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Case Report

Analysis of Myeloid Hypertension in the Treatment of Lumbar Disc Herniation by Uni-portal Bi-channel & Dual-media Spinal Endoscope Lumbar Discectomy

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Abstract

Background: The Uni-portal Bi-channel & Dual-media Spinal Endoscope (UBD) is a recently developed, minimally invasive spinal endoscopic technique. This article reviews the mechanism, clinical manifestations, diagnosis, treatment, and prevention of UBD-induced myeloid hypertension-like syndrome (MHI). Case presentation: A 44-year-old man was admitted for low back pain lasting >2 years and progressive left-leg pain for 3 months. Under general anaesthesia, L5/S1 discectomy was performed via an interlaminar approach using the UBD system. Fifteen minutes after extubation he developed head-and-neck and low-back pain, lower-limb numbness, immobility, and agitation. Intravenous midazolam 5 mg, dexmedetomidine 1 μg/kg, methylprednisolone sodium succinate, and mannitol were given for sedation and oedema control. Within 1 h the symptoms improved; they resolved completely after 3 h. Twelve hours post-operatively VAS scores were 1 for low back pain and 0 for leg pain. One month later both VAS scores were 0 and the patient reported no dizziness. Conclusions: MHI is a rare but potentially serious complication of water-medium spinal endoscopy. Prevention, early recognition, and prompt symptomatic and supportive care usually produce symptom relief within 1 h and complete resolution within 24 h. The UBD technique, which allows switching between air and water media, appears effective in preventing and treating MHI.

Keywords

Lumbar Disc Herniation, Myeloid Hypertension Like Syndrome, Uni-portal Bi-channel & Dual-media Spinal Endoscope, Back Pain, Anesthesia Resuscitation, Lumbar Disc Herniation

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1. Background

The UBD working sleeve consists of two channels, one for the endoscope channel and the other one for the working channel, which are slightly angled and form a "V" shape in lateral view. The two channels can be combined with each other, either with conventional endoscopes or with specially designed thin-diameter endoscopes, which can be enlarged to allow for large-space operations on the dorsal side, such as endoscopic fusion and posterior decompression fusion surgery [1]. Compared to traditional spinal endoscopic techniques, UBD technology greatly improves the efficiency of endoscopic surgery, with clearer and wider surgical vision, more precise and flexible operation, less limited use of instruments, and unique advantages in the minimally invasive treatment of complex lumbar degenerative diseases, especially free lumbar disc herniation and lumbar spinal stenosis [2].

With the promotion and application of UBD technology, related surgical complications have been continuously reported, such as dorsal ganglion injury, dural tear, epidural hematoma, nerve root injury, etc. This paper summarizes a rare case of MHI after UBD surgery in the Department of Spine Surgery at the Shanghai Tenth People's Hospital affiliated to Tongji University. It also reviews the mechanism of UBD-induced MHI, the clinical manifestations, diagnosis and treatment progress, and preventive measures.

2. Case Presentation

2.1. Clinical Data

A 44-year-old male patient with low back pain for more than 2 years and left lower limb pain for more than 3 months was admitted to the hospital. After oral medication, physical therapy and other treatments, there was no improvement. The VAS score for low back pain and leg pain were 7 and 7, respectively. The patient was previously in good health, without a history of hypertension, epilepsy, or neurological diseases.

The patient 's physical examination showed that body temperature was 36.5 ℃, heart rate was 70 bpm, blood pressure was 124/88 mmHg, respiratory rate was 18 breaths per minute, positive tenderness, positive straight leg raising test of the left lower limb at 40 °, positive strengthening test and percussion pain around the spinous process of the lumbosacral segment. The skin sensation on the lateral side of the left thigh and posterior lateral calf is decreased compared to the contralateral side. The patient is 183 cm tall and weighs 88 kg, with a BMI of 26.2 kg/m^2.

