

Appearance of Renal Cysts in Adult Human Cadavers

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ABSTRACT

Introduction: The cysts present on the kidney are generally developed due to either genetic or pathological factors. Such lesions of kidneys are usually found to be filled with fluid. An Autosomal Dominant Polycystic Kidney Disease (ADPKD) can be considered as a causative factor for the cysts found on kidneys. But deficit family history and agedness of cadavers encourage us to take on as “simple kidney cysts”. The increasing use of modern medical imaging helps in frequent finding of renal cysts in the general population. The frequency of simple renal cysts shows notable contrasts according to the gender. Their acceptance intensifies with age. Hence, the knowledge of the normal and abnormal anatomy is a point of paramount significance, be it, the complex procedure such as living donor kidney transplantation.

Aim: To evaluate the crucial presence of cysts on different area of kidneys. Number of cysts present on specific region of surface of specimens and the morphology of the covering wall of the cysts and nature of fluid found inside them was also looked into. Also, to assess the relations between various other pathologies and renal cysts, importance of

renal cysts in kidney transplantation surgeries.

Materials and Methods: This study was carried out on 150 cadaveric kidneys after removing them from cadavers. The kidneys were removed by incising anterior abdominal wall. The other abdominal organs were carefully removed to reach both the kidneys on posterior abdominal wall. The kidneys were collected from Department of Anatomy in Medical Colleges of state of Gujarat.

Results: After taking photographs the cysts from each group of kidneys were opened to observe the contents and morphology of cyst membrane. Out of 150 kidneys, 13 (8.66%) kidneys were having cysts on their upper poles. Two (01.33%) kidneys were found to have cysts on their middle segments. Six (4%) kidneys were having cysts on their lower poles. Multiple cysts were observed on 11 (7.33%) kidneys.

Conclusion: It is concluded that the cysts observed unilaterally/bilaterally may not have any either pathological effects/autosomal dominant disease effect because the age of donated cadavers is more than 60 years and the kidney transplants had not been observed in a single cadaver.

Keywords: Anterior abdominal wall, Autosomal dominant polycystic kidney disease, Polycystic kidney donors, Renal transplantation, Renal tumours,

INTRODUCTION

The cysts are the most common spaces that may develop due to genetic/pathological factors resulting into lesions/sacs of kidneys which are filled with fluid. The cysts are reported as inherited kidney disease: ADPKD. A polycystic kidney disease is an odd and untreatable disease and has been recognised for over 300 years [1]. On the other hand, simple cysts are also reported more frequently with increasing age in the general population. The reason behind appearance of simple renal cysts has yet not clearly expressed. But obstruction of renal tubules or impaired blood supply to the kidneys might be the possible causes. Though, the incidence of polycystic kidney disease is 1 in 1000 [2]. Due to lack of family history in present

study, the genetic inheritance as causative factor could not be confirmed. Looking to the age and frequent presence of cysts observed in the donated cadavers forced us to consider it as “simple kidney cyst”.

MATERIALS AND METHODS

This prospective, experiential study was accomplished on 150 kidneys, out of which 100 were acquired from 10% formalin fixed cadavers, and the rest 50 from already preserved specimens in the Anatomy Department of Medical College Baroda, Government Medical College Surat and Pramukh Swamy Medical College, Karmasad, India, during a three years period between November 2012-June 2014 in

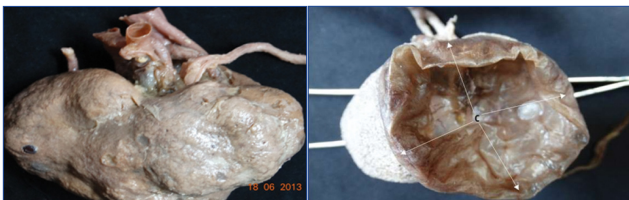
routine under graduate dissection. The study was initiated after taking necessary permission from the Institutional Ethical Committee. The age of cadavers was between 60-80 years. Cadavers with crushed injuries to abdomen and those with history of abdominal surgery were excluded from study. The intact kidneys were at first studied in situ and then taken out along with the corresponding parts of abdominal aorta and inferior vena cava, their renal vessels and ureters. Care was taken to not to disturb the morphology of any cyst. In present study the parameters evaluated were (1) site of the cyst on the surface of kidney, (2) number of the cysts present on an individual kidney. The cysts were then opened to observe (3) texture of the wall/the membrane of the cyst and (4) nature of fluid present inside the cyst with respect to its colour and morphology. Descriptive statistic was only used to analyse the data. Photographs were taken as and when required. The data obtained was tabulated and presented accordingly.

