Outcomes of Autogenous Hemodialysis Access at Siriraj Hospital

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Background: *The majority of hemodialysis cases in Thailand have used autogenous arteriovenous fistula (AVF), according to the recommendations in the 2006 KDOQI guideline. AVF maturation rate varies widely, from 25 to 80%. Many factors can affect the maturation rate.*

Objective: *The intent of this study is to demonstrate the outcomes of autogenous hemodialysis access treatments performed at Siriraj Hospital, in the aspect of the rate of maturation and factors for maturation of AVF.*

Material and Method: *All autogenous AVF created at Siriraj Hospital from July 2010 to February 2012 were included in this retrospective review. Patients with incomplete data and arteriovenous bridge grafts were excluded. The primary end point was the rate of fistula maturation and factors affecting maturation.*

Results: *Of 147 access procedures, 104 fistulas exhibited 70% successful maturation. A maturation rate of 61%, or 57 radiocephalic fistulas created at the wrist was achieved. Four proximal radiocephalic fistulas were created with the rate of maturation of 75%. Forty-two brachio-cephalic fistulas were created with maturation rate achieved of 76%. Thirty-two brachio-antecubital fistulas were created which gave an 81% maturation rate. Twelve brachio-basilic fistulas were created and the maturation rate achieved was 67%. Wrist cephalic vein diameter of less than 2.5 mm gave an only 40% maturation rate. Vein diameter greater than 3.5 mm gave the best maturation of up to 100%. Also, the selection of small diameter elbow veins for fistula creation especially diameters of less than 2.5 mm resulted in poor maturation rate. Within this study the presence of diabetes mellitus and, or a hemodialysis catheter did not affect the rate of fistula maturation.*

Conclusion: *Our experience showed an overall rate of fistula maturation at 70%. Brachio-basilic, brachio-antecubital, brachio-cephalic fistulas had the rate of maturation that of more than radiocephalic arteriovenous fistula, respectively. Vein diameter less than 2.5 mm should be avoided for fistula creation. Vein diameter more than 3.5 mm gave the best result for autogenous vascular access. Diabetes mellitus and, or the presence of a hemodialysis catheter were not factors affecting the AVF maturation.*

Keywords: *Outcomes, Autogenous, Hemodialysis access, Arteriovenous fistulas (AVF)*

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The number of end stage renal disease (ESRD) patients in need of chronic hemodialysis is increasing. The majority of these cases in Thailand implemented arteriovenous fistulas (AVF) (64.1%)[1] according to the report of Thailand renal replacement therapy. AVF exhibit superior long term function and fewer complications as compared with prosthetic arteriovenous bridge grafts[2-5]. According to the National Kidney Foundation Kidney Disease Outcome Initiative (NKF K/DOQI) guideline recommendation 2006, autogenous AVF is the preferred modality for hemodialysis access[6]. In addition to a complete history and physical examination, pre-operative duplex ultrasonography (DUS) may be adjunct to identify favorable vessels and should be incorporated in pre-operative assessment for hemodialysis access creation[7,8]. Previous studies reported 10 to 24% failure of autogenous arteriovenous fistula after creation[9,10]. Incomplete assessment and inappropriate vessel selection were the main causes in the failure of vascular access. Patients with complications and morbidities from temporary or permanent catheterization may have

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affected the planning and proper site selection for AVF[11-13].

However AVF maturation or function rate varies widely, from 25% to 80%[9]. Several factors can affect the function and ultimate success of AVF. In our study our intent is to demonstrate the outcomes of autogenous AVF at Siriraj Hospital, in terms of demographic data, rate of AVF function and factors that can affect maturation and, or the function of the AVF.

Material and Method

All autogenous AVF records created at Siriraj Hospital from July 2010 to February 2012 were retrospectively reviewed. Patients who had incomplete data and arteriovenous bridge grafts were excluded. Patients with failure of previous AVF, or had the presence of a temporary catheter were also included in this study. Approval from Siriraj ethical committee was obtained.

Demographic data such as age, gender, comorbidities and the absence or presence of prior central catheter access during fistula placement were documented. Pre-operative Duplex ultrasonography of arteries and veins were adjunct to physical examination in all patients.

