Kidney Transplantation

A Comparative Study on the Effect of Lidocaine and Furosemide on Urinary Output and Graft Function after Renal Transplantation

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ABSTRACT

Purpose: Renal transplantation is an ideal treatment for patients with chronic renal failure. It was demonstrated that despite the adhesion to surgical and anesthetic principles, urinary output is not satisfactory after transplantation. It seems that microvascular spasm of renal vasculature is responsible for this phenomenon. We designed a study to investigate whether lidocaine injection into renal artery can relieve vasospasm and subsequently improve output and graft function better than furosemide.

Materials and Methods: In a randomized clinical trial, from July 2002 to November 2003, 100 consecutive patients who were referred to our center for kidney transplantation were recruited in this study. After obtaining written informed consent, they were divided blindly into two groups. In group 1, lidocaine was injected into renal artery, before arterial anastomosis, and group 2 received furosemide as the conventional intervention. Urine volume within 1, 4, and 24 postoperative hours and serum creatinine levels in the first three weeks were recorded and compared between the two groups.

Results: Urine volumes at 1, 4, and 24 hours after transplantation were higher significantly in lidocaine group (P <0.001). Serum creatinine levels were lower significantly in the first postoperative day and also 21 days after transplantation in group 1 (P <0.001).

Conclusion: Comparing to furosemide, it seems that lidocaine can cause a more effective vasodilation in renal arteries of kidney allograft, resulting in a better diuresis. This may have a role in the betterment of graft function.

KEY WORDS: kidney transplantation, lidocaine, vasospasm, graft function, urinary output

Introduction

Vasospasm is a common problem in vascular surgeries that can cause hypoperfusion and subsequent organ dysfunction. Many studies have been conducted to introduce a safe vasodilator to use in surgical operations. There is a consensus that the ideal agents for relieving vasospasm are those effecting locally and improving flap blood flow.[1] Among these drugs are: papaverine,[1] lidocaine,[1] nicardipine,[1] verapamil,[2] and capsaicin.[3] Lidocaine had been extensively studied on various organs and animal models and its efficacy has been proved. Vasodilation can be induced by lidocaine doses higher than 40 μg/ml.[4] On the other hand, is has been demonstrated that a better diuresis in time zero and

within three days after transplantation (early polyuria) is associated with a better graft function.[5] The conventional diuresis induction method is to administer a large amount of intravenous fluid (5 to 7 liters) and diuretics, most commonly furosemide (5 mg/kg).[6] However, this method is not always effective; furosemide acts on the thick ascending limb of Henle's loop, so that it must enter glomerular blood flow and then be excreted by proximal tubular cells in order to reach its action site.[7] It means that, without a good perfusion, diuretics cannot be effective. Furthermore, furosemide can cause hyponatremia, hypokalemia, hyperglycemia, and metabolic alkalosis.[7] Heretofore, the vasodilatory effect of lidocaine has been demonstrated on rabbit's carotid vessels,[8] porcine's epicardial arteries,[9] and rat's cremasteric vessels.[4] In human models, its effect on femoral[10] and retrobulbar vessels[11] has been showed. In this study, we used lidocaine, as an intravenous injection to renal arteries of kidney allograft and compared its vasodilatory effect with furosemide.

Materials and Methods

A total of 100 consecutive patients who were referred to Shohada-e-Tajrish hospital for renal transplantation were enrolled in this randomized clinical study. Using a questionnaire, the following data were collected from patients: age, sex, weight (in the operation day morning), etiology of renal failure, hemodialysis duration, and time interval between disease diagnosis and the need for hemodialysis. The patients were randomly divided into two groups, each with 50 cases. All of the patients underwent renal transplantation, while the surgeon was blind to the random numbers based assignment of the patients by the operation time. During the operation, blood pressure in declamping time, fluid intake, and vital signs were recorded. In group 1, lidocaine 2%, 2 mg/kg, was injected into renal artery prior to anastomosis and then it was clamped with a bulldog. End to side anastomosis of renal vein to external iliac vein and then, end-to-end anastomosis of renal artery to internal iliac artery were performed. Before declamping, vital signs were recorded and the urine flow in the ureter was observed. If there was not enough diuresis within three minutes, a diuretic would be administered and the patient would be excluded from the study. Nevertheless, it did not happen in neither of the patients who received lidocaine. In group

2, furosemide, 3 to 5 mg/kg was administered before declamping and the remaining process was the same as that in group 1. The ureter was anastomosed over a double J stent into bladder with Lich method. Fascia was sutured with 0.0 nylon, after the insertion of a drain and skin was sutured with 2.0 nylon. After the closure of the wound, a nurse who was blind to the study groups recorded the urinary output volume, hourly. The urine volume within 1, 4, and 24 postoperative hours and was also calculated. Serum creatinine level was measured daily, for three weeks. Statistic analysis was done using t, chi-square, and repeated measurements tests.

