Kidney Transplantation

Surgical Aspects of Kidney Transplantation

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1. Introduction

Renal transplantation / kidney Transplantation (KT) is the best available form of renal replacement therapy (RRT) for end stage renal failure (ESRF) which improves survival and the quality of life compared to dialysis. Over 2 million people receive RRT all around the world at present [1], and most of them will need a kidney Transplantation. In United States at present more than a 100000 patients are awaiting kidney Transplantation [2] and in 2014 only 17,108 renal transplantations were done. The main reason for this less number of transplantations when compared with the waiting list all over the world is lack of suitable donors. And compared to dialysis, kidney Transplantation improves the survival and the quality of life i.e. in the United states of more than 46000 patients waiting on kidney Transplantation waiting list, the mortality was 68% lower among kidney recipients over 3 years follow up [3]. In the area where the author works, there are many patients with Chronic Kidney Disease of Unknown aetiology (CKDu) [4], and about 280 patients are on dialysis and many need kidney transplantation.

The idea of replacing the diseased organ with a healthy one remained in human mind for a very long time. This is also depicted in drawings in the past i.e. the mythical leg transplantation done by saint Cosmos and Damien in 3rd Century is one example.

The first successful kidney transplantation was done by Dr Joseph Murray in 1954 at Boston, United states between identical twins [5]. Since the kidney was donated by recipients, identical brother immunosuppressant's were not needed and the recipient lived for 8 years. Previous experimental transplants did not survive for a long time due to surgical factors and the rejection of the transplanted organ by the recipients' immune system. In early 1900 Jaboulay and Alexis carrel developed vascular anastomosis techniques which contributed immensely to

the development of the transplantation techniques. And the development of organ preservation techniques also improved the survival. In addition the improvements in postoperative Intensive Care Unit also lead to the improvement in the survival overtime. But still the number of patients awaiting transplantation is high compared to the number of transplants done the main reason for this is a lack of suitable donors [6].

2. Renal Donors

Renal donors can be broadly divided into;

• Cadaveric / Deceased donors

• Live donors

The gap between the potential recipients and the number of donors is widening rapidly. This can be overcome to great extent by increasing deceased donor numbers. At present the proportion of kidney transplantations done with either live donor or the deceased donor varies in different regions of the world depending on the culture the infrastructure development and the other factors in the region. For example, the centre where the author works only about 20% of the kidney transplantations are done from cadaveric source and this region has may patients affected with Chronic Kidney Disease of unknown origin (CKDu) who needs transplantation [7]. Therefore, to increase the number of renal transplantations the number of cadaveric donors should be increased.

2.1. Cadaveric organ donors

Cadaveric donors or the deceased donors can be further categorized into Donation after Brain Death (DBD) donors or Donation after Circulatory Death (DCD) /Non Heart Beating Donors (NHBD). Both DBD and DCD kidney donors are classified into Standard Criteria Donors (SCD) and Extended Criteria Donors (ECD) depending on the following factors;

1. If the donor is more than 60 years old or between 50 to 59 years old and having two of the following;

A) Hypertension

B) Death from cerebrovascular accident

c) Serum Creatinine more than 1.5 mg /dl.

Extended criteria Donor Kidneys are used to maximize further organ numbers.

2.2. Clinical criteria for diagnosis of brain death

Requirements for the diagnosis of brain death [8]

- The patient should be in coma (for example unresponsive to painful stimuli)

- Should be apneic

- Brainstem reflexes should be absent

Other factors which need to be considered (prerequisites) include;

- The injury / damage to the brain should be compatible with the diagnosis of brain death for example severe craniofacial trauma or severe brain injury / haemorrhage on imaging of the brain.

The factors which could cause reversible unresponsiveness should be excluded;

Hypothermia

Drugs e.g. sedatives, paralytic agents, barbiturates, alcohol intoxication, anti epileptics

Metabolic e.g. Electrolyte imbalance, acid base imbalance

Endocrine derangements e.g. hypoglycaemia

Other conditions leading to unresponsiveness e.g. hepatic encephalopathy, ketoacidosis

- Brainstem reflexes should be absent

Pupillary light reflex

Oculo-cephalic reflex / doll's eye sign

Vestibulo Ocular reflex caloric test

Corneal reflex

Gag reflex pharyngeal reflex

- Apnea testing

Prerequisites

- The patient should be normotensive and there should not be hypoxia.

Disconnect the patient from the ventilator and to maintain the arterial oxygen level insert insufflation catheter and administer oxygen at a rate of 6 l / min.

Observe For respiratory movements for about 8 to 10 minutes.

