Estimation of arteriovenous fistula recirculation with the use of blood gases

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OBJECTIVES

Arteriovenous fistula (AVF) malfunction is a major event which leads to inadequate haemodialysis dose through increased recirculation at the site of the fistula. The standard method for the calculation of AVF recirculation is the two-needle urea-based method, which needs the support of a laboratory and might be time consuming. We studied the probable usefulness of blood gases determination, for the estimation of AVF recirculation.

PATIENTS AND METHODS

Ten patients (6 male, age 62±8 years old) on chronic haemodialysis, with failure of a previously well functioning native AVF, were studied prospectively, before and after the surgical repair of their AVF. Adequate AVF function was defined as capability of the AVF to retain a circuit blood pump flow (Qb) of at least 300 ml/min, Kt/V values of ≥1.2 and prior two-needle urea-based recirculation values <5%, while AVF malfunction was defined as persistent failure of the AVF to support a Qb of at least 280 ml/min. Blood samples were drawn from the arterial line of the extracorporeal circuit as well as a peripheral vein at the opposite arm by the end of a 4-hour standard haemodialysis session and blood gases and K+ were determined immediately in whole blood on ABBOTT iSTAT handheld analyzer.

RESULTS

Blood gas normal value range for arterial and venous blood samples is shown in table 1. High pCO2, as well as low pH, sO2, and K+ values were universal findings in arterial line samples in all patients with AVF malfunction. Compared to peripheral vein samples, patients under AVF failure had significantly higher pCO2 values (60.5±12.5 vs 37.8±5.3 mmHg, P<0.05) and lower blood pH, sO2, and K+ values (7.26±0.08 vs 7.35±0.07, P<0.001, 42±5 vs 57±8%, P<0.05 and 3.43±0.4 vs 6.2±0.3 mEq/L, P<0.001, respectively) in their arterial line samples. In the same patients, after AVF repair, significantly higher sO2 values (89±8 vs 53±6%, P<0.001) and lower blood pH and K+ values (7.41±0.03 vs 7.44±0.01, P<0.001; and 4.0±2 vs 4.3±0.6 mEq/L, P<0.05, respectively) were found in arterial line samples, compared to peripheral vein samples. Differences (A) in pH, sO2, pO2, pCO2, HCO3 and K+ values between the two sites of sampling were statistically important in patients with failing AVF compared to the respective differences in the same patients after AVF repair (table 2). All cases of suspected recirculation were confirmed by calculation of the two-needle urea-based recirculation (37±11%).

CONCLUSIONS

Low blood pH (<7.30), sO2 and K+ values as well as high pCO2 values (>40 mmHg) in arterial line samples, differing significantly compared to peripheral vein samples, are indicative of an important recirculation in dialysis patients free of pulmonary disease. In such a case, the arterial line samples should not be trusted for the measurement of serum K+. Which should be done exclusively from samples drawn from peripheral vein, as long as spurious normokalaemia or even hypokalaemia in arterial line samples is the result of recirculation and can make a potentially life-threatening hyperkalaemia evade diagnosis. The use of blood gases for the estimation of an important AVF recirculation is a simple, cheap, instant and almost universally available method, which circumvents the metabolic and kinetic difficulties observed with the use of urea. Prospective studies will need to confirm these findings in larger populations, standardize and quantify this method.

REFERENCES