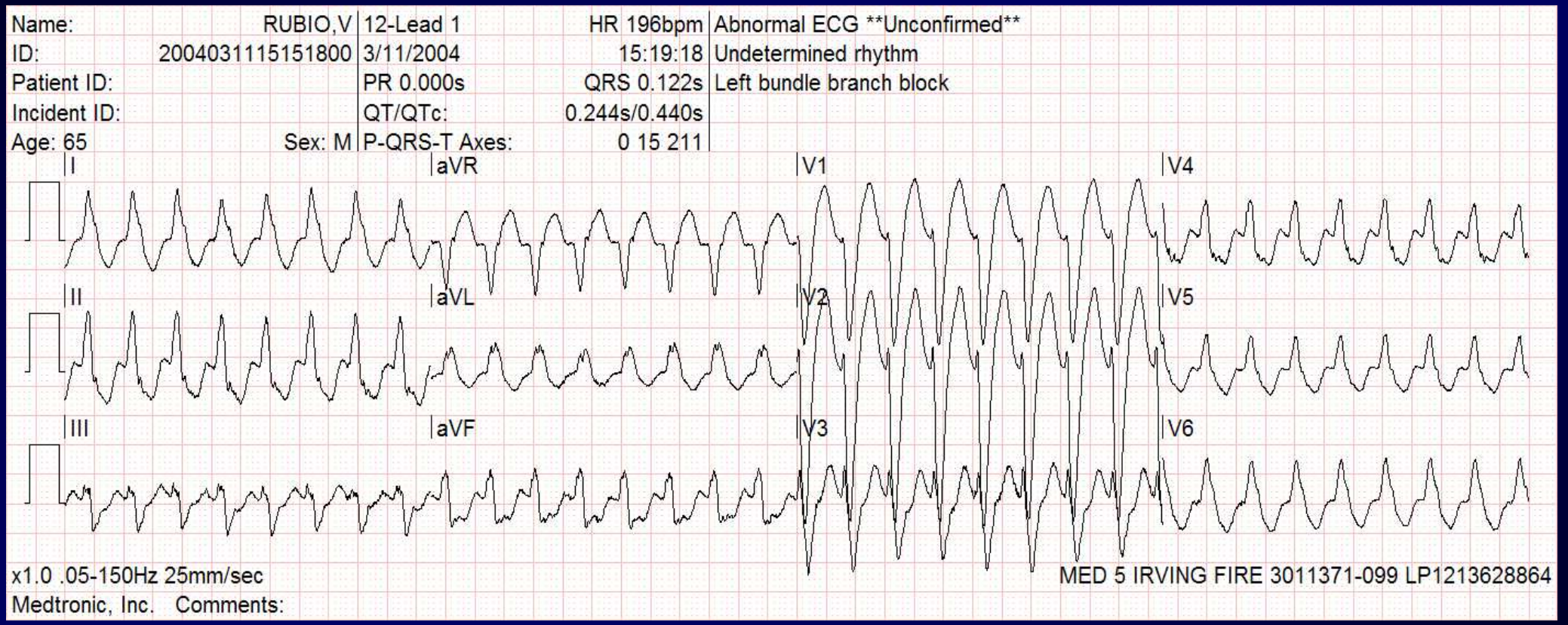
Diffuse ST Segment Elevation in Chest Pain in a middle-aged lady who has recently had a cold



