Nerve root compression by herniated intradiscal gas

Case report

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Intervertebral disc degeneration of any etiology may be associated with the formation of spaces or clefts within the disc. Gas collects within these spaces and can be seen roentgenographically. A case is presented in which intradiscal gas herniated into a connective tissue capsule, displacing the left S-1 nerve root and producing symptoms and signs identical to those of a herniated nucleus pulposus. The pathophysiology of gas within a disc space and the possibility that it may herniate much like the nucleus pulposus is discussed.

KEY WORDS • intervertebral disc • nerve root compression • vacuum disc phenomenon • gas

In 1937, Magnusson was the first to describe finding gas collections within intervertebral discs, although he ascribed no clinical significance to them. Since that time, it has been accepted that gas collections occur in cracks or spaces that develop within degenerated discs. This condition is commonly referred to as the “vacuum disc phenomenon.” A case is presented in which gas collected epidurally within a fibrofatty capsule and caused symptomatic impingement of a nerve root. This gas appears to have originated from within the adjacent disc space.

Case Report

This 57-year-old male dispatcher for an oil company presented to his general practitioner with a 1-month history of left hip pain which began gradually while he was playing golf. The pain was mechanical in nature, radiating down the posterolateral aspect of the left thigh into the calf, and was associated with intermittent paresthesias and numbness over the lateral aspect of the calf and foot. The patient denied back pain or weakness. There was no history of back trauma although his job occasionally required him to lift objects weighing up to 400 lb. His symptoms did not respond to conservative therapy. Lumbar spine films showed narrowing of the L5–S1 interspace with anterior spur formation; however, no vacuum disc phenomenon was seen. A computerized tomography (CT) scan demonstrated a vacuum disc phenomenon at L5–S1 with an epidural gas bubble on the left which extended superiorly to the level of the L-4 vertebral body. The patient had not undergone an invasive procedure prior to CT. A bone scan was normal. An epidural block gave relief for only 1 to 2 days. The patient showed no improvement and, 3 weeks later, metrizamide myelography followed by CT showed persistence of the intradiscal gas and epidural gas pocket as well as displacement of the left S-1 nerve root (Fig. 1).

Examination. On examination, the patient had a full range of motion of the lower back and no point tenderness. His straight-leg raising was positive on the left at 40° without a contralateral straight-leg raise. There was normal muscle strength but pinprick and light touch sensations were decreased over the lateral aspect of the calf and foot distally on the left. Patella reflexes were symmetrical but the left ankle reflex was diminished compared to the right. Laboratory analyses were normal and the erythrocyte sedimentation rate was 5 mm/hr.

Operation. At surgery, a tannish-green-colored mass approximately 1 × 1 × 1 cm was encountered. It appeared to be gas-filled and was deforming the left S-1 nerve root. Manipulation of the mass resulted in rupture and the release of gas. The displaced nerve root immediately relaxed into its normal location. With the root retracted, the capsule of the mass was removed. No disc fragments were visualized. The posterior aspect of the disc was flat and there was a tiny hole in the anulus at its attachment to the superior rim of the body.
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Fig. 1. Left: Lumbar myelogram showing amputation of the left S-1 nerve root sleeve and indentation of the thecal sac at the L5–S1 level (arrow). Right: Postmyelography computerized tomography scan at the L5–S1 level showing an epidural collection of gas (arrow) compressing the left S-1 nerve root and thecal sac.

of S-1. The disc space was entered and a degenerated disc was found. Only after vigorous curettage were a few small fragments of disc removed.

Pathological Examination. Pathological examination of the capsule revealed fibrofatty material and focal areas of cartilage which had undergone degeneration and cavitation. Aerobic and anaerobic cultures were negative. Postoperatively, the patient was free of pain and did extremely well over the ensuing years.

