EVALUATION OF SOME VASCULAR CHARACTERISTICS OF TRANSPLANTED KIDNEY AND RESULTS OF ANASTOMOSIS TECHNIQUES IN LIVING DONOR KIDNEY TRANSPLANT AT MILITARY HOSPITAL 103

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Summary

Objectives: To evaluate anatomical characteristics, anastomosis techniques of renal vessels, and results of vascular stitching applied in kidney transplant in Military Hospital 103. ***Subjects and methods:*** A prospective descriptive and cross-sectional study on 127 kidney transplant patients from living donors and 127 multislice computed tomography results of the transplanted kidney, collected in pairs of donors and recipients at Military Hospital 103, from December 2019 to December 2020. ***Results:*** There were 127 cases (88/127 cases 69.3% male and 39/127 cases 30.7% female). Patients aged from 18 to 66. *Vascular characteristics of the graft after nephrectomy*: 1 artery: 80.3%, 2 arteries: 17,3 %, 3 arteries: 2.4% and 1 vein: 91.3%, 2 veins: 7.9%, 3 veins: 0.8%. *Techniques for suture arteries*: end-end anastomosis to the internal iliac artery 105/127 (82.7%), end-side anastomosis to the external iliac artery 22/127 (17.3%). End-side anastomosis with external iliac vein:126 cases (99.2%). End-side anastomosis with common iliac vein: 1 case (0.8%). 100% of grafts had good blood supply, no bleeding at the connector, not narrow, and 100% of patients had urine on the operating table. There were no vascular complications that needed surgical intervention. ***Conclusion:*** Multiple renal arteries were the majority anomalies of renal vessels. Techniques for suture arteries: end-end anastomosis to the internal iliac artery (82.7%), End-side anastomosis with external iliac vein: 99.2%, no bleeding at the connector. 100% kidney with good blood supply, no bleeding at the anastomosis, no anastomotic stenosis, no vascular complications that need to be intervened after surgery.

* *Keywords: Kidney transplant; Vascular suture techniques.*

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INTRODUCTION

The kidney transplant technique has been standardized for many years. However, outcomes and techniques of kidney transplants depend on anatomical characteristics. of renal graft vessels. There are changes and differences in renal graft vessels in each case. So surgeons need to select different angiography techniques to ensure the optimal function of a transplanted kidney

Surgeons can perform different angiography techniques. To contribute to enhancing the quality of kidney transplants, we conduct this research: *To study anatomical characteristics and suture techniques of renal vessels and evaluate the early results of vascular stitching applied in kidney transplants in Military Hospital 103*.

SUBJECTS AND METHODS

1. Subjects

127 kidney transplant patients from living donors and 127 multislice computed tomography results of the transplanted kidney, collected in pairs of donors and recipients at Military Hospitals 103 from December 2019 to December 2020.

** Criteria for selecting patients:*

Patients with chronic kidney failure, or end-stage kidney failure, are indicated for a kidney transplant and meet the requirement for a kidney transplant.

2. Methods

- A prospective descriptive and cross-sectional study from December 2019 to December 2020.

- Placement position for transplant on the recipient: Right iliac fossa.

- General features of patients: Age, gender.

- Characteristics of transplanted renal vessels: On Multislice Computed Tomography and after nephrectomy: Quantity of vessels, length of main renal vessels, measurement of main vessels supplying blood to the kidney.

- Angiography and anastomosis techniques:

+ Management techniques in case of multiple arteries: Grafts side-side anastomosis with 2 renal arteries in case two arteries with the same length, same diameter, and branch into renal hilum. Perform end-side anastomosis of the renal polar artery to the main artery trunk in case the superior polar renal artery is short and far from the renal hilum artery.

In case we can not perform angiography and anastomosis techniques before transplant, we keep 2 renal arteries trunk to connect an external iliac artery to form 2 separated end-side anastomosis or connect 1 renal artery to internal iliac artery and 1 renal polar artery with epigastric artery

+ Angiography and anastomosis (artery): Perform whipstitch suture with thread Prolene 6.0. End-end anastomosis of the renal artery to the internal iliac artery. End-side anastomosis of the renal artery to external iliac artery. Anastomosis of the polar renal artery to epigastric artery

+ Venous suturing (vein): Perform whipstitch suture with thread Prolene 6.0.

