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Midline Omphalovesical Anomalies in Children: Contribution of Ultrasound Imaging

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Abstract. Based on reports of 9 surgically proven cases, the authors stress the contribution of high-resolution sonography in the work-up of omphalovesical midline anomalies in children. Sonography (US) proved useful, especially in disorders of urachal patency (cystic mass and sinus type of the malformation).

In the cystic-type mass (3 cases), a midabdominal echogenic cystic mass was demonstrated. The echogenic content resulted from infectious complication. In the sinus type, an echogenic, thickened, tubular omphalovesical tract (8–15 mm) was visualized. This tubular configuration results from the normal omphalovesical anatomy, as can be demonstrated by high-resolution US. With infection, the fascia surrounding the urachal remnants seems to limit the infection.

Differential diagnosis should include vesical duplications anomalies, dystrophic calcifications of the umbilical arteries remnants, and, in case of a solid mass, urachal carcinoma. Ultrasound should be part of the work-up of any suspected urachal or other midline anomaly.

Key words: Ultrasound, children — Ultrasound, urachus — Ultrasound, umbilical arteries.

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Omphalovesical midline anomalies are unusual congenital malformations. Among them, urachal patency anomalies are the most common; their various conventional radiologic appearances have been widely described [1–3]. The contribution of high-resolution ultrasound (US) to the differential diagnosis of these anomalies is illustrated in this report, not only in cases in which a definite midline mass is palpated but also in more subtle cases with isolated umbilical drainage.

Materials and Methods

We reviewed the diagnostic imaging studies and medical records of all patients with surgically proven midline omphalovesical anomalies who had undergone sonography as part of their work-up.

There were 9 such patients, ranging from 1 month to 5 years. Five were girls. Six had urachal patency, 1 had urachal carcinoma, 1 had umbilical artery calcification, and 1 had probable vesicourethral duplication.

All were studied with commercially available sonographic equipment using 5 and 7.5 MHz sector and linear array transducers.

Results

The clinical data, sonographic findings, and final outcome of the 9 patients are summarized in Table 1. In the patients with an urachal patency anomaly (cases 1–6), a plain film x-ray of the abdomen was performed in 5 and showed normal findings. A lateral x-ray study of the abdomen showed bulging of the suprapubic area in two (cases 1 and 2). A voiding cystourethrogram (VCUG) was performed in only 2 patients and it was normal in both (cases 2 and 3).

Table 1. Clinical data and US findings

Case	Sex	Age	Clinical and biological data	US findings	Surgical findings
1	F	4 yr	Infectious symptoms; midline suprapubic mass	Cystic echogenic mass, 65 × 45 mm (Fig. 1)	Infected urachal cyst
2	F	3 yr	Pain, temperature; 16,000 white blood cell counts	Cystic septate echogenic mass 87 × 35 mm	Infected urachal cyst
3	F	4 yr	Midabdominal suprapubic mass	Cystic echogenic tubular mass, 35 mm diameter (Fig. 2)	Infected urachal cyst/sinus
4	F	3 mo	Umbilical inflammation, thickening	Retroumbilical 15 mm mass; Thick (15 mm) diameter Omphalovesical (OV) tract	Infected urachal sinus with umbilical abscess
5	F	1 mo	Umbilical mass and drainage	Retroumbilical cyst Thick (15 mm) OV cord	Infected urachal sinus with umbilical cyst
6	M	2 mo	Umbilical mass and drainage	Retroumbilical mass Thick (8 mm) OV cord (Fig. 3)	Umbilical abscess with infected urachal sinus
7	M	2 yr	Rapidly growing suprapubic mass	12 cm solid pelviabdominal mass (Fig. 5)	Infiltrative adenocarcinoma of the urachus
8	M	4 mo	Umbilical thickening, no drainage	Normal OV channel Umbilical artery remnant calcifications (Fig. 6)	"Normal" urachus Umbilical artery calcifications
9	M	11 mo	Chronic suprapubic drainage Previous intervention for similar symptoms	2.5 cm anterior bladder wall mass No connections with umbilicus (Fig. 7)	Infected dorsal vesicourethral duplication

