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*Case Report*

# Stent placement for treatment of internal jugular vein stenosis: report of 3 cases

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**Abstract:** Internal jugular vein (IJV) is one of the central veins and is the largest vein in neck. The application of endovascular stent placement in internal jugular vein stenosis (IJVS) is rare. Here, we studied the feasibility and curative effect of the treatment of IJVS by stent placement. A total of 3 patients with IJVS were diagnosed by angiography and treated with stent placement. Anticoagulant therapy was conducted after surgery. The clinical presentations, endovascular procedures, as well as clinical results of the 3 patients were reviewed. The clinical symptoms of the 3 patients with IJVS improved after stent placement. Blood flowed fluently in the vein stent without thrombosis and the short-term curative effects were satisfactory. In conclusions, venous stent placement may be a good option for the treatment of IJVS.

**Keywords:** Stent placement, internal jugular vein stenosis, raised intracranial pressure, angiography

## Introduction

Central vein stenosis (CVS) is a common trouble in hemodialysis [1]. The pathogenesis of CVS may be related to the trauma on venous endothelium and a series of subsequent inflammatory responses on the vessel wall, which are induced by central venous catheters [2]. The treatments of CVS include conservative treatment, percutaneous transluminal angioplasty and endovascular stent placement, among which, the endovascular stent placement has a satisfying efficacy [3-5].

Internal jugular vein (IJV) is one of the central veins and is the largest vein in neck [6]. However, the pathogenesis of internal jugular vein stenosis (IJVS) remains unclear. The common reasons of IJVS include block by direct oppression or neoplasm invasiveness, dialysis for indwelling catheter, inflammation, nonspecific infection, multiple sclerosis, and internal jugular vein valve dysfunction [7, 8]. The application of endovascular stent placement in IJVS is rare, only a few cases have been reported [9-11] (**Table 1**).

In this study, the efficacy of endovascular stent placement on 3 cases with IJVS was reported. We aimed to find out the feasibility and curative effect of the treatment of IJVS by stent placement.

## Materials and methods

This study has been approved by the Ruijin Hospital Ethics Committee and performed in accordance with the ethical standards.

## Case presentation

*Case 1*

A 46-year-old woman was admitted to hospital because of progressive headache with nausea and emesis for 2 weeks. After admission, the lumbar puncture test was performed and showed a clear cerebrospinal fluid (CSF) with the pressure of 300 cm $H_2O$. Besides, no significant abnormity was revealed in the routine and biochemical test of CSF. However, continuity interrupt in the right IJV and a number of twisty and expansive external jugular veins and paravertebral veins in neck were showed in the examina-

**Table 1.** The cases that applied endovascular stent placement in internal jugular vein stenosis

| Case | Reference |
|---|---|
| A 15-year old female | [16] |
| An 18-year-old male | [17] |
| A 68-year-old male | [18] |

tion of head magnetic resonance imaging (MRI). Nevertheless, no obvious tumor signal was observed (**Figure 1A**). Therefore, the patient was firstly diagnosed as IJV thrombosis and was treated with unfractionated heparin (20 ml normal saline and 12500 U unfractionated heparin). In order to maintain the international normalized ratio of blood coagulation function at the level of 1.5-2.5, the heparin was pumped continuously by the venous pump at a speed of 2 ml/h. After three days' treatment, the patient's headache was obviously relieved. After 2 weeks, cerebral angiography showed that the right transverse sinus was the dominant side, and the right IJV was significantly thinner at C2 level of cervical vertebral. The right sigmoid sinus was communicated with external jugular veins through expansive mastoid emissary vein. External jugular veins and paravertebral veins revealed compensatory expansion and the return time of cerebral veins was prolonged slightly (**Figure 1B**). Then the right femoral vein was punctured and the selective IJV angiography revealed that the right IJV was narrow at C2 level but without obvious thrombus existing (**Figure 1C**).