End-side anastomosis of the renal vein to external iliac vein. In case there are 2 veins, perform grafts side-side anastomosis with 2 renal veins. If two veins are nearby each other, perform end-side anastomosis to an external iliac vein or end-side anastomosis of 2 veins to an external iliac vein. Transposition of the external iliac vein and external iliac artery in case renal veins are short.

3. Outcomes assessment

- Perform the outcomes assessment on the surgical table after removing the vessel clamps. Assess: vessels anastomosis, blood supplied to kidney, urine secretion on the surgical table [3].

- Perform post-operative assessment early: Kidney function, urine output, operating duration, and length of hospitalization [3].

- Perform renal vascular ultrasound after transplantation: 1 month, > 1 - 3 months, > 3 - 6 months, > 6 - 12 months, > 12 months: Renal artery systolic blood flow velocity, RI of the renal artery.

RESULTS

1. Clinical features of renal recipient

- Gender: Male: 88 cases (69.3%). Female: 39 cases (30.7%).

- Age: Youngest: 18, oldest 66, mean age 38.12 ± 9.8.

- Correlation between donor kidney and iliac fossa for placement of transplanted kidney: Donor kidney must be transplanted in right iliac fossa of recipients: 97.6%, transplanted in left iliac fossa of recipients: 2.4%.

2. Some vascular characteristics of transplanted kidney

Table 1: Renal vessel size in multislice computed tomography.

Size		Length (mm)			Diameter (mm)		
		$\bar{X} \pm SD$	Min	Max	$\bar{X} \pm SD$	Min	Max
1 Artery		30.9 ± 12.1	3.12	59.4	6.1 ± 0.9	3.75	8.55
2 Arteries	1 Artery	29.1 ± 12.1	12.3	55.8	5.3 ± 0.7	4.4	6.45
	2nd Artery	40.1 ± 15.2	14.0	62.8	3.3 ± 0.9	1.25	5.1
3 Arteries	1 Artery	38.5 ± 1.1	37.7	39.3	4.9 ± 0.3	4.7	5.1
	2nd Artery	53.2 ± 9.5	46.5	59.9	3.3 ± 0.4	3.0	3.5
	3rd Artery	62.2 ± 24.6	44.6	79.4	1.7 ± 0.2	1.6	1.85
1 Vein		46.8 ± 26.0	8.3	107.2	11.7 ± 2.3	5.5	17.25
2 Veins	1 Vein	22.9 ± 9.6	9.4	48.5	10.3 ± 2.8	6.3	15.8
	2nd Vein	25.0 ± 11.3	11.1	48.6	6.4 ± 2.6	2.95	10.25

Table 2: Conformity of renal arteries quantities, renal veins quantities in MSCT and after nephrectomy.

Vascular quantities		MSCT		After nephrectomy	
		Quantity	Ratio (%)	Quantity	Ratio (%)
Arteries	1	110	86.6	102	80.3
	2	15	11.8	22	17.3
	3	2	1.6	3	2.4
	Total	127	100	127	100
Veins	1	115	90.5	116	91.3
	2	12	9.5	10	7.9
	3	0	0	1	0.8
	Total	127	100	127	100

Table 3: Correlation between number of arteries and number of veins of transplanted kidney in MSCT and after nephrectomy.

Veins / Arteries	MSCT		Q'ty	Ratio (%)	After Nephrectomy			Q'ty	Ratio (%)
	1	2			1	2	3		
1	101	9	110	86.6	96	6	0	102	80.3
2	12	3	15	11.8	17	4	1	22	17.3
3	2	0	2	1.6	3	0	0	3	2.4
Total	115	12	127	100	116	10	1	127	100

3. Techniques of vascular suturing and results after transplantation

Table 4: Reconstruction techniques on vascular abnormality.

Arterial distribution	Techniques	2 Arteries	3 Arteries	Total
All arteries entered through the renal hilum (n = 15)	Grafts side-side anastomosis with 2 renal arteries	9	0	9
	Two anastomosis to the external iliac artery	1	0	1
	Anastomosis is the main renal artery to the internal iliac artery, anastomosis is the accessory renal artery to the external iliac artery	5	0	5
The main artery enters through the hilum of the kidney, the accessory artery enters the superior pole (n = 7)	Anastomosis is the main renal artery to the internal iliac artery, anastomosis, the accessory renal artery to the external iliac artery, ligation of the small superior polar artery	0	2	2
	Ligation of small superior polar artery	5	0	5

