

COMPARATIVE STUDY OF SHORT-TERM OUTCOME OF LIVE RELATED RENAL TRANSPLANTATION FROM GRAFTS HAVING SINGLE VS MULTIPLE ARTERIES

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Abstract

Objective: To compare the outcome of live related renal transplantation between the Grafts having single vs multiple arteries.

Materials and Methods: The data of 94 renal transplants with single and multiple arteries performed between January 2011 and December 2012 were collected from Bangabandhu Sheikh Mujib Medical University and National Kidney Foundation. Sixty three renal transplant with single renal artery were compared to 31 transplants with multiple arteries. The aspects analyzed were number of arteries of the graft, donor type, ischemia time, time spent for arterial anastomosis, time spent for total vascular anastomosis and time for whole operation, vascular reconstruction technique, the occurrence of surgical complications, the incidence of delayed graft function, graft function 6 month after transplantation, graft loss and mortality.

Results: The incidence of surgical complications in grafts with single artery and multiple renal artery was respectively: vascular 6.4% and 3.2%; urological 13.2% and 9.6%, other surgical complications was 3.2% and 3.2%, and the difference were not significant among the two groups. Symptomatic lymphocele was 3.2% observed in single artery group but the incidence of lymphoceles was 6.4% in grafts with multiple arteries ($p < 0.005$). The incidence of delayed graft function in grafts with a single artery and multiple arteries was respectively 6.4% and 6.4% ($p = < 0.005$). Mean serum creatinine at the end of 6th months of postoperative period was 1.33mg/dl and 1.67 mg/dl in grafts with single and multiple arteries respectively ($p < 0.005$). Cold ischemia time, preparation time duration of in vivo arterial anastomosis and the total length of operation time was significantly longer in the multiple artery group ($p < 0.005$). Six months grafts survival in single and multiple artery was 88.9% and 87.1% respectively.

Conclusions: Kidney transplantation using grafts having single and multiple arteries present similar indices of surgical complications and short-term outcome. Though, lymphoceles was more frequent among grafts with multiple arteries but the difference were not significant among the two groups. In other words. Live related renal transplantation from grafts having multiple arteries is safe and has a good outcome.

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Introduction

Renal transplantation is the organ transplant of a kidney into a patient with end-stage renal disease¹. The technical aspects of the procedure are well

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established and are typically accomplished without complications.

The first successful live donor kidney transplant was performed in 1954. The donor and recipient were identical twins. Since then, our understanding of donor compatibility and the development of immuno-

suppressant medications have greatly advanced living donor procedures. Today, approximately 75% of people who receive a kidney transplant from a living donor maintain their kidney function for 10 to 20 years[2].

Kidney transplantation is typically classified as living-donor transplantation or deceased-donor (formerly known as cadaveric) depending on the source of the donor organ. Living-donor renal transplants are further characterized as genetically related (living-related) or non-related (living-unrelated) transplants, depending on whether a biological relationship exists between the donor and recipient[1].

Renal transplantations have improved dramatically during the last 3 decades due to refinements in surgical techniques, new immunosuppressive regimens, improved kidney preservation and advances in antimicrobial therapy. Because of the relatively limited donor supply in relation to the large number of patients with chronic renal failure, kidney allografts that were previously judged to be unsuitable for transplantation are now accepted for donation. One of these challenges is the engraftment of kidneys with multiple renal arteries. Autopsy studies have documented an 18% to 30% prevalence rate of multiple renal arteries, with 15% being bilateral (Saidi R et al 2009). With current advances in vascular surgical techniques, kidneys with multiple or complicated renal arteries, particularly in cases of live donor transplantation, are now engrafted without hesitation[3].

Several techniques for bench or in situ reconstruction of multiple renal arteries have been described in order to reduce the incidence of these vascular complications. In grafts from cadaver donors, the Carrel aortic patch is the standard technique of vascular reconstruction in renal transplants with a single and multiple arteries[4].

