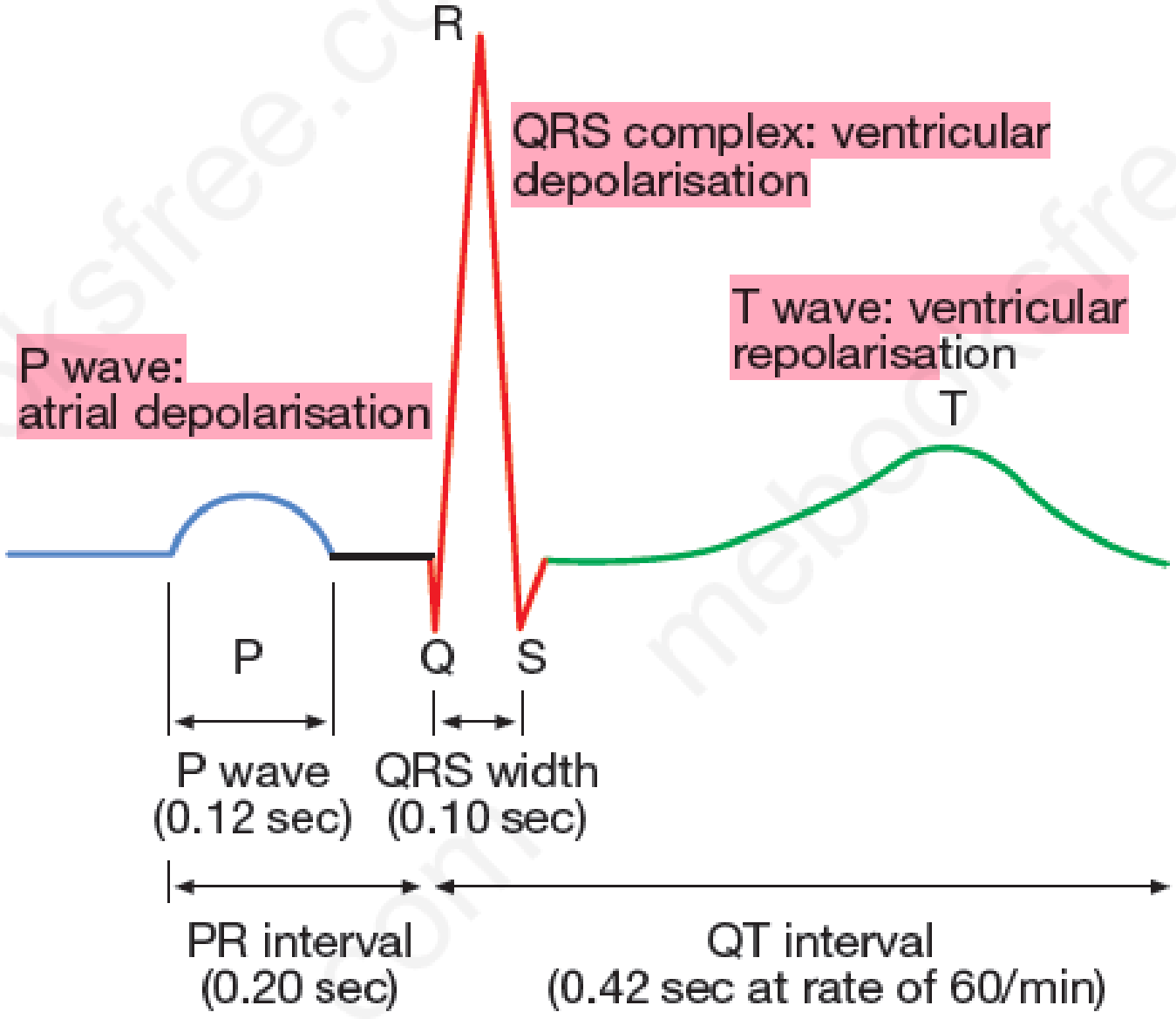
Electrocardiogram
ECG

Why?

The electrocardiogram (ECG) is used to assess cardiac rhythm and conduction, and is the main test used in the diagnosis of myocardial ischaemia and infarction.

The 12-lead ECG

The 12-lead ECG is generated from 10 electrodes, One electrode is attached to each limb and six electrodes are attached to the chest. the right leg electrode acts as an earthing electrode.

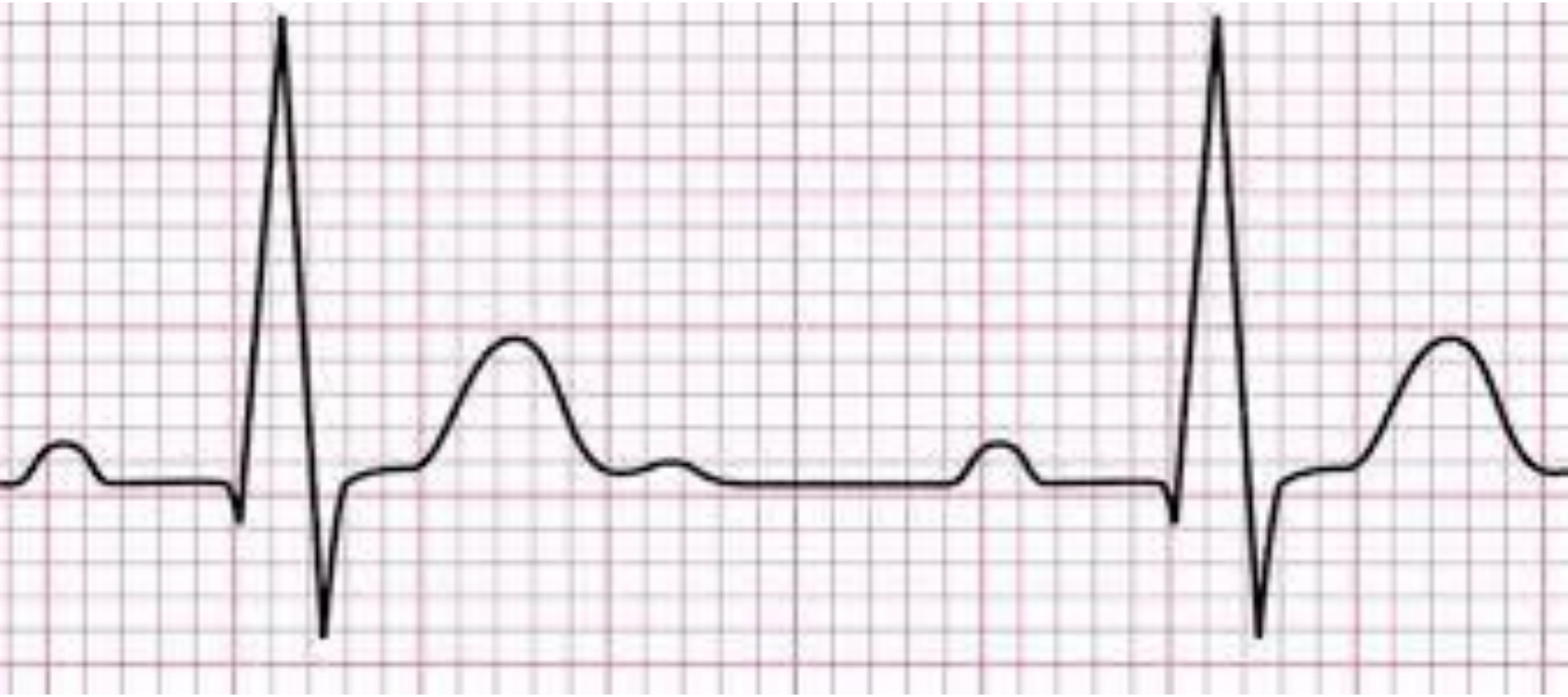

R
QRS complex: ventricular depolarisation
T wave: ventricular repolarisation
T
P wave: atrial depolarisation
P
Q
S
P wave (0.12 sec)
QRS width (0.10 sec)
PR interval (0.20 sec)
QT interval (0.42 sec at rate of 60/min)

