



EMERGILITY® EMERGENCY MEDICAL SERVICES

ACLS Cardiac Reference Guide

V.26.10

October 2026

DRAFT — PENDING OMD APPROVAL

For Advanced Practice Paramedics · Aligned to the 2025 AHA Guidelines for CPR & ECC

SHEET INDEX

Each sheet names its section in the companion manual

#	Sheet	Manual
1	ECG Interpretation	\$2
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Companion Materials (V.26.10)

- **Companion Manual** — full reasoning, tables, change log (\$1–15)
- **Practice & Assessment Package** — strip drills, cases, 30-question exam, keys
- **Pocket Card** — 4×6 in, arrest / brady / tachy + doses

60-Second 12-Lead Read

1. **Validate** — lead I upright? aVR negative? limb leads on limbs
2. **Rate & rhythm** — Sheets 1, 5–8
3. **Axis** — I and aVF, then II (Sheets 3–4)
4. **Intervals** — PR, QRS, QT (Sheet 2)
5. **QRS** — BBB, hemiblock, Q waves, voltage
6. **ST / T by column** — LII · LI · SSA · ALL (Sheet 10)
7. **Reciprocal & equivalents** — OMI patterns, Sgarbossa (Sheet 9)
8. **Act** — transmit, activate, repeat every 15–30 min

PROTOCOL CROSS-REFERENCE

The EMERGILITY® Protocols manual controls — enter its page numbers

Topic	Protocol page
Adult cardiac arrest (VF/pVT, PEA/asystole)	
Bradycardia with a pulse	
Tachycardia with a pulse	
Acute coronary syndrome / STEMI	
Post-ROSC care	
Termination of resuscitation	
Pediatric cardiac arrest	
Formulary: epinephrine, amiodarone, lidocaine, adenosine, diltiazem, metoprolol, procainamide, atropine, magnesium	

If this guide and the protocol manual ever differ, **follow the protocol** and report the difference to the OMD. Doses here are adult IV/IO unless stated; pediatric doses are on Sheet 16.

Color Key

- Assess / identify
- Arrest / life threat
- Intervals / post-ROSC
- Axis / tachy / changes
- Equivalents / therapy
- Special patterns

How to Use This Set

- **Sheets** — in the bag and at the bedside; one topic per page
- **Companion Manual** — the reasoning behind every sheet; read before class
- **Atlases (Sheets 7–8, 11–12)** — drill pattern recognition; cover the captions
- **Practice & Assessment Package** — cohort testing and remediation
- **Pocket Card** — arrest, brady, tachy and doses at a glance

DOCUMENT CONTROL

Version, preparation and approval

Version	V.26.10 (V.YY.MM)
Basis	2025 AHA Guidelines for CPR & ECC (Adult ALS, PALS, Special Circumstances)
Supersedes	Cardiology Rhythms sheet, Dec 10, 2023
Agency	EMERGILITY® · VA OEMS Agency 50537

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Effective date _____ · Next review _____

Remove the draft marking only after OMD signature. Log every later change on Sheet 17 and in manual \$9.

Review & Distribution

- Review annually, with each AHA guideline update, and after any formulary or monitor change
- Reissue sheets, manual, package and pocket card together under one version number
- Withdraw superseded copies from bags and classrooms
- Controlled copy: EMERGILITY® training records

Treat the patient, not the monitor · Pulse? · Causing compromise? · QRS narrow or wide? · Regular or irregular?

SYSTEMATIC READ

Same order, every strip

Six Steps

- Rate** — atrial and ventricular; separate if they differ
- Regularity** — march out R-R and P-P: regular, regularly irregular (grouped), irregularly irregular
- P waves** — present? upright in II? one per QRS? same shape? hidden in T? flutter / fib waves?
- PR interval** — 0.12–0.20 s; constant, lengthening, or no relationship?
- QRS** — narrow <0.12 s = supraventricular; wide ≥0.12 s = ventricular, BBB, aberrancy, pre-excitation, paced, ↑K⁺ / Na-channel toxicity
- QT, ST & T** — correct QT for rate; note ST ↑/↓ and T inversion; confirm on 12-lead

Always Check

- P before every QRS? QRS after every P?
- PR for AV blocks · QRS width for BBB
- Axis outside normal? Rule out hemiblock
- Scan the whole strip for pauses, premature beats, abnormal waves

Name the rhythm only after all six steps.

Confirm asystole in a second lead and check gain.

RATE

Regular, irregular, slow

Sequence Method (regular)

Start at an R wave on a heavy line. Name the next heavy lines:

300 150 100 75 60 50

The next R wave falls on the rate.

Exact Calculation

- 300 ÷ large boxes between R waves
- 1,500 ÷ small boxes between R waves

Irregular or Slow

- QRS complexes in a 6-second strip × 10
- 10 large boxes between beats = 30/min
- AF and other irregular rhythms: report the average ventricular rate

Rate Thresholds

- <60 bradycardia · <50 usual cutoff for symptomatic bradyarrhythmia
- >100 tachycardia · ≥150 usual cutoff for a primary tachyarrhythmia
- Sinus tach >150 in an adult: look hard for flutter 2:1 or SVT

Co-existing Rates

AV dissociation: P waves and QRS march independently. Measure atrial and ventricular rates separately.

PAPER & INTERVALS

25 mm/s · 10 mm/mV

Measure	Normal
Small box	0.04 s · 0.1 mV
Large box	0.20 s · 0.5 mV
6-sec strip	30 large boxes
P wave	≤0.11 s · ≤2.5 mm; upright I, II, aVF
PR interval	0.12–0.20 s
QRS	<0.12 s (normal ≤0.10)
QTc	Men <0.45 s · Women <0.46 s

Interval Flags

- Short PR** (<0.12) — pre-excitation (WPW) or junctional
- Long PR** (>0.20) — AV block
- QRS 0.10–0.12** — incomplete or nonspecific delay
- QTc >0.50 s** — high torsades risk

QT Correction

$$QTc = QT \div \sqrt{RR} \text{ (Bazett)}$$

Bazett overcorrects at fast rates. Bedside rule: a QT longer than half the R-R interval is prolonged.

Long QT? Avoid ondansetron, haloperidol, droperidol, amiodarone, procainamide where possible; correct K⁺ and Mg²⁺.

AXIS

Leads I and aVF first

I	aVF	Axis
↑	↑	Normal –30° to +90°
↑	↓	Left (LAD) if II also ↓; –30° to –90°
↓	↑	Right (RAD) +90° to +180°
↓	↓	Extreme –90° to ±180°

I ↑ / aVF ↓ but II upright = still normal (0° to –30°). Degrees: find the most isoelectric limb lead; axis runs 90° from it.

Common Causes

- LAD** — LAFB, LVH, inferior MI, paced, WPW
- RAD** — RVH, PE, COPD, LPFB, lateral MI, limb-lead reversal
- Extreme** — VT, hyperkalemia, lead reversal

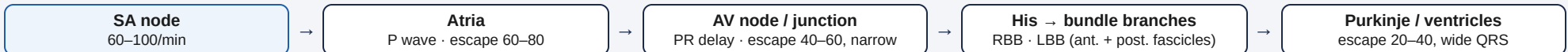
New extreme axis in a wide-complex tachycardia strongly favors VT.

Precordial Transition

R grows V1 → V6; R = S near V3–V4.

- Early** (V1–V2) — posterior MI, RVH, RBBB
- Late** (V5–V6) — anterior MI, LVH, lead misplacement

Conduction System & Escape Rates — lower pacemakers are slower and take over only when higher ones fail



Accessory pathway (WPW) bypasses the AV node: short PR + delta wave. **Never suppress an escape rhythm** — it is the backup keeping the patient alive.

Rhythm ID Grid — QRS width × regularity

	Regular	Irregular
Narrow <0.12 s	Sinus tach · SVT (AVNRT/AVRT) · atrial flutter 2:1 · atrial tach · junctional tach	AF · flutter with variable block · MAT · sinus with PACs
Wide ≥0.12 s	VT until proven otherwise · SVT with BBB · paced · hyperkalemia · Na-channel toxicity	Pre-excited AF (WPW) · AF with BBB · polymorphic VT / torsades

Artifact Pitfalls · Instability

- Tremor** mimics AF/flutter — QRS still regular
 - CPR, seizure, motion** mimic VF — check a pulse
 - Lead off / low gain** mimics asystole — 2nd lead
- Instability:** hypotension · AMS · shock · ischemic chest pain · acute heart failure.

Monitoring Leads · Weight

II best P waves · **MCL₁**: (–) under L clavicle, (+) 4th ICS R sternal border — mimics V1, separates RBBB/LBBB and aberrancy/VT · **MCL₆**: (+) at V6. Label every saved strip.

Weight: kg = lb ÷ 2.2 (180 lb → half 90 – 9 = 81 kg).

ECG Waveform, Paper & Intervals

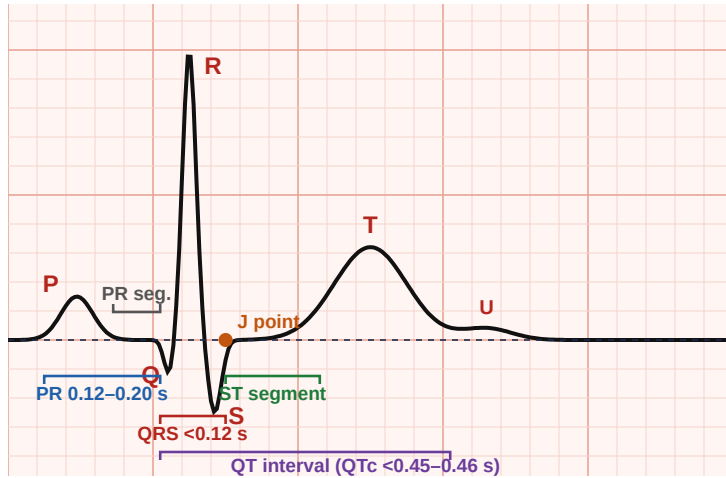
What each wave means — electrically and physically · how to measure time and voltage



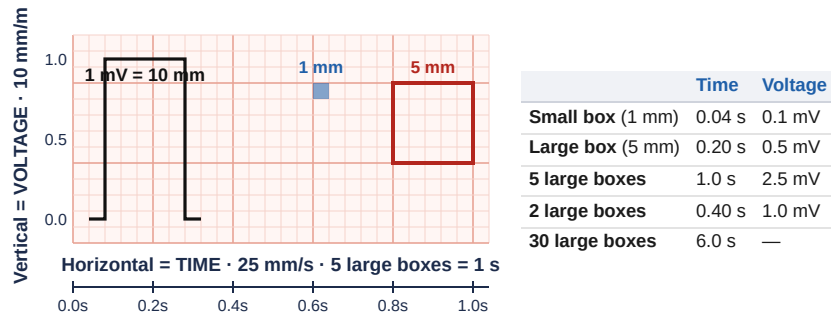
Electrical activity comes first, mechanical contraction follows · Atrial repolarization hides inside the QRS · Electricity without a squeeze = PEA

THE CARDIAC CYCLE ON PAPER

One beat · lead II · 25 mm/s · 10 mm/mV



READING THE GRID



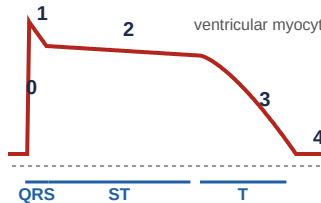
Naming the QRS: Q = first downward deflection before an R · R = any upward deflection · S = downward after an R · R' = second upward deflection · capital letters = large, lowercase = small (e.g., rSR', qR, QS).

