



Outcomes of Interrupted Suturing Techniques for Wrist Fistulas

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Abstract

Objective: In this study, we evaluated the results of our interrupted anastomosis operations.

Methods: A retrospective review was conducted on consecutive operations for interrupted anastomosis wrist AVF performed by staff surgeons from January 2005 to December 2018.

Results: Among the 50 cases, 45 (90%) were successful. The primary failure rate was 10%, and the maturation time required for the fistula to develop was 8.14 weeks. Patency rates were 79%, 70%, and 62% at the end of the 1st, 3rd, and 5th years, respectively. Anastomotic aneurysm was the second most common complication.

Conclusion: Interrupted anastomosis increases the opportunity for the construction of a successful wrist AVF and is a reliable, safe technique with a high patency rate.

Keywords: techniques, suturing, interrupted, fistulas, anastomosis operations



ผลของใช้เทคนิคการเย็บที่ละปมเพื่อการผ่าตัดหลอดเลือดล่างไตบริเวณข้อมือ

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บทคัดย่อ

วัตถุประสงค์: การศึกษานี้ เพื่อประเมินผลของการผ่าตัดหลอดเลือดล่างไตด้วยวิธีการเย็บที่ละปม

วิธีดำเนินการวิจัย: เป็นการศึกษาย้อนหลังของผู้ป่วยที่เข้ารับการผ่าตัดหลอดเลือดล่างไตด้วยศัลยแพทย์ แล้วใช้วิธีการเย็บที่ละปม ช่วง มกราคม พ.ศ.2548 จนถึง ธันวาคม พ.ศ.2561

ผลการวิจัย: มีผู้ป่วยเข้ารับการผ่าตัดด้วยวิธีนี้ทั้งสิ้น 50 ราย โดย 45 ราย ประสบความสำเร็จ (ร้อยละ 90) มีความล้มเหลวตั้งแต่ระยะแรกร้อยละ 10 ระยะเวลาที่หลอดเลือดโตจนใช้งานได้มีค่าเฉลี่ย 8.14 สัปดาห์ การเปิดอยู่ของหลอดเลือดเพื่อการใช้งานเท่ากับร้อยละ 79 ร้อยละ 70 และร้อยละ 62 เมื่อสิ้นสุดปีที่ 1 ปีที่ 3 และปีที่ 5 ตามลำดับ การเกิดหลอดเลือดโป่งพองบริเวณใกล้รอยต่อของหลอดเลือด คือ ภาวะแทรกซ้อนที่พบได้มากเป็นอันดับที่ 2

สรุป: การเย็บที่ละปมเพิ่มโอกาสการผ่าตัดหลอดเลือดล่างไตบริเวณข้อมือให้ประสบผลสำเร็จ การเย็บที่ละปมทำให้ผลการผ่าตัดดี ปลอดภัย การเปิดอยู่ของหลอดเลือดเพื่อการใช้งานทนทาน

คำสำคัญ: เทคนิค การเย็บ ที่ละปม หลอดเลือดล่างไต การฟอกเลือดด้วยเครื่องไตเทียม

Introduction

According to an ESRD study, the majority of hemodialysis patients (78%) usually stay in urban areas¹. Dialysis access with a low rate of long-term complications might improve the quality of life for these patients.

American and European guidelines have recommended wrist AVF as the first and best hemodialysis access² because it allows the preservation of the patient's vascular network and requires few interventions after maturation (infection, stenosis, and thrombosis). However, wrist AVF has high failure rates³⁻⁶. Compared with brachial fossa fistulas, wrist AVFs offer a lower rate of steal syndromes, high-output cardiac failure, and edema associated with central vein obstruction⁷⁻⁸.

Other clinical practices, including free flap surgery, coronary artery anastomoses, and hepatic artery anastomoses, use interrupted suturing techniques (or modifications with interrupted sutures for some parts of the anastomosis) for microanastomoses with excellent results⁹⁻¹².

We hypothesized that, similar to other microsurgical anastomoses, the small vessels of wrist AVFs may be an advantage for interrupted suturing techniques. Here, we study the early patency, late patency, and complication rates of wrist AVFs constructed with interrupted suturing techniques.