If respiratory moment does not begin when the arterial PaCO2 is more than 60 mmHg, the Apnea test is positive.

All findings should be confirmed by at least two physicians who are not part of the transplant team and do not have conflicting interests. All the findings should be properly documented.

2.3 Donation after Circulatory Death (DCD) /Non-Heart Beating Donors (NHBD)

DCD / NHBD are donors who has not filled the brain death criteria but who cannot otherwise survive. They are diagnosed based on absent spontaneous ventilation and absent cardiac activity (asystole /absent pulse).

2.3.1. Maastricht categories of Donation after Circulatory Death (DCD) / Non Heart Beating Donors (NHBD) donor categories [9]

• Category 1 - Dead on arrival

• Category 2 - Unsuccessful attempt at resuscitation

• Category 3 - Awaiting cardiac arrest

• Category 4 - Cardiac arrest in a brain dead Donor

Categories 1 and 2 are "uncontrolled" and categories 3 and 4 are "Controlled" categories. Usually categories 3 and 4 are considered for donation

3. Preservation of Organs

After cardiac arrest or when the blood vessels are clamped during retrieval surgery, the organs undergo ischemia.

Organ ischemia is classified into;

• Warm ischemia - From the time of cardiac arrest or clamping of the vessels to the time of initiation of cold preservation solution infusion.

• Cold ischemia - From the time of initiation of cold preservation solution infusion to the time of reperfusion of the transplanted organ.

Organs cannot tolerate warm ischemia for long duration but they can tolerate cold ischemia for variable period depending on the type of organ. For example, the heart can tolerate cold ischemia for about 4 hours while a kidney can tolerate it for more than 24 hours. During ischemia, there are changes, which occur at the cellular level, which will result in ischemia reperfusion type of injury during reperfusion.

Some of the changes which occur during the period of ischemia include;

1. Due to lack of oxygen there is anaerobic metabolism resulting in depletion of ATP and accumulation of lactic acid resulting in cellular acidosis.

2. Lack of ATP results in reduced function of membrane ion pumps which results in influx of sodium and Calcium into the cytoplasm which results in influx of water molecules which results in cellular oedema and activation of enzymes which results in cellular damage.

3. Also during ischemic period there is accumulation of hypoxanthine which is metabolized when reperfused resulting in formation of oxygen free radicals which will further increase the cellular damage.

Therefore preservation solutions are aimed at minimizing these changes which occur during the time of ischemia;

• The preservation solution is kept at 0 to 4 degree Celsius temperature, which will reduce the metabolism of the cells. For example the metabolic rate reduces by 5 times when the temperature is reduced from normothermia to 0 degree Celsius [10] which will reduce ATP depletion.

• The electrolyte composition of the preservation solutions is made in a way to minimize the electrolyte imbalance and the resulting changes during the cold ischemic period.

• Preservation solutions also contains;

Buffers to minimize acidosis (e.g.histidine,NaHCO3)

Antioxidants (e.g. Tryptophan)

Oxygen free radical scavenger molecules (e.g. Mannitol, tryptophan, Glutathione)

Impairments to prevent cellular oedema (e.g. mannitol, Citrate, Lactobionate)

Nutrients (e.g. glutamate, adenine, Ketoglutarate)

Some of the preservation solutions currently available are;

• Histidine Tryptophan Ketoglutarate solution (HTK)

- University of Wisconsin solution (UW)

- Euro-Collins solutions

- Ross-Marshall citrate solutions

- Phosphate-buffered sucrose solution

- Celsior solution

We use HTK Solution for organ Preservation and cold perfusion. The composition of HTK includes;

- Histidine - Acts as a buffer

- Tryptophan - Functions as an antioxidant

- Ketoglutarate functions as an energy source (substrate for anaerobic metabolism)

- Mannitol - Functions as a free radical scavenger

- Sodium - 15 mmol/l

- Potassium - 9 mmol/l

- Magnesium - 4 mmol/l

- Calcium - 0.015 mmol/l

- pH - 7.02 - 7.2 at 25°C

- Osmolarity - 310 mOsm/l

The concentration of the preservation solution reduces the intracellular accumulation of sodium, calcium, etc. and therefore reduces cellular oedema.

For organ preservation, the organ is flushed with cold preservation solution completely removing the red blood cells from the organ. Then there are two basic methods of storing the organ until it is transplanted;

1. Static cold preservation

2. Hypothermic machine perfusion

In static cold preservation, the organ is flushed of blood and kept in cold preservation solution in a plastic bag covered with ice slush. In hypothermic machine perfusion, the organ is perfused with cold preservation solution by a machine pump. There is no convincing difference

between these two methods of preservation. We use static cold preservation.