WAVE BY WAVE

Electrical event → physical (mechanical) event

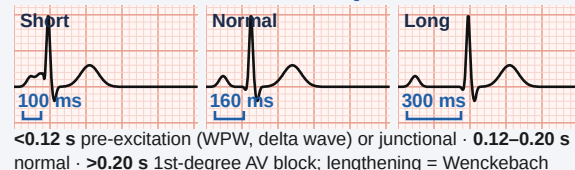
Wave	Electrical — what the current is doing	Physical — what the heart is doing	Normal
P wave	SA node fires; depolarization spreads across both atria (right first, then left)	Atria contract (atrial kick, ~20% of ventricular filling)	≤0.11 s; ≤2.5 mm; upright in I, II, aVF
PR segment	Impulse delayed in the AV node, then down the His bundle and bundle branches	Ventricles finish filling; AV valves still open	Isoelectric; depressed in pericarditis
Q wave	Septum depolarizes first, left to right	Start of ventricular depolarization	Small septal q in I, aVL, V5–V6 is normal
R wave	Main ventricular mass (apex and free walls) depolarizes via Purkinje fibers	Ventricles begin to contract; AV valves close (S1)	Grows V1 → V6; transition V3–V4
S wave	Last areas to depolarize: base of the ventricles and posterior wall	Isovolumetric contraction finishes; ejection begins	Deep in V1–V2, small in V5–V6
J point / ST	Ventricles fully depolarized; plateau phase (phase 2), no net current	Ventricles ejecting blood	Isoelectric; measure ST deviation at the J point
T wave	Ventricular repolarization (epicardium to endocardium)	Ejection ends, relaxation begins; aortic and pulmonic valves close (S2) near its end	Same direction as the QRS; ≤5 mm limb, ≤10 mm precordial
U wave	Late repolarization (Purkinje fibers / mid-myocardium)	Early ventricular relaxation	Small; prominent in hypokalemia, bradycardia

Action Potential → ECG → Drugs

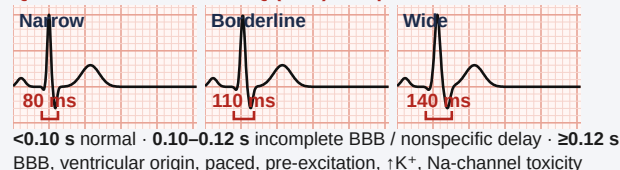


Phase	Ions	ECG	Drugs acting here
0	Na ⁺ rushes in	QRS	Na-blockers (lidocaine, procainamide, TCAs) widen QRS
1	K ⁺ out (brief)	J point	Brugada pattern
2 plateau	Ca ²⁺ in, K ⁺ out	ST segment	Calcium stabilizes it in ↑K ⁺
3 repol.	K ⁺ out	T wave / QT	Amiodarone, sotalol, procainamide ↑ QT
4 rest	Na ⁺ /K ⁺ pump; pacemaker leak	TP	Slope sets rate (β-blockers, adenosine, atropine); nodal phase 0 is Ca ²⁺ → diltiazem

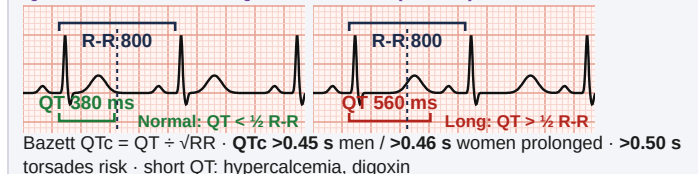
PR Interval — start of P to start of QRS



QRS Duration — start of Q (or R) to J point



QT Interval — start of QRS to end of T (rate 75)



Leads, Axis & Wide-Complex Tachycardia

Electrodes · Validation · 15-Lead · Axis & Hemiblocks · BBB · VT vs. SVT



A monitor lead watches the rhythm; a 12-lead assesses the heart · Get a 12-lead on every patient with a pulse and a cardiac problem — STEMI, tachy, brady, or block

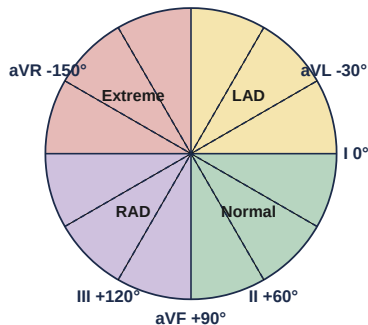
LIMB LEADS

Where each lead "looks" from

Lead	(-) → (+)	Angle
I	RA → LA	0°
II	RA → LL	+60°
III	LA → LL	+120°
aVR	→ right arm	-150°
aVL	→ left arm	-30°
aVF	→ left foot	+90°

Einthoven's law: Lead I + Lead III = Lead II (net QRS amplitudes).

Current moving **toward** a positive electrode writes an upright wave; **away** writes a negative one; **perpendicular** is isoelectric.



Electrode Colors (AHA)

RA **white** · LA **black** · LL **red** · RL **green**
"White on right · smoke over fire · clouds over grass"

ACQUIRE & VALIDATE

Before you read it, prove it's real

First-Pass Quality

- Position of comfort is acceptable; keep it consistent on serials
- Clip hair, dry diaphoresis, light abrasion for "noisy data"
- Limb leads on the limbs** (off the shoulders, below the inguinal ligament) — torso placement alters angle and amplitude
- Shaking or cold patient: hold the hands still, warm the patient

Validate the Tracing

- Lead I all negative** (P, QRS, T inverted) → arm electrodes reversed (dextrocardia is the rare exception)
- aVR** should be mostly negative
- R-wave progression:** R grows V1 → V6, transition V3–V4. Poor progression → check placement before calling pathology
- Computer intervals are usually reliable; its **interpretation** can be wrong — read it yourself

15-Lead in 20 Seconds

- Run the standard 12-lead
- Move **V4** → **V4R**, **V5** → **V8** (mid-scapular), **V6** → **V9** (paraspinal), 5th ICS level
- Run a second 12-lead
- Relabel** V4, V5, V6 as V4R, V8, V9 on the printout

Run it on: every inferior STEMI (before nitro), ST ↓ V1–V3, and a nondiagnostic 12-lead with ischemic symptoms. ≥1 mm ST ↑ in V4R = RV infarct; ≥0.5 mm in V7–V9 = posterior MI.

AXIS · HEMIBLOCK · BBB

Leads I, II, III and V1

Axis	I	II	III	Think
Normal 0° to +90°	↑	↑	↑	—
Physiologic left 0° to -30°	↑	↑	↓	Normal variant
Pathologic left -30° to -90°	↑	↓	↓	LAFB , inferior MI, LVH
Right +90° to +180°	↓	↑	↑	LPFB , RVH, PE
Extreme	↓	↓	↑/↓	Ventricular origin

Right axis is normal in infants and young children; in adults it is pathologic until proven otherwise.

BBB "Turn Signal" — V1, QRS ≥0.12 s

Look at the **terminal** part of the QRS in V1: **up** (rSR') = right turn = **RBBB**; **down** (QS / rS) = left turn = **LBBB**. You cannot reliably call BBB from lead II.

"Block Twice" = Complete Block Risk

- Mobitz II · 3rd degree · bifascicular block
- 1st degree + hemiblock · 1st degree + BBB

If the read says "block" twice: **pads on**, ready to pace, and don't suppress PVCs or escape beats with antiarrhythmics. A new hemiblock or BBB with ACS suggests a proximal occlusion and higher mortality.

WIDE & FAST: VT OR SVT?

Pulseless? Shock it. Stable? Look closer.

Default: a regular wide-complex tachycardia is VT until proven otherwise. Prior MI or structural heart disease + new WCT strongly favors VT. Lead II alone misleads.

Clues That Favor VT

- AV dissociation**, fusion or capture beats
- Extreme ("northwest") axis**
- Precordial concordance** — V1–V6 all up or all down
- V1 upright:** monophasic R, qR, or left "rabbit ear" taller than right
- V1 negative:** initial r >40 ms, or slurred/notched S downstroke (onset to S nadir >60 ms)
- V6:** QS or rS (mostly negative)
- aVR:** initial R wave (Verecke)
- QRS >0.16 s

Clues That Favor SVT With Aberrancy

- Typical RBBB or LBBB morphology; same QRS as a prior ECG
- Rate-related BBB that appears and disappears with rate
- Irregularly irregular → AF with BBB (or pre-excited AF if bizarre and >200)

Unstable → synchronized cardioversion. Stable, regular, monomorphic → adenosine is acceptable as a diagnostic step, then procainamide or amiodarone.

Coronary Supply → What to Expect

RCA — RV, inferior LV, SA node (~60%), AV node (~90%); inferior MI brings sinus brady and **nodal** AV block (usually transient, atropine-responsive) plus RV infarct. **LAD** — anterior LV, septum, bundle branches: anterior MI brings **infranodal** block, BBB, pump failure. **LCx** — lateral and (left-dominant) posterior LV, SA node (~40%).

AV Block Memory Aid

1st — long PR, every beat conducts.

Mobitz I — PR stretches, stretches, then a beat drops.

Mobitz II — PR steady, then a beat drops without warning.

3rd — P waves and QRS keep separate time.

ACS Clinical Clues

A normal 12-lead never rules out MI — repeat every 10–15 min. Pain at rest or unrelieved by nitro suggests a tighter or complete occlusion. Inferior MI or nondiagnostic 12-lead: run the 15-lead **before** nitrates.

Lead Misplacement Patterns — fix and re-run before reading

Swap	What you see
RA ↔ LA	Lead I fully inverted (P, QRS, T); aVR upright; II and III trade places
LA ↔ LL	Subtle: lead III inverted; I and II trade places; P taller in I than II
RA ↔ LL	II and aVF inverted; aVR upright
Right-leg (ground) swap	One limb lead nearly flat (II or III)
Precordial swap	R-wave progression breaks abruptly, then resumes

aVR Algorithm (Verecke) — wide-complex tachycardia

- Initial R wave in aVR?** → VT
- Initial r or q in aVR >40 ms wide? → VT
- Notch** on the down-stroke of a mainly negative QRS in aVR? → VT
- Voltage in first 40 ms ≠ last 40 ms (**V1/Vt ≤1**)? → VT
- None of the above → SVT with aberrancy

Any "yes" stops the algorithm. When unsure, treat as VT.

Axis, Hemiblocks & BBB

What each limb lead tells you · illustrative patterns · V1/V6 morphology · rabbit ears · concordance



Upright QRS = current flowing toward that lead's positive pole · Downward = flowing away · Equal up and down (isoelectric) = flowing at 90° to that lead

EVERY LIMB LEAD, DECODED

* aVR turns upright in extreme axis, dextrocardia, lead reversal, VT

Lead	+ pole	Upright QRS means vector points...	Negative means...	In LAD	In RAD
I	0°	Toward patient's left	Toward the right	Up	Down
II	+60°	Toward left leg (down-left)	Up and to the right	Down	Up
III	+120°	Toward right leg (down-right)	Up and to the left	Down	Up
aVR	-150°	Toward right shoulder — abnormal	Normal (away from aVR)	Down	Down*
aVL	-30°	Toward left shoulder	Down and to the right	Up	Down
aVF	+90°	Straight down (inferior)	Upward (superior)	Down	Up

Illustrative QRS Patterns

Axis	I	II	III	aVF
Normal (~+60°)				
LAD (~-60°)				
RAD (~+120°)				
Extreme (~-150°)				

WHAT THE AXIS MEANS — EXAMPLES

- 68-year-old, chest pain, axis -55°, QRS 0.09 s, qR in aVL: LAFB. With ACS it implies a proximal LAD lesion — pads on.
- 22-year-old tall athlete, axis +100°: RAD can be normal in the young and thin; in an older adult it needs a cause.
- Sudden dyspnea, new RAD + S1Q3T3 + sinus tach: right-heart strain — think PE.
- COPD, RAD, tall R in V1: RVH / cor pulmonale.
- Wide tachycardia, axis -150° (I and aVF both down): extreme axis = VT until proven otherwise.
- Inferior MI with axis -40°: Q waves in II, III, aVF can drag the axis left; don't call LAFB without qR in aVL and rS in II, III, aVF.

HEMIBLOCKS (FASCICULAR)

QRS <0.12 s unless combined with RBBB

Left Anterior (LAFB)

- Axis -45° to -90°
- qR in I and aVL; rS in II, III, aVF
- R-peak time in aVL ≥45 ms
- Single blood supply (LAD) — common

Left Posterior (LPFB)

- Axis +90° to +180°
- rS in I and aVL; qR in III and aVF
- Exclude RVH, PE, lateral MI, thin habitus
- Dual supply (LAD + PDA) — rare; when it appears with ACS, the infarct is large

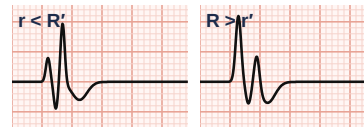
Combinations

- Bifascicular:** RBBB + LAFB (most common) or RBBB + LPFB
- Bifascicular + 1st-degree block:** conduction left in one fascicle — high risk of complete block
- Alternating RBBB/LBBB:** trifascicular disease — pace

Any "block twice" pattern with syncope or ACS: **pads on**, avoid antiarrhythmics for PVCs, be ready to pace.

RABBIT EARS

Two R peaks in V1 — which ear is taller?



Right ear taller (rSR') → typical RBBB → favors SVT with aberrancy.

Left ear taller (Rsr') in a wide tachycardia → favors VT. Monophasic R or qR in V1 also favors VT.

Why concordance means VT: the impulse starts in the ventricle and spreads front-to-back (or back-to-front) without using the bundles, so every chest lead sees it the same way. Highly specific for VT, but present in only a minority of VT — its absence does not rule VT out.

