Sonography of Wrist Ganglion Cysts

Variable and Noncystic Appearances

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Objective. In our clinical practice, we have noted wrist ganglion cysts that do not fulfill the criteria for simple cysts. This study retrospectively evaluated the sonographic features of wrist ganglia. ***Methods.*** After Institutional Review Board approval, medical records from 1993 through 2003 were searched using *International Classification of Diseases, Ninth Revision* codes and key words, and sonography log books from 2000 through 2004 were reviewed, which identified 20 wrist ganglion cysts in 16 patients that were proven at surgery or aspiration. A retrospective review of sonographic images was carried out by 2 musculoskeletal radiologists by consensus. Images were evaluated for cyst location, volume, largest dimension, joint or tendon extension, echogenicity, septations, internal echogenicity, posterior acoustic enhancement, margins, lobularity, and vascularity. ***Results.*** Of the 20 wrist ganglia, 15 were volar (10 between the flexor carpi radialis and the radial artery), and 5 were dorsal (2 over the scapholunate ligament). The mean volume was 2081 mm^3 (range, 90–15,000 mm^3), and the mean largest dimension was 17.3 mm (range, 7–30 mm). Seven volar ganglia showed joint communication. Ten ganglia were anechoic; 7 were hypoechoic; and 3 had anechoic and hypoechoic areas. Eight had septations; 8 had internal echogenic areas; 15 had posterior acoustic enhancement; 13 had well-defined margins; 12 were lobular; and none were vascular. Cysts that were anechoic ($P < .0001$) or with posterior acoustic enhancement ($P = .04$) were significantly larger than those that were hypoechoic or without posterior acoustic enhancement. ***Conclusions.*** Small wrist ganglion cysts (≤10 mm in the mean largest dimension) often appear hypoechoic without posterior acoustic enhancement and do not fulfill the criteria for a simple cyst. ***Key words:*** cyst; ganglion; sonography; wrist.

Sonography is an effective imaging method for evaluating a palpable soft tissue abnormality. Although sonography can often characterize and localize a palpable abnormality, the strength of sonography lies in its ability to differentiate a solid mass from a cyst; this is critical because the differential diagnosis for a solid mass typically includes malignant tumors. In the wrist, most masses are benign, with the most common palpable mass being a ganglion cyst.[1]

A simple cyst on sonography has been described as anechoic with a thin, almost imperceptible wall, a well-defined far wall, and posterior acoustic enhancement.[2] With regard to ganglion cysts of the wrist, their sonographic appearance has predominantly been described as anechoic, oval, round, or lobulated.[3–5] Noncompressibility and possible joint extension are other sonographic features of ganglion cysts of the wrist.[1,4] Ganglion cysts of the

Received April 9, 2007, from the Departments of Radiology (G.W., J.A.J., G.G., E.M.C., C.B.) and Radiation Oncology (F.Y.F.), University of Michigan, Ann Arbor, Michigan USA. Revision requested April 13, 2007. Revised manuscript accepted for publication May 17, 2007.

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ankle have also been described as predominantly anechoic, with consistent posterior acoustic enhancement.[6]

In our clinical practice, we have noted wrist ganglion cysts with variable echogenicity and a lack of posterior acoustic enhancement, at times simulating solid hypoechoic masses. The purpose of this study was to retrospectively characterize the sonographic appearances of wrist ganglion cysts.

Materials and Methods

Study Population

Institutional Review Board approval was obtained before initiation of this retrospective study, and informed consent was waived. A search of the radiology information system was conducted for all sonographic examination reports generated between September 30, 1993, and September 30, 2003, identifying those reports containing the word "ganglion" or "ganglia." In addition, medical records were searched over the same period using the *International Classification of Diseases, Ninth Revision* code for "ganglion." This search yielded 384 reports. Medical records were reviewed to limit cases to those with a ganglion cyst of the wrist proven at surgery or percutaneous aspiration. From these 2 databases, 14 examinations were included. Six additional examinations meeting these criteria were added after a review of the musculoskeletal sonography logbook (where pertinent findings are handwritten at completion of the sonographic examination) from January 2000 to September 2004.

