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Sacral Meningeal Cysts: Evaluation with MR Imaging[1]

It is often difficult for the radiologist to determine if a given sacral meningeal cyst is causing symptoms. Radiographic criteria for identifying cysts likely to be symptomatic are needed. Using conventional magnetic resonance (MR) imaging along with a specifically designed flow-sensitive sequence, the authors characterized 24 cysts (19 patients) with respect to diameter and communication with the subarachnoid space. They found no significant difference in size between symptomatic and asymptomatic cysts ($P > .05$) but did observe a clear-cut disparity in the context of communication: Five of five asymptomatic cysts were shown to communicate on MR flow studies, while seven of seven symptomatic cysts were not shown to communicate. The authors propose that flow-sensitive MR imaging is useful in differentiating communicating from noncommunicating sacral meningeal cysts and that this information may be of value in classifying these lesions as more or less likely to be symptomatic.

Index terms: Magnetic resonance (MR), pulse sequences • Meninges, 36.1484, 36.3611 • Sacrum, 33.1484, 33.3611 • Spinal cord, cysts, 36.3611

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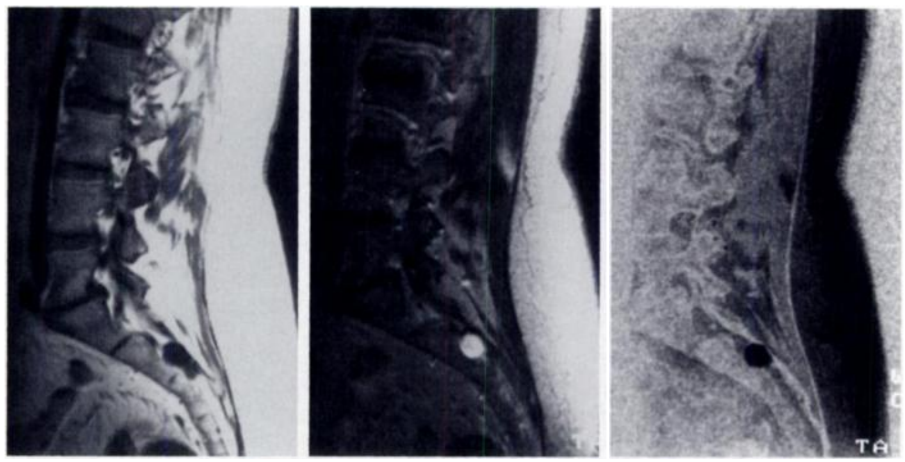

a. b. c.

Figure 1. Patient 4. MR images of 53-year-old woman with a symptomatic sacral meningeal cyst. **(a)** Sagittal T1-weighted image (SE 500/20) demonstrating cyst at level of S-2. **(b)** Corresponding T2-weighted image (SE 2,200/90). **(c)** Sagittal image obtained with flow-sensitive sequence (SF 16/6, 30° flip angle). Note homogeneous lack of signal intensity in area of cyst, indicating absence of fluid motion (ie, noncommunication).

Spinal meningeal cysts of the sacrum are a relatively common finding in patients being evaluated for sciatica, with a reported frequency of 17% in patients undergoing myelography for the investigation of low back pain with radicular characteristics (1). These cysts are often considered incidental findings; nevertheless, a certain unknown percentage will cause symptoms such as sciatica or bowel and bladder dysfunction (2–5). Frequently, a patient with these symptoms will have test results demonstrating both a sacral meningeal cyst and other coexisting findings, either of which are capable of explaining the symptoms. Unfortunately, there are currently no clearly established radiographic criteria for identifying which of these cysts are likely to be symptomatic.

Conventional magnetic resonance (MR) imaging is a highly effective means of locating and approximating the size of these entities (6,7), which generally appear as intraspinal masses of low intensity on T1-weighted and high intensity on T2-weighted images, similar to cerebrospinal fluid (CSF). Communication between the cyst and subarachnoid space, although traditionally investigated with plain or computed tomographic (CT) myelography, can now be readily studied with MR imaging by using a flow-sensitive sequence designed to detect fluid motion within the cyst. Using the MR imaging findings from a series of 19 cases, we characterized 24 sacral meningeal cysts with respect to size and communication with the subarachnoid space. Our purpose was to investigate whether symptomatic and asymptomatic cysts differ significantly in either or both of these variables, thereby providing some means of distinguishing them radiographically.

