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The Application Value of Swan-Neck Microcatheter in Peripheral Vascular Interventional Therapy

Xiang Zheng, Ruidong Zhao, Yao Zhou*

Department of Interventional Medicine, Zhuhai People's Hospital (Zhuhai Clinical Medical College of Jinan University), Zhuhai, China
Email: *245301858@163.com

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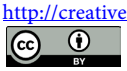

Abstract

Background and Objectives: Establishing a stable pathway is the basis for interventional surgery, and hyper-selected intubation has become the basic requirement for vascular intervention therapy. Super-selection intubation can not only significantly improve the efficacy of peripheral intervention treatment, but also greatly reduce surgical complications. However, during the treatment of peripheral vascular intervention (such as liver tumor arterial chemotherapy embolism, hemoptysis bronchial arterial embolism, gastrointestinal hemorrhagic gastrointestinal arterial embolism, etc.), vascular mutation is often large, and there are many branches, and the direction of blood flow is into the direction of blood flow, the horns are even reverse, and even the use of straight-headed microstructures will have difficulty interpolation difficulties or even failure, which increases the risk of surgery and affects safety treatment. To overcome this, pre-plasticized microcatheters have emerged, among which the InstantPass Swan-Neck Microstructure is a catheter with a head-end morphology similar to Cobra. Our research aims to explore the feasibility, safety, and technical advantages of the use of swan-neck microcatheter in peripheral vascular hyperboloid intubation. **Materials and Methods:** From January 2023 to March 2024, 31 patients with swan-neck microstructure were used in the peripheral vascular intervention therapy outside the hospital. Among them, there were 23 men and 8 women, aged 32 - 81 years old, an average (55 ± 13) years, and the average irradiation time was 35.1 ± 24.7 minutes. 10 cases of iodide oil arterial chemotherapy embolism, 7 cases of microspheres of hepatic arteries, 3 cases of gastric duodenal artery selective embolism, 3 cases of vein embolism with esophageal stomach, and 2 cases of sperm varicose vein embolism, 2 cases of selective embolism of the intestinal membrane, 2 cases of uterine arteries embolism, and 2 cases of renal arterial embolism. 11 of these patients switched

to the swan-neck microstructure after using the straight-headed microstructure super-selective intubation. To analyze whether the swan-neck microcatheter is successfully transported to the target location, whether it can provide a satisfactory path for subsequent intravascular treatment, evaluate the surgery instant image results and complications related to the microstructure during the surgery period, analyze the angle of the target blood vessels and the main blood vessels, the target blood vessels, the target blood vessels, the relationship between the degree of pedestrian and the success rate of ultra-selective intubation, and summarize the indication of the application of the swan-neck microstructure in peripheral intervention therapy. **Results:** In this study, 31 patients used 31 swan-neck microcatheters, of which 22 (70.9%) target vascular and main blood vessels were ≤90˚; 17 patients (54.8%) patients were curved and angulated; 11 cases (35.5%) were after the failure of the superselective intubation of the straight-headed microstructure, the swan-neck microcatheter was successful after the failure; 1 case (3.2%) patients with microstructure-related mezzanine occurred during surgery, and the complication rate of the perioperative ductation was 3.2%. All target lesions are finally successfully completed, and the success rate of surgical technology is 100%. **Conclusion:** Swan-neck microcatheters have a high success rate in superselective cannulation of peripheral blood vessels and perform well in vascular tortuosity and angulated lesions.

