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Subclavian artery stenting *via* bilateral radial artery access: Four case reports

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Abstract

BACKGROUND

Subclavian artery stenosis refers to the stenosis in the lumen caused by the presence of plaque or thrombus in the subclavian artery. It is a common problem in endovascular interventions. In fact, conventional subclavian artery stenting *via* the femoral artery approach is effective and safe. Nevertheless, because femoral artery puncture is not easy to stop bleeding, it requires longer femoral artery compression or more expensive hemostatic materials, such as staplers. Patients need to be catheterized and bedridden for a longer time, which may lead to many complications, such as pseudoaneurysm.

CASE SUMMARY

Herein, we reported a new interventional therapy of subclavian artery. From March 1, 2020 to August 31, 2021, we operated on four patients with subclavian artery stenting *via* bilateral radial artery access.

CONCLUSION

After reviewing four cases of successful placement of clavicular artery stents *via* bilateral radial arteries, we concluded that bilateral radial artery approach is feasible. Clavicular artery stenting is safe, effective, and timesaving. It is an excellent alternative to the traditional femoral artery procedure, with few complications and high comfort degree.

Key Words: Subclavian artery stenosis; Bilateral radial artery; Stenting; Subclavian artery steal syndrome; Case report

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Core Tip: In this study, we reported a new interventional therapy of subclavian artery. we concluded that bilateral radial artery approach is feasible. Clavicular artery stenting is safe, effective, and timesaving. It is an excellent alternative to the traditional femoral artery procedure, with few complications and high comfort degree.

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INTRODUCTION

Subclavian artery stenosis refers to the stenosis in the lumen caused by the presence of plaque or thrombus in the subclavian artery. Its prevalence in the general population is less than that in the patients with peripheral artery stenosis (2% *vs* 11.5% to 19%)[1]. Occlusion or stenosis in the subclavian artery can lead to some serious complications that endanger the upper extremities, brain and heart[2]. For example, subclavian steal syndrome (SSS) can result in ischemia of the vertebrobasilar system, with the manifestation of vertigo, syncope, diplopia, blurred vision, dysarthria, and tinnitus. The treatment of subclavian artery stenosis mainly includes open surgery, percutaneous transluminal angioplasty (PTA) and percutaneous transluminal stenting. Currently, endovascular intervention is more commonly accepted by clinicians and patients because of its minimal trauma, rapid recovery, and few complications[3].

Traditionally, the right femoral artery is the preferred therapeutic approach for subclavian artery stenting. However, the traditional femoral artery approach still has many limitations, including the need to expose the patient's private site, bed rest, and increased financial burden[4,5]. Moreover, there are also some rare complications, such as retroperitoneal hemorrhage. PTA and subclavian artery stenting *via* brachial approach has also been attempted to overcome those shortcomings[6]. However, previous studies have shown that brachial artery is mainly used as the blood supply to the upper extremity, with a high incidence of complications in access sites and ischemic complications[7]. Therefore, it is considered less favorable. In this case report, we described a new interventional therapy of subclavian artery. Subclavian artery stenting *via* bilateral radial artery access is an excellent alternative to the traditional femoral artery procedure, with few complications and high comfort degree.

CASE PRESENTATION

Chief complaints

Treating Subclavian artery stenosis. From March 1, 2020 to August 31, 2020, we operated on four patients with subclavian artery stenting *via* bilateral radial artery access. All participants signed the informed consent. When necessary, the legal guardian of volunteers signed the informed consent on their behalf. The case report was as follows.

Case 1: A male patient, 68 years old, had hypertension for 10 years and smoking history for 40 years. He was admitted to the hospital after 10 d of dysphonia with right-sided limb weakness. Magnetic resonance imaging (MRI) showed left pontocerebral lacunar cerebral infarction. The blood pressure of the right upper extremity was 186/92 mmHg, and that of the left upper extremity was 156/85 mmHg. Transcranial color Doppler (TCD) suggested steal of the left subclavian artery at stage 2. On March 30, 2020, the patient underwent subclavian artery stenting *via* bilateral radial artery access (Figure 1A-C). Consumables included 5F radial artery sheath (Terumo, Terumo Corporation, Tokyo, Japan), 6F radial artery sheath, 2.6 m long 0.035 guidewire, 5F Simon2 contrast catheter (Terumo, Terumo Corporation, Tokyo, Japan). Moreover, dynamic 9/25 mm ball expansion stent (Biotronika, Ackerstrasse, Bulach, Switzerland) and pressure pump were also used. The total procedure took 13 min.

