

COMPARATIVE STUDY BETWEEN ONE-STAGE AND TWO-STAGE BRACHIO BASILIC ARTERIOVENOUS FISTULA AS A HEMODIALYSIS ACCESS PROCEDURE

By

Mohammad Hussien Salama

Vascular and Endovascular Surgery Unit, Faculty of Medicine,
Al-Azhar University, Cairo, Egypt

ABSTRACT

Background: The primary use of autogenous arteriovenous access for chronic hemodialysis is recommended by the National Kidney Foundation–Dialysis Outcomes Quality Initiative practice guidelines. Brachioabasilic (BB) fistulae are a form of vascular access for patients requiring dialysis. Brachioabasilic (BB) fistulae can be created with either a single stage or a two stage procedure.

Objective: The goal of this study was to compare the failure rates and functional patencies of one-stage vs two-stages brachioabasilic fistulas.

Patients and Methods: Fifty patients with chronic renal failure (CRF) with the cephalic vein was unsuitable for use or failed brachio cephalic were admitted to The Vascular Surgery Unit in Al-Hussein University Hospital in the period from Jun. 2011 to Jun 2013. One stage procedure was done to twenty five patients of them and two stages procedure was done to the rest of the patients.

Results: Two stages procedure failure rates were lower than one stage procedure. Two stage procedure survived longer than one stage procedure. There was no difference in primary failure between the two groups which were due to hypotension, thrombosis of vein, and small sized basilic vein. Two cases of wound infection had occurred in obese and diabetic patients which was controlled by drainage and umbrella of antibiotics.

Conclusion: Two stage procedure BB fistulae was better than one stage procedure in primary patency and access survival.

INTRODUCTION

In the last two decades, there have been concerted efforts by the National Kidney Foundation Dialysis Outcomes Quality Initiative (NKF-DOQI), and the Fistula First Breakthrough Initiative to decrease the use of prosthetic grafts and increase autogenous (native) arteriovenous fistula (AVF) creation for hemodialysis access (Wolford et al., 2005). When considering vascular access for hemodialysis on the basis of patency, resistance to infection,

and associated complications, Native AVF should be selected as the first choice whenever possible. If the cephalic vein in the upper arm is unusable for AVF construction, the basilic vein can be superficialized and anastomosed to the brachial artery at the elbow to form a brachioabasilic arteriovenous fistula (BB) AVF (Kukita et al., 2015).

The 2006 updates to the NKF-DOQI Guidelines for hemodialysis access indicate that a radiocephalic fistula (RCF)

is the preferred form of permanent access, followed by a brachiocephalic fistula (BCF), and finally a brachiobasilic fistula (**National Kidney Foundation, 2006**).

As the percentage of patients with fistulae continues to increase, and with increasing longevity of patients with end-stage renal disease, BB fistulae have assumed a more important role in hemodialysis access (**Agarwal et al., 2014**).

Although BB fistulae do not show higher patency rate than Brescia-Cimino AVF, its use as autologous AVF has been increasing. Despite its large operative wound, long hospital stay, and high primary failure rate, the usage of BB fistulae have been increasing because radiologic intervention rate is low once matured, patency rate is high, infection rate is low, allows the possibility of another vascular access before using prosthetic grafts to create AVF especially for young patients who need to secure veins for long-term hemodialysis (**Lee et al., 2016**).

If a BB AVF is to be constructed, duplex ultrasound should be used to check the path and size of the basilic vein. It is also important to determine if an adequate length can be mobilized (**Woo et al., 2009**).

Patency rates of the TBBAVF have been reported to be better than an AVG (**Keuter et al., 2008**).

The BB fistulae can be formed in one stage or two stages. To date, limited and conflicting data exist regarding primary failure and the patency rates of one-stage and two-stage procedures. Each procedure has advantages and disadvantages

(**Wolford et al., 2005**). Meta-analysis of the existing literature comparing one-stage and two-stage suggests no difference in failure and patency rates, despite the two-stage procedure's being used in patients with smaller basilic veins (**Cooper et al., 2015**). Both one-stage and two-stage procedures have their advantages and disadvantages. Which procedure results in improved outcomes remains unclear.

