

The Cardiovascular Examination

From Practice to Evidence

Husain Alkhalidy · Department of Internal Medicine, King Khalid University, Abha · September 2026

Part 1 — The examination

Setting up. Patient at 45°, chest exposed, good light, examine from the right. Before touching the patient spend thirty seconds looking: breathlessness at rest, the position they have chosen, cyanosis, pallor, a malar flush, cachexia, a Marfanoid or Turner habitus, and what is at the bedside — oxygen, a glyceryl trinitrate spray, a fluid-balance chart, a pacemaker card. Scars on the chest are visible from the end of the bed and change the whole differential before a hand is laid on.

Peripheral survey

- **Hands.** Clubbing (cyanotic congenital heart disease, infective endocarditis, atrial myxoma), splinter haemorrhages, Osler nodes and Janeway lesions, peripheral cyanosis, temperature of the peripheries, and capillary refill time measured in a standard way — firm pressure on the fingertip for ten seconds, then the time to full recolouring. Tendon xanthomata and nicotine staining go to risk.
- **Radial pulse.** Rate and rhythm over fifteen seconds at least, thirty if irregular. An irregularly irregular pulse is atrial fibrillation until an electrocardiogram says otherwise, but the reverse is not safe: in only about seventy per cent of patients in atrial fibrillation is the sequence of intervals truly random, so a pulse that seems to have some pattern does not exclude it. Compare both radials and then radial with femoral for delay (coarctation). A collapsing pulse is felt with the arm raised and the palm across the wrist.
- **Blood pressure.** Seated, back supported, feet flat, arm at heart level, five minutes of rest, no talking, a cuff sized to the arm circumference, and a reading in both arms on the first visit. Record pulse pressure — wide in aortic regurgitation and the hyperdynamic states, narrow in aortic stenosis and low-output failure. Measure a postural drop when the history asks for it. Pulsus paradoxus is measured, not felt: inflate above systolic, deflate slowly, note the pressure at which Korotkoff sounds first appear only in expiration and the pressure at which they are heard through the whole cycle; a gap above 10 mmHg is abnormal.
- **Face and eyes.** Xanthelasma and corneal arcus, conjunctival pallor, a malar flush (mitral stenosis), central cyanosis under the tongue, Roth spots on fundoscopy, dental hygiene (endocarditis), and a high-arched palate.
- **Neck.** The jugular venous pressure and the carotid pulse, taken in that order and described below.

The jugular venous pressure

Head on the pillow, neutral, not turned to the side — turning tenses the sternocleidomastoid and hides the vein. Light from the side, across the neck. Look for the double waveform of the internal jugular between the two heads of the sternocleidomastoid. It is the venous column, not the carotid, if it has two peaks per beat, cannot be palpated, falls on inspiration and with sitting up, rises with pressure on the abdomen, and is obliterated by light pressure at the root of the neck. Measure the vertical height of the top of the column above the sternal angle; above 3 cm is raised. If nothing is seen at 45° the pressure may be very low or very high: lie the patient flatter to find a low column, sit them up to find the top of a high one.

- **Waveform.** Cannon *a* waves in complete heart block and ventricular tachycardia; giant *a* waves in pulmonary hypertension and tricuspid stenosis; absent *a* waves in atrial fibrillation; large *v* waves, often with a pulsatile liver, in tricuspid regurgitation.
- **Kussmaul sign.** A rise in the venous pressure on inspiration — constrictive pericarditis, restrictive cardiomyopathy, right ventricular infarction, massive pulmonary embolism.
- **Abdominojugular (hepatojugular) reflux.** Firm, sustained pressure over the mid-abdomen for ten seconds while watching the neck. A rise of 3 cm or more that is sustained for the whole compression, with an abrupt fall on release, is positive and, in the absence of isolated right ventricular disease, indicates a raised left-sided filling pressure. Ask the patient to breathe normally: a Valsalva during compression produces a false positive.

The carotids. Palpate one at a time, low in the neck, and describe the volume and the character of the upstroke: slow-rising and small in aortic stenosis, sharp and collapsing in aortic regurgitation, bisferiens in mixed aortic valve disease or hypertrophic cardiomyopathy, alternating in severe left ventricular failure. Then auscultate over both for a bruit, remembering that a loud aortic murmur radiates here.

