

A study of the variation of colonic positioning in the pararenal space as shown by computed tomography

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Abstract

In a review of 1708 consecutive CT examinations of the abdomen the position of the ascending and descending colon in relation to the posterior and lateral edge of the kidney was studied. It was found that part of the colon was positioned posterior or posterolateral to the kidney's edge in percentages that varied between 14.2% and 0.9% in the different sex groups at the levels of upper, mid- and lower poles of the right and left kidney. It is concluded that this anatomical variation should be known if colon perforation is to be avoided during percutaneous nephrostomy or biopsy.

Introduction

Normal anatomical variation in the position of the colon in the anterior pararenal space has not been reported extensively in the medical literature. It is our belief that knowledge of such variation is important if damage to the colon is to be avoided during percutaneous nephrostomy or biopsy. That implication is sporadically mentioned in the medical literature [1-4] but, in future, similar reports are expected to become more frequent with increasing use of interventional urologic procedures and percutaneous nephrostomy placements.

In this study we try to determine the frequency of normal variations in the position of the colon in the pararenal space for both sexes in a large number of CT examinations. Also, we discuss the importance of computed tomography as a preliminary diagnostic approach in patients scheduled to undergo percutaneous nephrostomy or biopsy.

Materials and Methods

A retrospective study of 1708 (1054 men and 654 women) consecutive abdominal CT examinations was made to determine the position of the ascending and descending colon and of the right and left colonic flexures in relation to the pararenal space. Patients with either obvious hepato- or splenomegaly, ascites, with renal cysts larger than 3 cm in diameter, having been previously subjected to surgical procedures, with space-occupying lesions of the kidneys and adrenals, and with congenital anomalies as to the position and size of the kidneys were excluded from the study. In those cases, there was a distinct change in the anatomical relations of the organs in the pararenal space, and they could not be used for the study of a normal anatomical variation.

All CT examinations were performed by a Pfizer 0450 CT scanner, using a standard technique. Patients were examined in the supine position with a 10 mm slice thickness and a 5-s exposure after oral administration of 250 ml of contrast material (gastrografin 2%).

To estimate the position of the various parts of the colon in the pararenal space, three CT images for each side of the retroperitoneum were chosen for further analysis. For each side an image was selected which

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showed the region of the upper and lower renal calyces; the third image was through the renal pelvis at the level of the renal vessels. On each image two lines were drawn, as shown in Fig. 1A and B. Line I was drawn in the coronal plane in contact with the posterior edge of the kidney; line II was drawn from the antero-lateral edge of the vertebra through the middle of the calyces. Although line II was drawn through standard points, its angle with the horizontal varied amongst patients and crossed the skin close to the lateral axillary line, on which the entry point in the percutaneous nephrostomy is often selected [5,6]. In this way, it was possible to determine the number of cases in which parts of the ascending or descending colon were situated posterior to Line I or Line II.

Data thus collected were subjected to statistical analysis by the χ^2 -test to determine whether there was a correlation between this anatomical variation and the sex or age of the patients. Patients were separated into three groups according to age: 20–39 years, 40–59 years, 60–89 years.

