

Respiratory artifact: A second vital sign on the electrocardiogram

Apparent dissociated P waves can actually represent respiratory artifact

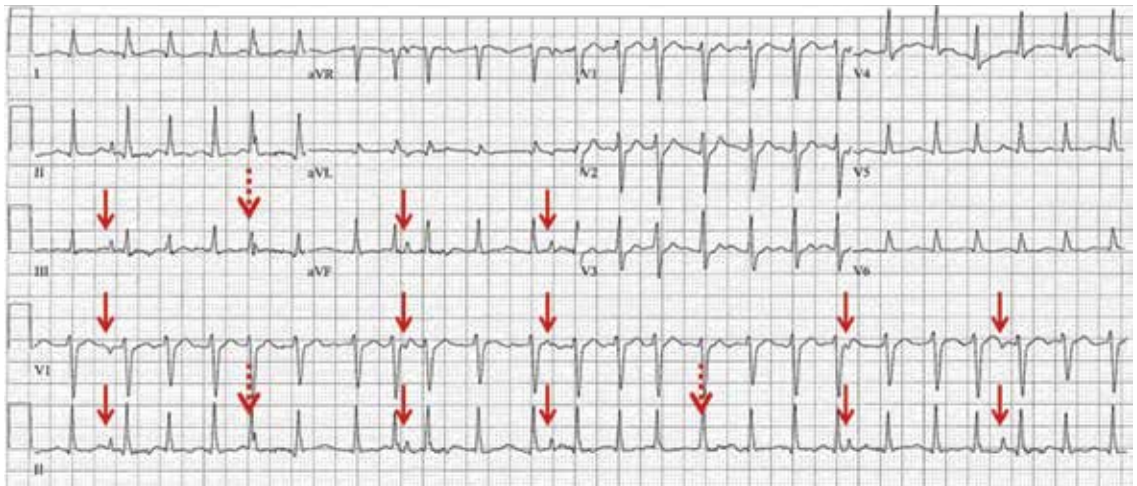


FIGURE 1. The patient's electrocardiogram demonstrates atrial fibrillation with rapid ventricular response. In addition, there are regularly spaced, distinct, sharp deflections suggestive of P waves, best seen in the inferior leads (arrows). Broken arrows indicate apparent P waves superimposed on QRS complexes.

A 57-YEAR-OLD MAN hospitalized for treatment of multilobar pneumonia was noted to have a rapid, irregular heart rate on telemetry. He was hypoxemic and appeared to be in respiratory distress. A 12-lead electrocardiogram (ECG) demonstrated atrial fibrillation with rapid ventricular response, as well as what looked like distinct and regular P waves dissociated from the QRS complexes at a rate of about 44/min (**Figure 1**). What is the explanation and clinical significance of this curious finding?

What appear to be dissociated P waves actually represent respiratory artifact.¹⁻³ The

sharp deflections mimicking P waves signify the tonic initiation of inspiratory effort; the subsequent brief periods of low-amplitude, high-frequency micro-oscillations represent surface electrical activity associated with the increased force of the accessory muscles of respiration.¹⁻³

Surface electromyography noninvasively measures muscle activity using electrodes placed on the skin overlying the muscle.⁴ Using simultaneously recorded mechanical respiratory waveform tracings, we have previously demonstrated that the repetitive pseudo-P waves followed by micro-oscillations have a close temporal relationship with the inspiratory phase of respiration.³ The presence of

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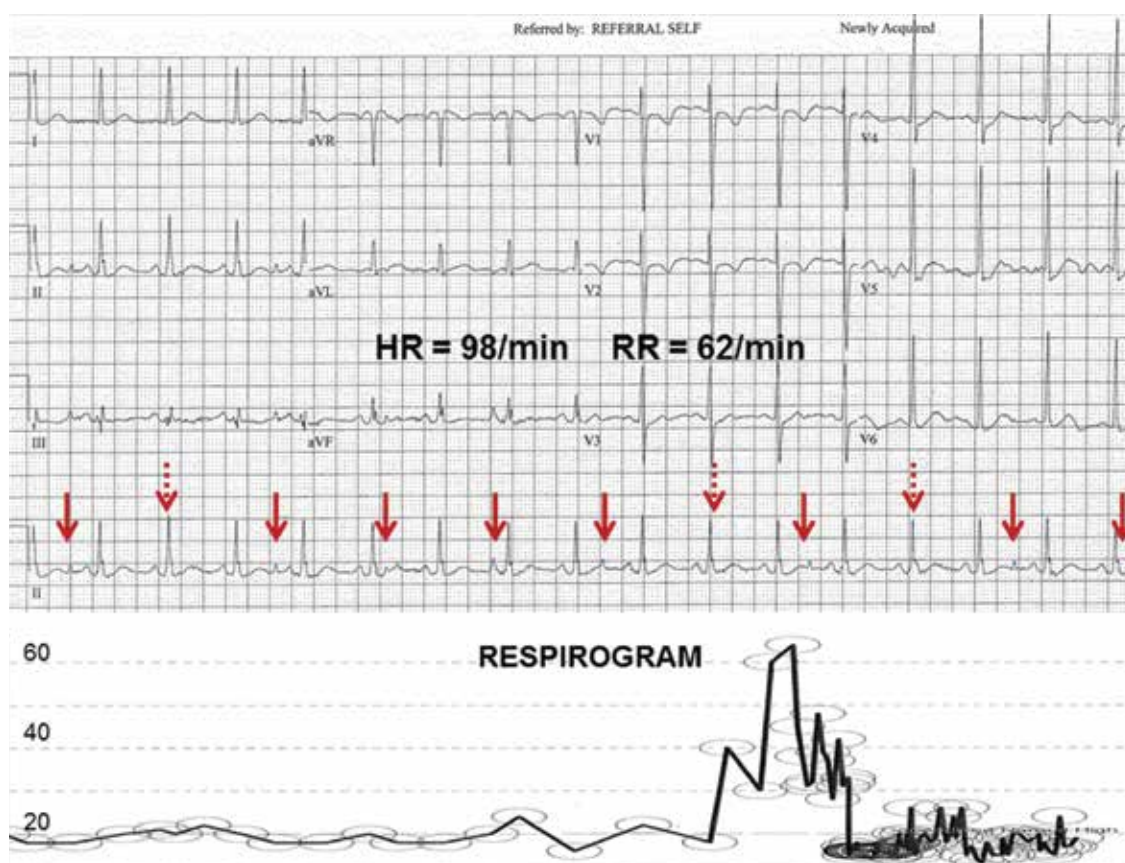


