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Renal Papillary Morphology in Infants and Young Children

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Summary. The morphology of the renal papillae was studied in a series of necropsy kidneys from infants and young children, and related to experimental data obtained in piglets. As in the piglet, extensively fused papillae of the type associated with intrarenal reflux occurred almost exclusively at the upper and lower poles of the kidney. However, the incidence of this kind of papilla was much lower in the children's kidneys, and in over a quarter of the specimens examined only cone-shaped papillae were found; this latter type of papilla is never associated with intrarenal reflux in the piglet.

Key words: Renal papillae, Intrarenal reflux, Reflux nephropathy, Chronic pyelonephritis.

Introduction

Experiments in piglets have shown that the occurrence of intrarenal reflux (IRR) depends primarily upon variations in renal papillary morphology (5, 3, 6). We thought it important to confirm the relevance of this finding to the human kidney.

Clinical and radiological studies of reflux suggest that both IRR and the initiation of chronic pyelonephritic scarring occur in the very young (7, 1, 8). For this reason we have examined papillary form in kidneys obtained at necropsy from infants and young children, and compared the results with similar data from young piglets.

Materials and Methods

Kidneys were obtained at necropsy from 18 children aged between 2 days and 16 months (median 3 months) dying from non-renal causes. In 15 cases both kidneys were examined; in 3 cases (1 unilateral renal agenesis, 1 unilateral pelvi-ureteric stenosis and 1 unilateral renal aplasia) only one kidney was suitable. In total, 33 organs were studied.

The kidneys were prepared, and each individual papilla photographed as described previously (6). Using the photographs, each papilla was classified as simple or compound type I, II or III as in the piglets (6). The location of each papilla in the upper third (upper pole), middle third (mid-zone) or lower third (lower pole) of the kidney was also noted.

Results

The numbers and distribution of papillary types in the children's kidneys are shown in Table 1. Simple and compound type I papillae were over seven times commoner in children than in piglets, representing 88% of the papillae examined. Although types II and III papillae were correspondingly less common, their polar distribution was more marked and only one kidney showed a solitary "refluxing" papilla in the mid-zone.

While type II or III papillae were found in all 25 pig kidneys examined previously (6), and in all but one they were present at both upper and lower poles, in the human material "refluxing" papillae were completely absent in 9 of the 33 kidneys, and in only 6 were they present at both poles (Table 2). As in the piglet kidneys, gaping papillary duct openings were commonly a feature of the area cribrosa in type II and III papillae (Fig. 1). However, in some of these

Table 1. Papillary numbers and distribution of papillary types in 33 children's kidneys

	Simple and compound type I	Compound type II	Compound type III
Upper pole	41	3	17
Mid-zone	119	1	0
Lower-pole	62	5	5
Total	222 (88%)	9 (3.5%)	22 (8.5%)

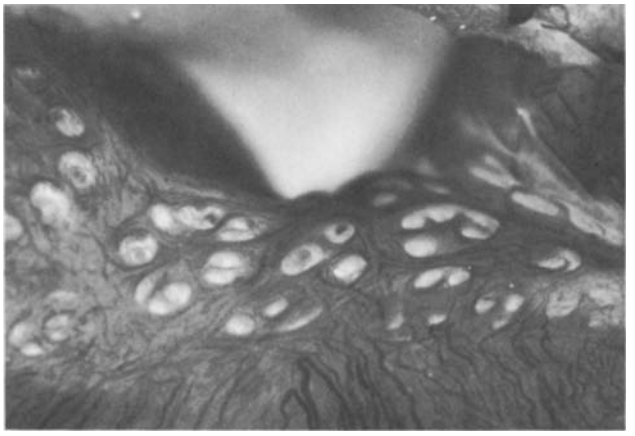

Fig. 1. Human compound type III papilla with prominent gaping papillary duct openings. Magn. X 14

Table 2. Distribution of compound type II and III papillae in young human and porcine kidneys

	Both upper and lower poles	Upper pole only	Lower pole only	Absent
Human (N=33)	6 (18%)	14 (42%)	4 (12%)	9 (27%)
Pig (N=25)	24 (96%)	1 (4%)	0 (0%)	0 (0%)

Fig. 2. Human compound type III papilla with relatively few open duct orifices at the centre of the area cribrosa. Magn. X 14

papillae the proportion of open central duct orifices was less than in the piglets (Fig. 2), and in just over half the human type II and III papillae duct orifices of this type were absent. Type II and III papillae without gaping duct openings in the piglet were not associated with IRR (6).

Discussion

In carrying out this study our initial observations confirmed that there was a wide variation of papillary form in infants and young children, and that the classification devised in the piglet was applicable to human kidneys. We were therefore able to proceed to a full analysis of the numbers and distribution of the various papillary types and to compare the results with those previously established in the pig. We did not perform radiological studies of the human kidneys since the results in necropsy material are unsatisfactory (2). It was found experimentally that IRR seen during life was often absent or confused by other forms of pyelorenal backflow as little as 1-2 hrs after death. However, since we had demonstrated a very good correlation between observed IRR and the presence of a compound type II or III papilla in the piglet, we were able to make some predictions from our morphological data alone concerning IRR in infants and young children. The most obvious difference between the human and porcine kidneys was the much higher proportion of "non-refluxing" simple and compound type I papillae in the former. Allowing both for this, and for the fact that just over one half the human type II and III papillae did not bear 'open' duct orifices, we deduce that IRR would occur in about one third of young children with gross vesicoureteric reflux (VUR). The frequency with which IRR is detected clinically has been less than this. Rolleston et al. (7) found IRR in approximately 10% of children

with gross reflux under the age of 4 years, but they suggested that this figure considerably underestimates the true incidence. In order to demonstrate IRR, radiographs showing fine detail unobscured by bowel shadows are necessary but are the exception rather than the rule in this age group; upper tract films must be taken while the child is still micturating since visible IRR fades rapidly over 1-2 min; pyelotubular backflow of urine already present in the upper tract may precede and prevent the flow of contrast medium into the kidney so that IRR is not detected. Thus a number of factors may interfere with the direct radiological detection of IRR; its true incidence in patients with severe VUR may be much higher, and be of the order suggested by our morphological data. It has been proposed recently that if the renal outline becomes visible during micturating cystography then IRR has occurred, and this observation may help to diagnose further cases (4).

The significance of IRR, and the possible mechanisms of renal damage in reflux nephropathy have been discussed recently (3). Some children with gross VUR develop segmental renal scarring while others do not, and it is likely that the main distinguishing factor between them is the occurrence of the IRR, whether or not it is recognised radiologically.

We do not at present know why IRR is seldom seen after the age of 4-5 years. It may be that voiding pressures, which are high in infancy, have fallen, or that there is some morphological change in the renal papillae, perhaps as a result of maturation or persistent reflux.

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