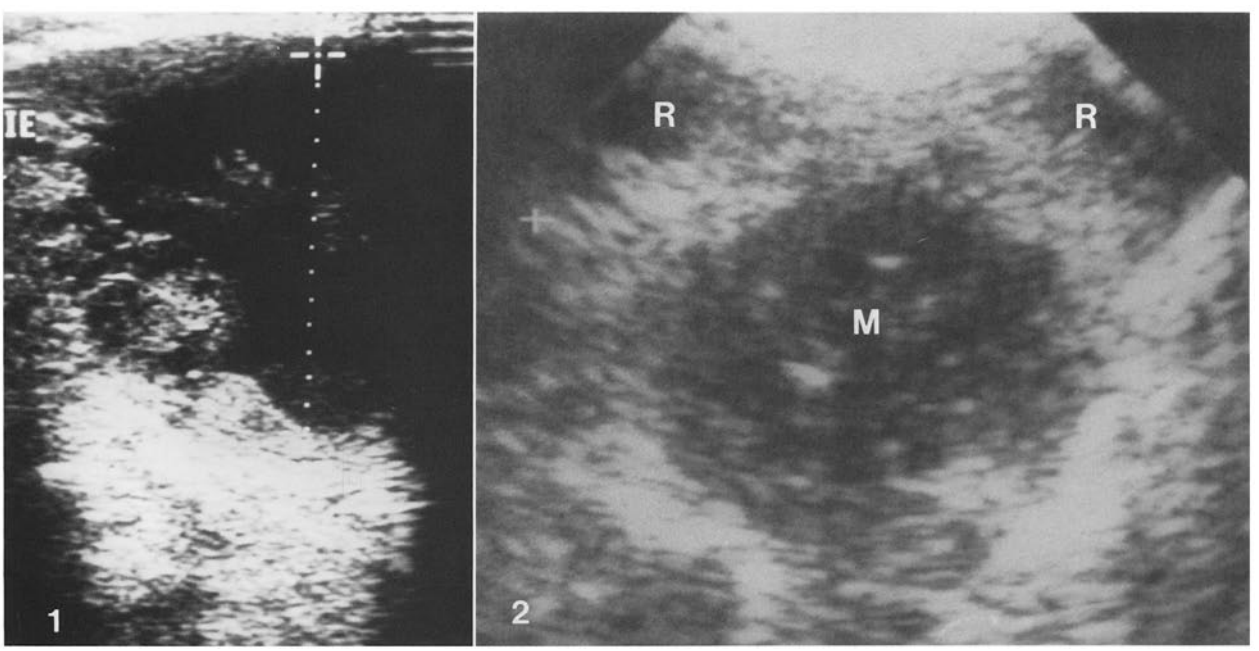

Fig. 1. *Case 1.* Infected urachal cyst. Transverse scan of the suprapubic area. A 4.5 cm cystic mass with echogenic debris is present.

Fig. 2. *Case 3.* Infected urachal cyst/sinus. Transverse suprapubic scan shows tubular echogenic mass (*M*) corresponding to infected urachal sinus. *R*, rectus sheath.

In case 7, an intravenous pyelogram (IVP) showed external compression of the ureters with hydronephrosis. Linear calcifications were demonstrated on the lateral x-ray study of the abdomen in case 8. The VCUG in this patient showed normal findings.