The precordium

- **Inspection.** A median sternotomy, a left thoracotomy (an old closed mitral valvotomy), a pacemaker or defibrillator pocket below the clavicle, a visible apical impulse, chest wall deformity, and the dilated veins of superior vena cava obstruction.
- **Apex beat.** The lowest and most lateral point at which the cardiac impulse is palpable — normally the fifth intercostal space in the mid-clavicular line. Its position and its character are recorded separately. Displaced: left ventricular dilatation, or a mediastinum pushed or pulled. Heaving and sustained, in place: pressure overload — aortic stenosis, hypertension. Thrusting, hyperdynamic and displaced: volume overload — mitral or aortic regurgitation. Tapping: the palpable first heart sound of mitral stenosis. Double: hypertrophic cardiomyopathy. It is impalpable in about half of patients — obesity, emphysema, a pericardial effusion — and that is a finding, not a failure; roll the patient to the left to find it before giving up.
- **Heaves and thrills.** The heel of the hand at the left sternal edge for a right ventricular heave; the flat of the fingers over each valve area for a thrill — a palpable murmur, which by definition

makes the murmur grade 4 or more. A palpable pulmonary second sound at the left second space signals pulmonary hypertension.

Auscultation

The stethoscope is used in an order, with both sides, and with the patient moved. Diaphragm then bell at the apex; diaphragm at the lower left sternal edge, the pulmonary area and the aortic area; then the carotids. Then the two positions that unmask the two murmurs most often missed: the patient rolled to the left with the bell held lightly at the apex in expiration for the rumble of mitral stenosis, and the patient sitting forward with the breath held out and the diaphragm at the lower left sternal edge for the early diastolic murmur of aortic regurgitation. Time everything against the carotid pulse.

- **First heart sound.** Loud in mitral stenosis with a pliable valve and in short PR intervals; soft in mitral regurgitation, a long PR interval, and a calcified immobile valve; variable in atrial fibrillation and complete heart block.
- **Second heart sound.** Physiological splitting widens on inspiration. Wide fixed splitting is an atrial septal defect. Reversed (paradoxical) splitting — wider on expiration — is left bundle branch block or severe aortic stenosis. A loud pulmonary component is pulmonary hypertension; a soft or absent aortic component is calcific aortic stenosis.
- **Added sounds.** A third heart sound is normal under about forty and in pregnancy, and after that means a failing or volume-loaded ventricle. A fourth heart sound is a stiff ventricle — hypertension, aortic stenosis, ischaemia — and cannot occur in atrial fibrillation. An opening snap follows the second sound in mitral stenosis, and the shorter the interval the tighter the valve. An ejection click marks a bicuspid aortic valve or pulmonary stenosis; a mid-systolic click marks mitral valve prolapse. A pericardial knock is early-diastolic and high-pitched, in constriction. A pericardial rub is scratchy, superficial, often triphasic, and changes with position.
- **Murmurs.** Describe timing (ejection systolic, pansystolic, late systolic, early diastolic, mid-diastolic, continuous), site of maximal intensity, radiation, grade on the Levine scale of one to six, pitch and quality, shape, and the effect of respiration and manoeuvres. Right-sided murmurs get louder on inspiration. Squatting, or passive leg raising, increases venous return and afterload and makes most murmurs louder, while making the murmurs of hypertrophic cardiomyopathy and mitral valve prolapse softer; standing and the strain phase of a Valsalva do the opposite. Sustained handgrip raises afterload and increases the murmurs of mitral regurgitation, aortic regurgitation and a ventricular septal defect while reducing that of aortic stenosis and hypertrophic cardiomyopathy.
- **An innocent murmur** is systolic, soft (grade 1 or 2), short, ejection in character, at the left sternal edge, without radiation, with a normal second sound and no added sounds, in a patient without symptoms and with a normal pulse and apex — and that is the whole list; any departure earns an echocardiogram.

Completing the examination

Lung bases for crackles and a pleural effusion; sacral and ankle oedema, graded by depth and by how far it extends; the liver — enlarged and tender in congestion, pulsatile in tricuspid regurgitation — and ascites; the femoral, popliteal, posterior tibial and dorsalis pedis pulses, with an ankle–brachial index whenever peripheral arterial disease is a question; the abdominal aorta by palpation; the fundi for hypertensive and diabetic retinopathy and for Roth spots; the temperature chart; a urine dipstick for blood and protein. Then request the electrocardiogram, the chest radiograph and the echocardiogram that the examination has argued for.

