CYSTS ARISING IN THE RENAL TUBULES

A MICRODISSECTION STUDY

BY

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The variety of the appearances and distribution of renal cysts shows the necessity for accumulating a large body of basic morphological knowledge before they can be properly understood. As yet relatively little precise information is available, though some microdissection studies have already been made on cystic kidneys by Greene (1922), Bialestock (1956, 1960), Paatela (1961), and Osathanondh and Potter (1964), and of cysts associated with infantile nephrosis or microcystic renal disease by Oliver (1960), Giles, Pugh, Darmady, Stranack, and Woolf (1957), Fetterman and Feldman (1960), and Paatela (1961, 1963).

These cysts show a wide variety of forms in regard to size, shape, and relation to the tubules which, in a group of reasonably comparable examples, can be recognized as being stages in the evolution of the larger (presumably older), well-developed forms.

The group of cases studied appears to give some indication of the general features and, though this investigation can be regarded as only preliminary, the information obtained indicates directions for further inquiry.

Material and Methods

The specimens were obtained *post mortem* from 18 cases and, in one instance (Case 25), by surgical removal. With this exception the condition was bilateral in all cases and covered a range from a foetus of 30-32 weeks' gestation to a child aged 7 years. The relevant details are given in Table 1.

Eight normal kidneys covering the age range of the cases were microdissected in order to establish normal nephron dimensions for comparison with the cystic tissue.

The kidneys were fixed in formol saline. Tissue was set aside for histological examination and wedges were cut and macerated with concentrated hydrochloric acid in accordance with the technique described by Oliver, MacDowell, and Tracy (1951). At the completion of maceration the tissue was washed and microdissected in a

manner similar to that employed previously (Baxter, 1961, 1965). The photographs (Figs. 9-20) are of unstained microdissected material.

Results

Macroscopical Appearances. Some of the kidneys are normal in size (Cases 12 and 13) or, sometimes, even smaller than usual (Cases 7, 8, 9, 10, 17, 21, 22, 23, 24). When enlarged, this is due to the presence of numbers of relatively large cysts replacing the renal tissue (Cases 14, 15, 16, 18, 19, 25). These cysts may occur diffusely through the organ or be localized to certain zones or areas. Relatively few obvious, large, cysts may be scattered throughout the tissue, but, on more detailed examination, numerous small cysts give the tissue a honeycomb appearance. Though cysts may occur in the subcapsular region, here a predominance of corpuscular cysts (Baxter, 1965) is not seen; cysts occur throughout both cortex and medulla.

Cysts may be 2-3 cm. or larger in diameter (occasional ones as large as the rest of the kidney) but many of them are small averaging 1 mm. in diameter. The method of examination (naked eye, with a lens, or by microdissection) determines the range that attracts most attention, and it is important that, to obtain an adequately comprehensive view, all three methods be integrated.

The distribution of cysts is usually uniform throughout the renal substance, but those nearer the surface, for simple physical reasons, may become larger and so dominate the remainder (Case 25). The parenchyma is usually compressed and may atrophy, though its total volume may be only slightly reduced.

Cysts are commonly spherical though small cysts in the medulla often have a linear form conforming with the general character of the surrounding tubules. The walls are thin but are increasingly thicker and fibrous with enlargement of the cyst.