How to read a 12-lead ECG

1- *Rhythm strip (lead II)*
To determine heart rate and rhythm

2- *Cardiac axis*
Normal if QRS complexes +ve in leads I/II
normal cardiac axis lies between −30° and +90

3- *P-wave shape*
Tall P waves denote right atrial enlargement (Ppulmonale) and notched P waves denote left atrial enlargement (P mitrale)



4- PR interval

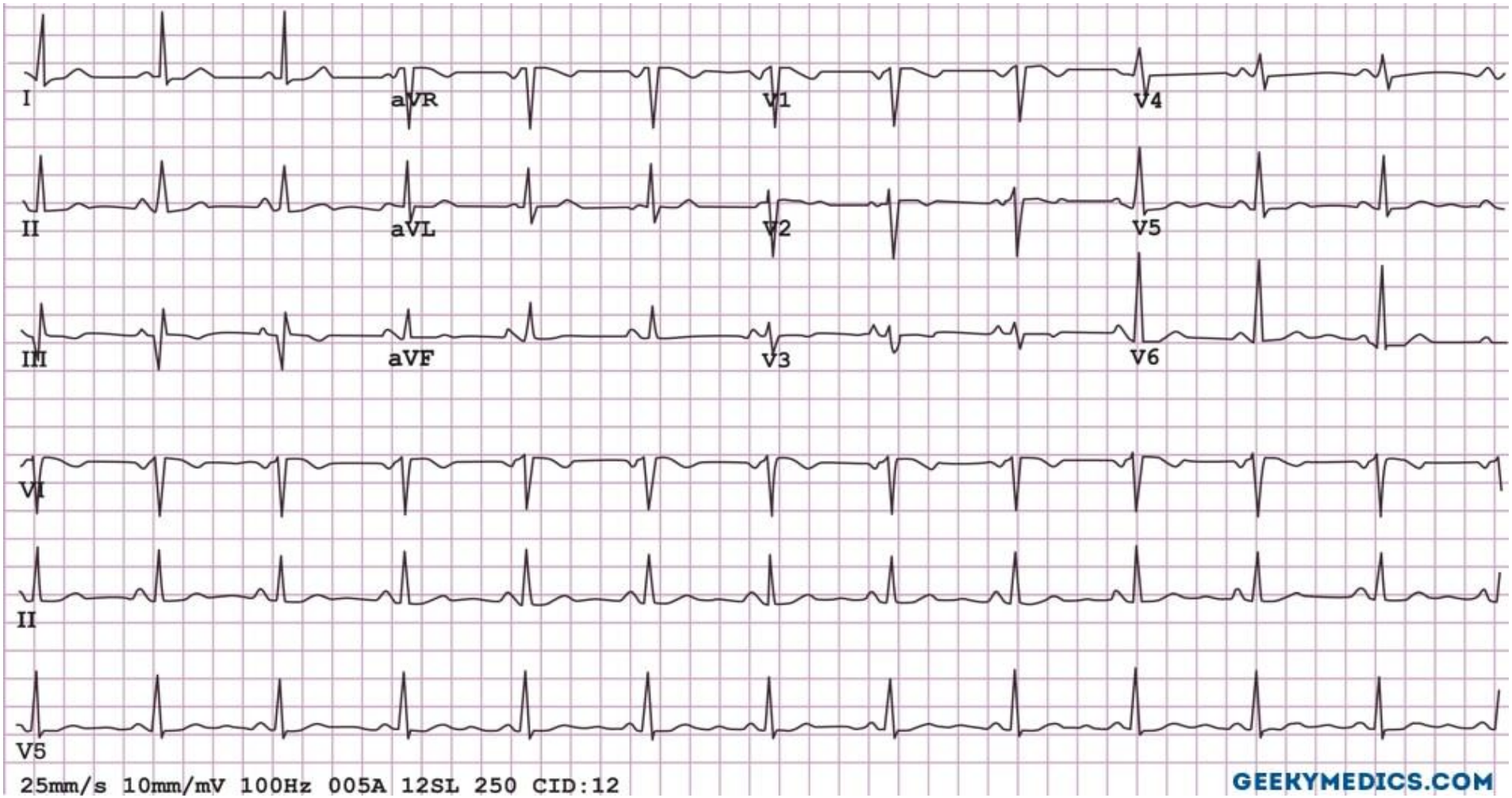
Normal = 0.12–0.20 sec. Prolongation denotes impaired atrioventricular nodal conduction. A short PR interval occurs in Wolff–Parkinson– White syndrome

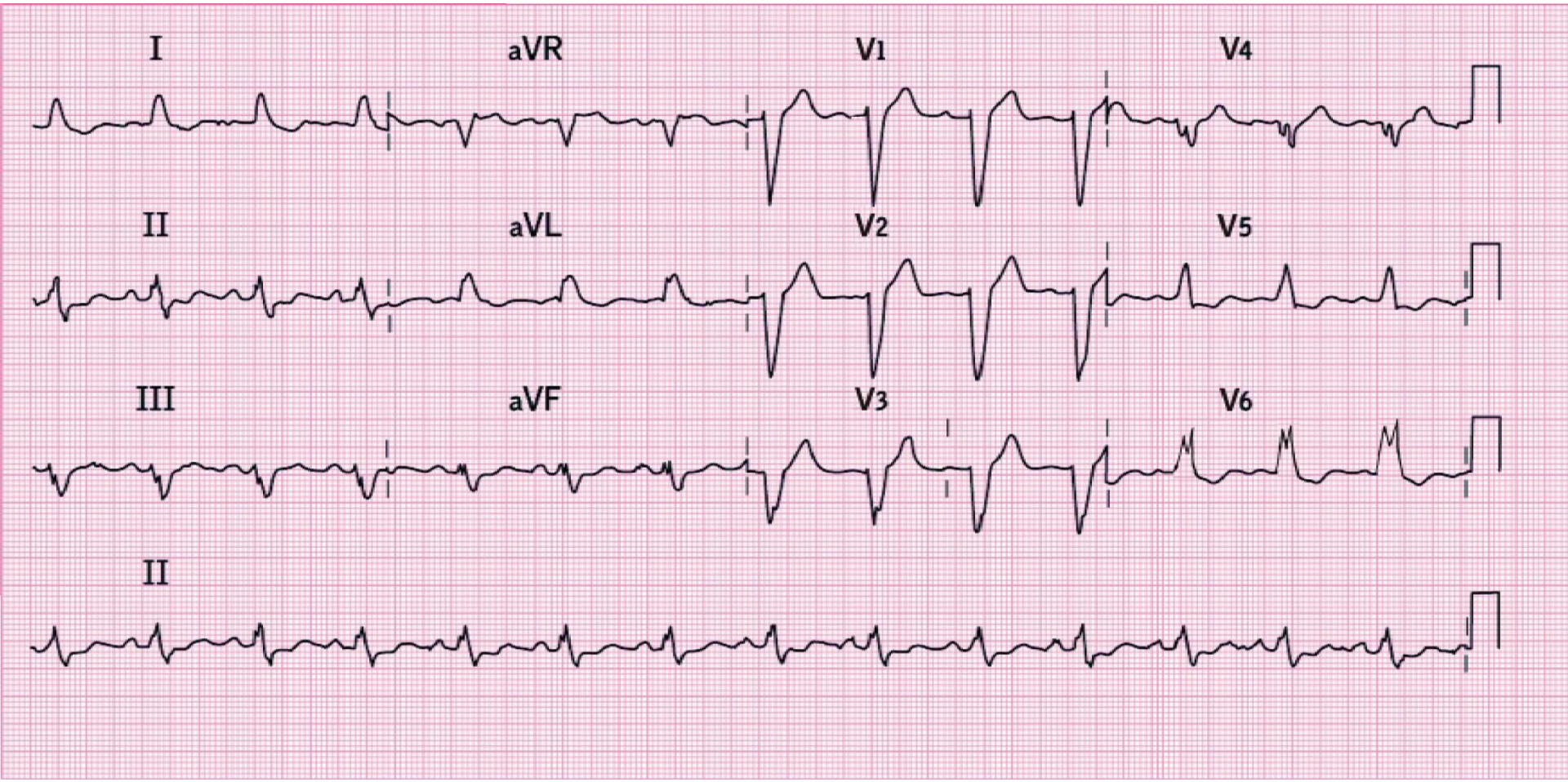
5- *QRS duration*

If > 0.12 sec, ventricular conduction is abnormal (left or right bundle branch block)

