Slitlike syrinx cavities: a persistent central canal

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Object. The authors review their experience in the diagnosis and management of 32 patients with slitlike syrinx cavities.

Methods. There were 18 men and 14 women with a mean age of 40 years. Presenting symptoms that prompted magnetic resonance (MR) imaging evaluation were mechanical spinal pain (13 patients), radicular pain (seven patients), paresthesia (six patients), numbness (five patients), and muscle spasm (one patient). In 12 patients neurological examination demonstrated normal status, and in the remainder only minimal sensory or motor abnormalities were found. The mean diameter of the syrinx cavity was 2 mm (range 1–5 mm), and on average it covered three vertebral levels. The cavities were limited to the cervical region in 16 patients, the thoracic in 12, and both regions in four patients.

The mean follow-up time for changes in clinical condition and repeated MR imaging features were 38 and 32 months, respectively. Thirty-one patients were treated nonoperatively, and one was treated surgically. During the follow-up period clinical improvement was documented in six patients, worsened status in seven, and no change was demonstrated in the clinical status of 19 patients. None of the syrinx cavities changed in size. In 16 patients medical workup revealed alternative diagnoses that were determined to be the true causes of each patient’s symptoms.

Conclusions. Slitlike cavities likely do not represent true syringomyelia but rather remnants of the central canal detected in a small percentage of adults. Review of the authors’ experience indicates that these cavities are asymptomatic and are unlikely to change in size. They can be considered an incidental finding, and in many of these patients another condition explaining the patient’s symptoms may be found.

KEY WORDS • syrinx • central canal • cavity

The management of syringomyelia continues to pose challenges to physicians. The exact mechanism of syrinx cavity formation remains elusive, and the causes are quite heterogeneous. Magnetic resonance imaging has provided significant insight into the pathophysiological function of syringomyelia; subsequently, these cavities have been divided into morphological subtypes that have a direct correlation with the neurological condition of the patient. Recent MR imaging studies have separated syringomyelic cavities into three groups: 1) simple central canal cavities, 2) central canal cavities with paracentral extension, and 3) eccentric cavities.5

In this study we identify a series of patients with a distinct form of spinal cavitation, the slitlike syrinx cavity. The hallmarks of this entity are the consistently thin diameter of the cavity, its lack of pathogenic factors that alter CSF dynamics, and its asymptomatic nature. The goal of this paper is to define the natural history and the salient neuroimaging and clinical features of these cavities.

Abbreviations used in this paper: CSF = cerebrospinal fluid; MR = magnetic resonance.

Clinical Material and Methods

Patient Population

Between 1992 and 2000, 45 patients with “slitlike” syrinx cavities were evaluated at the University of California at Los Angeles Medical Center. A retrospective hospital chart and MR imaging review was performed. Additionally, a follow-up questionnaire regarding present neurological status and recent MR imaging results was mailed to each patient. The Office for Protection of Research Subjects at our institution approved the protocol for this study. Thirty-two patients with both long-term follow-up information and repeated MR imaging studies to document changes in syrinx cavity size were included in the study. The mean patient age was 40 years (range 16–63 years); there were 18 men and 14 women.

Signs and Symptoms

Mechanical spinal pain, the most common symptom, was seen in 13 patients. The pain was predominantly located in the cervical region in nine patients, thoracic spine in one patient, and lumbar region in three patients. The pain was nonradicular in nature and was often worsened by...
movement. Seven patients presented with a chief complaint of radicular pain in either the upper or lower extremities. Six patients complained primarily of numbness in the extremities, and the remaining patient suffered from lower-extremity cramping. Abnormalities in bladder function were noted as secondary complaints in two patients.

**Neurological Examination**

A detailed neurological examination was performed by the senior author (U.B.) in each patient. In 12 patients completely normal motor and sensory status was demonstrated. In 20 patients minor motor (Grade 5-/5) or sensory deficits in the upper or lower extremities were noted. There was no evidence of long tract signs such as hypertonia, Babinski reflex, or clonus. Muscular atrophy or fasciculations were not evident in any of the patients.

**Medical History**

A history of trauma was reported by 10 patients: six motor vehicle accidents, three falls, and one sports-related injury. None of these events resulted in vertebral fracture. One patient had undergone a posterior C6–7 foraminotomy to alleviate nerve root compression.

**Neuroimaging Examination**

Axial MR imaging in all patients revealed symmetrically enlarged round central spinal cord cavities. The mean diameter of the cavities was 2 mm (range 1–5 mm). There was no evidence of spinal cord enlargement at the level of the cavity, and the diameter of the spinal cord was normal in all cases. None of the cavities showed enhancement following administration of intravenous gadolinium. They appeared to be linear on sagittal MR images with slight tapering at the superior and inferior poles. On average the cavities extended three vertebral levels (range one–nine levels).

