The differential diagnosis of umbilical polyps and granulomas in children: sonographic and pathologic correlation

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Introduction

An umbilical polyp is a rare form of omphalomesenteric duct (OMD) remnant consisting of intestinal mucosa at the umbilicus [1-6] and are occasionally associated with other OMD anomalies [2, 6-8]. The lesion does not regress with the application of silver nitrate and should be surgically excised due to the possibility of an associated underlying OMD remnant such as Meckel’s diverticulum, fistula, sinus tract, omphalomesenteric duct (OMD) cyst, or obliterated duct (fibrous cord) [2, 3, 6, 9]. The clinical outcomes of umbilical polyps vary from the trivial to severe. So, accurate diagnosis is important, according to treatment.

An umbilical granuloma is caused by incomplete epithelialization of the umbilical ring. Granulation tissue can overgrow and lead to an umbilical granuloma. Umbilical granulomas can be treated with one or two applications of silver nitrate. If the granuloma is too large or treatment with silver nitrate fails, it may need to be excised [2, 10-13].

Although both lesions are common umbilical lesions and present similar clinical manifestations with small discharging reddish umbilical nodules in children, they require different treatments [14, 15]. Therefore, differential diagnosis is important to determine the appropriate treatment.

Ultrasound (US) is the imaging technique initially used to evaluate umbilical lesions. US is easily accessible without sedation or radiation exposure to children and provides superior near-field resolution especially for superficial soft tissue lesions. The US characteristics of umbilical granulomas or umbilical polyps have been described in a few previous studies [3, 11, 16]. However, to our knowledge, there have been no investigations for differential diagnosis of umbilical granulomas and umbilical polyps.

The aim of this study was to identify US features that helped to differentiate umbilical polyps and granulomas based on their correlation with pathologic findings.
Materials and Methods

Study population

Institutional Review Board approval was obtained for this retrospective study and the requirement for informed consent was waived.

We collected 215 confirmed cases of umbilical masses by searching the pathology database for completed reports from 2010 to 2019 at our institution. There were 137 cases of pediatric umbilical masses, consisting of fifteen omphalomesenteric duct remnants (including nine umbilical polyps), fifty-two umbilical granulomas, and others, including forty-six umbilical hernias, eleven epidermoid cysts, six urachal remnants, and one hemangioma.

This study included umbilical polyps and umbilical granulomas which underwent both preoperative ultrasonography and surgery with pathologic confirm. Ultimately, twenty-two children (mean age, 11.8 months; range, 0.6 months to 108 months; seventeen boys and five girls) were enrolled in this study.

US image analysis

The US examinations were performed using a high-frequency (12 - 15 MHz) linear probe. Serial transverse and longitudinal US images of the lesions were evaluated. The US images were retrospectively reviewed by two radiologists who reached a consensus about the images (H.J.L. and D.H.K.; 32 and 2 years’ experience, respectively). Both were blinded to the pathology reports.

The following umbilical mass sonographic findings were evaluated: (1) size, (2) depth of the lesion (superficial vs. deep), (3) content (cyst, solid or complex), (4) internal echogenicity (anechoic, hypoechoic, isoechoic or hyperechoic), (5) intralesional vascularity (hypervascular or hypo-/avascular), and (6) unobliterated medial umbilical ligament (MUL) (present or absent). The size was measured as the largest diameter of three dimensions (length, width,
and height). The depth of the mass was classified as superficial when the most superficial portion of the nodule was abutted by an epidermis of the umbilicus and as deep when it was not. A complex mass was defined as the combination of a cyst and a solid lesion. The level of internal echogenicity was determined by comparison with that of the adjacent muscle. The unobliterated MUL was defined as the presence of an echogenic mucosal line (Fig. 1).

Pathologic analysis

The histologic analysis was performed using hematoxylin and eosin staining. Histologically, umbilical polyps are characterized by glandular structures lined by ectopic intestinal mucosa. Umbilical granulomas predominantly consist of fibroblasts, abundant small vessels, endothelial and inflammatory cells without neural elements. The specimens were retrospectively reviewed by one pathologist (H.R.J.; 18 years’ experience).

