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# *Vascular Access Survival: A Comparison of Simple Autogenous Fistulas, Basilic Vein Transposition Fistulas and Prosthetic Grafts*

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*Abstract*

*Objectives:* **Simple arteriovenous fistula (AVF), basilic vein transposition fistula (TAVF) and prosthetic bridge graft (AVG) provide good vascular access for hemodialysis. The 1- and 2-year results of such vascular access were assessed in this study.**

*Materials and Methods:* **From February 2006 to February 2008, 287 hemodialysis access procedures were performed in 274 consecutive patients at Maharat Nakhon Ratchasima Hospital, Bangkok Ratchasima Hospital and Saint Mary Hospital. Follow-up data of 204 procedures (149 AVF, 15 TAVF, and 40 AVG) in 191 patients were available for analysis. Functional patency rates were calculated with Kaplan-Meier method. Differences between patency rates of AVF, TAVF and AVG were determined with the Chi-square test.**

*Results:* **The cumulative functional patency rates at 1-year for TAVF, AVF, and AVG groups were 92.86%, 89.34% and 83.47% respectively and at 2-year were 92.86%, 89.34% and 74.19% respectively. The cumulative functional patency of the TAVF group was superior to those of the AVF and AVG groups and the patency of the AVF group was superior to the AVG group.**

*Conclusions:* **Autogenous AV fistulas (AVF, TAVF) should be the initial access of choice because of their better patency.**

## Introduction

The Kidney Disease Outcome Quality Initiative (K/DOQI) represents a comprehensive consensus statement using evidence-based methods to provide guidelines to optimize care of patients with chronic and end-stage renal diseases. First published in 1997 and revised in 2001, K/DOQI recommends that autogenous arteriovenous hemodialysis access makes up at least 50% of all new permanent hemodialysis access operations.[1]

Multiple studies[2-4] have shown that autogenous arteriovenous fistulas (AVF) demonstrate superior overall patency and lower revision rates compared with prosthetic grafts. Autogenous fistulas are less prone to recurrent stenosis, thrombosis, or infection.[5-7]

Demographic factors associated with poor AVF outcome include advanced age, female gender, African-American race, diabetes mellitus and obesity.[8-12]

We therefore reviewed our experiences with simple AVF (radiocephalic fistula, brachiocephalic

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fistula), basilic vein transposition fistulas (TAVF) and prosthetic bridge grafts (AVG) to determine the relative effect of access type on functional patency.

## Materials and Methods

From February 2006 to February 2008, 287 hemodialysis access procedures were performed in 274 consecutive patients by two surgeons at Maharat Nakhon Ratchasima Hospital, Bangkok Ratchasima Hospital and Saint Mary Hospital. Follow-up data of 204 procedures (149 AVF, 15 TAVF, and 40 AVG) in 191 patients were available for analysis. Information regarding patient demographic data, preoperative diagnostic workup, procedures and outcomes were collected through chart review, follow-up telephone calls and review of hemodialysis records. Functional patency was defined as the ability to deliver adequate flow rate at least 300 ml/min to maintain dialysis time for 4 hours. Time to functional patency was determined as the period between access placement and permanent access failure.

**Table 1** Demographic data

| Total procedure | AVF (n = 149) | TAVF (n = 15) | AVG (n = 40) |
|---|---|---|---|
| Male (%) | 68 (45.64) | 8 (53.33) | 15 (37.50) |
| Female (%) | 81 (54.36) | 7 (46.67) | 25 (62.50) |
| Age (yrs) Mean (range) | 53.92 (20-87) | 62.47 (44-73) | 59.10 (25-85) |
| Diabetes (%) | 59 (39.60) | 6 (40.00) | 27 (67.50) |

### *Statistic analysis*

Functional patency rates were calculated with Kaplan-Meier method. Differences between patency rates of AVF, TAVF and AVG were determined with the Chi-square test.

## Results

### *Patient population*

Data were available in 191 patients in whom 204 hemodialysis access were placed. Patients were stratified into three groups: AVF (n = 149), TAVF (n = 15) and AVG (n = 40). Details of the demographic data are outlined in Table 1.

The prevalence of female gender and diabetes mellitus was greater in the AVG group compared with the AVF and TAVF groups, and patients were older in the TAVF and AVG groups compared with the AVF group.