MATERIALS AND METHODS

The study group consisted of 19 patients who had undergone an MR imaging

Abbreviations: CSF = cerebrospinal fluid, SE = spin echo, SF = slow flow.

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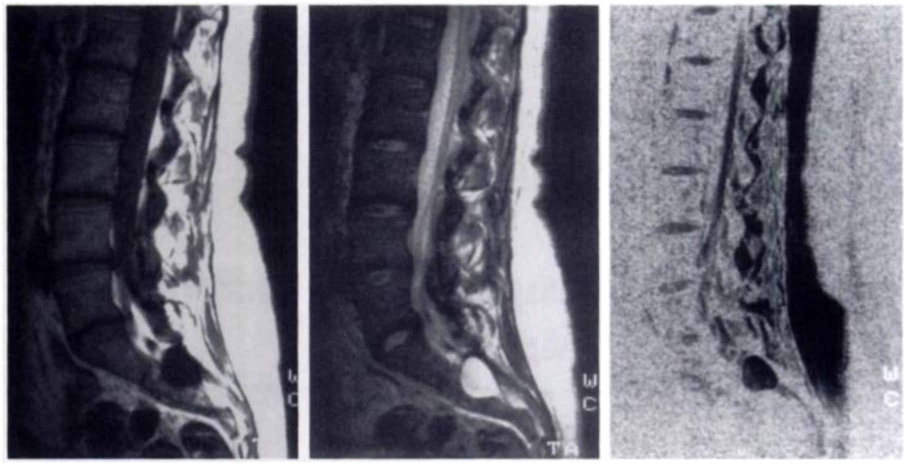
examination for the evaluation of sciatica and who were found at that examination to have one or more sacral meningeal cysts. These cases were identified and all data were obtained retrospectively by consulting the official staff readings of all neurologic MR imaging studies obtained at our institution between March 1991 and July 1992. Once identified, the images of a given case were reviewed by a senior neuroradiologist to verify the accuracy of the staff reading. In no case was the reading modified from the original interpretation. In all, 21 cases were collected, but two were discarded because the films could not be located and attempts to reload the images from magnetic storage media were unsuccessful.

The patients ranged in age from 25 to 79 years, with a clear predominance of women (84%). The cysts were classified as symptomatic, asymptomatic, or indeterminate according to specific criteria: (*a*) A symptomatic cyst involved at least one of the first three sacral nerve roots on the same side as the patient's sciatica. There were no coexisting abnormalities (eg, herniated disk, spinal stenosis) to explain the patient's symptoms. (*b*) An asymptomatic cyst did not involve any of the sacral nerve roots on the same side as the patient's sciatica. (The presence or absence of coexisting abnormalities was irrelevant in these cases.) (*c*) An indeterminate cyst involved at least one of the first three sacral nerve roots on the same side as the patient's sciatica. There were coexisting abnormalities that could potentially explain the patient's symptoms. Symptomatic and asymptomatic cysts were compared with respect to size and communication with the subarachnoid space. As these lesions are generally spherical, the reported size represents the cyst diameter. The data were then tested for statistical significance with a standard two-tailed t test.

All images were obtained with a 1.5-T Magnetom unit (Siemens Medical Systems, Iselin, NJ) with use of both conventional spin-echo (SE) acquisitions and a slow-flow (SF) pulse sequence. The SF sequence (8) is based on a three-dimensional steady-state free-precession scheme (9–11) with additional gradient pulses on the readout axis to provide increased flow sensitivity (see references 8–11 for more information on the SF sequence and steady-state free precession). This sequence has been used in over 4,000 spine and head examinations to date, often providing valuable information on CSF flow dynamics in a variety of central nervous system disorders (8).

Phantom studies with this sequence have demonstrated a very high sensitivity to fluid motion, down to flow velocities of 0.5–1.0 mm/sec. The in vivo flow sensitivity is probably somewhat less, since the sequence threshold must be adjusted to avoid the artifact generated when sequences such as this are applied to living subjects. In displaying the images, the gray scale was reversed, so that flowing CSF was white and static fluid was black. This resulted in communicating cysts manifesting as areas of increased signal intensity on the SF MR images, while noncommunicating cysts appeared as a homogeneous lack of signal intensity (Figs 1, 2).



a. b. c.

