

## Anatomic Classification of the Kidney Collecting System for Endourologic Procedures

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### ABSTRACT

This study was made on 140 polyester endocasts of the kidney collecting system. The pelvicaliceal endocasts were divided into four types according to the drainage of the polar regions and of the mid (hilar) zone. The types AI and AII (62% of the specimens) presented two major caliceal groups as a primary division of the renal pelvis and mid-zone drainage dependent on these two major groups. The types BI and BII (38% of the specimens) presented mid-zone drainage independent of the superior and inferior caliceal groups.

### INTRODUCTION

RECENT ADVANCES IN ENDOUROLOGY, percutaneous nephrolithotomy, and interventional radiology have revived interest in collecting system anatomy, as an accomplished understanding of such anatomy is necessary to perform reliable endourologic procedures.<sup>1-3</sup> In accordance with the classic study of Brödel in 1901,<sup>4</sup> some classifications of the kidney collecting system have been proposed.<sup>5-8</sup> However, we think that these classifications do not assist endourologic applications and that they group morphologic types that deserve to be classified separately. This work presents a pelvicaliceal classification that is interesting to endourologists and which includes all morphologic types of collecting systems.

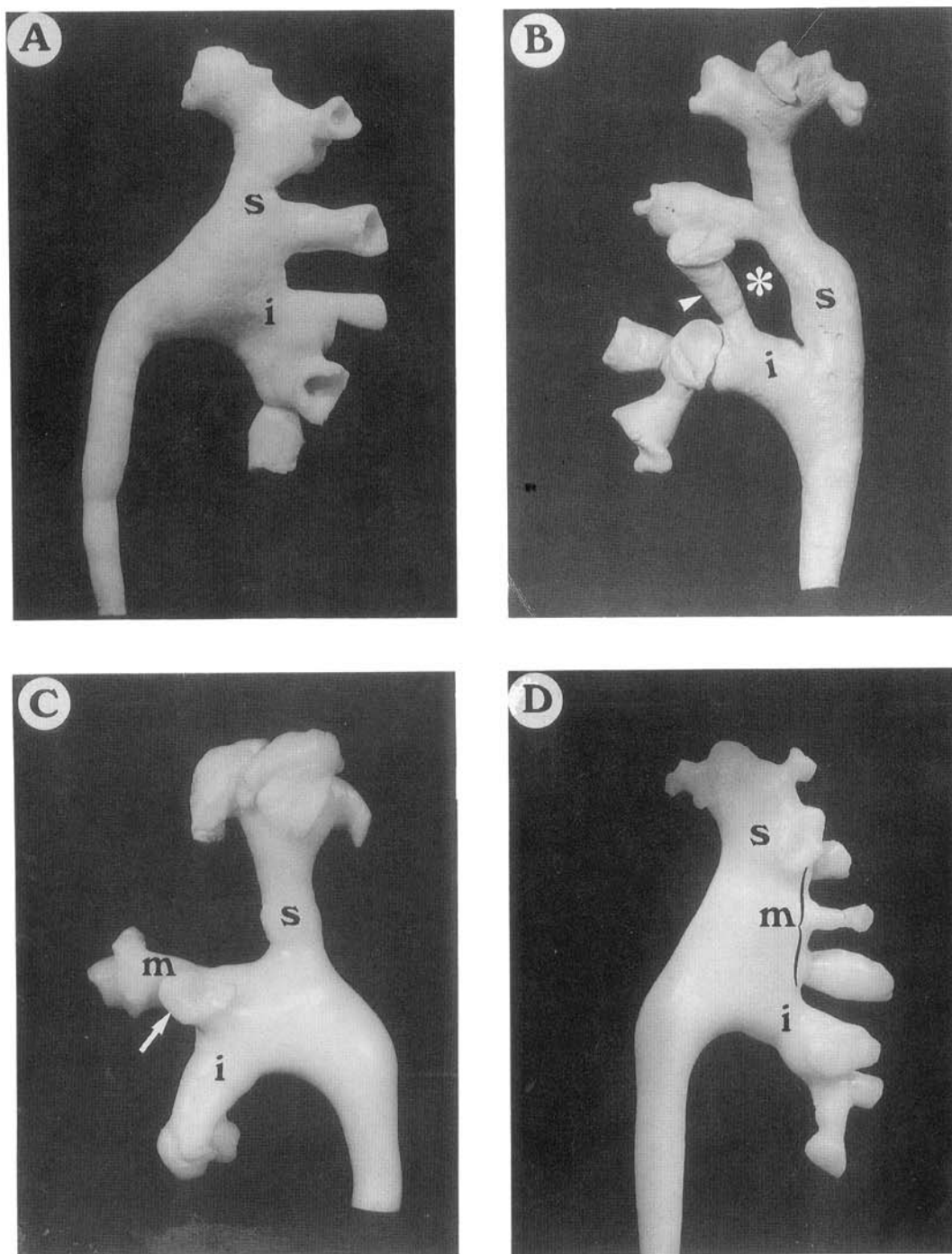
### MATERIAL AND METHOD

The material of the present study consisted of 140 polyester endocasts of the kidney collecting system obtained according to the injection-corrosion technique described by Tompsett.<sup>9</sup> The kidneys were taken from 70 fresh cadavers of both sexes, ranging in age from 16 to 60 years (mean = 32).