Putting the signs together

Signs are not reported as a list but assembled into a pattern, and it is the pattern that is defended in the viva.

Pattern	The signs that make it
Aortic stenosis	Slow-rising, small-volume carotid; narrow pulse pressure; heaving undisplaced apex; harsh ejection systolic murmur at the right second space radiating to the carotids, peaking late when severe; soft or absent aortic second sound; a fourth heart sound.
Aortic regurgitation	Collapsing pulse; wide pulse pressure; thrusting displaced apex; early diastolic murmur at the lower left sternal edge, sitting forward in expiration; often an ejection flow murmur; an Austin Flint rumble when severe.
Mitral stenosis	Malar flush; irregularly irregular small-volume pulse; tapping undisplaced apex; loud first sound, opening snap, low-pitched mid-diastolic rumble at the apex in the left lateral position; signs of pulmonary hypertension when advanced.
Mitral regurgitation	Displaced thrusting apex; soft first sound; pansystolic murmur at the apex radiating to the axilla; a third heart sound; louder with handgrip.
Congestive heart failure	Raised jugular venous pressure with a positive abdominojugular reflux; displaced apex; third heart sound; basal crackles; pitting oedema; tender hepatomegaly; cool peripheries and a narrow pulse pressure when the output is low.
Cardiac tamponade	Tachycardia; hypotension; a raised venous pressure that rises further, or fails to fall, on inspiration; pulsus paradoxus above 10 mmHg; quiet heart sounds.
Constrictive pericarditis	Raised venous pressure with a Kussmaul sign and a rapid y descent; pericardial knock; hepatomegaly and ascites out of proportion to oedema.
Pulmonary hypertension	Giant a waves; right ventricular heave; palpable and loud pulmonary second sound; pulmonary regurgitation murmur; large v waves and a pulsatile liver once the tricuspid valve leaks.
Infective endocarditis	Fever; a new or changed regurgitant murmur; splinter haemorrhages, Osler nodes, Janeway lesions, Roth spots; splenomegaly; microscopic haematuria.

Part 2 — What the literature says

How well do examiners agree?

The cardiovascular examination was studied for reliability later than the chest, and less systematically, but the verdict is similar: a few signs are reproducible, most are not, and the ones clinicians are most confident about are often the weakest. The third heart sound is the cleanest example. When several observers auscultated the same patients with heart failure, agreement on whether a third sound was present ranged from slight (κ 0.10–0.30) to at best moderate (κ 0.40–0.50) [1]. The classic hemodynamic study by Stevenson and Perloff went further: in patients with chronic heart failure, crackles, oedema and a raised venous pressure were all absent in 18 of 43 whose wedge pressure was 22 mmHg or higher — the signs miss congestion in almost half of those who have it [2].

Sign	Agreement (κ)	Comment
Abdominojugular (hepatojugular) reflux	≈ 0.92	Consistently the most reproducible venous sign, and better than the venous pressure it is meant to confirm [3, 4]
Raised jugular venous pressure	0.08 – 0.81	The published range is enormous; agreement depends on the examiner's training and on whether the column is visible at all [4, 5]
Pulmonary crackles	≈ 0.7	Substantial in heart failure cohorts [5]
Peripheral oedema	≈ 0.6	Moderate; the grading of depth is the unreliable part [5]
Third heart sound	0.10 – 0.50	Slight to moderate even among cardiologists; phonocardiography agrees with the ear poorly [1]
Cardiac murmurs	variable	Clinicians identified the structural murmurs on an echo-verified recording set with 78 per cent accuracy [6]; formal κ data for individual murmurs are thin, and only one interobserver study exists for the signs of aortic stenosis [7]
Apex beat position	—	Impalpable in about half of unselected patients; displacement beyond the mid-clavicular line had a sensitivity of 59 per cent and specificity of 76 per cent for radiographic cardiomegaly [8]
Carotid bruit	poor	Sensitivity for significant stenosis varied from 24 to 88 per cent and specificity from 40 to 98 per cent between observers and studies [9]
Peripheral pulses	poor	Inter-rater reliability of pulse palpation was poor in population screening; an absent pulse carried roughly a one-in-two chance of index-verified disease [10]
Capillary refill time	poor $\rightarrow$ good	Poor between untrained observers; good in centres that trained examiners to a standard technique [11]
Pulsus paradoxus	—	Pooled sensitivity 82 per cent for tamponade when measured with a cuff; palpation alone is not a measurement [12]