Figure 2. Patient 8. MR images of 48-year-old woman with an asymptomatic sacral meningeal cyst. **(a)** Sagittal T1-weighted image (SE 500/20) demonstrating cyst at level of S-2. **(b)** Corresponding T2-weighted image (SE 2,200/90). **(c)** Sagittal image obtained with flow-sensitive sequence (SF 16/6, 30° flip angle). Note areas of increased signal intensity within region of cyst, indicating movement of fluid (ie, communication).

Acquisitions included sagittal T1-weighted (SE 500/20 [repetition time msec/echo time msec]), spin-density (SE 2,200/45), and T2-weighted (SE 2,200/90) imaging, as well as axial T1-weighted (SE 600/15) and gradient-echo (fast imaging with steady-state precession [FISP]) (40/12, 15° flip angle) imaging, with use of 5-mm-thick sections and 1.5-mm gaps. Sagittal and occasionally axial SF images (16/6, 30° flip angle) were obtained with a 256 × 256 matrix, a single excitation, and a three-dimensional slab thickness of 40 mm with 16 partitions, resulting in 2.5-mm-thick contiguous sections and a total imaging time of 1 minute 9 seconds.

RESULTS

Illustrations of both symptomatic and asymptomatic cysts, including MR flow studies, are given in Figures 1 and 2. The MR imaging findings in all 19 patients are shown in Tables 1–3. A comparison of the various cyst classes is presented in Table 4.

There was no significant difference in size between symptomatic and asymptomatic cysts in these patients ($P > .05$). There was, however, a striking disparity in the context of communication with the subarachnoid space: Five of five asymptomatic cysts were shown to communicate on MR flow studies, while seven of seven symptomatic cysts were not shown to communicate. The cysts in patients 12, 16, and 19 could have been classified as symptomatic cysts with use of slightly less stringent criteria, since the coexisting findings in these patients were minimal and almost certainly were not responsible for their symptoms. In this event, 11 of 11 symptomatic cysts would not have been shown to communicate.

DISCUSSION

Since the original description of sacral meningeal cysts by Tarlov in 1938 (12), numerous articles have appeared in the literature that used different and often confusing terms to describe these lesions. In 1988, Nabors et al devised a classification scheme encompassing all types of spinal meningeal cysts according to operative and histologic appearance (6). These cysts are generally considered to be congenital (6,13,14) and arise as diverticula of the spinal meningeal sack, nerve root sheath, or arachnoid (6). The definitive treatment for symptomatic cysts involves surgical obliteration with oversewing of the cyst wall (6). The long-term efficacy of percutaneous cyst decompression has been low in some studies; therefore, this intervention is not commonly recommended (6).

MR imaging has demonstrated its ability to allow effective identification of these entities (6,7) and with the application of flow-sensitive sequences can now be used to investigate communication between the cyst and the subarachnoid space. Two potential difficulties involving the use of the SF sequence deserve mention. First, the patients in this series had not undergone plain or CT myelography; therefore, data comparing MR flow imaging with an established imaging modality are unavailable at present. We are currently conducting

Table 1
MR Imaging Findings in Five Patients with Symptomatic Sacral Meningeal Cysts

Patient/ Age (y)/Sex	Symptoms	Cyst Location	Cyst Size (cm)	Other MR Imaging Findings	Communication at MR Imaging
1/33/F	Left leg pain and weakness	Left S1-2	1.0	None	No
2/35/F	Leg pain (left = right)	Central S-3	1.5	None	No
3/43/M	Low back pain and leg pain (left > right)	Left and central S-2	2.0	None	No
		Right S-2	1.0		No
4/53/F	Right leg pain and weakness	Right S-2	1.5	None	No
5/76/F	Leg pain (left > right)	Left S-2	1.5	None	No
		Right S-2	1.5		No

Table 2
MR Imaging Findings in Five Patients with Asymptomatic Sacral Meningeal Cysts

Patient/ Age (y)/Sex	Symptoms	Cyst Location	Cyst Size (cm)	Other MR Imaging Findings	Communication at MR Imaging
6/39/F	Left leg pain and numbness	Right S-2	1.5	Moderate bulges diffusely	Yes
7/43/M	Right low back pain and leg pain	Left S1-2	1.5	Severe bulge L5-S1	Yes
8/48/F	Left leg pain and weakness	Right and central S-2	2.0	Moderate bulge L4-5	Yes
9/53/F	Leg pain (right = left)	Left S-2	1.5	Moderate bulge L4-5	Yes
10/76/F	Left leg pain and weakness	Right S-1	1.5	Severe bulge L3-4	Yes