### *Patency rates*

At 1 and 2 years, cumulative functional patency rates for the AVF group were 89.34% and 89.34% respectively compared with 92.86% and 92.86% respectively for the TAVF group (95%CI,-14.09-21.13; p = 0.986). When compared with the AVF group, the AVG group demonstrated inferior cumulative functional patency with rates of 83.47% at 1 year and 74.19% at 2 years (95%CI,-0.87-31.17; p = 0.028) and the AVG group demonstrated inferior cumulative functional patency compared with the TAVF group (95%CI,-4.72-42.06; p = 0.251). The details of all groups were outlined in Table 2-4 and Figure 1.

Data of native AVFs were also reviewed to determine the relative effect of advanced age (≥60

**Table 2** Functional patency at 1- and 2-year in AVF group

| Months | N | Failures | Interval failure rates | Interval patency rates | Cumulative functional patency (%) |
|---|---|---|---|---|---|
| 3 | 149 | 6 | 0.04 | 0.96 | 95.97 |
| 6 | 132 | 2 | 0.02 | 0.98 | 94.51 |
| 9 | 95 | 1 | 0.01 | 0.99 | 93.52 |
| 12 | 67 | 3 | 0.05 | 0.95 | 89.34 |
| 15 | 46 | 0 | 0 | 1 | 89.34 |
| 18 | 36 | 0 | 0 | 1 | 89.34 |
| 21 | 27 | 0 | 0 | 1 | 89.34 |
| 24 | 14 | 0 | 0 | 1 | 89.34 |

**Table 3** Functional patency at 1- and 2-year in AVG group

| Months | N | Failures | Interval failure rates | Interval patency rates | Cumulative functional patency (%) |
|---|---|---|---|---|---|
| 3 | 40 | 4 | 0.1 | 0.9 | 0.9 |
| 6 | 31 | 1 | 0.03 | 0.97 | 87.09 |
| 9 | 24 | 1 | 0.04 | 0.96 | 83.47 |
| 12 | 16 | 0 | 0 | 1 | 83.47 |
| 15 | 9 | 1 | 0.11 | 0.89 | 74.19 |
| 18 | 6 | 0 | 0 | 1 | 74.19 |
| 21 | 3 | 0 | 0 | 1 | 74.19 |
| 24 | 0 | 0 | 0 | 1 | 74.19 |

**Table 4** Functional patency at 1- and 2-year in TAVF group

| Months | N | Failures | Interval failure rates | Interval patency rates | Cumulative functional patency (%) |
|---|---|---|---|---|---|
| 3 | 15 | 0 | 0 | 1 | 1 |
| 6 | 14 | 1 | 0.07 | 0.93 | 92.86 |
| 9 | 9 | 0 | 0 | 1 | 92.86 |
| 12 | 9 | 0 | 0 | 1 | 92.86 |
| 15 | 9 | 0 | 0 | 1 | 92.86 |
| 18 | 7 | 0 | 0 | 1 | 92.86 |
| 21 | 6 | 0 | 0 | 1 | 92.86 |
| 24 | 6 | 0 | 0 | 1 | 92.86 |