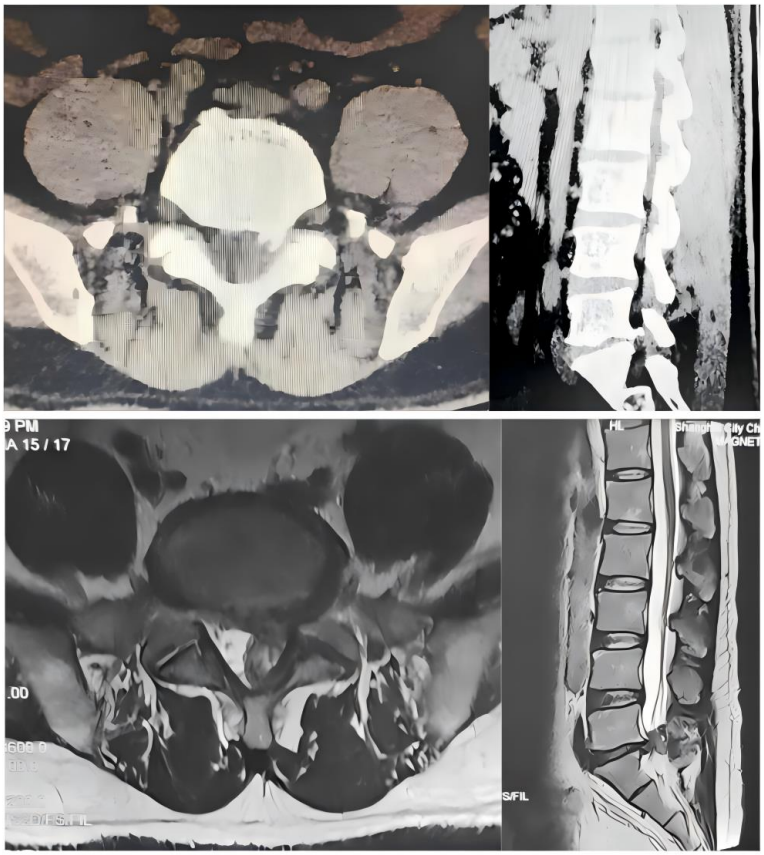

Figure 1. *Preoperative MRI and CT view. Patient was suffered from prompt lumbar degenerative disease, L5 / S1 disc herniation, the corresponding level of spinal stenosis.*

MRI in another hospital suggested L5/S1 intervertebral disc protrusion (Figure 1). After admission in our hospital, preoperative examinations were completed, and the patient's surgical indications were clear with no surgical contraindications. Therefore, under general anesthesia, the patient underwent L5/S1 intervertebral nucleus pulposus resection via the UBD endoscopic system through the interlaminar approach.

2.2. Surgical Procedure

After the general anesthesia took effect, the prone position was taken, and the position of the lamina space was determined by X-ray. The routine operation area was disinfected and paved. The middle transverse incision next to the L5 / S1 gap on the lower back was taken and placed in the UBD working channel. The medial edge of the vertebral plate was removed by microscopic grinding drill, and the partial adhesion between the ligamentum flavum and the dura mater was detected. After the ligamentum flavum was carefully separated by forceps, the channel was rotated and placed. The protruding nucleus pulposus tissue was carefully removed, and the bleeding was stopped. The shoulder and axilla of the root of the outlet were completely decompressed. The total operation time was 80 min, the irrigation time under the channel was 70 min, the total lavage fluid was 3000 ml normal saline (normal temperature saline), and the intraoperative blood loss was about 20 ml. The intraoperative systolic blood pressure fluctuated between 140-110 mmHg, the diastolic blood pressure fluctuated between 60-80 mmHg, and the heart rate fluctuated between 50-80 beats / min.

