Surgical Experience of Gas-Containing Disk Herniation

Kyung-Chul CHOI, Jin-Sung KIM*, and Sang-Ho LEE*

Department of Neurosurgery, Wooridul Spine Hospital, Daegu, R.O.K.;
*Department of Neurosurgery, Wooridul Spine Hospital, Seoul, R.O.K.

Abstract
Disk herniation with gas or gas-containing disk herniation (GCDH) is rare, although epidural gas is associated with the vacuum phenomenon. The clinical, radiologic, and surgical findings were retrospectively analyzed of 18 patients with GCDH. The demographic, clinical, and radiologic findings including computed tomography and magnetic resonance imaging, as well as operative methods were examined. The mean age was 64.4 years (range 51–84 years). All patients presented with acute radiculopathy or exacerbation of chronic pain associated with GCDH of the lumbar spine. All lumbar GCDHs were related to the vacuum phenomenon. Ruptured disks predominantly compressed the nerve root with gas in 17 cases, except in one with only compressed nerve root by gas without disk herniation. All patients had confirmed GCDH at surgery. All patients underwent removal of GCDH and five with another level of spinal stenosis or disk herniation underwent selective decompression. The six patients with instability underwent fusion. Visual analogue scale score of radicular pain was improved from 7.4 ± 0.9 before surgery to 3.2 ± 0.7 at the 3-month follow-up examination. No recurrence occurred after surgery. GCDH can occur as a space-occupying lesion in epidural space as well as a cause of radiculopathy. GCDH may indicate the source of clinical symptoms in the degenerative spine, especially combined with spinal stenosis or multiple spinal disk herniations.

Key words: gas-containing disk herniation, vacuum phenomenon, radiculopathy

Introduction
Gas in the spinal canal results from various causes associated with tumors, infections, trauma, diskography, and disk degeneration.13,19) Disk degeneration is intimately related to the vacuum phenomenon, which is relatively common in old age. The gas associated with the vacuum phenomenon has been found in the spinal canal, intervertebral foramen, epidural space, and subarachnoid space,8,17) but disk herniation with gas has rarely been reported. The majority of these cases have been the result of non-operative treatments.5,23) The present study analyzed 18 cases of disk herniation with gas associated with gas-containing disk herniations (GCDH) confirmed at surgery.

Materials and Methods
This study reviewed the records of 18 consecutive patients who underwent surgical treatment for GCDH between January 2006 and August 2008. All patients were treated conservatively with analgesics and physical therapy over 3 months at our institute or other hospitals. No patient had any history of tumors, infection, or trauma, and had undergone previous diagnostic or therapeutic procedures. The patients were preoperatively evaluated with computed tomography (CT) and magnetic resonance (MR) imaging. The following demographic, clinical, and radiologic findings, and operative methods were assessed: age, sex, symptoms, diagnosis, presence of the vacuum phenomenon, level of the gas-containing disk, radiologic findings, methods of operation, and pre/postoperative visual analogue scale (VAS) score for radiculopathy (Table 1).

Results
The 18 patients included 5 males and 13 females aged 51 to 84 years (mean 64.4 years). Eight GCDHs were located at L4-5, five at L5-S1, two at L3-4, two at T12-L1, and one at L2-3. The follow-up period was 4 to 15 months (mean 6.3 months).

All patients presented with radiculopathy associated with GCDH. Seven patients presented with acute radicular pain due to GCDH, 5 patients had underlying chronic symptoms of radicular pain, neurogenic claudication, or back pain associated with spinal stenosis, degenerative spondylolisthesis,
<table>
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<th>Case No.</th>
<th>Age (yrs)</th>
<th>Sex</th>
<th>Diagnosis</th>
<th>Preoperative symptom</th>
<th>Vacuum phenomenon</th>
<th>Level of GCDH</th>
<th>Radiologic finding</th>
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degenerative scoliosis, degenerative disk disease, and disk herniation of another level exacerbated by GCDH, and 6 patients presented with radicular pain of the GCDH and mechanical back pain due to instability in the affected level. CT revealed the vacuum phenomenon on the level of the disk in all lumbar GCDHs. CT and MR imaging showed the ruptured disks were compressing the nerve root in 17 patients. Only gas without disk herniation occupied the neural foramen and spinal canal, and the gas appeared to compress the nerve root in one patient.

At surgery, all 18 GCDHs were revealed as ruptured disks in accordance with the radiologic features, but also confirmed as gas-containing disk herniations compressing or displacing the nerve root. If ruptured disk material was encountered, the surgical field was filled with saline. The ruptured disk was meticulously manipulated with a probe, and the air bubble was found and released. Seven patients underwent removal of the fragment only through multiple approaches following location of the GCDH. Five patients with spinal stenosis or another level of disk herniation required additional selective decompression including removal of the GCDH. Six patients with instability required fusion. Preoperative VAS score of radicular pain was improved from 7.4 ± 0.9 to 3.2 ± 0.7 at the 3-month follow-up examination. No recurrence was observed during the follow-up period.

Representative Cases

Case 10: An 84-year-old woman was admitted with a 3-month history of severe right leg pain radiating down the anterolateral aspect of the leg. Radiography showed degenerative changes and CT revealed gas in the right extraforaminal area at L4-5 with the vacuum phenomenon. MR imaging showed a herniated disk containing a signal void in the presence of gas. The gas-containing disk fragment had compressed the right exiting nerve (Fig. 1). The disk herniation was successfully removed using the microscopic paraspinal approach. The radicular pain was resolved after surgery.