Two lessons sit inside that table. First, the venous signs that involve a manoeuvre with a defined end-point — the abdominojugular reflux, the cuff-measured paradox — outperform the passive

observations. Second, the numbers that are often quoted for oedema, crackles and the venous pressure come from a small number of heart-failure cohorts and are pooled in the standard compilations; where a single primary study could not be traced they are marked as approximate.

How accurate are the signs? The Rational Clinical Examination series

The JAMA series remains the reference set for likelihood ratios, and its cardiovascular chapters are among the strongest in the whole series because echocardiography and catheterisation gave them a hard reference standard.

Question	Finding	Likelihood ratio	Source
Does this dyspnoeic patient have heart failure?	Third heart sound	LR+ 11	Wang 2005 [13]
	Abdominojugular reflux	LR+ 6.4	
	Jugular venous distension	LR+ 5.1	
	Crackles, oedema	LR+ 1.3 – 2.8	
	History of heart failure	LR+ 5.8	
Is the central venous pressure raised?	Jugular venous distension	More specific than sensitive; a visible high column rules in, a normal-looking neck does not rule out	Cook & Simel 1996 [14]
Is this systolic murmur abnormal — aortic stenosis?	Slow carotid upstroke	LR+ 2.8 – 130	Etchells 1997 [15]
	Mid-to-late peaking murmur	LR+ 8.0 – 101	
	Murmur does not radiate to the right carotid	LR– 0.05 – 0.10	
	Diminished second heart sound (pooled, 7 studies)	LR+ 10.9 (3.9 – 30.1)	CJC Open 2023 [7]
	Delayed carotid upstroke (pooled)	LR+ 9.0	
Does this patient have aortic regurgitation?	Early diastolic murmur present	LR+ 8.8 – 32 (mild or worse)	Choudhry 1999 [16]
	Early diastolic murmur absent	LR– 0.2 – 0.3 (0.1 for moderate or worse)	
	Murmur augmented by transient arterial occlusion	LR+ 8.4, LR– 0.3	
Does this pericardial effusion mean tamponade?	Pulsus paradoxus > 10 mmHg	LR+ 3.3	Roy 2007 [12]
	Pulsus paradoxus ≤ 10 mmHg	LR– 0.03	
Does this patient have an	Palpable widened aortic	Sensitivity 29 per cent below	Lederle 1999 [17]

Question	Finding	Likelihood ratio	Source
abdominal aortic aneurysm?	pulsation	4 cm, 76 per cent above 5 cm	
Does this patient have peripheral arterial disease?	Any pulse abnormality, bruit, skin change	No single finding rules in or out; a femoral bruit LR+ $\approx$ 5.6; the handheld Doppler score performed best	Khan 2006 [18]; ESVS 2024 [19]
Does this carotid bruit mean stenosis?	Bruit for 50 – 99 per cent stenosis	LR+ 3.65, LR– 0.36	BMC Neurol 2008 [9]

The pattern is the one the respiratory chapter found: **the signs that rule in are strong and the signs that rule out are weak**. A third heart sound, a positive abdominojugular reflux and a late-peaking murmur with a quiet second sound are close to diagnostic; their absence proves little. The exception is aortic regurgitation, where a properly sought early diastolic murmur has a negative likelihood ratio good enough to be reassuring, and pulsus paradoxus, whose absence almost excludes tamponade.