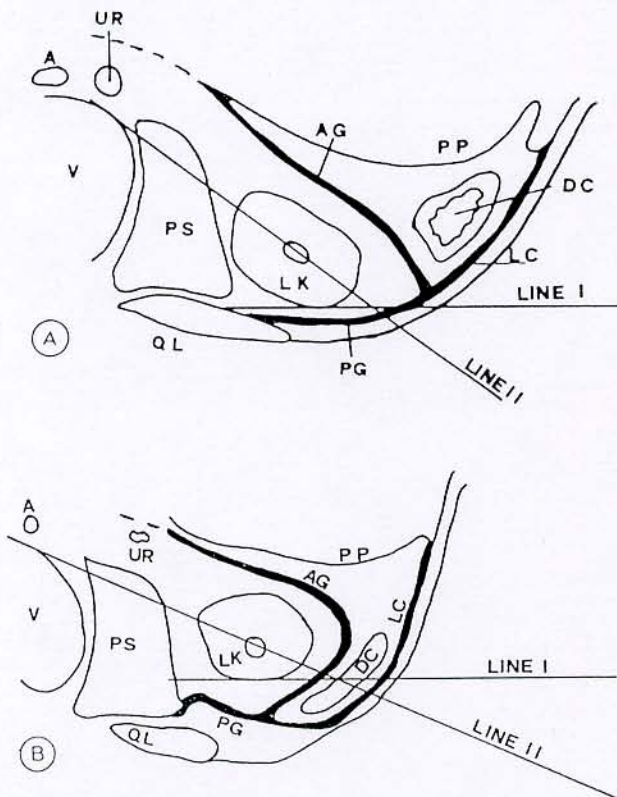


Fig. 1. (A) Schematic diagram of the left pararenal space: usual position of the colon anterior to lines I and II. (B) Normal variant: colon positioned posterior to lines I and II. A, aorta; AG, anterior renal fascia; DC, descending colon; LC, laterocoronal fascia; LK, left kidney; PG, posterior renal fascia; PP, parietal peritoneum; PS, psoas muscle; UR, ureter; QL, quadratus lumborum muscle; V, vertebra.

Results

The results are presented in Tables I and II. The descending colon (Table I) was demonstrated posterior to the lines I and II most frequently (3.6% and 10.4%, respectively) at the level of the lower calyces (Fig. 2), less frequently (0.8% and 6.4%) at the level of the renal pelvis, and seldom (0.4% and 1.2%) at the level of the upper calyces (Fig. 3). This normal variant was observed in smaller percentages (1% and 2.8% for lines I and II, respectively) for the ascending colon (Table II) at the level of the lower calyces, seldom at the level of the renal pelvis (0.2% and 0.6%) and almost never at the level of the upper calyces. Occurrence of the colon exactly behind the posterior renal border (retrorenal colon) was demonstrated in 17 cases (1%) at the level of the lower calyces and in 5 cases (0.3%) at the mid-hilar level while the descending colon was retrorenal in 13 cases (0.8%) at the level of the lower calyces.

TABLE I

Frequency of occurrence of the normal variation in the position of the descending colon in the left pararenal space

Line I			
	Male	Female	Sum
Lower calyceal level	23 (2.2%)	38 (5.8%)	61 (3.6%)
Renal pelvis level	8 (0.8%)	6 (0.9%)	14 (0.8%)
Upper calyceal level	0	6 (0.9%)	6 (0.4%)
Line II			
	Male	Female	Sum
Lower calyceal level	84 (8%)	93 (14.2%)	177 (10.4%)
Renal pelvis level	50 (4.7%)	60 (9.2%)	110 (6.4%)
Upper calyceal level	6 (0.6%)	15 (0.2%)	21 (1.2%)

TABLE II

Frequency of occurrence of the normal variation in the position of the ascending colon in the right pararenal space

Line I			
	Male	Female	Sum
Lower calyceal level	9 (0.9%)	8 (1.2%)	17 (1%)
Renal pelvis level	1	3 (0.5%)	4 (0.2%)
Upper calyceal level	0	1	1
Line II			
	Male	Female	Sum
Lower calyceal level	18 (1.7%)	30 (4.6%)	48 (2.8%)
Renal pelvis level	4 (0.3%)	6 (0.9%)	10 (0.6%)
Upper calyceal level	0	1	1

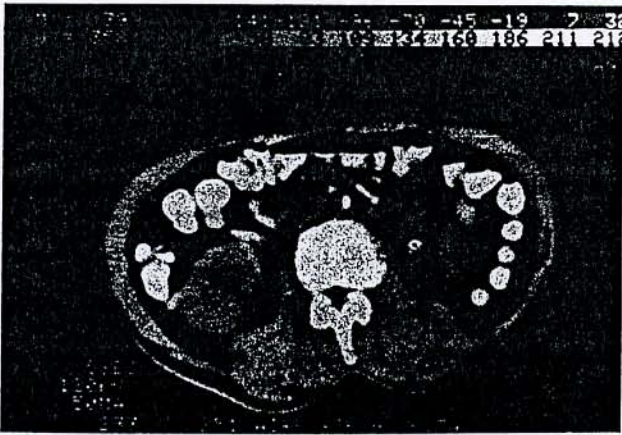


Fig. 2. Lower calyceal level: part of the colon extending posterior to the lines I and II in the left kidney; anterior renal displacement and stone in the lower calyces of the left kidney.