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TABLE 1
GENERAL FEATURES OF NINETEEN CASES OF CYSTIC KIDNEYS

Case No.	Sex	Period of Gestation(wk.) or Age	Size of Specimen (cm.)	Congenital Anomalies	Necropsy	Size of Cysts (diameter in mm.)
7	M	37	L—2 × 1 × 0·5 R—solitary cyst	Renal facies; talipes (bilateral)	Bladder thick walled; ureter and urethra dilated	Not visible in left kidney
8	F	40 (lived one day)	2·5 × 2 × 0·6	—	Small bowel atresia	< 1·0
9	M	40 (lived 3½ wk.)	4 × 2·2 × 1·2 L—6 g. R—4 g.	—	Early pneumonia	< 1·0
10	M	7 mth.	3·2 × 2 × 1·2	—	Ureters tortuous; one showed constriction 3 cm. from origin	0·5-3
11	F	7 mth.	Portion received	Polycystic disease of liver and pancreas	Gross left ventricular hypertrophy	0·5-2
12	F	7 yr.	13 × 5·5 × 5	Polycystic disease of liver	Obstructive biliary cirrhosis; splenomegaly	0·5-6
13	F	7 mth.	9 × 3·2 × 3·2	Polycystic disease of liver	Acute cholangitis	0·5-1·5
14	M	39	Enlarged; combined weight, 1,360 g.	Patent ductus arteriosus; cystic disease of liver and pancreas	Body weighed 5 kg. gross oedema; lungs atelectatic	0·5-3
15	—	40	Enlarged (portion received)	—	Partial atelectasis	0·5-1·5
16	F	40 (lived one day)	11 × 6 × 5; combined weight, 450 g.	Cystic dilatation of bile-ducts	Bilateral pneumothorax and partial atelectasis	0·5-1·5
17	F	7 wk.	R—2·6 × 1·8 × 0·8 L—3 × 2 × 1	Renal facies; well-developed urachus	—	0·5-1·0
18	M	30-32	Enlarged (portion received)	Head, feet, external genitalia; ventricular septal defect	Body oedematous, weighed 1,880 g.	0·5-1·0
19	M	36	12 × 8 × 5; combined weight—540 g.	Widespread defects of face, limbs, and CNS	—	0·5-1·0
20	—	40	Portion received	Information not available	Subdural haemorrhage	< 1·0
21	M	36	3 × 1·0 × 0·5	Renal facies; inversion of feet; mega-ureters	—	0·5-10·0
22	M	34-36	2 × 1·4 × 0·6	Bilateral talipes; vesico-urachal fistula	Bilateral pneumothorax; atelectasis	3·0-7·0
23	M	40	2·5 × 0·8 × 0·6; combined weight —5 g.	Renal facies	Pneumothorax; interstitial emphysema	0·5-2·0
24	F	37 (lived 7 days)	8 × 5 × 2·5	Turner's (Albright's) syndrome	Pneumonia	5-20
25	M	4 wk.	7·0 × 5·9 × 3·2	Unilateral cystic kidney (surgical specimen)	—	1·0-55·0

Microscopical Appearances. The cysts have a connective tissue layer wall, thin and tenuous in the smaller examples. Between these, the parenchyma is relatively normal (Fig. 1). The septa between larger cysts has less parenchyma and more connective tissue (Figs. 2 and 3). Frequently the older cysts are completely encircled by connective tissue.

The lining is a layer of cuboidal cells, commonly flattened and occasionally stratified in larger cysts, and sometimes columnar in smaller ones (Fig. 4). The cysts do not show special features and the lining does not correspond specifically with that of a component of the nephron. Blood vessels range from capillaries and sinusoids to thickened larger vessels.

Cellular infiltrations were present in all cases. Small round cells predominated, but plasma cells,

polymorphonuclear leucocytes, macrophages, and numerous fibroblasts were also present.

Microdissection Studies. Dissection of the softened tissue gives a group of tubules that are gradually separated. These may be normal, shrunken, or dilated. The various regions are recognized by continuity with other parts (corpuscle or Henle's loop) or by their convoluted or straight character. Where possible, the various parts are retained in continuity and so are easily recognized. A diffuse enlargement of tubules is often present and diverticula are frequently prominent.

Nephron length may be normal (Fig. 5) or may be increased. This occurs with greater convolution (Cases 9 and 10) in some zones, or increased length of Henle's loop. In other cases, diminution of

FIG. 1.—Low-power photomicrograph of renal cortex, showing a single renal corpuscle and mild cystic dilatation of tubules (Case 9). (Haematoxylin and eosin. $\times 100$.)

FIG. 2.—Low-power photomicrograph of capsule and subcapsular cortex, showing the subcapsular rim of parenchyma and a nephrogenic zone. The wide cystic spaces are lined by well-defined cells (Case 20). (Haematoxylin and eosin. $\times 100$.)

FIG. 3.—Low-power photomicrograph of large tubular cysts at the cortico-medullary junction (Case 12). (Haematoxylin and eosin. $\times 40$.)

FIG. 4.—Low-power photomicrograph of tubular cysts showing well-differentiated epithelial lining cells (Case 20). (Haematoxylin and eosin. $\times 100$.)

FIG. 5.—Diagrammatic representation of (A) normal long loop nephron and (B) the corresponding nephron from Case 11. There is a decrease in corpuscular size and all tubular components exhibit dilatation. Localized cysts are present in the proximal convoluted tubule and there is slight localized dilatation at the junction of the apex of the ascending limb of Henle's loop with the distal convoluted tubule. The collecting tubules show dilatation to a gross degree.