Arterial pulse intensity and the presence of calcification was recorded. Venous assessments include inspection of the veins in the dependent position with tourniquet placement in the upper arm. Vein diameter, depth, continuity and presence of stenosis was measured by duplex ultrasonography. Selection of arteries and veins for anastomosis during operation procedures was based on the decision of the vascular surgeon after pre-operative and intra-operative overall patient assessment.

All operations were performed in an operating room under local, regional, and/or general endotracheal anesthesia. All anastamoses were performed by a vascular surgeon or vascular fellows under the direct supervision of a vascular staff using monofilament non-absorbable polypropylene running sutures.

All patients were followed-up at one week for wound complications and at one month intervals for assessment of maturation and complications by physical examination and duplex ultrasonography.

The primary endpoint was fistula maturation. This was determined by a vascular surgeon regardless of whether an access was patent and ready for cannulation based on the findings of physical examination and duplex ultrasonography. The second endpoint was the successful cannulation of the fistula and its ability to maintain hemodialysis. All data were entered into an excel spreadsheet. Chi-square was used for independent variable values and $p = 0.05$ was considered statistically significant. Ethics Consideration: 502/2555 (EC4).

Results

From July 2010 to February 2012, 147 autogenous AVF were created at Siriraj Hospital. Demographic data showed the ages of patients in this study ranging from 29 to 91 years of age with the majority (79%) being between 50 to 79 year old. Patients with ages less than 50 years old accounted for 13% of the total group. The study included the same proportion of male and female patients. The total of patients with diabetes mellitus was at 59.1% and 62.6% of the patients had a central venous catheter before having the AVF procedure performed (Table 1).

Table 2 showed our 147 access procedures, with 104 fistulas achieving successful maturation, accounting for 70% maturation. Fifty-seven

Table 1. Demographic data

Clinical variable	Number of AVF (%) n = 147
Age (year)	
Range	29-91
≥80 years	12 (8.0)
50 to 79 years	116 (79.0)
<50 years	19 (13.0)
Gender	
Male	71 (48.3)
Female	76 (47.3)
Diabetes mellitus	87 (59.1)
Central venous catheter	92 (62.6)

Table 2. Site, creation and maturation of AVF

Site of access	Creation numbers (%)	Maturation numbers (%)
Radio-cephalic	57 (39.0)	35 (61.0)
Proximal radiocephalic	4 (3.0)	3 (75.0)
Brachio-antecubital	32 (21.0)	26 (81.0)
Brachio-cephalic	42 (29.0)	32 (76.0)
Brachio-basilic	12 (8.0)	8 (67.0)
Overall	147 (100.0)	104 (71.0)

radiocephalic fistulas were created at the wrist which accounted for 39% of total fistulas and with a rate of maturation at 61%. Four proximal radiocephalic fistulas were performed at the elbow area and accounted for 3% of total fistulas. These were created at the radial artery just distal to the bifurcation of the brachial artery and with a rate of maturation at 75%. Forty-two brachio-cephalic fistulas were created which accounted for 29% of the total fistulas and with a maturation rate achieved of 76%. Brachio-antecubital fistulas were created which accounted for 21% of total fistulas which gave maturation rate at 81%. Twelve brachio-basilic fistulas were created which accounted for 8% of the total fistulas and the maturation rate achieved was 67%.

Table 3 showed the correlation of wrist and elbow vein diameter with rate of maturation vein diameter less than 2.5 mm resulted in poor maturation rate. For vein diameter greater than 3.5 mm gave the best maturation (>85%).

Wrist vein diameter less than 2.5 mm resulted in only 40% maturation. Vein diameter of 2.5 to 3 mm resulted in 47% maturation (Fig. 1A). Vein diameter of 3 to 3.5 mm gave 71% which was an acceptable outcome and a diameter greater than 3.5 mm gave the best maturation. Also, selection of small diameter elbow veins for fistula creation, especially with diameters less than 2.5 mm resulted in a poor maturation rate (Fig. 1B) (Table 4).

There was no statistically significant difference in the rate of maturation within the age groups of patients who underwent fistula creation. In this study, the rate of fistula maturation in patients with diabetes did not differ from the previous study 73% and 68%, p = 0.518). There was no difference in the rate of maturation between patients who previously had a central venous hemodialysis catheter and those who have never had a hemodialysis catheter (70% and 73%, p = 0.387).