Sonographic Technique

Sonographic examinations of the wrist were performed by 1 of 7 musculoskeletal radiologists, all with musculoskeletal sonography experience (3–12 years of experience). Because of the retrospective nature of this study, sonographic examinations were performed with 7- to 15-MHz transducers (HDI 5000, Philips Medical Systems, Bothell, WA; and LOGIQ 9 and 700, GE Healthcare, Milwaukee, WI). The use of spatial compounding depended on the sonography machine and was at the discretion of the individual performing the sonographic examination. Ample transmission gel was used in the place of a standoff pad. Images were acquired and saved in digital or hard copy format.

Sonographic Image Review

Sonographic images from the 20 examinations were retrospectively reviewed by 2 musculoskeletal radiologists (with 4 and 12 years of musculoskeletal sonography experience, respectively) with agreement by consensus. Sonography reports were available at the time of retrospective review, and hard copy sonographic images were reviewed when the images were not available in digital format. The following sonographic data were collected by consensus: cyst location (volar or dorsal), joint capsule extension (visible contact between the cyst and the joint capsule), volume (cubic millimeters), largest dimension (millimeters), echogenicity (anechoic, hypoechoic, isoechoic, or mixed echogenicity compared with adjacent soft tissues), septations, focal internal echogenic areas, posterior acoustic enhancement, margins (well defined or poorly defined), lobularity, and vascularity on color or power Doppler imaging.

Statistical Analysis

Recorded data from the sonographic images were compared by the Student *t* test and Fisher exact test to determine significant differences and associations.

Results

Demographics

The 20 sonographic examinations of the wrist were from 16 patients, and the cysts were proven at surgery (17) or aspiration (3). The average age of the patients was 36 years (range, 6 months–64 years); 8 were male, and 12 were female. The left wrist was involved in 6 (30%) of 20 cases, and the right wrist was involved in 14 (70%).

Location

Of the 20 wrist ganglia, 15 (75%) were volar, with 10 of these located between the flexor carpi radialis and the radial artery (Figures 1–5), 2 at the ulnocarpal joint, 2 along the flexor carpi ulnaris, and 1 in the carpal tunnel. Ganglion cysts were located dorsally in 5 (25%) of 20 cases, with 2 of

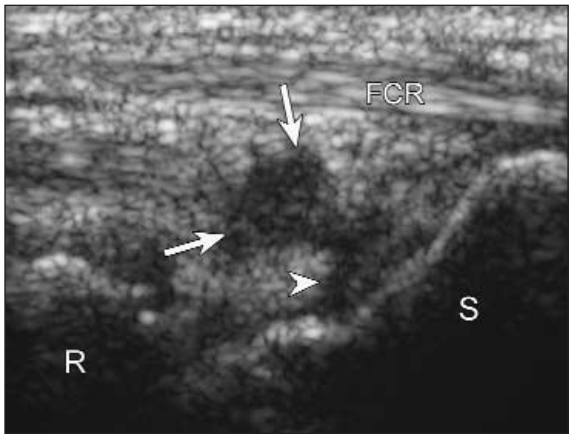


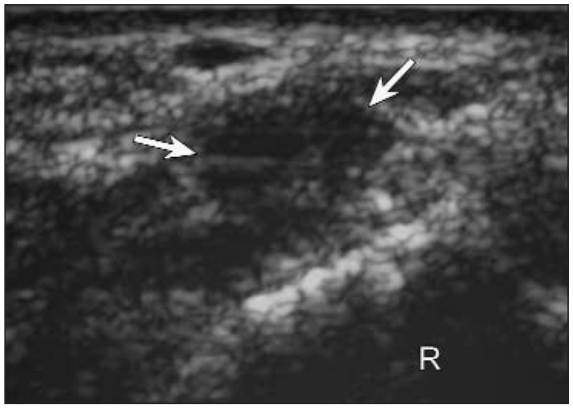
Figure 1. Volar ganglion cyst in a 29-year-old woman. Sagittal sonography shows a 7-mm hypoechoic ganglion cyst (arrows) without posterior acoustic enhancement. Note the poorly defined margins and radiocarpal joint extension (arrowhead). FCR indicates flexor carpi radialis tendon; R, radius; and S, scaphoid.

these overlying the scapholunate ligament (Figure 6) and 1 each adjacent to the extensor carpi radialis (Figure 7), scaphoid, and extensor carpi ulnaris. Joint extension was noted in 7 (35%) of 20 cases, with 5 extending to the radiocarpal joint (Figure 1) and 2 extending to the ulnocarpal joint, each confirmed at surgery.

Ganglion Size

The ganglia ranged in size from 90 to 15,000 mm^3 in volume, with a mean volume of 2081 mm^3. The largest cyst dimension ranged from 7 to 30 mm, with a mean largest dimension of 17.3 mm.