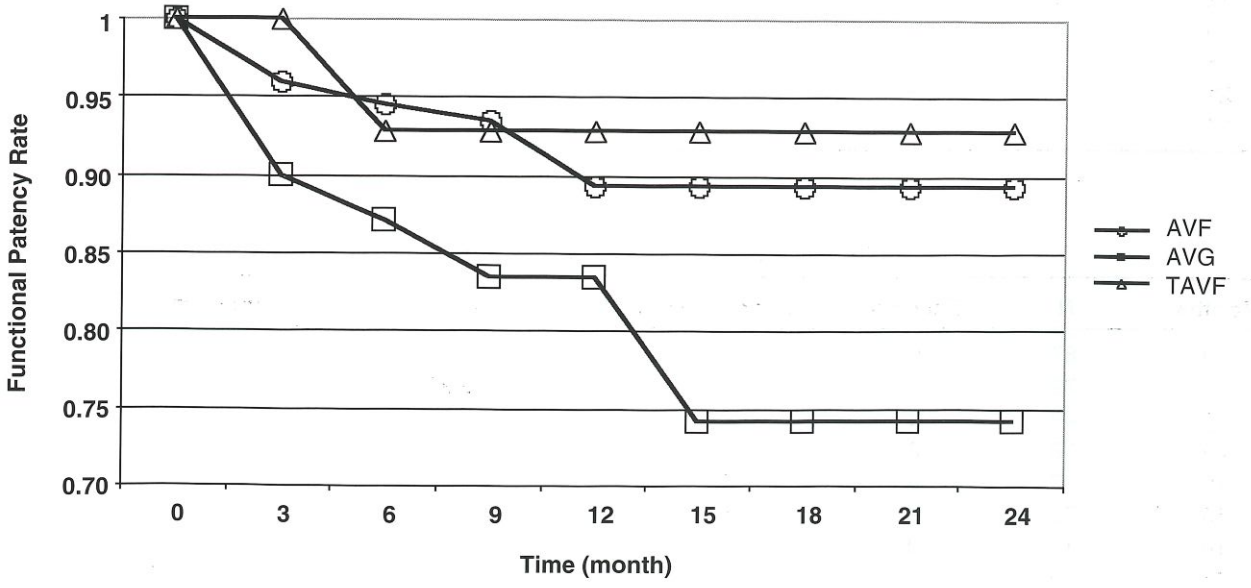



**Figure 1** Functional patency survival curves

years), diabetes mellitus, female gender, and repeated operative procedure on cumulative functional patency.

The equal cumulative patency rates at 1- and 2-year for the advanced age group were 83.44% compared with 86.26% for the young age group (95%CI, -10.73-16.37; p = 0.827). For the diabetic group, the equal cumulative patency rates at 1- and 2-year were 89.86% compared with 83.16% in the non-diabetic group (95%CI, -6.49-19.89; p = 0.420). The equal cumulative patency rates at 1- and 2-year in female were 91.14% compared with 78.48% in male (95%CI, -0.72-26.04; p = 0.068), and for the repeated AVF group, the equal cumulative patency rates at 1- and 2-year were 88.64% compared with 83.25% in the first AVF group. (95%CI, -11.04-21.82; p = 0.704) (Table 5)

**Table 5** Cumulative patency of all groups

| | Cumulative patency | |
|---|---|---|
| | At 1-year (%) | At 2-year (%) |
| Advanced age | 83.44 | 83.44 |
| Young age | 86.26 | 86.26 |
| Diabetic | 89.86 | 89.86 |
| Non-diabetic | 83.16 | 83.16 |
| Male | 78.48 | 78.48 |
| Female | 91.14 | 91.14 |
| First AV fistula | 83.25 | 83.25 |
| Repeated AV fistula | 88.64 | 88.64 |

At 1- and 2-year period, cumulative functional patency rates for the forearm AVF group were 76.82% and 76.82% compared with 88.57% and 88.57% for the upper arm AVF group (95%CI, -3.55-27.05; p = 0.120) (Table 6-7).

### *Complications*

One AVF patient developed severe arm edema in which a right to left axillary vein bypass was performed. One TAVF patient developed pseudoaneurysm requiring aneurysmal resection. Two AVGs were infected, graft removal with creation of new AVF was performed.

**Table 6** Cumulative patency of forearm AVF group

| Months | N | Failures | Interval failure | Interval patency | Cumulative patency (%) |
|---|---|---|---|---|---|
| 0 | 48 | 0 | 0 | 1 | 100 |
| 3 | 36 | 0 | 0 | 1 | 100 |
| 6 | 27 | 2 | 0.07 | 0.93 | 92.59 |
| 9 | 15 | 1 | 0.07 | 0.93 | 86.42 |
| 12 | 9 | 1 | 0.11 | 0.89 | 76.82 |
| 15 | 6 | 0 | 0 | 1 | 76.82 |
| 18 | 5 | 0 | 0 | 1 | 76.82 |
| 21 | 3 | 0 | 0 | 1 | 76.82 |
| 24 | 3 | 0 | 0 | 1 | 76.82 |

**Table 7** Cumulative patency of upper arm AVF group

| Months | N | Failures | Interval failure | Interval patency | Cumulative patency (%) |
|---|---|---|---|---|---|
| 0 | 87 | 0 | 0 | 1 | 100 |
| 3 | 79 | 2 | 0.03 | 0.97 | 97.47 |
| 6 | 49 | 2 | 0.04 | 0.96 | 93.49 |
| 9 | 38 | 2 | 0.05 | 0.95 | 88.57 |
| 12 | 27 | 0 | 0 | 1 | 88.57 |
| 15 | 20 | 0 | 0 | 1 | 88.57 |
| 18 | 14 | 0 | 0 | 1 | 88.57 |
| 21 | 12 | 0 | 0 | 1 | 88.57 |
| 24 | 7 | 0 | 0 | 1 | 88.57 |