We considered that the reflux obstruction of cerebral vein and the raised intracranial pressure might be caused by IJVS. Therefore, stent placement of IJV was used. Firstly, the 8F guide tube was placed in proximal end of the narrow segment in the right IJV. Secondly, a micro-guide wire with a diameter of 0.14 μm was carefully put into the right sigmoid sinus through the narrow segment. Then, a 6 × 40 Aviator-plus saccule (Johnson & Johnson, America) was used for expansion treatment with a pressure of 10 atmospheres, and the IJV retracted completely after expansion. Finally, a 9 × 40 self-expanding carotid precise stent (Johnson & Johnson) was embedded along the micro-guide wire, and the stent expanded satisfactorily after released (**Figure 1D**). Cerebral angiography revealed that the blood flow of the IJV was fluent and the compensatory expansion of external jugular veins and paravertebral veins improved (**Figure 1E**). Besides, the headache of the patient disappeared. After surgery, heparin was given for anticoagulant therapy. Three days later, heparin therapy was replaced by oral warfarin for 6months. After 6 months follow-up, color doppler ultrasound test showed that blood flowed fluently in the IJV stent without thrombosis (**Figure 1F**).

*Case 2*

A 16-year-old young man was admitted to our hospital due to headache for 2 weeks, sudden pain in neck and inability in both lower limbs for 3 days. After admission, physical examination showed that the muscle strengths of both lower limbs were 3 grads, the muscular tension decreased and the Babinski signs were negative in both sides. Neck MRI showed that spinal epidural hemorrhage occurred at thoracic 1-2 levels and spinal cord was deformed slightly due to compression. Meanwhile, a large number of abnormal vascular voids were found close to cervical vertebra in the back of the neck. Enhancement scan revealed that paravertebral vascular net was intensified (**Figure 2A** and **2B**).

Firstly, the patient was treated with dehydration treatment, and the inability of both lower limbs improved. Whole cerebral angiography showed a delay in the development of cerebral vein and revealed that the right transverse sinus was the dominant side. Besides, it also showed a narrow at C2 level in the right IJV and obvious expansions in the external jugular veins and vertebral veins (**Figure 2C** and **2D**). However, whole spinal angiography showed no obvious spinal intramedullary arteriovenous malformations, perimedullary arteriovenous fistula and spinal dural arteriovenous fistula.

Based on the above symptoms, we considered that this patient was hematorrhachis, which was caused by IJVS, abnormal expansions of paravertebral and intraspinal venous plexus, intraspinal venous hypertension, and fracture of epidural venous plexus. Thus, the stent placement of right IJV was performed. First of all, the right femoral vein was punctured and an 8F artery sheath was placed in it. Then, an 8F guide tube was selectively placed into the right IJV. The local stenosis of the right IJV was fur-