FIG. 6.—Diagrammatic representation of (A) and (A'), the normal short loop nephrons, and (B) and (C), the corresponding nephrons from Case 18. (B) shows an increase in corpuscular size and slight dilatation of all nephron components as well as localized cystic dilatation. These occur at both the crest and apex of Henle's loop, in the distal convoluted tubule and in the collecting tubules. The descending limb of Henle is absent and there is considerable reduction in length. With the diminutive unit (C), there is slight reduction in corpuscular size and there are localized cystic dilations involving the major portions of the nephron. At the crest of Henle's loop a large cyst is present and this opens to another cystic structure which involves almost the entire ascending limb of Henle. Cysts in the distal convoluted and collecting tubules were not observed in these diminutive units.

FIG. 7.—Diagrammatic representation of the range of incomplete nephrons observed in Case 14. (A), a short loop unit, shows the ascending limb of Henle's loop ending blindly just before the usual site of the localized cyst (observed in complete units). (B) and (C) represent two examples of diminutive type showing a persistence of the units as far as the localized cyst at the apex of the ascending limb of Henle's loop, while in (B) there also persists an isolated remnant of distal convoluted tubule.

length and diameter is found to be due to atrophy or relative 'failure of development' (Fig. 6).

Though the parts of the nephron may differ greatly in diameter, it is commonly a continuous structure. Sometimes only localized segments (referred to as 'incomplete units') are found. These have smooth blindly-ending extremities (Fig. 7). It is assumed that these arise where atrophy of the segments has resulted in their disappearance. A corpuscle may be absent and we then have an aglomerular nephron or proximal convoluted (Fig. 8).

Cysts are found in relation to all parts of the

tubule and may be either attached to or, though in close proximity, completely separated from the nephron.

They occur in various forms.

(i) A localized fusiform dilatation of part of a tubule, the cyst being in continuity with this and its cavity communicating with the tubule lumen above and below it. Though it commonly tapers at each end, the junction may be abrupt.

(ii) An eccentric enlargement of the tubule, the cyst thus projecting from one side of it. The larger examples expand and the communication with the lumen, at first wide, becomes gradually narrower. In some cases, the cyst is attached by a relatively narrow stalk.

(iii) Diverticula are usually small but, particularly where they are numerous, some are large. These resemble closely the cysts of the preceding group.

The attachment of these varies considerably in size: while it is long and narrow, with a negligible lumen in some, others have a longer, thinner, and even a tenuous union, and still others are quite separate from the tubule.

Cysts occur in complete nephrons and are found also in isolated segments or 'incomplete units'. It is noteworthy that even where there is complete obstruction of the tubule, dilatation is not necessarily present.

Cysts may be multiple or single. When multiple there may be several in one zone or they may be in widely separated regions: for example, in the proximal convoluted tubule and the collecting tubule (Fig. 5).

Cysts occur most frequently at certain specific sites; the repetition of this in different cases indicates a clear pattern of behaviour. There are naturally minor differences between different cases but the over-all agreement and conformity to type is a striking phenomenon and the important contribution of this study. The observations are given in Table 2, but in addition some special features deserve comment and are now discussed.

FIG. 8.—Diagrammatic representation of the range of incomplete nephrons observed in Case 25. (A) represents a small renal corpuscle attached to a well-convoluted proximal tubule. This passes to a cystic structure occupying almost the entire length of the ascending limb of Henle's loop. It terminates in a small dilatation close to the apex of the limb. (B) represents a large renal corpuscle attached to a short proximal tubule opening into a large cystic structure occupying the whole of the unit from the proximal tubule through to a region close to the apex of the ascending limb. (C) represents a proximal convoluted tubule (with attached renal corpuscle) terminating blindly in a small cyst. (D) and (E) represent aglomerular units, (D) consisting of a cystic tubule extending from the proximal tubule through the crest of Henle's loop where it terminates in a small diverticulum, and (E) a round cystic unit to which is attached a short tubule.

