INTERVENTIONAL RADIOLOGY
Official journal of the Japanese Society of Interventional Radiology and Asia Pacific Society of Cardiovascular and Interventional Radiology

CASE REPORT

Spinal Hematoma as a Rare Complication of Balloon-occluded Retrograde Transvenous Obliteration for Gastric Varices: A Case Report

Hiroaki Hagiwara[1)], Yuka Takeuchi[1)], Midori Komita[1)], Naofumi Yasuda[1)], Airi Higa[2)] and Masaaki Kondo[2)]

1) Department of Radiology, Yokohama Minami Kyosai Hospital, Japan
2) Department of Gastroenterology, Yokohama Minami Kyosai Hospital, Japan

Abstract:
We report a case of lumbar spinal hematoma caused by balloon-occluded retrograde transvenous obliteration for gastric varices in a woman in her 60 s with liver cirrhosis due to non-alcoholic steatohepatitis. The patient presented to the emergency department with a chief complaint of sudden nausea and hematemesis. Endoscopic sclerotherapy was performed, followed by balloon-occluded retrograde transvenous obliteration for residual varices. During balloon-occluded retrograde transvenous obliteration, she complained of back pain and subsequently developed thigh pain. CT and MR scans revealed subdural hematoma and subarachnoid hemorrhage within the spinal canal at the thoracolumbar level. It is presumed that balloon-occluded retrograde transvenous obliteration altered blood flow in the paravertebral plexus, causing an intraspinal canal hemorrhage. To our knowledge, this study is the first to report a case of an iatrogenic spinal hematoma caused by balloon-occluded retrograde transvenous obliteration.

Keywords:
balloon-occluded retrograde transvenous obliteration, gastric varices, spinal hematoma, spinal subdural hematoma, spinal subarachnoid hemorrhage

Interventional Radiology 2025; 10: e2024-0006
https://doi.org/10.22575/interventionalradiology.2024-0006
https://ir-journal.jp/

Introduction

Since its initial description by Kanagawa et al. in 1996, balloon-occluded retrograde transvenous obliteration (B-RTO) has been recognized as an effective treatment for gastric varices [1]. Complications associated with B-RTO are those related to the initial procedure and late portal hypertension. Typical early complications, such as nausea, back pain, fever, and hematuria, are prevalent in a significant percentage of cases [2]. However, they are transient and self-limiting.

In this study, we present a case of thoracolumbar spinal hematoma that occurred as a complication of B-RTO for gastric varices. To our knowledge, there are no previous reports on spinal hematomas caused by B-RTO. In this report, we outline our case and discuss the underlying mechanisms.

Case Report

A woman in her 60s with a history of liver cirrhosis due to NASH presented to the emergency room with a chief complaint of sudden nausea and dark-red vomiting. Contrast-enhanced CT revealed large gastric varices but no active bleeding. The gastric varices were confirmed to have been supplied through the posterior gastric vein, draining into the inferior phrenic vein (**Fig. 1A and 1B**).

Abnormal laboratory test results on admission were as follows: albumin, 3.5 g/DL (normal range, 4.1-5.1 g/dL); hemoglobin, 10.5 g/dL (normal range, 11.6-14.8 g/dL); platelet count, 8.4 × 10^3/μl (normal range, 15.8-34.8 × 10^3/mcL); prothrombin time, 13.3 s (normal range, 10.0-13.0 s); and activated partial thromboplastin clotting time (APTT), 23.7 s (normal range, 25.0-40.0). Her hepatic impairment status was Child-Pugh class A (mild hepatic impairment). Emergency endoscopy revealed varicose veins with white plugs, indicating bleeding but no active bleeding. Therefore, endoscopic sclerotherapy was performed the following day. A mixture of 1 ml of n-BCA (Histoacryl; B. Braun, Melsungen, Germany) and 0.5 cc Lipiodol (Lipiodol 480 injection; Guerbet Japan, Tokyo, Japan) was injected into the gastric