Statistics

Statistical analyses were performed using commercial software (SPSS ver. 25.0 for Windows, IBM Corp., Armonk, NY, USA). To compare the US findings between umbilical granulomas and umbilical polyps, the Mann-Whitney test was used for continuous variables and Fisher’s exact test was used for categorical variables. P-values of < 0.05 were considered to indicate statistical significance.

Results

The demographic and US characteristics of the umbilical polyps and umbilical granulomas are summarized in Table 1.

Eight children (mean age, 30.13 months; range, 2 to 108 months; four boys and four girls) were diagnosed as having an umbilical polyp and fourteen children (mean age, 1.33 months;
range 0.6 to 3 months; thirteen boys and one girl) as having an umbilical granulomas. The patients with umbilical granulomas were significantly younger than the patients with umbilical polyps \((p < 0.001)\). Umbilical granulomas predominantly involved males (92.3%) with a statistical difference \((p = 0.039)\).

The mean size of the umbilical polyps was larger \((10.25 \pm 10.11 \text{ mm})\) than the umbilical granulomas \((6.21 \pm 2.293 \text{ mm})\) but there was no statistical difference \((p = 0.33)\).

The location of the masses was deep in six (75%) of the umbilical polyps, whereas it was superficial in thirteen (92.9%) of the umbilical granulomas, which was statistically different \((p = 0.002)\).

The contents of the masses were cystic in five (62.5%) of the umbilical polyps, whereas it was solid in thirteen (92.9%) of the umbilical granulomas, which were statistically different \((p < 0.01)\). All cystic umbilical polyps revealed echogenic inner walls and the cyst wall was associated with intestinal mucosa, including two colon mucosa (Fig. 2), two small intestinal mucosa, and one ectopic pancreatic epithelium (Fig. 3) on pathologic findings. The three (37.5%) solid umbilical polyps contained one gastric mucosa (Fig. 4) and two fibroepithelial mucosa on pathologic findings.

The echogenicity of the masses was variable in the umbilical polyps, whereas eleven (78.6%) umbilical granulomas showed hypoechogeticity. The findings were statistically different \((p < 0.001)\).

Fourteen patients underwent color Doppler US. Five (83.3%) of six umbilical polyps showed hypo-/avascularity, whereas seven (87.5%) of the eight umbilical granulomas revealed hypervascularity. There was a significant difference in intrallesional vascularity \((p = 0.026)\). The pathologic findings revealed abundant vessels from the base of the umbilical granuloma (Fig. 5).

Seven (87.5%) umbilical polyps and eight (57.1%) umbilical granulomas demonstrated an
Discussion

The umbilicus is associated with the embryologic development of the gastrointestinal tract, urinary tract [3, 9, 16], and umbilical vessels (Fig. 6). Major umbilical masses in the pediatric population consist of OMD remnants, umbilical granuloma, umbilical hernia, urachal remnants, or benign soft tissue masses, such as epidermoid cysts, hemangiomas, or other benign soft tissue tumors [2]. The pathologically confirmed pediatric umbilical masses in our institution during the study period included, in frequency order, fifty-two umbilical granulomas, forty-six umbilical hernias, fifteen OMD remnants (including nine umbilical polyps), eleven epidermoid cysts, six urachal remnants, and one hemangioma.

