Original Article

Zahedan Journal of Research in Medical Sciences

Journal homepage: www.zjrms.ir

# Association of Live Donor Nephrectomy and Reversal of Renal Artery Spasm

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***Article information***

Article history:
Received: 25 Feb 2012
Accepted: 12 May 2012
Available online: 7 Jan 2013
ZJRMS 2014; 16(1): 36-39

Keywords:
Kidney transplantation
Live donor nephrectomy
Artery spasm
Graft function
Renal vasospasm

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***Abstract***

***Background*:** Kidney transplantation is the best treatment option for kidney failure. Major medical progress has been made in the field of renal transplantation over the last 40 years. The surgical procedure has been standardized and the complication rate is low. Overall, the outcome of renal transplantation is excellent and has improved over time. Vascular complications after renal transplantation are the most frequent type of complication following urological complications. Renal artery spasm (RAS) following manipulation of renal artery is a common problem during live donor nephrectomy (LDN). The aim of this study was to determine whether or not it is necessary to wait for reverse of RAS and resumption of urinary flow before nephrectomy.

***Materials and Methods*:** In this clinical trial 16 cases of LDN who developed RAS during surgery received intra-arterial injection of 40 mg papaverine. In 8 cases surgery continued towards nephrectomy and in other 8 cases we waited for reverse of RAS. All analyses were performed using SPSS-11.

***Results*:** In both groups urinary flow started a few minutes (Mean, 12 min) after declamping of transplanted kidney and normal renal consistency and color were achieved. There was no significant difference between urinary volume during 12 h after transplantation in two groups.

***Conclusion*:** The results showed that it might not be necessary to wait for reverse of RAS before LDN. Both patient (less anesthesia complications) and hospital (less expenses) will benefit from this time saving.



## Introduction

The incidence of end-stage renal disease (ESRD) in the United States is increasing dramatically [1] Kidney transplantation is an efficient treatment of end stage renal disease [2, 3]. It offers patients with end stage renal failure improved survival and quality of life compared with dialysis [4].

Kidney transplantation has progressed from an experiment in surgery, nephrology, and immunology to the preferred means of renal replacement therapy for patients with end-stage renal disease. Patient and graft survival rates are spectacular in the short run and improving [5]. The first successful renal transplant was carried out more than five decades ago between identical twins [6].

With organ shortage, new sources of donors are proposed, non heart beating donors and living donors. Living donor transplantation is the best transplantation with the best results [3]. The standard of care for patients with end-stage renal disease is kidney transplantation, which not only confers a survival benefit compared to hemodialysis, but is also cost-effective. Growing organ shortage has lead transplant surgeons to accept older, less healthy, and even non-heart-beating donors, with generally good results. Living-donation is safe for the donor; outcome is excellent and plays an increasing role today. It has surpassed the number of cadaveric kidney transplantations in some countries [7]. Preemptive renal transplant has been associated with better survival of both the allograft and the recipient than has conventional renal transplant. It remains unclear, however, whether preemptive transplant is optimal for renal replacement therapy [8]. Kidney donations are of particular interest with the currently increasing practice of living-donor transplantation [9]. Renal transplantation offers patients with end stage renal failure improved survival and quality of life compared with dialysis.

Vasospasm is a common complication in vascular surgeries that can cause hypo-perfusion and subsequent organ dysfunction, and even acute renal failure in cases of RAS during abdominal surgeries [10]. Renal artery spasm is a common problem during live donor nephrectomy (LDN). The ideal agents for relieving spasm are vasodilators which affect locally and improve flap blood flow [11]. Their principal effect is relaxation of smooth muscle, especially in the vascular system. When facing RAS, after treatment with a vasodilator there are two options to complete LDN procedure. It is plausible to continue the procedure right following administration of a vasodilator till nephrectomy despite artery spasm. It is also possible to wait for reverse of artery spasm, by observation of renal consistency and resumption of urinary flow before nephrectomy, which

takes about 7 to18 minutes. In this case the surgery team needs to keep patient under anesthesia for a longer period and consume more time and anesthetic medications.

In this study, along with using papaverine as a spasmolytic agent in both group, we compared the above mentioned methods to complete the LDN in cases of RAS. To our knowledge this is the first study to conduct this comparison in cases of RAS.

## Materials and Methods

In this clinical trial From April 2004 to September 2009, 204 kidney transplantation had been performed consecutively using live donors: 168 cases in Afzalipoor hospital in Kerman (2004-2006) and 36 cases in Ali-Ebn-e-Abitaleb hospital, in Zahedan, Iran (2007-2009). From these, 16 donors (12 male and 4 female) developed RAS following dissection of renal artery and before clamping. There were no hemodynamic or cardiovascular problems in either of cases. These were randomly divided in two groups. Control group, including 5 male and 3 female, mean age 26.2 years (range 18-32), and test group, including 7 male and 1 female, mean age 24.8 years (range 21-27). Renal artery spasm during surgical manipulation of renal artery was evident by loss of kidney consistency and loss of diuresis in affected kidney. Treatment started with intra arterial injection of 40mg papaverine, proximal to the spastic area in both groups. In control group, we waited for reverse of artery spasm, by observation of renal consistency and resumption of urinary flow before nephrectomy (mean waiting time12 minutes, range 7-18 minutes). In test group, surgical procedure was continued till nephrectomy despite artery spasm. Early graft function, immediately after starting circulation in the grafts (time to start urinary flow and observation of normal renal consistency and color), and urinary volume during 12 hours after transplantation in the recipients were compared between two groups. Unpaired *t*-test was used to analyze the data.

