A STUDY OF THE HUMAN FOETAL RENAL PELVICALYCEAL PATTERNS

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ABSTRACT

BACKGROUND
The renal pelvicalyceal system consists of the renal pelvis, major calyces and minor calyces. They present numerous patterns, which can be grouped into three. The pattern in the foetus may change to other patterns in the adult. Knowledge of these patterns in the foetus might be of use for the smooth execution of surgical procedures, since foetal surgery is emerging fast as a distinct specialty.

MATERIALS AND METHODS
50 human foetal kidneys of both sexes from the Department of Pathology, Government Medical College, Thiruvananthapuram, Kerala, were dissected to study the pelvicalyceal patterns.

RESULTS
Three major types of pelvicalyceal patterns – tricalyceal, bicalyceal and multicalyceal were observed. The surfaces of the foetal kidneys were lobulated and each lobe had minor calyces projecting into them. Tricalyceal pattern constituted 36%, multicalyceal 34% and bicalyceal 24% in the foetal kidneys. But there is an increase in the tricalyceal pattern from 36% in the foetal kidneys to 54% in the adult kidneys. Similarly, there is also an increase in the bicalyceal pattern from 24% in the foetal to 30% in adult kidney.

CONCLUSION
The change in the pelvicalyceal pattern in foetuses and in adult indicates that about 62% of the multicalyceal pattern in foetus matured mostly to tricalyceal pattern and some to bicalyceal pattern in the adult. The theory of multiple calyces in the foetus, fusing to form the adult pelvicalyceal system is further supported by the disappearance of foetal lobulations in the adult.

KEYWORDS
Foetal Kidney, Major Calyx, Minor Calyx, Pelvicalyceal System, Renal Pelvis, Lobulations.


BACKGROUND
The proximal parts of the urinary tract, which lies within the renal sinus constitutes the renal pelvicalyceal system. It serves as a conduit for the transport of urine from the kidney through the ureter to the bladder.¹ The minor calyces numbering from 8 - 18 may be loosely grouped into those draining the upper and lower poles and two parallel rows of anterior and posterior calyces draining the middle portion of the kidney. The minor calyces consist of a funnel portion encompassing the papillae and a neck of varying length known as the infundibulum. The coalescence of these calyces form a large chamber called a major calyx, which generally numbers two to three. The major calyces drain into the renal pelvis.²

Graves³ in 1986 and Sampaio⁴ in 1990 classified the pelvicalyceal patterns into different types. The present study followed the simple and recent classification of Ninghoujam DD⁵ (2005). His classification included all the subtypes of the previous two classifications. He classified the renal pelvicalyceal system into three groups. These three groups are bicalyceal (Y shaped), tricalyceal (Triangular) and multicalyceal (radiate).

Sykes⁶ in a thorough study made with casts of human kidneys showed that in the human foetus, cleft formation leads to lobulations of the kidney. In the foetus, the 14 minor calyces which are present in the 30th week correspond exactly to the 14 foetal lobules, later their number diminishes. He demonstrated that most often there is persistence of three upper lobe, three hilar lobe and two to three lower lobe calyces. He concluded that the foetal calyces follow a constant pattern of development and that the adult calyceal variation can be traced to their stage of development.

The objective of the present study was to find out the different patterns of pelvicalyceal system and the lobulations in foetal kidneys and to compare this data with previous studies on adult pelvicalyceal pattern.

MATERIALS AND METHODS
A cross-sectional study of 50 human cadaveric foetal kidneys of both sexes from the Department of Pathology, Government Medical College, Thiruvananthapuram, Kerala was conducted. The gestational age was calculated from the menstrual history obtained from the records. The youngest foetus studied was of 7 weeks gestation and the oldest that of full-term foetus. The dissected kidneys were inspected for surface lobulations and

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then cut coronally in a plane anterior to the renal pelvis from the lateral convex border. The major and minor calyces were observed to study the pelvicalyceal system. They were grouped into multicalyceal, bicalyceal and tricalyceal patterns and photographs were taken. Consecutive intact kidneys of both sides were included. Macerated foetuses and those with renal anomalies were excluded.

RESULTS

Surface Lobulations
At 10 weeks, the surface is smooth and no lobules were seen. At 14 weeks of gestation, faint lines were seen indicating the appearance of lobules. At 20 - 24 weeks of intrauterine life the surface showed typical surface lobulations, the number of which increased with age. After 32 - 34 weeks of intrauterine life, they became less prominent. The pattern was variable. The lobulations had different shapes like large triangular Fig. IA) and rectangular (Fig. IB).