Methods

This trial received ethical approval from the Vajira Research Ethics Committee and was carried out in accordance with the Declaration of Helsinki. Informed consent was not required. The patients were recruited from the Faculty of Medicine, Vajra Hospital. Data from all the patients who underwent dialysis access operations between January 2005 and December 2018 were entered into a vascular access database (which includes an operative record book and an OPD card) that details each patient's preoperative assessment, operative technique, and follow-up data.

Inclusion criteria included wrist AVFs created with the interrupted suturing technique. Exclusion criteria included wrist AVFs created using a continuous or a hybrid technique, operation by resident surgery alone, patient inability to participate in hand exercise program after surgery, and inability to extract the computer database.

Access patency was computed at the end of the study period, death, convert route dialysis,

transplantation, or loss to follow-up. Operative success (mature AVF) was determined as the successful puncture of the wrist AVF by needle No.16–17 with an access flow of at least 200 mL/min. Postoperative drugs were used only as per the surgeon's preference. The patients were not assessed routinely with ultrasound. A tourniquet with physical examination is a key component in the preoperative care of wrist AVF.

Reliable wrist AVF access achieved via interrupted anastomosis requires follow-up by the operator. The patients were generally assessed 1 week postoperatively and reexamined after 6 weeks prior to the clinical decision. During follow-up, each patient was advised to participate in a hand exercise program. Complications, including thrombosis, immature, bleeding, wound infection, and hand edema, were also recorded. After 6 weeks, if the wrist AVF is not enlarged or has grown to maturity, then ultrasound and physical examination are repeated and a revision or new AVF is considered. After initial access utilization, the blood flow rate (BFR) and venous pressure (VP) of patients were generally evaluated every 3 months. When the wrist AVF failed to sufficiently mature, physical examination and ultrasound were conducted to localize the lesion, and a fistulogram was provided. The majority of these nonmaturing wrist AVFs could be successfully treated with proximal AVFs.

Surgical technique

All operative procedures were performed by experienced vascular access surgeons. After clinical screening, snuffbox or Brescia–Cimino was offered as a primary wrist AVF whenever possible. Anesthesia was provided through local injection. The operation was performed under surgical loupe with 2x magnification.

The accustomed incision was 4–6 cm long and S-shaped at the radial end for the construction of the Brescia–Cimino fistula and 1.5–2 cm long at the anatomical snuffbox for creation of the snuffbox fistula. The incision site of the snuffbox AVF must be above the area of prominent posterior radial artery pulse and cephalic vein so it can pass over this region. The snuffbox AVF was simply mobilized to an anterior place for a tension-free anastomosis. Small veins (diameter less than 3 mm) were distended by saline until their diameters were larger than 3 mm. Small tributaries of the artery and vein were preserved as much as possible, except for the tributary vein to the

thumb. The radial artery must be larger than 2.0 mm and free from calcification. Surgical incision of the vessels with long arteriotomy was performed. The arteriotomy and venotomy sites must be cautiously determined and aligned to guard against distortion or contortion upon the completion of anastomosis with length of about 6–10 mm. Suture all over the anastomosis is crucial, especially at each end; only small volumes (0.3–0.5 mm) of tissues were first incorporated using each needle, the cautious radial positioning of the suture was adopted while the angles were created, and the volume of tissues incorporated in the suture was multiplied for successful outcomes¹³. Anastomoses were performed using 7–0 polypropylene. “Back wall first,” which is ordinarily used in these small vessels, was adopted following the technique described by Tellis et al¹⁴. An interrupted suture was used to complete the rest of the anastomosis.

Small veins were corrected by saline dilatation. The tributary vein to the thumb was ligated with a 4–0 silk during surgery. In case of faint thrill, the adventitia of the small vein was dissected using microscissors until the vein diameter was larger than 3 mm. After adequate dissection, the thrill usually becomes prominent. Some surgeons do not recommend the use of saline for vein dilatation because of the risk of injury to the intima.

After unclamping, bleeding was checked and corrected. An easily palpable thrill was established, and the wound was completed with sutures. The patients were monitored at least 2 hours postoperation.

Data collection and analysis

Primary AVF patency rate was calculated from the date of maturation to the date of the AVF dysfunction, mortality, or final follow-up visit and was estimated with the Kaplan–Meier survival estimator. Statistical analyses were processed using excel 2007 and manual calculation.