The examiner is the limiting reagent

Agreement and accuracy are both capped by skill, and the skill has been measured repeatedly. Mangione and Nieman played twelve recorded cardiac events to 453 residents and 88 students across 31 programmes: residents in internal medicine and family practice identified about 20 per cent of them correctly, and the score barely rose with year of training [20]. Vukanovic-Criley and colleagues tested 860 participants from students to faculty with a simulation-based examination and found that competence rose through the third year of medical school and then plateaued — practising physicians and faculty scored no better than students [21]. The most recent data are not more comforting: an eleven-year repeated cross-sectional study of 411 auscultation tests at an academic centre found that scores fell over time for every level of trainee, by about 0.15 points a year on a test with a mean of 7.7, although fellows still outsourced students by two points [22]. Whatever else the ultrasound and algorithm literature shows, this is the baseline it is competing with.

Technique changes the answer

A recurring finding of the last five years is that several signs are unreliable because they are measured carelessly, and become useful once standardised.

- **Cuff size.** In the Cuff(SZ) randomised crossover trial, a regular adult cuff on an arm that needed a larger one over-read systolic pressure by about 5 mmHg per size step, and by roughly 20 mmHg in the largest arms; a cuff too large under-read. The authors called the errors strikingly inaccurate and the practice of one cuff for all arms indefensible [23].
- **Head position for the venous pressure.** Turning the head away, the position most textbooks illustrate, tightens the sternocleidomastoid over the internal jugular; the column is best seen with the head neutral [24].

- **The abdominojugular reflux** needs ten seconds of firm pressure, quiet breathing and a defined threshold (a sustained rise of 3 cm or more); done that way it is the most reproducible sign in the venous examination and predicts a wedge pressure above 15 mmHg in the absence of isolated right heart disease [3, 4].
- **Capillary refill** was turned from an impression into a measurement in the ANDROMEDA-SHOCK trials: a glass slide pressed on the fingertip until it blanches, ten seconds of pressure, a stopwatch for the recolouring. Untrained observers disagreed; trained ones did not [11, 25].
- **Bendopnea** — dyspnoea within thirty seconds of bending forward, as when putting on shoes — was described in 2014 as a bedside marker of raised filling pressures, and a 2025 multicentre cohort found it an independent prognostic marker in hospitalised heart failure [26, 27]. It costs nothing to ask.
- **Pulsus paradoxus** must be measured with a cuff; the JAMA review's pooled sensitivity of 82 per cent applies to the measured sign [12].

What has changed, 2020 – 2026

Handheld and pocket ultrasound has become the comparator, and the examination loses. In patients referred for echocardiography, a handheld device in trained hands identified 82 per cent of those with an abnormal echocardiogram against 47 per cent for the physical examination, and 71 per cent of substantial valve disease against 31 per cent [28]. In 2025 a prospective primary-care study of 1,780 patients had family physicians perform focused cardiac ultrasound with AI guidance, against cardiologist echocardiography within 24 hours: overall accuracy 94 per cent, sensitivity 90 per cent and specificity 96 per cent for a screening composite of ejection fraction below 50 per cent, screening-level valve disease and pericardial effusion [29]. Automated ejection-fraction estimation on point-of-care devices has been validated separately [30].

The jugular vein is now measured rather than estimated. Ultrasound of the internal jugular against right-heart catheterisation in 100 patients gave a height above 8 cm in the semi-recumbent position a sensitivity of 73 per cent and specificity of 78 per cent for a central venous pressure above 10 mmHg, rising to a specificity of 95 per cent when the patient was upright, with an inter-rater reliability of 0.97 [31]. A portable-ultrasound study after cardiac surgery found the technique tracked catheter pressure to within a millimetre of mercury [32]; a 2024 study reported that the method is teachable to learners [33]; and the abdominojugular reflux itself has been reproduced on ultrasound, where agreement between observers was again higher for the reflux than for the resting vein [34]. The prognostic weight of the venous pressure and the third sound in heart failure, established in the NEJM analysis of the SOLVD cohort, is what makes this worth the effort [35].