6- *QRS amplitude*

Large QRS complexes occur in slim young patients and in patients with left ventricular hypertrophy


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
VI
II
V5
25mm/s 10mm/mV 100Hz 005A 12SL 250 CID:12
GEEKYMEDICS.COM


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

7- *Q waves*

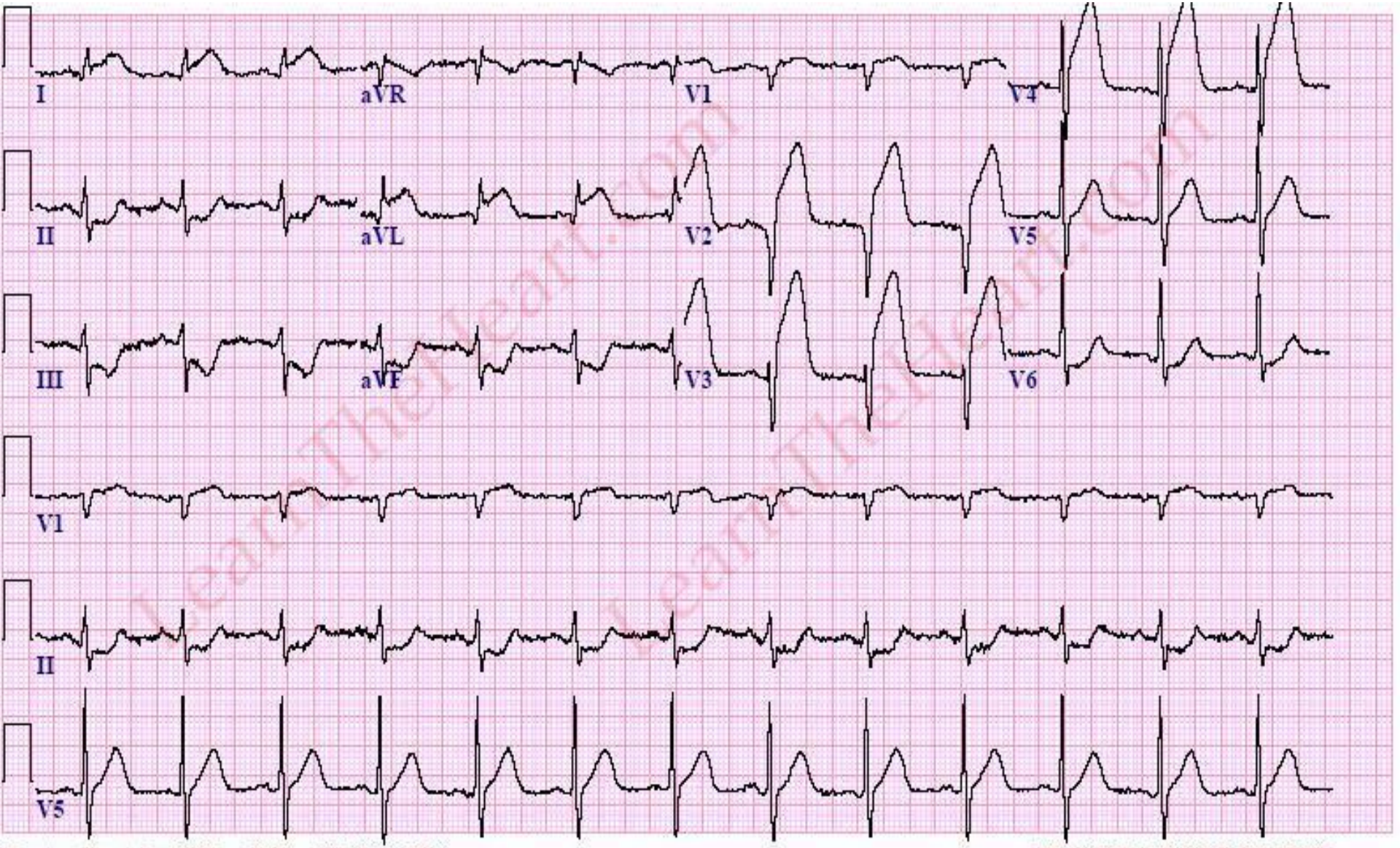
May signify previous myocardial infarction

8- *ST segment*

ST elevation may signify myocardial infarction, pericarditis or left ventricular aneurysm; ST depression may signify ischaemia or infarction

9- *T waves*

T-wave inversion has many causes, including myocardial ischaemia or infarction, and electrolyte disturbances


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
25mm/s 10mm/mV 150Hz 005C 12SL 250 CID: 1
EID:766 EDT: 14:50 12-SEP-2005 ORDER:

10- *QT interval*

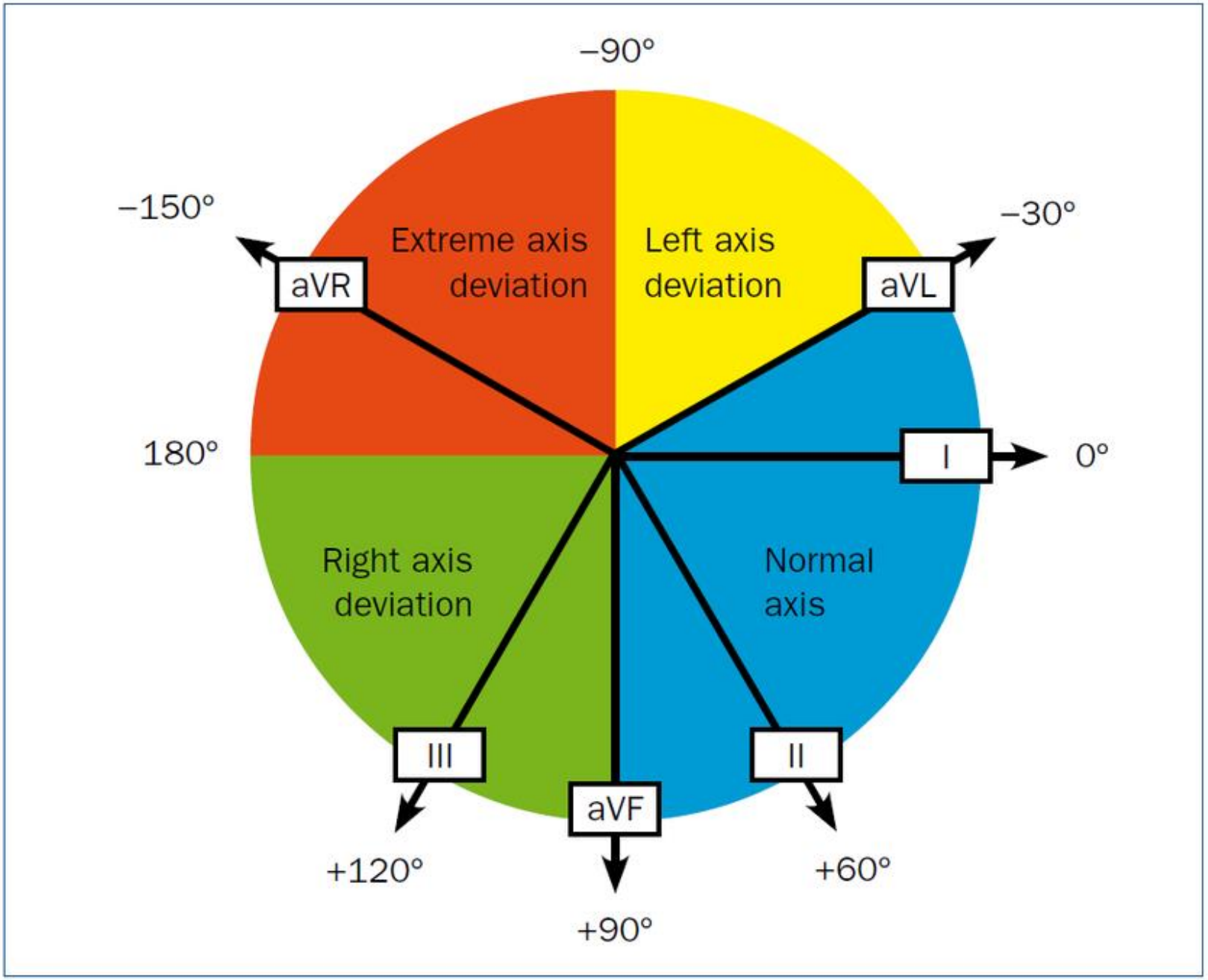
Normal < 0.42 sec. QT prolongation may occur with congenital long QT syndrome, low K+, Mg2+ or Ca2+, and some drugs