BBB MORPHOLOGY — V1 AND V6

"Turn signal": terminal QRS in V1 up = right, down = left

	V1	V6	Criteria
Normal			rS in V1 · qR in V6
RBBB			rSR' in V1 (terminal UP) · wide slurred S in I, V6 · T inverted V1-V3
LBBB			QS / rS in V1 (terminal DOWN) · broad notched R in I, aVL, V6, no septal q · discordant ST-T
Incomplete RBBB			rSR' in V1 with QRS 0.10-0.12 s

LBBB hides infarct patterns — use **modified Sgarbossa**. New LBBB alone is no longer a STEMI equivalent; activate for Sgarbossa-positive or unstable patients.

PRECORDIAL CONCORDANCE

V1 → V6 in a wide-complex tachycardia

Pattern · meaning	V1	V2	V3	V4	V5	V6
Normal progression R grows, S shrinks; transition V3-V4						
Positive concordance All QRS upright V1-V6 → VT (or posterior pre-excitation)						
Negative concordance All QRS negative V1-V6 → VT, almost always						
V1 up · V6 down Wide, fast, V1 positive and V6 negative → VT						

Rhythm Reference I

Sinus · Atrial · Junctional — rates are ventricular unless stated



Treat a rhythm only when it is causing compromise · "Brady" / "Tachy" = the 2025 AHA algorithms on Sheet 13

SINUS SA node · upright P in II · 1:1 conduction · PR 0.12–0.20 s · narrow QRS

Rhythm	Rate	Regularity	Key feature	Treatment
Normal sinus rhythm	60–100	Regular	Baseline	None
Sinus bradycardia	<60	Regular	Normal in athletes and during sleep	Compromise (usually <50): Brady algorithm
Sinus tachycardia	100–150	Regular	Gradual onset; rate varies with activity and treatment	Treat cause: pain, fever, hypovolemia, hypoxia, sepsis, PE. Never cardiovert
Sinus arrhythmia	60–100	Phasic with breathing	R-R varies >0.16 s; all P waves identical; normal	None
Sinus pause / arrest	Underlying	Irregular	Pause NOT a multiple of P-P; escape beat may end it	Compromise: Brady algorithm. Pauses >3 s need evaluation
SA exit block	Underlying	Irregular	Pause IS an exact multiple of P-P	Compromise: Brady algorithm
Sick sinus syndrome	Variable	Irregular	Brady, pauses, and atrial tachyarrhythmias alternate	Brady algorithm when slow; avoid AV nodal blockers; needs pacemaker

ATRIAL Ectopic atrial focus · P wave differs from sinus P · usually narrow QRS

Rhythm	Rate	Regularity	Key feature	Treatment
Premature atrial complex	Underlying	Early beats	Early, different P (may hide in T); blocked PAC mimics a pause	Remove triggers (caffeine, stimulants, hypoxia)
Atrial tachycardia (focal)	150–250	Regular	Non-sinus P before each QRS; warm-up / cool-down	Tachy algorithm — narrow, regular
Multifocal atrial tach (MAT)	>100	Irreg. irregular	≥3 P-wave shapes, varying PR; COPD, hypoxia; mimics AF	Treat cause (O ₂ , electrolytes); Mg may help. Do not cardiovert
Wandering atrial pacemaker	<100	Slightly irregular	≥3 P shapes, varying PR — MAT at a normal rate	None (not adenosine-responsive)
Atrial flutter	A 250–350 · V ~150 (2:1)	Regular or variable	Sawtooth F waves in II, III, aVF, V1; regular narrow at ~150 = flutter until proven otherwise	Unstable: sync ≥200 J. Stable: diltiazem or metoprolol
Atrial fibrillation	A 350–600 · V varies (>100 = RVR)	Irreg. irregular	No P waves; fibrillatory baseline; onset >48 h = stroke risk	Unstable: sync ≥200 J. Stable RVR: diltiazem or metoprolol. Never adenosine
Pre-excited AF (AF + WPW)	Often >200	Irreg. irregular	Fast, wide, bizarre; QRS width varies beat to beat; can → VF	Unstable: sync. Stable: procainamide. No AV nodal blockers (adenosine, CCB, β-blocker, digoxin, amiodarone)

JUNCTIONAL AV junction · retrograde P inverted in II, III, aVF — Before (PR <0.12), During (hidden), or After the QRS

Rhythm	Rate	Regularity	Key feature	Treatment
Premature junctional complex	Underlying	Early beats	Early narrow beat; inverted or absent P	None; find the cause
Junctional bradycardia	<40	Regular	Below the junction's intrinsic rate	Compromise: Brady algorithm
Junctional escape rhythm	40–60	Regular	Junction takes over when the SA node fails	Compromise: Brady algorithm. Do not suppress
Accelerated junctional	60–100	Regular	Think digoxin toxicity, inferior MI, post-cardiac surgery	Treat the cause
Junctional tachycardia	>100	Regular	Hard to separate from other SVT	Tachy algorithm — narrow, regular
Reentrant SVT (AVNRT / AVRT)	150–250	Regular	Abrupt on / off; P hidden or just after QRS	Modified Valsalva (preferred) → adenosine 12 mg once → sync cardioversion 50–100 J (sedate) OMD

Narrow + Regular + ~150?

Look for flutter waves in II, III, aVF, V1. Adenosine may slow the rate enough to unmask F waves — it will not convert flutter.

Treat the Ventricular Rate

In AF and flutter, the ventricular response decides treatment: <60 slow · 60–100 controlled · >100 rapid (RVR).

Modified Valsalva — preferred first line **OMD**

For patients who can follow instructions and tolerate the position change: semi-recumbent, strain against a 10 mL syringe or 40 mmHg for 15 s, then lie flat with legs raised 45° for 15 s.

Rhythm Reference II

AV Blocks · Ventricular · Arrest · Paced & Pre-excitation



Always check: is every P followed by a QRS? · Is the PR under one large box? · Is the QRS under 3 small boxes?

AV BLOCKS

Delay or failure of atrial impulses reaching the ventricles

Block	Recognition	Treatment
1st degree	PR >0.20 s, constant; 1:1. A delay, not a block	None; watch with inferior MI or nodal drugs
2nd degree type I (Mobitz I, Wenckebach)	PR lengthens until a QRS drops; grouped beating; P-P constant. Block at the AV node; common in inferior MI	Compromise: Brady algorithm. Atropine usually works
2nd degree type II (Mobitz II)	PR constant, then a P with no QRS; QRS often wide. Infranodal; can jump to complete block	Pads on. Compromise: pace early. Atropine often fails
2:1 AV block	Two P per QRS, PR constant. Can't call I vs II from one strip: narrow = nodal, wide = infranodal	Treat by stability and QRS width
3rd degree (complete)	P waves march through; no P-QRS relationship; atrial rate > ventricular. Escape narrow 40–60 (junctional) or wide 20–40 (ventricular)	Pads on; pace for compromise. Atropine rarely works with wide escape

ARREST RHYTHMS

No pulse — Cardiac Arrest algorithm, Sheet 13

Rhythm	Strip	Pathway
VF / pulseless VT	Chaotic baseline (coarse or fine), or wide regular complexes with no pulse	Shockable
PEA	Any organized rhythm, no palpable pulse. Narrow → mechanical cause (tamponade, tension PTX, PE, hypovolemia). Wide → metabolic or toxic (K ⁺ , Na-channel blockers)	Nonshockable; epinephrine ASAP; Hs & Ts
Asystole	Flat line. Confirm in a 2nd lead; check gain and leads	Nonshockable
P-wave asystole	P waves, no QRS (ventricular standstill)	As asystole if pulseless; pacing not effective in arrest (2025)
Agonal rhythm	Slow, wide, irregular complexes <20/min	As PEA / asystole

Escape rhythms are lifelines. Never give an antiarrhythmic to a junctional or idioventricular escape — pace or speed it up instead.

VENTRICULAR

No P before QRS · QRS ≥0.12 s · T wave opposite the QRS

Rhythm	Recognition	Treatment
PVC	Early wide beat, full compensatory pause. Patterns: bigeminy, trigeminy, couplets, multiform, R-on-T	Treat cause (ischemia, hypoxia, K ⁺ , Mg ²⁺); routine suppression not indicated
Idioventricular	20–40, regular, wide; ventricular escape	Pulse + compromise: pace. No pulse: PEA
Accelerated idioventricular (AIVR)	40–100, regular, wide; reperfusion rhythm after PCI or ROSC	Usually none; do not suppress
Monomorphic VT with pulse	100–250, regular, uniform wide complexes; AV dissociation, fusion and capture beats confirm VT	Unstable: sync 100 J+. Stable: procainamide or amiodarone
Polymorphic VT / torsades	150–300, irregular; QRS twists around baseline. Torsades = with long QT	Unsynchronized shock if unstable; Mg 1–2 g; stop QT drugs
VF	No measurable rate; chaotic, no QRS	Shockable pathway

PACED · PRE-EXCITATION · CHANNELOPATHY

Wide or odd QRS with a pulse

Pattern	ECG	Relevance
Ventricular paced	Spike → wide QRS (LBBB-like from RV lead)	Check capture, sensing, pacing; Sgarbossa for ischemia
Atrial / dual-chamber	Spike → P; spike → QRS after programmed delay	Same troubleshooting
Wolff-Parkinson-White	Short PR <0.12 s, delta wave, wide QRS	With AF: no nodal blockers. Orthodromic SVT: adenosine OK
Brugada pattern	Coved ST ↑ ≥2 mm V1–V2, inverted T	Polymorphic VT risk; fever unmasks it
Long QT	QTc >0.47–0.50 s	Torsades risk; avoid QT-prolonging drugs

Demand pacemakers fire below the set rate, are inhibited when the intrinsic rate is faster, and reset after a premature beat — absent spikes at a normal rate are expected. Modes: **AAI** atrial · **VVI** ventricular · **DDD** both. A magnet usually forces asynchronous pacing; on an ICD it suspends shocks, not pacing.

Failure to capture



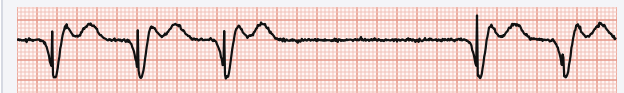
Spike with no QRS after it. Check pads/leads, raise output; battery or lead problem; ↑K⁺, ischemia raise threshold.

Failure to sense (undersensing)



Spikes fire regardless of the patient's own beats — may land on T (R-on-T risk). Device check; magnet behavior per device.

Oversensing / failure to pace



Pause with no spike — the device sees noise as beats. Muscle, EMI, or lead fracture. TCP backup if symptomatic.

Rhythm Strip Atlas I

Schematic lead II strips · 6 seconds · 25 mm/s · count QRS × 10 for rate



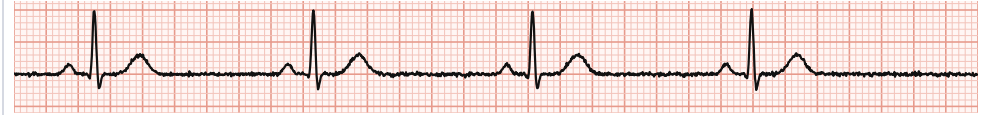
Rate · Regularity · P waves · PR · QRS — apply the six-step read to every strip before you name it

Normal sinus rhythm



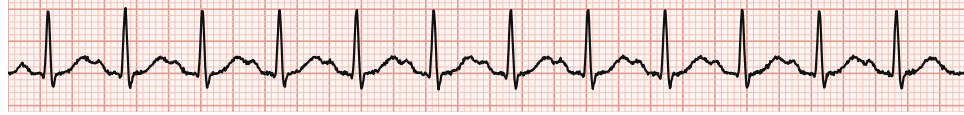
~75 · regular · upright P before every QRS · PR 0.16 · narrow

Sinus bradycardia



~44 · regular · normal P/PR · treat only if causing compromise

Sinus tachycardia



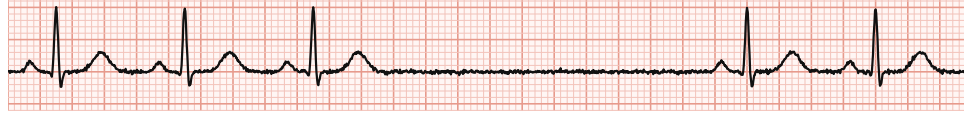
~125 · regular · P before each QRS · gradual onset; treat cause

Sinus arrhythmia



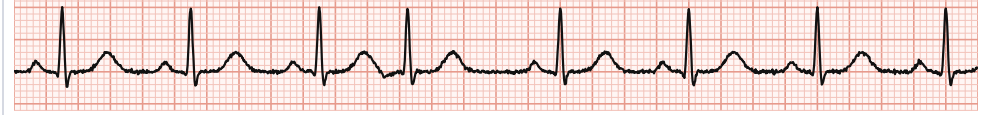
~75 · phasic R-R variation · identical P waves · normal