Corresponding author: Hiroaki Hagiwara, hhagi1936@gmail.com
Received: January 24, 2024, Accepted: March 17, 2024, Advance Publication by J-STAGE: August 7, 2024

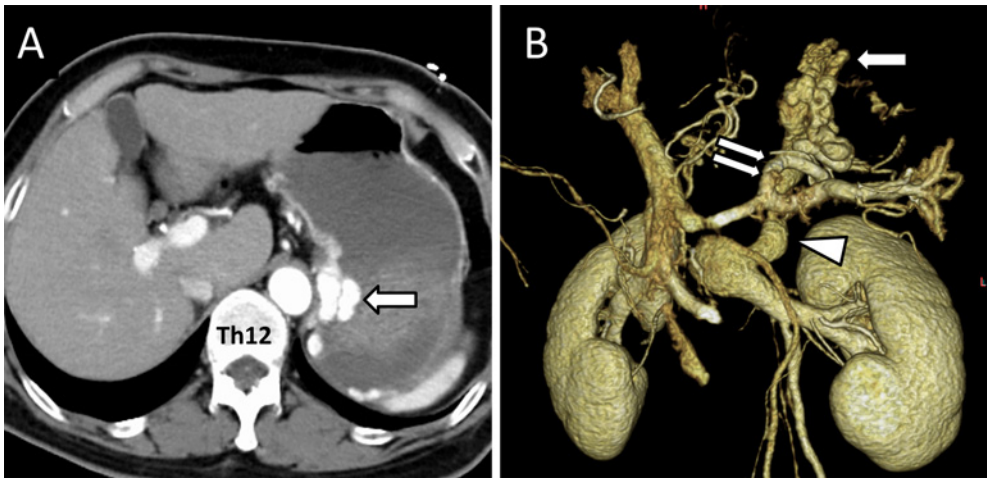

Figure 1. Contrast-enhanced CT at ER. A: Early phase of contrast-enhanced CT revealed large varices protruding into the gastric lumen (white arrow). There was no contrast extravasation suggestive of active bleeding. B: In 3D volume rendering images, gastric varices (white arrow) were found to receive blood from the posterior gastric vein (double white arrow) and drain to the inferior phrenic vein (arrowhead).

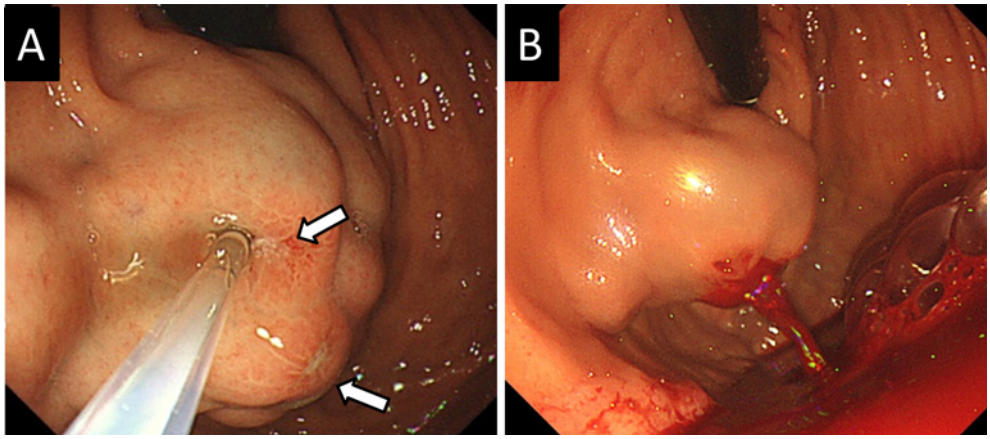

Figure 2. Emergency endoscopy. A: Gastric fundal varices with white plugs (white arrows) in retroflex view were observed. A catheter is inserted to inject NBCA. B: After injection, bleeding that could not be controlled with an endoscope appeared from the puncture site.

varices (**Fig. 2A**). However, after the catheter was removed, bleeding could not be controlled with endoscopic manipulation (**Fig. 2B**), and cessation was achieved by placing an S-B tube (All Silicone Sengstaken-Blakemore Tube; Create Medic Co., Yokohama, Japan).