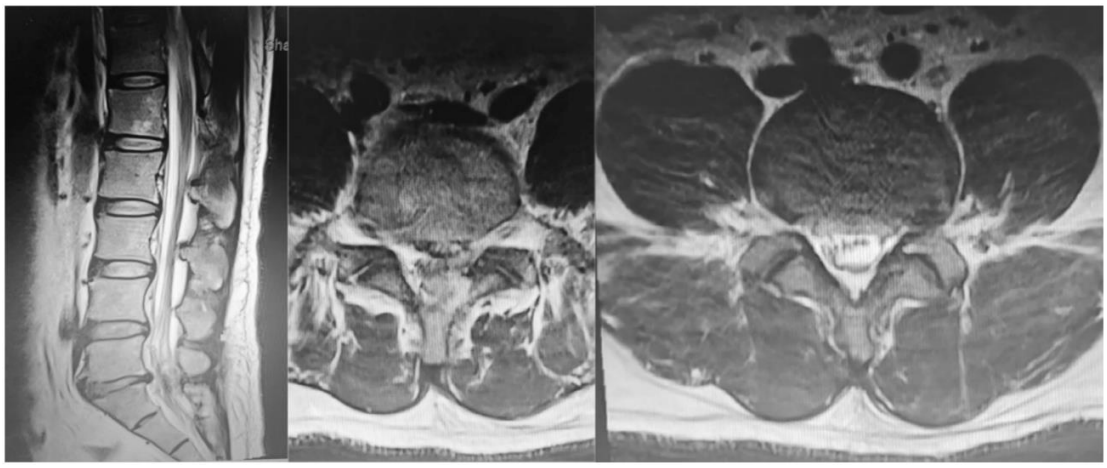

Figure 2. *Postoperative MRI view. L5 / S1 spinal canal decompression is sufficient, and there is no obvious hematoma compression.*

After being transferred to the anesthesia recovery room for anesthesia recovery for 15 minutes, the patient complained of pain at the surgical incision sites on his neck, head, back and waist, as well as numbness and paralysis in both lower limbs, with irritability. At this time, the blood pressure was 200/180 mmHg. Nitroglycerin (100μg/min intravenous infusion for 15 minutes) was given to reduce blood pressure, but after medication, there was no significant decrease in hypertension. They immediately received intravenously administered midazolam injection (5mg), butorphanol tartrate injection (1mg), dexmedetomidine hydrochloride injection at a concentration of 4μg/ml at a dose of 1μg/kg continuous intravenous infusion over 50 minutes, intravenous methylprednisolone sodium succinate 40mg injection, and mannitol 250ml injection intravenously for sedation and swelling reduction treatment. After that, sedation, analgesia and dehydration were continued, and the blood pressure gradually decreased. After 1 hour, the patient's muscle strength gradually recovered and the muscle tension returned to normal. Immediately perform a head MRI to exclude vascular accidents, Spinal MRI plain scan showed that the spinal canal decompression of L5/S1 was sufficient, and no obvious signs of spinal injury and hematoma compression were observed. The cauda equina sedimentation sign is positive, indicating that the pressure in the spinal canal was higher at this time (Figure 2). Invite neurology emergency consultation and complete electroencephalogram, electromyogram, no abnormalities were found, excluding hysteria, epilepsy and other diseases.

12 hours after surgery, the patient had no symptoms of dizziness, headache, etc. The VAS scores for low back pain and leg pain were 1 and 0, respectively. Vital signs were stable, and limb muscle strength and muscle tone were normal. Considering the relevant symptoms after surgery, the patient was diagnosed with spinal cord high pressure syndrome. Three days after surgery, the patient improved and was discharged.

One month after surgery, the patient was followed up by telephone. The patient's VAS scores for low back pain and leg pain were both 0. After discharge, there were no symptoms of dizziness, headache, neck pain, and abnormal sensation in both lower limbs (Table 1).

Table 1. Patient-related symptoms and signs.

