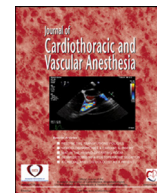


Contents lists available at [ScienceDirect](#)

Journal of Cardiothoracic and Vascular Anesthesia

journal homepage: [www.jcvaonline.com](http://www.jcvaonline.com)

## Editorial

## Every Beat Counts!

Nāḍiparikṣā (नाडीपरीक्षा), the ancient medical science of detecting early signs of disease based on palpation of the radial artery, was mentioned nearly a millennia ago in the Ayurvedic treatise in Sharangadhara Samhita.<sup>1</sup> Nadipariksa is still widely practiced today in India and Nepal. Interpreting a patient's pulse is no less important to practitioners of "Western" medicine. For example, the clinical significance of pulsus paradoxus is clear to all of us. In the operating room, plethysmography, arterial lines, right- and left-heart catheters, esophageal Doppler, and echocardiography are all different ways of capturing and measuring a patient's pulse that guide daily practice. We often titrate our volume administered by pulse-pressure variation (PPV) in clinical practice.

In this issue, Kumar et al. described a fascinating case of a middle-aged man with a history of methamphetamine use, reduced ejection fraction, schizophrenia, and bipolar disorder who was admitted with hypotension and tachycardia with possible acute heart failure.<sup>2</sup> On echocardiographic examination, ejection fraction was 10% with dilated right and left ventricles treated with diuretic therapy. Echocardiographic data demonstrated lower velocity, as well as the duration of flow with every other beat, consistent with markedly lower stroke volume in the abdominal aorta with a constant heart rate and sinus rhythm. Low velocities fluctuating between 20-to-40 cm/s, as described by the authors, were consistent with low stroke volume. These findings are consistent with pulsus alternans (aka mechanical alternans and pulsus alternans), an arterial pulse with alternating strong and weak beats despite a constant heart rate and sinus rhythm or atrial pacing.<sup>2</sup>

Pulsus alternans was first described by Ludwig Traube on Monday, April 15, 1872 in a weekly medical journal in Berlin in his observation titled "Ein fall von pulsus bigeminus nebst bemerkungen tiber die leberswellungenbei klappenfehlern und uber acute leberatrophie," which is translated as "A case of pulsus bigeminus with comments on swelling of the liver in valvular defects and on acute liver atrophy."<sup>3</sup> A great German internist, he described in fascinating detail how he was able to differentiate pulsus bigeminy from this new type of pulse that he named "pulsus alternans." In his observation of a critically

ill and deteriorating patient, he explained the journey of a patient who deteriorated from being able to do physical labor to being bedridden due to increasing heart failure. He noted that as the patient's clinical status deteriorated, which he described in elegant and accurate clinical detail in his original publication, as the pulse became hard to palpate in peripheral arteries, pulsus alternans could be appreciated in central arteries like the carotids.<sup>3</sup>

We must differentiate pulsus alternans from other conditions like electrical alternans and pulsus paradoxus. Electrical alternans is the beat-to-beat variability of the QRS complex on electrocardiogram seen during the setting of pericardial effusion whereas pulsus paradoxus results due to a drop in blood pressure of 10 mmHg with respiratory variation (inspiration).<sup>4,5</sup> It is also essential to distinguish PPV and stroke- volume variation (SVV) from the pulsus alternans. Although PPV and SVV represent the heart's position on the Frank-Starling curve, it is not an indicator of cardiac preload or volume status or the intrinsic contractile functions of the heart, but rather a state of fluid responsiveness, unlike pulsus alternans, which represents lower stroke volumes.<sup>6</sup> Both PPV and SVV are frequently accompanied by a rising heart rate; whereas, in pulsus alternans, the heart rate remains constant.<sup>7</sup>

As described by Kumar et al. in their e-challenge, echocardiographic findings represent pulsus alternans and offer a dynamic assessment of the functional status of the heart in terms of its stroke volume and meager ejection fraction, similar to what Traube described in his initial observations. The authors of this e-challenge described the prognostic value of the presence of pulsus alternans, especially in patients with heart failure. This, in addition to severe diastolic dysfunction that is seen commonly in patients with left-heart failure, make the presence of pulsus alternans another independent risk factor for morbidity and mortality.<sup>8</sup>

The presence of pulsus alternans in your patient should alert you of the underlying severe heart dysfunction and raise the alarm about the potential morbidity and mortality that this patient faces. One frankly wonders if the early practitioners of Nāḍiparikṣā (नाडीपरीक्षा) medicine might have recognized

DOI of original article: <http://dx.doi.org/10.1053/j.jcva.2022.12.038>.

<https://doi.org/10.1053/j.jcva.2022.12.032>

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this too. Today, tools such as echocardiography allow us to document the alternating stroke volume in detail and confirm our worst prognostic fears; but alternating beats on an arterial line tracing or plethysmography should raise alarms. In these subsets of patients who show the presence of pulsus alternans, every beat counts. These simple observation could foreshadow a grave outcome.<sup>9</sup>

### Conflict of Interest

None.

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### References

- 1 Kumar PVG, Deshpande S, Nagendra HR. Traditional practices and recent advances in Nadi Pariksha: A comprehensive review. *J Ayurveda Integr Med* 2019;10:308–15.
- 2 Kumar P, Aedma S, Varadarajan P. Invasive assessment with transthoracic echocardiography in end-stage heart failure. *J Cardiothorac Vasc* [e-pub ahead of print]. <https://doi.org/10.1053/j.jvca.2022.12.038>.
- 3 Traube L. Ein fall von pulsus bigeminus nebst bemerkungen tiber die leberschwellungen bei klappenfehlern und uber acute leberatrophic. *BerKlin Wschr* 1872;9:889.
- 4 Ingram D, Strecker-McGraw MK. Electrical alternans. In: *StatPearls*. Treasure Island, FL: StatPearls Publishing; 2022.
- 5 Sarkar M, Bhardwaj R, Madabhavi I, et al. Pulsus paradoxus. *Clin Respir J* 2018;12:2321–31.
- 6 Michard F, Chemla D, Teboul J-L. Applicability of pulse pressure variation: How many shades of grey? *Crit Care* 2015;19:144.
- 7 Michard F, Lopes MR, Auler J-OCJ. Pulse pressure variation: Beyond the fluid management of patients with shock. *Crit Care* 2007;11:131.
- 8 Rossi A, Temporelli PL, Quintana M, et al. Independent relationship of left atrial size and mortality in patients with heart failure: An individual patient meta-analysis of longitudinal data (MeRGE Heart Failure). *Eur J Heart Fail* 2009;11:929–36.
- 9 Allareddy V, Grundstad ML, Badheka A. Pulsus alternans: A visual clue to a grave disorder. *BMJ Case Rep* 2017;2017:bcr2017222242.