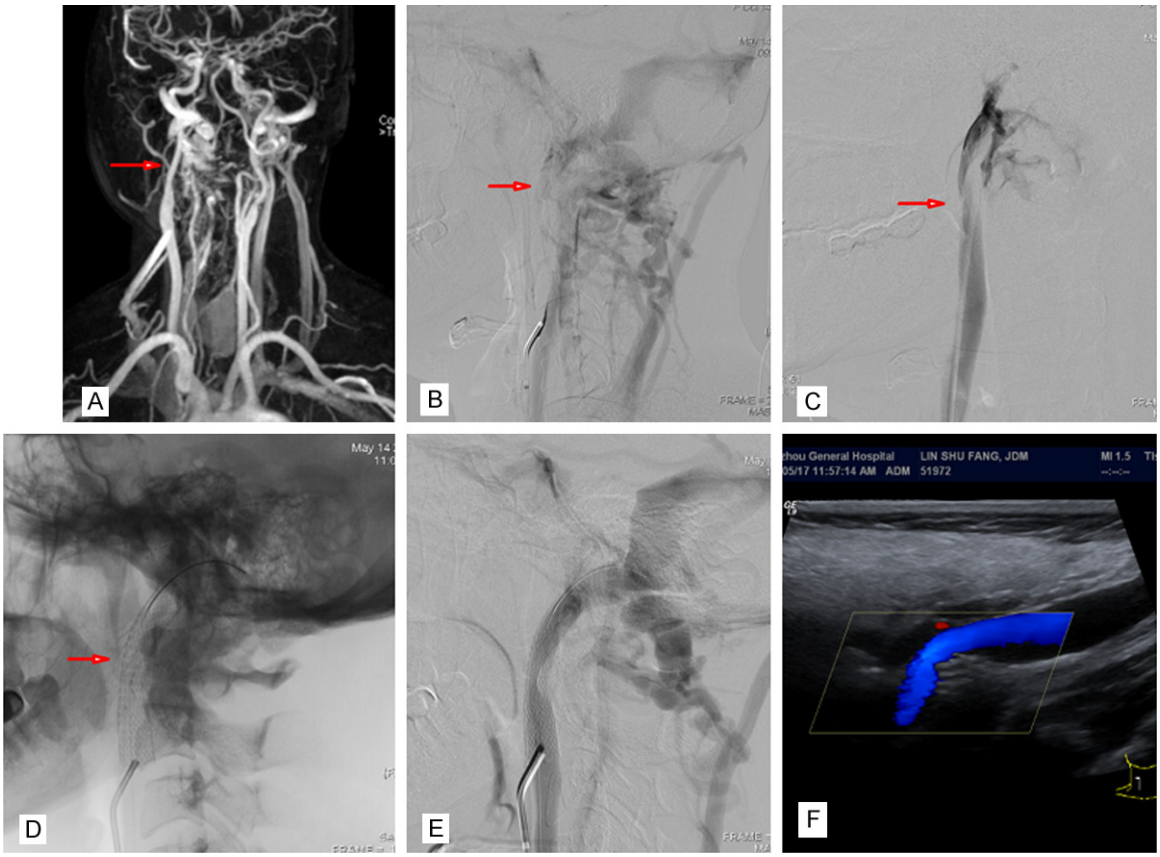


**Figure 1.** The images of case 1. A: Magnetic resonance imaging (MRI) of head and neck, the arrow refers to interruption of the right internal jugular vein (IJV); B, C: Internal carotid angiography and selective IJV catheterization angiography, the arrow refers to local stenosis in IJV; D, E: Image after stent placement and the expansive vein diameter; F: The color doppler ultrasound test after 6 months follow up.

ther confirmed by the angiography of proximal and distal end of the narrow segment (**Figure 2E**). Next, a micro-guide wire with a diameter of 0.14 μm was put into the right sigmoid sinus. Finally, a 9 × 40 self-expanding carotid precise stent (Johnson & Johnson) was embedded along the guide wire, and the stent expanded satisfactorily after released. In addition, no residue of stenosis was found. The original phenomena of the reflux delay of cerebral vein and the expansion of intervertebral venous plexus and external jugular veins disappeared (**Figure 2F**).

After surgery, oral warfarin was given for anticoagulant therapy for 6 months. After 4 months follow up, the headache of the patient disappeared and the muscle strengths of both lower limbs completely recovered. The MRI reexamination revealed that the hemorrhachis had been absorbed (**Figure 2G**) and color doppler ultrasound test showed that blood flowed fluently in the IJV stent (**Figure 2H**).

*Case 3*

A 68-year-old woman was admitted to hospital because of headache for more than 10 years and the headache aggravated in recent 2 weeks. After admission, lumbar puncture test was performed and showed a clear CSF with the pressure of > 320 cm $H_2O$. No obvious abnormity was found from the routine and biochemical test of CSF. Besides, no obvious signal of cerebral venous sinus thrombosis was observed from the head MRI and magnetic resonance venography test. We only found that the development of the left IJV was poor, and the left IJV was oppressed by the ipsilateral internal carotid (**Figure 3A** and **3B**).

We considered that the patient had benign intracranial hypertention, thus, ventriculo-peri-