FIGURE 2. An electrocardiogram from a different patient shows sinus rhythm with apparent atrial dissociation (arrows). The heart rate (HR) is 98/min. The respiratory rate (RR) as calculated from spacing of respiratory artifact is very high at 62/min. This was confirmed by a simultaneously recorded respirogram.

Recognizing rapid respiratory artifact can raise awareness of possible severe respiratory distress

respiratory artifact indicates a high-risk state frequently necessitating ventilation support.

In addition, when present, respiratory artifact can be viewed as the “second vital sign” on the ECG, the first vital sign being the heart rate. The respiratory rate can be approximated by counting the number of respiratory artifacts in a 10-second recording and multiplying it by 6. A more accurate rate assessment is achieved by measuring 1 or more respiratory artifact cycles in millimeters and then dividing that number into 1,500 or its multiples.³ Based on these calculations, the respiratory rate in this patient was 44/min.

The presence of two atrial rhythms on the same ECG, one not disturbing the other, is consistent with the diagnosis of atrial dissociation.⁵ Atrial dissociation is a common finding in cardiac transplant recipients in whom the transplantation was performed us-

ing atrio-atrial anastomosis.⁶ Most other cases of apparent atrial dissociation described in the old cardiology and critical care literature probably represented unrecognized respiratory artifact.^{7,8}

An ECG from a different patient (Figure 2) demonstrates rapid respiratory artifact that raised awareness of severe respiratory failure. The respiratory rate calculated from spacing of the pseudo-P waves is 62/min, confirmed by simultaneous respirometry.

■ A FREQUENT FINDING IN SICK HOSPITALIZED PATIENTS

Respiratory artifact is a frequent finding in sick hospitalized patients.³ Most commonly, it manifests as repetitive micro-oscillations.³ Pseudo-P waves, as in this 57-year-old patient, are less often observed; but if their origin is

not recognized, the interpretation of the ECG can become puzzling.^{1-3,7,8}

Respiratory artifact is a marker of increased work of breathing and a strong indicator of significant cardiopulmonary compromise. Improvement in the patient's cardiac or respiratory condition is typically associated with a decrease in the rate or complete elimination of respiratory artifact.³

REFERENCES

1. Higgins TG, Phillips JH Jr, Sumner RG. Atrial dissociation: an electrocardiographic artifact produced by the accessory muscles of respiration. *Am J Cardiol* 1966; 18:132-139.
2. Cheriex EC, Brugada P, Wellens HJ. Pseudo-atrial dissociation: a respiratory artifact. *Eur Heart J* 1986; 7:357-359.
3. Littmann L, Rennyson SL, Wall BP, Parker JM. Significance of respiratory artifact in the electrocardiogram. *Am J Cardiol* 2008; 102:1090-1096.
4. Pullman SL, Goodin DS, Marquezine AI, Tabbal S, Rubin M. Clinical utility of surface EMG: report of the therapeutics and technology assessment subcommittee of the American Academy of Neurology. *Neurology* 2000; 55:171-177.
5. Chung EK. A reappraisal of atrial dissociation. *Am J Cardiol* 1971; 28:111-117.
6. Stinson EB, Schroeder JS, Griepp RB, Shumway NE, Dong E Jr. Observations on the behavior of recipient atria after cardiac transplantation in man. *Am J Cardiol* 1972; 30:615-622.
7. Cohen J, Scherf D. Complete interatrial and intra-atrial block (atrial dissociation). *Am Heart J* 1965; 70:23-34.
8. Chung KY, Walsh TJ, Massie E. A review of atrial dissociation, with illustrative cases and critical discussion. *Am J Med Sci* 1965; 250:72-78.

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