



INOTROPES

Drive the pump · contractility, cardiac output & inodilators

RAISE

the CO

HOW THEY WORK

four routes to more contractility

β_1 -agonist

↑ cAMP → ↑ Ca^{2+} → contractility

dobutamine, adrenaline, dopamine

PDE-3 inhibitor

blocks cAMP breakdown → inodilator

milrinone

Ca^{2+} sensitiser

↑ myofilament Ca^{2+} sensitivity

levosimendan

Na/K-ATPase

↑ intracellular Ca^{2+} ; rate control

digoxin

AGENT ACTIVITY & DOSING

↑ increase ↓ decrease

Agent	Mechanism	CO	SVR	Dose	Best for
Dobutamine	β_1 (β_2)	↑↑	↓	2-20 mcg/kg/min	Cardiogenic shock; septic myocardial dysfunction
Milrinone	PDE-3	↑	↓↓	0.125-0.75 mcg/kg/min	RV failure, pulmonary HTN, beta-blocked
Adrenaline	β_1 β_2 α_1	↑↑	↑*	0.01-0.5 mcg/kg/min	Refractory low output; post-cardiac surgery
Levosimendan	Ca^{2+} sensitiser	↑	↓	0.05-0.2 mcg/kg/min	Decompensated / beta-blocked HF (long effect)
Dopamine	β_1 , dose-dep	↑	~	2-20 mcg/kg/min	Rarely; select bradycardic low output

* Adrenaline: β predominates at low dose, α (↑ SVR) at higher dose.

WHEN TO USE WHAT

- **Low CO, adequate MAP** → Dobutamine (first-line) or milrinone
- **RV failure / pulmonary HTN** → Milrinone or dobutamine + norepinephrine
- **Septic myocardial dysfunction** → Dobutamine, once MAP already restored
- **Low CO + hypotension** → Norepinephrine for MAP PLUS an inotrope
- **Beta-blocked / chronic HF** → Milrinone or levosimendan (bypass β receptor)
- **Post-cardiac surgery low output** → Adrenaline or dobutamine ± mechanical support

HANDLE WITH CARE

INODILATORS DROP SVR

Milrinone and dobutamine both lower systemic vascular resistance. Pair with a vasopressor (norepinephrine) if the patient is hypotensive.

ARRHYTHMIA & TACHYCARDIA

All beta-agonists raise heart rate and are arrhythmogenic, and raise myocardial oxygen demand. Monitor rhythm and titrate to the lowest effective dose.

LONG-ACTING AGENTS

Milrinone accumulates in renal failure (long half-life). Levosimendan's active metabolite keeps working for days - dose-error effects persist.

Titrate to perfusion, not a number: reassess with echo, lactate clearance, ScvO_2 , urine output and mentation. Restore MAP first, then add an inotrope for persistent low output.

Drugs not enough? Mechanical support: IABP (modest) · Impella / percutaneous VAD (LV unloading) · VA-ECMO (biventricular + oxygenation). Escalate early - involve the shock team (SCAI stage C-E).

PEARLS & PITFALLS

- An inotrope raises output but can drop blood pressure - in hypotension, pair it with a vasopressor.
- Restore MAP first, then add an inotrope for persistent low output or hypoperfusion.
- Do not use a pure vasoconstrictor alone in a low-output state - it raises afterload and can worsen CO.
- Dopamine causes more arrhythmia and higher mortality than alternatives - it is rarely the right choice.