Table 3. Correlation of wrist and elbow vein diameter with rate of maturation

Diameter (mm)	% muturation
<2.5	35
2.5 to 3.0	57
3.0 to 3.5	73
3.5 to 4.0	85
≥4.0	89

Discussion

Autogenous AVF is the most recommended method for hemodialysis patients by the Dialysis Outcomes Quality Initiative (DOQI) guideline. This is in spite of autogenous AVFs creating less than 50% of all initial permanent hemodialysis access procedures in many countries even though AVFs demonstrate superior overall patency and fewer complications compared with prosthetic access. However, AVF maturation or function rate varies widely from 25% to 80%. Previous studies shown that age, gender,

Table 4. Factors affecting maturation

	Maturation	Non-maturation	*p*-value
Age (year)			0.165
<50	17 (89.0)	2 (11.0)	
50 to 79	79 (68.0)	37 (32.0)	
>80	8 (72.0)	3 (28.0)	
DM	63 (73.0)	24 (27.0)	0.518
Non DM	41 (68.0)	19 (32.0)	
Catheter	64 (70.0)	28 (30.0)	0.387
No catheter	40 (73.0)	15 (27.0)	

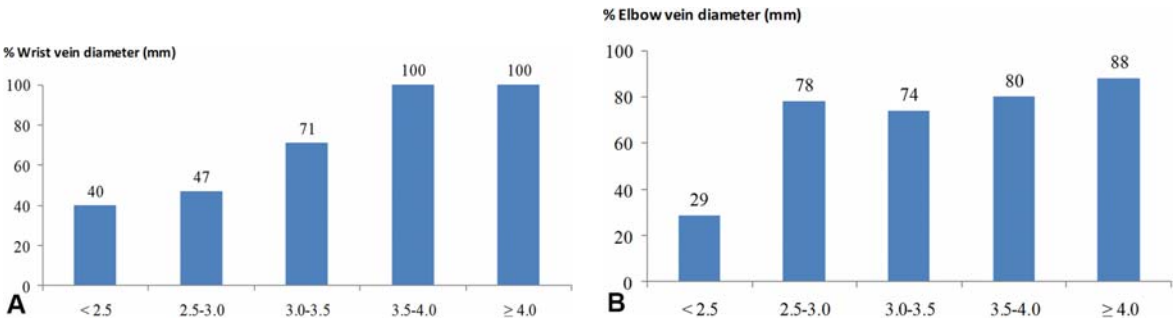

Fig. 1 A) Correlation of wrist vein diameter with rate of maturation, B) Correlation of elbow vein diameter with rate of maturation.

diabetes and BMI had no significant effect on functional maturation with the exception of vein diameter[14,15].

Our experience has shown an overall rate of fistula maturation at 71%. Radio-cephalic AVF creation had rate of maturation less than that of brachio-basilic brachio-cephalic and brachio-antecubital fistula, respectively. Many factors might affect the outcome of AVF creation, such as age, gender, diabetes mellitus and the presence of a previous hemodialysis catheter as many publications have reported. Meta-analysis indicated an increased risk of radial-cephalic fistula failure in elderly patients.

In our study, there was no statistical difference in the rate of maturation in each age group. Also, the presence of diabetes mellitus and a hemodialysis catheter did not affect the rate of fistula maturation.

A significantly higher rate of successful fistula maturation in patients with a preoperative minimal cephalic vein size greater than 2.0 mm was realized. Our analysis on the proper vein diameter in our population showed that a larger vein diameter has higher rate of maturation. Vein diameters less than 2.5 mm should be avoided for fistula creation. Vein diameters between 2.5 to 3.5 mm had an acceptable rate of maturation. Vein diameters greater than 3.5 mm is the optimal for fistula creation.

Conclusion

The majority of ESRD patients were prescribed with AVF for hemodialysis. The success of autogenous arteriovenous fistula after creation is critical for maturation. Previous studies have reported that AVF maturation or function rate varies from 25 to 80%. Our study has shown an overall rate of fistula maturation at 70%. This rate is compatible with other studies. Elbow arteriovenous fistulas recorded a rate of maturation more than that of the wrist. Fistula vein diameters less than 2.5 mm should be avoided for creation of arteriovenous fistulas. Vein diameters more than 3.5 mm gave optimal results. Diabetes mellitus and the presence of a hemodialysis catheter were not factors in affecting the maturation of AVF.