Based on the CT findings, gastric varices with residual blood flow were determined to be treatable with B-RTO, and B-RTO was performed 4 days after onset.

An 8Fr-guiding catheter (BRTO-ASA, Medikit, Tokyo, Japan) was introduced into the left adrenal vein via the right femoral vein under local anesthesia. Subsequently, a 6Fr balloon catheter (Selecon MP Catheter 2, Terumo Clinical Supply Co. Ltd., Gifu, Japan) was advanced peripherally into the left inferior phrenic vein via the 8Fr-guiding catheter. Retrograde venography during balloon occlusion of the left inferior phrenic vein with manual injection revealed gastric varices, afferent veins, and paravertebral collateral veins (**Fig. 3A**). To prevent leakage into the collateral veins, the balloon catheter was advanced distally, the balloon was reinflated, and venography was repeated with manual injection, which revealed only the gastric varices and their afferents (**Fig. 3B**). At this site, where the collateral veins had disappeared, 8 mL of 5% ethanolamine oleate with iopamidol (EOI) (a mixture of 10% ethanolamine oleate [Oldamin, ASKA Pharmaceutical, Osaka, Japan] an equal amount of iopamidol [Iopamiron 300, Bayer, Osaka, Japan]) was injected.

Prior to the EOI injection, the patient complained of left chest pain, but there were no electrocardiogram abnormalities. Immediately after the EOI was injected, her condition was checked, and she complained of back pain, which was not present before the EOI injection, but not epigastric pain.

The balloon remained inflated, and after confirmation that blood flow had disappeared on venography 4 h later, the balloon was deflated, and the catheter was removed.

Subsequently, the patient developed severe back pain and

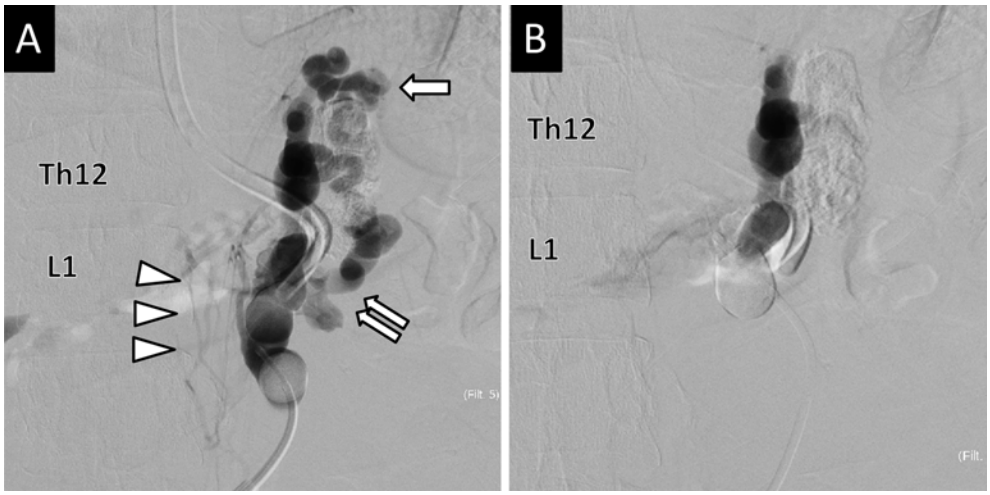

Figure 3. B-RTO. A: Retrograde venography under balloon occlusion of the left inferior phrenic vein demonstrated the gastric varices (white arrow) and its afferent vein from the posterior gastric vein (double white arrows). An anastomosis to the paravertebral vein (arrowheads) can be seen just above the cranial side of the inflated balloon. B: The balloon was inflated distal to the anastomosis to the paravertebral vein, and the EOI was injected from this location, where only the gastric varices were visualized.