However, the basic principle is to superficialize the basilic vein and make it amenable to needle puncture.

The aim of this work was to compare primary failure rates and the primary functional patency of one-stage vs two-stage brachiobasilic fistulas to compare the two surgical techniques.

PATIENTS AND METHODS

Fifty patients were admitted to Vascular and Endovascular Unit, Al-Hussein University Hospital. One stage BB fistulae was done to twenty five patients and two stage BB fistulae to the other twenty five patients.

All patients were exposed to full history taking, clinical examination and duplex mapping to the upper limb venous system for detection of adequacy of vessels for access placement. When brachiocephalic or radiocephalic fistulas can not be created because of exhausted cephalic vein, small vessel sizes, failure to mature, brachiobasilic fistulae were indicated in the upper limb before use of arteriovenous synthetic graft.

Clinical signs of dysfunction of cephalic vein preoperative included cord like vein, loss of thrill and previous multiple punctures at vein site.

The procedure has been explained to all patients and consent was taken for operation and possible complications.

Techniques of one stage BB fistulae:

The one-stage operation was performed under regional anesthesia. A 5-cm incision at the ante cubital fossa identifies the basilic vein. The incision was extended proximally, and the underlying deep fascia was opened. The basilic vein was mobilized up to its junction with the brachial vein. The median cutaneous nerve of the forearm was carefully dissected and preserved. After side branches were ligated, the basilic vein was tunneled subcutaneously, with a Roberts' forceps maintaining its axial orientation. An end-to-side arteriovenous anastomosis to the brachial artery was performed (Fig 1).

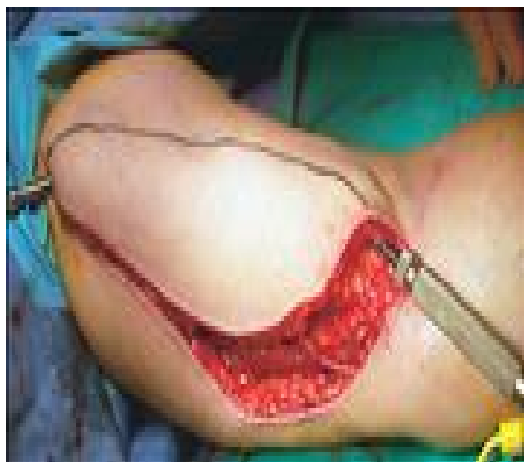


Figure (1): One stage BB AVF procedure



Figure (2): Two stage BB AVF procedure.

Techniques of two stage BB fistulae:

The first stage of the two-stage procedure was performed under local anesthesia by formation of the arteriovenous anastomosis with minimal disturbance of the basilic vein. After 4 to 6 weeks, a flow assessment of the AVF by duplex scanning was made to determine if revision of the anastomosis was necessary at the second stage. The second stage was performed under regional anesthesia. The entire length of the basilic vein was mobilized, a "subcutaneous flap" was created, and the vein was positioned anterolaterally. Usually, a further 2 weeks was required before the AVF can be used (Fig 2).

Statistical analysis

The collected data were organized, tabulated and statistically analyzed by a statistical computer package (SPSS) using chi-square test by *SPSS V20*.

Chi-square test was used to compare frequencies. Patency rate was assessed with the Kaplan -Meier method for survival analysis. P value. ≤ 0.05 was considered significant.

RESULTS

Fifty patients (33 males and 17 females) were included in the study. Mean age was 56 years (range 42-70).