## Results

Of 16 kidney recipients 10 were male and 6 female with mean age of 38.7 years. Mean interval between diagnosis of chronic renal failure (CRF) and kidney transplantation was 2.6 years. The etiology for CRF was diabetes mellitus (7 cases), glomerulonephritis (3 cases), polycystic kidney (2 cases), hypertension (2 cases), SLE and reflux nephropathy (each 1 case). No hemodynamic problem was observed in either of cases during surgery. Pelvic area of the recipient was provided by paramedian incision. Arterial anastomosis of kidney allograft was performed to internal or external iliac artery and end to side venous anastomosis. Mean interval between donor nephrectomy and declamping of transplanted graft was 37 minutes. During few minutes after declamping of transplanted kidneys, urinary flow started and normal renal consistency and color was achieved in all cases. There was no significant difference between two groups in these variable. Urinary volume during 12 hours after transplantation was 7900-14200 ml (mean 10125 ml), in control group, and 6500-13200 ml (mean, 9750 ml) in test group. There was no significant difference between two groups, in this variable as well.

## Discussion

Vascular complications after renal transplantation are the most frequent type of complication following urological complications. They may affect the function of the transplant. Early vascular complications include renal artery or vein thrombosis, lesions to the iliac vessels and cortical necrosis [12].

In addition; Intra renal artery spasm, should be taken into account for renal allografts with severe ischemia of unknown cause after restoration of renal blood flow, that was regarded as a sign of hyperacute rejection (HAR) or other irreversible lesions [13]. Delayed complications mainly include renal artery stenosis, arteriovenous fistula, and rarely false aneurysm [12].

Renal artery spasm is a common problem during LDN, it is also reported during transluminal angioplasty [14], and following abdominal surgery for neuroblastoma [15]. Multiple spasms of renal arteries following percutaneous transluminal renal angioplasty in children is also reported [16].

Manipulation of the renal artery during operative procedures seems to stimulate vasoconstriction in the manipulated kidney by a direct effect [17]. Prompt correction of the cause is required since interruption of arterial blood supply to the kidney results in acute renal failure. Vasodilators are the ideal agents for relieving spasm. When facing RAS, after treatment with a vasodilator there are two options to complete LDN procedure. The first option is to continue the procedure right following injection of the vasodilator till nephrectomy despite artery spasm. The second option is to wait for reverse of artery spasm by observation of renal consistency and resumption of urinary flow before nephrectomy which takes about 7-18 minutes. At present routine and preferred opinion is to wait for reversal of spasm before nephrectomy.

Relaxing agents are occasionally injected into an area where local vasodilatation is desired, especially into and around arteries and veins to relieve spasm during vascular surgery [12, 18]. There is a consensus that the ideal agents for relieving spasm are those effecting locally and improving flap blood flow [11, 19]. Among these drugs are; papaverine, lidocaine, nicardipine [11, 14, 19], verapamil [1, 14, 20], and capaicine [3, 21] tolazoline, nitrates, and heparin [14]. Papaverine is an alkaloid present in opium [4, 22], structurally unrelated to morphine which inhibits phosphodiesteras [5, 23]. Papaverine is used clinically as a vasodilator [6, 24]. In an experimental study on pigs, Zacherl and coworkers found that application of papaverine around the renal artery before nephrectomy in pigs can prevent mechanically induced renal angiospasm during the

operation and improve early graft function after transplantation [8, 25].

Razzaghi et al. investigated that despite the adhesion to surgical and anesthetic principles, urinary output was not satisfactory after transplantation. They postulated that microvascular spasm of renal vasculature is responsible for this phenomenon. They designed a study to investigate whether lidocaine injection into renal artery can relieve vasospasm and subsequently improve output and graft function, they concluded that, 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 [26].

In this study we used papaverine as a spasmolytic agent, in cases of RAS. Our study showed that there is no significant difference between the two options. Therefore by conducting the option of not waiting for reverse of the spasm, less time and anesthetic period and medications are consumed to complete nephrectomy which also reduces the complications of anesthesia compared to the second option. In the other hand saving the time of surgical team will provide more time for them to do another operation and reduce the expenses of patients and increase the earnings of both hospital and surgical team. For future investigations the authors suggest to include further criteria in the study such as measurement of urinary volume during more time intervals after transplantation. We concluded that it might not be necessary to wait for reversal of renal artery spasm after administration of a vasodilator before live donor nephrectomy.

## Authors' Contributions

Conceived and designed the experiments: FF. Performed the experiments: FF, JA. Analyzed the data: FF, JA. Contributed reagents/materials/analysis tools: FF, JA, HRA. Wrote the paper: FF, AJ.

## Conflict of Interest

The authors have no conflicts of interest to disclose.

## Funding/Support

Zahedan University of Medical Sciences

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***Please cite this article as***: Fazeli F, Azmandian J, Dehghani-Firoozabady M. Association of live donor nephrectomy and reverse of renal artery spasm. Zahedan J Res Med Sci (ZJRMS) 2014; 16(1): 36-39.