In case 9, the bladder wall mass was also demonstrated by a computed tomographic (CT) exam-

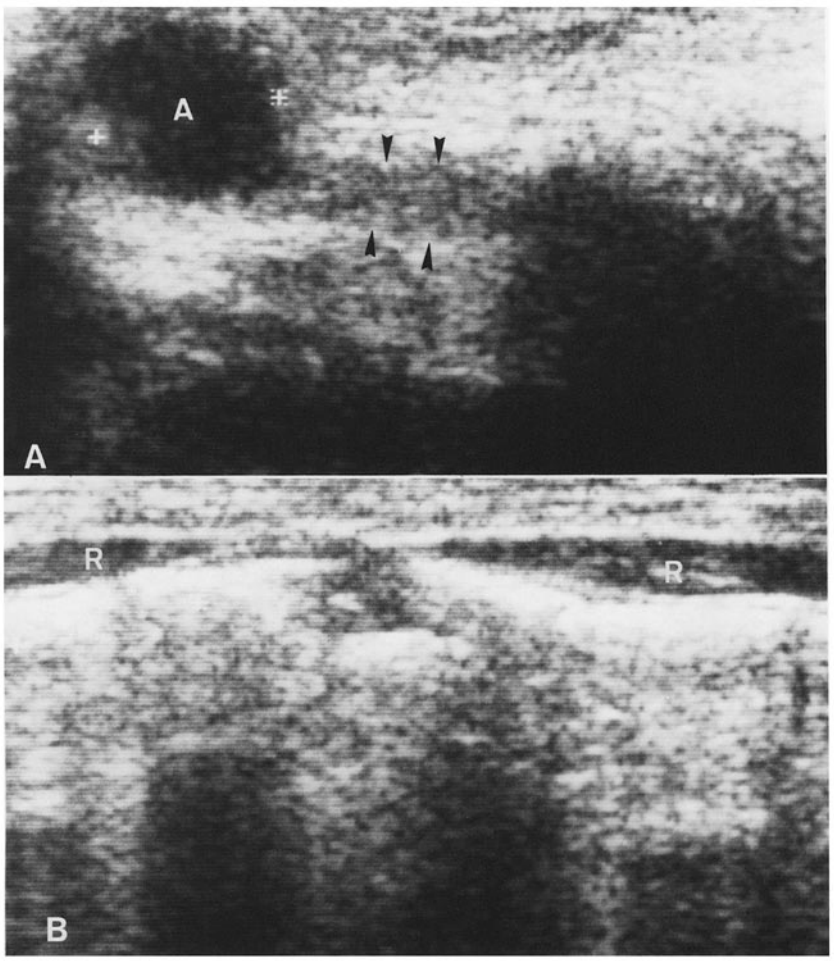

Fig. 3. *Case 6.* Infected urachal sinus with umbilical abscess. **A** Midline sagittal scan. *A,* umbilical abscess; *Arrowheads,* thickened omphalovesical (OV) tract. **B** Transverse scan. Thickened (8 mm) OV tract. *R,* rectus sheath.

ination (64–96 HU before and after contrast enhancement) (see Fig. 7B).

Discussion

Among omphalovesical anomalies, urachal malformations are the most common.

Some patency of the urachus is not uncommon and has been reported in as many as 1:1,000 autopsies. Symptomatic patency, however, seems to be rare, with fewer than 500 cases reported [4]. When it does occur, it usually presents in infants or children, but cases in adults have been reported [5]. An abdominal mass or umbilical drainage or both, as in most of our cases, are the usual presenting symptoms.

Urachal anomalies have been classified in 4 major groups [2]: the patent urachus, the urachal sinus (opening to the umbilicus), the urachal diverticulum (opening to the bladder), and the urachal cyst.

Until recently, the imaging evaluation of suspected urachal anomalies included some combination of fistulography IVP, and VCUG [1–3]; only cases with an opening to the umbilicus or to the bladder could be demonstrated preoperatively. Only a few cases with the sonographic diagnosis of a urachal cyst have been reported [3–5].

In our series, sonography helped to diagnose urachal patency in cases with both cystic-type and sinus-type (draining to the umbilicus) anomalies. Two sonographic patterns could be demonstrated: a cystic mass (Figs. 1, 2) or a less typical echogenic tract between the bladder and the umbilicus (Fig. 3). The "cystic mass" was seen in 3 (cases 1–3). Echogenic or septate contents in these cases corresponded to infectious complications (Figs. 1, 2).