4. Deceased Donor (Cadaveric) Organ Retrieval Surgery

Cadaveric kidney retrieval is often done in combination with other abdominal and thoracic organ retrieval.

4.1. Patient position

For multiple organ retrieval, the patient is positioned supine with lower neck, chest and abdomen fully exposed. The arms are positioned by the side of the patient and a sand bag is placed in between scapula and the chin is tilted upwards to facilitate the sternotomy. The ice slush, cold preservation solution and the back table should be ready for backbench procedure after the retrieval. For multi organ retrieval incision is made from suprasternal notch to the pubis with a transverse extension about an inch above umbilicus to facilitate the access especially in obese patients **Figure 1.**

Figure 1: Incision from suprasternal notch to the pubis with a transverse extension.

If only the kidneys are retrieved, the abdominal part of the incision with transverse extension is often adequate.

After opening into the peritoneal cavity an abdominal survey is performed to identify any pathologies, trauma to internal organs and any anatomical abnormalities. The caecum and ascending colon is mobilized medially protecting the ureter to visualize the lower abdominal aorta. The lower part of the aorta is dissected around and an umbilical tape / sling is passed around the aorta. Next the left lobe of the liver is mobilized to facilitate the exposure of Supra celiac aorta. The lesser omentum is divided. When dividing the lesser omentum care should be taken to avoid damage to accessory left hepatic artery. After dividing the lesser omentum the muscle fibres of the crura of the diaphragm is divided taking care to identify and stop bleeding from the muscular branches of the crura. The Supra coeliac aorta is dissected and umbilical tape may be passed around it.

After getting the control of the aorta superiorly and inferiorly, the right colon and the

duodenum is further mobilized exposing the whole length of the infrarenal aorta, left renal vein and the origin of the superior mesenteric artery. Then the left colon is mobilized exposing the Gerota's fascia for the placement of ice slush later. The inferior mesenteric artery is tied and divided. Intravenous heparin is administered at 300 IU / kg. After this the infrarenal aorta is tied just above the bifurcation. Then the aorta is cannulated with Aortic Cannula just superior to the division of the infrarenal aorta. The aortic cannula is tied secure with umbilical tape. The supra renal aorta is clamped. At this point the perfusion with cold preservation solution is started via aortic cannula. After starting the perfusion ice slush is placed around right and left kidneys. The effluent blood is drained via and incision in the lower IVC and another incision on the IVC is made inside the pericardium and then the blood is allowed to drain into the plural cavity through an opening in the pleura. After flushing the Kidneys with preservation solution the Kidneys are either removed individually or removed enbloc with aorta IVC and both ureters **Figure 2**. (Kidney retrieval is done after the heart, lungs, liver and pancreas are retrieved). The author uses enbloc technique and it will be described below.

The infrarenal aorta is divided just above its bifurcation and the infrarenal IVC is divided just superior to the common iliac vein Confluence. The ureters are divided as low as possible to get the maximum length. Care is taken to preserve peri ureteric tissues to preserve the blood supply. Then the aorta and IVC is lifted and dissected from the prevertebral tissues. The Kidneys are dissected with peri and para renal fat from the posterior abdominal wall. Superiorly the inferior Vena cava is divided superior the right renal vein and the aorta is divided above the superior mesenteric artery (if the liver is not retrieved) and immediately the kidneys are placed in the cold preservation solution.
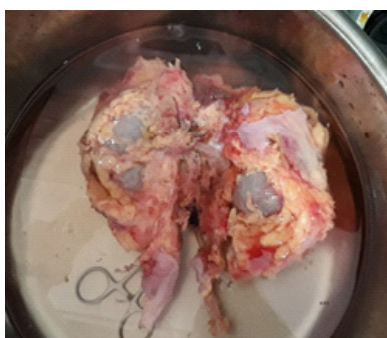

Figure 2: Enbloc Kidneys with aorta, IVC and both ureters.

In donation after circulatory death donors, there are two different methods of cold preservation solution perfusion;

1. Through a double balloon triple lumen arterial catheter inserted via femoral line.

2. By performing rapid laparotomy and cannulation of aorta and rapid perfusion with cold preservation solution before proceeding with the rest of the surgery.

Rapid laparotomy and perfusion is associated with better outcome compared to arterial cannulation and cold perfusion [11].