Results

From July 2002 to November 2003, 100 consecutive patients were enrolled in this study. Of patients, 68% and 32% were male and female in group 1 and 66% and 34% were male and female in group 2, respectively. Mean age of the patients was 36.8 ± 12.3 years in group 1 and 40.61 ± 11.1 years in group 2. There were not any significant differences regarding age and gender between the two groups. The etiologies for renal failure in group 1 were diabetes mellitus 40%, glomerulonephritis 22%, polycystic kidney disease 8%, hypertension 6%, and idiopathic 24%. In group 2, these were as follows: diabetes mellitus 44%, glomerulonephritis 8%, polycystic kidney disease 8%, hypertension 8%, and idiopathic 24%. Chi-square test showed no significant difference between the two groups. The mean hemodialysis duration was 1.6 and 2 years in groups 1 and 2, respectively. The time interval between diagnosis of renal insufficiency and the need for hemodialysis was 3.9 and 3.2 years in groups 1 and 2, respectively (p = NS). At declamping time, the mean systolic blood pressure in group 1 (13.12 ± 1.05 mmHg) was not different from that in group 2 (13.22 ± 1.13 mmHg) and the mean diastolic blood pressure in group 1 (7.4 ± 1.08 mm/kg) and group 2 (7.9 ± 1.05 mmHg) were not different significantly. Urine volume in the first hour after transplantation (V1) was 694 ± 299 ml and 348 ± 204 ml in groups 1 and 2, respectively, and the independent t test showed a significant difference between the two groups (P <0.001). The urine volume in the first 4 hours after transplantation (V2) was significantly different between group 1 (3980 ± 1547 ml) and group 2 (2575 ± 1187 ml) (P <0.001). In addition, urine volume in the first 24 hours after transplantation (V3) was signifi-

cantly higher in group 1(18590 ± 5379 ml) in comparison with group 2 (11078 ± 7698 ml) (P <0.001).

As the urine volumes of V2 and V3 were obtained from the summation of previous hourly urine outputs, we used repeated measurement test to evaluate the results; it was shown that urine volumes were statistically different between the two groups (P <0.001, F = 5.22). The urine volume in every three measurements in group 1 was higher than that in group 2.

Fluid intake during the surgery in group 1 (3.42 ± 0.57 liters) was significantly lower than that in group 2 (4.48 ± 0.5 liters) (P <0.001). Serum creatinine level in the first postoperative day (Cr1) was 6.07 ± 1.09 in group 1 and 6.1 ± 1.44 mg/dl in group 2. But, serum creatinine level in the second postoperative day (Cr2) was significantly lower in group 1 (2.1 ± 0.8 mg dl) than in group 2 (3.1 ± 1.5 mg/dl) (P <0.001). Likewise, serum creatinine level, 21 days after transplantation (Cr3), was significantly lower in group 1 (1.18 ± 0.9 mg/dl) than in group 2 (1.7 ± 1.6 mg/dl) (P = 0.0027).

Discussion

To our knowledge, this study has been done for the first time worldwide and there was not any similar study for comparison. Experimental animal studies have shown vasodilatory effect of lidocaine.

The obscure fact is effective vasodilatory dose of lidocaine. In animal studies, doses higher than 30 to 40 mg/ml have been used.[4] In one study on cadaver kidney transplantation, the dose of 2 mg/kg has been effective.[12] We also used this dose of lidocaine. The safe dose of lidocaine for local anesthesia is 2 to 4 mg/kg.[13] We also did not observe any side effect with the used dosage. With this dosage, the graft function was better after transplantation.

Conclusion

Lidocaine is a safe and effective drug for prevention of vasospasm in vascular surgeries. In this study, we demonstrated that it improves renal perfusion and results in better diuresis and graft function.

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