Sonography of the Hypertrophied Column of Bertin

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A prospective sonographic analysis of kidneys in 136 adults without clinical or radiologic evidence of renal disease revealed 22 cases of large columns of Bertin. Most were located in the middle third of the kidney, more frequently on the left side. They were bilateral in 18%. Water bath sonograms of normal cadaver kidneys and subsequent anatomic correlation revealed hypertrophied columns and confirmed the sonographic findings seen in vivo. The following are characteristic of a hypertrophied column of Bertin: It is a projection of cortex into the renal sinus (and therefore is isoechogenic with it). The sinus may engulf it in a clawlike fashion. The renal contour is smooth. Sonography is characteristic and obviates further investigation.

In 1744, the French anatomist Exupère Joseph Bertin gave a lecture before the Académie Royale des Sciences on the morphologic structure of the kidney [1]. He stated that "cortical substance not only envelops the external part of the kidney, but also runs in between papillae, separates them and gives rise to 'cloisons' which cross the whole thickness of the kidney." Since then, these intrusions of cortical substance between the pyramids have been called septa or columns of Bertin (translated from the word *colonne* commonly used by French anatomists).

While Bertin's original studies called attention to the fact that some columns are bigger than others and protrude deeply into the renal medulla, it was not until the late 1960s that radiologists became aware of their existence and concerned with their differentiation from renal tumors [2–7]. A number of nephrectomies were done until the radiologic characteristics of the column of Bertin were fully described [8].

During sonography of patients without known renal disease, we found what seemed to be unusual numbers of large or hypertrophied columns of Bertin. We therefore started a prospective study to determine their frequency as seen by clinical sonography and their frequency in normal cadaver kidneys.

Subjects and Methods

The kidneys of 136 adult patients (aged 18–76 years, 84 women, 52 men) without clinical evidence of renal disease were prospectively studied using commercially available real-time sonographic equipment (Philips model SDU 3000, ATL MK-100, 3.5 or 5 MHz transducers). Multiple cuts were obtained in sagittal and coronal planes from an anterior and axillary approach. Thirty-six patients were excluded because of abnormalities of the renal sonograms or because of technically suboptimal sonographic studies. Thirty-nine cadaver kidneys without gross pathology were scanned in a water bath with a static B-scanner (Philips, Sonodiagnost-B). Longitudinal sonograms were compared to corresponding gross sections.

A hypertrophied column of Bertin was defined as an isoechogenic cortical mass projecting into and indenting the hyperechogenic renal sinus. The longitudinal diameter of any such mass was measured as shown in figure 1 and graded on a scale from 1 to 3, where grade 1 was 0.5–1 cm, grade 2 was 1–2 cm, and grade 3 was over 2 cm. All observations and measurements were performed independently by two observers.

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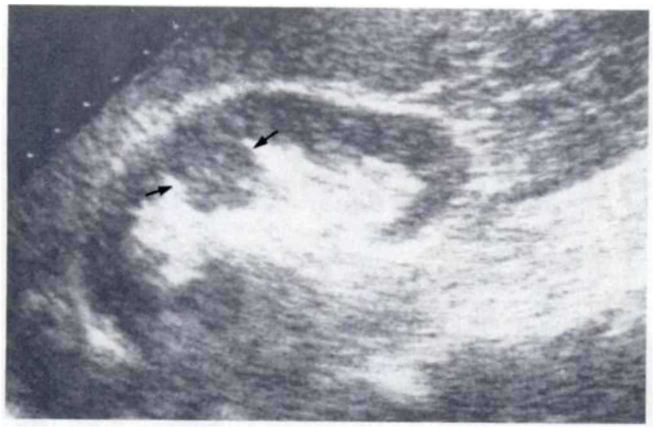


Fig. 1.—Longitudinal sonogram of right kidney. Typical hypertrophied column of Bertin. Mass is at junction of upper and middle third of kidney and projects into renal sinus, which engulfs it in clawlike fashion. It is isoechogenic with renal cortex. Renal contour is smooth. (*Arrows* show site of measurement of longitudinal diameter used in this study.)