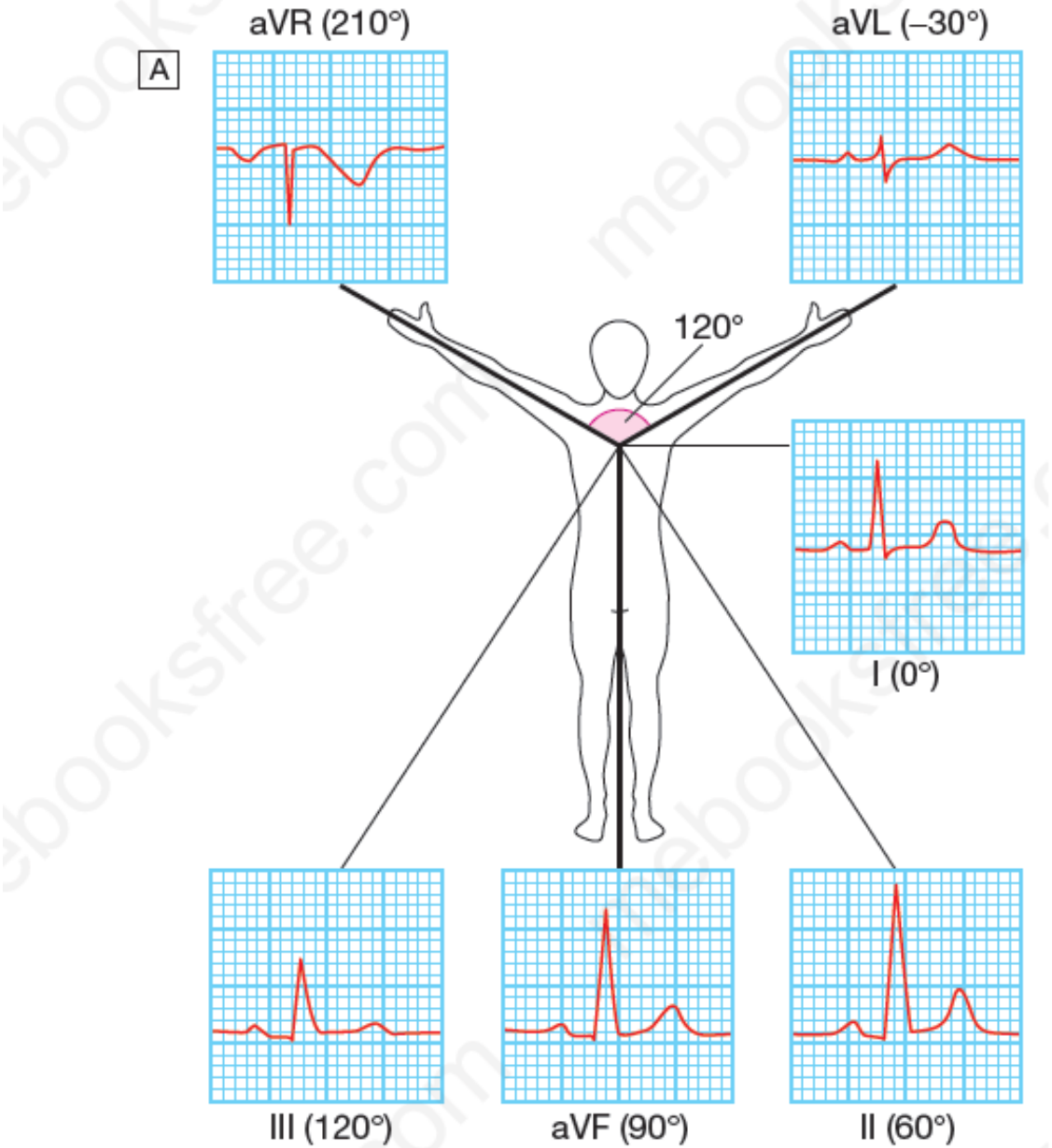
ECG conventions

Depolarisation towards electrode: +ve deflection
Depolarisation away from electrode: −ve deflection

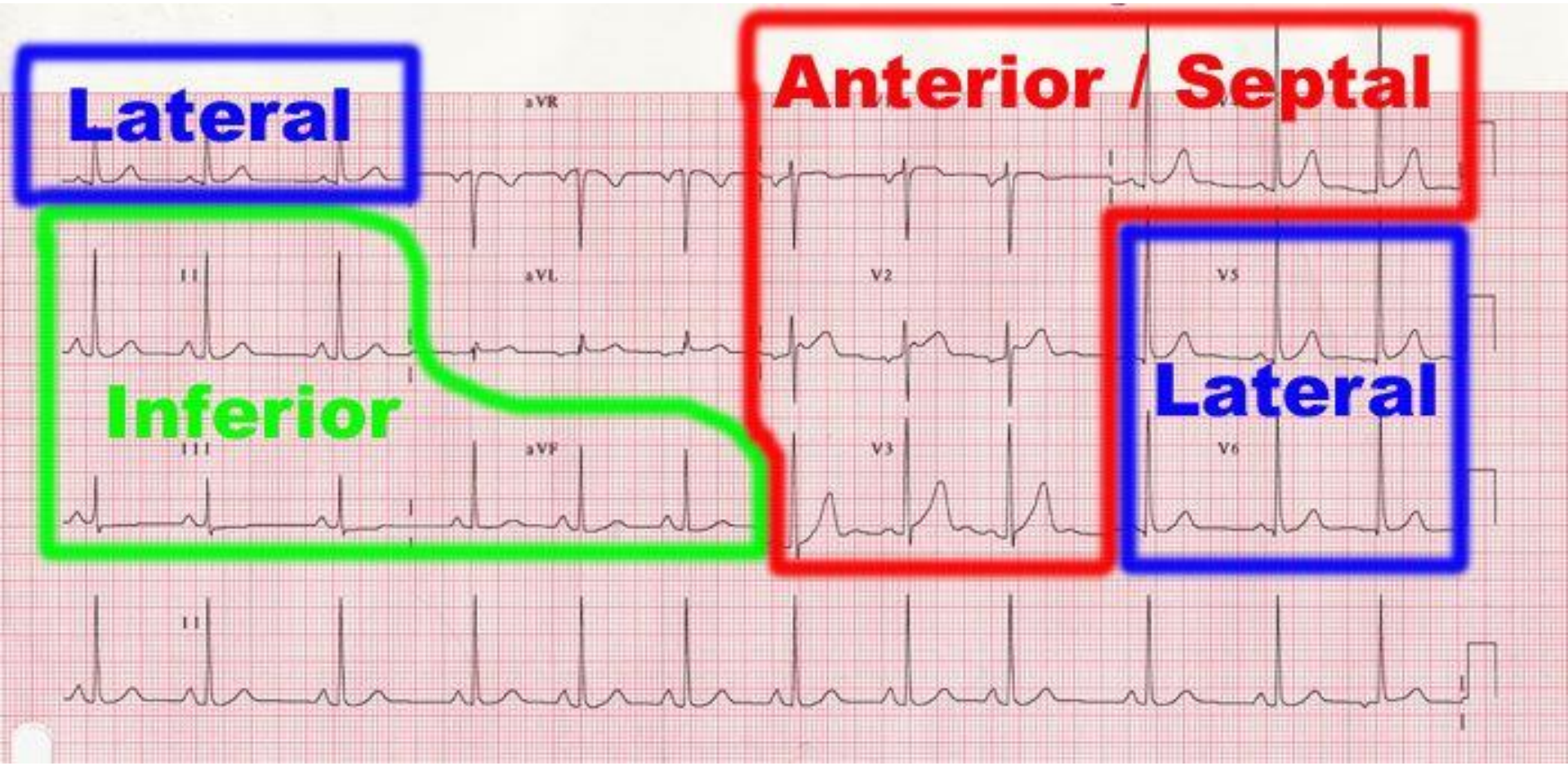
Sensitivity: 10 mm = 1 mV
Paper speed: 25 mm per sec