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**FIG. 1.** Ensemble view of the four morphologic types of pelvicaliceal systems. A. Type AI: Anterior view of left pelvicaliceal cast shows kidney mid zone drained by calices dependent on the superior (s) and inferior (i) caliceal groups. B. Type AII: Anterior view of left pelvicaliceal cast shows kidney mid zone drained by crossing calices. \* = interpelvic-caliceal region (space). The crossing calix that drains into the inferior caliceal group is in ventral position (arrowhead). C. Type BI: Anterior view of right pelvicaliceal cast shows kidney mid zone drained by hilar major calix (m). This cast shows also the existence of minor calices perpendicular to the collecting system (arrows). D. Type BII: Anterior view of left pelvicaliceal cast; kidney mid zone is drained by minor calices entering straight into renal pelvis (m).

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### RESULTS

Our sample of 140 pelvicaliceal endocasts was divided into two major groups according to the drainage of the kidney polar regions and of the mid (hilar) zone.

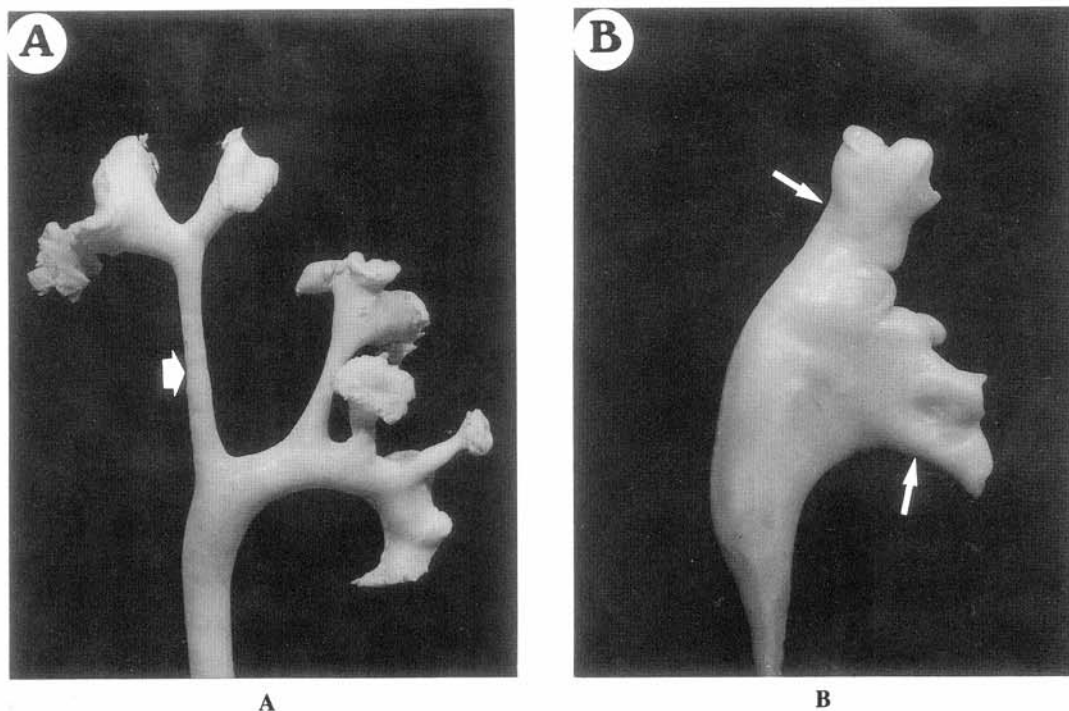
Group A was composed of 87 casts (62% of the specimens) that present two major caliceal groups as a primary division of the renal pelvis and mid-zone drainage dependent on these major groups (Fig. 1A, 1B). Group A includes two different types of casts. In Type AI (63 casts; 45%), the kidney mid zone is drained by minor calices that are dependent on the superior or the inferior caliceal groups (Fig. 1A). The drainage could also be dependent on both superior and inferior caliceal groups. In Type AII (24 casts; 17%), the kidney mid zone is drained by crossing calices, one draining into the superior caliceal group and another draining simultaneously into the inferior caliceal group. When we analyzed the endocasts that have crossing calices in the kidney mid zone, we observed that the crossing calices (laterally) and the renal pelvis (medially) bound a region (space) we denominated the interpelvic-caliceal (IPC) (Fig. 1B). When there were crossing calices, the calix that drained into the inferior caliceal group was in the ventral position in 88% of the cases (Fig. 1B).