Sinus pause / arrest



~65 · 2.7-s pause not a multiple of P-P · escape may follow

Premature atrial complex



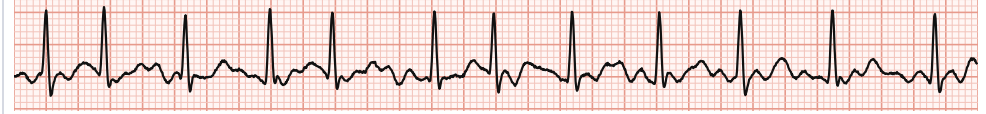
~75 · early beat with a different P · non-compensatory pause

Atrial flutter, 4:1



A 300 / V ~75 · sawtooth F waves · no measurable PR

Atrial fibrillation with RVR



~125 · irregularly irregular · fibrillatory baseline, no P

Multifocal atrial tachycardia



~115 · irregular · ≥3 P-wave shapes and PR intervals

Supraventricular tachycardia



~180 · regular · narrow · P not visible

Junctional escape rhythm



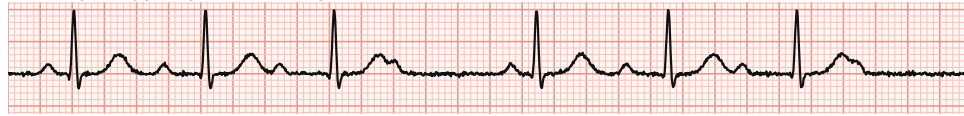
~48 · regular · narrow · retrograde (inverted) P after QRS

First-degree AV block



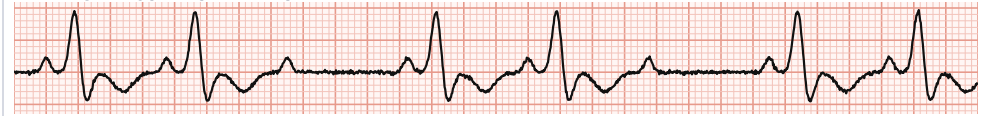
~70 · regular · PR 0.32 s, constant · every P conducts

2nd-degree type I (Wenckebach)



PR lengthens 0.16 → 0.34 then a P drops · grouped beating

2nd-degree type II (Mobitz II)

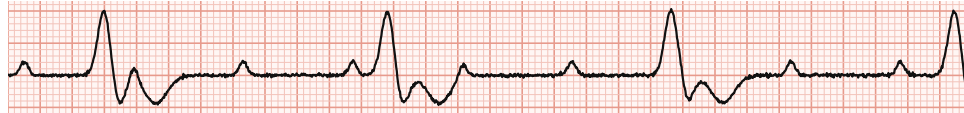


Constant PR · every 3rd P not conducted · wide QRS

Strips are computer-generated teaching schematics: time scale is true (1 small box = 0.04 s); amplitude is scaled to fit. Practice versions without labels are in the Practice & Assessment Package.

Rate · Regularity · P waves · PR · QRS — apply the six-step read to every strip before you name it

Third-degree (complete) AV block



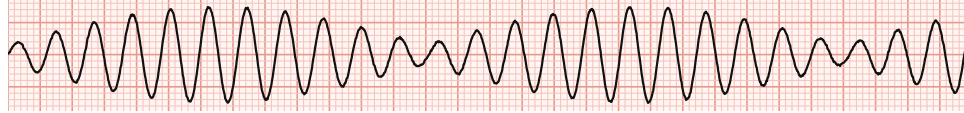
A ~88 / V ~34 · P waves march through · wide escape

Multiform PVCs with couplet



PVCs of different shapes · two in a row = couplet

Polymorphic VT / torsades de pointes



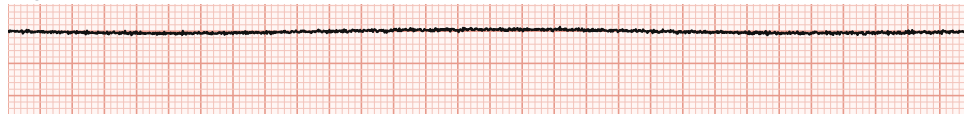
~250 · QRS twists around baseline · long QT setting

Ventricular fibrillation, fine



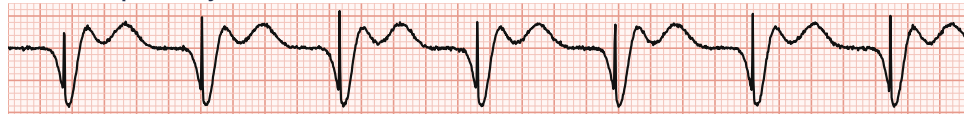
Low-amplitude chaos · confirm not asystole · shockable

Asystole



Flat line · confirm in a 2nd lead, check gain

Ventricular paced rhythm



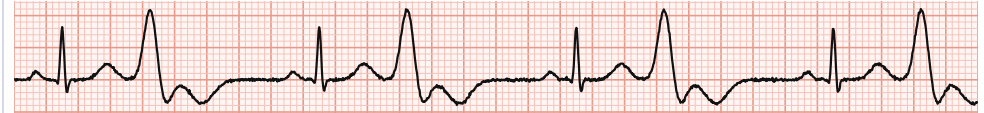
~70 · spike then wide QRS · 100% capture

Hyperkalemia



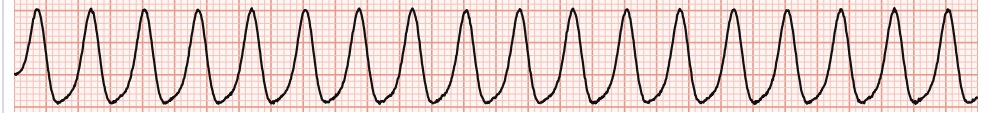
Flat P · widened QRS · tall peaked T waves

Ventricular bigeminy



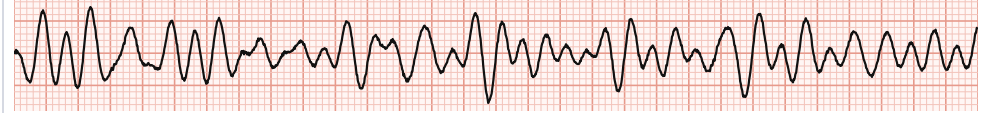
Every other beat a wide PVC with opposite T wave

Monomorphic ventricular tachycardia



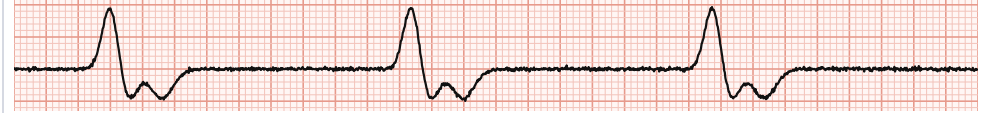
~180 · regular · wide, uniform · no P waves

Ventricular fibrillation, coarse



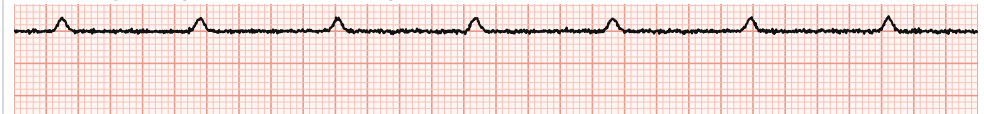
Chaotic, no QRS · shockable

Idioventricular rhythm



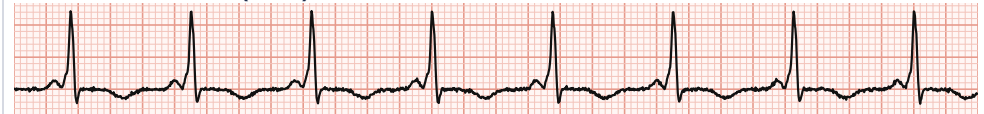
~32 · regular · wide · no P · ventricular escape

P-wave asystole (ventricular standstill)



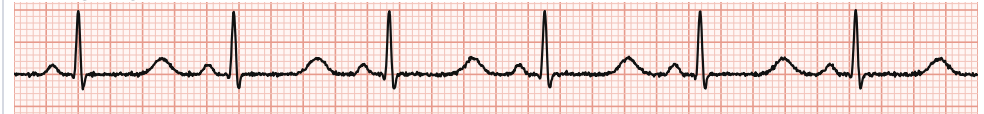
P waves ~70 · no QRS · pulseless = asystole pathway

Wolff-Parkinson-White (sinus)



~80 · short PR · slurred delta upstroke · wide QRS

Prolonged QT



~62 · QT ≈ 0.60 s (more than half the R-R) · torsades risk

Strips are computer-generated teaching schematics: time scale is true (1 small box = 0.04 s); amplitude is scaled to fit. Practice versions without labels are in the Practice & Assessment Package.

12-lead within 10 min of first contact · Transmit · Repeat every 15–30 min or with any change · Compare with a prior ECG when available

ACQUIRE

Placement drives accuracy

Lead	Position
V1	4th ICS, right sternal border
V2	4th ICS, left sternal border
V3	Midway V2 → V4
V4	5th ICS, midclavicular
V5	Anterior axillary, level V4
V6	Midaxillary, level V4
V4R	5th ICS, right midclavicular
V7–V9	Level V6: post. axillary, mid-scapular, paraspinal

- Limb electrodes on limbs or proximal torso; torso placement shifts axis and can mimic infarct
- V3–V6 under the breast, not on it

Get Extra Leads When

- **V4R** — every inferior STEMI (before nitro)
- **V7–V9** — ST depression V1–V3 or ischemic symptoms with a nondiagnostic 12-lead

Indications

Chest pain or anginal equivalent, syncope, unexplained dyspnea, weakness or diaphoresis in elderly / diabetic / female patients, post-ROSC.

STEMI CRITERIA

Two contiguous leads, at the J point

Region	Leads	Artery
Inferior	II, III, aVF	RCA (~80%) / Cx
Septal	V1, V2	LAD
Anterior	V3, V4	LAD
Lateral	I, aVL, V5, V6	Cx / diagonal
RV	V4R (± V1)	Proximal RCA
Posterior	V7–V9	Cx or RCA

ST Elevation Thresholds

- All leads except V2–V3: ≥ 1 mm
- V2–V3: ≥ 2 mm men ≥ 40 · ≥ 2.5 mm men < 40 · ≥ 1.5 mm women
- V7–V9: ≥ 0.5 mm
- V4R: ≥ 1 mm

Reciprocal Change

Inferior STEMI → ST ↑ in I, aVL. Lateral STEMI → ST ↓ in III, aVF. Reciprocal depression supports true occlusion over a mimic.

Inferior + RV = preload dependent. Avoid nitrates; fluid bolus for hypotension.

OMI EQUIVALENTS

Occlusion without STEMI millimeters

- **Hyperacute T** — broad, tall, symmetric, bulky vs. QRS; earliest sign
- **De Winter** — upsloping ST ↓ > 1 mm V1–V6 + tall T; proximal LAD
- **Wellens A / B** — biphasic (A) or deep inverted (B) T in V2–V3, often pain-free; critical LAD stenosis
- **Posterior MI** — ST ↓ V1–V3, tall R, upright T; confirm V7–V9
- **aVR ↑ + diffuse ST ↓** (≥ 6 leads) — left main / 3-vessel or severe demand
- **High lateral** — ST ↑ I, aVL, V2 with ST ↓ III; first diagonal

Modified Sgarbossa

LBBB or ventricular paced — any one suggests occlusion:

1. Concordant ST ↑ ≥ 1 mm where QRS is positive
2. Concordant ST ↓ ≥ 1 mm in V1–V3
3. Discordant ST ↑ $\geq 25\%$ of preceding S-wave depth (ratio ≤ -0.25)

Treat De Winter, posterior MI, and positive Sgarbossa as STEMI equivalents for activation.

STEMI MIMICS

Consider — never delay transmission

- **Early repolarization** — J-point notch, concave ST ↑ V2–V5, no reciprocal change, stable on serials
- **Pericarditis** — diffuse concave ST ↑ across territories, PR ↓ (PR ↑ in aVR)
- **LVH** — tall voltage; ST ↑ V1–V3; lateral strain
- **LBBB / paced** — expected discordance; apply Sgarbossa
- **Brugada** — coved ST ↑ ≥ 2 mm V1–V2
- **Hyperkalemia** — peaked T, wide QRS, pseudo-STEMI
- **LV aneurysm / Takotsubo** — persistent ST ↑ after old MI; stress apical ballooning; can't exclude in field

Infarct Evolution

Hyperacute T → ST ↑ (injury) → Q waves (necrosis) → T inversion as ST returns to baseline.