Each large (5 mm) square = 0.2 sec
Each small (1 mm) square = 0.04 sec
Heart rate = 1500/RR interval (mm) (i.e. 300 ÷ number of large squares between beats)


−90°
−150°
−30°
Extreme axis deviation
Left axis deviation
aVR
aVL
180°
I
0°
Right axis deviation
Normal axis
III
II
aVF
+120°
+60°
+90°


A
aVR (210°)
aVL (–30°)
120°
I (0°)
III (120°)
aVF (90°)
II (60°)

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


Lateral
Anterior / Septal
Inferior
Lateral
aVR
I
V1
II
aVL
V2
V5
III
aVF
V3
V6
II

Where to place the chest leads

V1 : Right sternal edge, 4th intercostal space.

V2 : Left sternal edge, 4th intercostal space.

V3 : Half-way between V2 and V4.

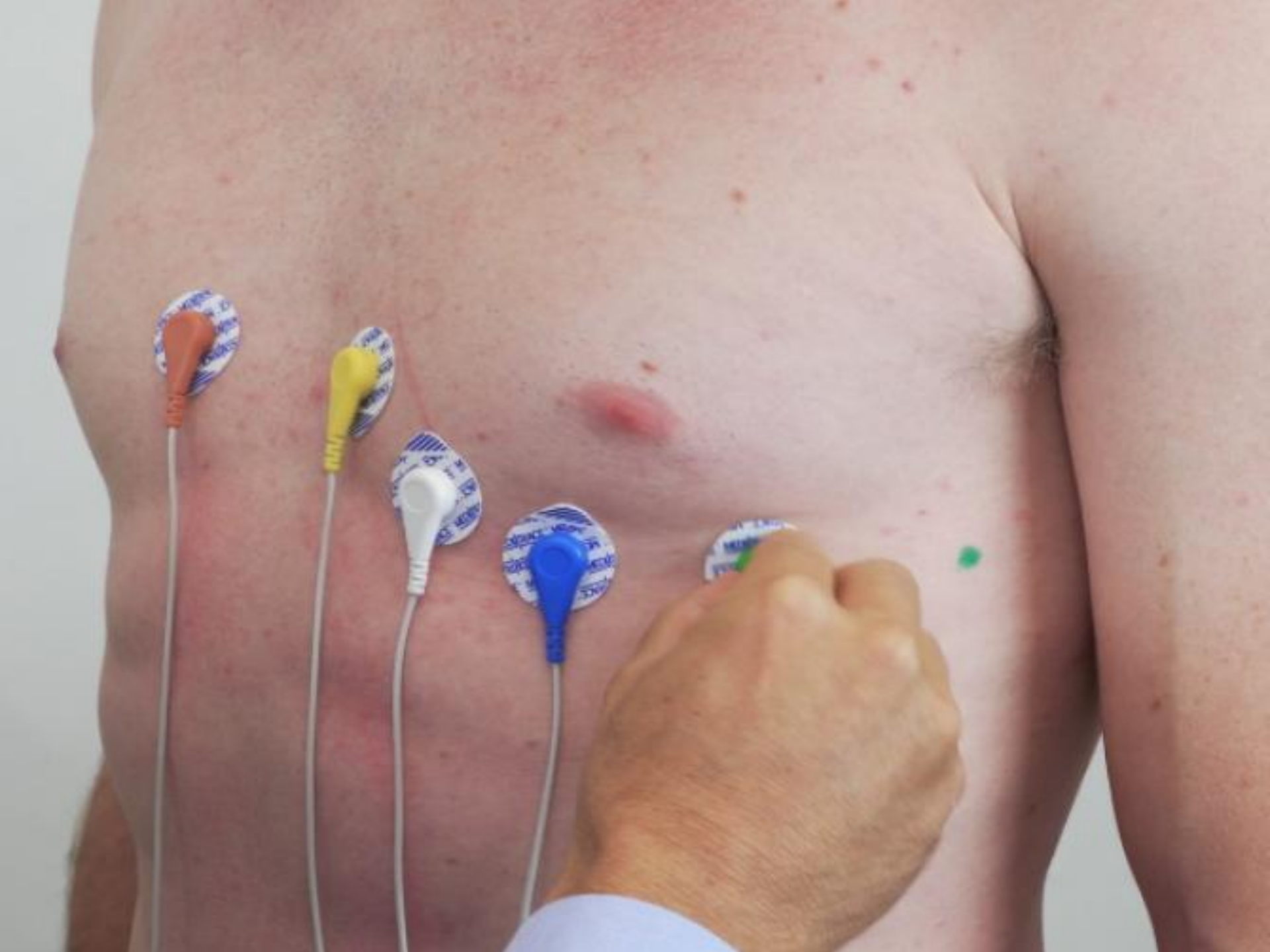
V4 : 5th intercostal space, mid-clavicular line; all subsequent leads are in the same horizontal plane as V4.

V5 : Anterior axillary line.

V6 : Mid-axillary line (V7: posterior axillary line).

Good skin preparation (clean with non-alcoholic wipe, shave if hairy, etc.) will improve ECG quality.

Finish 12-lead ECGs with a long rhythm strip in lead II.



Exercise or stress electrocardiography

a 12-lead ECG is recorded during exercise on a treadmill or bicycle.

It is similar to a resting ECG, except that the limb electrodes are placed on the shoulders and hips rather than the wrists and ankles.

The Bruce Protocol is the most commonly used.
During an exercise ECG, BP is recorded and symptoms are assessed.
The test is considered positive if angina occurs,
BP falls or fails to increase, or if there are ST segment shifts of more than 1 mm.

Exercise testing is useful in confirming the diagnosis of coronary artery disease in patients with suspected angina.

False negative results can, however, occur in patients with coronary artery disease.

False positive , not all patients with a positive *test* have coronary disease. This is especially true in low-risk individuals, such as asymptomatic young or middle-aged women

Stress testing is contraindicated in the presence of acute coronary syndrome, decompensated heart failure and severe hypertension.

Ambulatory ECG

These devices usually provide limb lead ECG recordings only, on a continuous basis for periods of between 1 and 7 days. The main indication for ambulatory ECG is in the investigation of patients with suspected arrhythmia, such as those with intermittent palpitation, dizziness or syncope.

Blood pressure

treatment of hypertension is the most common reason for office visits and for the use of chronic prescription medications . In addition, roughly half of hypertensive individuals do not have adequate blood pressure control.