Case 3 represents an intermediate form between the cystic and sinus "thick cord" type. The "thick cord" type was visualized in 3 patients (cases 4–6). It had a tubular appearance on transverse scans (Figs. 2, 3B). This is related to the normal anatomy of the omphalovesical tract, as can now be demonstrated by high-resolution sonography (Fig. 4). The urachus lies in the space of Retzius between the peritoneum and fascia transversalis. A fascial sheath, the umbilicovesical fascia, surrounds the urachus. This fascia extends to each umbilical artery and spreads inferiorly over the dome of the bladder [6]. There-

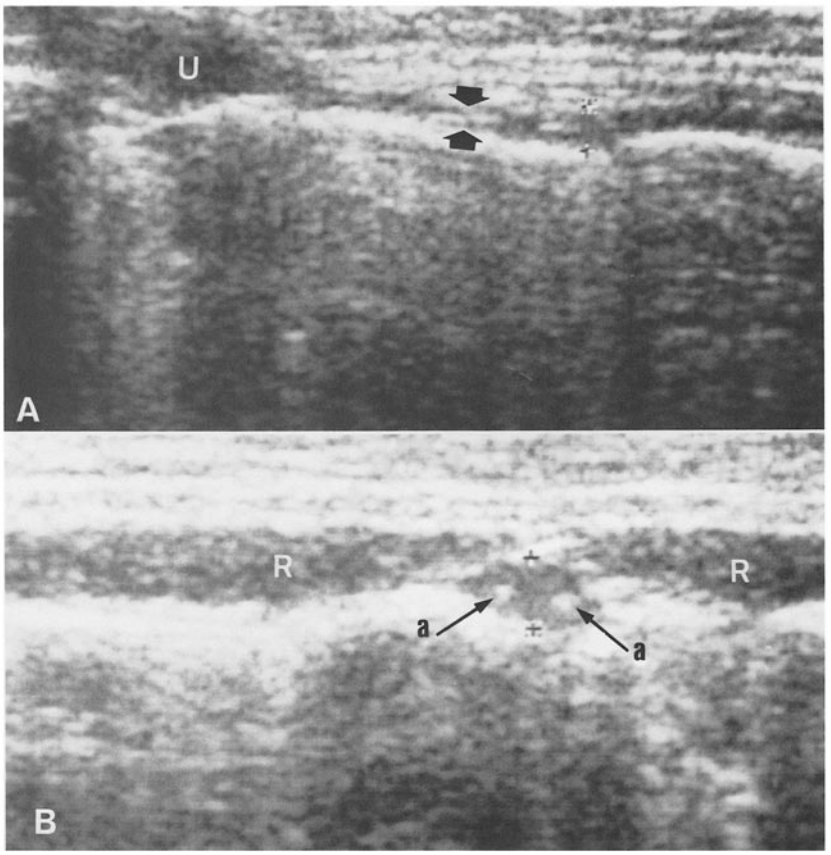

Fig. 4. "Normal" omphalovesical anatomy. **A** Sagittal scan. *U*, umbilicus; *Arrows*, periurachal space (3–4 mm diameter). **B** Transverse scan. *R*, rectus sheath Crosses, omphalovesical channel (4 mm diameter); *a*, umbilical artery remnants.

fore, on a sagittal scan (Fig. 4A), the omphalovesical channel containing the urachus can be visualized between the rectus sheath anteriorly and the peritoneum posteriorly. On a transverse scan, a tubular area (Fig. 4B) measuring approximately 3 mm in diameter can be visualized containing the hyperechoic umbilical artery remnants. With patency and infection of the urachus, a thickening of this channel occurs (8–15 mm diameter in our cases) leading to a tubular mass as observed in 4 patients (Figs. 2, 3). The spread of the infection is apparently limited by the various fascias laterally. As in 2 of our cases, the thick tract does not always reach the dome of the bladder. An umbilical mass may be associated with the thick cord, as in 3 of our cases, corresponding to a small localized abscess (Fig. 3).