Table 3
MR Imaging Findings in Nine Patients with Indeterminate Sacral Meningeal Cysts

Patient/ Age (y)/Sex	Symptoms	Cyst Location	Cyst Size (cm)	Other MR Imaging Findings	Communication at MR Imaging
11/25/F	Leg pain (left > right)	Left S1-2	2.0	Moderate bulge L5-S1	Yes
		Right S1-2	2.0		Yes
12/36/F	Left leg pain and numbness	Left and central S-2	2.0	Mild bulges L4-5, L5-S1	No
13/37/F	Leg pain (left = right)	Central S-2	2.0	Moderate bulge L5-S1	Yes
14/42/F	Right leg pain and weakness	Right S-2	1.0	Moderage bulges L4-5, L5-S1	Yes
15/43/M	Leg pain (left > right)	Left S-2	1.0	Moderate bulge L4-5	Yes
		Right S-2	1.0		Yes
16/56/F	Right leg pain and weakness	Right S-2	1.0	Mild bulges L4-5, L5-S1	No
17/66/F	Right leg pain and weakness	Right S-3	2.0	Moderate bulges diffusely	Yes
18/72/F	Left leg pain and numbness	Left S1-2	1.0	Severe bulge L4-5	Yes
19/79/F	Leg pain (right > left)	Left S-2	1.0	Mild bulges diffusely	No
		Right S-2	2.5		No

Table 4
Comparison of Symptomatic, Asymptomatic, and Indeterminate Sacral Meningeal Cysts

Parameter	All Cysts	Symptomatic Cysts	Asymptomatic Cysts	Indeterminate Cysts
Total no.	24 (100)	7 (29)	5 (21)	12 (50)
Communication at MR imaging	13 (54)	0 (0)	5 (100)	8 (67)
Size range (cm)	1.0–2.5	1.0–2.0	1.5–2.0	1.0–2.5
Average size (cm)	1.5	1.4	1.6	1.5

Note.—Numbers in parentheses are percentages.

studies that will give us this information. Second, since the SF sequence relies on the detection of CSF motion within the cyst to demonstrate communication, concern arises over what effect transmitted pulsations from nearby vessels or the thecal sac may have on the displayed image. It is conceivable that pulsations from nearby structures might be transmitted across a thin or compliant cyst wall, causing fluid motion within the cyst and thus increased signal intensity with the flow-sensitive sequence.

The fact that many of these lesions do not exhibit free communication with the subarachnoid space (46% in our series) can be explained by the presence of a complex valve mechanism in the cyst, whereby intermittent surges in CSF pressure allow fluid influx with restricted outflow (15). The obstruction to free flow is more complicated than a simple one-way valve, because CSF is impeded from entering as well as exiting the cyst. This situation can result in increased pressure within the cyst, contributing to its expansion (6). It has been shown that *delayed* CT myelography of many ostensibly noncommunicating cysts will demonstrate increased opacity of the mass, consistent with a valvelike phenomenon (6).

Sacral meningeal cysts are generally assumed to behave like other mass lesions of the sacrum, with symptoms resulting from compression or deformation of the exiting nerve roots. It seems reasonable to expect that larger cysts would be more likely to cause symptoms than average-size or smaller ones. Our results do not support this contention; however, further research with a larger sample size might be desirable. Alternatively, perhaps factors other than size are important in determining if a given cyst will be symptomatic. It is well known that nerve roots often pass through or run within the walls of certain sacral meningeal cysts (6). Perhaps these particular cysts become symptomatic when they accumulate fluid under relatively high pressure (due to the valve mechanism described earlier), thus exerting increased pressure on the contained nerve roots, leading to dysfunction. Freely communicating cysts would not generate this elevated intracystic pressure. This might explain why in our series 100% of the symptomatic cysts were not shown to communicate on MR flow studies, while 100% of the asymptomatic cysts were. It would be interesting to observe the response of these patients to surgical or percutaneous cyst decompression; unfortunately, none have undergone these procedures to date.

Regardless of the underlying pathophysiology, it appears that by using MR flow studies to demonstrate noncommunicating cysts, we are able to identify lesions that are more likely to be symptomatic. If these results withstand further investigation, then we will have documented a relatively simple device to aid the radiologist in deciding whether a given sacral meningeal cyst is causing symptoms. This in turn will enable the clinician to provide the most appropriate care for the patient. ■

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