- **Pathologic Q:** ≥ 0.03 s and ≥ 1 mm deep in 2 contiguous leads, or any Q ≥ 0.02 s in V2–V3. Ignore aVR
- ST ↑ + Q = acute/recent; Q alone = old until proven otherwise
- **Ischemic T inversion** is symmetric; asymmetric = strain

Bundle Branch Blocks (QRS ≥ 0.12 s)

RBBB — rSR' "rabbit ears" V1–V2; wide slurred S in I, V6; T inversion V1–V3 expected. New RBBB: think PE or anterior ischemia.

LBBB — broad notched R in I, aVL, V5–V6; deep QS / rS V1; no lateral septal q. Use Sgarbossa; LVH voltage unreliable.

Fascicular Blocks (QRS < 0.12 s)

LAFB — LAD $\leq -45^\circ$; qR in I, aVL; rS in II, III, aVF. Most common.

LPFB — RAD $+90^\circ$ to $+180^\circ$; rS in I, aVL; qR in III, aVF. Exclude RVH, PE, lateral MI first.

Bifascicular — RBBB + LAFB or LPFB. With syncope or new 1st-degree block: pads on.

Chamber Enlargement

RAE — P ≥ 2.5 mm in II, III, aVF; tall initial P in V1.

LAE — P ≥ 0.12 s, notched in II; wide deep terminal negative P in V1.

RVH — R $>$ S in V1; persistent S V5–V6; RAD.

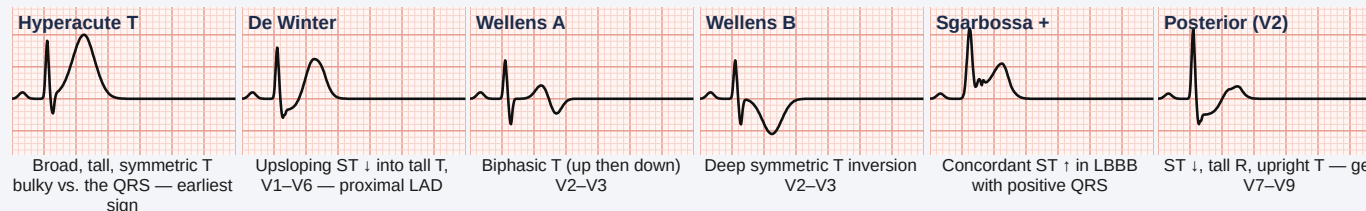
LVH — S V1 + R V5/V6 ≥ 35 mm (age > 35) or R aVL > 11 mm; often LAD + strain.

Pulmonary Embolism

Sinus tachycardia is the most common finding; a normal ECG does not exclude PE.

Right-heart strain: S1Q3T3 (specific, uncommon) · new RBBB · RAD · late transition · T inversion V1–V4 + III (mimics anterior ischemia) · new AF / flutter.

OMI Patterns — drawn



STEMI Activation Script

"STEMI alert. [Age] [sex], onset [time]. ST elevation in [leads] — [territory]. BP [], HR [], SpO₂ []. Given: aspirin [], nitro []. Transmitting now. ETA [] minutes. Contraindications: []."

- Transmit first, then call; give the time of first medical contact
- Repeat and re-transmit with any change

12-Lead Layout, Territories & Vessels

Where to look · how to measure · which vessel, which wall, which conduction tissue



Read down each column: Big LI · Little LI · "ASS" backwards (SSA) · ALL — L-I-I · -L-I · S-S-A · A-L-L · then confirm two contiguous leads

THE 12-LEAD LAYOUT

3 rows × 4 columns · each column = 2.5 s

L · I · I	- · L · I	S · S · A	A · L · L
I Lateral	aVR aVR	V1 Septal	V4 Anterior
II Inferior	aVL Lateral	V2 Septal	V5 Lateral
III Inferior	aVF Inferior	V3 Anterior	V6 Lateral
II — 10-second rhythm strip			

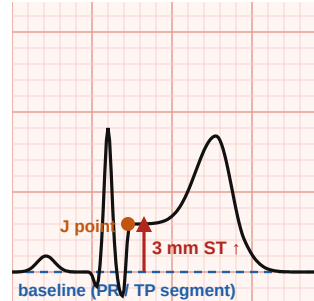
- **Column 1** (I, II, III): Lateral, Inferior, Inferior
- **Column 2** (aVR, aVL, aVF): -, Lateral, Inferior
- **Column 3** (V1, V2, V3): Septal, Septal, Anterior
- **Column 4** (V4, V5, V6): Anterior, Lateral, Lateral

Inferior STEMI (II, III, aVF): check V4R before nitrates. RV involvement makes the patient preload-dependent — nitrates can drop the pressure sharply; treat hypotension with fluid.

aVR has no territory of its own, but **ST ↑ in aVR with diffuse ST ↓** suggests left main or 3-vessel ischemia.

STEMI CRITERIA — HOW TO MEASURE

At the J point, against the PR/TP baseline



1. Find the baseline (PR or TP segment)
2. Find the J point (end of QRS)
3. Count small boxes from baseline to J
4. Confirm in a **contiguous** lead
5. Look for **reciprocal ST ↓**

Leads Threshold (new ST ↑ at J, 2 contiguous leads)

All except V2–V3	≥1 mm
V2–V3, men ≥40	≥2 mm
V2–V3, men <40	≥2.5 mm
V2–V3, women	≥1.5 mm
V7–V9 (posterior)	≥0.5 mm
V4R (RV)	≥1 mm

Reciprocal Pairs

Inferior (II, III, aVF) ↔ ST ↓ in I, aVL (most reliable) · High lateral (I, aVL) ↔ ST ↓ in III, aVF · Anterior ↔ ST ↓ in inferior leads (inconsistent) · Posterior MI shows as ST ↓ with tall R in V1–V3 — confirm with ST ↑ in V7–V9 · Septal and V5–V6 changes have no reliable reciprocal lead

BLOCK vs. VESSEL OCCLUSION

Where the block is predicts how it behaves

Level	Rhythm	Usual vessel	Atropine works?	Plan
SA node	Sinus brady, pauses, SA exit block	RCA or LCx	Usually	Atropine; pace if needed
AV node (nodal)	1st-degree, Mobitz I, 3rd with narrow escape (40–60)	RCA — inferior MI	Usually	Atropine; usually resolves
His / bundles (infranodal)	Mobitz II, 3rd with wide escape (20–40), new BBB / bifascicular	LAD — anterior MI	Rarely	Pads on, pace early; ominous

Inferior MI + block: usually nodal (ischemia + vagal tone), transient.
Anterior MI + block: infranodal from septal necrosis — a sign of a large infarct and high mortality.

Narrow escape (40–60) = block above the His bundle. Wide escape (20–40) = block below it — the backup is slow and unreliable.

Clues at the Bedside

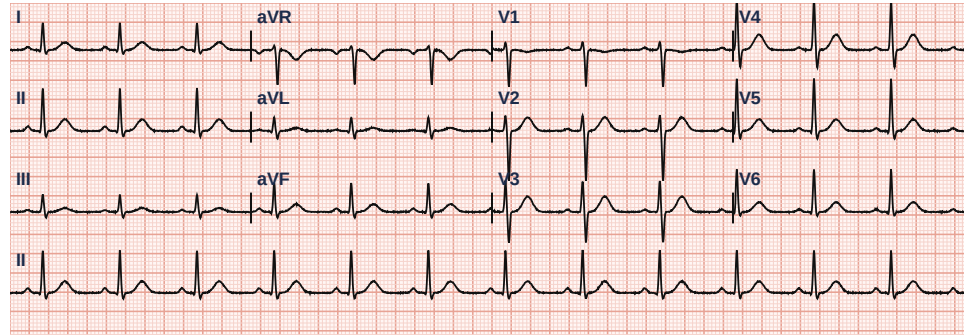
- Block appears with **inferior** ST ↑ → expect nodal behavior; treat hypotension with fluids (RV) and atropine
- Block appears with **anterior** ST ↑ → expect sudden asystole or wide escape; pads on before you move the patient
- New RBBB or LAFB during ACS → septal involvement; watch for progression to complete block
- The posterior fascicle has dual supply (LAD + PDA): LPFB in ACS implies a large territory

ELECTRICAL · PHYSICAL · VESSEL — HOW THEY CONNECT · occlude the artery → lose the muscle and the conduction tissue it feeds → see it in these leads

RCA	MUSCLE (wall) Inferior LV · RV · inferior septum	LEADS THAT SEE IT II, III, aVF · V4R	CONDUCTION TISSUE SA node (~60%) · AV node (~90%) · posterior fascicle (shared)	ELECTRICAL RISK Sinus brady · 1st-degree · Mobitz I · 3rd-degree with narrow escape — usually transient, atropine-responsive	PHYSICAL RISK RV infarct → preload-dependent hypotension · posteromedial papillary muscle → acute mitral regurgitation
LAD	MUSCLE (wall) Anterior LV · anterior 2/3 of septum · apex	LEADS THAT SEE IT V1–V4 (± I, aVL, V5–V6)	CONDUCTION TISSUE Bundle of His (part) · RBB · LBB anterior fascicle · posterior fascicle (shared)	ELECTRICAL RISK Mobitz II · 3rd-degree with wide escape · new RBBB, LAFB, bifascicular — infranodal, often permanent, atropine fails	PHYSICAL RISK Largest muscle mass → pump failure, cardiogenic shock, VF; "widowmaker" when proximal
LCx	MUSCLE (wall) Lateral LV · posterior LV (left-dominant)	LEADS THAT SEE IT I, aVL, V5–V6 · V7–V9	CONDUCTION TISSUE SA node (~40%) · AV node (~10%, left-dominant)	ELECTRICAL RISK Sinus node dysfunction; AV block if left-dominant	PHYSICAL RISK Often electrically "silent" on the 12-lead — get V7–V9; lateral MI with mitral regurgitation

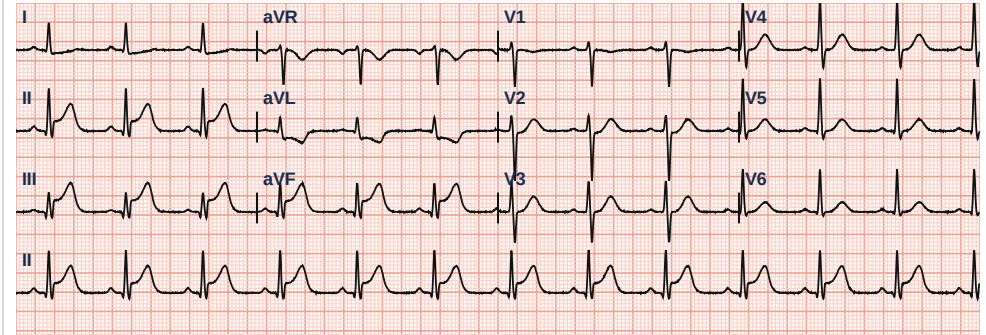
Read by column (LII · LI · SSA · ALL) · rate → rhythm → axis → intervals → QRS → ST/T · confirm contiguous leads and reciprocal change

Normal 12-lead



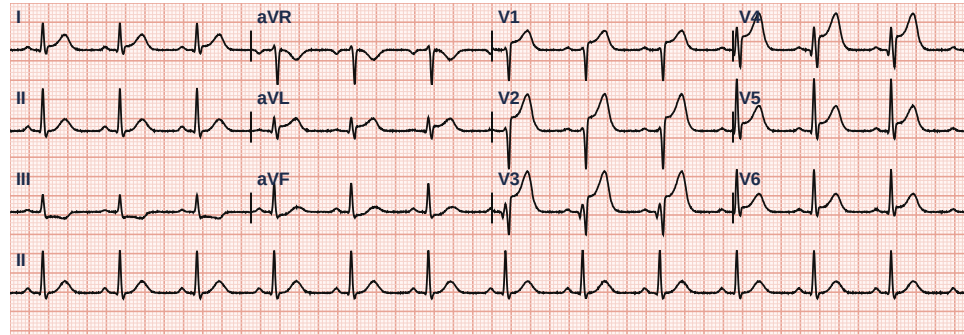
Rate / rhythm	Sinus 75
Axis	Normal (I, II, aVF up)
Intervals	PR 0.16 · QRS 0.08 · QT normal
QRS	Transition V3–V4; aVR negative
ST / T	None
Action	Baseline for comparison — keep the first 12-lead with the patient