Keywords

Peripheral Artery, Superselective Catheterization, Swan-Neck Microcatheter

1. Introduction

In recent years, the incidence of peripheral arterial disease caused by arterial lesions has increased year by year, becoming an important type of atherosclerotic lesion with a high degree of harm. The risk factors for peripheral vascular disease include age, gender, family history, person type, etc., risk factors that cannot be changed, and risk factors that can be changed, such as hypertension and hyperlipidemia [1] [2]. At present, the treatment methods for peripheral vascular disease are surgical treatment and intravascular intervention treatment [3] [4]. Traditional surgical surgery has a large trauma and high surgical risk. For some special locations of vascular disease, surgery is often compared due to the difficulty of vascular showing blood vessels and the difficulty of surgery's large limit. In recent years, the emergence and development of intravascular intervention treatment technology has expanded the surgical indication certificate, which has the advantages of small trauma and short recovery time. More and more guidelines for vascular diseases are recommended for intervention treatment. In the intervention treatment, the establishment of a stable pathway is the basis for intervention surgery. Super-selection intubation has become the basic requirement for vascular intervention therapy [5]-[8].

With the widespread application of microcatheter technology, super-selected intubation is used to perform fine embolism of target vascular, thereby reducing the incidence of heterogeneous embolism, reducing surgical risks and side reactions, and improving surgical efficacy [7] [9]-[11]. The continuous improvement of related consumables and the technique of guiding silk shaping have reduced the difficulty of ultra-selective intubation to a certain extent, but there are still patients with difficulty in selecting intubation, which leads to the failure of the operation. Stabilizing it is always a problem in the vascular cavity. In order to increase the success of the super-selected intubation, new types of microstructures are constantly emerging. These new types of microstructures have been improved to varying degrees of visibility, support, and passability. Nowadays, there are various types of microstructures on the market. Among them, InstantPass Swan-Neck Microcatheter is a pre-shaped microstructure similar to Cobra Catheter tip. This study retrospectively analyzes the centers to apply the relevant information of the goose-cervical microstructure for external peripheral vascular intervention therapy and summarizes its application technology and indications in peripheral vascular intervention therapy. The report is now reported as follows.

2. Materials and Methods

2.1. General Information

Collecting from January 2023 to March 2024, the Intervention Department of the Zhuhai People's Hospital adopted a swan-neck microstructure for the complete cases of clinical data for peripheral vascular intervention. A total of 31 patients, 23 men and 8 women, 32 - 81 years old, an average (55 ± 13), the average irradiation time is 35.1 ± 24.7 minutes. Among them, 10 cases of iodized oil hepatic arterial chemotherapy embolism, 7 cases of microspheres of hepatic arteries, 3 cases of gastric duodenal artery selective embolism, 3 cases of vein embolism with esophageal stomach There are 2 cases of embolism, 2 cases of hypoplasia of the intestinal membrane, 2 cases of uterine arterioscope embolism, and 2 cases of renal arterial embolism. All patients showed no vascular stenosis or occlusion during the intraoperative angiography, and angiography confirmed that interventional treatment required superselective cannulation using a microcatheter.

2.2. Treatment Process

Patients take the supine position and routine disinfection towels. Under the guidance of color Doppler ultrasound, the femoral artery adopts Seldinger puncture technology. The puncture is successfully rear 5F blood vessel sheath. The main blood vessels and target vascular formation conditions, evaluate the angle between target vascular and main blood vessels, and the pedicle of target blood vessels. The cases of this group use an InstantPass Swan-Neck Microcatheter with an outer diameter of 2.7F. Use the goose neck micro-tube for super-selected intubation and the embolism treatment. Pay attention to the recording of the movement of the tube head and whether there are any related complications. 11 of them first used

the straight-headed microstructure of the microstructure to shake the microcontroller, and the microfilled wire was shaped. It was not successful. Then, the goose-necked microstructure was replaced for super-selective intubation. The standard of successful interpolation of microstructure: The catheter is stable in the target blood vessels; the microstructure is not shifted during the radiography and the embolism; the target vascular vascular after surgery has no damage and no heterochromial embolism signs.

