

## Interposition of the Colon Between the Kidney and the Psoas Muscle: A Normal Anatomic Variation Studied by CT

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**Abstract.** The position of the bowel in the pararenal space was examined in relation to the kidney and the psoas muscle in 1203 abdominal computed tomographic (CT) examinations. The ascending colon was found between the lower kidney pole and the psoas muscle in 1.7% and the descending colon in 0.7% of the patients. This variation appeared more frequently in women, young adults, and individuals with less intrabdominal fat. Lateral displacement of the lower kidney pole was observed in 40% of the patients with this normal variation. These findings may be of value when interpreting urographic and abdominal CT examinations.

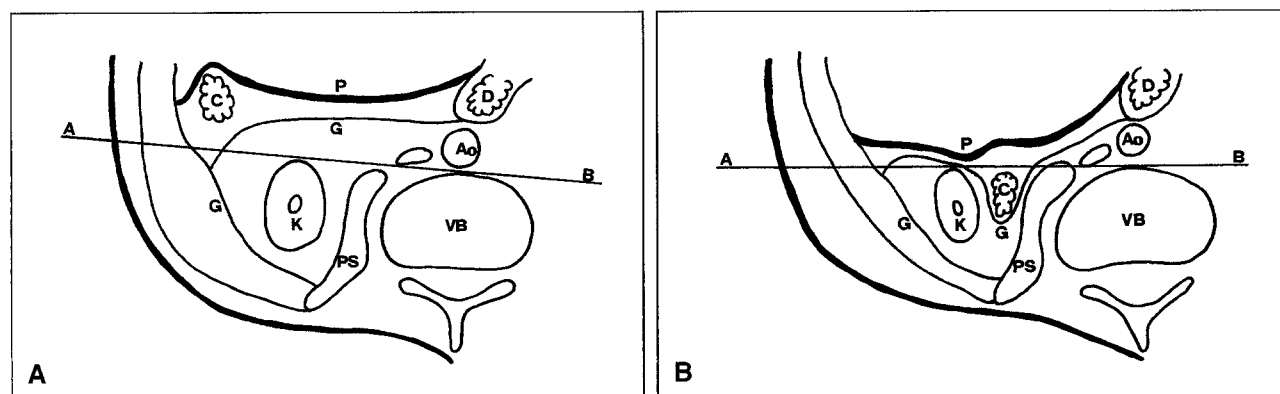
**Key words:** Bowel anatomy, normal variation—Pararenal space, CT—Kidney displacement.

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Normal variations of colonic positioning in the pararenal space are of diagnostic significance and clinical importance [1–3]. Interposition of the colon (CI) between the right kidney and the psoas muscle has been previously reported as anatomic variation only in two case studies [3, 4]. In this study, the frequency of this normal variation in relation to the patient's age, sex, and amount of intrabdominal fat was examined in a large number of computed tomographic (CT) examinations.

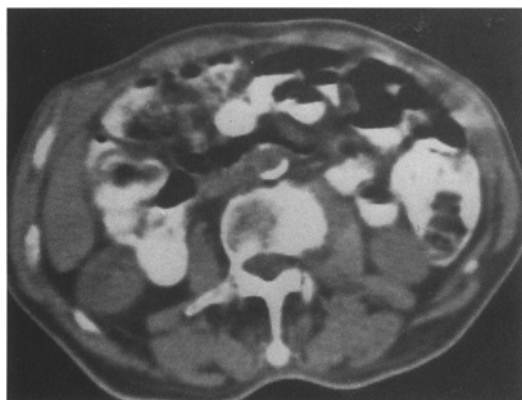
### Materials and Methods

We reviewed 6230 consecutive abdominal CT examinations performed during the last 11 years. For the purposes of this study, 1203 examinations reported as normal or with findings that do not affect the position of the colon were selected. Patients with intraabdominal space-occupying lesions, ascites, congenital anomalies, cancerous



**Fig. 1.** Schematic diagram of the right pararenal space: (A) usual position of the colon anterolaterally to the kidney and anteriorly to the line AB. (B) CI variation with colonic positioning posteriorly to the

line AB, between the kidney and psoas muscle. Ao, aorta; C, colon; D, duodenum; G, Gerota's fascia; K, kidney; P, peritoneum; PS, psoas muscle; VB, vertebral body.



**Fig. 2.** Opacified colon between the right kidney and the psoas muscle with minimal displacement of the lower kidney pole.

emaciation, hepato- or splenomegaly, or with history of abdominal surgical procedures were not included.

