NEW METHOD OF MEASURING VOLUME OF VASCULAR ACCESS FLOW THAT REQUIRES NO SPECIAL DEVICE.

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INTRODUCTION

Vascular access blood flow rate (Qa) measurement methods have been proposed include the Doppler ultrasound system and dilution methods. Dilution techniques use the reversal of hemodialysis blood lines and the dialysis circuit flow (Qb) allows the calculation of Qa. In contrast, Kenneth Hoyt reported that modern ultrasound systems were reasonably accurate in measuring Qa. In any case, a specialized device is required in order to carry out a Qa measurement. If we measure the Qa after the blood line has been filled, it becomes difficult to measure the dilution ratio. Therefore, a special device such as the Transonic Hemodialysis Monitor (Transonic Inc., Ithaca, NY) becomes required. On the other hand, if the blood line is filled with saline solution, it is simpler to measure the dilution rate. We have devised new methods that can measure Qa easily without the requirement of a special device. The following is the explanation of the principle and the equation to calculate Qa. Firstly, the gross weight of hemoglobin streaming down a blood vessel is calculated as Hb(g/dl) level X Qa (ml/min). The volume of blood streaming down a blood vessel increases after saline is infused at the speed of Qb. Both are combined and become Qa+Qb. However, hemoglobin levels become diluted. In this situation, we name the hemoglobin concentration before the infusion of saline solution Hb1, and after infusion, Hb2. Suppose the total amount of flowing hemoglobin does not change. Qa (ml/min) X Hb1 = (Qa + Qb) Hb2. The following equations are established from the formula above. Qa = Hb2 X Qb /(Hb1-Hb2). We can calculate Qa using this equation.

METHODS

This study was conducted on the hemodialysis patients at Yokohama Minami clinic. Pumping of blood lines was initiated after the reversal of hemodialysis blood lines, at a rate of 50 ml/min of Qb. The blood was collected after it passed around 3 times the length from the puncture point to a drawing blood port to insure that the collected sample was undiluted.

RESULTS

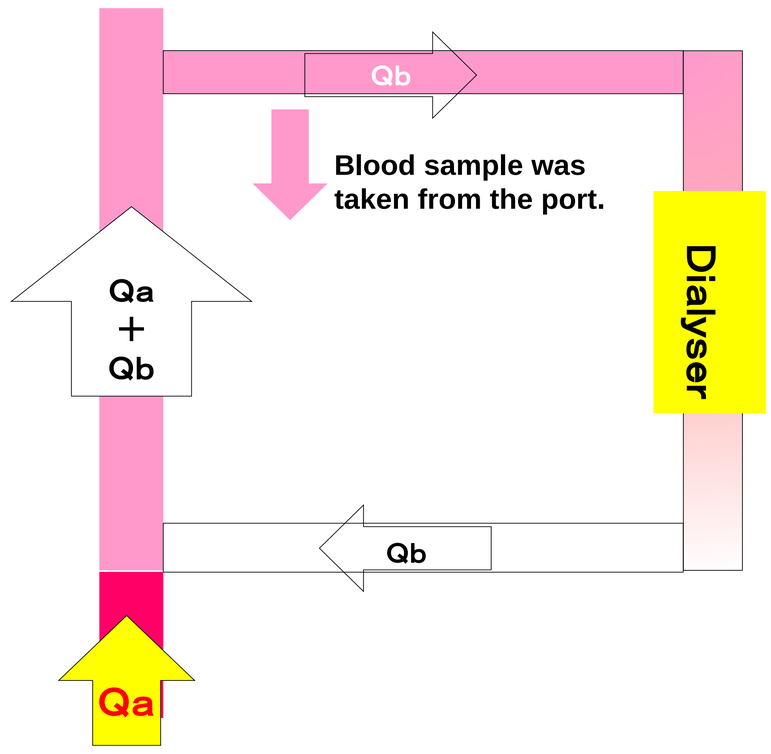

FIG1. Explanation of the reversal of hemodialysis blood lines and the flow volume in each section.