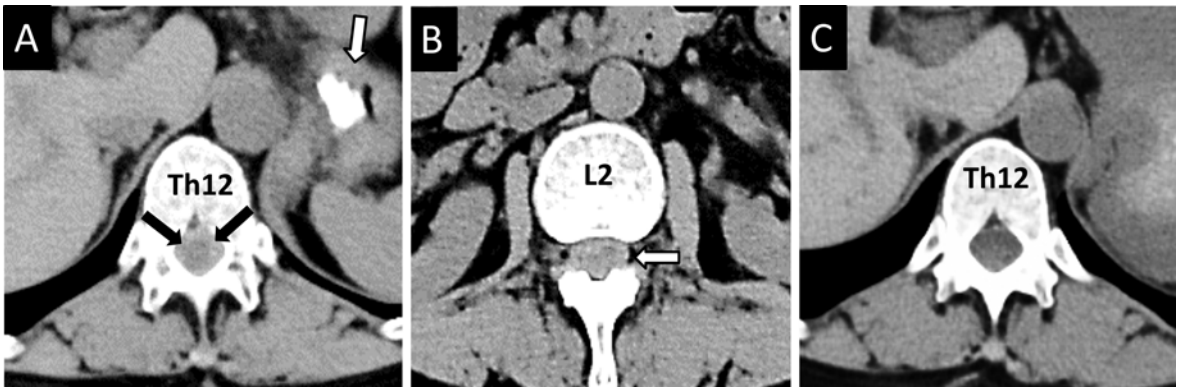

Figure 4. A: Noncontrast CT the day after B-RTO. In the axial image of the 12th thoracic vertebra (Th12) level, the spinal cord was surrounded by high density, which suggests subarachnoid hemorrhage (black arrows). Lipiodol accumulation by EIS was observed in the gastric varices (white arrow). B: Noncontrast CT the day after B-RTO. At the second lumbar vertebra (L2) level, the outline of the dural sac is clearly delineated (white arrow), and the lumen of the dural sac is high density, which suggests subarachnoid hemorrhage. C: Noncontrast CT at ER. In the axial image of the 12th thoracic vertebra (Th12) level, the attenuation within the spinal canal is homogeneous, and it is difficult to distinguish between the spinal cord and cerebrospinal fluid.

bilateral thigh pain. CT was performed the following day to identify the cause of the pain and showed embolization of the varicose veins. However, a high-density area was found around the spinal cord in the thoracolumbar spinal canal (**Fig. 4A and 4B**), which was not recognized in the prior CT on admission (**Fig. 4C**). Suspecting hemorrhage within the dural sac, a lumbar MRI was subsequently performed. In T1- and T2-weighted sagittal images, the water signal in the cerebrospinal fluid space was obscured, and the contrast between the spinal cord and cerebrospinal fluid was decreased, indicating a subarachnoid hemorrhage when combined with the CT findings (**Fig. 5A and 5B**). T2-weighted axial images showed a crescent-shaped low signal in the left posterior part of the spinal cord within the dural sac, which was believed to be a subdural hematoma (**Fig. 5C**), due to which the spinal cord had deviated to the right.

Although the pain was severe in the lower back, buttocks, and thighs, there was no motor paralysis; therefore, pain control and conservative treatment were performed. In the T1-weighted MRI image taken 1 week after B-RTO, the subdural hematoma had an increased signal and could be recognized as a clear, high-intensity area on the T1-weighted images (**Fig. 6A and 6B**).

Although the patient's symptoms disappeared after 1 month, she was discharged from the hospital without any sequelae.