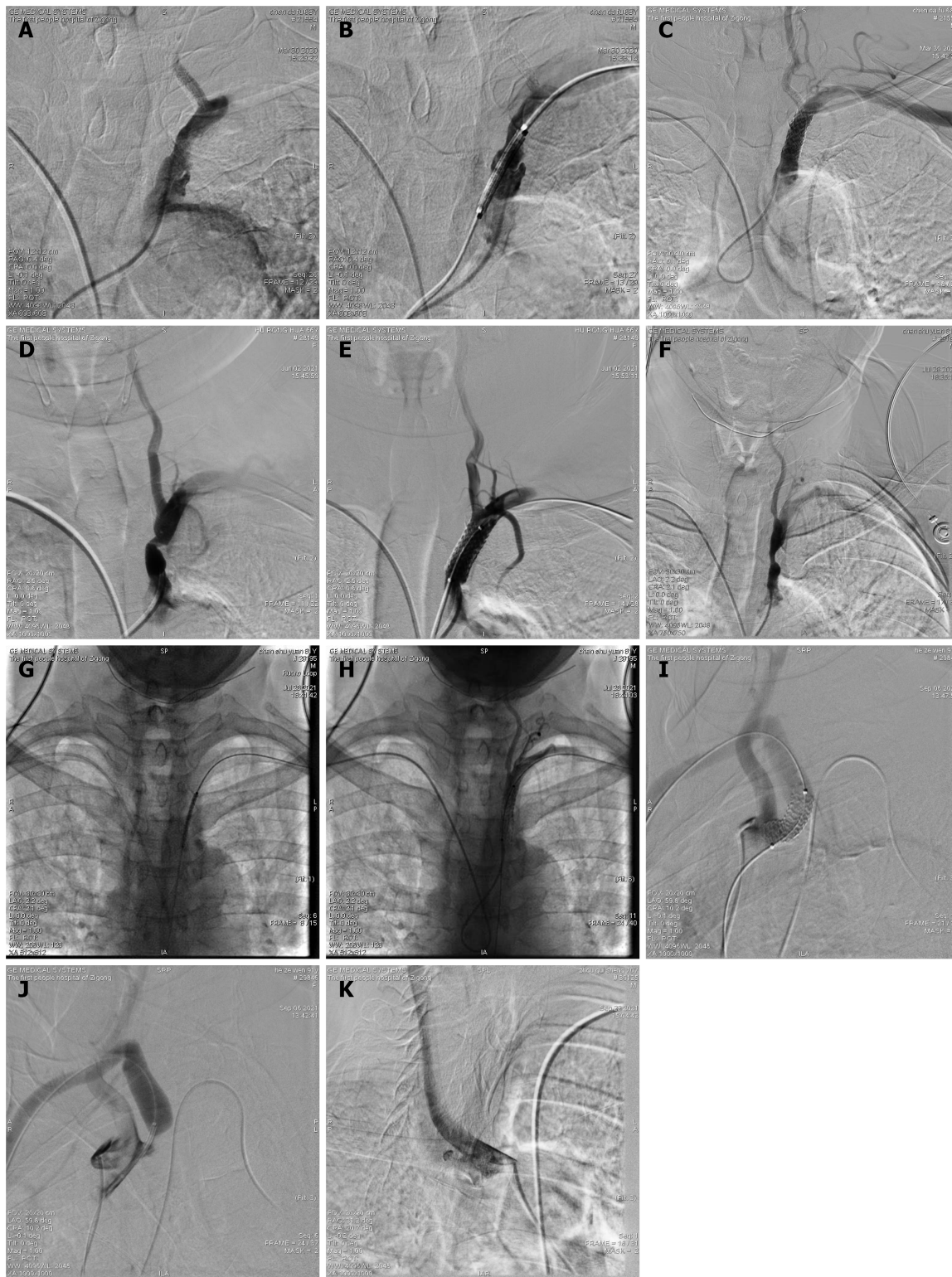


Figure 1 The imaging of cases. A-C: Case 1. At 15:29, right radial artery puncture was inserted into 5F arterial sheath, and Simon2 catheter was selected for left subclavian artery angiography (A); At 15:33, the left radial artery was punctured and a 6F arterial sheath was inserted. A 2.6 m 0.035 guidewire was used for stenting to the left subclavian artery ulcerated plaque with stenosis under Simon2 catheterization positioning (B); At 15:42, 12 ATM dilated the balloon to release the stent. The stent was in good shape. The total procedure took 13 min (C); D and E: Case 2. At 15:45, the right radial artery was punctured and inserted into the 5F arterial sheath, and the Simon2 catheter was selected for left subclavian artery angiography (D); At 15:53, the 6F arterial sheath was inserted *via* left radial artery puncture. The stent was guided into the place with a 2.6-length 0.035 guidewire and successfully released under Simon2 catheter angiographic positioning. Its morphology was good (E); F-H: Case 3. At 18:35, the right radial artery was punctured and a 5F arterial sheath was inserted. The Simon2 catheter was selected for left subclavian artery angiography (F); At 18:41, the 6F arterial sheath was inserted by left radial artery puncture. A 2.6-length 0.035 guidewire was used to guide the stent to the subclavian artery stenosis under Simon2 catheterization positioning (G); At 18:44, 13 ATM dilated balloon to release the stent. Its morphology was good (H); I-K: Case 4. At 13:28, the left radial artery was punctured and a 5F arterial sheath was inserted. The Simon2 catheter was selected into the unnamed artery for imaging (I); At 13:39, the 6F arterial sheath was inserted through the right radial artery puncture. A 2.6-length 0.035 guidewire was used to guide the stent into place