The following definitions and staging system, were suggested in 2017 by the American College of Cardiology/American Heart Association (ACC/AHA

Normal blood pressure – Systolic <120 mmHg and diastolic <80 mmHg

Elevated blood pressure – Systolic 120 to 129 mmHg and diastolic <80 mmHg

Hypertension

Stage 1 – Systolic 130 to 139 mmHg or diastolic 80 to 89 mmHg

Stage 2 – Systolic at least 140 mmHg or diastolic at least 90 mmHg

Isolated systolic hypertension is defined as a blood pressure ≥130/<80 mmHg

Isolated diastolic hypertension is defined as a blood pressure <130/≥80 mmHg.

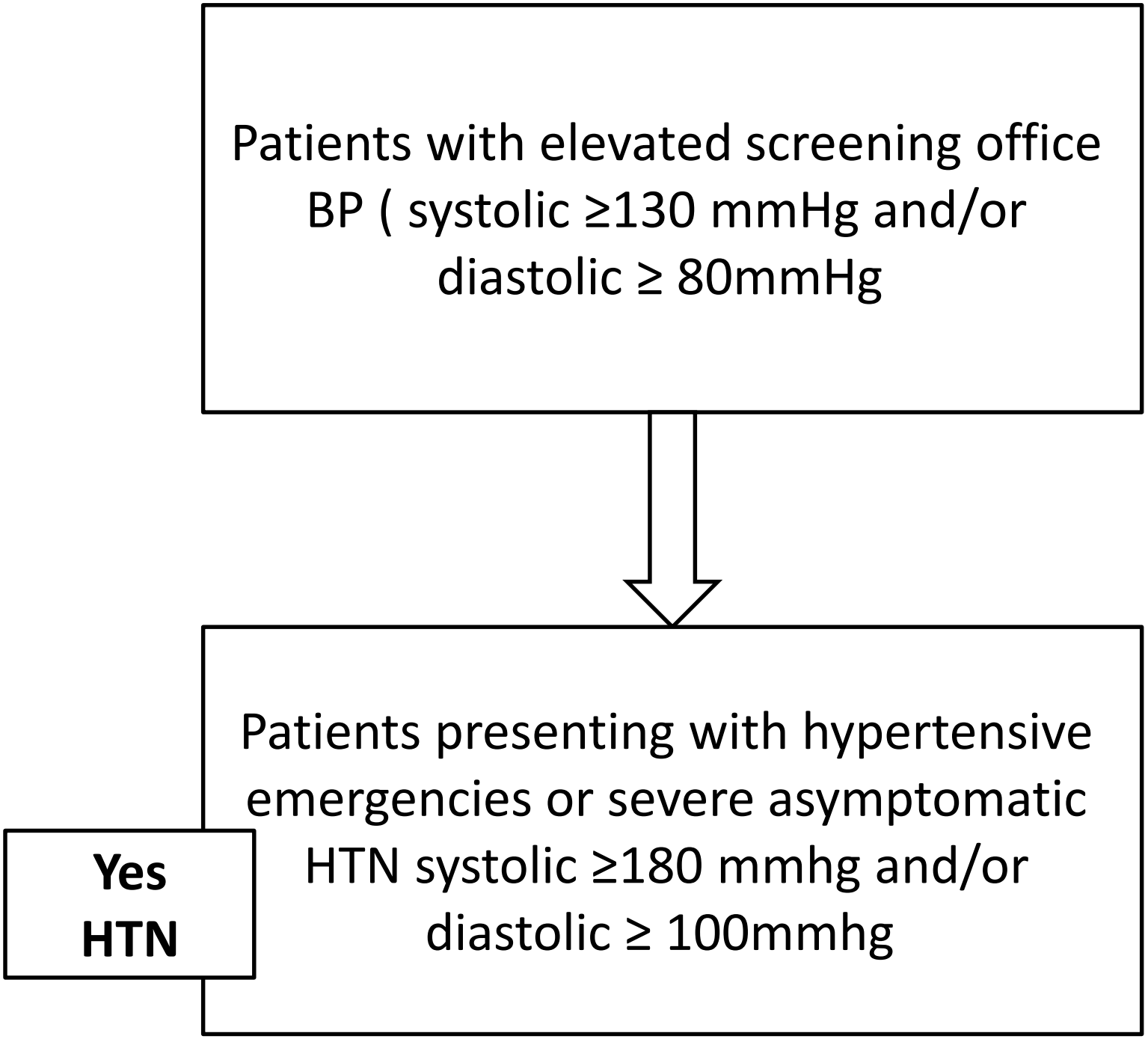
Patients with a blood pressure ≥130/≥80 mmHg are considered to have **mixed systolic/diastolic hypertension**

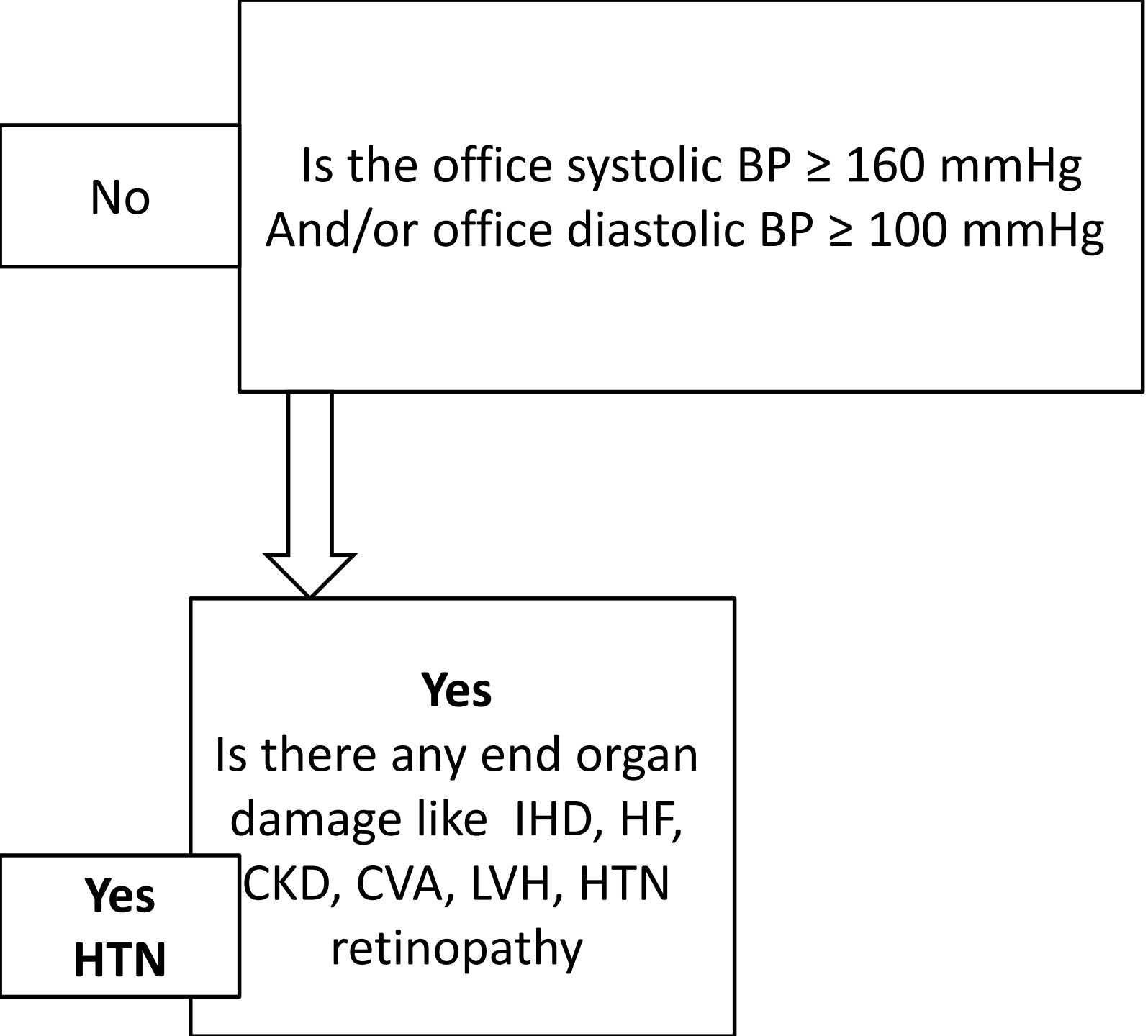
European guidance on the definition of hypertension contrasts with that of the **ACC/AHA**. The European Society of Cardiology and European Society of Hypertension (ESC/ESH) define hypertension, using office-based blood pressure, as a systolic pressure ≥140 mmHg or diastolic pressure ≥90 mmHg