Discussion

B-RTO is widely accepted as an interventional therapy for

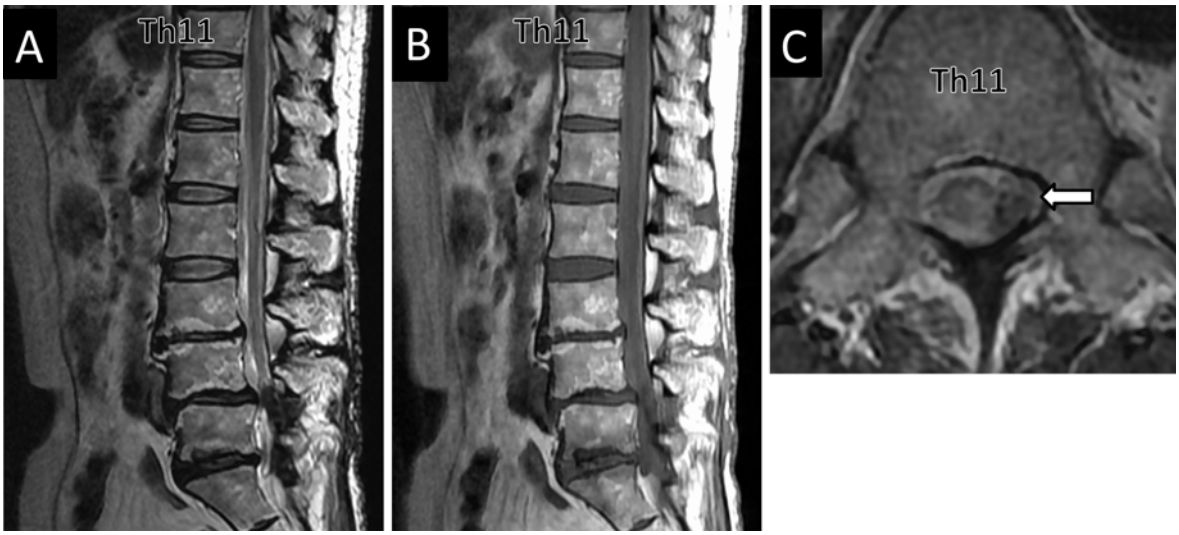

Figure 5. MRI performed the day after B-RTO. A: In T2-weighted sagittal image, the CSF signal within the dural sac is heterogeneous. Incidental lumbar spinal canal stenosis is noted at the lower lumbar level. B: In T1-weighted sagittal image, the CSF signal dorsally increases, with poor contrast with the spinal cord. C: T2-weighted axial image shows a crescent-shaped low-signal subdural hematoma in the dural sac with spinal cord deviation (white arrow).

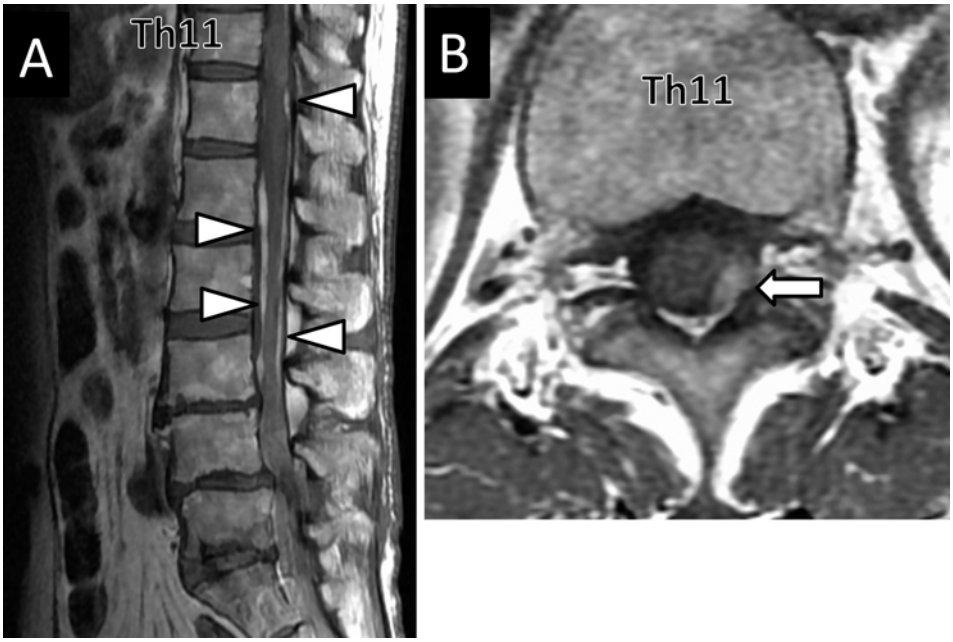

Figure 6. MRI performed 1 week after B-RTO. A: T1-weighted sagittal image shows subdural hematoma (arrowheads) as high-intensity area along inner edge of dural sac. B: T1-weighted axial image shows subdural hematoma as crescent high intensity (white arrow).