Coronal section revealed that each lobe has a central calyx, which receives a pyramid. The lobes were separated by interlobar septa of Bertin, indicated by the grooves on the surface. These lobulations contained minor calyces projecting into them.

Renal Pelvicalyceal Patterns
The renal pelvicalyceal patterns were the triangular or tricalyceal pattern, radiate or multicalyceal pattern and Y shaped or bicalyceal pattern and some unusual forms.

The percentage of foetal pelvicalyceal patterns observed in the present study is depicted in Table I.

<table>
<thead>
<tr>
<th>Pelvicalyceal Pattern</th>
<th>Numbers</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tricalyceal</td>
<td>18</td>
<td>36</td>
</tr>
<tr>
<td>Multicalyceal</td>
<td>17</td>
<td>34</td>
</tr>
<tr>
<td>Bicalyceal</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>Others</td>
<td>03</td>
<td>06</td>
</tr>
</tbody>
</table>

Table I. Percentage in Foetal Pelvicalyceal Patterns

a) The triangular type or tricalyceal type (Fig. III-A) was seen in 36% (18 kidneys). The infundibulum is longer and resembles the stalk of a cauliflower. Pelvis space is moderate in size. Three major calyces – superior, middle and inferior formed by the fusion of respective minor calyces open into it. This was the commonest type of renal pelvis. The position of the middle calyx was variable, sometimes located close to the upper calyx. The three calyces are usually of the same size.

b) The multicalyceal or radiate type (Fig. III-B) was seen in 34% (17 kidneys). The pelvis was the biggest in this category characterised by the presence of upper and lower major calyces. Three or more minor calyces drained independently into the pelvis between the two major calyces. In this category, no distinct anterior and posterior division of the middle calyces are seen. Infundibulum of the minor calyces is so short that they seem to open directly into the pelvis.
Comparison of the Foetal Pelvicalyceal Pattern with that of the Adult

Purvi Mishra in the studies on the pelvicalyceal patterns in adult kidneys reported that tricalyceal pattern constituted 54%, bicalyceal 30% and multicalyceal 12% respectively. Studies by Wadkar in 100 cadaveric adult kidneys and Ningthoujam in 100 adult Intravenous Pyelograms also showed similar results.

On comparing the data collected on foetuses in this study with the above reported findings, it is clear that there is an increase in the tricalyceal pattern from 36% in the foetal kidneys to 54% in the adult kidneys. Similarly, there is an increase in the bicalyceal pattern from 24% in the foetal to 30% in adult kidney. This change indicates that about 62% of the multicalyceal pattern matured into mostly tricalyceal pattern and some into bicalyceal pattern in the adult. The multicalyceal pattern formed 34% in the foetal kidneys and only 12% in the adult.

The comparison of the pelvicalyceal patterns in foetuses in the present study with the adult pelvicalyceal patterns as described by Purvi Mishra is shown in Table II.

<table>
<thead>
<tr>
<th>Type of Pelvicalyceal Pattern</th>
<th>Percentage in Foetal Kidneys (Present Study)</th>
<th>Percentage in Adult Kidneys (Purvi Mishra - 2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tricalyceal</td>
<td>36</td>
<td>54</td>
</tr>
<tr>
<td>Multicalyceal</td>
<td>34</td>
<td>12</td>
</tr>
<tr>
<td>Bicalyceal</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>Others</td>
<td>04</td>
<td>04</td>
</tr>
</tbody>
</table>

CONCLUSION

The multicalyceal pattern of pelvicalyceal system constituted a significant percentage in the foetal kidneys. But, however, it formed only a minor in the adult, as mentioned in early studies. This decrease in the multicalyceal pattern was made up by an increased proportion of tricalyceal and bicalyceal patterns as against the foetal kidneys. These findings support the theory of merging of minor calyces in a massive fashion in the upper major calyces. A significant percentage of multicalyceal pattern in the foetus matured into tricalyceal pattern and some into bicalyceal pattern in the adult. This theory of multiple calyces in the foetus fusing to form the adult pelvicalyceal system is further supported by the disappearance of foetal lobulations in the adult.

Knowledge of such wide ranging pattern of pelvicalyceal system would serve to help the surgeons to plan and execute their prenatal, intraterine procedures correctly.

REFERENCES