4.2. Back bench procedure

The Kidneys with the aorta, IVC and ureters, are placed in a bowl containing cold preservation solution submerged with the anatomy oriented. The left renal vein is divided at the entry site into the IVC. The aorta is split in the anterior mid line and posteriorly in the mid line in between the ostia of the lumbar arteries. Right and left Kidneys are separated and placed in different bowls with cold preservation solutions. Inspection of the number ostia from inside the aorta will give an idea about the number of renal arteries present in each kidney. If there are more than one renal artery they can be taken together with an aortic patch.Figure 9. Further the renal arteries and the veins are dissected from perivascular soft tissues. Taking care not to damage those branches of the renal arteries. Avoid dissection deep into the hilum. Ligate and divide tissues around hilum to avoid lymphatic leak. The gonadal vein and the adrenal veins are ligated and divided from the left renal vein. The donor IVC is reconstructed into a cuff to elongate the right renal vein **Figure 3**.
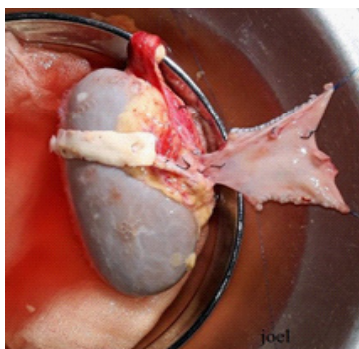

Figure 3: Reconstructed donor IVC

The peri and Para renal fat is removed while taking care to avoid damage to the renal capsule. Preserve soft tissue around the ureter to preserve its blood supply.

5. Live Donors

5.1. Donor acceptance criteria

Renal donors should be carefully evaluated to diagnose any underlying diseases will affect kidney function and general health in the future.

Most of the donor selection guidelines exclude following donors;

1. Less than 18 years.

2. Hypertension with blood pressure over 130 / 90 mmHg and less than 50 years old with evidence of end organ damage.

3. Uncontrolled Diabetes mellitus.

4. Psychiatric conditions.

5. BMI of greater than 35 kg/m2

6. Heart disease e.g. severe coronary vascular disease.

7. Urological abnormalities.

8. Creatinine clearance rate of less than 80ml/min.

9. Protein urea more than 300mg / d.

10. HIV, hepatitis B, hepatitis C infection.

In addition, patients with more than 3 renal arteries are also not considered for kidney donation because of the associated complications to the donor and recipients.

Overall the best functioning and disease free kidney is left behind in the donor. Other factors which are considered during the selection of the kidney side includes; the differential function of the kidneys assessed by renal isotope scan (Diethylene Triamine Penta Acetic Acid - DTPA) where the kidney with the best split function is left behind in the donor (usually split function range of 45 to 55 percentage is accepted as normal). When the differential function of both Kidneys are within the accepted range then the anatomy of the kidneys are considered. When there are multiple arteries, kidney with the least number of arteries is selected to make the anastomosis in the recipient easier. For the transplantation left kidney is preferred because the left renal vein is longer and stronger which will facilitate the anastomosis in the recipient.

6. Donor Nephrectomy

6.1 Live Donor nephrectomy

Live Donor nephrectomy can be done by open and laparoscopic methods.

6.1.1. Open live Donor nephrectomy

The patient is positioned in the lateral decubitus position with the lower costal margin over the kidney rest. The upper leg is positioned straight and the lower leg flexed at the knee joint and hip with a pillow in between the legs. The upper arm resting on the arm board and the lower arm kept under the head. The head is supported by head support. The kidney rest is raised and the operating table is then flexed. This position will widen the space between the lower costal margin and the iliac crest and helps to make the access better. Then the patient is stabilized with back supports and tapes to the operating table **Figure 4**.
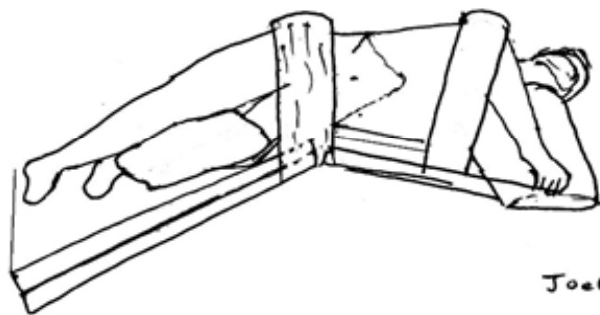
Figure 4: Patient position for donor nephrectomy

An incision is made in line with the 12th rib. Latissimus dorsi and Serratus posterior inferior posteriorly and the External Internal oblique ,internal oblique and the Transversus abdominis muscles anteriorly are divided in line with the incision with cautery. The intercostal muscles are separated along the superior border of the 12th rib with the periosteum. The pleura is carefully separated from the inner surface of the rib. The para nephric fat is divided .then the Gerota's fascia is incised longitudinally. Self retaining retractor is placed retracting the11th and the 12th ribs apart. Then the kidney is dissected from the peri nephric fat starting from the anterior surface the superior pole, inferior pole and finally the posterior surface.