Figure 2. Volar ganglion cyst in a 42-year-old woman. Sagittal sonography shows a 6-mm hypoechoic ganglion cyst (arrows) without posterior acoustic enhancement. Note the internal echoes and poorly defined margins. R indicates radius.



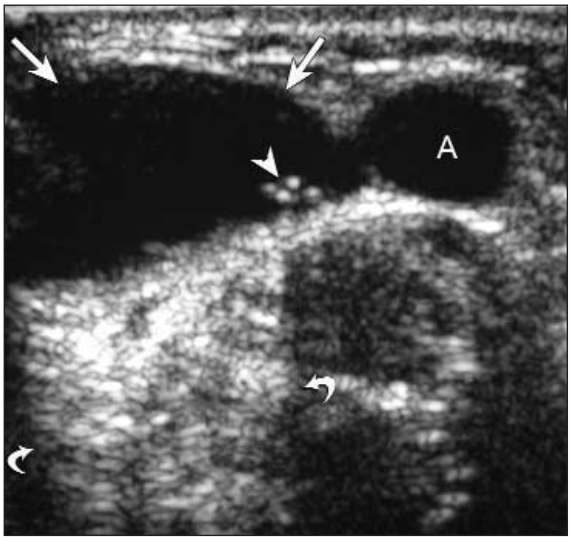
Sonographic Characteristics

With regard to echogenicity, 10 (50%) of 20 cysts were anechoic (Figures 3–7); 7 (35%) were hypoechoic (Figures 1 and 2); and 3 (15%) were mixed anechoic and hypoechoic. With regard to margins, 16 (80%) of 20 were well defined (Figure 3), and 4 (20%) were poorly defined (Figure 2). With regard to lobulations, 17 (85%) of 20 were multilobular (Figure 5), with the number of lobulations ranging from 2 to 10. Eight (40%) of 20 had internal septations (Figure 5); 8 (40%) had foci of internal echogenicity (Figure 3); and 15 (75%) showed posterior acoustic enhancement (Figure 3). In 11 of the 20 examinations, color or power Doppler imaging was performed. None of the ganglia showed color or power Doppler flow.

Statistical Analysis

With regard to cyst echogenicity, anechoic ganglion cysts had a mean volume of 2948.4 mm^3, a mean largest dimension of 21.46 mm, and an average of 3.53 lobulations; hypoechoic cysts had a mean volume of 468.86 mm^3, a mean largest dimension of 9.57 mm, and an average of 0.86 lobulations. There were significant differences in cyst size (volume, $P = .0411$; largest dimension, $P = .0002$), lobulations ($P = .0355$), and cyst echogenicity; anechoic cysts were larger

Figure 3. Volar ganglion cyst in a 6-month-old. Sagittal sonography shows a 29-mm anechoic ganglion cyst (arrows) with posterior acoustic enhancement (curved arrows). Note the lobular well-defined border and internal echoes (arrowhead). A indicates radial artery.



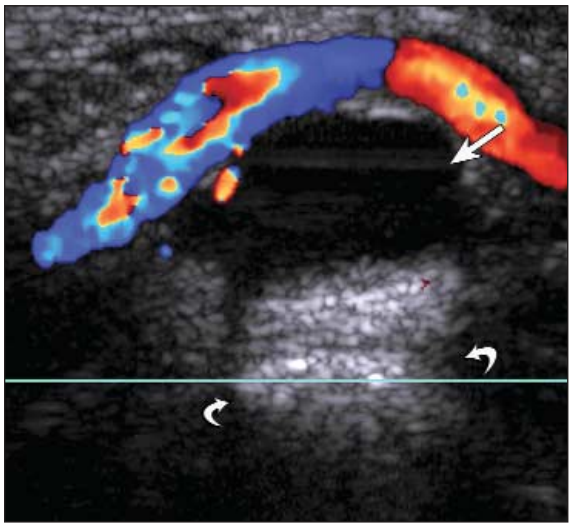


Figure 4. Volar ganglion cyst in a 36-year-old man. Sagittal sonography shows a 14-mm anechoic ganglion cyst (arrow) with posterior acoustic enhancement (curved arrows). Note the well-defined border and displacement of the radial artery.

with more lobulations (Figures 3 and 7). All hypoechoic ganglion cysts (7/7) measured 10 mm or less in the mean largest dimension (Figures 1 and 2).