RESULTS

The kidneys were studied carefully with respect to: (1) Site of the cyst on the surface of kidney; (2) Number of the cysts present on an individual kidney; (3) Texture of the wall/the membrane of the cyst; (4) Nature of fluid present inside the cyst with respect to its colour and morphology.

Kidneys were grouped according to the site of presence of the cysts. Group A-Cysts present on upper pole [Table/Fig-1]; Group B-Cysts present on middle segment [Table/Fig-2-4]; Group C-Cysts present on lower pole [Table/Fig-2-6]; Group D-Cysts present on all three parts i.e. multiple cysts [Table/Fig-7,8].

1. Site-The site wise distribution of the kidneys [Table/Fig-9].
2. Number of Cyst-They varied from one to three in three



[Table/Fig-1]: A posterior view of left kidney showing a small cyst at upper pole. **[Table/Fig-2]:** The right kidney showing the enlarged view of cyst- translucent lined by grey, glistening and smooth membrane.



[Table/Fig-3]: Anterior view of both the kidneys. A large simple cyst (c) is translucent and lined by grey, glistening smooth membrane. It is also filled with clear fluid in the cortical region of the right kidney extending from middle segment to lower pole. **[Table/Fig-4]:** Cysts (C) on the anterior surface of left kidney.



[Table/Fig-5]: A thin walled, transparent Large Cyst (LC) containing straw colour fluid seen on the lower pole of right kidney. The left kidney with Coagulated Cyst (CC) can be observed. **[Table/Fig-6]:** A large Cyst (c) lined by grey, glistening membrane in the cortical area on the posterolateral surface of lower pole of left kidney is seen.



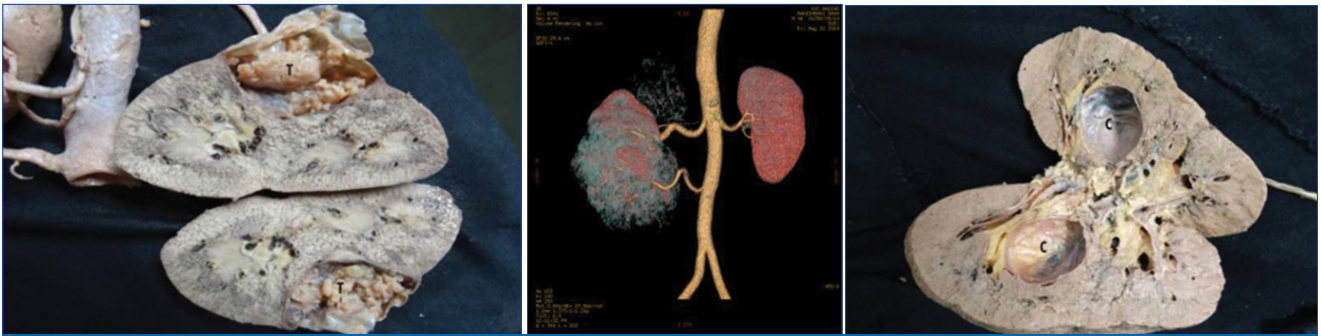
[Table/Fig-7]: Multiple cysts (C) on the anterior surface of left kidney. **[Table/Fig-8]:** Multiple cysts (C) on both the surfaces of left kidney.

No. of Kidneys	Site of Cysts			
	Upper Pole Group A	Middle Segment Group B	Lower Pole Group C	Cysts Present on Upper Pole, Middle Segment and Lower Pole Group D
150	13	02	06	11
%	08.66%	01.33%	04%	07.33%

[Table/Fig-9]: Site of cysts at different areas of cadaveric kidneys.

kidneys in Group (A). Ten (6.66%) specimens had single cyst except for three, out of which one (0.66%) had two and another two (1.33%) had three cysts in the upper pole. In Group (B) all the kidneys had single cysts (1.33%). In Group (C) all the kidneys had single cyst except for two (1.33%) specimens where one (0.66%) specimens had three cysts each and the other (0.66%) had two cysts in the lower pole.