Group B was composed of 53 casts (38%) that present kidney mid-zone (hilar) drainage independent of the superior and inferior caliceal groups (Fig. 1C, 1D). Group B also includes two different types of casts. In Type BI (30 casts; 21%), the kidney mid zone is drained by a major caliceal group independent of the superior and inferior groups (Fig. 1C). In Type BII (23 casts; 16%) the kidney mid zone is drained by one to four minor calices entering straight into the renal pelvis (Fig. 1D). Such calices are independent of the superior and inferior caliceal groups.

The kidney collecting system is amply varied and showed morphologic bilateral symmetry in only 37% of the cases (26 pairs of casts).

### DISCUSSION

The polyester resin proved to be a useful material for studying the collecting system anatomy; the shrinkage on setting is minimal, and the casts are permanent.



**FIG. 2.** Anterior view of two left pelvicaliceal casts. A. This cast shows long and thin superior caliceal infundibulum (arrow). B. This cast shows short and thick superior and inferior caliceal infundibula (arrows).

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Our pelvicaliceal classification is similar to, and agrees in some aspects with, the classifications proposed by Fine and Keen,<sup>6</sup> Berberian and Chevrel,<sup>7</sup> and Graves.<sup>8</sup> However, we have identified important and frequent types of collecting systems (AII and BII) not mentioned by these authors. They had not taken into account either the importance of crossing calices in the kidney mid zone or the consequent formation of the interpelvic-caliceal (IPC) region (space).

A type of renal pelvis that does not present major calices has been described by some authors.<sup>5-7</sup> Because our results do not show any cast without major calices, it is quite possible that the findings of those authors are consequent to deformities on the endocasts caused by retraction of the resin employed (vinylite). Another factor that may have led those authors to such results is the interpretation. For instance, Sykes presented in his work an image of a cast to demonstrate the absence of major calices; nevertheless, in our view, this cast shows both a superior and an inferior major calix. It is worthwhile to say that in his work, Sykes found 62% of the casts without major calices.

Although our pelvicaliceal classification includes all morphologic types of calices and renal pelves, we must be aware that the collecting system anatomy is amply varied and that endourologic procedures can be influenced by this variation. To exemplify, we have Figure 2A, which shows a cast presenting a long and thin superior caliceal infundibulum; such an anatomic formation will certainly cause difficulty in the introduction and manipulation of the nephroscope in the superior pole. On the other hand, Figure 2B shows a cast that presents short and thick superior and inferior caliceal infundibula, which will certainly make easier the introduction and manipulation of the nephroscope.

In our study, we evidenced the existence of crossing calices in the kidney mid zone and the consequent formation of the interpelvic-caliceal region. We also demonstrated the existence of minor calices perpendicular to the surface of the collecting system draining into a major calix or into the renal pelvis (Fig. 1C, arrows). These anatomic details, which have already been fully discussed by us in previous studies,<sup>10-12</sup> must be taken into account during the interpretation of pyelograms and during endourologic procedures.

## ACKNOWLEDGMENTS

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