under Simon2 catheterization positioning (J); At 13:48, 14 ATM stent was released accurately. Its morphology was good (K).

Case 2: A female patient, 66 years old, had hypertension for three years. She was admitted to the hospital with dizziness for 10 d. On admission, the blood pressure of the right upper extremity was 130/73 mmHg, and that of the left-sided upper extremity was 103/58 mmHg. TCD suggested steal in the left subclavian artery at stage 2. On June 2, 2020, the patient underwent subclavian artery stenting *via* bilateral radial artery access (Figure 1D and E). Consumables included 5F radial artery sheath, 6F radial artery sheath, 2.6 m long 0.035 guidewire (APT, Hunan, China), 5F Simon2 contrast catheter (Yixinda, Shenzhen, China), Omnilink Elite9/19mm ball Expandable stent (Abbott Vascular, Santa Clara, CA, United States), and pressure pump. The total procedure took 9 min.

Case 3: A male patient, 81 years old, had hypertension for three years. He was admitted to the hospital with recurrent dizziness for 15 d. On admission, the blood pressure of the right upper extremity was 137/85 mmHg, and that of the left upper extremity was 115/61 mmHg. TCD suggested steal of the left subclavian artery at stage 2. On July 28, 2021, he received subclavian artery stenting *via* bilateral radial artery access (Figure 1F-H). Consumables included 5F radial artery sheath, 6F radial artery sheath, 2.6 m long 0.035 guidewire (APT, Hunan, China), 5F Simon2 contrast catheter (Yixinda, Shenzhen, China), Omnilink Elite8/29mm ball-expandable stent (Abbott Vascular, Santa Clara, CA, United States), and pressure pump. The total procedure took 9 min.

Case 4: A female patient, 91 years old, had hypertension for five years. She was admitted to the hospital with recurrent dizziness for six months and exacerbated for two days. On admission, the blood pressure of right upper limb was 95/52 mmHg and that of the left upper limb was 146/78 mmHg. TCD suggested steal of right subclavian artery at stage 3. On August 30, 2021, she received subclavian artery stenting *via* bilateral radial artery access (Figure 1I-K). Consumables included 5F radial artery sheath, 6F radial artery sheath, 2.6 m long 0.035 guidewire, 5F Simon2 contrast catheter, Omnilink Elite10/29 mm ball Expandable stent (Abbott Vascular, Santa Clara, CA, United States), and pressure pump. The total procedure took 20 min.

History of present illness

Case 1: He was admitted to the hospital after 10 d of dysphonia with right-sided limb weakness.

Case 2: She was admitted to the hospital with dizziness for 10 d.

Case 3: He was admitted to the hospital with recurrent dizziness for 15 d.

Case 4: She was admitted to the hospital with recurrent dizziness for six months and exacerbated for 2 d.

History of past illness

Case 1: He had hypertension for 10 years and smoking history for 40 years.

Cases 2 and 3: The patients had hypertension for 3 years.

Case 4: She had hypertension for 5 years.

Laboratory examinations

Case 1: The blood pressure of the right upper extremity was 186/92 mmHg, and that of the left upper extremity was 156/85 mmHg.

Case 2: On admission, the blood pressure of the right upper extremity was 130/73 mmHg, and that of the left-sided upper extremity was 103/58 mmHg.

Case 3: On admission, the blood pressure of the right upper extremity was 137/85 mmHg, and that of the left upper extremity was 115/61 mmHg.

Case 4: On admission, the blood pressure of right upper limb was 95/52 mmHg and that of the left upper limb was 146/78 mmHg.

Imaging examinations

Case 1: MRI showed left pontocerebral lacunar cerebral infarction. TCD suggested steal of the left subclavian artery at stage 2.

Cases 2 and 3: TCD suggested steal in the left subclavian artery at stage 2.

Case 4: TCD suggested steal of right subclavian artery at stage 3.

FINAL DIAGNOSIS

There were satisfactory results and without any complications. The patients were able to get out of bed right after the operation with high comfort degree. Moreover, the radial artery access procedure allows the use of no-guiding catheter.