In group (D) the cysts were present all over the kidneys and the number of cysts ranged from 5-8. (1) In two kidneys (1.33%) there were three cysts on upper pole, two on lower pole and one on middle segment. (2) In two kidneys (1.33%) there were four cysts to upper pole, two cysts to lower pole and one on middle segment. (3) In three kidneys (2%) two cysts were found on upper pole, one on middle segment and two cysts on lower pole. (4) In one kidney (0.66%) there was one cyst on upper pole, one on middle segment and three were on lower pole. (5) In three (2%) kidneys there were one cyst on upper pole, one on middle segment and two cysts on lower pole. The membranes of the cysts were varied from thin walled transparent with slippery surface inside to thick walled semitransparent. Most simple cysts are epithelial lined,



[Table/Fig-10]: A probable tumour (T) in the cortical region observed in right kidney. **[Table/Fig-11]:** Renal angiograph of patient shows multiple cysts on right kidney with aberrant renal artery from abdominal aorta to lower pole of same kidney. (Obtained from Muljibhai Patel Urological Hospital, Nadiad, Gujarat). **[Table/Fig-12]:** A coronal section of left kidney found to have a large simple cyst (C).

fluid-filled cavities that have very thin, transparent exterior walls [3]. In some cases, cysts were found ruptured. [Table/Fig-2,4,8]. In present study, it was observed that, the content of the most of cysts was a straw colour fluid and in few cases it is coagulated [Table/Fig-5]. In some of kidneys, along with cysts tumours were found [Table/Fig-10-12]. The presence of cysts in such high frequency in cadavers of mentioned region couldn't be proved scientifically because of unavailability of information regarding the habitats of donors. An increase in size of cadaveric kidneys unilaterally or bilaterally because of presence of cysts as generally observed in PKD wasn't reflected. The cysts found in groups A, B and C were largely single whereas Group D has more than five cysts present all over the surfaces of kidneys.

DISCUSSION

Despite of an increase in organ donation, it does not fulfil the demands in patients worldwide. Such shortage of kidney donors urges that there is a clear requirement to review exclusion criteria for both cadaver and living donor. Cysts present on kidneys of donors have significant importance as if the cystic donor kidney is suitable for transplantation. An adult population, above the age of 50 years, is more commonly affected with cystic lesions of kidneys. The incidence of appearance of renal cysts ranges up to 50% in adults [3]. A large number of cystic lesions found on kidneys exhibit simple morphological characteristics. They are benign histologically. So in renal transplantation procedures, such cystic kidneys should be accepted and not rejected. The kidneys with large cysts on them can be considered suitable for the surgical procedure [3]. The excretory system develops from intermediate mesoderm and primitive cloaca. It is composed of a pair of kidneys, pair of ureters, a urinary bladder and the urethra. The permanent kidneys develop from two distinct sources A. Metanephros which forms secretory system and B. Ureteric bud which forms collecting system of the kidney in the sacral region [4]. A Congenital Polycystic Kidney disease (CPK) is a typically bilateral disorder in which cysts are found

on the surface of kidney. These cysts are loaded up with urine and they are present in solicited of the organ. A justification was given before for appearance of congenital polycystic kidney as a non fusion of excretory or secretory and collecting tubules. But according to the latest concept the reason behind occurrence of CPK is an abnormal dilatation of uriniferous tubules, mainly the loop of Henle. It is fairly a common hereditary disease and it is also clinically incorporated with cysts present on lungs, hepatic and pancreatic cyst [4].

The renal cysts are possessed of enclosed liquid or semisolid fluid and are commonly identified on abdominal imaging [Table/Fig-11] [5]. The frequency of simple renal cysts shows notable contrasts according to the gender. Their acceptance intensifies with age [6]. Hence, the knowledge of the normal and abnormal anatomy is a point of paramount significance, be it, the complex procedure such as living donor kidney transplantation. Even though there is an increase in living kidney donation, a remarkable shortage of kidney donors is global alarming. In a South Korean study, it was mentioned that there is a higher rate of occurrences of hypertension seen in patients with large and peripheral cysts as well as multiple cysts than in patients with small peripheral cysts and single cyst [6]. The sites of cysts on kidneys did not show any effect on the increase of hypertension. As there is an increased necessity of renal transplantation and a remarkable shortage of living kidney donors, hypertension should be considered as one of the exclusion criteria for the same. Simple renal cysts might be the causative factor for lost renal function and hypertension [3]. Patients with hypertension are considered non-suitable for kidney donation by 64% of the transplant centres of US. Centres other than these presently use the kidneys of living donors with mild or borderline hypertension [3]. The presence of cysts on the kidney surface has great importance in transplantation surgeries. A study carried out in Italy has provided a data of successful renal transplantation. It has stated that a left living (65 years old mother) donor kidney with large renal cyst on its superior surface was transplanted to a 34-year-old patient (son).