Postoperative duration	15 minutes	30 minutes	45 minutes	1 hour	2 hours	3 hours	12 hours	24 hours
Blood pressure (mmHg)	180/120	180/110	200/120	159/90	150/100	140/80	120/75	120/80
Heart rate (bpm)	90	110	130	110	100	90	80	86
Neck pain (VAS score)	3	1	1	1	0	0	0	0
Stoma pain (VAS score)	5	3	3	3	3	3	1	1
Muscle strength of both lower limbs (LOVETT classification)	0	0	0	1	3	4	5	5
Muscle tension (ASHWORTH grade)	2	2	2	1	0	0	0	0
Sensory disorder plane	Below umbilical level	Below umbilical level	Below umbilical level	Below the middle of groin	Normal	Normal	Normal	Normal
Irritability	Yes	Yes	Yes	Yes	No	No	No	No
Defecation	-	-	Incontinence	-	-	-	-	Normal
Key treatment	Butorphanol tartrate injection 1mg	Position head high feet low; midazolam injection 5mg	Dexmedetomidine hydrochloride injection 60ug; mannitol injection 250ml; methylprednisolone 40mg					

3. Treatment and Prognostic

The syndrome of spinal cord compression-like hypertension is mostly transient and has a good prognosis. The treatment mainly focuses on early diagnosis, symptomatic treatment, and life support. There is no consensus on the early diagnosis criteria of the syndrome of spinal cord compression-like hypertension. Based on previous literature reports, patients who undergo lumbar endoscopic surgery under water medium may experience emotional tension, anxiety, sense of impending death, neck and back muscle pain/spasm, limb sensory and motor dysfunction, and progressively increasing foreign body sensation in the perineum. These symptoms can be diagnosed as the syndrome of spinal cord compression-like hypertension. At the same time, it needs to exclude surgical pain stimulation, cardiovascular and cerebrovascular diseases, acute water intoxication with hyperchloremia, nervous system diseases, and a history of epilepsy [3, 4].

When patients show symptoms of the syndrome of spinal cord compression-like hypertension during surgery, it is recommended to immediately adjust the body position to ensure that the head is higher than the feet, reduce the perfusion pressure of the irrigation fluid, and give sedation and treatment to lower the intracranial pressure according to the situation [5]. For patients who develop the syndrome of spinal cord compression-like hypertension during surgery, reducing the height of the irrigation fluid, suspending perfusion for more than 5 minutes, most patients will naturally be relieved. If the symptoms are not improved after reducing the irrigation fluid, changing the body position, or suspending the operation for a period of time, analgesics and sedatives can be added for symptomatic treatment. At the same time, the operation should be completed as soon as possible. If the patient experiences respiratory difficulties or severe convulsions and consciousness damage, the operation should be terminated immediately and emergency treatment should be given.

For cases of spinal cord compression-like hypertension reported in previous literature, early detection and early symptomatic treatment and life support therapy can usually relieve symptoms within 1 hour and completely eliminate symptoms within 24 hours. There are no related sequelae in short-term follow-up after surgery.

4. Discussion and Conclusions

The endoscopic spinal surgery is one of the commonly effective methods for the treatment of lumbar degenerative diseases. With the increasing attention of scholars at home and abroad to endoscopic spinal surgery, more and more

reports are emerging on the relatively rare and unexpected unique complications of endoscopic spinal surgery. The clinical manifestations are a series of systemic reactions such as transient headache and neck pain, neck and back muscle spasms, arch retractions, irritability, near-death feelings, sensory and motor dysfunction of the limbs, and genital foreign body sensation [3]. These complications can occur during intraoperative water-based endoscopic spinal surgery (local anesthesia), and also after surgery (general anesthesia) [4]. The incidence rate is 0.37-0.93% [6-8].

The pathogenesis of these complications is currently unclear. Choi et al. [9] believe that the main cause of them is epileptic seizures during surgery due to increased intracranial pressure (ICP) in percutaneous endoscopic spinal surgery, so they call this concurrent state as perioperative seizures. Kim et al. reported 1 case of dural rupture and subsequent seizure of this type. The author believes that intraoperative dural rupture and flushing fluid entering the subarachnoid space leads to increased intracranial pressure, which is the main cause of this type of epileptic seizure. Lin et al. believe that foreign substances (such as iodixanol, cefazolin, air, and fat) entering the cerebrospinal fluid (CSF) space during surgery is one of the possible reasons [6]. In addition, it has also been reported that personal or family history of epilepsy or craniofacial trauma history is an important cause of perioperative epileptic seizures in percutaneous endoscopic spinal surgery [10].