What is already known on this topic?

The majority of ESRD patients in need of hemodialysis undergo this treatment due to AVF. Previous studies have demonstrated a 25 to 80% rate of AVF maturation or function rate. There are many factors which can affect maturation of AVF, such as incomplete assessment and inappropriate selection of the vessels.

What is study adds?

In our study, we can demonstrate an overall rate of fistula maturation at roughly 70% which is comparable with other studies. For AVF creation, vein diameter should be at least 2.5 mm or more, in order to achieve good maturation of AVF.

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Potential conflicts of interest

None.

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ผลการผ่าตัด autogeneous hemodialysis ในโรงพยาบาลศิริราช

เฉนียน เรืองเศรษฐกิจ, ภาณุวัฒน์ เชื้อหมอ, เกียรติศักดิ์ หงษ์คู, สุธีคณิต หัถพรสวรรค์, คามิน ชินศักดิ์ชัย, ณัฐวุฒิ เสริมสาธนสวัสดิ์, ชุมพล ว่องวานิช, ประมุข มุทิรางกูร

ภูมิหลัง: การทำ hemodialysis ในประเทศไทยส่วนใหญ่จะทำ autogenous arteriovenous fistula (AVF) ตาม KDOQI guideline ปี พ.ศ. 2549 อัตรา maturation ของ AVF ร้อยละ 25 ถึง 80 และมีปัจจัยหลายอย่างที่มีผลต่ออัตรา maturation

วัตถุประสงค์: เพื่อศึกษาผลการผ่าตัด autogeneous hemodialysis ในโรงพยาบาลศิริราช โดยมุ่งเน้นในอัตรา maturation และปัจจัยที่มีผลต่อ maturation ของ AVF

วัสดุและวิธีการ: การศึกษาข้อมูลย้อนหลังในผู้ป่วยที่เข้ารับการผ่าตัด AVF ในโรงพยาบาลศิริราช ตั้งแต่ เดือนกรกฎาคม พ.ศ. 2553 ถึง เดือนกุมภาพันธ์ พ.ศ. 2555 โดยคัดข้อมูลที่ไม่สมบูรณ์และ arteriovenous bridge graft ออกจากการศึกษา ศึกษาอัตราและปัจจัยที่มีผลต่อ maturation ของ AVF

ผลการศึกษา: การผ่าตัด 147 ราย, มี 104 fistula ที่ maturation คิดเป็น 70%, 57 radio cephalic fistulas ที่ข้อมือ มี maturation 61%, 4 proximal radiocephalic fistula มี maturation 75%, 42 brachiocephalic fistula มี maturation 76%, brachio-antecubital fistula มี maturation 81%, 12 brachio basilic fistula มี maturation 67% เส้นผ่าศูนย์กลางของ cephalic vein ที่ข้อมือน้อยกว่า 2.5 มิลลิเมตร มี maturation เพียง 40% ถ้าเส้นผ่าศูนย์กลางมากกว่า 3.5 มิลลิเมตร จะมี maturation ร้อยละ 100 ดังนั้นเส้นผ่าศูนย์กลางของหลอดเลือดดำ elbow ที่เล็กกว่า 2.5 มิลลิเมตร จะให้ผล maturation ไม่ดี

สรุป: จากประสบการณ์ของเราแสดงให้เห็นว่า อัตรา maturation โดยรวมเท่ากับร้อยละ 70 bracliocepasilic, brachio-antecubital, brachio-cephalic fistula มีอัตรา maturation มากกว่า radiocephalic AVF ควรหลีกเลี่ยงการทำ AVF ในหลอดเลือดดำที่มีเส้นผ่าศูนย์กลางที่น้อยกว่า 2.5 มิลลิเมตร การทำผ่าตัดในหลอดเลือดดำที่มีเส้นผ่าศูนย์กลางมากกว่า 3.5 มิลลิเมตร จะให้ผลสำเร็จมากกว่า