15 months after transplantation, the left kidney has continued to provide the recipient with satisfactory renal function [3]. A UK based study was carried out on a kidney donor with multiple cysts [7]. The donor had both kidneys with multiple cysts out of which the right one was transplanted into an old high risk patient with end stage renal failure and malignant hypertension. The kidney functioned immediately after transplantation. The possible fatal risk factors associated with polycystic kidneys are cerebrovascular accidents, hypertension, stone formation, cancer [Table/Fig-10] and infection [7]. The advanced medical imaging provides frequent findings of renal cysts in the general population. In the present study, absence of a family history of renal cystic disease or evidence of chronic kidney disorder, the manifestation of a solitary/multiple renal cysts has been generally considered benign. A number of recent studies have been carried out to prove association with the development of hypertension/malignant change. Therefore, according to some clinicians the living donor kidney if at all has presence of cysts on it is unsuitable for transplantation procedure [5]. Hypertension is generally accepted as a relative contraindication for living kidney transplantation [3]. The shortage of cadaver donor kidneys has led to increased utilisation of expanded criteria donors, including hypertensive donors. An imbalance between need and availability of living kidney donors gets bigger. So, it brings around more extensive privilege of living donor selection criteria. The guiding principles for kidney donor selection should be elaborated. Donor malignancy, bacterial and viral infections can be considered as contraindications. In specific terms of anatomical abnormalities of kidneys there are no thoroughgoing contraindications for donor usage [3] [Table/Fig-13].

A study was carried out in Scotland; UK also showed that unilateral cysts were more common in all age groups (66%), bilateral cysts became increasingly common with advancing age and their association with hypertension, flank pain, erythrocytosis, haematuria and proteinuria have so far been largely indeterminate. The clinical significance of simple renal cysts is as yet unclear [11]. In present study, an association

between hypertension and simple renal cysts has been already stated [6]. A Japanese study carried out on 69 patients with aldosteronoma had shown 16 patients (23.2%) having renal cysts and they were suffering from hypertension and severe hypokalemia. A survey on 27 patients of pheochromocytoma was achieved. Out of 27 patients eight were found to have renal cysts and hypertension as well [12]. In a study, M. Hayakawa et al., elucidated a link between renal cysts and Renal Cell Carcinoma (RCC). The investigators discovered that 60% of the renal cysts found with RCC were the simple cysts and Acquired Cystic Disease of Kidney (ACDK) [13]. According to the Bosniak renal cysts classification, the cystic lesions of kidney are put into four separate categories [14]. Category-1 is for simple renal cysts. Category-2 contains cysts with minimum thickness in their walls with lowest amount of calcification or smooth, thin septa. Category-3 is for more complicated cysts with thick and irregular walls or septa. Category-4 has cysts with increasing soft tissue areas. They either lie close to or remain distinct from the cyst wall. Category-3 can be seen in benign and malignant kidney lesions. Category-4 exclusively marks the malignant lesions [14]. In echotomographic findings, a 32-year-old patient had cystic mass on her right kidney. It was diagnosed as Bosniak-4 renal cyst [15]. Computed tomography and ultrasonography of abdomen region help in finding of asymptomatic renal cysts. Simple renal cysts are generally asymptomatic [16]. Haemorrhage, infection and rupture of cyst make it complicated. Complex renal are generally calcified. Oval or circular shaped simple renal cysts generally deform the outline of kidneys. The wall of such cysts is smooth, avascular and transparent. The wall is composed of fibrous tissue. It is lined by cuboid or flattened epithelia. Such cysts are filled with clear/straw coloured fluid. They are mostly unilateral [16]. Simple cysts may present at the time of birth but generally most of them get cleared up after birth [17]. In a case study, carried out in Verona, Italy, a retroperitoneal spontaneous haemorrhage was linked to a huge haemorrhagic cyst present on patient's left kidney [18]. Along with renal cysts; various other pathologies were also found. Wunderlich Syndrome (WS) is a rare existence in which there is spontaneous renal bleeding seen due to spontaneous rupture of a simple kidney cyst. The bleeding is generally restricted to the subcapsular and perirenal spaces of kidneys followed by acute flank pain on the affected side [19]. The reason for appearance of simple renal cysts might be an obstruction of renal tubules or impaired blood supply to the kidneys while ADPKD is a genetic disorder. Mutation takes place in either *PKD 1* or *PKD 2* gene results into ADPKD. The approximate acceptance of ADPKD is 1 of 400-1000 live births [20]. A study was carried out on 561 patients in Atlanta, Georgia, mentioned an association between simple renal cysts with ageing, diminished renal function and gender.