Discussion

The finding of gas within the disc space, referred to as the vacuum disc phenomenon, was first described in 1937 by Magnusson. It was Knutsson who first ascribed clinical significance to this entity; he believed that when seen centrally it was pathognomonic of disc degeneration and when seen peripherally it indicated spondylitis deformans. It is now known that there are numerous other causes of intradiscal gas including infection, trauma, chymopapain chemonucleolysis, calcium pyrophosphate dihydrate deposition disease, osteonecrosis (alkaptonuria), osteonecrosis with vertebral collapse, skeletal metastases, cartilaginous (Schmorl's) nodes, and limbus vertebra.

By far the most common etiology for intradiscal gas is degenerative disc disease. With age, the intervertebral disc desiccates and develops cracks, a process known as "primary intervertebral osteochondrosis." This should be distinguished from secondary intervertebral osteochondrosis, in which the etiology is other than normal aging. Regardless of the etiology of the osteochondrosis, the cracks or spaces within the discs collect gas from the surrounding tissues and can be seen as radiolucent areas. This gas is composed of greater than 90% nitrogen, along with oxygen, carbon dioxide, and other trace gases. The vacuum disc phenomenon has been observed in cervical, thoracic, and lumbar regions, with the vast majority occurring in the lumbar spine. As expected, it occurs with increasing frequency with age. This disorder is most often identified by CT; it is found more easily when the spine is in extension than in a neutral position.

The vacuum phenomenon is better understood when considered as one of two types: acute and chronic. The acute type is seen when external forces cause a rapid increase in the volume of a joint space and thus a decrease in intra-articular pressure. A vacuum is produced which resolves instantaneously when the forces acting on the joint are released. Fick first described this in 1910 when he demonstrated that traction on a joint could produce radiographic luencies. Radiolucent areas can be seen in the shoulder joints of infants when their arms are held overhead in order to obtain a chest roentgenogram and when knuckles are "cracked." In the spine, cracks or clefts that form in discs are expanded by extension, creating a space with decreased pressure which can be seen radiographically. Magnusson postulated that the creation of such a space required reducing the pressure within a joint to 1/20th atmospheric pressure; hence the name "vacuum phenomenon."

The chronic vacuum phenomenon is seen in the spine when there is long-standing disc degeneration. Unfortunately, here the term "vacuum" is not only misleading but incorrect. As the disc degenerates, there is loss of disc material and consequently loss of disc space volume. However, this loss of disc space volume is not as great as the loss of disc material and therefore gas is liberated from the surrounding tissue to compensate. The partial pressure of a gas in a liquid will equilibrate with the partial pressure of that gas in the gas phase (Henry's law). This gas is predominantly nitrogen which is consistent with the fact that nitrogen has the highest partial pressure of any gas in the sur-
The pressure \(\times\) the volume of a gas is a constant for isothermic conditions (Boyle's law). Extension of the spine will widen the spaces, resulting in decreased pressure and expansion of the gas already present. Flexion will decrease the volume and increase the pressure of the gas within the disc space. As pressure increases, the gas may then be forced out of the disc space through a weak spot or defect in the anulus. If this extruded gas were to collect within a connective tissue capsule, it could then conceivably compress a nerve root and produce symptoms. Epidural gas associated with intradiscal gas has been observed. There are two previously reported cases of epidural gas collections producing symptomatic impingement of a nerve root. A retroperitoneal collection of gas associated with gas within the intervertebral disc has also been noted.

The case presented here supports the concept that in long-standing disc disease gas collects within the defects that develop in the disc. This gas is not in a vacuum and, as external forces are applied to the disc space, the gas within can be forced out through a weak spot or rent in the anulus. When the "herniated" gas is collected within a capsule, it can act as a mass and produce symptoms, much like a herniated nucleus pulposus. The capsule in our patient may have been reactive tissue associated with a previously unrecognized disc herniation or may have been connective tissue. The gas herniation may have occurred all at one time or may have proceeded in a stepwise fashion with a ball-valve effect. The resultant gas-filled mass compressed the patient's left S-1 nerve root and produced his symptoms.

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References

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