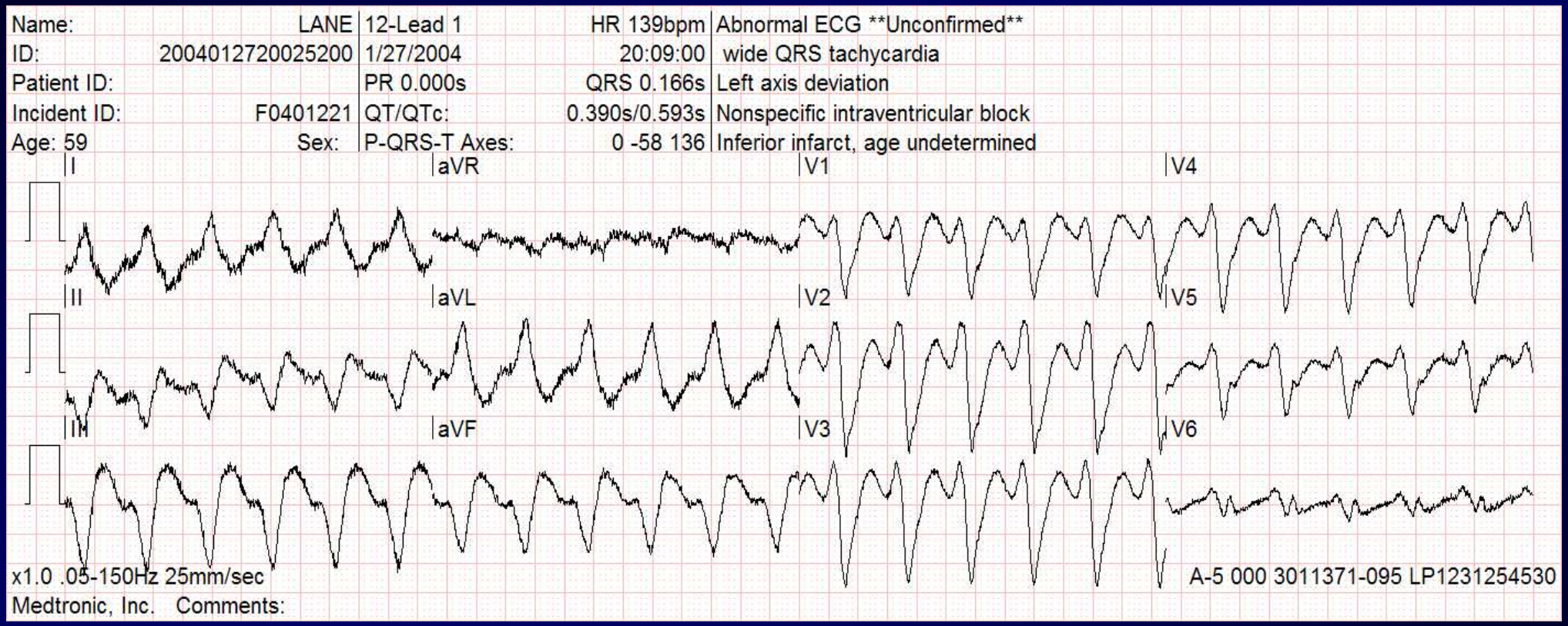
Check the axis and the PR Interval…



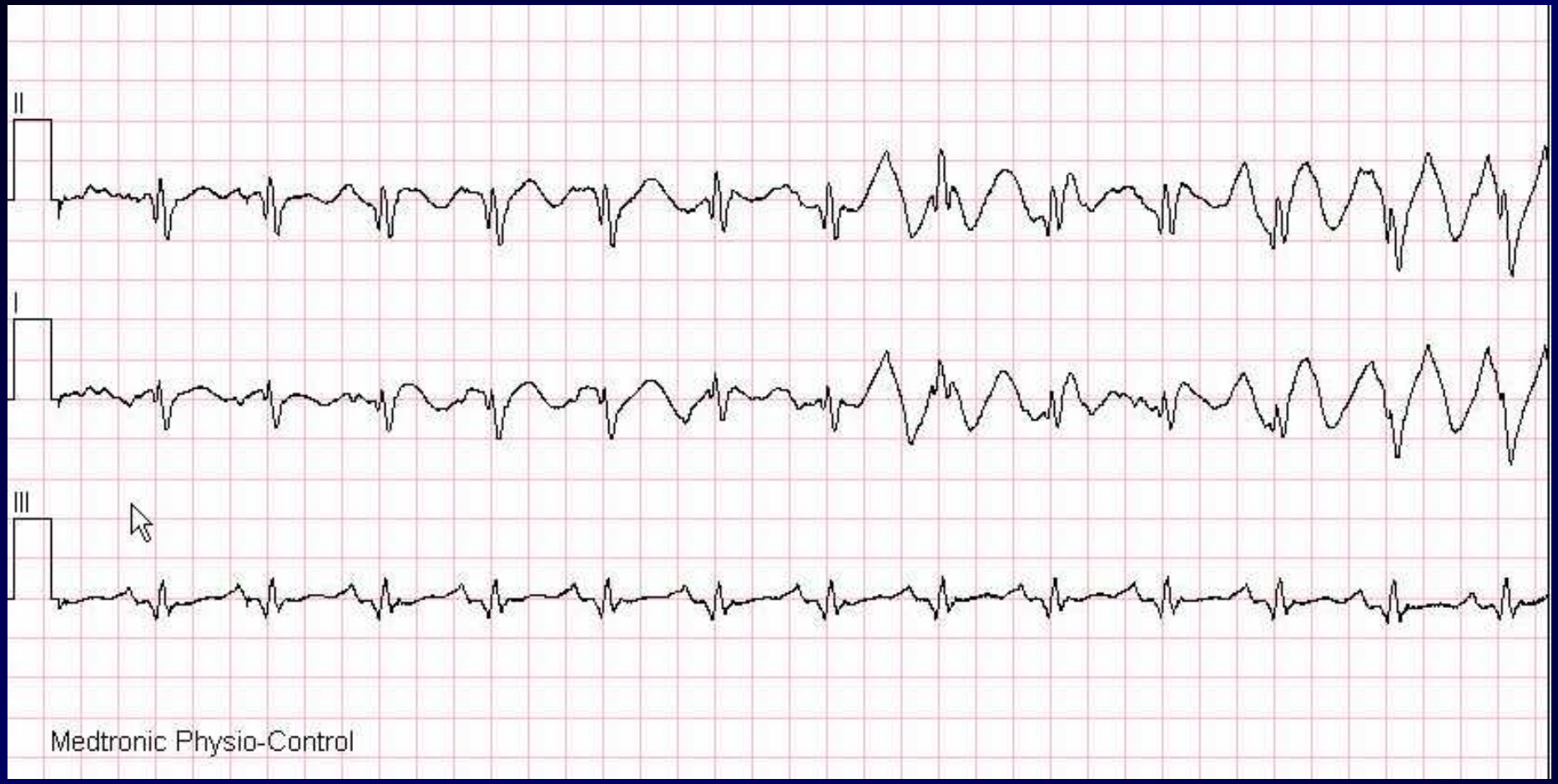
Older guy, feeling crummy…



Older guy having palpitations and lightheadedness

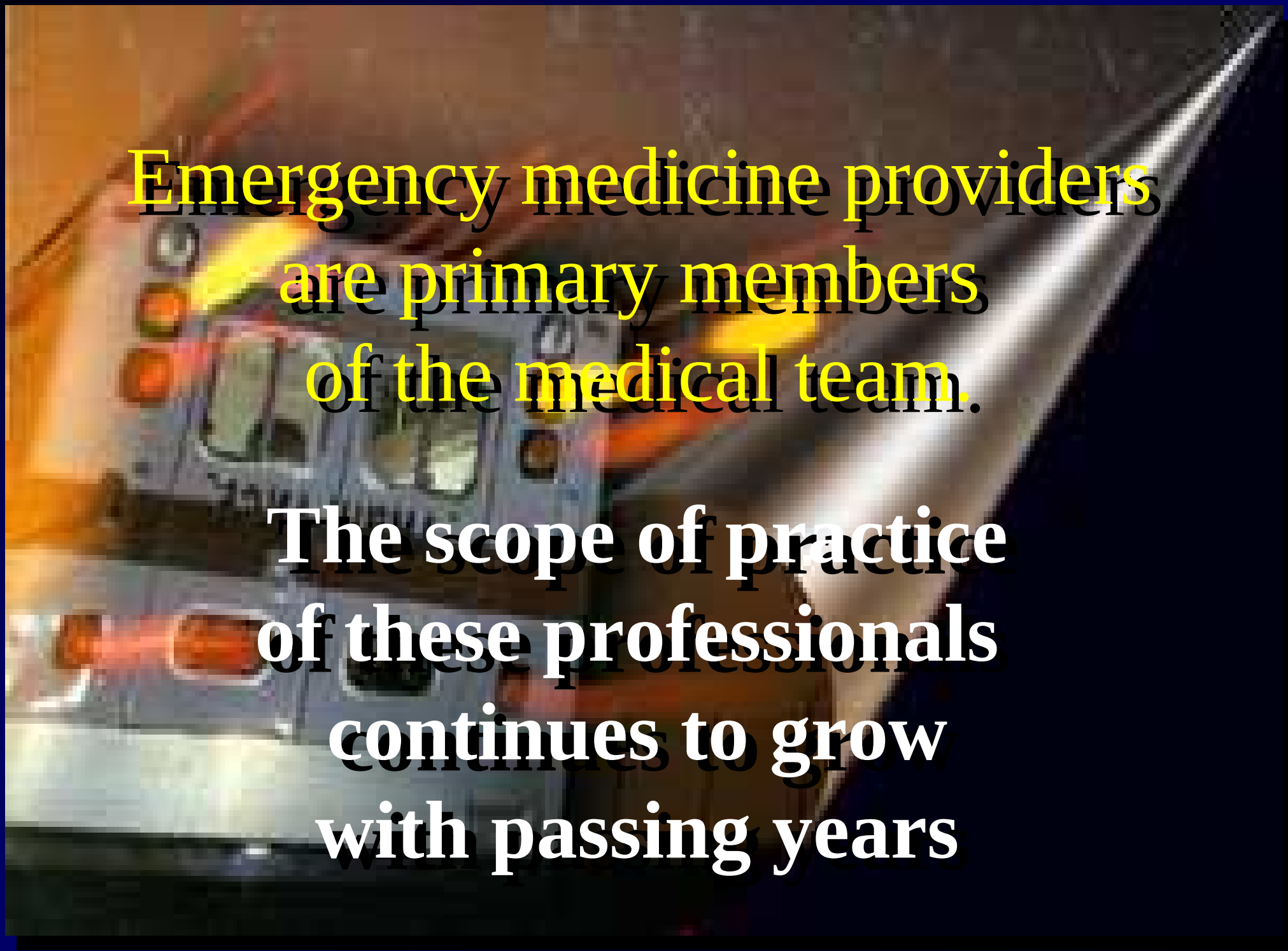


Middle-aged guy found semi-conscious with weak radial pulse

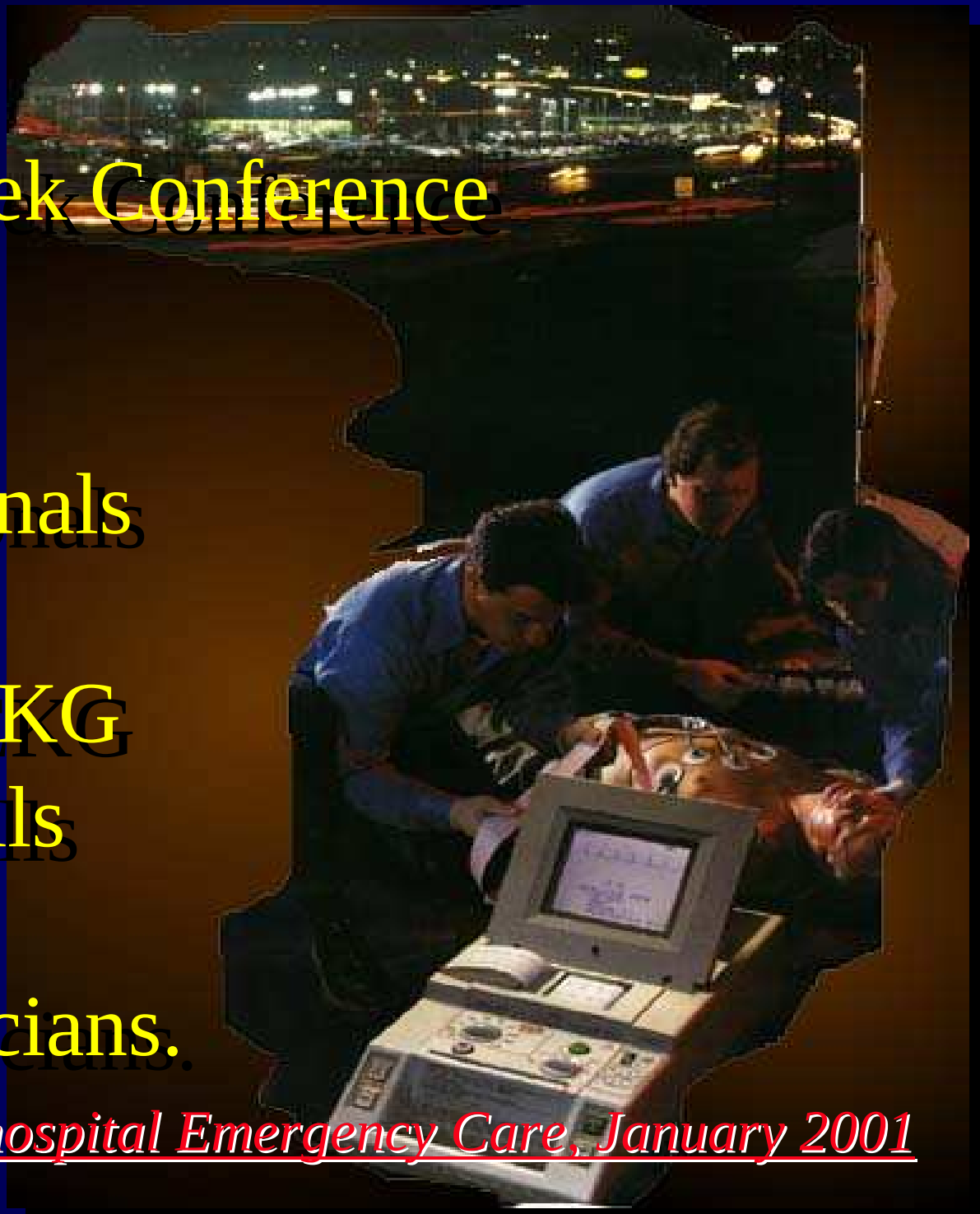


What is this patient's blood pressure?


Synthesis


Emergency medicine providers
are primary members
of the medical team.
The scope of practice
of these professionals
continues to grow
with passing years

The report of the recent Turtle Creek Conference indicates that paramedics and nursing professionals can be trained to have 12 lead EKG interpretation skills rivaling that of emergency physicians.



Prehospital Emergency Care, January 2001

Let's insist
that basic 12 lead
interpretation skills
(and, later, advanced skills)
should become part of
the standard of practice
of all medical
professionals.

www.doctorfowler.com


Questions??