After mobilizing the Kidney the ureter is mobilized. While mobilizing the ureter care is taken to preserve the periureteral tissue which is needed to preserve the blood supply to the ureter. The ureter is slung on a tape to facilitate the dissection. The mobilization of the ureter is done generally up to the common iliac vessel level. Then the hilar dissection begins. Avoid dissecting deep into the hilar fat to avoid damage to the branches of the renal vessels and the renal pelvis of the ureter. The artery and vein is dissected from the surrounding lymphatics and neural tissues. Gonadal vein and suprarenal vein are ligated and divided on the left side. Usually there is a lumbar vein draining into the posterior aspect of the left renal vein which should be carefully mobilized and ligated to avoid troublesome bleeding. On the right side the vein is very thin and there are flimsy veins draining into the right renal vein (especially along the superior border of vein where it joins with the IVC) damage to them should be avoided. In addition on the right side about a centimeter of IVC is exposed around the base of the renal vein to facilitate the clamping and suturing of the IVC after the kidney is removed. When dissecting the renal artery excessive traction should be avoided because this may result in intimal damage or spasm of the artery.

When the vessels are dissected the donor kidney can be removed. Coordinate with the transplant surgeon before removing the donor kidney to minimize the ischemic time.

The donor the ureter is ligated and divided. This is followed by clamping and division of the artery and the vein. In the right side a Satin sky clamp is applied to the IVC. The kidney is removed and immediately placed in cold preservation solution. The artery and the vein are either tied or clipped. The author uses a nonabsorbale '1' Silk ties and haemostatic clips. The

IVC is sutured with either 5/0 or 4/0 Polypropylene running suture. Haemostasis is confirmed and the muscles are closed with absorbable Polydioxanone sutures (either en masse closure or layered closure).

6.1.2. Other techniques of Donor nephrectomy

Hand assisted Laparoscopic Donor nephrectomy

Laparoscopic Donor nephrectomy was first done in 1995 [12]. Most of the centres at present perform Donor nephrectomy by laparoscopic method. At the centre where the author practice donor nephrectomies are done by open method.

Procedure

The procedure is described for the left Donor nephrectomy. Patient is placed in the right lateral decubitus position. The kidney rest is elevated and the table is flexed. And the patient is supported with back supports and strapped to the table.

Supra umbilical midline incision is made (some prefer Pfannenstiel incision, then the rest of the port placement varies accordingly) to the length of about 7 cm to 9 cm (size of the hand of the operator). The hand port is inserted. A 12 mm port is inserted in the left lower quadrant and the pneumo peritoneum is achieved. Pneumo peritoneum is maintained at 10 mmHg to 12 mm Hg. Another 12mm port is inserted in the epigastric region and this is used as the camera port. A 30 degree angled camera is inserted through the 12mm port. The left colon and the splenic flexure is mobilized. Then the ureter is mobilized up to the pelvic brim preserving peri ureteral tissues to maintain its blood supply. The artery is dissected from neural tissues and the lymphatics up to its origin from the aorta. The renal vein is mobilized, the tributaries draining into the renal vein is ligated and divided. The vessels are divided with cutting stapler devices and the kidney is immediately removed through the hand port incision and placed in cold preservation solution.

In total laparoscopic Donor Nephrectomy the hand port is not used and the dissection is done laparoscopically as described above. At the end of the procedure after clamping and dividing the renal vessels, a Pfannenstiel incision is made to retrieve the donor kidney.

6.1.3. Micro invasive Donor nephrectomy

Micro invasive donor nephrectomy is a combination procedure of laparoscopic and open nephrectomies. In micro invasive donor nephrectomy a small incision of about 3 inches is made from the tip of the tenth costal cartilage to the lateral border of the rectus abdominis and the dissection is done extraperitoneally. The dissection is similar to open Donor nephrectomy but laparoscopic instruments are used to visualize the dissection.

7. Renal Transplantation

7.1. Patient selection criteria

Renal transplantation is a major Complex surgery. Therefore the recipient should be fit enough to undergo this procedure. The patient selection is crucial for the successful outcome. Most of the transplant centres have developed criteria for recipient selection.

7.2. Selection criteria for renal transplantation [13].

Generally patients with End Stage Renal Failure (i.e. creatinine clearance of less than 15 ml /min) o dialysis, are considered for kidney transplantation. Some patients who are not on dialysis are also selected on an individual basis i.e. pre-emptive transplantation.