The presence of multiple renal arteries (MRA) is the most frequently encountered anatomic variation during kidney transplantation. In report, the incidence of unilateral and bilateral MRA during kidney transplantation was 23% and 10%, respectively. Because of improved surgical technique and better imaging modalities, the use of allografts with multiple renal arteries has increased in the era of laparoscopic donor nephrectomy[5].

The bulk of kidney for transplantation in our country is from live related donor. Although, live-donor renal transplantation of kidneys with more than one artery is technically more demanding, in a situation of organ scarcity and in a case of donor having bilateral multiple

arteries, there remains no options other than accepting him as a donor.

It would be a good opportunity to launch the current study to compare the outcome of these grafts with the single artery transplants. This may encourage our fellow transplant surgeons to adopt multiple arteries live donation into their programs more easily.

Materials and Methods

This prospective comparative study was carried out in the department of urology and nephrology department of Bangabandhu Sheikh Mujib Medical University (BSMMU) from January 2011 and December 2012. Purposive data were also collected from National Institute of Kidney Diseases & Urology (NIKDU) and Kidney Foundation Hospital in Dhaka city. Ninety six cases were included in this study. Causes of ESRD were chronic glomerulonephritis (51), hypertension (22), diabetes mellitus (20) and rest were of unknown etiology. A total of 96 recipients who underwent renal transplantation receiving either single or multiple renal arteries graft were included in the study. They were divided into Group – I and Group –II. Those receiving grafts having single renal artery were placed under Group – I (n-64) and those receiving grafts having multiple arteries were placed under Group – II (n-32).

Surgical Procedure:

Open donor nephrectomy was performed as per standard procedure. Good diuresis was ensured before organ retrieval. The recipient procedure was performed using the standard extra-peritoneal approach with end-to-side anastomosis of the renal vessels to the recipient iliac vessels. In cases of multiple renal arteries, revascularization was performed for all vessels that supplied more than 5% to 10% of the renal parenchyma, as estimated by the preoperative imaging and intraoperative in situ and back-table evaluations. To minimize warm ischemia time, ex vivo side-to-side conjoint artery to- artery anastomosis (Bench surgery) using 7-0 polypropylene continuous sutures was carried out (Bench surgery) while the kidney remained in cold preservation solution. Side-to-side spatulated anastomoses had been our preferred method because of the creation of a wide lumen for anastomosis with recipients external iliac artery. The details of the procedures are as follows.

a) Kidney with early branching renal artery: In the patients who had double renal artery with a short common

segment stump, all precautions were taken during retrieval and meticulous dissection was done upto its origin. A stump of appropriate length was saved and end to side anastomosis was performed with the external iliac artery.

b) Kidney with double renal arteries : In kidneys having two major arteries of equal diameter, reconstruction was done as conjoined anastomosis to make a common ostium which was anastomosed end to side with external iliac artery (Figure-1, a,b,c and Figure-2, a) In kidneys having one major artery and another slender lower polar artery. In these cases, sequential multiple anastomosis was performed. The anastomosis of the major artery was done first and the clamps were released to perfuse the kidney (Figure-1D). Subsequently, the lower polar artery was anastomosed end to end with the inferior epigastric artery (Figure - 1).

c) Kidney with three renal arteries: One kidney had three renal arteries .One artery was small in diameter and other two were equal in diameter. Bench surgery was performed to do side to side anastomosis of two arteries to create a common ostium (Figure- 1, a,b,c.). Subsequently, the lower polar artery was anastomosed end to end with the inferior epigastric artery (Figure – 2B).

