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A Reliable Method: Purse-String Hemostasis for Arteriovenous Fistula or Arteriovenous Graft Cannulation after Percutaneous Transluminal Angioplasty

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Percutaneous transluminal angioplasty (PTA) is the most common therapy used to treat dialysis patients with an occluded arteriovenous fistula (AVF) or arteriovenous graft (AVG). AVF or AVG hemostasis after PTA is time consuming, and it may be complicated with acute thrombosis of the AVF or AVG and re-bleeding from the puncture site. In this study, we prospectively studied 145 hemodialysis patients with occluded AVF or AVG using a modified purse-string suture with short tubing tourniquet technique for hemostasis following PTA, during which we used heparin and urokinase infusion. The results indicated that the modified technique for hemostasis of AVF orAVG was effective and safe in achieving immediate hemostasis withoutmanual compression in all patients.

Key Words: Fistula hemostasis • Purse-string suture

The prevalence and incidence of uremic patients in Taiwan is high. Data from the national health insurance system in Taiwan have shown that the number of patients needing dialysis is about 60000 to 70000 per year. At our hospital, about 400 to500 patients per year need percutaneous transluminal angioplasty (PTA) to treat a diseased arteriovenous fistula (AVF) or arteriovenous graft (AVG). AVF or AVG hemostasis after PTA is time consuming. The process of hemostasis may complicate with acute thrombosis of AVF or AVG. Re-bleeding after the hospital discharge is also common after PTA, which will distress the patients and their families. Clinically, the bleeding rate is higher than the thrombosis rate after PTA. For these patients, uremic toxins play an important role in coagulation disorders and cardiovascular disease, especially atrial fibrillation.[1] Chronic kidney disease itself and its therapeutic medications increase the likelihood of bleeding after the procedure. If these patients have acute coronary syndrome and require triple or double antithrombotic therapy, reducing any in-hospital bleeding can improve their outcome.[2] We have been trying to find an appropriate method for hemostasis of an AVF or AVG after PTA since 2011, and we are particularly interested in the "fistula hemostasis with purse-string suture" method. Therefore, we prospectively used this method in our PTA patients with diseased AVF or AVG. This technique has been shown to be reliable for hemostasis in patients undergoing PTA with only heparin infusion. In this study, we evaluated the efficacy and safety of hemostasis in patients using both anticoagulant and thrombolytic therapy during PTA for diseased AVF or AVG.

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MATERIALS AND METHODS

From August 2014 to June 2016, we prospectively

studied 145 consecutive patients who used heparin and urokinase for PTA. Of these cases, 46 had an AVF and 99 had an AVG. All of these patients presented to our hospital due to a completely occluded AVF or AVG. All patients received adequate pain control and sedation. During the PTA procedure, IV heparin (5,000 U) and urokinase 250,000 U were used routinely in all patients for possible mural thrombus or pulmonary emboli. In every patient, we used a 7 French and a 8 French sheath introducer (Merit Medica; Prelude® Sheath Introducers, 7 French; 8 French). The 8F sheath introducer and an 8F multipurpose catheter were used for thrombectomy. CONQUEST PTA dilatation catheters with a balloon diameter from 5 mm to 10 mm were used for lesion dilatation. Similar to a demonstration on relevant website (refer to https://www.youtube.com/watch?v=Pn39zD49-I8), our modified technique consisted of placing two loops of suture material underneath the skin in a symmetric purse-string suture arrangement using 4-0 Covidien DERMALON™ monofilament nylon sutures. Subcutaneous sutures were placed approximately 2-3 mm peripheral to the puncture site. The side tube of the sheath introducer was cut into 1- to 2-cm segments and used as a tourniquet. The tourniquet was then placed beneath the suture before it was tightened. An assistant held the tourniquet in place and applied manual compression over the puncture site. The sheath introducer was then removed by the assistant and the suture was tightened with three surgical knots by the operator (Figure 1). The patients were then monitored for approximately 20 minutes in our recovery room after the procedure. If the patient underwent hemodialysis immediately after the PTA, the sutures were left in place until the next day of dialysis. The sutures remained in place for 12 hours to 24 hours in these patients. We informed the patients not to remove the suture on the day of PTA and to keep the puncture site dry. The sutures were easily removed by the dialysis staff with a simple incision over the tourniquet.

RESULTS

A total of 290 purse-string sutures were deployed. The technique, which we termed “purse string hemostasis”, was successful in achieving immediate hemostasis without manual compression in all patients. Two patients had a diffusely swollen arm on the day after the procedure, reported by dialysis staff. Before leaving the hospital, these two patients did not have bleeding or hematoma near the puncture site of the sheath introducer. All AVFs and AVGs were patent when the patients received hemodialysis after PTA. The sutures did not obstruct flow. Two cases had incidental re-bleeding from the puncture site after they left the hospital. One female patient with dementia removed the tourniquet by herself when she arrived at home, and new dialysis staff removed the suture of another male patient on the day of PTA. Five patients had some oozing from the puncture or suture sites, for which digital compression stopped the oozing in minutes. No case had an infection related to their PTA.