Case 11: A 52-year-old housewife was admitted to our institute complaining of back and right leg pain as well as numbness persisting for one year. Radiography showed narrowing of the disk space and segmental instability at L5-S1. CT showed an 8.2 × 6.3 mm gas-containing disk at the right paracentral upper portion of the spinal canal at S1 and the vacuum phenomenon at the intervertebral disk at L5-S1. MR imaging demonstrated a round and signal void lesion at the right paracentral portion of the spinal canal at S1 (Fig. 2). Considering the instability, we decided to fuse the L5 and S1 levels. After laminectomy, the gas-containing lesion appeared as a bluish ruptured disk herniation that was adherent to the right subarticular disk herniation. Her symptoms markedly improved after surgery.

Case 14: A 70-year-old woman presented with radiating pain in the bilateral lower extremities. She complained of more severe pain in the right anterolateral aspect of the thigh and leg. CT showed a 6.2 × 4.8 mm gas lesion occupying the entire right neural foramen at the L2-3 level. Mid-sagittal T2-weighted MR imaging showed disk extrusion of the L3-4 level had obliterated the thecal sac. Sagittal and axial T1-weighted MR imaging showed a signal void in the right neural foramen at the L2-3 level (Fig. 3). The patient underwent removal of the ruptured disk and foraminotomy at L2-3 and L3-4. The gas at L2-3 was revealed as a ruptured disk herniation with gas in the neural foramen. After surgery, the patient’s radicular symptoms disappeared.

Discussion

GCDHs are common in elderly patients (mean age 63
canal has been reported.21) The case was suggested with gas-associated disk herniation in the spinal spine is still unknown. One case of radiculopathy foramen. C: Mid-sagittal T2-weighted magnetic signal void (arrow) at the L2-3 level in the right neural foramen. A: Axial computed tomography scan at L2-3 showing that gas occupies the entire right neural foram. B: Axial T1-weighted magnetic resonance image showing a docyst may be followed by recurrence of the gas cyst with radicular pain 2 years afterwards, followed by absorption of the gas.2,26) Gas can produce radicular symptoms, but disk herniation with gas and operative findings is rare. In our series, CT and MR imaging patterns of gases revealed mostly a mixture of ruptured disk and gas, called the gas-containing disk. Whereas simple gas-containing cyst or cystic gas with disk herniation was described previously,15,26) all GCDHs consist of a predominant ruptured disk that includes a small amount of gas. We found that the ruptured disk compressed or displaced the nerve root in the operative field. Disk herniations of the 18 symptomatic GCDHs were removed and the symptoms improved. GCDH does not actually carry high risk of recurrence of symptomatic GCDH or epidural gas, although the vacuum disk can communicate with the epidural space after removal of GCDH. This study has the limitation of short follow-up period. Therefore, we are concerned about the recurrence rate of GCDH in the long term.

Many gas collections in the spine have been reported with only CT findings.1,6,9,16,23,26) CT is definitely the most valuable neuroimaging method for identifying gas in the spinal canal and this modality demonstrates air more effectively than MR imaging. In particular, MR imaging has some limitations in the assessment of structures that contain air and calcification, which typically appear as signal void areas. However, MR imaging is a diagnostic tool capable of the evaluation of degenerative spinal changes with detailed information about lesion morphology, disk condition, and the status of adjacent neurologic structures. MR imaging is useful in the assessment of other spinal diseases that are occasionally perplexing in surgical consensus in GCDH, especially in old age. MR imaging can also distinguish intradural disk herniation with gas from extradural lesion (Case 13). CT and MR imaging are useful for the detection of gas collection and disk herniation, respectively, in GCDH.

Several surgical experiences of gas in the spinal canal have been reported. Intraoperative findings demonstrated simple gas cyst, granulation, and ruptured disk herniation.9,10,16,28) One study documented 19 cases of disk herniation with gas in the lumbar spine with CT findings, and only 6 patients required surgery.9 In our series of 18 GCDHs, seven patients...
underwent removal of only the GCDH and five patients with another level of spinal stenosis or disk herniation underwent removal of the GCDH and selective decompression. These five patients had long-standing claudication or leg pain. Leg pain associated with GCDH abruptly occurred or exacerbated. Six patients with instability underwent fusion with removal of the GCDH. The postoperative VAS score for radicular pain was improved in all patients. We believe that GCDH was a source of clinical symptoms or of acute exacerbation of chronic pain in our series, especially in multi-level spinal stenosis or disk herniations.

GCDH may indicate a source of clinical symptoms in the degenerative spine, especially if abrupt exacerbation of symptoms is experienced combined with spinal stenosis or multiple spinal disk herniations. GCDH appears as gas within the spine on CT and coexistent with disk herniation on MR imaging.

Acknowledgment

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References

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Address reprint requests to: Jin-Sung Kim, M.D., Department of Neurosurgery, Wooridul Spine Hospital, 47-4 Chungdam-dong Gangnam-gu, Seoul, 135-100, R.O.K.
e-mail: mddavidk@dreamwiz.com

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