As the placental circulation increases in the 5th to 9th week of gestation, the OMD usually regresses [3, 16]. However, a remnant is retained in approximately 1% to 4% of infants [3, 5, 10, 16], making it the most common congenital gastrointestinal anomaly of the umbilicus. Discrimination for umbilical polyp and OMD cyst is needed. An umbilical polyp occurs when the OMD mucosa grows outward, associating with the gastric epithelium, small intestinal, colonic, and even islands of pancreatic tissue [4, 5, 7, 9, 16, 17]. On the other hand, an OMD cyst is formed when an intermediate portion of the duct retains patent, but both ends are sealed. Both can appear as a bright red nodule at the umbilicus with secretions; any such lesion is often clinically referred to as an “umbilical polyp”, but an OMD cyst has a fluid-filled lumen with grossly cystic appearance. The histology of umbilical polyps and OMD cysts is the same, showing a lining of cuboidal or columnar epithelium with gastrointestinal differentiation [7, 9]. Reflecting this, the definition of “umbilical polyp” we studied includes the concept of umbilical polyp and OMD cyst. In this study, five umbilical polyps
demonstrated colon, small bowel, and pancreatic tissue. All these lesions revealed a cystic content surrounded by echogenic walls, suggesting secretion from the inner mucosa on pathologic correlation. Three umbilical polyps revealed stomach and fibroepithelial polyps without cyst formation.

The association of umbilical polyps with other OMD remnants and the necessity for surgical exploration is controversial. Kutin et al. [6] cited a 56% positive yield for internal OMD remnants in patients with cutaneous umbilical polyps. They recommend mini-laparotomies in all cases of umbilical polyps. This is because the underlying anomalies can lead to serious complications, including occult bleeding, intestinal obstruction, and abdominal masses. However, a recent review by Pacilli et al. [18] suggested the opposite. In their study, thirteen children underwent surgical resections of umbilical polyps and six children were suspected of having underlying OMD abnormalities. However, no abnormality was found after abdominal exploration. In addition, the remaining seven children who did not undergo intraperitoneal exploration had no symptoms after 5.8 years of follow-up. Therefore, the authors suggested that abdominal exploration may not be necessary because the polyp may exist alone in the absence of other abnormalities. None of the umbilical polyps in our study were associated with internal OMD remnants seen on surgery.

The major differential diagnosis includes umbilical granuloma [8, 12, 13, 18]. When the fibromuscular ring of the umbilicus closes and the umbilical cord sloughs, the ring is covered anteriorly by skin and posteriorly by peritoneum. After cord detachment, there may be incomplete epithelialization on the ring and beefy red granulation tissue is visible after the first few weeks of life [2]. Most of the umbilical granulomas in this study abutted the skin (93%) and sonographic features can identify the superficial location of the umbilical granuloma. Granulation tissue formation is a normal stage in wound healing and represents endothelial cell division and migration to form a rich bed of new capillaries [2, 13, 14]. These
pathologic findings correlated with the sonographic findings of hypervascular solid nodules in our study, whereas most (83.3%) of umbilical polyps revealed hypo- or avascularity. The location of the masses was also helpful for differential diagnosis of the two lesions. In most (92.9%) cases, umbilical granulomas were superficially located, but umbilical polyps were usually (75%) located deep. Small amounts of serous or serosanguinuous discharge may develop in both umbilical granulomas and polyps. The secretion may be caused by unobliterated MUL in umbilical granulomas and by lining intestinal mucosa in umbilical polyps. Although there was no statistical correlation, umbilical polyps demonstrated more frequently obliteration of MUL. The reason may be associated with older age of the patients. The age of the patients was also an important factor. Umbilical granulomas occurred in patients younger than those who had umbilical polyps. Also, umbilical granulomas predominantly involved male infants, with a statistical difference.

Other differential diagnosis of reddish lesions in the umbilicus and proximal umbilical cord includes urachal cysts [12, 19]. These result from the incomplete regression of the allantoic duct (urachus), a second ductal structure in the cord that connects to the embryonic bladder [1, 4, 15]. Urachal remnants are less common than OMD remnants and are usually lined by a single layer of flattened epithelium. They typically present as an infra-umbilical or suprapubic mass, but occasionally can occur as a red papule at the umbilicus. If located in the proximal umbilical cord, urachal cysts can cause an enlarged/giant cord and are positioned at the inferior surface between the umbilical arteries. A urachal cyst near the umbilicus is rare and may represent an associated sinus or fistula tract along the course of the urachus.