TREATMENT

The patients underwent subclavian artery stenting *via* bilateral radial artery access.

OUTCOME AND FOLLOW-UP

There were satisfactory results and without any complications. The patients were able to get out of bed right after the operation with high comfort degree. Moreover, the radial artery access procedure allows the use of no-guiding catheter. It avoids the use of hemostatic devices, such as vascular blockers or anastomoses.

DISCUSSION

Nowadays, transradial artery access has been widely used in interventional treatment of the heart. Numerous studies have proven that radial artery puncture is safe and feasible[7,8]. Although the radial artery is small, it is superficial and easy to puncture, and the actual puncture success rate is similar to that of the femoral artery[9-11]. Moreover, the access to the subclavian artery from the radial artery is very easy, especially for the right subclavian artery in type 3 arch. The problem that needs to be addressed is how to deliver larger-diameter stents. In a Korean study, the radial artery diameter was 2.74 ± 0.41 mm in men and 2.26 ± 0.42 mm in women[12]. There is no problem matching the radial artery with an arterial sheath of 6F, with maximum inner diameter of 2.2 mm and outer diameter of 2.46 mm. Furthermore, 8F arterial sheath (2.67 mm ID) is not matched in most people. The only option available to us is the 6F arterial sheath. However, the diameter of the stent needed for subclavian artery stenosis is usually above 8 mm. How to deliver the stent to the stenosis is a problem.

There are currently two options. One is to choose a long 6F sheath (2.2-mm inner diameter and 2.6-mm outer diameter). Due to the large outer diameter, a large percentage of patients are not suitable. Another way is to deliver the stent directly to the stenosis site through the guide wire guidance. Since the upper extremity vessels are generally straight, it is relatively easy to stent in place, and it is more advantageous for the right subclavian artery in type 3 arch. However, because there is no guiding catheter, it is not possible to do the angiographic localization. Therefore, it is necessary to first do a good map of the pathway through the angiographic catheter or localize it using bony markers. After delivery, the balloon or stent is dilated or released under the guidance of the roadmap or bony marker. However, actual patient movement, vascular pulsation, and respiration can cause the roadmap to shift from its actual position. Moreover, as the guidewire and stent are delivered, the vessel morphology will change accordingly. The road map and bony markers do not represent the actual vascular situation, which can easily lead to inaccurate stent positioning. Herein, we thought to perform a dual access procedure, with a Simon2 catheter to access the subclavian artery. A 6F arterial sheath is inserted through the radial artery on the side of the lesion, and a guidewire is passed directly through the stenosis to guide the balloon and stent to the stenosis.

We actually reviewed the relevant literatures and found few reports. A single-center Croatian study on subclavian artery stenosis with a total of 50 SSS was basically performed through the femoral and brachial arteries[1]. The right femoral approach was the most commonly used (62%), followed by the left brachial approach (17%), without transradial procedures. In a Italian study, the opening of the left subclavian artery *via* unilateral radial access was performed with a stent positioned using bony markers, which was clearly more blinded[13]. A relatively large number of Canadian study have been reported[14]. From February 2010 to February 2015, there were 54 patients with stenosis or chronic occlusion of the subclavian artery. In 35 patients, a bilateral radial artery approach was used. However, a 6F guiding catheter was used on the lesion side in all cases, which is different from the present study. A single ipsilateral radial artery approach was used in the other 19 patients. The procedural success rate was 97% in the bilateral group in comparison with 95% in the single group. None of them had major complications except for a small hematoma. It was effective and safe with single femoral access or combined femoral and brachial access, with vascular complications (6.3%) and neurological complications (0.6%-9%).

We have performed more than 2000 cases of whole brain angiography *via* radial artery access in our hospital. We are very proficient in both left radial artery and right radial artery puncture. In combination with the above studies, we demonstrated that it is safe and effective to perform subclavian stenting with bilateral radial artery access. After the approval of the hospital ethics committee, we performed four cases of subclavian stenting *via* bilateral radial artery access. There were satisfactory results and without any complications. The patients were able to get out of bed right after the operation with high comfort degree. Moreover, the radial artery access procedure allows the use of no-guiding catheter. It avoids the use of hemostatic devices, such as vascular blockers or anastomoses. Excluding the cost of an additional radial artery sheath, the cost of per patient is reduced by approximately \$500.

CONCLUSION

The case report suggested that subclavian artery stenting can be done quickly from either left or right subclavian artery *via* bilateral radial artery puncture. Through the application experience and literature review, we believe that the treatment of the clavicular artery *via* bilateral radial artery access is safe, effective, and timesaving, with few complications and high comfort degree. It deserves further studies to confirm its safety and efficacy in comparison with the femoral artery.

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