The patient should be fit to undergo the transplantation and should be compliant to undergo postoperative rehabilitation. There should be no active malignancies. Patients should have good social support.

Contra indications for listing include;

1. Severe heart disease.

2. Severe lung disease e.g. corpulmonale and patients on home oxygen therapy etc.

3. Active malignancies and patients with previous malignancies. In general people who were treated for malignancies should wait for a period before they are listed and should list these patients in consultation with an oncologist.

4. Active infections e.g. tuberculosis.

5. Cognitive impairment and previous history of noncompliance resulting in non-adherence with therapy.

6. Substance abuse and anti-social behavior.

7. Severe peripheral vascular diseases.

7.3. Renal Transplantation procedure

Patient is placed supine. The bladder is irrigated and distended with 200mls of antibiotic solution (Netilmicin) and the catheter is clamped. This facilitates the identification of the bladder and the dissection of the bladder wall for ureteric anastomosis later in the transplantation.

A curved Supra inguinal incision (Modified Gibson) or inverted 'J'/ 'Hockey stick' incision made usually in the right iliac fossa area **Figure 5**.
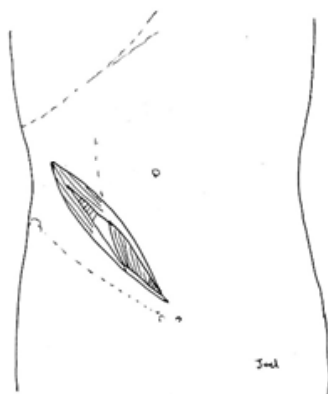
Figure 5: Modified Gibson incision.

The author prefers the former. Curved incision is made extending from a finger breath above the pubic symphysis to two finger breadths medial to the anterior superior iliac spine. The skin, subcutaneous tissue and the Scarpa fascia are incised in line with the skin incision. The anterior rectus sheath is opened and the lateral abdominal wall muscles i.e. external oblique and internal oblique are divided in line with the incision. The peritoneum is mobilized from the posterior abdominal wall. In females round ligament is tied and divided, and in males the spermatic cord is mobilized and circled with a tape and retracted. The inferior epigastric vessels are ligated and divided (ligated long enough for anastomosis of lower pole artery if present in the donor kidney). Peritoneal mobilization is continued until there is adequate space for the kidney to be placed and the iliac vessels are visualized. The iliac vessels are now mobilised. The lymphatics crossing the iliac vessels are tied and divided to avoid lymphocele formation. The iliac artery and the vein are encircled with tapes and lifted gently to facilitate the mobilization and atraumatic dissection. The external iliac artery is usually mobilized up to the bifurcation of the common iliac artery. Usually the external iliac artery does not have major branches in this region other than one or two small muscular branches which should be ligated and divided. Similarly the external iliac vein is also mobilised up to the confluence of external and internal iliac veins taking care not to avulse the tributaries to avoid troublesome bleeding. At this point the kidney which was already prepared in the back bench is brought to the operating table.

Kidney is placed in the fossa created by dissection and the site of arterial and venous anastomosis is determined. The Kidneys are kept covered with ice gauze pack during the time of anastomosis to prevent warming.

A Satinsky clamp is applied to the external iliac vein. A venotomy is made with a number 11 blade and it is extended with a Potts scissors. Two stay sutures with 5/0 monofilament sutures e.g. polypropylene, is placed to the upper and lower end of the venotomy and the corresponding sides of the renal vein. Stay sutures are tied and the renal vein to the external iliac vein anastomosis is completed in an end to side manner with continuous sutures. This is followed by arteriotomy on the external iliac artery which is then fashioned with an aortic

punch. The arterial anastomosis is done with 6/0 monofilament polypropylene continuous sutures. Before the arterial anastomosis is fully completed, a bulldog clamp is applied to the renal artery and the distal clamp on the external iliac artery is temporarily released to allow bleeding to flush out the clots and air from the renal artery. The anastomosis is then completed. The external iliac vein clamp is removed first followed by the clamps on the external iliac artery to reperfuse the kidney **Figure 6**.
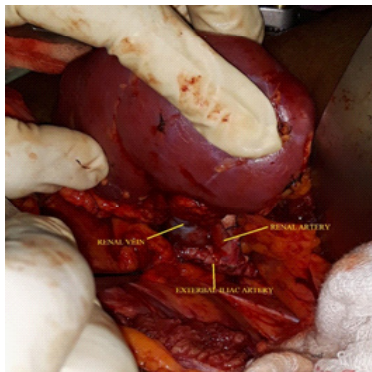

Figure 6: Renal arterial and Venous anastomosis.