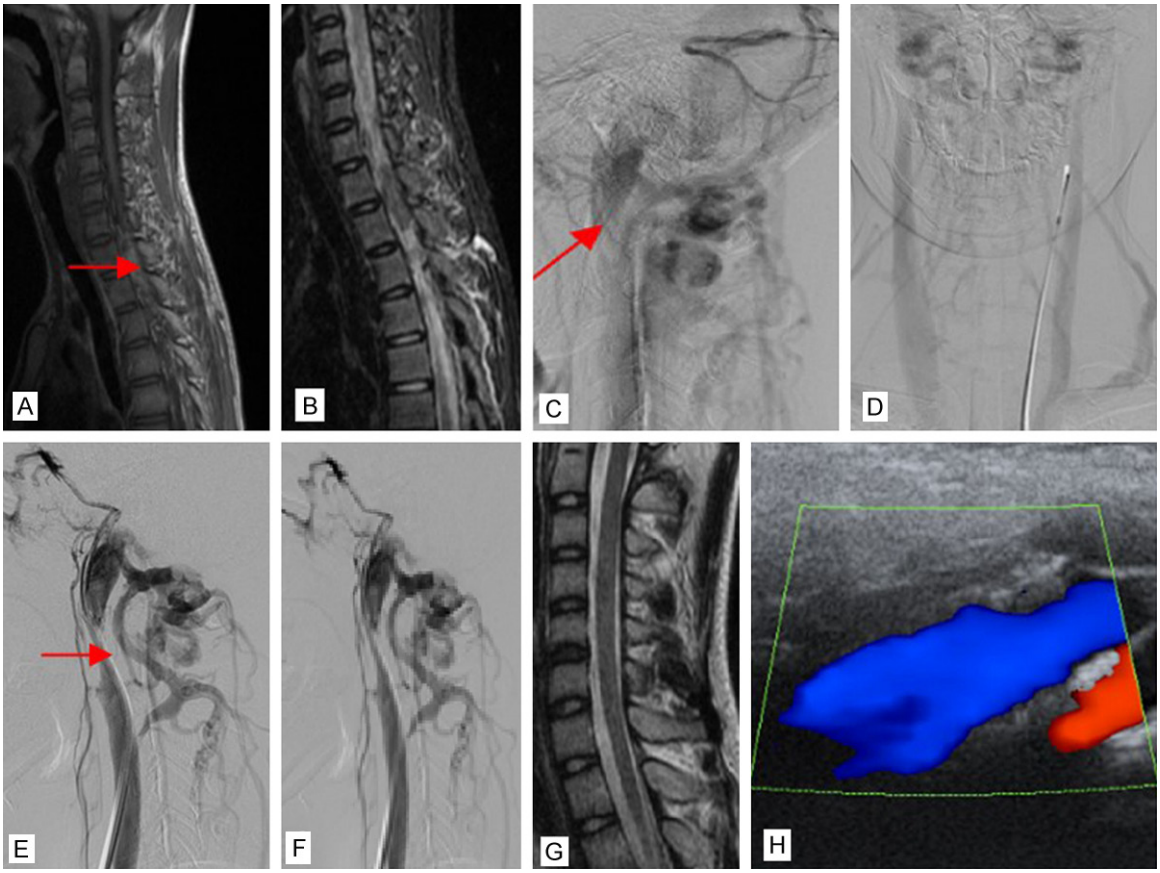


**Figure 2.** The images of case 2. A, B: MRI test of neck, the arrow means intraspinal spinal epidural hematoma; C-E: Internal carotid angiography and selective IJV catheterization angiography; F: Image after stent placement; G, H: MRI test and color doppler ultrasound test after stent placement for 4 months.

toneal shunt was performed. The headache of the patient improved during the initial period after surgery. However, 3 days after surgery, the headache of the patient aggravated and the patient began to vomit frequently. The progressive aggravating disturbance of consciousness of the patient appeared subsequently. Lumbar puncture was performed again, and the result showed that the CSF was clear. However, the pressure was still high with the value of > 320 cm $H_2O$. Moreover, head CT test showed obvious narrow of ventricular system, aggravating swell of brain tissue, disappeared sulcus of cortex and the narrowed cisterna ambiens. Cerebral angiography test showed that the return time of cerebral vein was prolonged slightly and revealed that the right IJV was obvious narrow at C2 level. However, the flood flow in the left transverse sinus showed a reverse flow and the left IJV was undeveloped. The right femoral vein was punctured and the selective venography of the right IJV showed a narrow in the right IJV. The proximal and distal pressures of this narrow were 8 and 14 cm $H_2O$ (with a pressure difference of 6 cm $H_2O$), respectively. Meanwhile, the selective venography of the left IJV showed 2 narrows in the left IJV. Contrast agent did not flow back to truncus brachiocephalicus vein but retrograded to the contralateral side through the expansive transverse jugular vein, external jugular vein and the left transverse sinus (**Figure 3C-E**). In addition, the left brachiocephalic vein was obvious narrow, but the left subclavian vein expanded obviously (**Figure 3F**). The proximal and distal pressures of this left narrow were 6 and 16 cm $H_2O$ (with a pressure difference of 10 cm $H_2O$), respectively.