3. Results

In this study, 31 patients used 31 swan-neck microstructures to reach the target location to obtain satisfactory treatment support. The Interventional surgery success rate was 100%. 22 of 31 patients (70.9%) target vascular and main vascular angles ≤ 90˚, of which 13 cases of hepatic arteries (9 cases of liver left artery, 4 cases of liver right artery), 2 cases of gastric duodenal arteries, esophagus and stomach. There are 2 cases of bottom veins, 2 cases of bronchial artery, 2 cases of intestinal arteries, and 1 case of renal artery; 17 patients (54.8%) patients with a target vascular curved and angulated, including 10 cases of hepatic arteries, gastric duodenal artery 2 case, 1 case of bronchial arteries, 1 case of esophageal stomach vein, 1 case of an superior mesenteric artery, 1 case of renal artery, and 1 case of uterine arteries (Table 1). 11 patients (35.5%) (liver artery in 7 cases, gastroduodenal artery in 2 cases, bronchial artery in 1 case, renal artery in 1 case) failed to achieve superselective intubation using a straight-headed microcatheter, but were then successfully intubated using a swan-neck microcatheter. One microcatheter-related complication occurred in this group, with a complication rate of (3.2%). The complications of that case are in the process of interpolation of the renal arteries, which leads to the dissection of the renal arteries. No thrombosis is seen and hindered the blood flow.

Table 1. Main angiographic signs of superselective cannulation target vessels (examples).

Target blood vessels	Vascular and main blood vessels were ≤90˚	Curved and angulated
Hepatic artery	13	10
Gastroduodenal artery	2	2
Esophageal fundic vein	2	1
Bronchial artery	2	1
Superior mesenteric artery	2	1
Renal artery	1	1
Uterine artery	0	1

4. Discussion

With the in-depth development of medicine, interventional therapy has become more minimally invasive, accurate, safe and effective. A large number of clinical

intervention practices have confirmed that super-selection intubation can not only significantly improve the efficacy of peripheral intervention therapy, but also greatly reduce surgical complications [7]. Choosing a suitable microstructure to obtain satisfactory channels and support is essential. The ideal microstructure should have good support, flexibility, visibility through the head end, and a larger inner cavity under the same diameter. During the treatment of peripheral vascular intervention surgery (such as liver tumor arterial chemotherapy embolism, hemoptysis bronchial arterial embolism, gastrointestinal hemorrhagic gastrointestinal arterial embolism, etc.), often due to vascular mutation, many branches, and the direction of blood flow into the corner of the blood flow. Even in the reverse shape, the use of a straight-headed microstructure is difficult to interpolate or even fail.

At present, a variety of super-selected intubation techniques have appeared clinically, such as micro-guide wire shaping technology [12] [13], microstripidicization technology [14]-[16], balloon blocking technology and other intubation technologies and head-end controlled microstructures [17] [18]. The super-selected intubation techniques provide a variety of solutions for clinical operations. However, it requires higher operating skills. If various techniques are forcibly used for superselective intubation, it may cause arterial spasm or endothelial stripping at the mildest, affecting further operations. It may also cause blood vessel rupture or even massive bleeding, putting the patient's life at risk, how to use microcatheter intubation technology is still challenging for young doctors [19] [20]. Although the commonly used straight-headed microstructures can be artificially shaped, it can cause the softness and handling of the microstructure to decrease. The repeated operation of the mechanical not only increases the surgery time, but also stimulates the blood vessels to cause spasm difficulties and risks of choosing lesions. Even if you barely reach the target lesion, it can easily lead to mezzanine or thrombosis and affect safety treatment.

In order to cope with the curved vascular path, the new pre-plastic microstructure enters the clinic. This type of catheter is soft and good, with good passability, and it is easy to reach the target position under complex vascular pathway. InstantPass Swan-Neck Microcatheter's three-layer tube design of stainless steel woven, has good force transmission, strong resistance and pressure resistance. In addition, the goose neck micro-tube head end of the 0.8 mm platinum tadpole metal mark can clearly show that the position of the microstructure head end is more conducive to super-selective intubation. 31 cases (100%) in this group arrived at the target location, and successfully reached the target position to complete the operation. It confirmed that InstantPass Swan-Neck Microcatheter has a high success rate in the peripheral intervention super-selective intubation, but its price is slightly higher than ordinary microstructure. The catheter increased the cost of surgery.