Any major bleeding sites are noticed and additional sutures are applied if necessary. The kidney is washed with warm saline and gauze swabs are applied to the anastomosis sites. A well perfused kidney should look pink and firm and should start to produce urine immediately in case of live donor. Some surgeons prefer to anastomose the renal artery to the internal iliac artery in an end to end fashion. But the author prefers end to side method.

Once kidney is reperfused, this is followed by the anastomosis of the ureter to the recipients' bladder (ureteroneocystostomy). Two techniques of ureteroneocystostomy are commonly used after transplantation.

• Lich and Gregoir ureteroneocystostomy

• Extra vesical Politano and Leadbetter ureteroneocystostomy

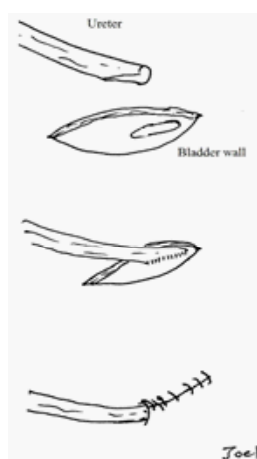The author uses Lich and Gregoir technique and it will be described here **Figure 7.**

Figure 7: Lich and Gregoir ureteroneocystostomy.

The bladder is filled with about 150 to 200 ml of saline to facilitate the bladder wall dissection and anastomosis. The sero muscular layer of the superior-lateral wall of the distended bladder is incised for about 2.5 to 3 centimetres in the direction of the ureter. The mucosa of the distended bladder will bulge at this point. A plane is created between the mucosa and the muscular wall on either side of the incision for about five millimeters (to create a sub mucosal tunnel later). An opening of about 1 centimeter is created on the distal end of the mucosa. The ureter is trimmed to the appropriate length and spatulated. A 5 French double 'J', 12 centimeter ureteric stent is inserted. 5/0 monofilament absorbable suture (Polydioxanone PDS) is used for ureter - bladder mucosa anastomosis (full thickness of ureteric wall and the mucosa of the bladder). The toe end of the ureter is anchored to the full thickness of the bladder wall. The anastomosis is completed with continuous running sutures. The muscular wall is sutured over the ureter with 2/0, 3/0 absorbable (Polyglactin – Vicryl) interrupted sutures thus creating a sub mucosal tunnel for the ureter.

After completion of ureteroneocystostomy, haemostasis is confirmed and a drain could be placed if there is oozing. The kidney is positioned and the position of the artery and vein is checked to make sure that they are not kinked.

The abdominal muscular wall is approximated enmasse with size '0' or size '1' absorbable (Polydioxanone PDS) continuous sutures.

Postoperatively the patient is sent to Intensive Care Unit for immediate care.

7.3.1. Alternative anastomosis techniques when there are multiple renal arteries

• Instead of external iliac artery the internal iliac artery can be used for anastomosis. In this instant end to end anastomosis with interrupted sutures can be done.

• When there are two arteries of similar calibre, they can be spatulated and anastomosed in a side to side manner to create a common ostium. This common ostium is anastomosed to the external iliac artery **Figure 8.**
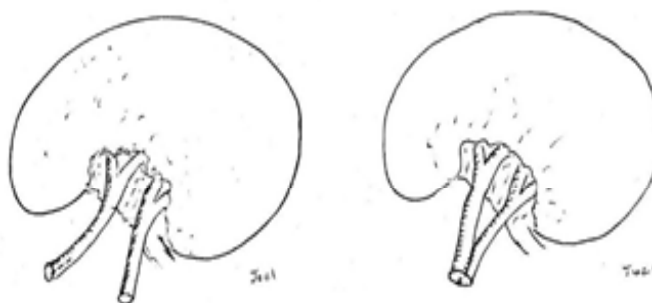

Figure 8: Two renal arteries are anastomosed to form a common ostium

- Smaller lower polar artery can be anastomosed to the inferior epigastric artery.

- In deceased donor kidney the arteries are retrieved with patch of aorta (Carrel patch) Figure 9 and the patch is anastomosed to the external iliac artery.

- When there are multiple renal arteries in disease donor Kidneys, all of them can be taken with the patch of aorta. If the arteries are separated by a long distance the patch can be shortened and then anastomosed to the external iliac artery **Figure 9**.

Figure 9: Carrel patch taken from donor aorta can be shortened to reduce the length of arteriotomy in the recipients' external iliac artery.