Forty percent of the patients from 42 years to 49 years, thirty percent of the patients from 50 years to 59 years, thirty percent of the patients from 60 years to 70 years. Thirty percent (15 patients) were non-insulin-dependent diabetics, forty percent (20 patients) were insulin-dependent diabetics, and the rest of the patients (30%) were non diabetics. Sixty percent (30 patients) were hypertensive. Female patients were 5 in one stage

procedure and 12 in two stage procedure. The procedure has been doin left arm for 35 patients (70%) and in right arm for 15 patients (30%). Vein diameter by duplex for one stage procedure was 3.5-4.5 mm while in two stage procedure was 2.5-3 mm. It was the first access for 13 patients (26%), second access for 32 patients (64%) and third access for 5 patients (10%) (Table1).Time interval for one stage maturation was 8 weeks (6 weeks to 10 weeks),and for second stage was 6.5 weeks (4 weeks to 9 weeks). No perioperative mortality was recorded. Early failure of access was 10 patients (40%) of one stage procedure and 3 patients (12%) of two stage procedure. Early complications (less than 30 day) were thrombosis 5 patients (20%) of one stage procedure,

hematoma (2 patients of one stage and 2 patients of two stage) managed by drainage, wound infection (one patient of every group) improved by parental antibiotic and dressing.(Table 2).

Late complications were steal syndrome (2 patients of two stage) managed by access ligation, mild venous hypertension (2 patients in one stage and 1 patient of two stage) improved with follow up and stenosis (2 patients of one stage)managed by operative release with patch angioplasty (Table 2).Functional patency for one year after exclusion of early failure and thrombosis was 9(90%) patients of one stage and 20(100%) Of two stages (Fig. 3) and (Fig. 4).

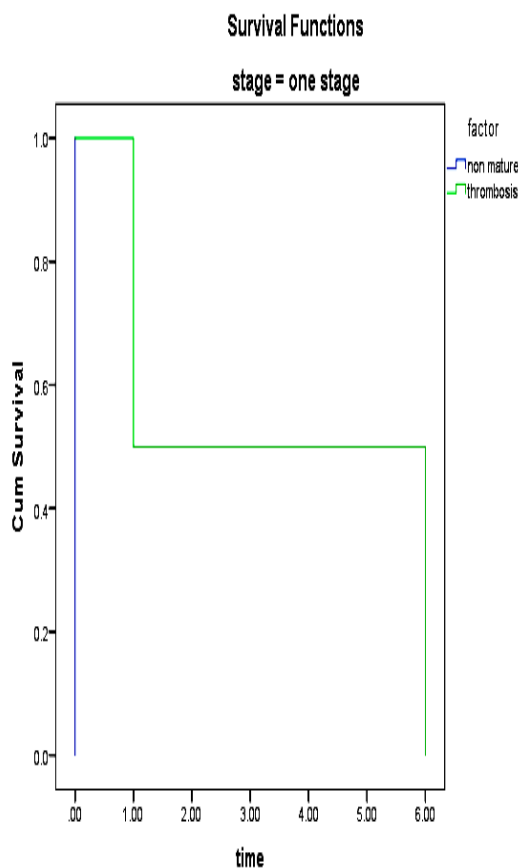


Figure (3): Kaplan Meir survival analysis for detection of patency rate at the first year for one stage procedure.

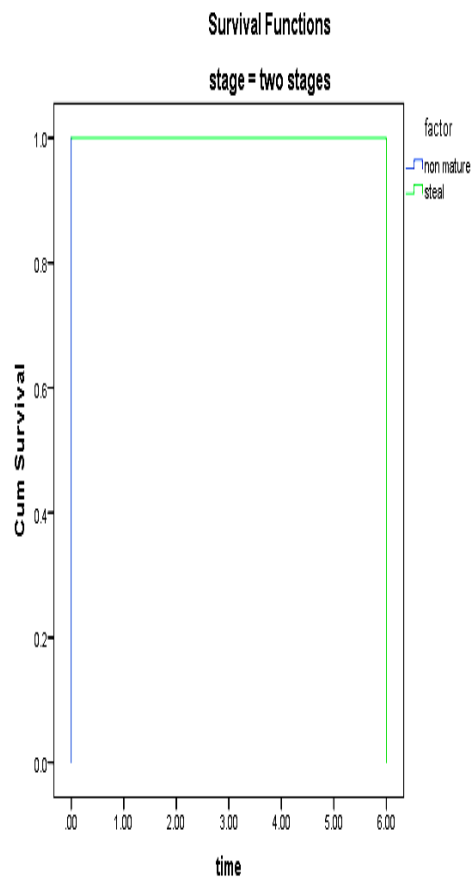


Figure (4): Kaplan Meir survival analysis for detection of patency rate at the first year for two stages procedure.

