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The Relationship between the Dialysis Volume and Total Fluid Infused in Patients Undergoing Renal Transplantation

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ABSTRACT

Background: *Volume therapy is important to keep the graft kidney function and organ perfusion during kidney transplantation, and almost all patients undergo dialysis before operation. The study is designed to show whether the dialysis volume is more closely associated with the total fluid infused during renal transplantation.*

Methods: *Thirty patients undergoing kidney transplantation were included. The dialysis volume was recorded just before operation. Stroke volume variation (SVV) was kept under 13, and central venous pressure (CVP) was kept between 8 to 12 mmHg before the reperfusion of the graft kidney until the end of the operation. The total fluid infused was recorded at the end of the operation.*

Results: *All patients included in the study underwent successful renal transplantation and recovered to normal after operation. The MAP, CVP, CO before graft renal reperfusion and 30 minutes after reperfusion increased significantly than that of after anesthesia, while SVV before graft renal reperfusion and 30 minutes after reperfusion decreased significantly than that of after anesthesia. The total fluid infused was significantly different from the dialysis volume, and was not correlated with the dialysis volume.*

Conclusions: *These data suggested that fluid therapy is necessary to the recovery of graft renal function, and that the dialysis volume, as part of the volume lost before operation, cannot be used to assess the need of total fluid infusion.*

Keywords

Dialysis volume, Fluid infusion, Renal transplantation, Stroke volume variation, Central venous pressure.

Abbreviations

SVV: Stroke Volume Variation; CVP: Central Venous Pressure; CO: Cardiac Output; PEEP: Positive Expiratory End Pressure.

Introduction

The patients need kidney transplantation is always with a terminal renal disease and in a condition of sodium and water retention, so most of them undergo dialysis before renal transplantation. Volume therapy is important to keep the graft kidney function and organ perfusion during kidney transplantation, by the contrast, excess blood volume can result in heart failure [1-3]. By now, it is difficult to predict the exact fluid requirement during renal transplantation. Dialysis volume, taken as the weight loss after diaysis, is the direct fluid lost before operation; it remains unclear whether dialysis volume before operation can predict the fluid requirement during kidney transplantation.

The study is designed to show whether dialysis volume can predict the total fluid requirement in patients undergoing kidney transplantation, and to show whether the dialysis volume is more

closely correlated with the total fluid infusion during the renal transplantation.

Materials and Methods

Patients

Medical ethics committee approved this study, and the written informed consent was obtained from all subjects enrolled in the study. Thirty patients, aged 18~50 years old, without a history of heart failure, with a fasting time of 6~10 hours, were enrolled in the study. The bleeding volume during the operation was limited to less than 100 ml. Saline and sodium bicarbonate (to rectify the acid-base balance) were continuously infused in these patients. The intravascular volume was kept at CVP 8~12 mmHg and SVV less than 13 before the reperfusion of the graft kidney until the end of the operation. The operation time was limited to 2 ~ 3 hours. Patient's characteristics were shown in Table 1.

Mechanical ventilation

All patients in the study were undergoing mechanical ventilation by a volume-controlled mode. The tidal volume was set at 6~8 ml/kg, PEEP at 5 cmH_2O, and inspiratory/expiratory ratio at 1/2. The inspired oxygen concentration was set at 50%, and respiratory rate was adjusted to ensure the arterial carbon dioxide pressure between 36~40 mmHg.

Hemodynamic monitoring

After anesthesia, the CVP catheter (Arrow, CV-17702, and American) was inserted into the position between the superior vena cava and the right atrium, which was positioned by the chest X-ray. The zero point was set at the level of the fourth intercostal space in the middle axillary line. The MAP was recorded at the time of after anesthesia, before renal reperfusion and 30 minutes after reperfusion.

Vigileo monitoring

After the Allen's test, the 20 G arterial catheter (BRAUN, Germany) was inserted into the left radial artery, which was connected to the Vigileo system (Edwards Lifesciences) to monitor the SVV and CO.

Statistical analysis

The results were expressed as mean±SD. The SPSS V22.0 was used to the Statistical analysis. The relationship between the dialysis volume and the total fluid infused were evaluated by Spearman correlation. A P-value (one tail) less than 0.01 was recognized as statistically significant.

Results

All patients included in the study underwent successful renal transplantation, without complications of heart failure and pulmonary edema, the urine output, blood creatinine and urea nitrogen levels gradually recovered to normal after operation. The patient's characteristics were shown in Table 1.

Patient hemodynamics after anesthesia, before renal reperfusion and 30 minutes after renal reperfusion were shown in Table 2. After fluid therapy, the MAP, CVP, CO before graft renal reperfusion and 30 minutes after reperfusion increased significantly than that of after anesthesia, while SVV before graft renal reperfusion and 30 minutes after reperfusion decreased significantly than that of after anesthesia.

Table 1: Clinical characteristics and disease leading to transplant (n=30 Mean ± SD or number).

Characteristics	
Underlying disease	
Primary glomerulonephritis	21
Chronic pyelonephritis	5
Interstitial kidney	2
Polycystic kidney disease	2
Age (yr)	41±10
Gender	
Male	17
Female	13
Weight (kg)	61±17
Fasting time (hour)	8.2±2.3
Donor kidney ischemia time (hour)	5.7±1.6
Tidal volume (ml/kg)	9.1±1.2
PEEP (cmH_2O)	3
Inspiratory/expiratory ratio	1/2
Inspired oxygen concentration	50%
Arterial carbon dioxide pressure (mmHg)	37±2.3
Bleeding volume (ml)	89±10
Complication	without history of heart failure

Table 2: Hemodynamics during renal transplantation.