Treatments of stent-assisted angioplasty were performed in bilateral IJVs (with 10 × 30 and 9 × 40 precise stent, respectively; Johnson & Johnson) and the left truncus brachiocephalicus vein (14 × 60 Precise stent, Johnson &

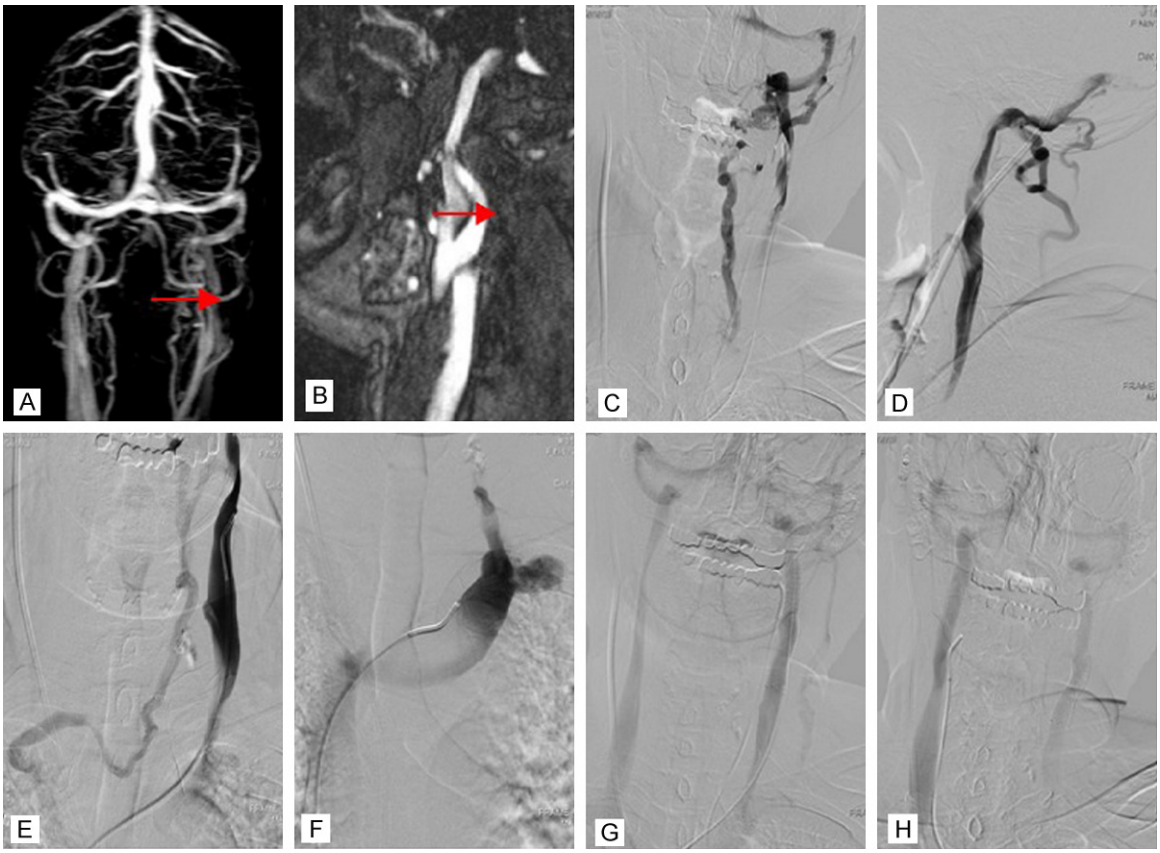


**Figure 3.** The images of case 3. A, B: MRI images of head and neck; C-E: The left IJV catheterization angiography; F: The image of the left truncus brachiocephalicus vein; G, H: Images after bilateral jugular venous stent placement.