Table (1): Patient characteristics, associated morbidity and access characteristics in studied cases.

| Characteristics | Stages | One stage | | Two stages | | Chi-square | |
|-------------------------------|--------|-----------|------|------------|------|----------------|---------|
| | | N | % | N | % | X ² | P-value |
| Sex | | | | | | | |
| Male | | 20 | 80.0 | 13 | 52.0 | 4.367 | 0.037* |
| Female | | 5 | 20.0 | 12 | 48.0 | | |
| Associated comorbidity | | | | | | | |
| HTN | | 20 | 80.0 | 10 | 40.0 | 8.333 | 0.004* |
| Types of diabetes | | | | | | | |
| Nidd | | 7 | 28.0 | 8 | 32.0 | 3.533 | 0.171 |
| Idd | | 13 | 52.0 | 7 | 28.0 | | |
| Non | | 5 | 20.0 | 10 | 40.0 | | |
| Fistula side | | | | | | | |
| Right | | 5 | 20.0 | 10 | 40.0 | 2.381 | 0.123 |
| Left | | 20 | 80.0 | 15 | 60.0 | | |
| Frequency of access | | | | | | | |
| First | | 3 | 12.0 | 10 | 40.0 | 6.069 | 0.048* |
| Second | | 18 | 72.0 | 14 | 56.0 | | |
| Third | | 4 | 16.0 | 1 | 4.0 | | |
| Early failure | | 10 | 40.0 | 3 | 12.0 | 5.094 | 0.024* |

Nidd = Non-insulin-dependent diabetics , Idd = Insulin-dependent diabetics, Non=no diabetes, *= significant.

Table (2): Early and late complications.

| Complications | Stages | One stage | | Two stages | | Chi-square | |
|----------------------------|--------|-----------|------|------------|-----|----------------|---------|
| | | N | % | N | % | X ² | P-value |
| Early complications | | | | | | | |
| Thrombosis | | 5 | 20.0 | 0 | 0.0 | 5.556 | 0.018* |
| Hematoma | | 2 | 8.0 | 2 | 8.0 | 0.000 | 1.000 |
| Wound infection | | 1 | 4.0 | 1 | 4.0 | 0.000 | 1.000 |
| Late complications | | | | | | | |
| Steal | | 0 | 0.0 | 2 | 8.0 | 2.083 | 0.149 |
| Stenosis | | 2 | 8.0 | 0 | 0.0 | 2.083 | 0.149 |
| Venous hypertension | | 2 | 8.0 | 1 | 4.0 | 0.355 | 0.552 |

*= significant.

DISCUSSION

The usefulness of brachiobasilic fistula has been recognized as an internal shunt that can replace AVG in patients in whom AVF creation is difficult in the forearm and elbow (**Shibutani et al., 2013**). The BB fistula is considered as an option when either previous fistulae have failed, or when the cephalic vein is unsuitable for use (**Gonzalez et al., 2010**).

There is an evidence to suggest that BB fistulae has a good outcome comparable patency rates to cephalic fistulae (**Ayez et al., 2012**). The BB fistula has patency rate equal to brachiocephalic fistula (**Koksoy et al., 2009**).