With regard to posterior acoustic enhancement, ganglion cysts with posterior acoustic enhancement had a mean volume of 2707 mm^3 and a mean largest dimension of 20.4 mm, whereas those cysts without acoustic enhancement had a mean volume of 198 mm^3 and a mean largest dimension of 8 mm. There was a significant difference in cyst size (volume, $P < .0001$; largest dimension, $P = .018$) for those with and without posterior acoustic enhancement; larger cysts showed posterior acoustic enhancement (Figures 3 and 7). All 5 ganglion cysts that did not show posterior acoustic enhancement measured 10 mm or less in the mean largest dimension (Figures 1 and 2).

With regard to internal hyperechoic foci, ganglion cysts without internal echoes had a mean largest dimension of 20.33 mm and an average of 3.7 lobulations, whereas those cysts with internal echogenic foci had a mean largest dimension of 12.75 mm and an average of 1.0 lobulation. There were significant differences in cyst size (largest dimension, $P = .0312$) and lobulations ($P = .0298$) for those with and without internal echogenic foci; cysts with internal echogenic foci were smaller and had fewer lobulations.

With regard to cyst margins, there was a significant association between echogenicity and margins ($P = .0223$); anechoic masses were more likely well defined, whereas hypoechoic masses were more likely poorly defined (Figures 1 and 2).

Discussion

Ganglion cysts are the most common (50%–70%) soft tissue masses of the wrist and are composed of mucoid material surrounded by fibrous tissue without a synovial lining.[1] The etiology of ganglion cysts is unclear, although prior trauma,

Figure 5. Volar ganglion cyst in a 43-year-old woman. Sagittal sonography shows a 15-mm anechoic ganglion cyst (arrows) with posterior acoustic enhancement (curved arrows). Note the lobular margins and septations.

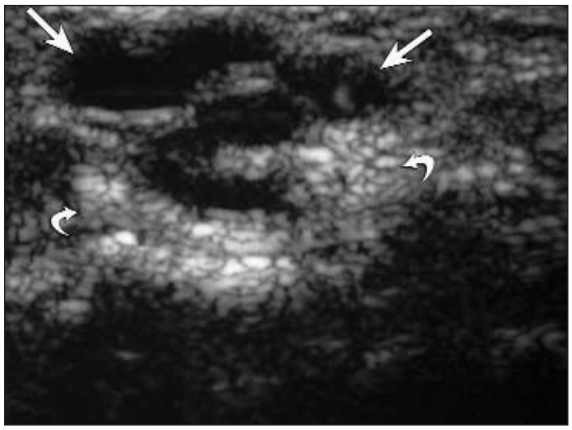
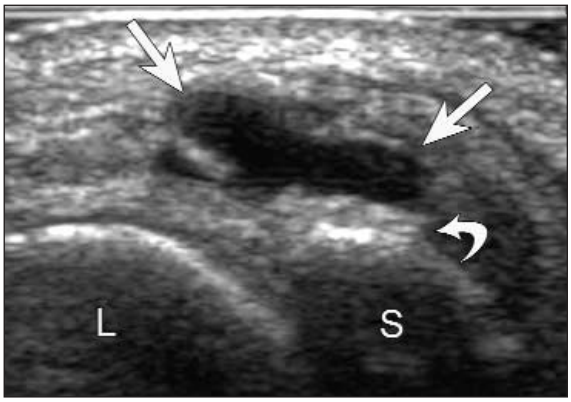


Figure 6. Dorsal ganglion cyst in a 37-year-old woman. Sagittal sonography shows a 10-mm anechoic ganglion cyst (arrows) with posterior acoustic enhancement (curved arrow). Note the lobular and well-defined border with septations. L indicates lunate; and S, scaphoid.