## Discussion

Since 1966, the radiocephalic fistula developed by Brescia and Cimino has provided the best vascular access with a low risk of infection and improved convenience for patients.[11,13] Brachiocephalic fistulas were the alternative autogenous vascular access while poor quality forearm vessels were detected. Better survival rates for brachiocephalic fistulas than radiocephalic fistulas was reported.[10] In 1976, many nephrologists and surgeons felt compelled to use prosthetic devices and there was reports on the basilica vein transposition fistulas as an alternative vascular access.[6,11,14]

Cumulative patency rates vary considerably between dialysis centers. These differences probably reflect multiple factors such as the demographic factors, the expertise of dialysis staff, and the skill and preferences of surgeons. However, most series demonstrate cumulative patency rates of approximately 66.7% to 90% for native AVFs at 1 year and 56.2% to 72% at 2 years.[2,11,15]

Failure in the first month after creation of AVF is usually due to technical errors or premature use of the access. Canulation of AVF before sufficient dilatation increases the risk of thrombosis. Primary causes of late AVF failure include venous stenosis, excessive post-dialysis fistula compression, hypotension, hypovolemia, fistula compression due to sleeping position, hypercoagulability and arterial stenosis.[12]

In practice, we attempt to initially place a wrist radiocephalic fistula if anatomically favorable. From there, we then move to a brachiocephalic fistula at the antecubital fossa. If this is not feasible, we place either a prosthetic bridge graft or create a basilic vein transposition fistula.

In this study, the prevalence of female and diabetes mellitus was greater in the AVG group compared with the AVF and TAVF groups, and patients' age was older in the TAVF and AVG groups compared with the AVF group. These findings are supported by demographic factors that are associated with poor AV fistulas outcome which include advanced age, female gender, race, diabetes mellitus, and obesity.[8-10]

Regarding patency, our data demonstrated that in the study population, the cumulative functional patency of the TAVF group was superior to those of the AVF and AVG groups, and the patency of the AVF group was superior to the AVG group. The superior outcome of TAVF was probably related to ligation of side branches, which increased shear stress and placement of vein in a more superficial location.[15]

One- and 2-year cumulative functional patency of all groups in this study was better than in other studies.[3,5,11,13] This may be because of the difference in the criteria of patency. Adequate flow rate in this study was 300 ml/min where it was 350 ml/min in most studies. The same patency at 1- and 2-year of the AVF and TAVF groups demonstrated no access failure after the first year.

Gibson et al.[3] demonstrated that the performance of simple AVF was superior to those of prosthetic bridge grafts and basilic vein transposition fistulas.

Choi et al.[15] reported that basilic vein transposition fistulas demonstrated better long-term patency and required fewer revisions at 24 months compared with simple AVFs and prosthetic bridge grafts.

Several studies[4,6,16] demonstrated that basilic vein transposition fistulas had superior long-term patency and lower infection rate compared with prosthetic bridge grafts.

For the risk factors associated with poor AVF outcomes, our data demonstrated that the cumulative functional patency in the advanced age group was inferior to the young age group, the patency of the diabetic group was superior to the non-diabetic group, the patency of female was superior to male, and the patency of the repeated AVF group was superior to the first AVF group. However, there was no statistical significance in the differences of all groups.

Interestingly, the patency in the diabetic group was superior to the non-diabetic group, and the patency in female was superior to male. These findings may result from selection bias, i.e. 71.75% of AVF in the diabetic group and 72.86% of AVF in female were created at upper arm compared with 58.43% of AVF in the non-diabetic group and 52.31% of AVF in male.

The superior patency in the repeated AVF group compared with the first AVF group was due to the fact that most repeated AVFs were created at the upper arm, and the cumulative patency of upper arm AVF was superior to those of forearm AVF.

Woo et al[4] demonstrated that the history of previous access increased the risk of AVF failure while age, gender, diabetes, and race did not significantly influence AVF failure.

Huijbregts et al[10] concluded that factors associated with the risk of AVF failure were female gender, diabetes mellitus, and AVF placement at the wrist (in comparison to the elbow).

In this study, advanced age, female gender, diabetes mellitus, and repeated operative procedure were not associated with poor AVF outcomes, and native AVF should be initially performed before prosthetic bridge graft. We do not agree with the proposal that forearm prosthetic bridge graft should be initially performed in women, diabetics, and older patients.

## Conclusion

Simple AVFs (radiocephalic fistula, brachiocephalic fistula) should be the first vascular access for long-term hemodialysis because of its simplicity, good patency, low complication rate and low cost. While simple AVF failure occurs, basilic vein transposition fistulas should be the next choice of procedure for vascular access. Prosthetic bridge grafts should be considered when autogenous AVFs could not be done.

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