Heart Rate: Goals, Differential Diagnosis, and the Drugs That Change It

THE QUESTION

Where the evidence disagrees

This topic was selected because an evidence synthesis beats a textbook on it: the trials disagree, or the guidance has moved recently.

THE EVIDENCE

What each source contributes, and how strong it is

Study design first — a cohort and a randomised trial do not carry the same weight.

Design	Year	Journal	What it found
Other	2018	Anesth Analg	The top of the adult range is the end that tracks with harm
Other	2018	Anesth Analg	The bottom of the range is far less frightening than residents expect — in the
Other	2007	J Anesth	Most intraoperative bradycardia in a healthy adult is drug or reflex rather th
Other	1977	Anesth Analg	Glycopyrrolate and atropine both raise heart rate, but glycopyrrolate protects
Other	2012	Clin Pharmacokinet	Esmolol is a cardioselective beta-1 blocker with rapid onset and a short durat
Other	1983	Drug Intell Clin Pharm	Labetalol antagonises alpha-1 as well as beta-1 and beta-2 receptors

12 resolved citations behind this deck; every point above traces to one of them.

IN PRACTICE

What the cohorts and reviews add

6 findings, each on the slide that follows.

ANESTH ANALG 2018

The top of the adult range is the end that tracks with harm

The top of the adult range is the end that tracks with harm: in the VISION cohort a maximum intraoperative heart rate above 100 beats per minute was…

ANESTH ANALG 2018

The bottom of the range is far less frightening than residents expect — in the

The bottom of the range is far less frightening than residents expect — in the same VISION analysis a minimum intraoperative heart rate below 55…

J ANESTH 2007

Most intraoperative bradycardia in a healthy adult is drug or reflex rather th

Most intraoperative bradycardia in a healthy adult is drug or reflex rather than disease: in a multivariable analysis of adult surgical records the…

ANESTH ANALG 1977

Glycopyrrolate and atropine both raise heart rate, but glycopyrrolate protects

Glycopyrrolate and atropine both raise heart rate

IN PRACTICE

The top of the adult range is the end that tracks with harm

Other · Anesth Analg

The top of the adult range is the end that tracks with harm: in the VISION cohort a maximum intraoperative heart rate above 100 beats per minute was associated with myocardial injury, myocardial infarction and 30-day mortality, and a separate cohort analysis found the definition of intraoperative tachycardia with the strongest predictive power for death and infarction was a heart rate of at least 100 sustained for at least 30 minutes.

Abbott et al., Anesth Analg 2018 · PMID 29077608

IN PRACTICE

The bottom of the range is far less frightening than residents expect — in the

Other · Anesth Analg

The bottom of the range is far less frightening than residents expect — in the same VISION analysis a minimum intraoperative heart rate below 55 beats per minute was associated with less myocardial injury and lower mortality, and a retrospective analysis of time spent above 90 beats per minute found no association with myocardial injury at all, so a slow rate with a good pressure is a number to explain rather than a number to chase.

Abbott et al., Anesth Analg 2018 · PMID 29077608

IN PRACTICE

Most intraoperative bradycardia in a healthy adult is drug or reflex rather th

Other · J Anesth

Most intraoperative bradycardia in a healthy adult is drug or reflex rather than disease: in a multivariable analysis of adult surgical records the strongest predictor was the absence of anticholinergic premedication, with propofol induction and neuraxial blockade adding risk, and neostigmine-glycopyrrolate reversal is itself a dose-dependent cause of both bradycardia and tachycardia in the same patient.

Yorozu et al., J Anesth 2007 · PMID 17458640

IN PRACTICE

Glycopyrrolate and atropine both raise heart rate, but glycopyrrolate protects

Other · Anesth Analg

Glycopyrrolate and atropine both raise heart rate, but glycopyrrolate protects better against neostigmine-induced bradycardia while producing less initial tachycardia, fewer arrhythmias and less junctional rhythm, whereas intravenous atropine produces the more marked and more immediate tachycardia — which is why glycopyrrolate is the routine partner for neostigmine and atropine is what you reach for when you need rate right now.

Ostheimer, Anesth Analg 1977 · PMID 322545

IN PRACTICE

Esmolol is a cardioselective beta-1 blocker with rapid onset and a short durat

Other · Clin Pharmacokinet

Esmolol is a cardioselective beta-1 blocker with rapid onset and a short duration of action, which is exactly why it suits a heart rate you want under control within minutes and are willing to hand back afterwards; its main tolerability cost is hypotension, and that hypotension is itself rapidly reversible.

Wiest et al., Clin Pharmacokinet 2012 · PMID 22515557

IN PRACTICE

Labetalol antagonises alpha-1 as well as beta-1 and beta-2 receptors

Other · Drug Intell Clin Pharm

Labetalol antagonises alpha-1 as well as beta-1 and beta-2 receptors, so it lowers blood pressure and peripheral resistance with a less pronounced fall in heart rate than a pure beta-blocker, while metoprolol is the longer-acting beta-1 choice — and POISE is the reason nobody starts a beta-blocker on the morning of surgery, because extended-release metoprolol cut myocardial infarction from 5.7% to 4.2% but raised stroke from 0.5% to 1.0% and death from 2.3% to 3.1%.