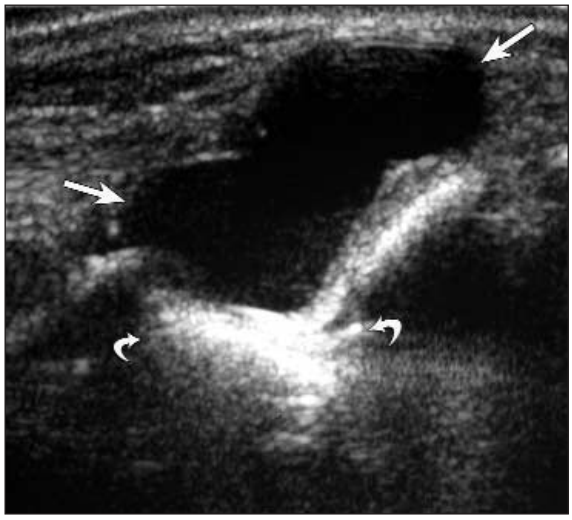


synovial herniation, internal derangement, and a degenerative process associated with mucin production are possible.[1,3,7] Wrist ganglion cysts may connect to an adjacent joint in up to 70% of cases and are more common in women.[1,3]

The results of this study show that ganglion cysts of the wrist may have a variable appearance on sonography. Although 50% were anechoic and 75% had posterior acoustic enhancement typical of a simple cyst, many wrist ganglion cysts do not fulfill the criteria for a simple cyst (Figures 1 and 2). All ganglion cysts that were hypoechoic without posterior acoustic enhancement measured 10 mm or less in the mean largest dimension. Internal echogenic foci were also more common in small ganglion cysts. The larger the ganglion cyst, the more likely it will appear anechoic with posterior acoustic enhancement (Figures 3 and 7). Larger ganglion cysts more likely had well-defined borders and multiple lobulations.

Other variable sonographic features of ganglion cysts of the wrist include the presence of lobulations, defined margins, internal echoes, and septations. In general, larger ganglion cysts tended to have more lobulations. This may be related to sequential growth and chronicity of a ganglion cyst. We could not directly correlate sonographic findings with cyst chronicity given the retrospective nature of this study. In addition, larger ganglion cysts were more often well defined, possibly because of the higher likelihood of such larger ganglion cysts being anechoic. Although 40% of wrist ganglion cysts had internal echoes, and 40% had septations, there was no statistical significance between these features and other sonographic findings. Both internal echoes and septations could be related to prior trauma; septations may also contribute to the lobular appearance of some ganglion cysts. None of the ganglion cysts with available color or power Doppler imaging showed increased flow. Joint communication via a neck was identified at sonography in 35% of cases.

Figure 7. Dorsal ganglion cyst in a 32-year-old woman. Sagittal sonography shows a 30-mm anechoic ganglion cyst (arrows) with posterior acoustic enhancement (curved arrows). Note the lobular and well-defined border.



Ganglion cysts of the wrist are most commonly (60%–70%) found dorsally over the scapholunate ligament, followed by a volar location adjacent to the flexor carpi radialis and radial artery[3,8]; similarly, 12 of the 20 ganglion cysts in this study were found in 1 of those 2 locations. However, 75% of the ganglion cysts in our study had a volar rather than dorsal location. This may be related to selection bias because the clinical presentation of a dorsal ganglion may not require imaging for confirmation, in contrast to a volar ganglion cyst, which may be clinically occult or associated with the radial artery. Although larger ganglion cysts often present as asymptomatic palpable masses, smaller occult ganglion cysts are difficult to detect by physical examination and are an important cause of chronic wrist pain through mechanisms that include increased ligamentous pressure or compression of the peripheral nerve branches.[1] Sonography has been shown to be effective in the detection of occult dorsal ganglion cysts.[1,9]

Ganglion cysts of the wrist may be treated surgically or aspirated in combination with steroid injection.[10] Sonography can provide guidance for percutaneous aspiration and injection. A large-gauge needle may be required at aspiration because of the high viscosity of the mucoid material.

Limitations to this research included the retrospective nature of this study. Probe selection and the use of compound imaging varied among the individuals performing the sonographic examinations. In addition, the sample size was relatively small, although we used a number of selection processes to capture all cases proven to be ganglion cysts of the wrist. A selection bias was also

likely introduced because more symptomatic patients or more clinically difficult cases were more likely to be imaged with sonography. The sonographic findings may also have added a selection bias because atypical findings at imaging may have increased the likelihood of aspiration or surgery. In addition, the diagnosis of a ganglion cyst may not be prospectively raised if atypical in appearance on sonography, possibly changing treatment and introducing selection bias.

In summary, small ganglion cysts (≤10 mm in the mean largest dimension) often appear hypoechoic without posterior acoustic enhancement, not appearing as simple cysts. Larger ganglion cysts will more likely appear anechoic with posterior acoustic enhancement. Ganglion cysts were volar between the radial artery and the flexor carpi radialis tendon in 50% of cases and dorsal over the scapholunate ligament in 10%.

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