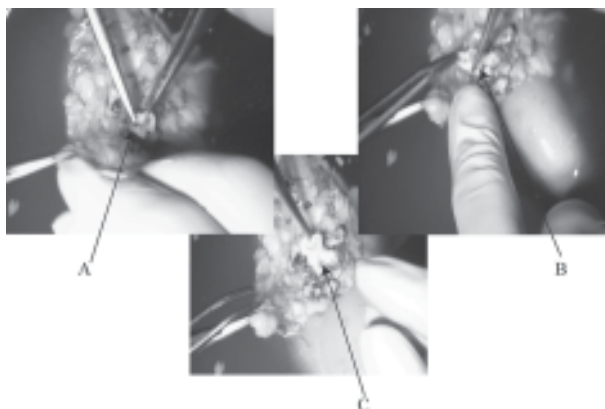


Figure-1: Bench surgery: i) side to side anastomosis of two renal arteries of almost equal diameter to make a wide lumen (Fig a,b,c)

Lastly, the ureter was reimplanted into the bladder by modified Lich's Gregoir Technique and ureteric DJ-Stenting was carried out in all recipients. As a routine,

stents were removed after two to three weeks Patients were discharged after 2 to 3 weeks of transplantation. They were followed at the out patient department initially once a week during the 1st months after discharged from hospital, then once a month for the following three months and 6 monthly for rest of the life.

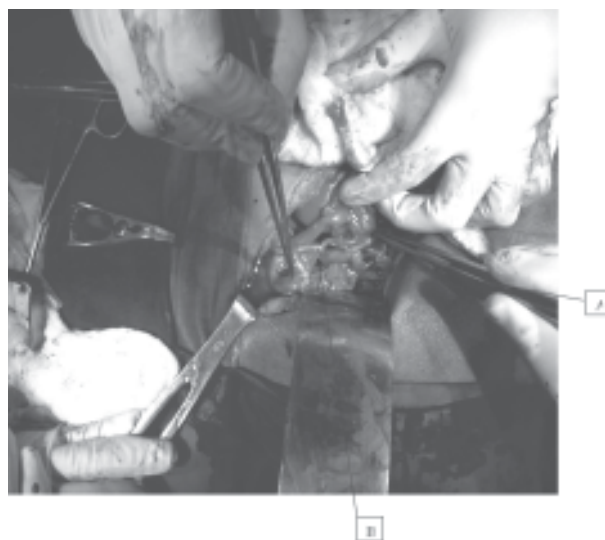


Figure-2: end to side anastomosis with external iliac artery (Figure-A) and iii) end to end anastomosis of the lower polar artery with the inferior epigastric artery (B).

Results

Among 96 transplants, single artery anastomosis was done in 64 patients and double renal artery transplant in 32 patients. Two patients died of graft failure within three months of transplantation, one from each group and they were excluded from this study. Cold ischemia time was 20-50 (39.45+/-3.92) minutes and 40-100 (68.93+/-16.49) minutes respectively, Both groups were identical in relation to age and sex of the patient, mean serum creatinine level, ischemia time, total time of arterial and vascular anastomosis, intra-operative and post-operative complications and hospital stay. In present study, we observed duplication of renal arteries in 30 cases and triplication in one case. Among the multiple arteries, 10 were on the right, 12 on the left and 6 were bilateral. Three cases had early branching of the renal artery (Figure 3,D).