Resection of the infected urachus is the usual treatment [4]. Resection of a cuff of the dome of the bladder is recommended to prevent secondary neoplastic degeneration [3, 4]. The differential diagnosis of anomalies of urachal patency is illustrated in our series by the last 3 cases. Urachal carcinoma is rare in children. Most cases occur in adults in their 50s and 60s. Only a few cases of benign mesenchynoma or hystiocytoma have been reported in children [3, 4]. In adults, these carcinomas appear to develop from the normal urachal epithelium and, therefore, as noted above, surgery should include a cuff of the dome of the bladder [7, 8].

Sonography is helpful because it can demonstrate a solid mass instead of the usual cystic (irregularly echogenic or septate if infected) mass (Fig. 5).

Dystrophic calcifications of the obliterated umbilical arteries have been reported in the pelvic portion of the arteries [9]. Our case is the first with calcifications seen in the anterior abdominal wall segment. The cause of these calcifications is unclear. There were no urachal anomalies on ultrasound; this was confirmed by pathologic examination (Fig. 6).

In the last case, with probable infected dorsal vesicourethral duplication [10], US demonstrated the mass in the bladder wall. A urachal malformation was excluded on the basis of the suprapubic drainage and the sonographically normal appearance of the omphalovesical channel (Fig. 7A).

The differential diagnosis should include large cystic pelviabdominal masses, such as an ovarian or mesenteric cyst. The anterior and midline presentation of the anomaly makes the diagnosis of

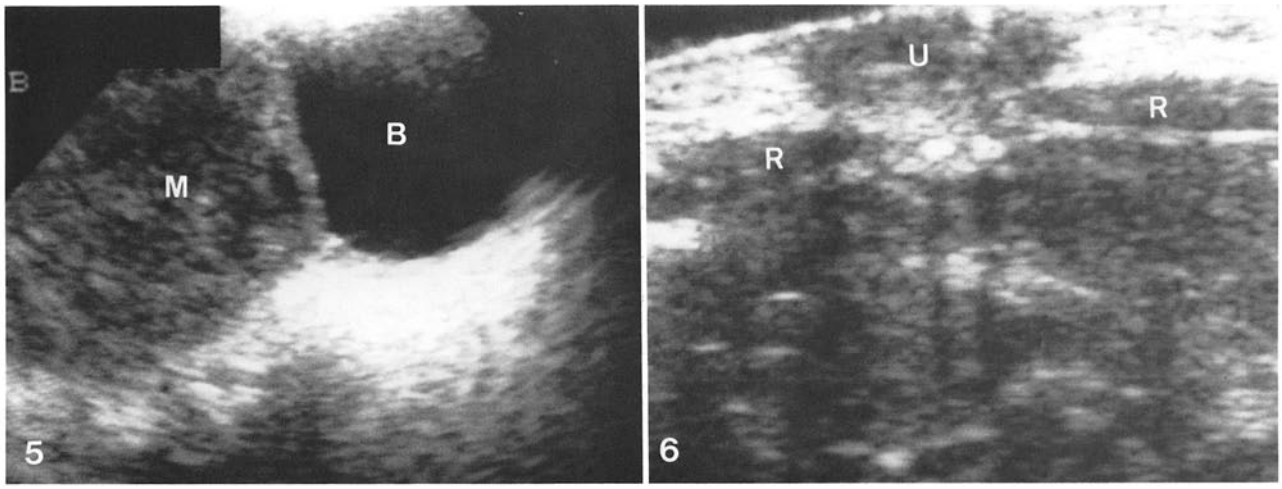

Fig. 5. *Case 7.* Urachal carcinoma. Right parasagittal scan shows 12 cm solid mass (*M*). *B*, bladder (courtesy of O. Michel, MD, Tours).