Some Chinese scholars have also proposed the concept of MHI [3]. Zhang et al. [11] believe that MHI may belong to a type of venous hypertensive myelopathy (VHM) syndrome. Kendall et al. [12] believe that the supplying artery from the intercostal artery spinal branch enters the spinal surface veins through the rupture in the dura mater, which causes increased pressure in the veins, subsequently induces spinal congestion and microcirculation dysfunction, and ultimately impairs spinal function and causes a series of neurological symptoms.

4.1. Factors Affect This Type of Complication

4.1.1. Intraoperative High Perfusion Pressure

Choi et al. found that the epidural sheath was compressed in a "Y" shape in patients who developed neck pain after surgery through lumbar MRI examination [13]. Joh et al. measured 8 patients who developed perioperative epileptic seizures and found that the epidural pressure outside the cervical spine was significantly higher than that of normal patients at the time of complication occurrence [9]. Xin Zhijun et al. found that the risk of MHI was higher through posterior approach compared to intervertebral foramen approach, which may be related to the fact that irrigation fluid directly applies pressure to the epidural sheath through the posterior approach, making it easier to cause increased intracranial pressure [14].

4.1.2. Intraoperative Dural Tear

Multiple studies have found that MHI often occurs secondary to intraoperative dural tear. It is considered that the irrigation fluid flows reversely through the dural tear, directly stimulating the spinal surface or rapidly increasing the pressure inside the dura mater, compressing the spinal cord. Zhang et al. reported 4 patients who developed increased heart rate, elevated blood pressure, convulsions, irritability and extreme fear, accompanied by numbness and discomfort of both lower limbs, cold, perineal numbness, bulge and abnormal sensory plane elevation during the operation. Careful examination of the surgical field found that all patients had dural tears. The liquid flow in the vertebral canal after dural tear [11]. Ying et al. suggested that during normal surgery, the irrigation fluid is distributed in the epidural space, and the intact epidural sheath and cerebrospinal fluid act as a buffer against the pressure generated by irrigation fluid. However, when the dura mater is ruptured, the pressure generated by irrigation fluid exerts a squeezing effect on the epidural sheath of the surgical area, and cerebrospinal fluid leaks out through the tear. At the same time, a large amount of irrigation fluid is injected into the epidural sheath through the rupture site. Under magnetic resonance imaging, it can be seen that cerebrospinal fluid spaces gradually expand and their pressure increases significantly [15]. Lin et al. also believed that foreign substances (such as iodixanol, cefazolin, air, and fat) entering the CSF space during surgery may be one of the possible reasons [6].

4.1.3. Anesthetic Drugs and Anesthesia Methods

Epileptic seizures are usually related to local anesthesia, but the relationship between anesthesia methods and MHI remains controversial. Some scholars believe that since endoscopic spinal surgery is mostly performed under local anesthesia, MHI can be detected during surgery. When general anesthesia with tracheal intubation is used, patients' circulation and respiration are controlled by anesthetic drugs and ventilators during surgery. Under general anesthesia, patients' responses cannot be feedback, making it difficult to determine whether this complication occurs in patients under general anesthesia. Some anesthetic agents can also cause epileptic seizures, such as sevoflurane and propofol, chloral hydrate, opioids, but the relationship and mechanism between anesthetic drugs and MHI remain unclear [4].

4.1.4. Longer Operation Time

Longer perfusion time and faster perfusion speed are considered to be important risk factors for MHI. An animal experiment showed that peak epidural pressure and intracranial pressure are positively correlated with perfusion speed, while the height of irrigation fluid in the epidural space is positively proportional to perfusion time [16]. Han et al. showed that when the height of irrigation fluid suspension exceeds 1.9 meters during surgery, the incidence of MHI is higher. After reducing the height of irrigation fluid suspension, most discomfort symptoms can be alleviated in a timely manner [17].