Arterial distribution	Techniques	2 Arteries	3 Arteries	Total
The main artery enters through the hilum of the kidney, the accessory artery enters the inferior pole (n = 3)	Grafts side-side anastomosis with 2 renal arteries + Ligation of small inferior polar artery	0	1	1
	Anastomosis of axillary renal artery to main renal artery	1	0	1
	Ligation of small inferior polar artery	1	0	
Total		22	3	25

- Grafts side-side anastomosis with 2 renal veins: 8 cases. Two separate venous anastomoses the vein to the external iliac vein: 1 case. Ligation of a small vein: 1 case. Grafts side-side anastomosis with 2 renal veins + ligation of a small vein: 1 case.

Transposition of iliac vein: 33 cases, Transposition of the iliac vein + dissection of the renal hilum to prolong the renal vein: 02 case. Dissection of the renal hilum, change the position of the renal vein posterior to the renal artery: 04 cases.

- Renal arterial suturing techniques for transplant

+ End-end anastomosis with internal iliac artery: 105 cases (82.7%).

+ End-side anastomosis with external iliac artery: 22 cases (17.3%).

- Renal venous suturing techniques for transplant

End-side anastomosis with external iliac vein: 126 cases (99.2%). End-side anastomosis with common iliac vein: 1 case (0.8%).

- Suturing duration of renal vessels

+ Vein: mean 13.75 ± 4.05, shortest: 6 minutes, longest: 31 minutes.

+ Artery: mean 13.99 ± 4.83. shortest: 7 minutes, longest: 37 minutes.

4. Results after transplant

** Early results after kidney transplant:*

- General surgical outcomes: Operating duration (minutes): mean 145.2 ± 23.8. shortest: 100 minutes, longest 210 minutes. 100% of transplanted kidneys excrete urine after the vascular clamp is released at the operating table.

- Results of renal vessels suturing for transplant: 127 cases (100%) of good outcomes right after releasing vascular clamp: Good patency of anastomosis, no bleeding, bulged renal vessels, no folded renal vessels, homogenously pinkish kidney, bulged kidney, urine secretion on the surgical table [2].

- Results of early renal function after transplant: Serum creatinine before transplantation with mean value: 765 ± 497 mmol/L. 24 hours after transplant: 403 ± 310 mmol/L. Serum creatinine before hospital discharge with mean value: 87 ± 23 mmol/L. The concentration of serum creatinine 24 hours after surgery decreased significantly compared to before surgery. This decrease was also significant when comparing 24 hours post-transplant and hospital discharge ($p < 0.05$).

- Some early complications after transplant: The long-lasting incision is not due to infection: 1 case (0.8%). Bleeding complications: 3 cases (2.4%). No/delay in passing urine in few first days after transplant, and patient had to undergo renal dialysis: 5 case (3.9%).

** Long-term results after transplant:*

In the first 1 month after a kidney transplant, 100% of patients went to the doctor for examination, procedures, and performed all tests and ultrasounds as prescribed by the doctor, this rate decreased to only 81.9% at different times during the next follow-up time.

Table 5: Doppler Ultrasonography for Renal Artery of Transplanted Kidneys.

Ultrasound results	RI			VS		
	$\bar{X}$ ± SD	Min	Max	$\bar{X}$ ± SD	Min	Max
1 month	0.709 ± 0.06	0.58	0.88	114 ± 38	53	276
>1 - 3 months	0.689 ± 0.060	0.56	0.84	109 ± 30	45	222
>3 - 6 months	0.690 ± 0.057	0.56	0.85	104 ± 23	38	171
>6 - 12 months	0.693 ± 0.053	0.56	0.85	102 ± 24	29	171
> 12 months	0.696 ± 0.557	0.56	0.84	103 ± 24	29	149

100% of kidney transplant cases have RI < 0.75 and VS < 180 cm/sec.

There were no vascular complications requiring surgical intervention.

DISCUSSION

1. Patients features

- Gender, age of kidney recipients: Mean age: 38.12 ± 9.8. Youngest 18, oldest 66. Male: 88 cases (69.3%). Female: 39 cases (30.7%).

2. Some vascular characteristics of the transplanted kidney

- Renal vascular characteristics for graft during surgery.

+ Renal arterial characteristics for graft: After nephrectomy, the majority with 1 renal artery (80.3%), 2 renal arteries (17.3 %), 3 cases with 3 renal arteries (2.4%). There are relevant results of other researches [1, 2, 5].