Inferior STEMI



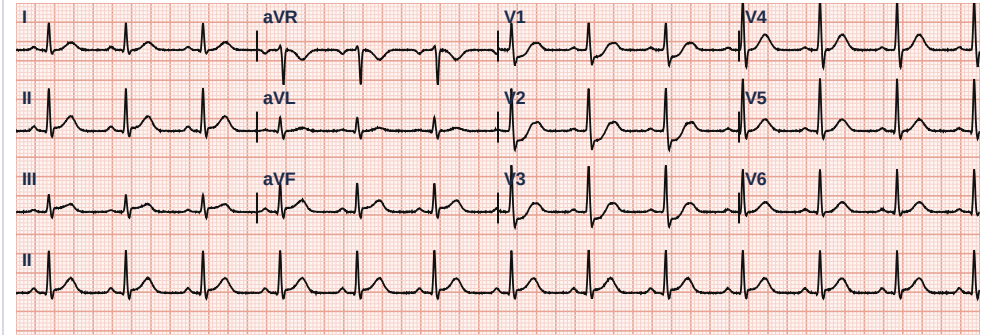
Rate / rhythm	Sinus 75
Axis	Normal
Intervals	Normal
QRS	Small inferior Q waves
ST / T	ST ↑ II, III, aVF (III > II) · reciprocal ST ↓ I, aVL
Action	Activate cath lab · aspirin · 15-lead (V4R) before nitrates · watch for AV block and hypotension

Anterolateral STEMI



Rate / rhythm	Sinus 75
Axis	Normal
Intervals	Normal
QRS	Poor R progression V1–V3 (QS pattern)
ST / T	ST ↑ V1–V6, I, aVL · hyperacute T · reciprocal ST ↓ III, aVF
Action	Activate cath lab · pads on (VF, infranodal block, pump failure) · proximal LAD

Posterior MI (with inferior involvement)

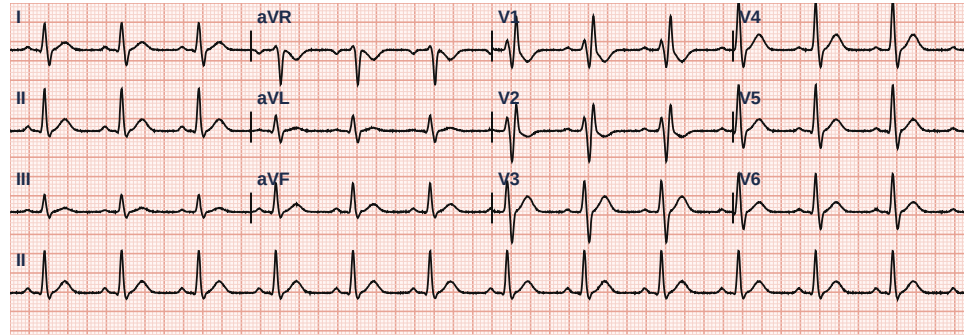


Rate / rhythm	Sinus 75
Axis	Normal
Intervals	Normal
QRS	Tall R in V1–V2 (R:S ≥ 1)
ST / T	ST ↓ V1–V3 with upright T · slight inferior ST ↑
Action	Run V7–V9: ≥ 0.5 mm ST ↑ = posterior STEMI → activate

Computer-generated teaching schematics that show each pattern clearly; real tracings are noisier and patterns overlap. Unlabeled versions are suitable for drills in the Practice & Assessment Package.

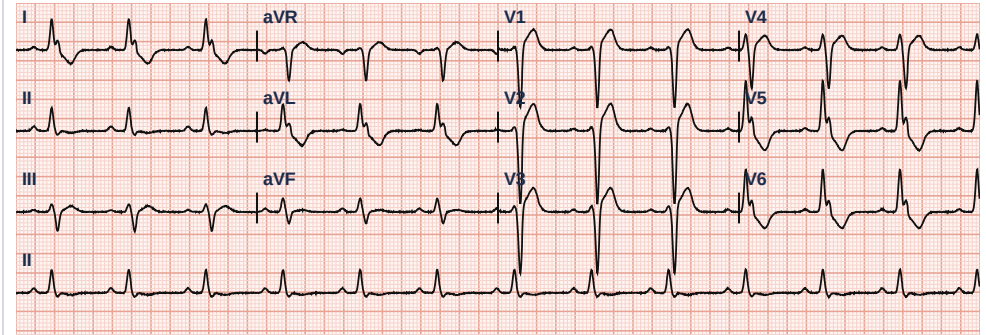
Read by column (LII · LI · SSA · ALL) · rate → rhythm → axis → intervals → QRS → ST/T · confirm contiguous leads and reciprocal change

Right bundle branch block



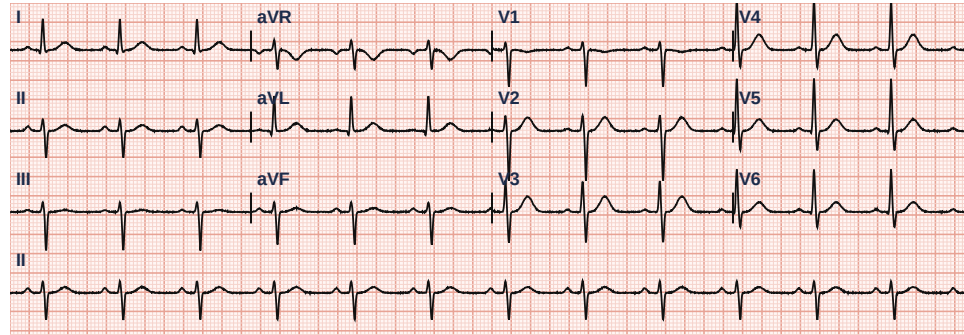
Rate / rhythm	Sinus 75
Axis	Normal
Intervals	QRS ≈0.14 s
QRS	rSR' V1–V2 · wide S in I, aVL, V5–V6
ST / T	Secondary T inversion V1–V2 (expected)
Action	STEMI criteria still apply · new RBBB with symptoms: think PE or anterior ischemia

Left bundle branch block



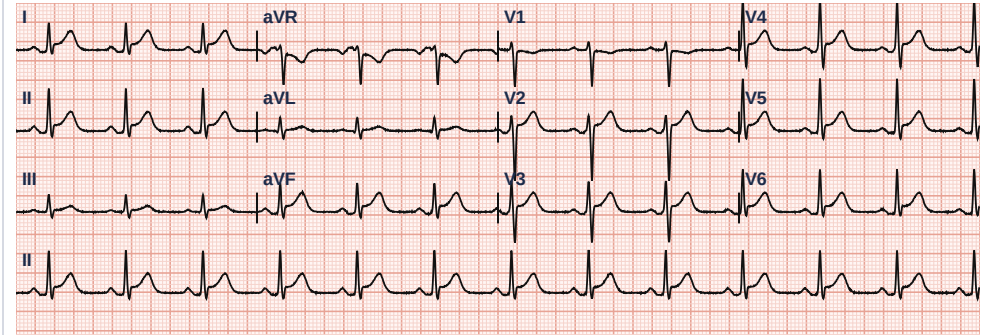
Rate / rhythm	Sinus 75
Axis	Normal to left
Intervals	QRS ≈0.16 s
QRS	QS/rS V1–V3 · broad notched R I, aVL, V5–V6 · no septal q
ST / T	Discordant ST-T (expected)
Action	Apply modified Sgarbossa · compare with old ECG · unstable or Sgarbossa-positive → activate

Left anterior fascicular block



Rate / rhythm	Sinus 75
Axis	≈ -60° (I up, II/III/aVF down)
Intervals	QRS <0.12 s
QRS	qR in I, aVL · rS in II, III, aVF
ST / T	None
Action	Benign alone · with ACS or another block → "block twice": pads on

Pericarditis (STEMI mimic)



Rate / rhythm	Sinus 75
Axis	Normal
Intervals	PR depression
QRS	Normal
ST / T	Diffuse concave ST ↓ · aVR ST ↓ / PR ↑ · no reciprocal change
Action	STEMI mimic — when unsure, transmit and treat as ACS

Computer-generated teaching schematics that show each pattern clearly; real tracings are noisier and patterns overlap. Unlabeled versions are suitable for drills in the Practice & Assessment Package.

Decision points: Pulse? → Shockable? · Causing compromise? → QRS ≥0.12 s? → Regular? · **OMD** = EMERGILITY® medical-director directive (Oct 18, 2026) that differs from AHA — follow it in the field; AHA courses test the AHA answer

ADULT CARDIAC ARREST

No pulse · CPR first, always

Start CPR · give O₂ · attach monitor / defibrillator

Shockable?

YES — VF / pVT

SHOCK 1 — A-P pads **OMD**

CPR 2 min · IV/IO · consider **T-CPR**: bilateral LE auto-transfusion tourniquets ASAP **OMD**

↓ **still shockable**

SHOCK 2 — A-L pads (vector change) **OMD**

CPR 2 min · advanced airway, waveform ETCO₂ · **no epinephrine** for shockable rhythms **OMD**

↓ **still shockable**

SHOCK 3 — 720 J (DSED) if available **OMD**

CPR 2 min · **Amiodarone 300 mg** (then 150) **or lidocaine 1–1.5 mg/kg** · treat Hs & Ts

Every 2 min: rhythm check (<10 s), then the matching lane. Shockable at any check → shock lane. ROSC (pulse, BP, abrupt ETCO₂ rise) → post-ROSC care.

Shock sequence **OMD**: A-P pads first (no roll mid-code) → A-L set (vector change) → 720 J dual sequential if a 2nd defibrillator is available. AHA 2025 instead gives epi after shock 2 and reserves VC/DSED for persistent VF.

NO — Asystole / PEA

Epinephrine 1 mg ASAP · max **3 doses** total **OMD**

CPR 2 min · IV/IO · consider advanced airway, waveform ETCO₂

↓ **not shockable**

CPR 2 min · epinephrine q3–5 min (to 3 doses) · consider T-CPR · treat Hs & Ts

Pacing is **not** effective in established arrest (2025).

BRADYCARDIA WITH A PULSE

HR typically <50 if bradyarrhythmia

Assess & support: airway, assist ventilation as needed, O₂ if hypoxemic, monitor, IV, 12-lead (don't delay treatment)

Causing compromise?

No → identify and treat cause; observe

↓ **yes**

ATROPINE 1 mg IV

Repeat q3–5 min · max **3 mg**. Often fails in Mobitz II, complete block with wide escape, heart transplant

↓ **ineffective**

Transcutaneous pacing and/or **Dopamine** 5–20 mcg/kg/min or **Epinephrine** 2–10 mcg/min infusion

Expert consultation · transvenous pacing

Don't wait for 3 mg of atropine before pacing a crashing patient or a high-grade block.

Causes: ischemia / MI · β-blocker, CCB, digoxin · hypoxia · hyperkalemia · hypothermia · ↑ICP (Cushing's: ↑HR, ↑BP, irregular resp.)

TACHYARRHYTHMIA WITH A PULSE

HR typically ≥150 if tachyarrhythmia

Assess & support: airway, O₂ if hypoxemic, monitor, BP, SpO₂, IV, 12-lead; treat the cause

Causing compromise?

↓ **yes**

SYNCHRONIZED CARDIOVERSION

Sedate if conscious and time allows · regular narrow: may try adenosine 12 mg first · **AF / flutter ≥200 J**, else device energy · polymorphic: **unsynchronized**

↓ **no compromise**

QRS ≥0.12 s?

NARROW

Regular: modified Valsalva (preferred) → **adenosine 12 mg once** → **sync cardioversion** 50–100 J, sedate (no repeat adenosine) **OMD**

Irregular (AF, flutter, MAT): rate control — diltiazem or metoprolol

Refractory: treat cause · increase energy · add antiarrhythmic · expert consult. Sotalol removed (2025). Pre-excited AF: no AV nodal blockers.

Sinus tach is not on this pathway — treat its cause. Regular wide-complex tachycardia = **VT until proven otherwise**.

WIDE

Adenosine 12 mg once, **only** if regular + monomorphic

Procainamide or **amiodarone** infusion

Torsades: **Mg 1–2 g**

High-Quality CPR

100–120/min · 2–2.4 in depth · full recoil · CCF >80% · 30:2, or 1 breath q6 s with advanced airway · avoid hyperventilation · rotate q2 min · pre-charge before checks · ETCO₂ <10 = fix compressions · opioid arrest: CPR before naloxone · no routine mechanical CPR (2025).

Post-ROSC Care

Advanced airway + waveform ETCO₂ 35–45 · SpO₂ **90–98%** · SBP ≥90, MAP >65: lay flat, fluid + bilateral LE ATT, then push-dose epi first, then infusion **OMD** · 12-lead ASAP, STEMI → cath-capable center · glucose · Hs & Ts · prevent fever, 32–37.5 °C; no large cold-fluid boluses · no prognosis in the field.