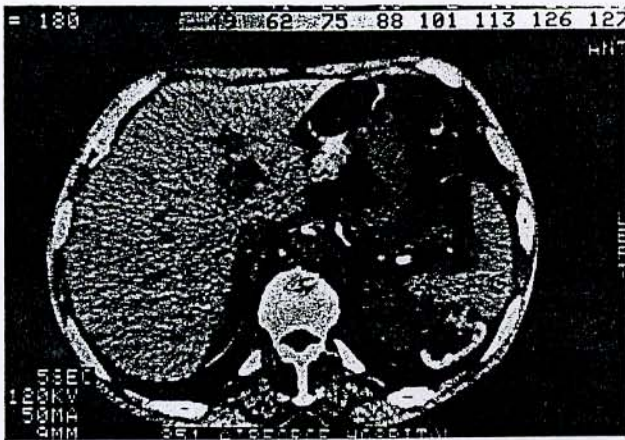


Fig. 3. Upper calyceal level: part of the descending colon posterior to the lines I and II.



Fig. 4. Part of the colon between the right kidney and the psoas muscle.

This variant was more frequently demonstrated in women than in men at a statistically significant level ($p < 0.001$), while there were no significant differences found amongst the age groups.

Discussion

The increasing use of percutaneous procedures renders the knowledge of normal variation in the position of the colon in the pararenal space important.

There are but few reports in the medical literature to this subject. In a study of 140 patients, Hadar and Gadoth [8] found that in elderly men the retroperitoneal colon was often located anteriorly, while in women of all ages it was usually seen laterally. The former observation was mainly due to the extensive accumulation of intraabdominal fat in men with age. In an other study of 200 patients by Sherman et al. [9], it was found that in 10% of the cases the descending colon extended posterior to a line drawn through the posterior margin of the left kidney and that there were no significant differences found amongst the age or sex groups. Hopper et al. [10], in a series of 90 prone and 500 supine abdominal CT scans, found that the bowel was positioned posterior to the kidneys in 10% and 1.9% of the cases, respectively. The majority of the patients with this colonic variant were older than 60 years of age and there were no significant differences found between the sex groups. In all those studies the relationship of the retroperitoneal colon to the kidneys was evaluated at three levels: the upper renal pole, the mid-hilar level and the lower renal pole.

Another interesting variation of this study concerned the presence of the transverse colon in the space between the kidney and the psoas muscle (Fig. 4). Similar observations have been reported in two case studies by Silverman et al. [14] and by Boijesen and Lin [15].

Most authors [3,5,11,12], on performing the percutaneous nephrostomy, usually select the lower calyces with a posterior or postero-lateral approach and an entry point on the skin at the lateral axillary line in front of the 12th rib. In the present study the variable orientation of the retroperitoneal colon with respect to the kidneys was evaluated at the levels through the calyces (instead of the poles). In addition, line II was drawn in a direction similar to that followed during percutaneous nephrostomy with postero-lateral approach to the kidney. Our findings revealed that part of the colon was situated posterior to the horizontal line I more often at the level of the lower calyces and almost never at the level of the upper calyces. This variation was more frequently found in the left pararenal space, and it was

observed twice as frequently in women as in men; there were no significant differences between the three age groups. Finally, if our results for the supine position are considered in relation to those obtained by Hopper et al. [10], we should expect an increased incidence for the retrorenal colon in the prone position.

Our results are in agreement with those of Raptopoulos et al. [13] and of Hopper et al. [10] in that the position of the retroperitoneal colon is determined by the antero-posterior point of fusion of the anterior and posterior renal fascia into the lateroconal fascia. The possibility of non-formation of the lateroconal fascia cannot be ruled out since, according to Feldberg [7], the renal fasciae are only demonstrated by CT in 54% of cases.

This normal anatomical variation in the position of the colon in the pararenal space should be considered in the assessment of computed tomography or intravenous urography.

Furthermore, the frequency of occurrence of this normal colonic variation should caution us as to the necessity of a preliminary examination by either computed tomography or ultrasonography for patients scheduled for percutaneous nephrostomy or biopsy.

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