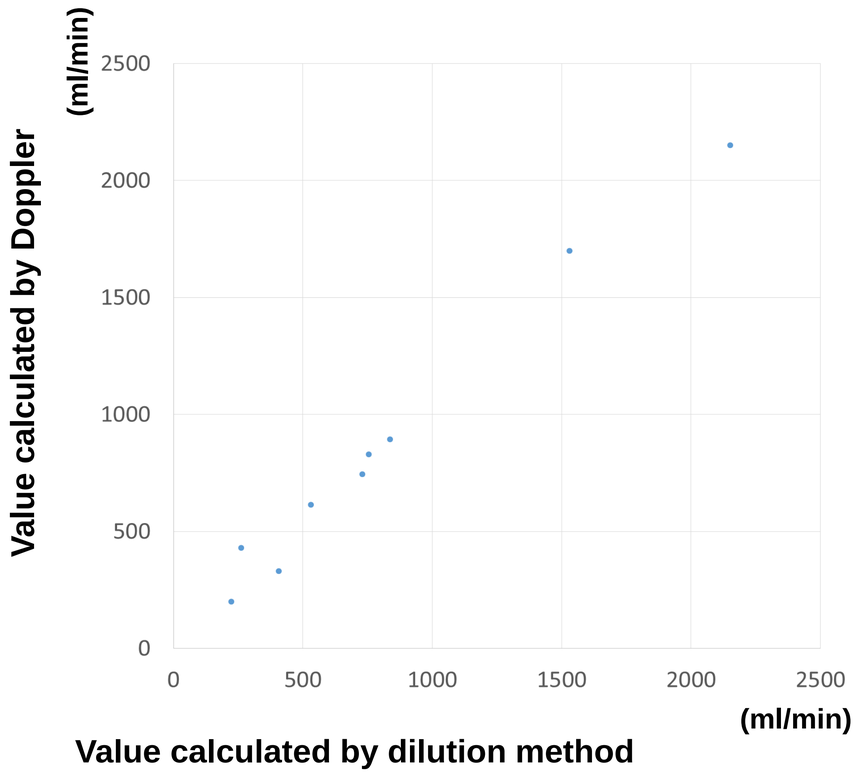

Table1. Correlation chart of the measurement value of Doppler and dilution methods.

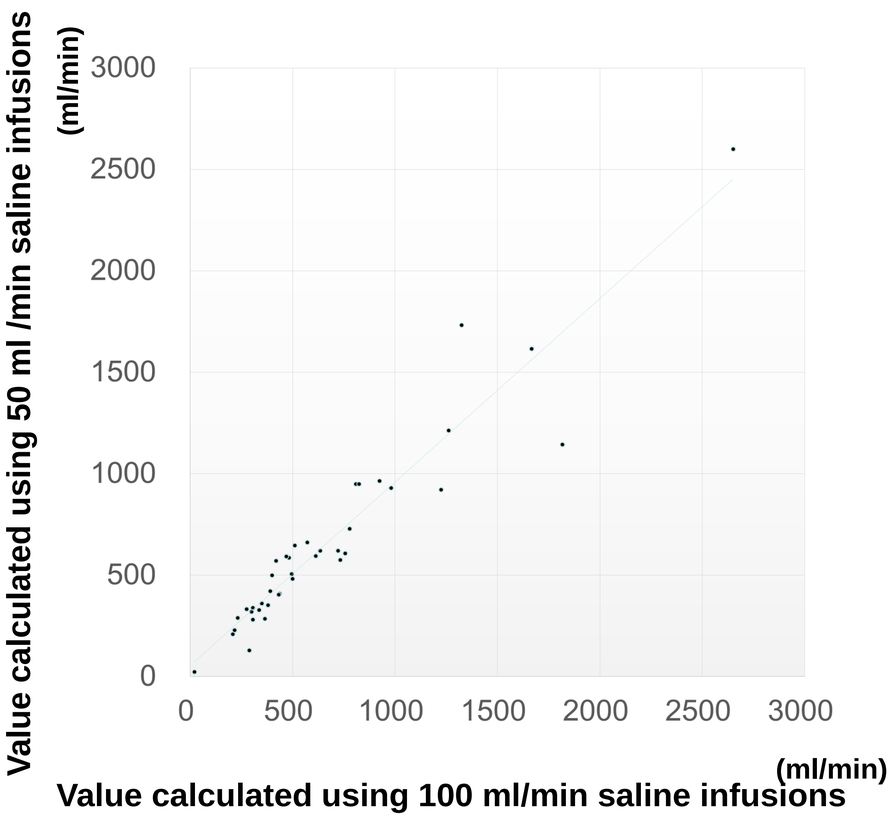

Table2. Correlation chart of the measurement value of two different infusion speeds of saline.

METHODS

The drawing of blood was carried out by the following methods to determine the average hemoglobin level influenced by heartbeats. We collected 10 ml of blood over 10 seconds, returned 9 ml, and used the remaining 1 ml for Hb level measurement. We conducted the same procedure again but this time at Qb of 100ml/min. In seven cases, we measured Qa by using the Doppler echocardiography in Shonan Kamakura General Hospital. Then, we calculated the average value of both Qb rates from all seven cases. Finally, we compared the results and Qa measured by using the Doppler method.

RESULTS

We measured vascular access blood flow 40 times at a rate of 100 ml of saline infusions and compared it with the data of 50 ml. The measurement value of 50 ml of saline infusions was 728 ±399ml, and the value of 100 ml was 661±551 ml. These values showed excellent reproducibility (coefficient correlation of 0.95). The Qa of seven patients was measured by using the newest commercial ultrasound systems. In these cases, the Qa measured by the dilution method was 836.60 ±729.8 ml/min, and by echocardiography was 893.43±744.3ml/min. The correlation between the two was excellent. (R = 0.99)

CONCLUSIONS

This method can measure blood flow of the vascular access without the need of a special device making it very useful. It can be provided in all dialysis facilities.

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