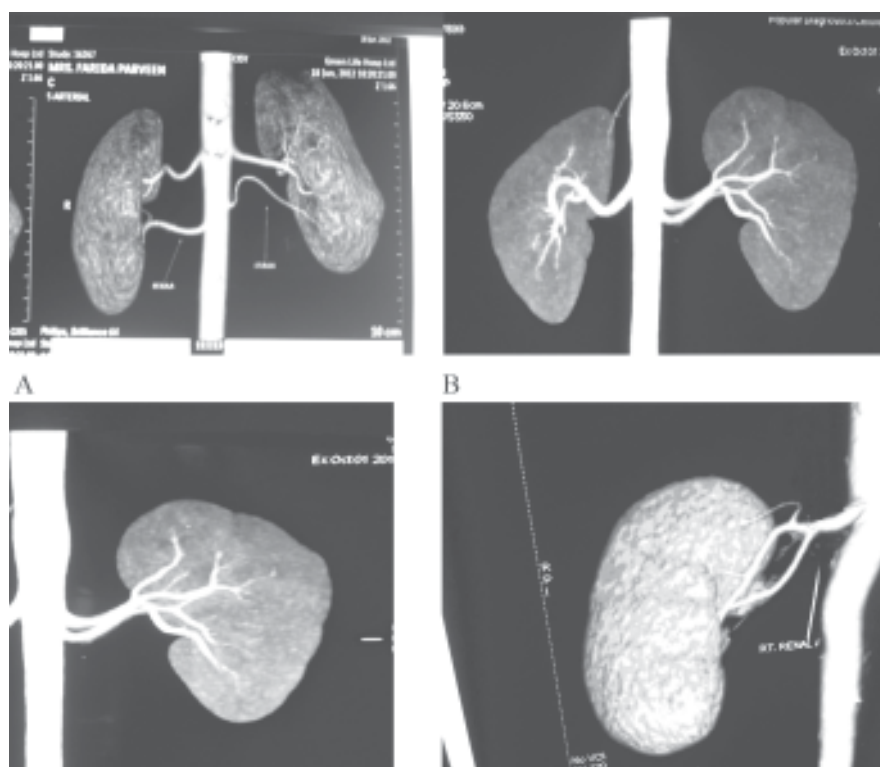


Fig.-3 : Duplicated renal arteries on both sides. a) Bilateral double renal arteries, b) double artery on left side and early branching right renal artery, c) Two arteries on the left side, D) Early branching of the renal arteries.

Demographic Characteristics

The table II reveals that out of 94 recipients, male and female were 57.31% and 41.62% in group-1 and 58.06% and 41.93% in group -2 respectively. The table II also demonstrates that mean age of the recipients having

single and multiple artery were 34.1 \pm 7.72 and 33.2 \pm 9.63 respectively. There was no significant difference between the two groups in terms of age and sex ($p=0.543$ and $p=0.831$).

Table-II
Comparison of demographic characteristics between two groups

| Characteristics | Single-A (n=63) | Multiple-A (n=31) | P-value* |
|-----------------|------------------------|------------------------|----------|
| Male | 36(57.37%) | 18(58.06%) | 0.543 |
| Female | 27(42.62%) | 13(41.93%) | |
| Mean age (yrs) | 15-50(34.1 \pm 7.72) | 20-45(33.2 \pm 9.63) | 0.831 |

*Chi-square (χ^2) test was employed to analyze the data.

Table III
Comparison of intra-operative variables between two groups

| Variables | Single-A(n1=63) | Multiple-A (n2=31) | p value* |
|--|-----------------------------|-----------------------------|----------|
| Time to prepare the vessels(min) | 20-60(40.10 \pm 4.13) | 40-90(65.1 \pm 5.23) | 0.432 |
| Warm ischemia time(sec) | 10-30(15.29 \pm 4.61) | 10-35(21.35 \pm 6.50) | 0.461 |
| Cold ischemia time(min) | 20-50(39.45 \pm 3.92) | 40- 100(68.93 \pm 16.49) | 0.031 |
| Time for arterial anastomosis(min) | 08-30(12.25 \pm 4.34) | 08-35(7.22 \pm 7.67) | 0.298 |
| Time for total vascular anastomosis(min) | 20-50(32.58 \pm 7.62) | 20-55(33.70 \pm 9.31) | 0.570 |
| Total time of operation(min) | 210-270(231.29 \pm 20.78) | 210-315(269.03 \pm 25.08) | 0.474 |

*Chi-square (χ^2) test was employed to analyze the data.

The table -III, demonstrates that time to prepare the vessels was on average 40.11 +/- 4.13 minutes and 65.17+/-5.23 minutes, cold ischemia time 39.45 +/- 39.45 minutes and 68.93+/16.49 minutes and time for total vascular anastomosis 231.29+/20.78 and 269.03+/25.08 minutes respectively. They were longer in the multiple artery groups (P=0.432,P=0.031,p=0.570)

The table IV shows average blood loss in recipients having single and multiple artery grafts was 179.33+/-7.98 ml. and 169.83+/-7.54 ml respectively. There was no significant difference between the two groups.