		After anesthesia	Before reperfusion	30 min after reperfusion
Mean arterial pressure	(mmHg)	91±12	115±14 *	115±13 *
Heart rate	(beats/min)	76±10	81±11	79±11
Central venous pressure	(mmHg)	7.2±1.7	10.3±1.1 *	10.6±1.4 *
Cardiac output	(L/min)	6.4±1.1	8.6±1.3 *	8.6±1.5 *
Stroke volume variation	(%)	13.9±3.5	9.3±1.9 *	8.9±1.7 *

*:compared with the values after anesthesia, P<0.01

The dialysis volume and total fluid infusion were shown in Table 3. The dialysis volume was significantly different from the total fluid infusion (Figure 1). There was no correlation between fluid infusion and dialysis volume (Figure 2).

Discussion

Almost all the patients undergo dialysis before renal transplantation, and the outcome of renal transplantation is closely

related to the modality and duration of dialysis pre-transplantation. On the operation day, patients undergo dialysis to improve the hyperkalemia and natrium and water retention, and to provide a better preoperative condition [4-7].

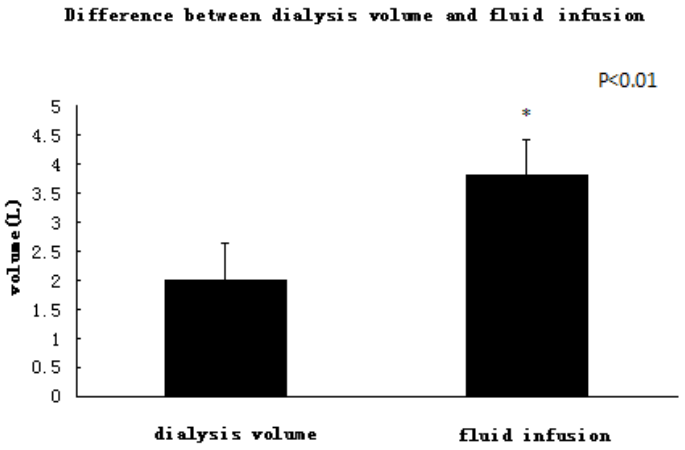

Figure 1: Difference between dialysis volume and fluid infusion.

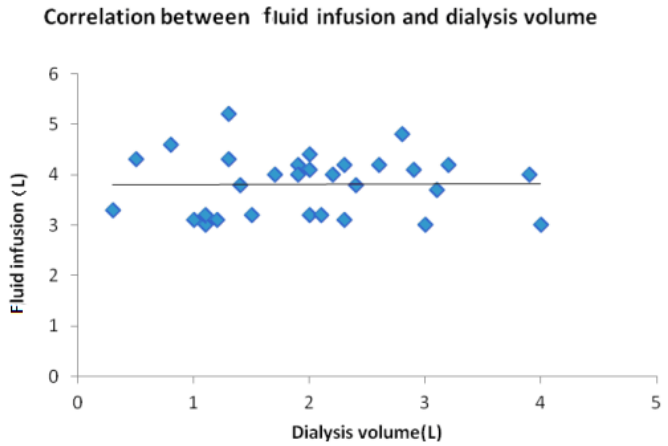

Figure 2: The correlation between fluid infusion and dialysis volume.

Table 3: The dialysis volume before operation and the total fluid infusion during renal transplantation.

	Dialysis volume (L)	fluid infusion (L)
Mean	1.99	3.81 *
SD	0.63	0.60

*: compared with the dialysis volume, P<0.01.

In this study, the dynamic indices SVV (<13) and the static indices CVP (8~12 mmHg) were adopted to monitor the preload of the body. This standard ensures the enough intravascular volume and less complication of the sodium and water retention. According to the previous study, SVV is superior to CVP in predict the intravascular volume status [8-10]. However, SVV is affected by the airway pressure and tidal volume [11-13]. In this study, the tidal volume was set at 6~8 ml/kg with a PEEP level of 5 cmH_2O, and the inspiratory/expiratory ratio was set at ½ [14-16].

The fluid therapy is important to ensure the sufficient blood volume, while sufficient blood volume is conducive to the perfusion of organs and recovery of graft renal function during renal transplantation. Fluid infusion during renal transplantation increases the perfusion pressure, ensures the enough preload before the renal reperfusion, at the same time, the stroke volume variation decreases [1-2]. By the contrast, overload volume may result in pulmonary edema and heart failure, particularly in the condition that graft renal function remains uncertain.

In this study, it was found that the total fluid infusion was significantly different and was not related to the dialysis volume, although the dialysis volume was actually part of the volume lost before operation.

In this study, the standard of recruited cases were patients without a history of heart failure, and with the bleeding volume less than 100 ml. The patients with a history of heart failure may influence the normal fluid infusion and the result of the study. Less bleeding may reduce the difference of the requirement of fluid. The fasting time was set at 6~10 hour to reduce the influence of physical requirements on the results of the study.

The fluid requirement is affected by many factors, such as the dialysis volume, physical requirement, bleeding during operation, fasting time and the third gap transferred volume. In this study, we tried to control all the other factors besides the dialysis volume to reduce the deviation of the result [1-2].

In conclusion, our study show that volume therapy is necessary to the recovery of graft renal function, and dialysis volume cannot be used to predict the fluid requirement during renal transplantation.

Acknowledgments

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