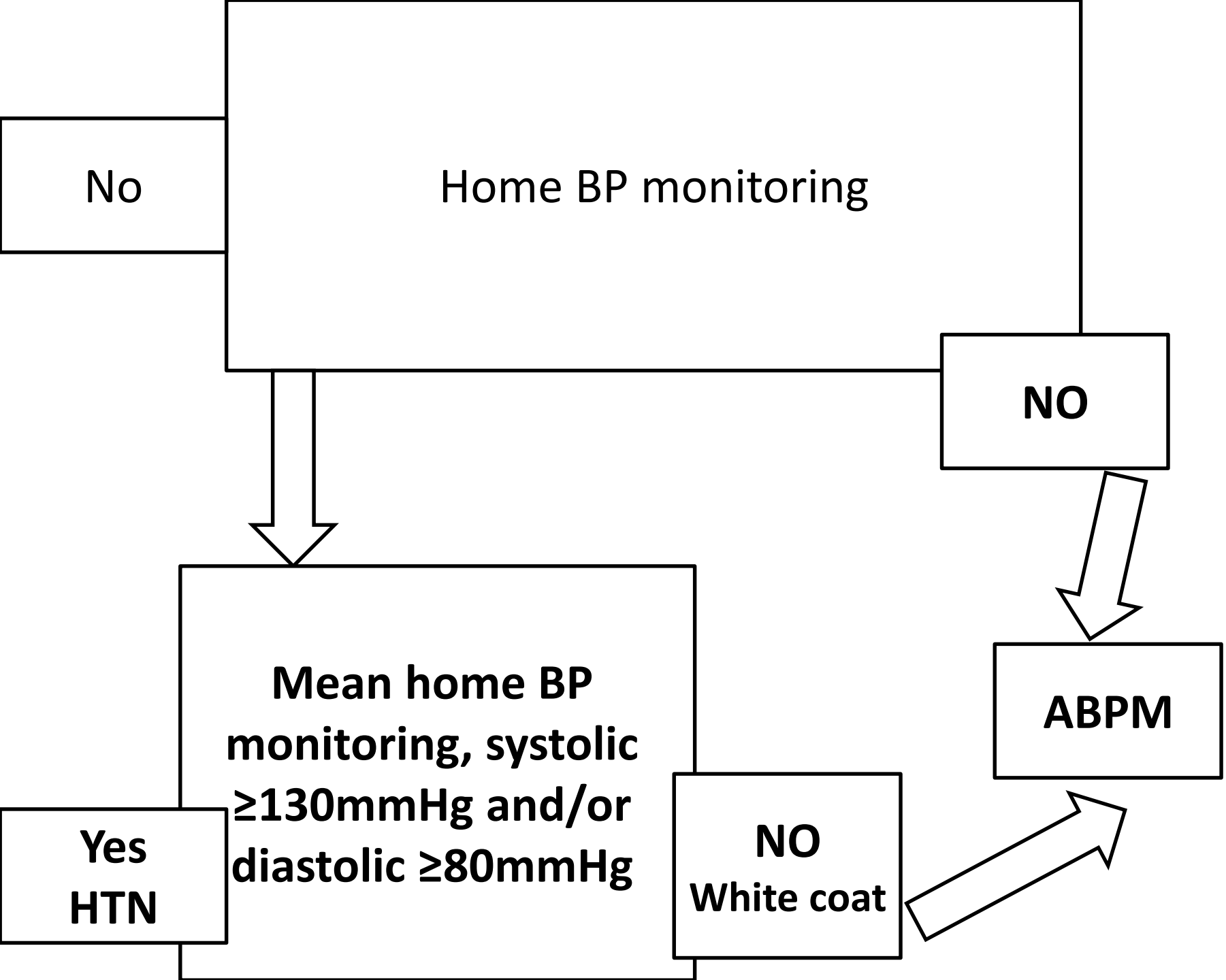
In general, definitions for hypertension are based upon the relationship between blood pressure and the incidence of cardiovascular events in large populations, derived from numerous observational studies and randomized trials, in which blood pressure was measured in various types of office settings with variable equipment and technique

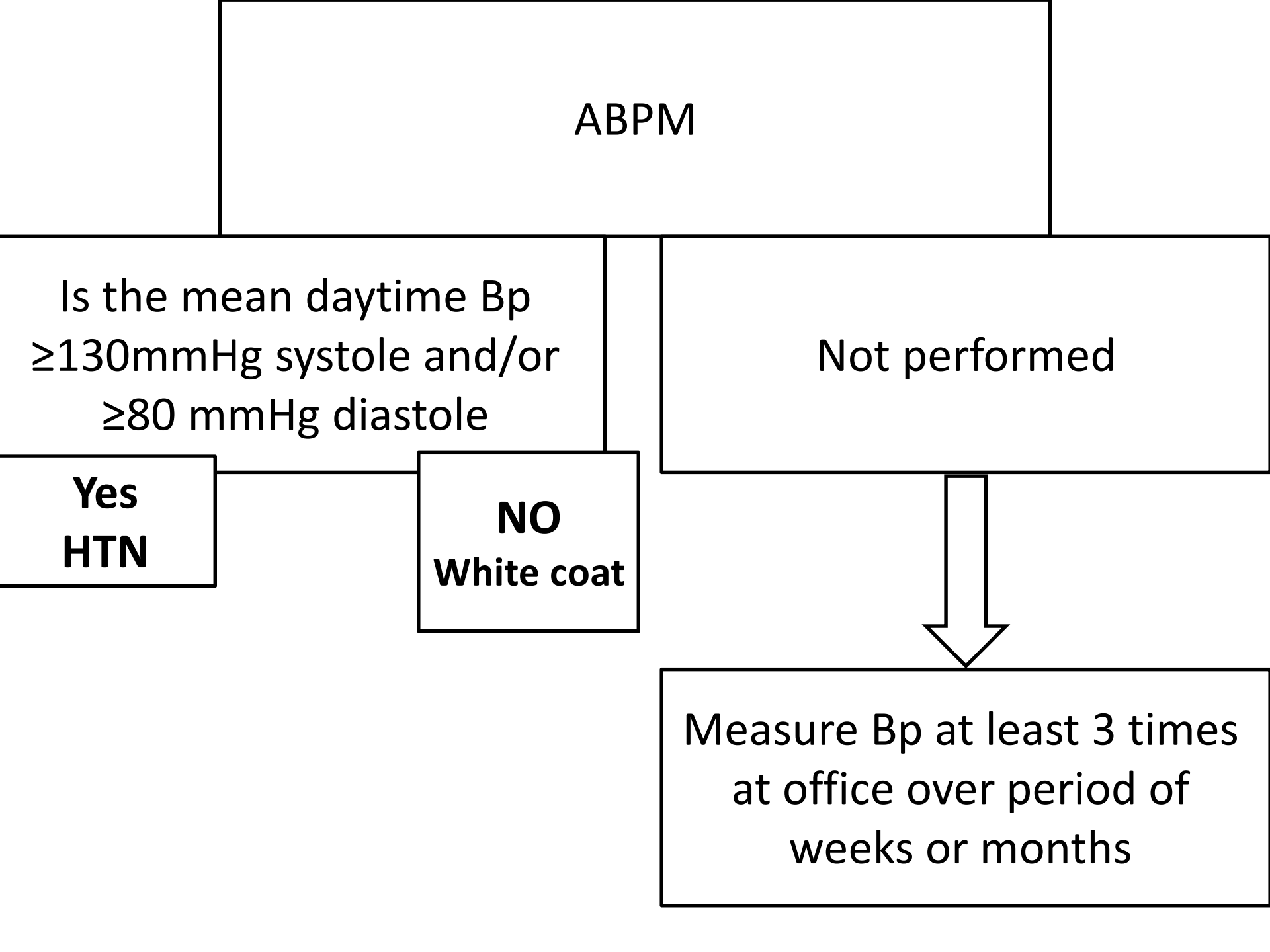
The following diagnostic criteria were suggested by the 2017 ACC/AHA guidelines; meeting one or more of these criteria using ABPM qualifies as Hypertension