Fifty patients with CRF underwent brachiobasilic arteriovenous fistulae in the period from June 2011 to June 2013, one stage procedure for twenty five patients and two stages procedure for another twenty five patients, Thirty three males and seventeen females ranged from forty two years old to seventy years old with mean age 56 compared to **Reynolds et al. (2011)** study which include 90 patient (60 in one stage and 30 in two stage) and the operation was done in two institute every one used one procedure, also this compared to **Vrakas et al., (2013)** study which include 149 patient with 65 patient for one stage and 84 patient for two stage ,49 female for one stage and 52 female for two stage and mean age was 58 year for one stage and 63 year for two stage .in study of **Robertson et al. (2013)** was 73 patient 29 for one stage and 44 for two stage while in **Keuter et al. (2005)** was 31 patient all of them for one stage only with

mean age 56.7 . In our study, 30% (15 patients) were non-insulin-dependent diabetics, 40% (20 patients) were insulin-dependent diabetics compared to **Abd El Mabood et al. (2014)** study was 25% and in **Vrakas et al. (2013)** study was 51.68%.

In our study , there were 66% males and 34% females. Compared to **Agarwal et al. (2014)** there were 45.83% males and 54.17% females and in the study of **Keuter et al. (2005)** there were 35.48% males and 64.52% females.

In our study, there was no relation between old age and fistula failure which was a risk of failure in **Dix et al. (2006)**.

The procedure has been done in left arm for 70% of patients and right hand for 30% of patients compared to the study of **Vrakas et al. (2013)** was left arm in 66.44% and right arm in 33.56%, in the study of **Keuter et al. (2005)** was left arm in 58.06% and right arm in 41.94% also in the study of **Abd El Mabood et al. (2014)** was left arm in 82% and right arm in 18% and in the study of **Agarwal et al. (2013)** left in 60% and right arm in 40%.

The time interval in two stage procedure was 6.5 weeks in our study while in the study of **Reynolds et al. (2011)** was 11.2 weeks, in the study of **Vrakas et al. (2013)** was 12.8 weeks and in the study of **Robertson et al. (2013)** was 14.4 weeks.

No operative mortality was recorded in the present work which similar to the studies of **Robertson et al. (2013)** and **Vrakas et al. (2013)** but there were postoperative complications. Early failure of access was 40% of one stage procedure and 12% of two stages procedure. In the

study of **Vrakas et al . (2013)**, it was 45% for one stage and 42% in two stages. **Reynolds et al. (2011)** mentioned that it is 22.9% in one stage and 9.1% in two stages.

Early complications (less than 30 day) were thrombosis 20% in one stage procedure, hematoma 8% in one stage and 8% in two stages managed by drainage, wound infection 4% in every group improved by parental antibiotic and dressing. **Vrakas et al. (2013)** showed thrombosis 4%, hematoma 3%, and wound infection 3% in one stage while were thrombosis 1%, hematoma 3%, and wound infection 2% in two stages procedure. **Abd El Mabood et al. (2014)** showed thrombosis 4%, hematoma 8%, and bleeding 4% in one stage while was thrombosis 12%, hematoma 4%, and bleeding 12% in two stages .

Late complications were steal syndrome 8% in two stages managed by access ligation, mild venous hypertension 4% in one stage and 4% in two stages, and stenosis 8% in one stage managed by operative release with patch angioplasty. **Vrakas et al. (2013)** showed steal syndrome 2 % in one stage and 3 % in two stages, venous hypertension 2% in one stage and 1 % in two stages , and stenosis 9 % in one stage and 20 % in two stages. **Reynolds et al. (2011)** showed steal syndrome 2.1 % in one stage and 4.5 % in two stages, thrombosis 45.1% in one stage and 3.1 % in two stages, and stenosis 18.8 % in one stage and 9.1% in two stages.

Functional patency for one year after exclusion of early failure and thrombosis was 90% in one stage and 100% in two stages. **Syed et al. (2012)** showed 82% in

one stage and 67% in two stages. In the study of **Reynolds et al. (2011)** it was 78% for one stage and 84% for two stage, **Robertson et al. (2013)** showed 76% in one stage and 84% in two stages. **Agarwal et al. (2013)** showed 100% in one stage and 96% in two stages. **Sheldrake and Rowlands (2015)** showed 58.8% in one stage and 90% in two stages.