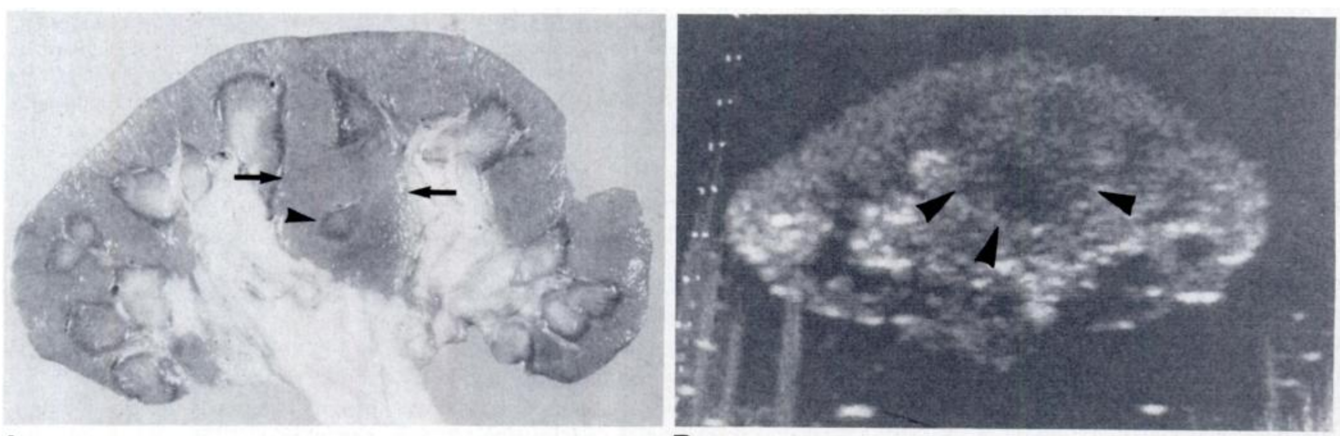
Results

In vitro

A comparison of the sonographic studies of cadaver kidneys with their anatomic cuts showed an excellent correlation. The masses indenting the renal sinus in this group of cadaver kidneys were, in fact, hypertrophied columns of Bertin (fig. 2).

In vivo

The incidence and size of masses indenting the sinus echoes are summarized in table 1. Almost one-half of the kidneys examined (47% in vivo, 51% in cadavers) had at least one such mass. Of these, almost half were grade 2 or 3 (more than 1 cm). The most frequent site was the junction of the upper and middle third of the kidney. The left kidney was more frequently involved than the right kidney at a ratio of 2:1. Bilateral masses were more frequent in cadaver kidneys (left:right, 3:2) than in vivo. A few kidneys (18%) had two



A B

Fig. 2.—Anatomic-sonographic correlation of hypertrophied column of Bertin. **A**, Longitudinal cut of normal cadaver kidney shows large column of Bertin (*arrows*) indenting renal sinus and containing small "imprisoned" papilla (*arrowhead*). **B**, Sonogram of same kidney in water bath. Although visual detail is not as good as in vivo, hypertrophied column is outlined (*arrowheads*).

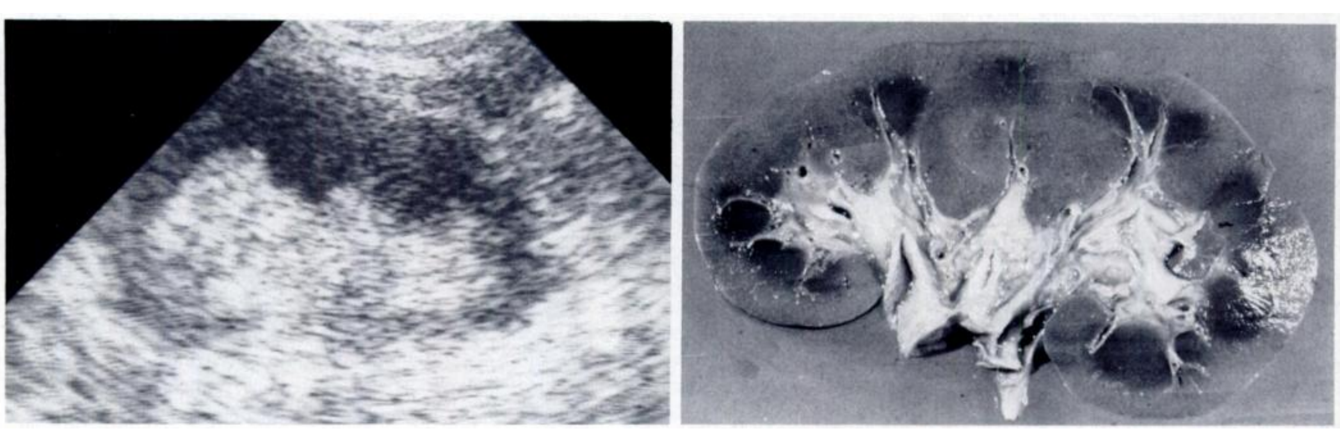


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Fig. 3.—Two large columns of Bertin in middle third of kidney. **A**, Longitudinal sonogram in 68-year-old man. **B**, Longitudinal cut of normal cadaver kidney.

TABLE 1: **Incidence and Site of Hypertrophied Column of Bertin**

	Patients (n = 100), no. (%)	Cadaver Kidneys (n = 39), no. (%)
One column	47 (47)	29 (74)
Two columns	4 (4)	2 (5)
Left to right ratio	2:1	3:2
Diameter over 1 cm (grade 2 and 3)	22 (47)	16 (55)
Bilateral	18 (18)	13 (33)

masses (fig. 3). Some columns of Bertin (17%) were the site of a complete split of the sinus echoes, creating a bifid intrarenal collecting system.

The columns of Bertin were isoechogenic with the cortex. They were usually perpendicular or rarely oblique to the renal capsule (fig. 4). The renal contour was always smooth. There was no acoustic enhancement behind a large column of Bertin.