Carter, Drug Intell Clin Pharm 1983 · PMID 6354658

IN THE ROOM

What this changes about the next case

Colour is the strength of the evidence behind each step, not the urgency.

1. **1**
   The top of the adult range is the end that tracks with harm: in the VISION cohort a maximum intraoperative heart rate above 100 beats per minute was associated with myocardial injury, myocardial infarction and 30-day mortality, and a separate cohort analysis found the definition of intraoperative tachycardia with the strongest predictive power for death and infarction was a heart rate of at least 100 sustained for at least 30 minutes.
2. **2**
   The bottom of the range is far less frightening than residents expect — in the same VISION analysis a minimum intraoperative heart rate below 55 beats per minute was associated with less myocardial injury and lower mortality, and a retrospective analysis of time spent above 90 beats per minute found no association with myocardial injury at all, so a slow rate with a good pressure is a number to explain rather than a number to chase.

3 **3**

Most intraoperative bradycardia in a healthy adult is drug or reflex rather than disease: in a multivariable analysis of adult surgical records the strongest predictor was the absence of anticholinergic premedication, with propofol induction and neuraxial blockade adding risk, and neostigmine-glycopyrrolate reversal is itself a dose-dependent cause of both bradycardia and tachycardia in the same patient.

4 **4**

Glycopyrrolate and atropine both raise heart rate, but glycopyrrolate protects better against neostigmine-induced bradycardia while producing less initial tachycardia, fewer arrhythmias and less junctional rhythm, whereas intravenous atropine produces the more marked and more immediate tachycardia — which is why glycopyrrolate is the routine partner for neostigmine and atropine is what you reach for when you need rate right now.

5 **5**

Esmolol is a cardioselective beta-1 blocker with rapid onset and a short duration of action, which is exactly why it suits a heart rate you want under control within minutes and are willing to hand back afterwards; its main tolerability cost is hypotension, and that hypotension is itself rapidly reversible.

KEY TAKEAWAYS

What to carry into the next case

> **The top of the adult range is the end that tracks with harm**
> Anesth Analg 2018

> **The bottom of the range is far less frightening than residents expect — in the**
> Anesth Analg 2018

> **Most intraoperative bradycardia in a healthy adult is drug or reflex rather th**
> J Anesth 2007

> **Glycopyrrolate and atropine both raise heart rate, but glycopyrrolate protects**
> Anesth Analg 1977

A heart rate is a symptom, not a diagnosis: find the reason before you reach for a drug, and if you do reach, pick the one whose duration matches how long you want to own the effect.

QUESTIONS I'LL ASK YOU IN THE ROOM

1. The heart rate moved and the blood pressure did not — what does that combination tell you that either number alone does not?
2. Before you treat this rate, what have you actually excluded: light anaesthesia, hypovolaemia, pain, hypercarbia, fever, the surgeon pulling on something?
3. How long do you want this effect to last? Now pick the drug whose duration matches that answer.
4. If you slow this heart and the blood pressure follows it down, what is your next move — and do you have it drawn up?

ORAL BOARDS STEM

> *You are anaesthetising a 68-year-old with hypertension and a remote drug-eluting stent for an open right hemicolectomy. Forty minutes in, at roughly 1 MAC of sevoflurane, with the blood pressure stable at 118/70 and the surgeon working deep in the pelvis, the heart rate climbs from 72 to 118 and stays there. The examiner wants you to talk through what you would consider before you touch a syringe, what you would do first, and — if you decided the rate itself needed treating — which drug you would give, at what dose, and how long you expect that decision to bind you.*

A heart rate is a symptom, not a diagnosis: find the reason before you reach for a drug, and if you do reach, pick the one whose duration matches how long you want to own the effect.

SOURCES

[1] Abbott et al., Anesth Analg 2018 · PMID 29077608
[2] Shcherbakov et al., Eur J Anaesthesiol 2022 · PMID 34690273
[3] Ruetzler et al., Eur J Anaesthesiol 2019 · PMID 30507620
[4] Yorozu et al., J Anesth 2007 · PMID 17458640
[5] Shay et al., Anesth Analg 2020 · PMID 30896593
[6] Ostheimer, Anesth Analg 1977 · PMID 322545
[7] Oduro, Can Anaesth Soc J 1975 · PMID 1139387
[8] Takkunen et al., Acta Anaesthesiol Scand 1984 · PMID 6485732
[9] Wiest et al., Clin Pharmacokinet 2012 · PMID 22515557
[10] Garnock-Jones, Drugs 2012 · PMID 22191799

[11] Carter, Drug Intell Clin Pharm 1983 · PMID 6354658
[12] Devereaux et al., Lancet 2008 · PMID 18479744