Interposition of the bowel between the kidney and the psoas muscle was determined when part of the colon or the small intestine was found posterior to a reference line AB, drawn tangentially to the anterior margins of both the kidney and the spine (Fig. 1). Patients were separated subjectively into three groups of normal, increased, and decreased amount of intraabdominal fat. Data were analyzed employing the  $\chi^2$  test to examine differences in the frequency of occurrence of this anatomic variation between males and females, younger (<40 years) and older, and right and left pararenal space.

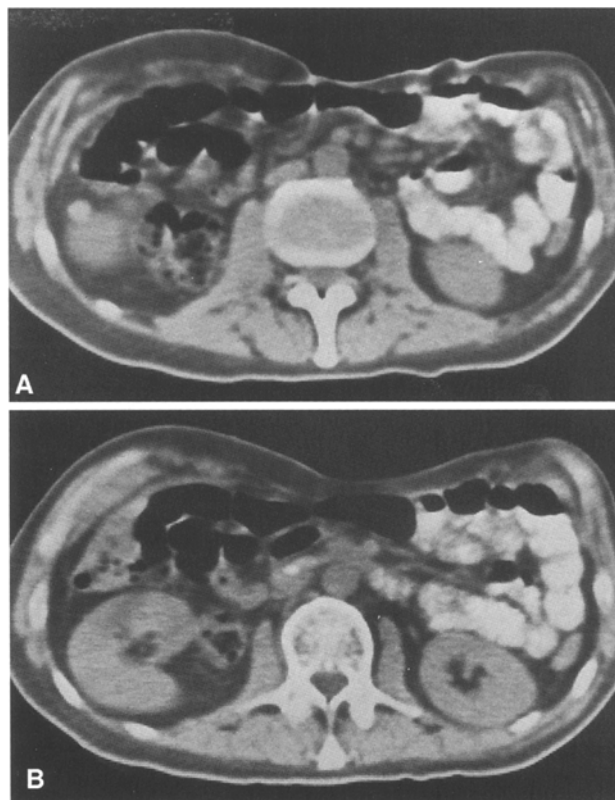
**Results**

The frequency of the colonic interposition (CI) between the kidney and the psoas muscle (Figs. 2 and 3) was found in 21 (1.7%) patients for the ascending and in nine (0.7%) for the descending colon (Table 1). This variation was observed more often in women than in men ( $p < 0.05$ ) and in younger than in older adults ( $p < 0.05$ ). In 19 of 30 (63%) patients with CI, a decreased amount of retroperitoneal fat was observed. In 12 of 30 (40%) patients, the lower pole of the kidney was laterally displaced as compared to the position of the contralateral kidney. No patient of this study exhibited a CI at a level above the renal pelvis.

Small bowel loops were also found slightly posterior to the reference line AB (Figs. 4 and 5) in 42 (3.5%) patients on the left and 10 (0.8%) on the right side, at the level of the lower renal pole. The intraabdominal fat was reduced in 39 of those 52 patients and in no case lateral displacement of the kidney was observed.

**Discussion**

Lateral displacement of the lower pole of the kidney, caused by interposition of the colon between the kidney and the psoas muscle, may simulate a mass at intrave-



**Fig. 3.** CT section through the (A) lower kidney pole and (B) below the renal pelvis in a patient with less intraabdominal fat. The ascending colon without contrast material is found between the kidney and the psoas muscle, causing moderate displacement of the kidney.

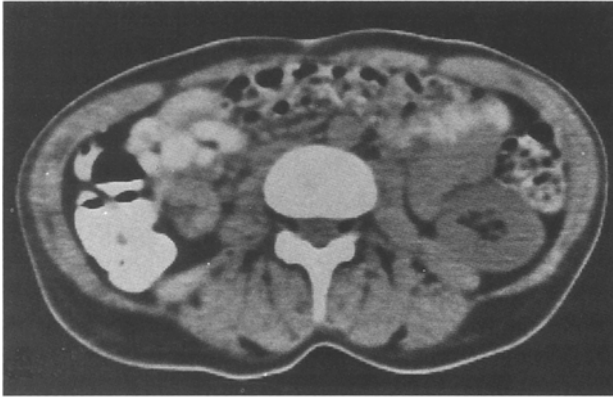
**Table 1.** Frequency of the CI variation in a sample of 1203 patients<sup>a</sup>

	Men	Women	<40 yr	>40 yr	Total
Left side	2 (0.3%)	7 (1.4%)	3 (1.6%)	6 (0.6%)	9 (0.7%)
Right side	8 (1.1%)	13 (2.6%)	6 (3.3%)	15 (1.5%)	21 (1.7%)