Table V shows that symptomatic lymphoceles in single and multiple artery grafts was 3.2% and 6.4%

respectively. The incidence of rejection and infection was not statistically different among the two groups. Six months graft survival in single and multiple arteries transplants were 88.9% and 87.1% respectively.

Table VI shows that hospitalized for recipients of single artery was 14.9+/-4.87 days while the recipients of multiple arteries kidneys stayed 17.8+/- 5.01 days. There was no significant statistical difference in two group (P=0.312).

Table VII reveals that mean serum creatinine level at the end of six months of transplantation was 1.33+/-0.3 mg/dl and 1.67+/-0.39 mg/dl in grafts having single vs. multiple arteries respectively There was no significant statistical difference among the two group (P=0.354).

Table IV

Comparison of intra-operative complications between the two groups

| | Single-A (n1=63) | Multiple-A (n2=31) | p value* |
|----------------------------|------------------------|------------------------|----------|
| Hemorrhage(ml) | 100-500(179.33+/-7.98) | 100-400(169.83+/-7.54) | 0.543 |
| Transfusion | 7(10.5%) | 3(9.6%) | 0.345 |
| Peritoneal perforation | 1(1.5%) | 1(3.2%) | 0.038 |
| Complication of anesthesia | 2(3.2%) | 2(6.45%) | 0.871 |

*Chi-square (χ^2) test was employed to analyze the data.

Table-V

Comparison of post-operative complications between the two groups,

| Complications | Single-A (n1=63) | MultipleA (n2=31) | p value |
|------------------------------------|------------------|-------------------|---------|
| Vascular reanastomosis | - | - | - |
| Temporary post transplant dialysis | 2(3.2%) | 2(6.45%) | 0.534 |
| Transplant nephrectomy | 2(3.2%) | 1(3.2%) | 0.234 |
| ATN | 1(1.5%) | 1(3.21%) | 0.053 |
| Urine leak | 2(3.2%) | 1(3.21%) | 0.452 |
| Arterial stenosis | 2(3.2%) | 1(3.21%) | 0.753 |
| Symptomatic lymphocele | 2(3.2%) | 2(6.45%) | 0.853 |
| Infection3 | 3(4.5%) | 1(3.21%) | 0.340 |

*Chi-square (χ^2) test was employed to analyze the data.

Table-VI

Comparison of post-operative hospital stay between the two groups:

| Duration | Single-A (n1) | Multiple-A(n2) | p value |
|------------------------|--------------------|---------------------|---------|
| Hospital stay(in day) | 10-30(14.9+/-4.87) | 12-28(17.8+/- 5.01) | 0.312 |

*Chi-square (χ^2) test was employed to analyze the data.

Table-VII
Mean serum creatinine level at the end of 1, 3 and 6 months of post operative period.

| Mean serum creatinine (mg/dl) | Single-A(n=63) | Multiple-A(n=31) | p value* |
|-------------------------------------|------------------------|------------------------|----------|
| At the end of 1 st month | 0.80-1.90(1.71+/-0.22) | 0.90-2.80(2.12+/-0.40) | 0.322 |
| At the end of 3 rd month | 0.70-1.72(1.45+/-0.29) | 1.10-2.50(1.81+/-0.44) | 0.432 |
| At the end of 6 th month | 0.90-1.90(1.33+/-0.30) | 1.10-2.80(1.67+/-0.39) | 0.354 |

*Chi-square (χ^2) test was employed to analyze the data.

Discussion

Kidney transplantation is the treatment of choice for patients with end-stage renal disease. Advances in surgical techniques, immunosuppressive therapies, and post transplant monitoring have led to an impressive increase in allograft survival. However, donor organ shortage has become one of the problems preventing the wider application of this treatment. Therefore, every organ must be used in a maximal favorable condition. Theoretically, transplanting a kidney with multiple arteries has several drawbacks, such as prolonged warm ischemia time; an increased incidence of acute tubular necrosis, which can increase the likelihood of acute rejection episodes, prolonged hospitalization; and decreased graft function. In deceased donor kidney allografts, use of the Carrel aortic patch incorporating the multiple renal artery ostia represents a good method for revascularizing the graft. However, this technique is not applicable to live donor transplantation[6].