CONCLUSION

The brachio basilic arteriovenous fistula was a good option as a native access for regular hemodialysis in chronic renal failure patients. This operation can be done in one operative sitting or in two operative sittings with overall better outcome with two stage procedure.

REFERENCES

1. **Abd El-Mabooda E, Bahbah M, Adbelmofeed A, Alia H, Abd El-Fattah MH and Hasan M I (2014):** Outcomes of brachio basilic arteriovenous shunting with superficialization as a vascular access for renal dialysis: an early experience in Benha University. *The Egyptian Journal of Surgery*, 33:146-153.
2. **Agarwal A, Mantell M, Cohen R, Yan Y, Trerotola S and Clark W (2014):** Outcomes of Single-Stage Compared to Two-Stage Basilic Vein Transposition Fistulae . *Seminars in Dialysis.*, 27(3): 298–302.
3. **Ayez N, van Houten VA, de Smet AA, van Well AM, Akkersdijk GP, van de Ven PJ and Fioule B (2012):** The basilic vein and the cephalic vein perform equally in upper arm arteriovenous fistulae .*Eur JVasc Endovasc Surg Aug.*, 44(2):227e3.
4. **Cooper J, Power AH, DeRose G, Forbes TL and Dubois L (2015):** Similar failure and patency rates when comparing one- and two-stage basilic vein transposition. *J Vasc Surg.*, 61(3):809-825.
5. **Dix FP, Khan Y and Al-Khaffaf H (2006):** The brachial artery-basilic basilic vein arteriovenous fistula in vascular access for heamo-

- dialysis review paper . Eur J Vasc Endovasc Surg.,31:70–79.
6. **Gonzalez E, Kashuk JL, Moore EE, Linas S and Sauaia A (2010):** Two-stage brachial-basilic transposition fistula provides superior patency rates for dialysis access in a safety-net population. *Surgery*, 148(4): 687 e 93.
 7. **Kukita K , Ohira S , Amano I, Naito H, Azuma N, Ikeda K, Kanno Y, Satou T and Sakai S (2015):** 2011 update Japanese Society for Dialysis Therapy Guidelines of Vascular Access Construction and Repair for Chronic Hemodialysis Therapeutic Apheresis and Dialysis; 19(1):1-39.
 8. **Keuter XH, De Smet AA, Kessels AG, van der Sande FM, Welten RJ and Tordoir JH (2008):** A randomized multicenter study of the outcome of brachial-basilic arteriovenous fistula and prosthetic brachial-antecubital forearm loop as vascular access for hemodialysis. *J Vasc Surg*, 47: 395–401.
 9. **Keuter XH, van der Sande FM, Kessels AG, de Haan MW, Hoeks AP and Tordoir JH (2005):** Excellent performance of one-stage brachial-basilic arterio venous fistula. *Nephrol Dial Transplant*, 20:2168-71.
 10. **Koksoy C, Demirci RK, Balci D Solak T and Kose SK(2009):** Brachio-basilic versus brachio-cephalic arteriovenous fistula: a prospective randomized study. *J Vasc Surg*, 49:171–177.
 11. **Lee Y, Song D, Kim MJ and Yun SC (2016):** Upper Arm Basilic Vein Transposition for Hemodialysis: A Single Center Study for 300 Cases. *Vascular Specialist International*, 32 (2): 51-56.
 12. **National Kidney Foundation (2006):** KDOQI Clinical Practice Guidelines and Clinic Practice Recommendations for 2006 updates: haemodialysis adequacy, peritoneal dialysis adequacy and vascular access. *Am J Kid Dis*, 48: 1–22.
 13. **Reynolds TS, Zayed M, Kim KM, Lee JT, Ishaque B, Dukkipati RB and Kaji AH (2011):** A comparison between one-and two-stage brachio-basilic arterio venous fistulas. *J Vasc Surg*, 53(6):1632 e8.
 14. **Robertson GA, Robertson BF, Khan L and Raza Z (2013):** Brachio-basilic Fistula Formation Single versus Two Stage Procedure. *European Journal of Vascular and Endovascular Surgery Volume*, 45(6): 689-692.
 15. **Sheldrake IL and Rowlands TE (2015):** A comparison between one-stage and two-stage procedures for the creation of brachio-basilic arteriovenous fistulas. *international journal of surgery*, 18: 71–74
 16. **Shibutani S, Obara H, Ono S, Kakefuda T and Kitagawa Y (2013):** Transposed Brachio-basilic Arteriovenous fistula *Ann Vasc Dis*, 6(2): 164–168
 17. **Syed FA, Smolock CJ, Duran C, Anaya-Ayala JE, Naoum JJ and Davies MG (2012):** Comparison of one stage versus two stage brachio-basilic fistula. *Ann Vasc Surg*, 26:852–857.
 18. **Vrakas G, Fatima Defigueiredo, Turne S, Jones C, Taylor J and Calder F (2013):** A comparison of the outcomes of one-stage and two-stage brachio-basilic arterio venous fistulas . *Journal of vascular surgery*, 58(5):1300-1304
 19. **Wolford HY, Hsu J, Rhodes JM, Shortell CK, Davies MG, Bakhru A and Illig KA (2005):** Outcome after autogenous brachial-basilic upper arm transpositions in the post-National Kidney Foundation Dialysis Outcomes Quality Initiative era. *J Vasc Surg*, 42:951-957.
 20. **Woo K, Doros G, Ng T and Farber A (2009):** Comparison of the efficacy of upper arm transposed arteriovenous fistulae and upper arm prosthetic grafts. *J Vasc Surg*, 50:1405–1416.