AI-enabled stethoscopes have moved from validation to implementation. A deep-learning murmur classifier trained on echo-labelled recordings detected structural murmurs with a sensitivity of 85.6 per cent and specificity of 84.4 per cent, beating the clinicians who listened to the same recordings (84.7 versus 77.9 per cent accuracy) [6]. The same platform's single-lead electrocardiogram algorithm for a reduced ejection fraction, first validated in London primary care [36], was cleared by the US Food and Drug Administration in 2024 and then tested in 2,960 patients across four US health

systems: area under the curve 0.85, sensitivity 78 per cent, specificity 78 per cent, and a negative predictive value of 98 per cent, which is where its value lies [37]. The decisive trial is TRICORDER, a cluster-randomised implementation study across 205 English general practices with 1.5 million registered patients and more than 12,800 device examinations, published in *The Lancet* in January 2026: use of the device was associated with 2.3 times the detection of heart failure, 3.5 times that of atrial fibrillation and 1.9 times that of valvular disease, but the primary outcome — the overall rate of new heart-failure diagnoses — did not rise significantly, because too few clinicians kept using a device that added steps and did not talk to the record system [38]. A US primary-care study published the following month found the device identified moderate-to-severe valve disease with 92 per cent sensitivity against 46 per cent for the conventional stethoscope [39].

The pulse has moved to the wrist of the patient. Photoplethysmographic irregular-rhythm notifications on consumer wearables had a positive predictive value of 0.84 for atrial fibrillation in the Apple Heart Study and were confirmed by patch monitoring in the great majority of Fitbit Heart Study participants who received one, though only a third of all notified participants turned out to have the arrhythmia and an electrocardiogram remains the diagnosis [40, 41]. The radial pulse still has to be taken, but it is no longer the first place an irregular rhythm is found.

Guidelines have absorbed all of this without abandoning the examination. The 2022 AHA/ACC/HFSA heart failure guideline makes assessment of clinical congestion — the venous pressure above all — a core of every visit, while requiring natriuretic peptides and echocardiography for the diagnosis [42]. The 2024 ESC guideline on peripheral arterial disease makes the ankle-brachial index the first test and treats pulse palpation as the trigger for it, not the answer [43, 19].

Part 3 — Practical synthesis for teaching

- Weight the reproducible, high-specificity signs — the abdominojugular reflux, a measured pulsus paradoxus, a third heart sound in a patient over forty, a late-peaking systolic murmur with a soft second sound, an early diastolic murmur sought sitting forward — over the impressions that examiners cannot agree on.
- Teach the venous pressure as a measurement with a technique: head neutral, tangential light, vertical height above the sternal angle, then the reflux with ten seconds of pressure. Where an ultrasound probe is available, put it on the same neck and let the student compare.
- Standardise the small things that the trials standardised: the cuff sized to the arm, the fingertip pressed for ten seconds, the paradox measured with a cuff.
- Teach dynamic auscultation as physiology, not as a list — what venous return and afterload do to each murmur — because that is what survives the exam room.
- Frame the examination as the instrument that sets the pre-test probability and decides which imaging to order, with handheld ultrasound as its natural extension. A student who can find the apex and the venous column will learn the probe faster than one who cannot.

- Be honest about the kappa values and about the 20 per cent. Students examine more carefully, not less, when they know how easily the signs are missed — and they understand why the algorithm on the stethoscope is a colleague rather than a threat.