Epidermoid cysts represent another differential diagnosis. Epidermoid cysts can contain keratin and desquamated squamous cells. The sonographic findings have been reported as onion skin-like or a target appearance, with varying internal echogenicity. Rarely, does it present with a cystic appearance as in umbilical polyps or the hypervascularity seen in
umbilical granulomas [20].

In conclusion, umbilical polyps revealed deep-seated, hypovascular nodules with cyst formation surrounded by thick echogenic walls. In contrast, umbilical granulomas revealed superficially located hypervascular solid nodules in young infants.
References


13. Fahmy M. Umbilicus and umbilical cord. Springer, 2018


Table 1. Demographic and ultrasound features of umbilical polyps and umbilical granulomas

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Umbilical polyps</th>
<th>Umbilical granulomas</th>
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<tr>
<td>Total</td>
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<tr>
<td>Age (month)</td>
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<td>Sex</td>
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<td>13</td>
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</tr>
<tr>
<td>Female</td>
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<td>1</td>
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<tr>
<td>Size (mm)</td>
<td>10.25±10.11</td>
<td>6.21±2.293</td>
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<td>Depth</td>
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<tr>
<td>Superficial</td>
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<tr>
<td>Deep</td>
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<tr>
<td>Content</td>
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<tr>
<td>Cyst</td>
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<tr>
<td>Solid</td>
<td>3 (37.5)</td>
<td>13 (92.9)</td>
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<tr>
<td>Complex</td>
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<tr>
<td>Unobliterated medial umbilical ligament (MUL)</td>
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<td>6 (42.9)</td>
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<tr>
<td>Absent</td>
<td>7 (87.5)</td>
<td>8 (57.1)</td>
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Fig. 1. Status of the medial umbilical ligament A. The unobliterated medial umbilical ligament is defined by the presence of echogenic mucosal lines (arrows) along the course of both medial umbilical ligaments. B. The image reveals a completely obliterated medial umbilical ligament without echogenic mucosal lines.
Fig. 2. An umbilical polyp in a 3-month-old boy. A. Transverse ultrasonography shows a 5-mm-sized cystic lesion with an echogenic inner wall. The lesion shows deep-seated location (arrows) without abutting the epidermis. B. Transverse color Doppler ultrasonography shows hypovascularity of the lesion. C. The pathologic findings show a cyst surrounded by abundant inflammatory cells and a detached intestinal epithelial component (arrow) (hematoxylin and eosin stain, x 40).
Fig. 3. An umbilical polyp in a 15-month-old boy A, B. Transverse (A) and longitudinal (B) ultrasonography show a 35-mm-sized, deep-seated, cystic lesion with an echogenic inner wall. C. The pathologic finding reveals cystic space (asterisk). Also, the specimen contains ectopic pancreatic tissues (arrows) (hematoxylin and eosin stain, x 12.5).
Fig. 4. An umbilical polyp in an 11-month-old girl A. Transverse ultrasonography shows an 8-mm-sized, superficially located, hyperechoic solid lesion. B. The pathologic findings show glandular structures lined by columnar epithelium (arrow) with apical mucinous globules. This structure resembles gastric mucosal structure (hematoxylin and eosin stain, x 40).
Fig. 5. An umbilical granuloma in a 1-month-old boy. A. Transverse ultrasonography shows a 9.5-mm-sized, hypoechoic solid lesion. The lesion shows superficial location (arrow) with abutting the epidermis. B. Transverse color Doppler ultrasonography shows hypervascularity of the lesion. C. Transverse ultrasonography shows presence of echogenic spots (arrows) along the course of both medial umbilical ligaments. D. The pathologic findings show rich vascular structures (arrows) with surrounding fibrous tissues, correlating well with the sonographic findings (hematoxylin and eosin stain, x 12.5).
Fig. 6. The illustration of the anatomy of the umbilicus.