gastric varices. Most of its complications, such as nausea, epigastric pain, hematuria, fever, and back pain, are transient and self-limiting [3]. Serious complications, such as pulmonary embolism, ascites, pleural effusion, liver failure, cardiogenic shock, and gastric ulcers, some of which can be fatal, have been also reported. However, spinal hemorrhage has not been reported. In a meta-analysis of 1016 patients from 24 studies, the frequency of significant complications defined according to the Society of Interventional Radiology clinical practice guidelines was 2.6% [4]. Two of these cases resulted in procedure-related death (defined as death within 24 h of B-RTO), both of which had concomitant HCC; one case had a tumor embolism in the right branch of the portal vein prior to B-RTO, and the other had Child-Pugh class C liver cirrhosis. In addition, although rare, life-threatening complications, such as anaphylactic shock and cerebral embolism, have been reported [5, 6].

In this case, thoracolumbar spinal hemorrhage can be considered as a complication of B-RTO since lower back pain as a symptom of hemorrhage developed during the procedure. The most likely cause of hemorrhage was balloon obstruction of the efferent flow, which caused a sudden increase in collateral paravertebral venous blood flow, increasing venous pressure within the spinal canal and eventually

causing the vein to rupture. The venous plexus in the spinal canal (internal vertebral venous plexus) consists of the anterior plexus located behind the vertebral body and the posterior plexus located in front of the vertebral arch. These venous plexuses communicate with the external vertebral venous plexus around the vertebrae via basivertebral vein in the vertebral body and intervertebral vein in the intervertebral foramina. Since the vertebral venous system is a valveless network, blood flow is affected in various pathological conditions in the retroperitoneum. Cases of epidural varices caused by inferior vena cava thrombosis, inferior vena cava agenesis, and Budd-Chiari syndrome have been frequently reported [7]. A case of varicose veins due to portal vein thrombosis was also reported, and this case also developed cauda equina syndrome [8].

There are two possible routes of blood flow to the vertebral venous plexus in this case. First, the initial balloon dilation in the distal inferior phrenic vein allowed the outflow of blood from the gastric varices directly into the paravertebral vein. This possibility is supported by the fact that the onset of low back pain occurred early during the procedure. Second, the gastric varices were occluded by the injection of EOI, and portal vein blood flow, which could no longer flow into the varices, flowed into the paravertebral vein. This second possibility is supported by the fact that the patient's symptoms worsened to include not only lower back pain but also thigh pain, suggesting that bleeding continued after the procedure. However, it is difficult to distinguish between these two possibilities. A decrease in platelets due to pancytopenia associated with liver cirrhosis is another factor that can cause hemorrhage. However, the patient has no history of surgery that could affect the retroperitoneal vein circulation, and there was no history of anticoagulant therapy.

A meta-analysis with 613 patients revealed that in one-third of spinal hematomas, no etiology was identified as the cause of bleeding [9]. After idiopathic spinal hematoma, anticoagulant-related treatments and vascular malformations emerged as the second and third most common cause, respectively. Other common causes of idiopathic spinal hematoma include spinal and epidural anesthesia combined with anticoagulation therapy. The cranial extension of the spinal hematomas included in this analysis displayed two peaks: one in the middle to upper cervical region and the other in the lower thoracic region of the spinal column. Epidural hematoma was the most prevalent hematoma within the spinal canal (75%), followed by subarachnoid hemorrhage (16%) and subdural hematoma (4.1%). The rates of bleeding involving multiple layers were 1.5%, 0.33%, and 0.33% in combined epi- and subdural, combined epidural/subarachnoid, and combined subarachnoid/subdural/subarachnoid hematomas, respectively. It is noteworthy that combined subdural/subarachnoid bleeding, as observed in our case, was not addressed in this meta-analysis, indicating that it may be extremely rare. Iatrogenic intraspinal bleeding is rare; common causes of this phenomenon include anticoagulation, spinal anesthesia, lumbar puncture, and spinal surgery. Regarding other causes, one case has been reported in which bleeding occurred after removing the catheter tip of the central venous line that had penetrated the jugular vein and entered the intervertebral foramen [10]. To our knowledge, there are no previous reports on cases of bleeding into the spinal canal associated with B-RTO or other intravascular interventions.