دراسة مقارنة بين الناصور الدموى (بين الشريان العضدى والوريد الباسيليكي) على مرحلة واحدة او مرحلتين كوسيلة للغسيل الدموى

محمد حسين سلامه

وحدة جراحة الأوعية الدموية - كلية الطب - جامعة الأزهر

خلفية البحث : يتم توصيل الوريد الباسيليكي بالشريان العضدى لعمل ناصور وريدى شريانى يستخدم فى الغسيل الكلوى . لكن الوريد الباسيليكي يكون عميقا تحت اللفائفى ويحتاج الى التسطیح تحت الجلد لتسهيل عملية الغسيل الكلوى .

الهدف من البحث : دراسة مقارنة للنتائج والمضاعفات الناتجة عن هذه العملية فى حال تم انجازها فى مرحلة واحدة او فى مرحلتين .

المرضى وطرق البحث : شملت الدراسة خمسون مريضا يعانى من الفشل الكلوى ولديه الوريد الباسيليكي بحالة جيدة ويصلح لعمل الناصور الوريدي الشريانى . تم عمل اشعة دوبلكس لتقييم الوريد الباسيليكي . وتم عمل ناصور بين الشريان العضدى والوريد الباسيليكي على مرحلة واحدة فى 25 حالة وعلى مرحلتين فى 25 حالة اخرى تحت تأثير مخدر موضعى . وكان تقييم الحالات عن طريق الفحص الاكلينيكي والسونار فى المرحلة الأولى كل أسبوعين لمدة ستة أسابيع وفى المرحلة الثانية كل شهرين لنهاية العام .

نتائج البحث : بلغت نسبة الفشل المبكر للناصر 40% فى المرحلة الواحدة و12% فى المرحلتين. المضاعفات المبكرة خلال شهر من العملية كانت تجلط الدم داخل الناصور 20% وتجمع دموى 8% وعدوى سطحية 4% للمرحلة الواحدة بينما كانت تجمع دموى 8% وعدوى سطحية 4% للمرحلتين. المضاعفات المتأخرة كانت ارتفاع الضغط الوريدي فى حالتين وضيق الناصور فى حالتين للمرحلة الواحدة بينما كانت نقص الدورة الدموية فى حالتين وارتفاع الضغط الوريدي فى حالة واحدة .

الخلاصة : يعتبر الناصور الوريدي الشريانى بين الشريان العضدى والوريد الباسيليكي على مرحلتين أفضل من مرحلة واحدة.