TABLE 2
LOCATION OF CYSTS, INCIDENCE OF DIFFUSE DILATATION, AND INCOMPLETE UNITS
IN 19 CASES OF POLYCYSTIC KIDNEY

Case No.	Location of Cyst					Diffuse Dilatation	Incomplete Units
	Proximal Convoluted Tubule	Crest of Henle's Loop	Apex of Henle's Loop (junction with distal tubule)	Distal Convoluted Tubule (DCT)	Collecting Tubule (CT)		
7	—	—	—*	—	—	+	+
8	—	—	—	—	—	+	+
9	C	—	—	—	C	+	+
10	C	—	—	—	C	+	—
11	C	—	—	—	C	+	—
12	—	—	—	—	C	+	—
13	—	—	—	—	C	† (DCT only)	—
14	—*	—	—	—*	C	—	—
15	C*	—	—	—	C	† (CT only)	+
16	—*	—	—	—	C	+	+
17	—	—	—	—	C	+	+
18	—	—	—	—	C	+	+
19	—	—	—	—	C	+	+
20	C	—	—	—	C	+	+
21	—	—	—	—	—	+	+
22	—	—	—	—	—	+	+
23	—	—	—	—	C	† (CT only)	+
24	—	—	—	—	C	† (DCT only)	+
25	—	—	—	—	—	—	+
No. of cases	5	6	9	6	14	10	11

C = Cysts. * Diverticula present. † Diffuse dilatation and incomplete units present.

A diffuse readily observable dilatation of tubules was found in 10 examples (over one-half of the cases). If less obvious distension were included, the proportion would be higher; those of about twice the normal diameter or above were arbitrarily placed in the 'dilated' group. Several zones were commonly affected, but in two cases dilatation was confined to the collecting system. Incidentally, in one of these, in addition to cysts in this region, there were cysts at the crest of Henle's loop where no diffuse dilatation occurred. Thus cysts may or may not be associated with diffuse tubular dilatation.

Cysts are commonest in the collecting tubules and least frequent in the proximal convoluted tubule and ascending limb of Henle's loop. In this group they were not found in either corpuscles or the descending limb of Henle's loop.

Cysts of the proximal convoluted tubule occurred five times in this series (Fig. 9). In every case there were cysts also in the collecting tubules, but otherwise no special feature was observed. Diverticula were associated in one of these cases. Cysts arose in any part of the convolution, but in a given case they were found localized to a specific zone. In two of the cases segregated tubular segments were present and cysts were found in some of these.

The descending limb of Henle was commonly dilated, and was then not demarcated clearly from the proximal convolution; consequently it was not practicable to determine its precise limits.

The crest of Henle's loop was the site of cysts in six examples (a third of the cases, Figs. 10 and 11).

Though commonly single, the cyst was sometimes double. Being relatively large and sharply delimited from the very narrow tubule, it presented an arresting appearance. Diverticula were prominent in one case (Case 14).

The ascending limb was frequently diffusely dilated but could be recognized since it was delimited by the crest and the apex of the loop (Fig. 12). Isolated tubular segments were commonly found. Though cysts did not occur along the length of this portion, diverticula were seen occasionally and, in one case, were numerous and large. On the other hand cysts occurred often at the distal extremity.

The junction of the ascending limb of Henle and the distal convoluted tubule was one of the commonest sites of cyst formation, cysts being found here in 9 cases (Figs. 13 and 14). The cysts were single or multiple, clearly delimited from the communicating tubule, and often occurred at the junction. When they were found on either the loop or convolution side of the junction they extended for only a short distance along the tubule. Occasional detached lengths in this unit contained a cyst. Most cysts of the junction were associated with cysts of the collecting tubules.

Cysts of the distal convoluted tubules were seen in 6 cases. Single or multiple, they occurred at various places in the convolution. Some were found in sequestered segments of the tubule. They were commonly, though not invariably, associated with cysts of the junction or of the collecting tubules.

Cysts of the collecting tubules were the most

FIG. 9.—Low-power montage of typical short loop nephron from Case 10. There is slight increase in corpuscular size and over-all dilatation of all components as well as localized cysts in the proximal convoluted tubule. The crest of Henle's loop shows coiling and convolution of the ascending limb. ($\times 46$.) Renal corpuscle, $260 \times 160 \mu$; diameter ranges proximal convoluted tubule, $37-225 \mu$; of Henle's loop, descending limb, $25-50 \mu$; of ascending limb, $30-87 \mu$; and distal convoluted tubule, $30-74 \mu$; the nephron length, 14.9 mm .