+ Renal venous characteristics for graft: Abnormality of renal venous quantity for graft is less common compared to artery. After nephrectomy, in total: 10 cases of 2 renal veins (7.9%), 1 case of 3 renal veins (0.8%). Most of the abnormalities occurred in the right kidney. These results are similar to the research results of Do Ngoc Son [2].

3. Techniques of renal vascular anastomosis

* *Techniques of renal vascular anastomosis:*

- Management techniques of renal vessels abnormality before transplant

Grafts side-side anastomosis with 2 renal arteries: 9 cases. Two anastomoses to the external iliac artery: 1 case. Anastomosis is the main renal artery to the internal iliac artery, anastomosis is the accessory renal artery to the external iliac artery: 5 cases. Anastomosis of the main renal artery to the internal iliac artery, and anastomosis of the accessory renal artery to the external iliac artery, ligation of small superior polar artery: 2 cases. Ligation of small superior polar artery: 5 cases. Grafts side-side anastomosis with 2 renal arteries + Ligation of small inferior polar artery: 1 case. Anastomosis of axillary renal artery to main renal artery: 1 case. Ligation of small inferior polar artery: 1 case.

Some investigators said that if they checked renal parenchyma < 1 cm, we can perform artery ligation. As far as we think, if small vessels can't be washed, we will not suture them. We should perform ligation.

- Renal venous suturing technique for transplant: In the study, there were 126 cases of end-side anastomosis of the transplanted renal vein to the external iliac artery (99.2%), 1 case

(0.8%) of end-side anastomosis of the transplanted renal vein to common iliac artery.

- Renal artery suturing for transplant: In the study, there were 105 cases of end-end anastomosis to the internal iliac artery (82.7%), 22 cases of end-side anastomosis to the external iliac artery (17,3%). No case of suturing of transplanted renal artery to common iliac artery [4].

4. Results after kidney transplant

** Early outcomes after kidney transplant:*

- General surgical outcomes

+ Shortest operating time: 100 minutes, longest operating time 210 minutes, mean operation duration: 145.2 ± 23.8 minutes

+ 127/127 cases in total: Urine on the surgical table (100%). It was equivalent to the research of Nguyen Thi Anh Huong, Do Ngoc Son [2, 3].

- Results of vascular suturing for kidney transplant

+ Results assessment of vascular suturing on the surgical table: 100% of good outcomes right after releasing vascular clamp: Good patency of anastomosis no bleeding, bulged renal vessels, no folded renal vessels, homogenously pinkish kidney, bulged kidney, urine secretion on the surgical table [2].

+ Results renal function assessment with serium Creatinin at hospital discharge: 87 ± 23 mmol/L. It was equivalent to the research of Nguyen Truong Giang et al. [4].

- Vascular complications after kidney transplant: 3 cases of bleeding after surgery (2.4%): 2 cases of blood clots causing obstruction of the ureter and renal pelvis, re-operated on the 3rd day after transplant, blood collection, pyelonephritis, after surgery, kidney function recovered and discharged after surgery 20 days of treatment. 1 case of anuria in a few intitial hours after kidney transplant caused by perirenal hematoma compressing on transplanted kidney. The patient underwent the second time of surgery. Post-operative condition: Urine output during 24 hours was more than 5000 mL, kidney function was recovered and came back to normal

** Long-term outcomes after transplant:*

All post-renal transplant cases were followed up with normal vascular doppler ultrasound results: Mean RI of renal artery < 0.75, mean renal artery velocity of RI < 0.8 [6, 4]. No vascular complications require surgical intervention.

CONCLUSION

Vascular characteristics of the graft after nephrectomy: 1 artery: 80.3%, 2 arteries: 17,3 %, 3 arteries: 2.4% and 1 vein: 91.3%, 2 veins: 7.9%, 3 veins: 0.8%. Techniques of renal vascular anastomosis: end-end anastomosis to the internal iliac artery 105/127 (82.7%), end-side anastomosis to the external iliac artery 22/127 (17.3%). End-side anastomosis of the transplanted renal vein to external iliac artery 126 cases (99.2%), 1 case (0.8%) of end-side anastomosis of the transplanted renal vein to common iliac artery. Results: 100% cases of kidney with good blood supply, no bleeding at anastomosis, no the anastomotic stenosis, no vascular complications that need to be intervened after surgery.

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