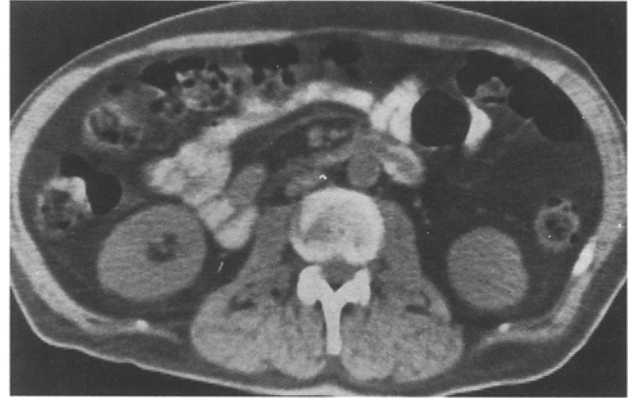
<sup>a</sup> 714 men, 489 women; 183 patients < 40 years of age and 1020 patients > 40 years of age

nous urography. This unusual position of the bowel has been described only for the ascending colon in two case reports [3, 4]. However, to our knowledge, a systematic study of this normal anatomic variation has not been previously performed.

According to the results of this study the CI variation appears more frequently in women, young adults, and individuals with decreased amount of intraabdominal fat. It has been shown that women have less intraabdominal fat than men [5] and the young than the elderly [6]. It seems that the amount of intraabdominal fat is mostly a contributing parameter in the appearance of CI. In individuals with less retroperitoneal fat, the ascending or descending colon



**Fig. 4.** Unopacified small bowel loops between the left kidney and the psoas muscle in a patient with decreased amount of intraabdominal fat.



**Fig. 5.** Small bowel loop interposed between the right kidney and the psoas muscle with no evidence of renal displacement.

may be displaced posteriorly together with the anterior renal fascia, especially under increased intraperitoneal pressure.

The ascending and descending colon are positioned in the pararenal space, anterolaterally to the external margin of the kidney. In contrast, in patients with CI these parts of the colon are found closely to the internal border of the kidney. Since the transverse mesocolon varies widely among individuals [7], it is possible that patients with CI may have a short transverse mesocolon, which restricts the ascending and descending colon to a position near to the midline. This may serve as an explanation in cases that the bowel is situated between the kidney and the psoas muscle and not close to the lateral abdominal wall.

In some individuals the ascending or descending colon are intraperitoneal, suspended by the mesocolon [3]. It has been also shown that the presence of mesentery is more frequently associated with the ascending than the descending colon [8]. Furthermore, adequate mesocolon allows increased mobility of these parts of the colon [3, 4]. According to the results of this study, the CI variation is observed twice as often on the right than the left side and, thus, it is probable that increased mobility of the bowel is related to the appearance of this normal anatomic variation.

The findings of the present study underscore the occurrence of CI in the population. This variation may be of diagnostic significance when interpreting urograms with evident renal displacement or CT examinations with inadequate bowel opacification.

## References

1. Helms CA, Munk PL, Witt WS, Davis CW, Morris J, Onik G. Retrorenal colon: implications for percutaneous discectomy. *Radiology* 1989;171:864–865
2. Prassopoulos P, Gourtsoyannis N, Cavouras D, Pantelidis N. A study of the variation of colonic positioning in the pararenal space as shown by computed tomography. *Eur J Radiol* 1990;10:44–47
3. Boijesen E, Lin G. Lateral displacement of the right kidney by the ascending colon. *J Comput Assist Tomogr* 1983;7:344–346
4. Silverman PM, Kelvin FM, Korobkin M. Lateral displacement of the right kidney by the colon: an anatomic variation demonstrated by CT. *AJR* 1983;140:313–314
5. Dixon AK. Abdominal fat assessed by computed tomography: sex difference in distribution. *Clin Radiol* 1983;34:189–191
6. Borkan GA, Halts BA, Gerzof SG, Robbins AH, Silbert CK. Age changes in body composition revealed by computed tomography. *J Gerontology* 1983;38:673–677
7. Meyers MA. Normal anatomic relationships and variants. In: *Dynamic radiology of the abdomen: normal and pathologic anatomy*. New York: Springer Verlag, 1988:27–48
8. Whalen JP, Riemenschneider PA. An analysis of the normal anatomic relationships of the colon as applied to roentgenographic observations. *AJR* 1967;99:55–61