Study	No. of Specimen	Cysts Present			Multiple Cysts
		Upper Pole	Middle Segment	Lower Pole	
Kaur M et al., [8]	01	-	-	-	01
Ashwini NS et al., [9]	90	-	-	-	03
Kaur J et al., [10]	30	-	-	-	04
Present study	150	13	02	06	11

[Table/Fig-13]: A comparison of cadaveric studies carried out by different researchers.

The frequency of presence of cysts was more common in male patients than in female patients [21]. A case report of 64-year-old male patient with benign haemorrhagic renal cyst mentioned a giant cyst with thick and irregular wall and heterogeneous contents present on his left kidney. The patient underwent for a radical nephrectomy as the cyst was hemorrhagic and a malignant tumour was suspected inside the cystic wall [22]. Terada N et al., brought off an observational study on 61 patients detected with renal cysts [23]. The researchers found an increase in number as well as the size of renal cysts. Moreover, the growth of multiloculated renal cysts was much faster than other cysts. They also found renal neoplasm from renal cysts in two patients. In this 10 years follow-up study, the size of simple renal cysts which grew rapidly in younger patients was observed. The growth rate of cysts decreased with ageing gradually was also marked [23]. Kidney transplantation surgery is a well established option and providing warranting a better quality of life and an upgraded survival for older patients. Grottemeyer D et al., performed a long term follow-up in 25 living donors with simple renal cysts. The investigators found no clinical complications or drawbacks in a single kidney donor due to donor nephrectomy and any requirement of dialysis because of deficit kidney. Furthermore, no inconvenience was seen in donors with remaining contralateral kidneys which were also having cystic lesions on them. The study also stated that the transplanted kidneys did not show any malfunction or cyst related complication [24]. Kidneys with simple renal cysts may be responsible for hypertension and reduced renal function but in past many cases are found in which such kidneys after transplantation procedure functioned well and improved quality life of recipient. These cysts sometimes show haemorrhagic characteristics. A surgeon must aware of it while performing surgery. The researchers Kortram K et al., reported a case study of an 11-year-old girl patient with End Stage Renal Disease (ESRD). The patient received her first renal transplant from an 11-year-old brain dead boy. The left donor kidney had several small cysts and it was implanted into the left iliac fossa of recipient. The right donor kidney did not have any cyst. After five years of transplantation procedure the renal function of left kidney started to reduce in patient. The right kidney later on was also found polycystic. The left kidney gradually showed increase in size as well as number of cysts. Patient once again was diagnosed as ESRD due to diminished renal function. After 15 years of first transplantation, transplant nephrectomy procedure was carried out to remove the left polycystic kidney in recipient. The study revealed that though earlier the donor's left kidney already had numerous cysts at the time of transplantation procedure, it functioned well and for long time [25]. An asymmetry between rising demand for kidneys and the limited supply of donor has been increasing. In present study, unavailability of information of cadavers, age of donated cadavers and morphology of cystic lesions seen on

kidneys indicate to consider being simple renal cysts. Despite of some drawbacks, kidneys with simple renal cysts can be useful for saving life. So the criteria for selection of kidney donors should be expanded. Kidneys with simple renal cysts should be considered to be suitable for grafting. Hypertension should also be excluded from the list of contraindications for renal transplant procedure. These steps if taken will help to minimise the pool created between need of organs and availability of donors.

LIMITATION

As it is a cadaveric study, we could not find out what symptoms a patient was facing during his/her lifespan due to presence of renal cysts.

CONCLUSION

In present study, renal cysts were found on different area of specimens. Moreover, the frequency of number of polycystic kidneys is found more than the other researchers. Renal transplants unilateral/bilateral were not observed in a single cadaver during present study. This observation supports the conclusion that the age of donated cadavers (range 60 and above) and the morphology of the multiple simple cysts found unilaterally/bilaterally probably may not have pathological effects on the life of an individual. Present study can be helpful to find out the association between renal cysts and other pathologies. The knowledge of presence of simple cysts on various parts of kidneys is of utmost importance for the surgeon to carry out successful management of renal transplantation procedure.

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