Presently available imaging techniques have a sensitivity of 98% in identifying the number of vessels preoperatively (Saidi R et al 2009). Rarely, the surgeon faces unexpected hilar vascular anomalies. In our experience, we had one instance of a donor whose preoperative imaging suggested one renal artery but intra-operatively three renal arteries were found. This was due to the superimposed visual images of the adjacent renal arteries giving a reconstituted image that did not distinguish the multiplicity of the vessels. Recent studies have demonstrated that laparoscopic donor nephrectomy of kidneys with multiple renal vessels is safe and effective, providing kidney donor and allograft outcome comparable to those of open surgery[4].

The mean time spent for preparing the vessels in single artery group was 40.10±4.13 compared to 65.1±5.23 minutes in multiple arteries groups. In a multiple arteries live donor transplantation, the vascular dissection is more elaborate and the reconstruction is time-consuming, hence the preparation time was longer in our study as well as others[7]. Warm ischemic time was identical

between the two groups. The mean value of cold ischemic time for single artery group was 39.45±3.92 and the mean value for the multiple artery group was 68.93±16.49 min (p=0.031). The difference in cold ischemia time, is due to the time used for arterial reconstruction. This was not functionally detrimental to the allograft, because the kidneys of both groups were kept in same ice slash container or bag until the release of the vascular clamps.

The time spent to complete the arterial and venous anastomosis in the recipient did not differ significantly among the two groups. There was not a considerable difference in the total operation time among the two groups (p=0.570). With proper timing, recipient spent nearly the usual length of time being under anaesthesia, and in the gap period. It would only the grafts in ice-slash under reconstruction.

Hemorrhage was less in the recipients of multiple artery group (p=0.543). A more delicate dissection and attention to details had lessened the complication. Peritoneal perforations and complications of anaesthesia were more frequent in the recipients of multiple artery kidney transplants. More dissection for better preparation of the transplant bed has probably caused this difference. However, this has not affected the out come. A more attentive approach to this group may account for this finding.

Mehraban D and G, H. Naderi reported on 22 living donor open nephrectomies with multiple renal arteries, in which there was no urological and vascular complications were observed. In our study, the rate of vascular 2(3.2%) and urological 4(6.1%) (2 urine leak and 2 obstruction) was observed in the single artery group. On the other hand, vascular 1(3.2%) and urological 3(9.65%) (1 urine leak, 2 obstruction) complications were observed in multiple artery group. Postoperative complications were present similarly in both groups. This could be because of our meticulous ex vivo microsurgical technique to create a wide lumen by performing side-to-side anastomosis and

routine use of low-molecular weight dextran with aspirin. Moreover, all efforts were made to ensure the ureter had adequate vascular supply and that redundant length of the ureter was trimmed accordingly to maintain excellent vascular viability for the ureteroneocystostomy anastomoses. Hospital stay did not differ significantly among the recipients of each group in our study as well as in others[4].

According to literature, delayed graft function occurred in 85(292) patients in group- 1 (29.1%) and in 23(64) patients in group -2 (35.1%) ($p = 0.295$). Mean serum creatinine at 30th postoperative day was 1.81 mg/dl in group -1 and 2.46 mg/dl in group - 2 ($p = 0.271$) [4]. In our study delayed graft function occurred in 2 patients in group - 1(3.2% ($p < 0.005$)) and in 2 patients in group -2(6.4%). Mean serum creatinine at the end of 6 month was 1.33 mg/dl in single artery graft and 1.67 mg/dl in kidney grafts having multiple arteries ($p = 0.354$).

Delayed graft function was more frequent among grafts with multiple arteries, but without statistically significant difference, and this fact can be explained by the manipulation necessary for vascular reconstruction in these grafts, causing an increase in warm ischemia period. It is clear that warm ischemia time is longer in transplants with multiple arteries and this may influence the immediate function of the graft. Consequently, serum creatinine at the end of six months of post operative period of transplantation was higher in this group but, again, no statistically significant difference was found between the two groups.