In 22% of patients, the sinus echoes embraced the column of Bertin in a clawlike fashion (fig. 1). In two patients and in one cadaver kidney, the hypertrophied column of Bertin was pierced by a small hypoechogenic focus (fig. 5). On anatomic cut, this focus represented a small engulfed papilla (fig. 2).

Fig. 4.—Longitudinal cut of kidney. Obliquely directed column of Bertin (*arrowheads*) engulfed by renal sinus fat.

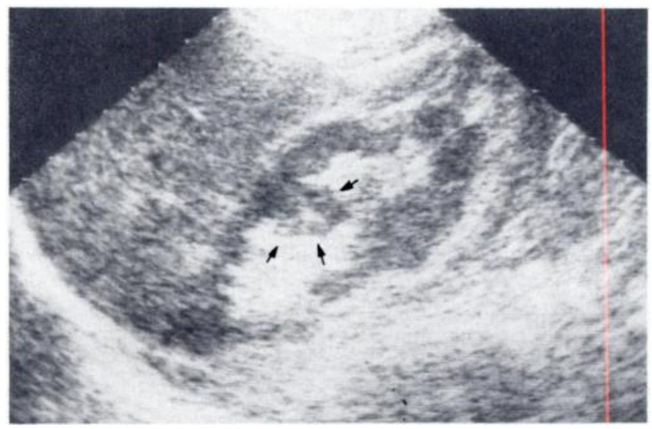

Fig. 5.—Longitudinal sonogram of right kidney. "Imprisoned" papilla (*arrows*) in center of hypertrophied column in 59-year-old woman.

Discussion

Hypertrophied columns of Bertin have been a diagnostic challenge to radiologists, especially since the routine use of nephrotomography as part of the excretory urogram. Because it simulated a solid mass, it resulted in instances of needless nephrectomies before the detailed angiographic signs of an enlarged column of Bertin were described [2–7]. The radiologic descriptions of the hypertrophied column of Bertin are numerous and many synonyms have come into use: renal pseudotumor [3, 6], focal nodular hyperplasia [5], cortical invagination with prominent column of Bertin [6], lobar dysmorphism [7], benign cortical rest [8], cortical nodule [9], and recently, large cloisons [10].

Hodson and Mariani [10], in calling them "large cloisons," returned to the original term used by Bertin in 1744. In his description of the hypertrophied column of Bertin, Hodson [11] traces the formation of such columns through renal development in several animals in which kidneys are formed by the fusion of multiple small kidneys. Each renal lobe is composed of a central mass of medullary tissue enveloped by a cortical layer. In the human, the "cloison" of Bertin is thought to be formed by the fusion of two layers of septal cortex of two adjacent lobes. In the adult, the grooves on the outer surface of the kidney (or fetal lobulation) become less visible than in a child and disappear altogether.

Hodson's classic description of the hypertrophied "cloison" of Bertin shows an increase both in incidence and size of the cloison in the middle third of the kidney. The septa or cloisons seem to be smaller and less intrusive in the polar regions of the kidney.

It is possible that sonography displays large columns of Bertin better than the classic excretory urography and nephrotomography. The kidney is viewed in several planes and from several directions on sonography. We found the axillary view especially revealing in our search for large columns of Bertin. This view is rarely available by excretory urography. In addition, details of parenchymal and sinus architecture are better appreciated by sonography than by excretory urography.

Both in Hodson's description and in our cadaver population, large septa of Bertin were often present bilaterally. Among our patients, hypertrophied columns of Bertin were seen less frequently on the right, possibly because the sonographic axillary view of the right kidney is more cumbersome to perform than the left and is rarely needed.

The sonographic signs of hypertrophied columns of Bertin are characteristic. The only possible pitfall is the parapelvic cyst. Careful analysis of the echogenicity of such a cyst and its acoustic enhancement will help to differentiate it from hypertrophied columns of Bertin. The small hypoechogenic focus that represents an engulfed papilla has already been described at urography [12]. It may be connected to a small or abortive calix [10, 13, 14].

A review of 48 consecutive hypernephromas seen at sonography in our institution did not show one tumor that did not distort the contour of the kidney. The normal renal contour seen with a hypertrophied column of Bertin is thus an important feature distinguishing it from hypernephroma. Similarly, adenomas can be distinguished from hypertrophied columns of Bertin by their cortical rather than parapelvic position and by their mass effect on the outer surface of the kidney. When small, even if they are isoechogenic with the cortex, adenomas are well demarcated [15].

There have been no reports of nephrectomy performed for a hypertrophied column of Bertin since 1976. However, the literature abounds with complex investigative algorithms to establish the diagnosis of hypertrophied columns of Bertin. These usually include selective renal angiography, radionuclide studies, and CT [10, 16–19].

Our study shows that the hypertrophied column of Bertin is a frequent anatomic variant and that it has sonographic features that reliably distinguish it from pathologic renal masses.

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