Results

Patient characteristics

Fifty wrist AVFs with interrupted anastomosis were consecutively performed on 50 patients at Vajira Hospital University. The age range was 29–80 years (mean = 49 years, 5 months). Among these patients, 17 (35%) and 25 (50%) had diabetes and hypertension, respectively, and 20 (40%) had a history of statin usage during perioperative care. Table 1 shows the other patient demographics.

Table 2 lists the operations. Overall, the maturation rate was 90% with a mean maturation time of 8.14 weeks. The side-to-side snuffbox AVF was the most common operative technique (n = 33, 66%). The side-to-side Brescia-Cimino AVF was the second most common operative technique (n = 8, 16%). Side-to-side wrist AVF was performed on 41 patients (82%).

Table 3 shows the complications of interrupted anastomosis wrist AVFs. Five (10%) cases failed (thrombosis 1, fail to mature 4). All the patients were corrected by brachial fossa AVF. One patient with patent wrist AVF died from stroke 9 months after operation. Nine patients with a functioning AVF were lost to follow-up, and the mean follow-up was 33.11 months.

Table 1:

Demographics of 50 patients with interrupted anastomosis wrist AVF

Data	Results
Gender (M:F)	28:22
Age (mean±SD) (range)	49 years 5 months±12 years 10 months (29-80 years)
Comorbidity	
Diabetes	17 cases (34%)
Hypertension	25 cases (50%)
Dyslipidemia	3 cases (6%)
Statin usage	
20 mg per day	17 cases (34%)
40 mg per day	3 cases (6%)

Table 2:

Results of interrupted anastomosis wrist fistula

variables	
1. mean of maturation time	8.14 weeks
2. type of wrist fistula	
2.1. snuffbox side-to-side fistula	33 (66%)
2.2. snuffbox side-to-end fistula	5 (10%)
2.3. Brescia-Cimino side-to-side fistula	8 (16%)
2.4. Brescia-Cimino side-to-end fistula	4 (8%)

Table 3:

Complications of interrupted anastomosis wrist AVF

Complications	Case (percentage)
1. Thrombosis or fail to mature	5 cases (10%)
2. Infection	1 case (2%)
3. Central vein obstruction	0 case (0%)
4. Hand edema	1 case (2%)
5. Anastomotic aneurysm	4 cases (8%)
6. Steal syndrome	0 case (0%)

Four snuffbox AVFs developed anastomotic aneurysm at 13 months, 14 months, 4 years, and 6 years (4/38, 10.53%). Two of the aneurysms expanded and were corrected by proximal autogenous fistula. The other two patients were observed; one developed AVF thrombosis 2 years later, and the other remained functional. No patient postoperatively developed clinical

steal syndrome or central vein obstruction. One patient had mild hand swelling that was resolved with observation, and another had a wound infection.

Figure 1 shows the Kaplan–Meier analysis. The primary patency rate of interrupted anastomosis wrist AVF was 79% in 1 year, 70% in 3 years, and 62% in 5 years.

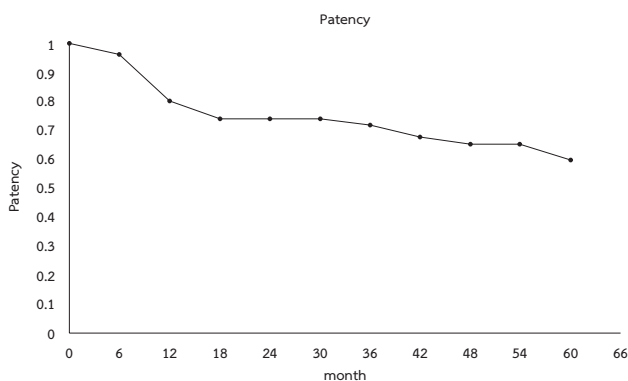


Figure 1: Interrupted anastomosis wrist AVF analysis by Kaplan Meier survival shows primary patency at 1, 3 and 5 years, respectively.