FIG. 10.—Nephron, diminutive type from Case 18, showing localized cysts at the crest of Henle's loop and in the collecting tubule into which the short distal convoluted tubule opens. ($\times 70$.) Renal corpuscle, $100 \times 87 \mu$; diameter range of proximal convoluted tubule, $25-37 \mu$. The cyst at crest of Henle's loop $285 \times 260 \mu$. The diameter ranges of ascending limb of Henle's loop, $25-31 \mu$; of distal convoluted tubule, $25-31 \mu$; and of collecting tubule, $125-200 \mu$; the cyst length, 430μ ; and the nephron length, 1.4 mm .

FIG. 11.—Low-power photomicrograph to show more clearly the renal corpuscle and adjacent tubules of Fig. 10. ($\times 110$.)

FIG. 12.—Ascending limb of Henle's loop (Case 17), showing over-all dilatation which is maximal at the junction of the limb with the distal convoluted tubule. Dark material is deposited within the lumen of the distal tubule, diameter range, $37-198 \mu$. ($\times 66$.) AH = ascending limb of Henle's loop; DT = distal convoluted tubule.

FIG. 13.—Nephron, diminutive type (Case 14), showing coiling of the tubule at the crest of Henle's loop and a localized cyst at the apex of the limb at its junction with the distal convoluted tubule. ($\times 105$.) Renal corpuscle, $125 \times 87 \mu$; diameter ranges of proximal convoluted tubule, $12-44 \mu$; of ascending limb of Henle's loop, $19-44 \mu$; and of distal convoluted tubule, $25-44 \mu$. The cyst, $112 \times 112 \mu$; and nephron length, 1.9 mm .

FIG. 14.—Apex of the ascending limb of Henle's loop and its junction with the distal convoluted tubule showing a prominent localized cystic dilatation (Case 8). ($\times 120$.) AH = ascending limb of Henle's loop; DT = distal convoluted tubule. Diameter ranges of ascending limb of Henle's loop, 25-100 μ ; and of distal convoluted tubule, 30-60 μ .

FIG. 15.—Collecting tubule and branches showing numerous cysts and diverticula along their course. A variety of shapes is exhibited here (Case 12). ($\times 60$.)

FIG. 16.—Montage showing a cystic collecting tubule with branches. Each of the top branches appears to terminate blindly in a small diverticulum. ($\times 46$.) Diameter ranges of main trunk, 87-275 μ ; and of branches, 25-124 μ .

FIG. 17.—Large cone-shaped cyst from Case 20. This is characteristic of the grossly cystically dilated collecting tubules found in this kidney. ($\times 50$.) Diameter range, 48-350 μ ; attached tubule, 12-25 μ .

FIG. 18.—Proximal convoluted tubule terminating in a cystic dilatation. The arterioles are clearly seen (Case 25). ($\times 140$.) Renal corpuscle, 100 $\times$ 87 μ ; proximal convoluted tubule, diameter range, 25-50 μ ; cyst, maximum diameter, 136 μ , minimum diameter, 50 μ .

FIG. 19.—Short proximal convoluted tubule opening into a massive cyst. The cyst had a fine tubular connexion which was disrupted during dissection. This terminated blindly (Case 18). ($\times 56$.) Renal corpuscle, 160 $\times$ 125 μ ; proximal tubule, diameter range, 31-62 μ ; cyst, maximum diameter, 650 μ .

FIG. 20.—Small cyst with insignificant tubular connexion. This was dissected free from enmeshing connective tissue and its origin was quite obscure (Case 19). ($\times 90$.) Cyst, 590 $\times$ 410 μ ; tubule diameter, 12 μ .

common, occurring in 14 cases. These showed a wider range of features than those in other parts. The cysts, either single or multiple, were spherical, ovoid, or flask-shaped, at times pedunculated, and occurred in all parts of the collecting tubule (Figs. 15, 16, and 17). Diverticula were prominent in one case (Case 12).

Cysts were accompanied either by diffuse dilatation of tubules (in one case this being confined to the collecting tubules), or their shrinkage and partial disappearance resulted in incomplete elements that were either isolated segments or blindly-ending portions of tubule in continuity with the main tree.

Incomplete units were found in 10 cases (Figs. 18 and 19). In most instances their position, relation to other parts of the nephron, and size and conformation enabled them to be assigned to their appropriate segment; only in 2 (Cases 19 and 21) was the majority of the various components and structures insufficiently characteristic to prevent their origin being recognized (Fig. 20). In one of these there were many diverticula attached to portions of tubules of indeterminate lineage (Case 21).