In this case, when the patient complained of back pain, we assumed that it is similar to the usual epigastric pain caused by EOI injection. When she complained of thigh pain, we finally realized that an unusual complication was occurring. We emphasize that patient complaints should always be interpreted with caution, as unexpected complications can always occur in intravascular interventions. Based on our experience, we recommend that retrograde venography under balloon occlusion should be performed with caution due to the risk of spinal hemorrhage.

Acknowledgement: We would like to thank Jun Ogasawara for the image acquisition and processing. We would also like to thank Editage (www.editage.jp) for English language editing.

Conflict of Interest: None

Author Contribution: All authors were directly involved in the case and made significant contributions to the report. Each author was either involved in the conception, execution, acquisition of data, analysis, and interpretation or in all these areas. Furthermore, each author took part in drafting, revising, or critically reviewing the article, gave final approval of the version to be published, agreed on the journal to which the article has been submitted, and agreed to be accountable for all aspects of the work.

Informed Consent: Informed consent for use of medical records and submission of this case report was obtained from the patient.

References

1. Kanagawa H, Mima S, Kouyama H, Gotoh K, Uchida T, Okuda K. Treatment of gastric fundal varices by balloon-occluded retrograde transvenous obliteration. J Gastroenterol Hepatol. 1996; 11: 51-58.
2. Cho SK, Shin SW, Lee IH, et al. Balloon-occluded retrograde transvenous obliteration of gastric varices: outcomes and complications in 49 patients. AJR Am J Roentgenol. 2007; 189: W365-W372.
3. Patel A, Fischman AM, Saad WE. Balloon-occluded retrograde transvenous obliteration of gastric varices. AJR Am J Roentgenol. 2012; 199: 721-729.
4. Park JK, Saab S, Kee ST, et al. Balloon-occluded retrograde transvenous obliteration (BRTO) for treatment of gastric varices: review and meta-analysis. Dig Dis Sci. 2015; 60: 1543-1553.
5. Hirota S, Matsumoto S, Tomita M, Sako M, Kono M. Retrograde transvenous obliteration of gastric varices. Radiology. 1999; 211: 349-356.
6. Miyayama S, Yamashiro M, Ikeda R, et al. Cerebral embolism as a rare complication of balloon-occluded retrograde transvenous obliteration for gastric varices: A case report. Interv Radiol (Higashimatsuyama). 2021; 6: 9-13.
7. Lee JH, Song WJ, Kang KC. Myelopathy-mimicking symptoms of epidural venous engorgement and syringomyelia due to inferior

vena cava stenosis at the thoracolumbar junction in a patient with Budd-Chiari syndrome. J Neurosurg Spine. 2015; 23: 467-470.

8. Campione A, Agresta G, Locatelli D, Pozzi F. Cauda equina syndrome secondary to portal vein thrombosis: case report of favorable outcome with conservative treatment. J Neurosurg Spine. 2021; 1: 1-6.

9. Kreppel D, Antoniadis G, Seeling W. Spinal hematoma: a literature survey with meta-analysis of 613 patients. Neurosurg Rev. 2003; 26: 1-49.

10. Yokoyama K, Kawanishi M, Yamada M, Tanaka H, Ito Y, Kuroiwa T. Spinal epidural hematoma following removal of incorrectly placed jugular central venous catheter. J Neurosurg Spine. 2011; 15: 206-209.