Figure 1: shows (a) Man age 48 years right side-to-side snuffbox fistula 12 years (b) Man age 67 years right side-to-side snuffbox fistula 7 years

Discussion

Guidelines from NKF/DOQI advice wrist AVF as the first choice for hemodialysis⁵. Snuffbox is an alternative for wrist AVF and supposedly has low rates of failure². However, some researchers reported that Brescia–Cimino and snuffbox AVFs have high failure rates. Brachial AVF is recommended as the second choice whenever a wrist AVF is impossible or unsuccessful; however, it poses the risk of developing steal syndrome and central vein obstruction. Complications arise in up to 47% of these patients, and fistula maturation takes as long as 6 months¹⁵⁻¹⁷. Wrist AVFs reduce the risk of steal syndrome and central vein obstruction, consequently lowering the risk of intervention and cost. Therefore, our results were confirmed.

Snuffbox AVF was performed on 38 (76%) patients. Radiocephalic AVF in the snuffbox region was first introduced in 1969 by Rassat and his colleagues¹⁸. This technique provides the possibility of fistula creation in the most distal region of the upper extremity. Although many researchers reported snuffbox AVF to have high patency rates^{2,21,22}, some surgeons have failed to achieve low thrombosis and failure rates^{19,20}. Despite the similar procedures of anastomosis construction between Brescia–Cimino and snuffbox, some divergences seem to be crucial. First, the skin incision of snuffbox AVF is extremely small (picture 1), so tissue trauma is reduced. This outcome is good in terms of aesthetics. Second, the cephalic vein of the snuffbox has a small diameter but can still be an adequate caliber for hemodialysis. The vein of snuffbox AVF is invisible even when the patient wears a sleeveless shirt. Third, the vein is parallel to the artery, and the risk of vessel distortion is extremely low. Finally, the anastomosis angle is extremely narrow, and changing the locally annoyed flow patterns reduces the development of neointimal hyperplasia.

The most common complication was failure to mature or thrombosis, which was observed in 10% of the cases. The second most common complication was anastomotic aneurysm, which was observed in 8% of the cases. Venous dilatation and adventitial dissection may address this problem. According to Rajput A et al.²³, juxta-anastomosis aneurysms are usually associated with brachial fossa AVF and venous outflow obstruction.

The shape of AVF is important because it determines the hemodynamic situation, a significant booster of endothelial malfunction and subsequent NIH development²⁴⁻²⁷. In this report, the most common configuration was side-to-side AVF. We believe that the size of vessels is important²⁸⁻²⁹, and the tiny vessels of wrist AVFs may be utilized with side-to-side techniques²⁹.

Interrupted anastomosis is used regularly in clinical practice for microsurgical anastomoses¹⁰. Many studies demonstrated configuration and suturing techniques. Many clinical studies showed the utility of interrupted over continuous anastomosis^{11,30}. Although some studies are similar³¹, no research demonstrated the superiority of continuous to interrupted anastomosis. Interrupted anastomosis for arterial repair features a reduction in anastomosis stenosis³², an improvement of anastomotic compliance^{12,33-35}, a decrease in pulsatility indices, and an increase in diastolic and peak flow³³. These phenomena might increase the anastomotic luminal diameter^{34,36}, particularly between the interrupted stitches³⁷. This circumstance is especially significant in small vessels, which are frequently <2 mm³⁸⁻³⁹.

According to Moss SH⁴⁰, the valve of the dorsal venous arch of the hand, which is manipulated to direct flow from the radial to ulnar in the hand, is present in the dorsal venous arch. Dorsal venous arch flow is established in the basilica vein by direction of the native valve. In the present work, one patient had an edematous hand that is a side-to-side Brescia–Cimino AVF. This phenomenon may be the reason why no hand swelling or venous hypertension occurred among the side-to-side snuffbox AVF patients. We routinely ligated a tributary vein to the thumb to allow for distal basilica vein dilatation in the future. However, permitting the outflow into nondialysis venous branches may lead to the late maturation of the fistula.

Several limitations of this study merit consideration. The results of operations were only retrospectively analyzed from the medical records. Another limitation was the evaluation of statin administration (statin was administered in 40% of patients). Statin administration is associated with a decrease in NIH, which may improve outcome⁴¹. This study showed the good outcome of interrupted anastomosis wrist AVF with high-patency rate and low complications; however, our hospital performs

250–300 cases of vascular access surgery per year. These patients may be a highly selective group for wrist AVF.

Conclusions

Interrupted anastomosis wrist AVF has high success and high-primary patency rate and extremely low complication rate. Further studies should define the optimal selection for this procedure.

Conflict of interest

The authors declare that they have no conflict of interest.

Acknowledgement

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