Fig. 6. *Case 8.* Calcification of umbilical arteries. Transverse scan at the level of the umbilicus. Echogenic dots with acoustic shadowing correspond to the calcifications (compare with Fig. 4B, where no acoustic shadowing is present). *U*, umbilicus; *R*, rectus sheath.

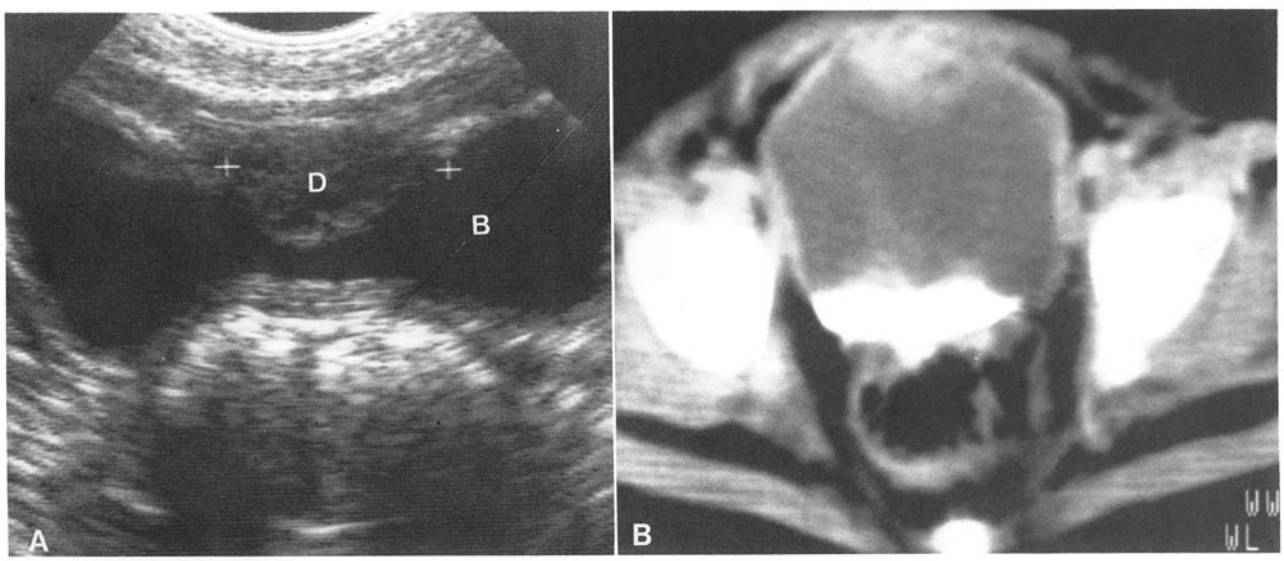

Fig. 7. *Case 9.* Probable dorsal vesicourethral duplication. **A** Transverse scan of the bladder. B, bladder; D, duplication. Distance between crosses: 25 mm. **B** Contrast-enhanced CT scan. Heterogenous mass is present (96 HU) in the anterior bladder wall.

urachal patency most probable. When the mass is limited to the umbilicus, differentiating between an omphalomesentric malformation or omphalitis may not be possible.

In addition to sonography, VCUG should be performed in all patients with suspected omphalovesical anomalies in order to rule out bladder outlet obstruction [1, 6]. The use of fistulography should be limited to cases usually associated with patent urachus (*i.e.*, prune belly syndrome) [3].

The use of CT should usually be reserved for cases with a solid mass, to assess extra extension [7, 8] (Fig. 7B).

In conclusion, because of the ease with which it can demonstrate local anatomy, high-resolution US should be part of the initial evaluation of patients with suspected urachal or other midline anomalies. It is most helpful in demonstrating not only midline masses but also thickened omphalovesical tracts.

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