Histological demonstration of the gas precursor in a symptomatic L5-S1 disc herniation containing gas: A case report

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ABSTRACT

Vacuum phenomenon is a commonly observed radiological entity in the degenerated intervertebral disc of the lumbar spine in the elderly population. The entity is frequently asymptomatic. Although disc herniation containing gas (DH-CoG) is commonly associated with the vacuum phenomenon, DH-CoG associated with clinical symptoms is a rare condition. There are very few reports which have histologically demonstrated the existence of the gas itself within DH-CoG. Herein, we report a rare case of a 65-year-old female with symptomatic DH-CoG at L5/S1. The patient was admitted to our hospital with a one-month history of pain in the left buttock and leg in addition to neurogenic claudication. Roentgenograms illustrated a degenerative lumbar spine with the vacuum phenomenon at the L5/S1 disc space. Computed tomography showed a round and low-density lesion within the spinal canal at left L5/S1. Additionally, a lesion characterized by an iso- and partially hypointense signal on T1 and hypointense signal on T2 was detected in magnetic resonance imaging (MRI) by the spin-echo method. The decision for posterior lumbar interbody fusion surgery using pedicle screws was made as the symptoms had not responded to the conservative treatment. After a degenerated prolapsed nucleus was carefully extracted, the specimen was sent to the laboratory for histopathological analysis. The prolapsed nucleus of DH-CoG histologically showed many small vacuoles containing degenerated mucopolysaccharides. The left leg pain drastically resolved on the first post-operative day, and no recurrence had been observed. Degenerated mucopolysaccharide may be a precursor of nitrogen or “the gas itself” in DH-CoG. Surgical intervention for DH-CoG should be considered if conservative treatment fails.

Introduction

Disc herniation containing gas (DH-CoG) is frequently observed in a situation associated with vacuum phenomenon of the degenerative lumbar intervertebral disc: on roentgenograms and/or computer-assisted tomosgrams (CT) in elderly populations [1, 2]. It is hypothesitically proposed that a ball-valve type connection between the intervertebral vacuum disc space and DH-CoG leads to increased pressure inside DH-CoG, and could result in neurological symptoms [3]. Symptomatic DH-CoG is a rare condition. Some authors have already reported the clinical symptoms and the radiological findings: fibrous tissue or cystic lesion surrounding the gas itself has been intra-operatively and histologically mentioned [3-9]. Nonetheless, to my knowledge, there are very few reports that histologically unveiled the existence of the gas itself within the prolapsed nucleus portion of DH-CoG. We present a case with symptomatic DH-CoG in which the vacuoles containing degenerated mucopolysaccharides were histologically confirmed. In the current patient, posterior lumbar interbody fusion (PLIF) with pedicle screws (PSs) was performed to erase the vacuum disc space and obtain the stability of the affected segment, and no recurrence of the symptoms has been observed for two years after surgery.

Case Presentation

A 65-year-old female suffering left buttock and leg pain for a month was admitted to our hospital. The patient had failed to respond to conservative management with non-steroidal, anti-inflammatory drugs, and muscle relaxant for eight weeks. She also had neurogenic claudication less than 500 m due to the severe left leg pain. The pain was rated at 80/100 in the visual analogue scale. The straight leg raise test was positive at 70° on the left side. Roentgenograms showed degenerative changes of the whole lumbar spine, and a narrowing with vacuum phenomena of the L5/S1 disc space. CT demonstrated a round and low density lesion in the spinal canal at left L5/S1 (Fig. 1).
ly associated with the disc vacuum phenomenon, but a symptomatic specically (1, 2). They are usually asymptomatic. DH-CoG is frequent around 1%-20% and 28% as detected on roentgenograms and CT, re

Discussion

The surgery. solid bone fusion in the L5/S1 intervertebral space two years after recurrence of the symptoms, and roentgenograms have shown a markedly decreased on the first post-operative day. She has reported no some but not all of the vacuoles (Figure 4b). The left leg pain drastically decreased on the first post-operative day. She has reported no recurrence of the symptoms, and roentgenograms have shown a solid bone fusion in the L5/S1 intervertebral space two years after the surgery.