In some small-angle ultra-selective intubation, "Angiography" technology can be used to directly perform ultra-selective intubation. Of the 31 (70.9%) patients in this study, 22 of the target vascular and main vascular angles of the target vascular

and main blood vessels were ≤90˚, and the main blood vessels were 13 cases of hepatic arteries (9 cases of liver left artery, 4 cases of liver right artery), 2 cases of gastric duodenal arteries, 2 cases of esophageal stomach veins, 2 cases of bronchial arteries, 2 cases of intestinal membrane arteries, and 1 case of renal artery. Such vascular also has the characteristics of many branches, closer branches, and often crossing the main blood vessels. Therefore, for radiography to display the complex internal visceral blood vessels with blood vessels, the use of the swan-neck microcatheter can use its own swan-neck morphological advantages to the greatest degree.

The peripheral vascular variation is large and there are many branches. 22 (70.9%) target vascular and main blood vessel angles are sharp or straight. 17 patients (54.8%) patients can see the pedantic blood vessels in the radioscopy. The difficulty of interpolation is the following situations: 1) Tumor patients, especially when the tumor is huge, due to the tumor's positioning effect, pushing the surrounding normal tissue to move it, deviate from the normal anatomical position [21] [22]; 2) blood supply to the lesion site area The arteries are complicated, often with multiple vascular participation in blood supply, and the angle of the aortic is small [23]; 3) The target blood vessels after multiple intervention are often derived from the side branches, and the blood vessels are more crowded and small; After forming an angle, an angle with the superior blood vessels [24] [25]; 4) After the use of hemorrhagic drugs, the blood vessel shrinkage becomes more likely to become more likely to cause arterial spasm to cause super-choice difficulty.

After 11 patients (35.5%) patients using straight-header microstructure ultra-selective intubation failed, the swan-neck microstructure was successfully used for ultra-selective intubation. Among them, 7 cases of target blood vessels and backward folding angles (**Figure 1**), micro-guide wire cannot be oversupplied to the remote target blood vessels. Even if the micro-conducting wire shapes successor through the target vascular, it cannot provide sufficient support to follow up with the microstructure. As a result, the super-choice failed, and the goose-necked microstructure was later replaced to push the microstructure to the vascular split mouth and then for the ultra-selective intubation. It is indicated that if the case can be reasonably selected, the swan-neck microstructure can be simple and convenient in operation to avoid replacing the catheter, especially to avoid repeated operations of microstallic microstructures caused by vascular spasm or endometrial damage.

In this study, 3 patients with pedestrian and stomach vein embolism were treated, and two of them used controllable spring rings to increase granular gum sponge. One case was used with controllable spring rings and tissue glue. The position and blockage of the pipe shows its better conveyingability and can meet the needs of large flow channels. When the microstructure enters the target blood vessels, the swan-neck type head-end design causes the blood vessel wall to retreat on the microstructure. Under the interaction of the microstructure neck, the