References

1. Interobserver agreement by auscultation in the presence of a third heart sound in patients with congestive heart failure. *Chest*. <https://www.sciencedirect.com/science/article/abs/pii/S001236921543168X>
2. Stevenson LW, Perloff JK. The limited reliability of physical signs for estimating hemodynamics in chronic heart failure. *JAMA* 1989;261:884–8.
3. The ultrasound hepato-jugular reflux: measuring the hepato-jugular reflux with ultrasound with comparison to invasive right heart catheterization. *Am J Med* 2024. [https://www.amjmed.com/article/S0002-9343\(24\)00097-4/fulltext](https://www.amjmed.com/article/S0002-9343(24)00097-4/fulltext)
4. Thibodeau JT, Drazner MH. The role of the clinical examination in patients with heart failure. *JACC Heart Fail* 2018;6:543–51.
5. Shellenberger RA, Balakrishnan B, Avula S, Ebel A, Shaik S. Diagnostic value of the physical examination in patients with dyspnea. *Cleve Clin J Med* 2017;84:943–50.
6. Deep learning algorithms to detect murmurs associated with structural heart disease. *J Am Heart Assoc* 2023;12:e030377. <https://doi.org/10.1161/JAHA.123.030377>
7. Bedside physical examination for the diagnosis of aortic stenosis: a systematic review and meta-analysis. *CJC Open* 2023. [https://www.cjcopen.ca/article/S2589-790X\(23\)00031-8/fulltext](https://www.cjcopen.ca/article/S2589-790X(23)00031-8/fulltext)
8. Diagnostic value of the apex beat. *Lancet* 1989;1:410–1. <https://pubmed.ncbi.nlm.nih.gov/2563789/>
9. Carotid bruits as predictor for carotid stenoses detected by ultrasonography: an observational study. *BMC Neurol* 2008;8:23. <https://doi.org/10.1186/1471-2377-8-23>; and Evaluation of the clinical utility of a carotid bruit. *QJM* 2012;105:1171–7.
10. Pulse palpation is an effective method for population-based screening to exclude peripheral arterial disease. *J Vasc Surg* 2016. [https://www.jvascsurg.org/article/S0741-5214\(15\)02445-3/fulltext](https://www.jvascsurg.org/article/S0741-5214(15)02445-3/fulltext)
11. Monitoring capillary refill time in septic shock. *Intensive Care Med* 2024. <https://doi.org/10.1007/s00134-024-07361-3>
12. Roy CL, Minor MA, Brookhart MA, Choudhry NK. Does this patient with a pericardial effusion have cardiac tamponade? *JAMA* 2007;297:1810–8.
13. Wang CS, Fitzgerald JM, Schulzer M, Mak E, Ayas NT. Does this dyspneic patient in the emergency department have congestive heart failure? *JAMA* 2005;294:1944–56.
14. Cook DJ, Simel DL. Does this patient have abnormal central venous pressure? *JAMA* 1996;275:630–4.
15. Etchells E, Bell C, Robb K. Does this patient have an abnormal systolic murmur? *JAMA* 1997;277:564–71.
16. Choudhry NK, Etchells EE. Does this patient have aortic regurgitation? *JAMA* 1999;281:2231–8.
17. Lederle FA, Simel DL. Does this patient have abdominal aortic aneurysm? *JAMA* 1999;281:77–82.
18. Khan NA, Rahim SA, Anand SS, Simel DL, Panju A. Does the clinical examination predict lower extremity peripheral arterial disease? *JAMA* 2006;295:536–46.
19. Nordanstig J, Behrendt CA, Baumgartner I, et al. European Society for Vascular Surgery (ESVS) 2024 clinical practice guidelines on the management of asymptomatic lower limb peripheral arterial disease and intermittent claudication. *Eur J Vasc Endovasc Surg* 2024;67:9–96.
20. Mangione S, Nieman LZ. Cardiac auscultatory skills of internal medicine and family practice trainees: a comparison of diagnostic proficiency. *JAMA* 1997;278:717–22.
21. Vukanovic-Criley JM, Criley S, Warde CM, et al. Competency in cardiac examination skills in medical students, trainees, physicians, and faculty: a multicenter study. *Arch Intern Med* 2006;166:610–6.
22. Cardiac auscultation skills among medical trainees. *Am Heart J* 2025. <https://doi.org/10.1016/j.ahj.2025.03.006>
23. Ishigami J, Charleston J, Miller ER, Matsushita K, Appel LJ, Brady TM. Effects of cuff size on the accuracy of blood pressure readings: the Cuff(SZ) randomized crossover trial. *JAMA Intern Med* 2023;183:1061–8.