4.1.5. Anxiety / Depression

Sang-Wook Shin et al. believed that perioperative seizures may resemble generalized or partial seizures, but do not involve abnormal cortical neuronal discharge. They are caused by physiological or psychological conditions. Previously, some scholars found that perioperative seizures usually occur mainly in women and are related to previous mental illness. The patient in this study had no history of any mental illness, but showed anxiety tendency during preoperative evaluation. However, the physiological environment after surgery, including hypothermia, hypoxia, hypoglycemia, hyponatremia, and arrhythmia, exacerbated the psychological stress response. Therefore, abnormal psychological states may also be a predisposing factor for perioperative seizures [18].

4.1.6. Temperature of Irrigation Fluid

In addition, there are also reports that the low temperature of the irrigation fluid during surgery is also an important cause of seizures during the perioperative period of percutaneous endoscopic spine surgery [19]. Using normal temperature saline as irrigation fluid, the water temperature is lower than body temperature, which can stimulate spinal cord vascular contraction after entering the spinal canal, leading to spinal cord ischemia. Some studies have pointed out that using 37 ° body temperature saline for flushing can reduce the occurrence of adverse reactions in spine endoscopy, alleviate local inflammatory reactions, reduce intraoperative bleeding, and shorten operation time.

4.2. Preventive Measure

The preventive measures for spinal cord-like high pressure syndrome mainly include avoiding dural injury during surgery and reducing the compression and stimulation of the dural membrane by irrigation fluid. (1) During surgery, careful operation is required to avoid dural rupture. Once dural tear occurs, attention should be paid to reducing the perfusion pressure and promptly treating the breach to complete the surgery as soon as possible and shorten the perfusion time. If the UBD technique is used for surgery, immediate switching to air medium when dural tear is detected during surgery. (2) Try to shorten the operation time. When the perfusion pressure is constant, the longer the irrigation time, the larger the irrigation channel, and the more fluid in the internal/external spinal cord cavity. During UBD surgery, priority should be given to using a 3.8mm internal diameter UBD decompression working channel to perform surgery, which can effectively reduce the amount of fluid flowing into the epidural cavity and reduce the pressure borne by the epidural space. (3) Reduce the irrigation speed of surgical irrigation fluid. While ensuring that the requirements of endoscopic visual operation and work efficiency can be met, the irrigation speed should be minimized. The irrigation speed should be maintained below 100mL/min, and the height of the irrigation tower should be less than 1.80m [17]. (4) Avoid using saline-containing impurities (such as iodine hexanol and cefazolin) during surgery. If dural sac damage is found during surgery, surgery should be completed or water medium should be closed as soon as possible to prevent air or fat from entering the dural sac [6]. (5) Prioritize transforaminal approach surgery to avoid perfusion fluid directly impacting the dural sac through posterior interlaminar approach [14]. (6) During surgery, avoid positioning with head low and feet high. Closely monitor various signs of patients, such as early signs of increased blood pressure and heart rate, and take immediate measures to prevent further deterioration of the condition. (7) Conduct detailed medical history inquiry and screening before surgery. If patients have a history of intracranial disease or neuropsychiatric disease, relevant departments should be consulted to assess whether they can tolerate UBD surgery.

In conclusion, MHI is a rare but potentially serious complication of water-medium spinal endoscopy. Prevention, early recognition, and prompt symptomatic and supportive care usually produce symptom relief within 1 h and complete resolution within 24 h. The UBD technique, which allows switching between air and water media, appears effective in preventing and treating MHI.

Abbreviations

UBD	Uni-portal Bi-channel & Dual-media Spinal Endoscope
MHI	Myeloid Hypertension Like Syndrome
ICP	Increased Intracranial Pressure
CSF	Cerebrospinal Fluid
VHM	Venous Hypertensive Myelopathy

Author Contributions

Furui Liu: Data curation, Investigation, Methodology, Writing – original draft

Yukun Wang: Data curation, Investigation, Writing – original draft

Huang Yan: Conceptualization, Methodology, Resources, Visualization

Yunshan Fan: Methodology

Shisheng He: Conceptualization, Funding acquisition, Resources, Supervision, Writing – review & editing

Consent for Publication

The patient has given written informed consent for personal or clinical details along with the identifying image to be published in this study.

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Availability of Data and Materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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