7.4. Surgical Complications after renal transplantation

7.4.1. Wound infection

Wound infection occurs at a rate of 3.8 to 6.6% [14]. The main causes for wound infection includes; diabetes, obesity, lymphatic leak, wound hematomas and re-opening.

7.4.2. Bleeding

Renal failure patients have platelet dysfunction and they are often hypertensive and the renal graft vessels in the hilum can also bleed. As in any other major surgeries, coagulation function should be assessed preoperatively and drugs causing bleeding e.g. clopidogrel should be omitted for at least seven days prior to the surgery. Close observation in the early postoperative period is essential to detect bleeding and immediate intervention should be done if;

- The Hematoma is compressing the kidney or the hilum resulting in graft dysfunction

- The patient is hemodynamically unstable and the hemoglobin is dropping

- There is large Hematoma on abdominal scanning resulting in discomfort

In these instances the patient should be immediately taken to the operating room and explored.

Late haemorrhage can occur due to mycotic aneurysm at the renal artery anastomosis. This results in catastrophic bleeding and graft loss. The graft should be removed and the iliac artery is either repaired with a venous patch or if the operating field if infected and severely

inflamed the iliac artery should be tied and extra anatomical bypass is done to maintain the limb perfusion. Mycotic aneurysm at the renal artery anastomosis is rare (occur at less than 1% of transplants in Authors experience) [15].

7.4.3. Lymphocele

Lymphocele is an organized collection of lymph. The incidence of Lymphocele varies from as low as 0.6 % to 33.9% [4,16]. Usually the patients present after a period of 4 weeks [16].The main sources of lymph leak are the lymphatics around iliac vessels and the lymphatics at the renal hilum. Meticulous ligation of lymphatics during mobilization of iliac vessels and ligating the tissues around the renal hilum at back bench would minimize the incidence of lymphocele.

Treatment includes aspiration or aspiration and injection of irritants like Povidone iodine for the recurrent lymphoceles. Some lymphoceles may need surgical drainage or marsupialization.

7.5. Vascular complications

7.5.1. Arterial complications

Commonest vascular complication following renal transplantations is renal arterial stenosis (RAS). It occurs at a rate of 1% to 23% [17]. Transplant renal arterial stenosis occurs due to anastomotic technical issues, kinking of the renal artery, due to trauma during transplantation, rejection and cytomegalovirus infection. Patient presents with uncontrollable hypertension and graft dysfunction. If RAS is neglected renal arterial thrombosis and graft loss can occur. Diagnosis is confirmed by CT angiography angiography and stenting is the preferred choice of treatment [17].

Renal arterial thrombosis (RAT) is rare and occurs at a rate of 0.5% to 3.5% [18]. RAT results from anastomotic technical issues, kinking, rejection and infections. RAT results in sudden reduction in urine output and graft tenderness. Diagnosis is confirmed by duplex ultrasound scanning. Treatment includes urgent exploration and thrombectomy but renal artery thrombosis often results in graft loss.

Other arterial complications include kinking. Kinking often results from positioning of the kidney. Especially if the artery is longer than the vein which often occurs in right donor kidney. Careful Positioning and non-tight abdominal closure minimize the incidence. Early detection and repositioning of the graft results in good outcome.

7.5.2. Renal vein thrombosis

Again rare but commoner than RAT. Occur at a rate of about 6% [18]. Technical errors

and intraoperative venous complications (Venous tear) are the common causes [18]. It occurs especially in the right renal vein where the vein is very thin and short. Patient present with sudden deterioration of graft function, haematuria and graft discomfort. Urgent confirmation with duplex ultrasound scanning is need. Urgent exploration and graft thrombectomy is the treatment. But this complication often results in graft loss.

7.5.3. Ureteric anastomotic leak

This is complication occurs at a rate of 2% to 6% (4) [19]. Ureteric complications occur as a result of having a long ureter and excessive dissection of soft tissues around the ureter during donor surgery resulting in damage to ureteric blood vessels. This results in necrosis of the distal end of the ureter and disruption of the ureteroneocystostomy. The patient presents around 3rd to 5th postoperative day with lower abdominal pain, reduced urine output and urinary leak through the surgical incision. Ultrasound scan may show fluid collection (urinoma) and the contrast enhanced CT scan may demonstrate urinary leak. Exploration and Trimming of the ureter and re- anastomosis to the bladder over the stent is the treatment.

8. Conclusion

Since the time it was first performed in 1954 the renal transplantation has become the only successful replacement therapy available for end stage renal failure. The outcome of renal transplantation has improved over time with improved surgical techniques, organ preservation methods and new immunosuppressive agents. Careful patient selection and meticulous attention to details are the key to success.

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