24. Measuring the jugular venous pressure: do not turn the head! *Am J Med* 2022. [https://www.amjmed.com/article/S0002-9343\(22\)00076-6/fulltext](https://www.amjmed.com/article/S0002-9343(22)00076-6/fulltext)
25. Hernández G, Ospina-Tascón GA, Damiani LP, et al. Effect of a resuscitation strategy targeting peripheral perfusion status vs serum lactate levels on 28-day mortality among patients with septic shock: the ANDROMEDA-SHOCK randomized clinical trial. *JAMA* 2019;321:654–64.
26. Thibodeau JT, Turer AT, Gualano SK, et al. Characterization of a novel symptom of advanced heart failure: bendopnea. *JACC Heart Fail* 2014;2:24–31.
27. Bendopnea as an independent prognostic marker for adverse events in hospitalized heart failure patients: insights from a multicenter prospective cohort study. 2025. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC12504264/>
28. Mehta M, Jacobson T, Peters D, et al. Handheld ultrasound versus physical examination in patients referred for transthoracic echocardiography for a suspected cardiac condition. *JACC Cardiovasc Imaging* 2014;7:983–90.
29. Diagnostic accuracy of AI-assisted focused cardiac ultrasound (FOCUS) in primary care. 2025. <https://pmc.ncbi.nlm.nih.gov/articles/PMC12610991/>
30. Diagnostic accuracy of point-of-care ultrasound with artificial intelligence-assisted assessment of left ventricular ejection fraction. *npj Digit Med* 2023. <https://www.nature.com/articles/s41746-023-00945-1>
31. Wang L, Harrison J, Dranow E, Aliyev N, Khor L. Accuracy of ultrasound jugular venous pressure height in predicting central venous congestion. *Ann Intern Med* 2022;175:344–51.
32. Portable ultrasound assessment of jugular venous pressure is an accurate method for estimating volaemic status in patients with cardiac disease. 2022. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9705668/>
33. The teachability of point-of-care ultrasound of the jugular venous pulse for estimation of central venous pressure. *J Am Coll Cardiol* 2024 (abstract). [https://www.jacc.org/doi/10.1016/S0735-1097\(24\)04523-6](https://www.jacc.org/doi/10.1016/S0735-1097(24)04523-6)
34. The ultrasound hepato-jugular reflux compared to invasive right heart catheterization. Society of Hospital Medicine abstract. <https://shmabstracts.org/abstract/the-ultrasound-hepato-jugular-reflux-compared-to-invasive-right-heart-catheterization/>
35. Drazner MH, Rame JE, Stevenson LW, Dries DL. Prognostic importance of elevated jugular venous pressure and a third heart sound in patients with heart failure. *N Engl J Med* 2001;345:574–81.
36. Bachtiger P, Petri CF, Scott FE, et al. Point-of-care screening for heart failure with reduced ejection fraction using artificial intelligence during ECG-enabled stethoscope examination in London, UK: a prospective, observational, multicentre study. *Lancet Digit Health* 2022;4:e117–25.
37. Automated detection of reduced ejection fraction using an ECG-enabled digital stethoscope: a large cohort validation. *JACC Adv* 2025;4:101619. <https://doi.org/10.1016/j.jacadv.2025.101619>
38. Triple cardiovascular disease detection with an artificial intelligence-enabled stethoscope (TRICORDER) in the UK: a cluster-randomised controlled implementation trial. *Lancet* 2026. [https://doi.org/10.1016/S0140-6736\(25\)02156-7](https://doi.org/10.1016/S0140-6736(25)02156-7)
39. Artificial-intelligence-enabled digital stethoscope improves point-of-care screening for moderate-to-severe valvular heart disease. *Eur Heart J Digit Health* 2026;7:ztag003. <https://academic.oup.com/ehjdh/article/7/2/ztag003/8425125>
40. Perez MV, Mahaffey KW, Hedlin H, et al. Large-scale assessment of a smartwatch to identify atrial fibrillation. *N Engl J Med* 2019;381:1909–17.
41. Lubitz SA, Faranesh AZ, Selvaggi C, et al. Detection of atrial fibrillation in a large population using wearable devices: the Fitbit Heart Study. *Circulation* 2022;146:1415–24.
42. Heidenreich PA, Bozkurt B, Aguilar D, et al. 2022 AHA/ACC/HFSA guideline for the management of heart failure. *Circulation* 2022;145:e895–e1032.
43. Mazzolai L, Teixido-Tura G, Lanzi S, et al. 2024 ESC guidelines for the management of peripheral arterial and aortic diseases. *Eur Heart J* 2024;45:3538–700.
44. Rawles JM, Rowland E. Is the pulse in atrial fibrillation irregularly irregular? *Br Heart J* 1986;56:4–11.
45. McGee S. Evidence-Based Physical Diagnosis. Latest edition. Philadelphia: Elsevier.

Caveats

Several kappa values in the agreement table are taken from the compilations in the JACC Heart Failure and Cleveland Clinic reviews and from McGee rather than from the primary papers, and are marked approximate. Where a reference is given by title and address only, the search results did not return an author list; check before distribution. The reference for the irregularity of the pulse in atrial fibrillation [44] and the compilation in McGee [45] are cited in the text by their findings rather than by number.