Discussion

Renal cysts, which arise from the parenchyma, may occur in any part of the nephron and it is customary to divide them into two groups: glomerular and tubular. The former have been discussed previously (Baxter, 1965).

Tubular cysts are the more common and were found in 19 cases of the present series of 25. One example, not included here but already referred to (Baxter, 1965), was of a mixed type. These tubular cysts, occurring in all parts of the nephron, show a wide range of appearance and relation to adjacent structures. The naming of cysts as 'tubular' is merely a simple and very elementary designation. The recognition of the different forms and sites is the significant contribution of microdissection to the study of these cysts.

That the tubular cysts show such a wide variety of characteristics is important not only from the viewpoint of simple morphology but also because these have such an important bearing on current views of their origin and mode of formation.

Although the cysts are necessarily circumscribed and thus involve localized segments of the nephron, there is practically invariably involvement of the whole unit. This is a feature that cannot be demonstrated readily by ordinary histological methods but can be shown clearly in microdissection material, especially when this is carefully and precisely measured and the measurements are

compared with those of corresponding normal structures.

Two pathological processes, hyperplasia and hypoplasia, are both evident. Increase in the amount of tissue with cellular proliferation is apparent in the cysts, in that, apart from stratification of cells or papillary developments, there is clearly a greater number of cells lining the increased area of the cyst wall. It is shown also in the increase in the nephron components between the cysts, with the elongation of some tubules and their frequent dilatation.

On the other hand hypoplasia and even atrophy of parts of the tissue occur in some areas and is in some cases a predominant feature with loss of most of the nephron structure. This is well shown by the disappearance of lengths of a nephron and the occurrence of segments of tubule which end blindly and do not necessarily communicate in any way with a nephron. That the two processes are frequently closely associated is demonstrated by the dilatation (with a typical epithelial lining) of some of these segments and the occurrence of cysts in them.

At first sight, when only a few cases have been studied, the cysts appear to be scattered haphazardly along the nephron. When further cases are studied, however, it becomes clear that there are, in most, some well-defined patterns of distribution of the cysts. In some cases cysts are localized to one area but, more often, they occur in more than one part of the tubule and may sometimes be consistently present in widely separated areas, such, for example, as the junction of the ascending limb of Henle's loop with the distal convoluted tubule, and the collecting tubule. Cases 7, 23, and 25 did not conform to the well-defined cyst patterns shown in the other kidneys investigated but showed a generalized dilatation of the tubules and a relatively random distribution of cysts. In this respect these cases were similar to that described by Bialestock (1956). When cysts occur in incomplete and isolated segments their general location is similar to that found in the complete nephron.

The factors responsible for these changes are complex and far from being understood. Some are clearly of a general nature, as indicated by the involvement, in some measure, of the whole of the nephron and a large proportion of those present. At the same time, there are also local factors to explain the remarkable localization of maximal change in many cases. The repetition of patterns in different cases is an indication of a frequent regional activity of some factors. Some of these have already been envisaged but there are certainly others that are still unknown and, what is more important, the

interaction of these various agents and processes is still obscure.

Although several of these patterns of distribution of cysts have been demonstrated in these cases, it is apparent that, with the investigation of further examples, still others will be found. This present study, therefore, is to be regarded as a preliminary to more complete examination of a larger group of cases.

Conclusions

Cysts of the tubular type are the common form found in the kidney and were present in about three-quarters (19) of a series of 25 cases.

They occur throughout the whole renal substance. Small cysts are scattered throughout the parenchyma, but some typical types, such as occur in the sponge kidney, constitute unique subgroups. They occur in the cortex but do not show the distinctive predominantly subcortical distribution of corpuscular cysts.

Cysts are commonly round or ovoid on section, but elongated structures lying between and in line with the parallel tubules in the midzone are often a prominent feature.

They occur as diffuse or localized dilatations in various parts of the tubule.

Some zones of the tubule are commonly involved so that specific sites recur in different cases, thus providing definite sub-types of tubular cysts.

The cysts from different parts of the nephron are essentially similar in appearance, so that, at present, they are to be distinguished principally by their association with some special part of the nephron.

Cyst formation is, usually of necessity, associated with proliferative cellular activity. However, retrogressive changes also occur, as shown by the presence of aglomerular nephrons and, following atrophy and disappearance of parts of the tubule, incomplete, blindly-ending segments.

Detailed observations such as these have an important bearing on hypotheses of aetiological factors determining the formation of the cysts.

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