DISCUSSION

The purse-string suture is a continuous, circular inverting suturing technique which is made to secure apposition of the edges of a surgical or traumatic wound. This technique helps to enhance hemostasis in some surgical wounds.[3] Vorwerk et al. reported a simple purse-string suture for percutaneous grafts and fistulae in 1997.[4] Purse-string sutures are helpful to achieve hemostasis

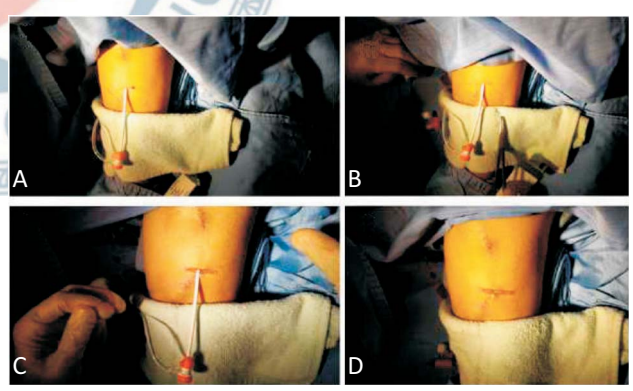

Figure 1. *The technique included placing two loops of suture material underneath the skin in a symmetric purse-string suture arrangement using 4-0 Covidien DERMALON™ monofilament nylon sutures. Subcutaneous sutures were placed approximately 2-3 mm peripheral to the puncture site. The side tube of the sheath introducer was cut into 1- to 2-cm segments and used as a tourniquet. The tourniquet was placed beneath the suture before it was tightened. An assistant held the tourniquet in place and applied manual compression over the puncture site. The sheath introducer was removed by the assistant and the suture was tightened with three surgical knots by the operator.*

after removing the sheath introducer, however achieving precise tension on the sutures can be challenging. In addition, the suture is partially buried in subcutaneous tissue, which makes removal difficult. In 2000, Zaleski described a modified purse-string suture technique which included a miniature tourniquet that allowed the tension on the purse-string suture to be adjusted and the suture easily cut and removed.[5] The procedure required the rotation of the tourniquet clockwise until complete or near-complete hemostasis was achieved. The tourniquet was then taped down parallel to the graft with sterile tape. This technique was successful in achieving immediate hemostasis without complications.

The MERIT MEDICA "slip-Not suture retention device" can also be used to achieve hemostasis, however, it needs extra cost. This product has a similar design to the Woggle technique. Simons showed the efficacy and safety of the Woggle technique to achieve hemostasis at hemodialysis catheterization sites in 2003.[6] We found a demonstration of the "fistula hemostasis with purse-string suture" technique on a relevant website, however it did not involve rotation of the tourniquet. We had already used this modified technique more than 500 times before conducting this study, and it has proven to be safe and reliable, with no contrast exudation being noted from the puncture site in imaging, and no significant reduction in lumen (Figure 2).

In this study, two patients had swollen hands after PTA. We believe that this situation was not related to the purse-string suture because there were no obvious local hematomas. Re-bleeding of purse-string suture sites may be caused by increased intravascular pressure, such as incomplete thrombectomy and lesion dilatation, or in conditions when mural thrombus migrate into the outflow tract. After dealing with these problems, hemostasis was obtained immediately. Therefore, we believe that the purse-string suture for hemostasis is valid if the pressure in the AVG or AVF is not high. Stenosis of the outflow tract can cause the pressure in the fistula or graft to be greater than 100 mmHg.[7] Therefore, this technique is not applicable when the femoral artery catheter is withdrawn. Bacterial adherence is greater for silk and other braided materials than for monofilaments.[8] We used nylon monofilaments because braided material such as silk is associated with a greater risk of infection.[9,10] One of our patients who received purse-string suture after PTA in 2012 lived in a nursing home and had poor personal hygiene. His suture was removed after more than 1 week, and a puncture site infection with Staphylococcus aureus bacteremia was noted. He finally underwent removal of the artificial graft due to failed antibiotic therapy. Therefore, we suggest that the suture should be removed within 12 to 24 hours. Using a side tube as a tourniquet in this procedure may cause a stage 1 pressure ulcer after 12 to 24 hours. However, using a plastic dilator as the tourniquet can often results in a stage 2 or more severe pressure ulcer after removal of the sutures. Aesthetics is another consideration for some patients.

Figure 2. *Fistulography showed a significant lesion after anastomosis. PTA was performed with a retrograde approach via a sheath introducer in the fistula. After fistula hemostasis had been achieved with a purse-string suture, there was no bleeding or vessel lumen loss around the puncture site. In our experience, adequate hemostasis can be obtained when the entry point of the needle faces the surface of the blood vessel directly. If the entry site is at the side ofthe vessel, hemostasis will be not good. Introducing a sheath via these dialysis puncture sites is not suggested, because these locations often produce scarring or skin thinning. Moreover, sutures at these location are prone to more severe pain and risk tissue tears. Furthermore, it will hinder postoperative dialysis. In order to obtain a good skin condition for suturing, we sometimes identify an appropriate puncture site under fluoroscopic guidance.*

CONCLUSIONS

Purse string hemostasis is effective and safe for hemostasis following removal of a vascular sheath after PTA, even for patients using heparin and urokinase infusion.

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