Nine patients harbored multiple cavities that were separated by cyst-free regions of spinal cord. In 16 patients the cavities were limited to the cervical region, in 12 the thoracic, and in four they were present in both regions (Fig. 1). None of the cavities appeared to communicate with the fourth ventricle; C-3 was the most rostral level to harbor a cavitation. Chiari malformation, hydrocephalus, neoplasia, and spina bifida (aperta or occulta) were absent in this population. One patient harbored a moderately sized C6–7 herniated disc, which slightly abutted the spinal cord at the level of cavitation.

**Results**

The mean follow-up period in which changes in clinical condition were documented was 38 months (range 6–110 months). Thirty-one patients were managed nonoperatively with pain medication and/or physical therapy as needed. During the follow-up period, six patients were determined to have improved clinically, seven to have worsened, and 19 to have remained unchanged. Included in this assessment is the one patient who underwent operative intervention for his symptoms. He presented with C-7 radiculopathy, and MR imaging revealed a herniated C6–7 disc associated with a 2-mm spinal cord cavitiation. He underwent an anterior C6–7 discectomy and fusion, and postoperatively his symptoms improved without change in cavity size over the subsequent 55 months. The mean follow-up period in which repeated MR imaging evaluation was performed was 32 months, and the mode was 24 months (range 3–192 months). None of the syrinx cavities changed in size during this time period. In the majority (17) of the 32 patients follow-up imaging was performed at the same time as the repeated neurological assessments. In 12 patients the neurological assessments were conducted after the repeated MR imaging studies; in these patients clinical status was stable, and it was determined that additional imaging was unnecessary.

In 16 patients medical workup including repeated MR imaging, laboratory, and electrodiagnostic studies revealed alternative diagnoses that were determined to be the true cause of each patient’s symptoms. Electrodiagnostic studies demonstrated no findings that were likely to be associated with the cavities. Electromyography demonstrated normal results in four patients, and a brachial plexopathy in the remainder. Somatosensory evoked potentials were nor-
Slitlike syrinx cavities

Fig. 2. Representative images obtained in a 48-year-old man who presented with right arm pain. A cervical MR image demonstrated no evidence of Chiari malformation or spondylolisthesis. This axial T2-weighted MR image of the midthoracic region reveals a slitlike syrinx that was believed to be incidental and unrelated to his chief complaint.

The central canal is an ependymal-lined structure in the spinal cord that extends inferiorly from the fourth ventricle to the conus medullaris. The exact function of the central canal remains poorly understood. It has been postulated that it serves in a “sinklike” capacity, clearing waste products from the spinal cord. It is widely accepted that the canal is patent in prenatal life and that it undergoes age-related stenosis such that the canal is obliterated in the vast majority of adults.

The relationship between the central canal and the occurrence of syringomyelia has long been controversial and of keen interest to those studying the pathophysiological mechanisms of syringomyelia. Gardner first postulated that fourth ventricular outlet obstruction caused pulsatile CSF flow through a patent obex, resulting in dilation of the central canal and syringomyelia. This theory was in part supported by laboratory studies performed by Becker, et al., who demonstrated that kaolin-induced hydrocephalus resulted in marked dilation of the central canal; this did not occur if the animal’s central canal aperture was occluded at the obex and terminal filum. Other authors have argued, however, that because the obex frequently does not communicate with the central canal, this theory cannot adequately account for syrinx cavity formation in man. Milhorat, et al., found that in patients with hindbrain and cervicomedullary abnormalities, the upper cervical cord was compressed, and the syrinx was often quite a distance from the fourth ventricle below the distorted cord. Yasui, et al., who analyzed the spinal cord in 158 autopsy cases, concluded that because the central canal undergoes a process of obliteration, syringomyelia does not result from communication with the fourth ventricle and central canal enlargement.

Magnetic resonance imaging has provided useful insight into the pathophysiology of syringomyelia. Milhorat, et al., have reviewed axial MR images of nonneoplastic spinal cord cavities in 115 patients and described three distinct cavity types. The first pattern was a symmetrically enlarged circular or oval central canal cavitation. The second pattern was found predominantly in the center of the spinal cord but expanded paracentrally in one or more regions. Irregular eccentric cavitations that were frequently located in the watershed area between the distribution of the anterior and posterior spinal arteries represented the third form.

