

Unexpected values of mixed venous blood analysis: Back to basics before sampling

Dear Editor,

A 62-year-old man, an operated case of coronary artery bypass graft surgery and aortic valve replacement, had low-cardiac-output syndrome in the intensive care unit. A mixed venous blood sample was taken from the pulmonary artery (PA) catheter to determine whether the cardiac output and oxygen delivery are sufficient enough to meet the body's requirement. Compared to the simultaneous arterial blood sample, the sample obtained from the PA port revealed a higher pH (7.804 vs. 7.466), Partial Pressure of Oxygen (PO_2) (197.3 mmHg vs. 112.3 mmHg), Oxygen saturation (SO_2) (99.5% vs. 98.5%), anion gap (8.6 mmol/L vs. 7.5 mmol/L), and lactate (2.96 mmol/L vs. 1.93 mmol/L); and a lower Partial Pressure of carbon dioxide (PCO_2) (8.4 mmHg vs. 23.7 mmHg), Total carbon dioxide (tCO_2) (13.2 mmol/L vs. 17.4 mmol/L), and bicarbonate (12.9 mmol/L vs. 16.7 mmol/L) [Figure 1a and b]. A careful observation of the PA pressure tracing revealed a wedge pressure waveform. After

the PA catheter was withdrawn by 3 cm, the blood gas analysis of the mixed venous sample showed a lower PO_2 (28.8 mmHg) compared to the arterial and “wedge” blood samples [Figure 1c].

The case described highlights the importance of checking the position and waveform of the PA catheter while withdrawing mixed venous blood. Brewster *et al.*^[1] also found a significantly higher PO_2 and pH; and lower PCO_2 in the “wedge” samples compared to the simultaneous arterial samples during cardiac catheterization. They presumed that wedging a catheter in a branch of PA produces a localized area of abnormally high ventilation-perfusion ratio and that the blood sampled via collateral pathways equilibrates with the overventilated segment. Dual blood supply of the lungs and contribution of the bronchial arteries to the higher PO_2 is another explanation. The blood so obtained has flowed from the pulmonary capillaries and possibly pulmonary veins in a retrograde fashion producing high PO_2 and saturation. They rationalized that the blood passes through the pulmonary capillaries twice—once forward and a second time backward—while flowing to the aspirating catheter. The second exposure to alveolar gas increases the PO_2 of the pulmonary capillary blood. Recently, Khirfan *et al.*^[2] have compared the PA wedge sample with mixed venous blood. They found higher PO_2 , pH, lactate, and lower PCO_2 , bicarbonate in the “wedge” sample

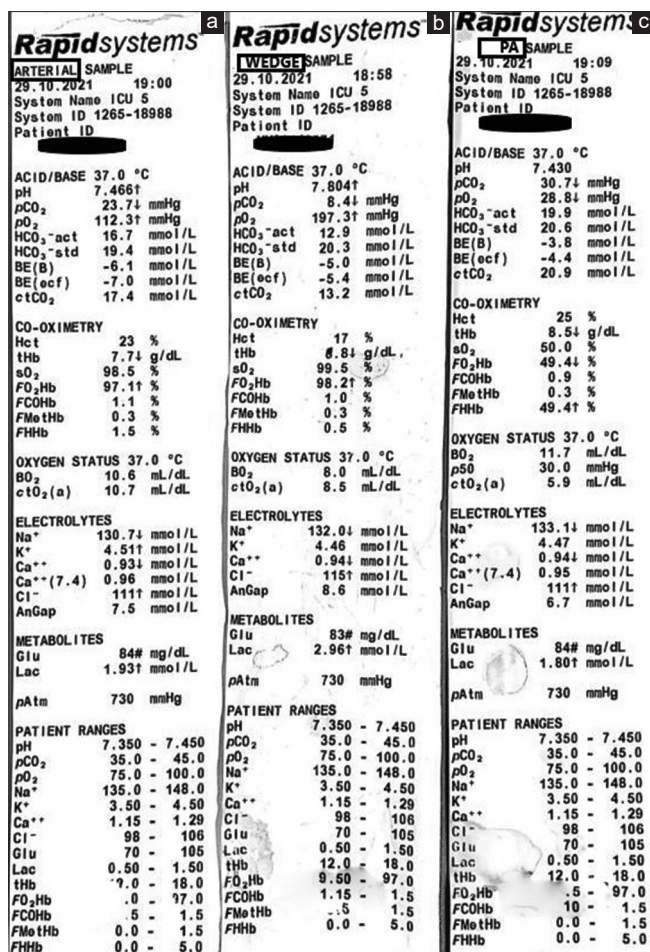


Figure 1: Blood gas analyses of the samples withdrawn from the systemic artery (a), pulmonary artery catheter in wedge position (b), and mixed venous blood from the pulmonary artery (c)

compared to the mixed venous sample. They also postulated that the differences in the “wedge” blood are due to the double passage of the blood through the lungs and its exposure to the alveolar gas for a longer period. Higher lactate in the wedge sample suggests its increased production in the lungs in patients with circulatory and respiratory failures. Douzinas *et al.*^[3] have also found a similar organ-specific increase in the lactate concentration in the wedge sample in patients with respiratory failure. Even a mild degree of lung dysfunction occurring after cardiopulmonary bypass is associated with an increased pulmonary lactate release.^[4]

In conclusion, the blood gas values can indicate the source of blood withdrawn from a flow-directed PA catheter. At the same time, we need to be careful about the PA pressure waveform, as prolonged, unintentional, distal migration of the PA catheter in a “wedged” position may lead to pulmonary infarct and must be avoided.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/

their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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