Suspected ACS

12-lead ≤10 min + transmit · aspirin 162–325 mg chewed · O₂ only if SpO₂ <90% · NTG 0.4 mg SL q5 min if SBP ≥90, no RV infarct, no recent PDE-5 · fentanyl for pain · STEMI / OMI: activate cath lab from field; FMC-to-device ≤90 min (≤120 with transfer) · pads on.

Code Clock — rhythm check every 2 minutes **OMD**

Minute	0	2	4	6	8	10
VF / pVT	Shock 1 A-P · T-CPR	Shock 2 A-L · airway	Shock 3 720 J · Amio 300	Shock · CPR	Shock · Amio 150	Shock · CPR
Asystole / PEA	Epi #1 ASAP · CPR	Check · CPR	Epi #2 · CPR	Check · CPR	Epi #3 (last)	Check · CPR

No epinephrine for VF/pVT; max 3 doses, nonshockable only. 720 J = dual sequential with a second defibrillator, if available. T-CPR = bilateral LE auto-transfusion tourniquets ASAP. Record every shock and drug time.

Signs of ROSC

- Palpable pulse and measurable BP
 - Abrupt, sustained ETCO₂ rise** (often to ≥40 mmHg)
 - Spontaneous breathing, movement, or eye opening
 - Pleth / arterial waveform returns
- Then: don't hyperventilate, repeat 12-lead, start post-ROSC bundle.

Energy: follow the manufacturer for first-shock success; maximum if unknown · Doses: EMERGILITY® protocol pages govern · mg/mL labeling (1:10,000 retired)

ELECTRICAL THERAPY

Typical biphasic starting points

Indication	Mode	Energy
VF / pVT OMD	Unsync	1st A-P · 2nd A-L (vector change) · 3rd 720 J DSED if available; device energy 120–200 J → max
Polymorphic VT / torsades, unstable	Unsync	Defib dose
AF / flutter, unstable	Sync	≥200 J (2025)
Regular narrow SVT	Sync	50–100 J
Monomorphic VT + pulse	Sync	100 J, escalate

Synchronized Cardioversion

1. Pads on (A-P preferred for AF); O₂, suction, IV, airway ready
2. Sedate if conscious and time allows; don't delay for a crashing patient
3. SYNC on — marker on every R wave, not T
4. Select, charge, clear, press and hold
5. Re-check rhythm and pulse; re-enable SYNC before each shock
6. Degenerates to VF → sync off, defibrillate

Transcutaneous Pacing

1. Pads A-P + monitor ECG leads (demand mode)
2. Analgesia / sedation if conscious
3. Rate 60–80; raise mA from minimum to **electrical capture** (wide QRS + broad T after each spike)
4. Confirm **mechanical capture**: femoral pulse or SpO₂ waveform at paced rate; BP rising
5. Set ~10% (or 2 mA) above threshold; typical 50–100 mA
6. Reassess often; arrange transvenous pacing

Output is in **mA**, not joules. Pacing is for bradycardia with a pulse — not established arrest.

CARDIAC ARREST DRUGS

IV first; IO if IV is delayed · no ET drugs (2025)

Drug	Dose · Notes
Epinephrine OMD	1 mg (0.1 mg/mL, 10 mL) q3–5 min · max 3 doses Nonshockable only, ASAP. Not given for VF/pVT
Amiodarone	300 mg push → 150 mg Shock-refractory VF/pVT
Lidocaine	1–1.5 mg/kg → 0.5–0.75 mg/kg q5–10 min; max 3 mg/kg Alternative to amiodarone
Magnesium	1–2 g diluted in 10 mL Torsades or low Mg only
Calcium chloride 10%	1 g (10 mL) slow ↑K ⁺ , CCB toxicity, ↓Ca. Not routine
Sodium bicarbonate	1 mEq/kg ↑K ⁺ , TCA / Na-channel toxicity. Not routine

BRADYCARDIA DRUGS

Alternative or adjunct to pacing

Drug	Dose · Notes
Atropine	1 mg q3–5 min; max 3 mg <0.5 mg may slow HR paradoxically
Epinephrine infusion	2–10 mcg/min, titrate
Dopamine infusion	5–20 mcg/kg/min, titrate; taper slowly

TACHYCARDIA DRUGS

Stable patients

Drug	Dose · Notes
Adenosine OMD	12 mg rapid push + 20 mL flush · single dose No repeat → sync cardioversion. 6 mg if central line, carbamazepine, dipyridamole, transplant. Blunted by theophylline / caffeine. Avoid: active bronchospasm, pre-excited AF
Diltiazem	0.25 mg/kg (15–20 mg) over 2 min → 0.35 mg/kg (20–25 mg) in 15 min Avoid: hypotension, HFrEF, WPW, wide complex
Metoprolol	5 mg over 1–2 min q5 min; max 15 mg Avoid: decompensated HF, bronchospasm, cocaine
Procainamide	20–50 mg/min to max 17 mg/kg; then 1–4 mg/min Stop: suppressed, hypotension, QRS ↑ >50%. Avoid long QT, CHF
Amiodarone	150 mg/10 min, repeat PRN; 1 mg/min × 6 h
Magnesium	1–2 g over 5–15 min — torsades with pulse

ACS & POST-ROSC

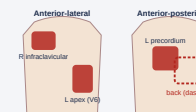
Drug	Dose · Notes
Aspirin	162–325 mg chewed
Nitroglycerin	0.4 mg SL q5 min × 3 — hold SBP <90, RV infarct, PDE-5 <24 h (48 h tadalafil)
Fentanyl	25–50 mcg IV, titrate
Oxygen	Only if SpO ₂ <90% · post-ROSC 90–98%
Hypotension OMD	Flat (no Trendelenburg) · fluid + bilateral LE ATT → push-dose epi → infusion; MAP >65

Infusion Rates (mL/hr)

Drug · example mix	Concentration	Dose → mL/hr							
Epinephrine 1 mg / 250 mL	4 mcg/mL	2 mcg/min = 30 · 5 = 75 · 10 = 150	Dopamine 400 mg/250 mL (1,600 mcg/mL) · mL/hr	50 kg	60 kg	70 kg	80 kg	90 kg	100 kg
Norepinephrine 4 mg / 250 mL	16 mcg/mL	2 mcg/min = 7.5 · 10 = 37.5 · 20 = 75	5 mcg/kg/min	9	11	13	15	17	19
Amiodarone 150 mg / 100 mL load	1.5 mg/mL	over 10 min = 600 mL/hr	10 mcg/kg/min	19	22	26	30	34	38
Amiodarone 900 mg / 500 mL maint.	1.8 mg/mL	1 mg/min = 33 · 0.5 mg/min = 17	15 mcg/kg/min	28	34	39	45	51	56
Procainamide 1 g / 250 mL	4 mg/mL	20 mg/min = 300 · maint. 1–4 mg/min = 15–60	20 mcg/kg/min	38	45	52	60	68	75
Push-dose epi 0.1 mg + 9 mL NS	10 mcg/mL	0.5–2 mL (5–20 mcg) q2–5 min							

mL/hr = dose (mcg/min) × 60 ÷ concentration (mcg/mL) · weight-based: multiply dose by kg first · on a 60-gtt set, gtt/min = mL/hr. Mixes shown are examples — use EMERGILITY® formulary concentrations.

Pad Placement



- Either position is acceptable for defibrillation
- A-P often preferred for AF cardioversion and pacing, and for small chests
- Pads ≥8 cm from implanted devices
- Remove patches, dry the skin, clip dense hair
- **OMD sequence**: shock 1 A-P, shock 2 A-L (vector change), shock 3 dual sequential 720 J if available — apply A-P first so the patient isn't rolled mid-code

Special Circumstances

Arrest and peri-arrest situations that change the standard algorithm



Standard high-quality CPR and defibrillation still come first · These are the additions and exceptions · Verify each against EMERGILITY® protocol

HYPERKALEMIA

Dialysis, missed dialysis, crush, renal failure

Peaked T → wide QRS → sine wave → arrest. Brady + wide QRS in a dialysis patient = hyperkalemia until proven otherwise.

- **Calcium chloride 1 g** IV/IO (repeat for persistent ECG changes) — stabilizes the membrane
- **Sodium bicarbonate** 50 mEq if acidotic or in arrest
- **Albuterol** 10–20 mg nebulized (with a pulse)
- Insulin + dextrose, dialysis at hospital

Avoid succinylcholine. Pacing often fails until K⁺ is treated.

PREGNANCY

Two patients — resuscitate the mother

- Fundus at or above the umbilicus (~20 wk): **manual left uterine displacement** during CPR
- Standard compressions, defibrillation energy, and ACLS drug doses
- IV/IO above the diaphragm; early airway (hypoxia develops fast)
- Magnesium infusion running? Stop it; give **calcium** for suspected Mg toxicity
- Notify early: resuscitative hysterotomy is targeted within **5 minutes** of arrest — transport to a capable facility per protocol

HYPOTHERMIA

Not dead until warm and dead

- Handle gently — rough movement can trigger VF
 - Take longer to confirm pulselessness (up to 60 s) in profound hypothermia
 - Defibrillation and ACLS drugs are reasonable per standard algorithm; follow protocol on repeat dosing while very cold
 - Remove wet clothing, insulate, warm IV fluids; transport toward ECMO-capable center
- ECG: Osborn (J) waves, bradycardia, AF, long intervals.

RESPIRATORY CAUSES

Asthma arrest: slow rate, small volumes, long exhalation; briefly disconnect the BVM and compress the chest to release trapped air; consider bilateral tension pneumothorax.

Drowning: hypoxic arrest — ventilation first, then compressions; AED as soon as available.

Anaphylaxis: epinephrine IM per protocol with a pulse; arrest = standard ACLS plus aggressive fluids.

OPIOID-ASSOCIATED

- Respiratory arrest with a pulse: ventilate with BVM first, then **naloxone** per protocol
- Cardiac arrest: **start CPR without delay**; naloxone may be given but never delays compressions, ventilation, or shocks (2025)
- Rescue breaths matter — hypoxic arrest

LVAD PATIENT

Pulse may be absent normally

- Assess **perfusion** (mental status, skin, cap refill, ETCO₂), not pulse
- MAP by Doppler; listen for the pump hum; check controller alarms and power
- Call the VAD coordinator number on the device
- Unresponsive with no signs of perfusion: **start compressions** and standard ACLS

HEAT STROKE

- Altered mental status + hyperthermia: **cool first, transport second**
- Cold-water immersion is the fastest method when feasible; otherwise ice-water towels, misting, fanning
- Stop active cooling around 39 °C to avoid overshoot

DIALYSIS PATIENT

- No BP cuff, IV, or tourniquet on the **fistula / graft arm**
- Ask when they last dialyzed and how much fluid they normally remove
- Missed dialysis + weakness, brady, or wide QRS: treat as hyperkalemia
- Fluid overload: CPAP, nitrates per protocol; avoid large boluses
- Bleeding access site: firm direct pressure — never a clamp

PACEMAKER / ICD

- Pads ≥8 cm (about 3 in) from the generator; anterior-posterior works well
- An ICD firing during CPR is not dangerous to rescuers wearing gloves
- Repeated ICD shocks in a conscious patient: sedation and analgesia; a magnet suspends shocks (not pacing)
- Check for failure to capture or sense on the monitor (Sheet 6)

METABOLIC

- **Hypoglycemia** can mimic stroke, seizure, or arrest — check glucose on every altered or arrested patient; treat per protocol
- **Hypomagnesemia:** alcohol use, diuretics, PPIs — torsades risk; magnesium 1–2 g
- **Acidosis** (DKA, sepsis, toxic ingestion): ventilate to compensate after intubation — don't drop the minute ventilation the patient was using

STROKE MIMIC OR CAUSE?

- New AF + focal deficit: likely cardioembolic stroke — note last known well, do not cardiovert in the field unless unstable
- Syncope with brady or a pause: get a 12-lead and keep pads on
- Deep T-wave inversions or long QT can follow intracranial hemorrhage — don't anchor on ACS

Toxicology

Na-channel blockers, β-blockers, CCBs, digoxin, QT drugs, sympathomimetics: see Sheet 17. Poison center: 1-800-222-1222.

ECPR / Transport Decisions

Refractory VF, hypothermia, PE, and toxic arrests may benefit from transport with mechanical CPR to an ECMO-capable center — per protocol and medical control.

Family & Termination

Family presence is encouraged when feasible. Termination follows the EMERGILITY® termination-of-resuscitation protocol, never ETCO₂ or ultrasound alone.