Discussion

It is reported that the incidence of the disc vacuum phenomenon is around 1%-20% and 28% as detected on roentgenograms and CT, respectively [1, 2]. They are usually asymptomatic. DH-CoG is frequently associated with the disc vacuum phenomenon, but a symptomatic one is relatively rare. If the annulus of the intervertebral disc ruptured, the gas inside the vacuum disc space could be pushed into the epidural and/or the foraminal space. The unstable motion of the affected vertebral segments that is caused by the degenerative changes may give rise to a shift of the gas from the vacuum disc space towards the epidural and/or the foraminal space (3). In the L5/S1 CT discogram of the current case, a connection between the vacuum intervertebral disc and the DH-CoG in the epidural space was clearly proven by a contrast pooling. In terms of qualitative analyses, MRI, especially by spin echo method, is a more beneficial tool to demonstrate DH-CoG than CT. It was reported that MRI by spin echo method could identify the gas as small as 0.1 cc in the cadaveric experiment (5, 10). It can distinguish the gas itself, which is mathematically hypointense both on T1 and T2 images, from a prolapsed nucleus and a cystic wall of DH-CoG despite having a limitation that gas, air, and calcification appear as the same signal void area. The current case had a vacuum phenomenon at the L5/S1 disc space and a gas-filled cystic mass that showed iso- and partially hypointense signal on T1, and whole hypointense signal on T2 image.

There are several articles which described histological finding of DH-CoG in the lumbar spine, but the gas itself in DH-CoG has not been histologically identified. Lee et al. described an intra-operative finding of a symptomatic DH-CoG at left L3/4 of a 76-year-old female. According to them, it was covered with a fibrous material-like annulus despite no histological specimen being demonstrated in the article (7). Ryu et al. reported a 72-year-old male with symptomatic DH-CoG at right L3/4, and disclosed that DH-CoG was simply a fibrous tissue (8). In 2015, Ayberk et al. presented a 60-year-old female with a symptomatic DH-CoG at L5/S1, and they also mentioned that the cystic wall of DH-CoG was a simple cyst (9). Unfortunately, none of these reports have mentioned whether prolapsed nucleus was present within or beneath the cystic lesion of DH-CoG. Strictly speaking, the cases in the previous reports should be categorized as epidural cysts containing gas. Meanwhile, in the current case, a prolapsed nucleus (2x3x7 mm3 sized) was identified at the left posterolateral margin of the affected disc, and it was connected with an epidural cystic lesion. Furthermore, the most important finding is that multilobular shaped vacuoles were histologically observed within the degenerated prolapsed nucleus. The current case probably is the first one in which the gas itself was disclosed in DH-CoG. It is well known that a decrease of total mucopolysaccharides and water contents has already started in the degenerated lumbar disc, particularly in the nucleus pulposus as a physiological change of ageing (11). Glucosamine
(C6H13NO5) is an amino sugar, which is an important part of mucopolysaccharide. Therefore, if changes in the proportion of proteins developing with age, nitrogen gas could be generated as a by-product from the mucopolysaccharide. Gas chromatography has disclosed that the gas lesion in the lumbar spine is consisted of nitrogen (more than 90%) combined with oxygen, carbon dioxide, and very few others materials [12]. No positive histological evidence to support this presumption has been established to date. Alcian blue usually stains mucopolysaccharide well. In the current case, some kinds of contents stained by Alcian blue were sparsely observed in the portions of the vacuoles. This finding has strongly suggested that the degenerated mucopolysaccharide is a precursor of nitrogen or "the gas itself".

In the elderly people, the degenerated discs not always demonstrate the vacuum phenomenon, despite the disc vacuum phenomenon getting remarkable in extension, and diminish in flexion. It is speculated that the disc vacuum phenomenon could not be developed when motion in the degenerated lumbar segment was restricted by the spur formation and/or the ossification of the ligaments in its natural course. Surgical intervention for DH-CoG should be considered if conservative treatment fails; removal of the fibrous material or cyst is proposed as the first surgical procedure for DH-CoG and excellent results have been reported without recurrence in the short term [3-5, 7-9]. Contrarily, Choi et al. has mentioned a possibility of DH-CoG recurrence if instability of the vacuum intervertebral space lingers, and lumbar interbody fusion was additionally performed in 6 of 18 cases in their series (6). The definition of the instability of the lumbar spine in vivo is very controversial, but given that degenerated mucopolysaccharide is a precursor of nitrogen or "the gas itself" and the ball-valve type connection between the intervertebral vacuum disc space and DH-CoG exists, a possibility of recurrence of the symptoms, which is caused by a high pressure of the gas, could not be denied in the long term. Gulati et al. had suggested a possibility that extracellular fluid, which was probably mucopolysaccharide, produces gas in the vacant space by extension of the spine [2]. Therefore, complete curettage of the degenerated disc material including the intervertebral vacuum space, and stabilization of the affected segment are crucial in terms of the recurrence.

Conclusion

• A 65-year-old female with a symptomatic DH-CoG at L5/S1 was presented.
• In the current case, the vacuoles containing degenerated mucopolysaccharides were histologically demonstrated in the prolapsed nucleus portion.
• PLIF using a PS is a beneficial surgical intervention to prevent the recurrence of GCo-DH.

Informed Consent: Written informed consent was obtained from the patient in the case.

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