In the present series we detail a unique type of spinal cord cavitation—the slitlike syrinx cavity. This form of spinal cord cavitation has some similarities to the simple central canal syrinx described by Milhorat, et al., but enough significant differences are present to deem it a distinct clinical entity. In both series the patients were found to harbor oval or symmetrically enlarged midline spinal cord cavitations. In the series reported by Milhorat, et al., however, the transverse diameter of the spinal cord was consistently increased to greater than 80% of the interpédicular diameter, whereas no spinal cord enlargement was detected in our series. This is likely because the mean cavity diameter in our series was only 2 mm (maximum diameter 5 mm). In contrast, in the patients reported by Milhorat, et al., significant variation in cavity diameter was present, and in some cases the remaining spinal cord parenchyma was reduced to a thin mantle. Lastly, all of the central canal syringes they described were associated with CSF flow abnormalities such as Chiari malformation and hydrocephalus. There was no evidence of abnormalities that could alter CSF flow dynamics in our patient population except in one patient with a herniated cervical disc. Myelography was performed in another patient in whom CSF flow obstruction was suspected because of degenerative joint disease; however, CSF flow was normal.

Our patients were either neurologically intact or determined to have relatively minor nonspecific deficits in motor or sensory function. In contrast to those reported by Milhorat, et al., with central canal syringes, in our patients no lower-extremity long tract signs were present. Stretching of the long tracts around the perimeter of the cavity was suggested as a possible cause. The lack of such findings in our study suggests the cavity is too small in diameter to result in significant neural compression. Based on clinical and neuroimaging studies, our patients appeared to be quite stable throughout the follow-up period. An equal and small percentage of patients felt that their symptoms had improved or worsened, with the majority noting no change. The syrinx cavities did not change in size in any patient, including a 31-year-old man in whom a repeated MR imaging study was obtained at a 16-year interval. In 16 patients (50%), medical workup revealed alternative diagnoses responsible for their symptoms, and some patients improved after appropriate therapy.
Because of the central location, cavity size, absence of neurological deficits, and stability over time, we believe that these lesions represent an asymptomatic persistent central canal. The exact incidence of visible MR imaging–documented central canals is unclear. Petit-Lacour, et al.,12 reviewed 794 consecutive MR imaging studies, excluding those in which hindbrain abnormalities or dysraphism were demonstrated, and found 12 (1.5%) with visible central canals. The diameter of the cavity ranged from 2 to 4 mm, 69% were located in the thoracic region, and none reached the obex. Follow-up imaging was performed in only four patients, and no changes in cavity size were detected. Newman, et al.,10 detailed an autopsy study in 60 cadavers in whom the central canal ranged in size from a core of tightly packed ependymal cells to a patent canal 1000 μm in diameter. It is therefore likely that there is a certain canal size threshold below which the histologically patent canal cannot be visualized on current MR imaging systems. One may speculate that trauma, found in nearly 30% of our patients, might act as a local irritant delaying or impeding central canal involution.

Two logical questions arise when studying patients with slitlike syrinx cavities. First, if it is accepted that asymptomatic slitlike syrinx cavities do not represent true syringomyelia, is there any risk that these patients may develop syringomyelia in the future? Second, do these cavities represent an early stage in the spectrum of syringomyelia? A persistent central canal does not resemble the presyrinx entity clinically or radiographically.2,11 Takamura, et al.,16 however, reported a single case of a patient with a patent central canal who developed hydrocephalus and an acquired Chiari malformation following a severe head injury; subsequently, progressive symptomatic enlargement of the central canal occurred 2 months postinjury. Craniovertebral decompression resulted in collapse of the syrinx cavity and neurological recovery. Their report implicates the patent central canal as the site for initial accumulation of fluid during syrinx cavity pathogenesis. A similar observation was also made by Oldfield11 and Milhorat, et al.7 Milhorat, et al., reviewed the central canal in 232 autopsy specimens and concluded that in hindbrain herniation differences in canal patency can affect the development of syringomyelia. Holocord syrinx cavities are more frequently found in children, in whom the canals are more likely to be patent. Conversely, adults are more likely to harbor focal syrinxes or none at all, in part influenced by the patency of the central canal. This theory has been validated by Stoodley, et al.,14 who determined that asymp-

Conclusions

Slitlike cavities can be the cause of significant concern for both doctors and patients. The cavitations likely do not represent true syringomyelia, however, but rather remnants of the central canal detected in a small percentage of adults. Our experience indicates that these cavities are asymptomatic and unlikely to change in size. They can be considered an incidental finding; another condition to explain the patient’s symptoms should be sought and may often be found. The term syringomyelia should be avoided in describing this finding.

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References


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Slitlike syrinx cavities


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