Toxicology Antidote Quick List — adult · per protocol and Poison Control (1-800-222-1222)

Opioids	Naloxone 0.4–2 mg IV/IM/IN, titrate to breathing
β-blocker	Glucagon 3–10 mg IV; calcium; high-dose insulin (hospital)
Ca-channel blocker	Calcium chloride 1 g (or gluconate 3 g), repeat; insulin (hospital)
Na-channel (TCA, etc.)	Sodium bicarbonate 1–2 mEq/kg to narrow the QRS
Organophosphate	Atropine 2–4 mg, doubling until secretions dry; pralidoxime

Flumazenil is not recommended for undifferentiated overdose (seizure risk).

Digoxin	Digoxin immune Fab; correct K ⁺ , Mg ²⁺
Local anesthetic	Lipid emulsion 20% 1.5 mL/kg bolus
Cyanide (smoke)	Hydroxocobalamin 5 g IV
Sympathomimetic	Benzodiazepines; cool; avoid β-blockers
Hypoglycemic agent	Dextrose; octreotide for sulfonylurea (hospital)

Pediatric (PALS) Quick Reference

2025 AHA/AAP · infants and children · weight-based dosing



Pediatric arrest is usually respiratory — oxygenate and ventilate early · Use a length-based tape for weight · Read back weight, dose, route

ASSESS

PAT first, from across the room

Age	HR awake	RR
0–3 mo	85–205	30–53
3 mo–2 y	100–190	22–37
2–10 y	60–140	18–30
>10 y	60–100	12–20

Hypotension (SBP)

- Term neonate <60 · infant <70
- 1–10 y: <70 + (2 × age in years)
- >10 y: <90

Size Estimates

- Weight (1–10 y) ≈ (2 × age) + 8 kg — tape preferred
- ETT cuffed ≈ (age ÷ 4) + 3.5

Hypotension is a **late** sign. Tachycardia, delayed cap refill, and altered mental status come first.

CARDIAC ARREST

- CPR 100–120/min; depth ≥½ AP chest (infant ~1.5 in, child ~2 in)
- 30:2** one rescuer · **15:2** two rescuers
- Advanced airway: 1 breath every 2–3 s (20–30/min)
- Infant compressions: heel of one hand or two-thumb encircling (2-finger removed, 2025)

Shockable (VF/pVT)

Shock **2 J/kg** → **4 J/kg** → ≥4 J/kg (max 10 J/kg or adult dose). Epinephrine after initial shocks; amiodarone or lidocaine for refractory VF.

Nonshockable

Epinephrine as early as possible (2025), then every 3–5 min. Hunt Hs and Ts (hypoxia, hypovolemia first).

Epinephrine 0.01 mg/kg = 0.1 mL/kg of 0.1 mg/mL; max 1 mg.

BRADY · TACHY

With a pulse

Bradycardia

- Oxygenate and ventilate first
- HR <60 with poor perfusion despite oxygenation: **start CPR**
- Epinephrine 0.01 mg/kg q3–5 min
- Atropine 0.02 mg/kg (max single dose 0.5 mg) for vagal cause or primary AV block
- Consider pacing

Tachycardia — Sinus Tach or SVT?

	Sinus tach	SVT
Rate	Infant <220, child <180	Infant ≥220, child ≥180
P waves	Present, normal	Absent / abnormal
Pattern	Varies	Fixed, abrupt change

- Vagal: ice to the face (infant); Valsalva (child)
- Adenosine 0.1 mg/kg → 0.2 mg/kg, rapid flush
- Unstable: sync **0.5–1 J/kg** → **2 J/kg**
- Wide-complex: expert consult; amiodarone 5 mg/kg over 20–60 min or procainamide 15 mg/kg over 30–60 min (not both)

POST-ROSC & SHOCK

- SpO₂ **94–99%**; avoid hyperoxia and hypoxia
- Avoid hypotension (keep SBP above 5th percentile)
- Normocapnia; check glucose; prevent fever
- 12-lead and transport to pediatric-capable center

Shock

- Fluid bolus **10–20 mL/kg**, reassess after each (lungs, liver, perfusion)
- Fluid-refractory septic shock: epinephrine or norepinephrine infusion
- Cardiogenic shock: smaller boluses (5–10 mL/kg), early expert help

BVM ventilation is adequate for most pediatric arrests — don't let advanced airway attempts interrupt CPR.

Length-Based Tape Color Zones

Grey 3–5 kg	Pink 6–7 kg	Red 8–9 kg	Purple 10–11 kg	Yellow 12–14 kg	White 15–18 kg	Blue 19–23 kg	Orange 24–29 kg	Green 30–36 kg
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Measure head to heel, supine. Use the zone for every dose and equipment size; over the tape length, use adult dosing or actual weight per protocol. Confirm zones against the tape edition you carry.

Pediatric ECG Is Different

- Faster rates; shorter PR (0.08–0.16 s) and QRS (wide is >0.09 s in young children)
- Right axis is normal** in newborns and infants, shifting toward adult range by childhood
- Dominant R in V1** is normal in infants
- T-wave inversion V1–V3** is normal from about day 7 into adolescence ("juvenile T pattern"); an upright T in V1 in that window can mean RVH
- QTc >0.46 s is prolonged
- Infant pads (<10 kg): use A-P if pads would touch

QUICK DOSE TABLE · verify with length-based tape and EMERGILITY® pediatric protocol

Weight	Epinephrine (arrest)	Defib 1st / 2nd	Adenosine 1st / 2nd	Amiodarone	Lidocaine	Sync cardioversion	Atropine
3 kg	0.03 mg = 0.3 mL	6 / 12 J	0.3 / 0.6 mg	15 mg	3 mg	1.5–3 / 6 J	0.06 mg
5 kg	0.05 mg = 0.5 mL	10 / 20 J	0.5 / 1.0 mg	25 mg	5 mg	2.5–5 / 10 J	0.10 mg
10 kg	0.10 mg = 1.0 mL	20 / 40 J	1.0 / 2.0 mg	50 mg	10 mg	5.0–10 / 20 J	0.20 mg
15 kg	0.15 mg = 1.5 mL	30 / 60 J	1.5 / 3.0 mg	75 mg	15 mg	7.5–15 / 30 J	0.30 mg
20 kg	0.20 mg = 2.0 mL	40 / 80 J	2.0 / 4.0 mg	100 mg	20 mg	10.0–20 / 40 J	0.40 mg
25 kg	0.25 mg = 2.5 mL	50 / 100 J	2.5 / 5.0 mg	125 mg	25 mg	12.5–25 / 50 J	0.50 mg
30 kg	0.30 mg = 3.0 mL	60 / 120 J	3.0 / 6.0 mg	150 mg	30 mg	15.0–30 / 60 J	0.50 mg
40 kg	0.40 mg = 4.0 mL	80 / 160 J	4.0 / 8.0 mg	200 mg	40 mg	20.0–40 / 80 J	0.50 mg

Reversible Causes & 2025 Changes

Hs & Ts · Electrolytes · Toxicology · What Changed · OMD Review



Work the Hs & Ts in every arrest and every unstable rhythm · POCUS never interrupts compressions or delays a shock

Hs & Ts

Clues → field treatment

Cause	Clues	Treatment
Hypovolemia	Narrow PEA, flat veins, bleed	Fluids / blood; stop bleeding
Hypoxia	Airway problem, brady before arrest	Oxygenate, ventilate; ETCO ₂ tube check
H⁺ (acidosis)	DKA, renal failure, long arrest	Ventilate; bicarb for specific causes
Hypo / hyper K⁺	Dialysis, diuretics, wide QRS	See electrolytes
Hypothermia	Exposure, low core temp	Rewarm; hypothermic arrest protocol
Tension PTX	Absent sounds, high airway pressure, narrow PEA	Needle / finger thoracostomy
Tamponade	Trauma, cancer, renal failure, narrow PEA	Pericardiocentesis if authorized; transport
Toxins	History, toxidrome, wide QRS or long QT	Antidote (see toxicology)
Thrombosis — PE	Sudden collapse, DVT risk, RV strain	Lytics per receiving direction; transport
Thrombosis — coronary	Pre-arrest chest pain, STEMI after ROSC	Post-ROSC 12-lead; cath lab

PEA shortcut: narrow QRS → mechanical (tamponade, tension PTX, PE, hypovolemia); wide QRS → metabolic / toxic (K⁺, Na-channel blockers).

Termination: never on ETCO₂ or ultrasound alone. Follow EMERGILITY® termination-of-resuscitation protocol and medical control.

ELECTROLYTES

ECG progression → treatment

Disorder	ECG	Treatment
↑K ⁺	Peaked T → long PR, flat P → wide QRS → sine wave → VF / PEA / asystole	CaCl 1 g (or gluconate 3 g); albuterol 10–20 mg neb; bicarb if acidotic
↓K ⁺	Flat T, ST ↓, prominent U wave	Replace K ⁺ and Mg ²⁺
↓Mg ²⁺	Long QT, torsades	Mg 1–2 g IV
↑Ca ²⁺	Short QT	Fluids
↓Ca ²⁺	Long QT (long ST segment)	Calcium
Hypothermia	Osborn J waves, brady, long intervals, AF	Rewarm; handle gently

TOXICOLOGY

Cardiac toxidromes

Agent	ECG	Treatment
Na-channel (TCA, diphenhydramine, cocaine)	QRS >0.10 s, terminal R >3 mm in aVR, wide tachycardia	Bicarb 1–2 mEq/kg, repeat to narrow QRS
β-blocker / CCB	Brady, AV blocks, junctional	Calcium, glucagon, pacing, pressors
Digoxin	Scooped ST, accelerated junctional, bidirectional VT, PAT with block	Digoxin Fab; fix K ⁺ , Mg ²⁺
QT drugs	Long QTc, torsades	Mg; stop drug; fix K ⁺
Sympatho-mimetics	Sinus tach, ischemia, wide QRS (cocaine)	Benzodiazepines first; avoid β-blockers

WHAT CHANGED

2023 rhythm sheet → this guide (2025 AHA)

Was	Now
Atropine 0.5 mg, max 6 mg	1 mg q3–5 min, max 3 mg
Atropine / drugs via ET	IV first, IO if delayed; ET removed
Dopamine 2–20 mcg/kg/min	5–20 mcg/kg/min
AF/flutter cardiovert 120–200 J	≥200 J first shock
Unstable VT: adenosine first	Cardiovert now; adenosine only stable, regular, monomorphic
Flutter: rate control if unstable	Unstable = cardioversion
WAP: adenosine 6 mg	No treatment
IVR: arrest algorithm	Pulse: pace. No pulse: PEA
Diltiazem over 5 min	Over 2 min
Metoprolol over 5 min	Over 1–2 min, max 15 mg
Epi 1:10,000	1 mg (0.1 mg/mL)
Pacing max 200 J	Output in mA (50–100 typical)
Sotalol for stable wide QRS	Removed (2025)
Pacing in arrest / P-wave asystole	Not effective in arrest
Adenosine 6 → 12 mg	12 mg once, then cardiovert OMD
Epi in VF after shock 2	Nonshockable only; max 3 doses OMD
VC / DSED only if persistent VF	A-P → A-L → 720 J DSED OMD

Open for OMD: item 7 wording · peds scope · ATT device/limits · sedation · procainamide

Sources: 2025 AHA Guidelines for CPR & ECC — Part 9 Adult ALS (Wigginton et al., *Circulation* 2025;152[suppl 2]:S538); AHA 2025 Bradycardia and Tachyarrhythmia algorithms · NAEMT AMLS 2nd ed. · Dubin, *Rapid Interpretation of EKG's* 6th ed. (concepts paraphrased) · EMERGILITY® Cardiology Rhythms sheet, Dec 2023.

OMD Review Checklist

- | | |
|---|--|
| ☐ Adult doses match the EMERGILITY® formulary (Sheet 14) | ☐ Defibrillation, cardioversion and pacing settings match the monitor in service |
| ☐ Shock sequence A-P → A-L → 720 J DSED (directed Oct 18, 2026) — equipment in place | ☐ Auto-transfusion tourniquets (T-CPR, hypotension): device, time limits, contraindications |
| ☐ Pediatric dose table and tape zones (Sheet 16) | ☐ Infusion concentrations and drip tables (Sheet 14) |
| ☐ Special circumstances and antidotes (Sheet 15) | ☐ Protocol page numbers entered on the cover |
| ☐ Training package passing standard (80%, no critical errors) | ☐ Remove the draft marking and sign the cover |

Revision Log

Version	Date	Change	By	OMD
V.26.10	Oct 2026	Initial release: 17 sheets, manual, practice package, pocket card	AB	
V.26.10	Oct 18, 2026	OMD directives incorporated: Valsalva first, adenosine 12 mg once → cardioversion, no epi in VF (max 3), A-P → A-L → DSED, T-CPR / ATT, push-dose epi, positioning	AB	