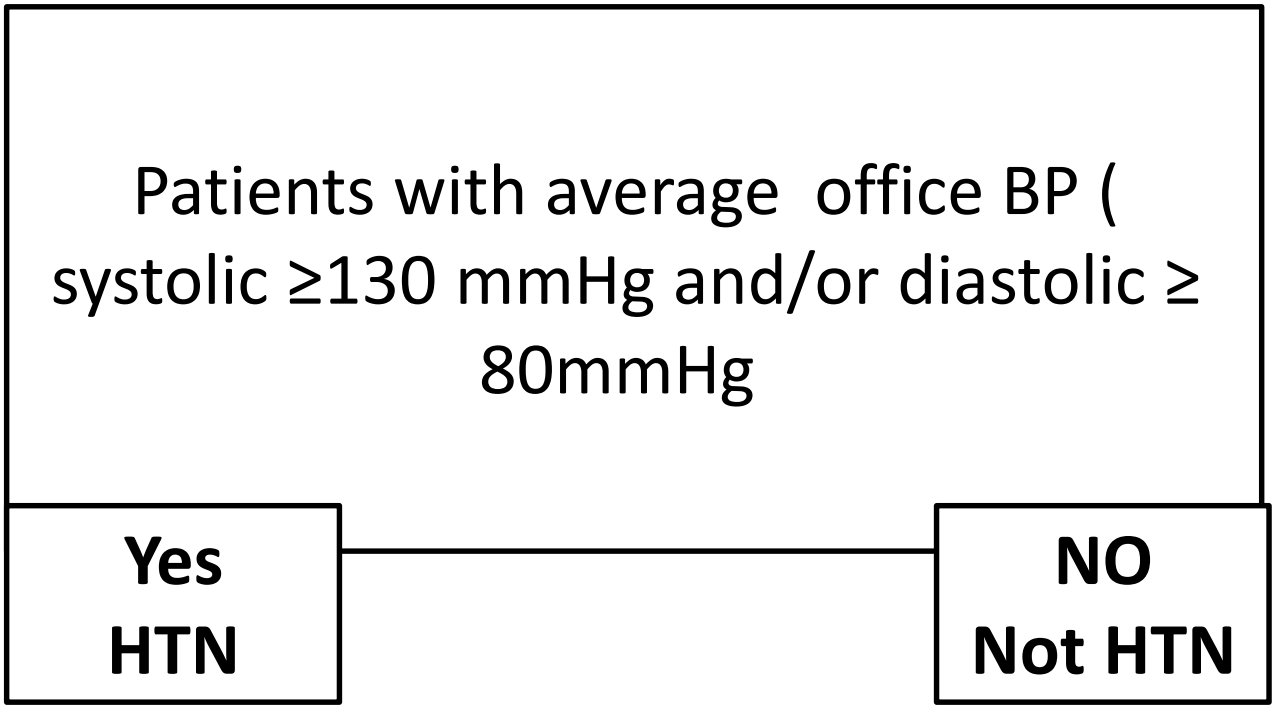
1- 24-hour mean of 125/75 mmHg or above
2- Daytime (awake) mean of 130/80 mmHg or above
3- Nighttime (asleep) mean of 110/65 mmHg or above


Patients with elevated screening office BP (systolic ≥130 mmHg and/or diastolic ≥ 80mmHg
Patients presenting with hypertensive emergencies or severe asymptomatic HTN systolic ≥180 mmhg and/or diastolic ≥ 100mmhg
Yes HTN


No
Is the office systolic BP ≥ 160 mmHg
And/or office diastolic BP ≥ 100 mmHg
Yes
Is there any end organ damage like IHD, HF, CKD, CVA, LVH, HTN retinopathy
Yes
HTN


No
Home BP monitoring
NO
Mean home BP monitoring, systolic ≥130mmHg and/or diastolic ≥80mmHg
ABPM
Yes HTN
NO White coat


ABPM
Is the mean daytime Bp ≥130mmHg systole and/or ≥80 mmHg diastole
Not performed
Yes HTN
NO White coat
Measure Bp at least 3 times at office over period of weeks or months


Patients with average office BP (systolic ≥130 mmHg and/or diastolic ≥ 80mmHg
Yes
HTN
NO
Not HTN

There’s three common types of blood pressure meters: mercury, aneroid and oscillometric devices.


Jziki
健之康
22-32cm
2-3cm
DATE
SYS
DIA
PUL
119
81
70
83
WHO
M
S

In a study in British hospital, 3% of the mercury meters and 19% of the aneroid meters used in patient care and judged to be in good working order returned readings that differed by more than 5 mmgH from a calibrated meter.

The accuracy of oscillometric devices was compared to that of mercury devices in clinics in North Carolina and London. Both studies found that the digital devices tended to understimate blood pressure readings compared to a practitioner using a mercury device, by an *average* of 3–5 mmHg.

Which is More Accurate in Measuring the Blood Pressure? A Digital or an Aneroid Sphygmomanometer

J Clin Diagn Res. 2016 Mar; 10(3): LC11–LC14.
Published online 2016 Mar 1. doi: 10.7860/JCDR/2016/14351.7458

Sensitivity and specificity of aneroid device was higher (86.7% and 98.7%) than digital device (80% and 67.7%). Receiver Operating Characteristic curve had larger area under the curve for aneroid device than digital device for both SBP and DBP.

Procedures

To begin blood pressure measurement, use a properly sized blood pressure cuff.

The length of the cuff's bladder should be at least equal to 80% of the circumference of the upper arm.

Wrap the cuff around the upper arm with the cuff's lower edge one inch above the antecubital fossa.

Lightly press the stethoscope's bell over the brachial artery just below the cuff's edge.

Some health care workers have difficulty using the bell in the antecubital fossa, so we suggest using the bell or the diaphragm to measure the blood pressure.

Rapidly inflate the cuff to 180mmHg. Release air from the cuff at a moderate rate (3mm/sec).

Listen with the stethoscope and simultaneously observe the sphygmomanometer. The first knocking sound (Korotkoff) is the subject's systolic pressure. When the knocking sound disappears, that is the diastolic pressure (such as 120/80).

Record the pressure in both arms and note the difference; also record the subject's position (supine), which arm was used, and the cuff size (small, standard or large adult cuff).

If the subject's pressure is elevated, **measure blood pressure** two additional times, waiting a few minutes between measurements.

Precautions

Aneroid and digital manometers may require periodic calibration.

Use a larger cuff on obese or heavily muscled subjects.

Use a smaller cuff for pediatric patients.

Don't place the cuff over clothing.

Flex and support the patient's arm.

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In some patients the Korotkoff sounds will disappear as the systolic pressure is bled down. After an interval, the Korotkoff sounds reappear. This interval is referred to as the "auscultatory gap." This pathophysiologic occurrence can lead to a marked under-estimation of systolic pressure if the cuff pressure is not elevated enough. It is for this reason that the rapid inflation of the blood pressure cuff to 180mmHg was recommended above. The "auscultatory gap" is felt to be associated with carotid atherosclerosis and a decrease in arterial compliance in patients with increased blood pressure