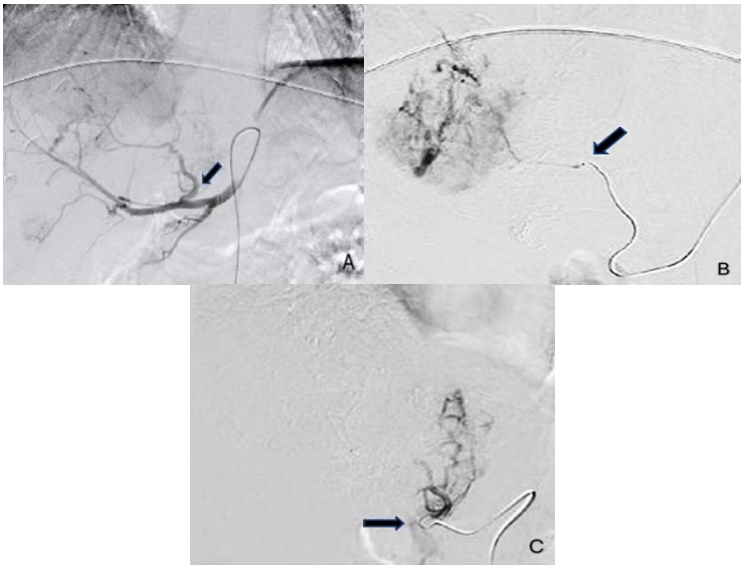

Figure 1. Patients, male, 45 years old, metastatic liver cancer, liver arterial chemotherapy embolism. (A) The tumor during surgery shows that the tumor is mainly supplying blood from the left artery, left artery blood vessels and backward folding angles (arrows); (B) The swan-neck microstructurel is ultra-selective into the left artery, and the metal marking shall be seen (arrow); (C) After the iodide oil emulsion embolism is completed, the swan-neck microstructurel are angiography in the left artery opening (arrow).

stability of the microstructure is increased. Therefore, for patients who are planning to undergo coil or tissue glue anatomy, this microcatheter can provide better recoil support, ensure accurate and efficient embolization, and avoid the risk of microcatheter popping out and causing embolism in other locations. It is a good alternative microcatheter. A variety of specifications (2.1F, 2.4F, 2.6F, 2.7F) swan-neck microstructures can provide a variety of options according to the types of different blood vessels and embolism materials. Its 2.6F and 2.7F swan-neck micro-conductors have a large internal cavity (0.028"), which can meet the needs of clinical large flow channels.

Of course, the swan-neck microstructure also has certain limitations. The formation consideration of the mezzanine caused by 1 case (3.2%) of this group (3.2%) is caused by the damage of the duct head end. Pay attention to the clinical operation of this microstructure: the head end has a 0.8mm of the development mark, which increases the hardness of the head-end. The choice of target blood vessels requires a certain internal diameter to form. The visualization label was pulled violently on the pedantic vascular wall. Secondly, due to the pre-plastic swan-neck head end design, be careful when the reversing operation is needed to avoid violence to reverse and gently operate; otherwise, there will be a potential risk of discounts and even break. When the microcatheter enters the distal blood vessel, the friction between the microcatheter wall and the blood vessel wall and the gradual decrease in controllability make it more difficult to adjust the direction of the microcatheter head. At this time, we can use a neurointerventional microguidewire, which can easily pass through twisted blood vessels and has good

trackability and flexibility. The combination of the two can complete most superselective intubations.

Reasonable application of swan-neck head end and gentle movement are the basic operation of this microstructure hyper-selected technology. The preliminary experience of this center using its super-selection of intubation is: after the angiography the target blood vessel position, use micro-wire for super-selection and then send microstructures; if the micro-wire can not be oversized, you can slowly transport it under the guidance of the guide wire. Microconduration to the vascular split mouth, use the angle of your own catheter to transport microstatic wires and then perform ultra-selective intubation; or insert the microstructure hypertrophic into the neighboring branch blood vessels adjacent to the target blood vessels, so that the microstarted tube head is consistent with the direction of the target blood vessels. After perspective guidance, pull or rotate the catheter to complete the ultra-selective intubation. Yang *et al*. [26] discussed the application of Maestro's swan-neck microstructure in the peripheral arterial hyperselection of intubation. Maestro's swan-neck microstructure completes super-selective intubation, indicating that the swan-neck microstructure can improve the peripheral arteries of the peripheral arteries. The success rate of tube, ensuring embolism efficiency and safety and reducing vascular damage, has similar conclusions to this study.

5. Conclusion

In conclusion, the InstantPass Swan-Neck Microstructure is safe and effective in peripheral vascular interventional therapy. It can be used as an effective alternative to straight-headed microcatheter superselective cannulation when it is difficult to cannulate. It performs outstandingly in vascular tortuosity and angulated lesions and has important clinical application value.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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