Can central venous oxygen saturation replace arterial blood gas sampling in patients with end-stage renal failure having arteriovenous fistula?

To the Editor,

A 50-year-old male patient with hypertension, diabetes, and end-stage renal failure on regular dialysis was admitted to our hospital for acute coronary syndrome. He underwent coronary artery angiography. Heparin was used for blood anticoagulation. Unfortunately, he developed intracranial bleeding and became unconscious. He was then shifted to our intensive care unit (ICU). He had Glasgow Coma Scale of 7 at the time of admission in ICU, so he was intubated and put on full ventilatory support of volume-controlled mode with FiO\textsubscript{2} 0.5. Ultrasound was done with a plan to insert a catheter into the right internal jugular vein (IJV) to monitor the central venous pressure (CVP) and for fluid management. But this site had previously been used for dialysis catheter, due to which the IJV had a small diameter. It was decided to insert one catheter into the left IJV. Size 7 Fr triple lumen catheter (TLC) was inserted into the left IJV using Seldinger technique. The procedure succeeded in the first attempt. The monitor showed typical venous waveform with a pressure reading of 10 mm Hg. A blood sample was taken, through the proximal port of the TLC, to analyze venous blood gas. Surprisingly, it showed high oxygen saturation and high oxygen tension as if it was an arterial sample. It showed oxygen saturation of 97.8% with partial pressure of oxygen (pO\textsubscript{2}) of 107 mmHg. It gave the impression that the catheter had been inadvertently placed in the artery. The arterial blood sample from the right radial artery was taken, which showed a saturation of 97.9% with pO\textsubscript{2} of 124 mmHg. The operating physician informed the senior anesthesiologist, who ordered an immediate chest X-ray and another ultrasound. Both procedures confirmed that the catheter was in the vein and was placed correctly.

We collected blood samples from the remaining two ports of catheter. The middle port had a saturation of 96.3% with pO\textsubscript{2} of 96 mmHg. The distal port had a saturation of 87.6% with pO\textsubscript{2} of 57.8 mmHg. We noticed that the patient had an arteriovenous fistula (A-V fistula) in the left arm which was made for his intermittent dialysis.

In another case, a 61-year-old male patient with coronary artery disease, hypertension, chronic renal failure, and A-V fistula in the left arm got admitted with congestive heart failure. He was treated with diuretics, analgesics, and oxygen through a face mask at 5 L/min. A TLC was inserted in his left IJV for CVP monitoring and fluid management. Chest X-ray and ultrasound confirmed that the catheter tip was correctly placed. The blood samples taken from the proximal port, the middle port, and the distal port showed the saturation of 94.7%, 80.4%, and 70.1%, respectively, with pO\textsubscript{2} of 85.8, 44, and 38.1 mmHg, respectively. The blood sample taken from the right radial artery showed a saturation of 97.8% with pO\textsubscript{2} of 89.6 mmHg.

Patients with end-stage renal disease require hemodialysis. To facilitate dialysis, an AV fistula is made in the upper limb, most commonly on the left side. High pressure in the artery leads to backflow in the venous system. The vein
dilates and elongates in response to the increased blood flow and shear stress. There is an admixture of arterial blood with venous blood. This arterIALIZATION of venous blood leads to high oxygen saturation and high oxygen tension in venous blood samples.[1] In one case, presence of high oxygen saturation in the femoral venous catheter led to the presence of an A-V fistula between the common femoral vein and artery.[2] It is found that the greater the flow through the A-V fistula the more is the chance of high oxygen saturation measured in the venous catheter.[3]

Santiago-Delpin et al. compared the blood samples from the femoral artery with the samples taken from A-V fistula made in the upper limb. They observed that the blood samples from femoral artery have comparatively higher values of saturation and oxygen tension than in A-V fistula line, but there was no significant difference between them.[4]

In our cases, pressure transduction, chest X-ray, and ultrasound were consistent with catheter placement in central vein. The arterIALIZATION increased the oxygen saturation and oxygen tension in the venous system. We observed that saturation and pO_{2} was highest at the proximal port. It correlated to the blood sample taken from the radial artery. These values were less in the middle port and least in the sample taken from the distal port. The closer the port to dialysis fistula, the greater was the amount of arterIALIZED blood flow through it. As we gradually move away from the fistula site, admixture becomes less so there is less saturation and less oxygen tension. Critically ill patients, who are on dialysis, require frequent determination of arterial blood gas composition. These patients generally have difficult venous and arterial access. We feel that when central line catheter is required in such patient for their treatment, it is better to insert it in the left IJV rather than on the right side. Take a blood sample from the proximal port and compare it with the one taken from the artery. If the results are similar, we can use proximal port of TLC inserted in left IJV as a sample taken from an arterial line. In this way, frequent, difficult, and painful arterial punctures can be avoided. It can be a practical approach to use proximal port of catheter placed in left IJV as a convenient site for determination of arterial blood gas and pH in patients with end-stage renal disease with difficult arterial access. Studies are required to draw a definite conclusion.

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Conflicts of interest
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Rajinder Singh Rawat, Chandrashekhar Laxmannao Mankar, Said Musallam Al Maashani
Department of Cardiac Anaesthesia, Cardiac Center, Sultan Qaboos Hospital, Salalah, Sultanate of Oman

Address for correspondence: Dr. Rajinder Singh Rawat, Department of Cardiac Anaesthesia, Cardiac Center, Sultan Qaboos Hospital, Salalah, Sultanate of Oman.
E-mail: drawat2000@gmail.com
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