Johnson). After stent placement, oral warfarin was used for anticoagulant therapy for 6 months. Venography showed that the narrows and pressure differences between proximal and distal of the narrows disappeared. The return time of cerebral vein also went back to normal (**Figure 3G** and **3H**). The conscious disturbance of the patient improved gradually. The patient had no obvious headache and the head CT test showed that the swell of cortex improved as well. After 6 months follow up, color doppler ultrasound test showed that blood flowed fluently in the IJV stent without thrombosis.

## Discussion

In this study, the treatments of 3 cases with IJVS by venous stent placement were reported. All of the 3 patients had no history of dialysis and no IJV catheter. For the symptoms and signs of the patients, the lumbar puncture test and angiography were used to check the pathogenesis and to reveal the stenosis in the IJV. In case 1 and case 2, the right transverse sinus was the dominant side. Due to the small drainage effect of the non-dominant side, the angiography is generally not performed in the non-dominant side. The stent placement was performed in the stenosis site and the symptoms of patients improved.

The stenosis sites of the 3 patients were at C2 levels in the neck. The start of internal carotid crossed IJV for twice. Therefore, the IJVS may be related to the oppression of internal carotid. High oppression would cause the reflux obstruction of IJV, raised pressure of cerebral vein, swelling of brain, raised intracranial pressure and hematorrhachis. In some cases, the IJVS could induce the sinus thrombosis and acute raised intracranial pressure, or further lead to dural arteriovenous fistula.

In general, the reflux of IJV in dominant side can reach the normal reflux of IJV. While the stenosis of vein or venous sinus in dominant side can also cause the reflux obstruction of intracranial venous, leading to severe symptoms of raised

intracranial pressure or venous bleeding. However, symptomatic IJVS is rare. Generally, there are two types of symptoms for IJVS. One is the acute symptoms including sudden headache, nausea and vomiting, disturbance of consciousness and neck pain with spinal cord dysfunction. Another type of symptoms includes chronic headache, blurred vision and ache of neck [12], which are caused by the reflux obstruction of cerebral vein and intraspinal venous hypertension. In our study, headache and intracranial hypertension were observed in the 3 cases, and nobody showed facial swelling. For case 2, it also showed the secondary lesions of intraspinal venous hypertension, hematorrhachis and spinal cord compression, with symptoms of persistent headache and inability in both lower limbs. These symptoms are similar to a patient reported by Huang et al. [11], who had bilateral IJVS and had been treated by direct thrombolysis and stent placement successfully.

For asymptomatic and mild symptomatic IJVS, oral aspirin or warfarin can improve the reflux of cerebral vein and prevent the secondary intracranial venous sinus thrombosis. For severe symptomatic IJVS, vein bypass and venous stent placement are two alternative treatments [13]. However, vein bypass treatment will result in severe trauma. By contrast, venous stent placement has advantages of minor trauma, easy operating, besides, it accords with normal anatomy and physiology of human body. Therefore, the 3 cases in this study were treated with venous stent placement. For case 1, a saccule was used for pre-dilation. However, no obvious resistance was found when the saccule expanded. The vein retracted rapidly after pre-dilation. This result indicates that the pure saccule expansion is not essential. Therefore, the saccule pre-dilation is abolished in the treatment of the other 2 patients. In addition, hematorrhachis was found in case 2. However, spinal canal decompression was not performed because of the little bleeding and slight compression of spinal cord. And the symptoms improved after dehydration treatment.

In order to avoid thrombosis after stent placement, anticoagulant therapy is needed. In this study, case 1 was treated with heparin for 3 days after stent placement, and then the heparin was replaced by oral warfarin. The oral warfarin was given to the 3 cases for 6 months, and no evidence of thrombosis was found. Studies have reported that oral warfarin for anticoagulant therapy was given in ilia vein after venous stents placement and the patency rate of the stent was up to 95% in a two-year follow up [14, 15].

To our knowledge, a few cases of IJVS were successfully treated with venous stent placement. In this study, the successful treatments of the 3 cases and the short-term curative effects may provide references for treating rare IJVS. However, further observations with long-term curative effects of the stent placement for IJVS are still needed.

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## Disclosure of conflict of interest

None.

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