All of our multiple artery grafts functioned promptly after the release of the vascular clamp. We prefer to anastomose the renal artery to the external iliac artery. Factors that influence the choice of the recipients artery and vein for the anastomosis are stump length, vascular kinking, pressure on the vein and the presence of atheromatous plaques. The outcome was not affected by the type of anastomosis.

Although the number in the group is small, it may say that at least the number of post operative complications is not more than the single artery group.. The six months grafts survival was 88.9% in the single artery group and 87.1% in the multiple arteries group. Considering the study variables, intra and post operative complications and the six months graft survival, the outcome of live donor renal transplants from grafts having multiple

arteries is comparable to the more usual single artery renal allograft.

Conclusion

In this study, there was no significant difference in the occurrence of vascular and urologic complications, as well as delayed graft function when we compared grafts with single and multiple arteries. Improvement in surgical techniques has made recovery of renal allografts with multiple arteries safe and feasible and, therefore, a more common practice recently.

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Conflict of Interest : None Declared

References

1. Nicolson NR, Michael L, (2003)., Kidney Transplantation from non heart-beating donors, Surgeon vol 1 no 6 , pp 311-322.
2. Smith CR, Kidney Transplantation. 1999-2011. Columbia University Medical Centre, Department of Surgery, New York, NY.
3. Aydin C, Berber I, Altaca G, Yigit B, Titiz I (2004), The outcome of kidney transplants with multiple arteries, BMC Surgery, vol .4, p 4
4. Mazzucchi E, Souza AA, Nahas WC , Antonopoulos IM , Piovesan AC, Arap S, (2005), Surgical Complications after Renal Transplantation in Grafts with Multiple Arteries, Internationl Braz J Urol vol. 31 no. 2, pp 125-130.
5. Mark D, Tyson, Erik P, Castle , Edmund Y. Ko , Paul E, Andrews , Raymond L. Heilman , Kristin L, Mekeel, Adyr A, Moss , David C, Mulligan, and Kunam S, Reddy, (2010) Living Donor Kidney Transplantation With Multiple Renal Arteries in the Laparoscopic Era ,Urology vol. xx, no xxx, pp xxx.
6. Saidi R, Kawai T, Kennealey P, Tsouflas G, Elias N, Hert M et al 2009. Livivg Donor Kidney Transplantation With Multiple arteries. Arch Surg, vol. 144, no 5. p 472-475.
7. Mehraban D, Naderi GH(1998), Outcome of Live Donor Renal Transplantation from single vs multiple arteries grafts, Acta Medica Iranica vol. 36 ,no. 1, pp 51-54.

8. Beckmann JH, Jackobs S, Klempnauer J (2008) Arterial Reconstruction in Kidney Transplantation. *Tx Med* 20: 7-12
9. Desai MR, Ganpule AP, Gupta R, Thimmegowda M(2007,)Outcome of renal transplantation with multiple versus single renal arteries after laparoscopic live donor nephrectomy: a comparative study. 2007 May;69(5):824-7.
10. Gil-Vernet JM, Gil-Vernet A, Caralps A, et al: Orthotopic renal transplant and results in 193 consecutive cases. *J Urol* 1989; 142:248.
11. Jafri SSA, Younas M, Chughtai MN, (2009), Surgical Aspects and Outcome of Kidney Transplantation with Multiple Renal Arteries. *Annals* vol. 15, no. 2, pp 88-91.
12. Khana R, Sood R, Madhusoodanan P, Sinha T, Sandhu AS , Gupta Sk, Pradhan AA, Kumar A, Sethi GS, Srivasatava A, (2004), Multiple Vessel Renal Transplant- Army Hospital(Research and referral) experience, *Indian Journal of Urology* vol. 20, no. 2, pp 130-133.
13. Mahmoud IM, Sobh MA, El-Habashi AF, et al: Interferon therapy in hemodialysis patients with chronic hepatitis C: study of tolerance, efficacy and post-transplantation course. *Nephron Clin Pract* 2005; 100:133.