

## The Survey of the Life Span of Vascular Access for Patients with Diabetes on Hemodialysis

Chien-Wen Chen, Li-Ing Lai, Shu-Huei Shiao, Jen-Tzu Lee, En-Chyh Yang, Shan-Liang Hsiao

Department of Nephrology, Ping-tung Christian Hospital, Ping-tung, Taiwan.

Corresponding Author: Shan-Liang Hsiao, Department of Nephrology,

Ping-tung Christian Hospital, No. 60, Da-Lain Road, Pingtung City, Taiwan.

Tel: +886 8 7368686 ext 1625, Fax: +886 8 7366494, E-mail: hdr1@ptch.org.tw

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### ABSTRACT

**Key words:** hemodialysis, AV fistula, AV graft, thrombosis, percutaneous transluminal angioplasty (PTA).

**Objective:** Patients with end stage renal disease (ESRD) on hemodialysis must maintain good vascular access function for treatment so sufficient blood flow is provided and sufficient clearance is achieved, otherwise inadequate dialysis will lead to a variety of complications caused by uremia. Diabetes accounts for about 40% of the common causes of ESRD, and it causes arteriosclerosis, which causes thrombosis or stenosis of vascular access.

**Methods:** We analyzed the life span of AV fistula of 362 regular hemodialysis patients in our hospital with the HOPE database and investigated whether there are any differences of the life span and thrombotic rate of vascular access between diabetic and non-diabetic patients.

**Results:** The results showed that the life span of arteriovenous fistula (AV fistula) of non-diabetic patients is significantly longer than that of the diabetic patients (1,787 days  $\pm$  1051 days to 1,473 days  $\pm$  853 days;  $P = 0.007$ ). There are no differences of the life span of AV graft between non-diabetic and diabetic patients (1,410 days  $\pm$  929 days to 1,366 days  $\pm$  984 days;  $P = 0.873$ ). Moreover, the study showed that there are no significant statistical differences between the life span of AV graft and AV fistula of patients with diabetes (1,366 days  $\pm$  984 days to 1,473 days  $\pm$  853 days).

**Conclusions:** However, AV graft forms

adequate vascular diameter more easily. Therefore, for patients with diabetes or poor vascular condition, whether to give priority to AV fistula or not needs further investigation.

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### INTRODUCTION

According to the statistics of the National Kidney Foundation Taiwan R.O.C. in 2007, 46,000 end-stage renal failure patients (accounted for 91% of ESRD patients) chose hemodialysis as renal replacement therapy[1]. Vascular access has been considered as a secondary lifeline for hemodialysis patients. The main purpose of vascular access is to provide sufficient blood flow for hemodialysis. All patients must have good vascular access in order to keep sufficient clearance and avoid inadequate dialysis that leads to a variety of complications caused by uremia. Thus excellent vascular access is vital for hemodialysis patients. Diabetes accounts for about 40% of common causes of end stage renal failure. Diabetic patients are prone to abnormal lipid metabolism, and lipoprotein profile would be impacted by glycation and oxidation that result degeneration. The fat that deposits on vascular wall becomes arteriosclerosis easily from thrombus and stenosis of vessels. In this study, we investigated 362 dialysis patients in our hospital from 2005 to 2007, and explored if there are any

significant differences of the life span and thrombotic rate of fistulas between diabetic and non-diabetic patients.

The object of the study is to evaluate the life span of AV fistula of dialytic patients with or without diabetes. From January 2005 to December 2007, 362 patients enrolled and they maintained chronic hemodialysis at our hospital for hemodialysis for more than three months, including 204 female (56.4 %) and 158 male (43.6 %). The average age is  $57.8 \pm 13.7$ . There were 50 patients who had AV graft and 312 have AV fistulas. There were 228 non-diabetic patients accounting for 62.9 % (fasting glucose  $95.1 \pm 24.5$  mg/dl), and 134 diabetic patients accounting for 37.1% (fasting glucose  $168.9 \pm 87.0$  mg/dl). The biochemical and hematologic parameters of 362 hemodialysis patients are shown as **table 1**.

## MATERIALS & METHODS

From 2005 to 2007, patient's blood flow below 200ml/min was considered as thrombotic event, and PTA or access reoperation would be recommended. The lifespan of patients' fistula access was defined and recorded from the date the patients underwent blood vessels operation to December 31, 2007, or to the date PTA or access reoperation was carried out. 53 cases met the above definition, while 309 cases were still in good condition until December 31, 2007, that is the date the record ended. We analyzed the data of fistula on the HOPE (Hemodialysis Operation, Plan, and Executive) system from January 2005 to December 2007. The data is shown as the mean  $\pm$  SD. All statistical analyses were performed

using Statistical Package for Social Science (SPSS for windows, version 10.0, SPSS Inc, Chicago IL). Student's t test was used to compare the life span of fistula between diabetic and non-diabetic subjects. Chi-square test was used to compare the embolic rate of AV fistula and AV graft subjects.  $p < 0.05$  was considered as statistically significant. The study was approved by Pingtung Christian Hospital Medical Ethics Committee.

## RESULTS

The patient's average life span of all fistulas is  $1,633 \pm 993$  days (approximately 4.5 years). During the investigation, there were 53 cases suffering from vascular thrombosis and percutaneous transluminal angioplasty (PTA) was carried out as treatment. As shown in **table 2**, the thrombotic rate of AV fistula of diabetic dialysis patients is prominently higher than non-diabetic dialysis patients' ( $p = 0.0074$ ), and the thrombotic rate of AV graft is higher than AV fistula ( $p < 0.001$ ) as **table 3** shows.

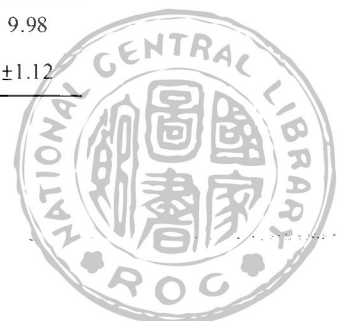
## DISCUSSION

Surgery of arterial and venous anastomosis creating vascular access is to provide sufficient blood flow during hemodialysis for uremic patients. The blood flow passing through artificial kidney is expected to reach 250 to 300 ml/min at least. If the flow is inadequate, it will result in insufficient dialysis[2]. The main types of vascular access for long-term dialysis patients are AV fistula and AV graft. AV graft is an implanted synthetic fistula (the material is mainly polytetrafluoroethylene, PTFE) that forms a

**Table 1. Biochemical and hematologic parameters of hemodialysis patients (n=362).**

Item	Age	TG	Cholesterol	Platelet	Albumin	HCT	HB
Mean	58.1	121.4	168.0	195.6	3.74	31.2	9.98
SD	$\pm 13.6$	$\pm 85.91$	$\pm 39.1$	$\pm 72.3$	$\pm 0.494$	$\pm 3.3$	$\pm 1.12$

SD: standard deviation



**Table 2. Comparison of the life span of fistula between diabetic and non-diabetic patients.**

Mean of Life Span of AV fistula				Mean of Life span of AV graft			
Item	Number	Days	p value	Item	Number	Days	p value
Non-DM	198	1787 ± 1051	0.007	Non-DM	30	1410 ± 929	0.873
DM	114	1473 ± 853		DM	20	1366 ± 984	
Total	312	1633 ± 993		Total	50	1393 ± 942	

Student's *t* test; *p* <0.05 indicates statistical significance

**Table 3. Comparison of embolic rate between AV fistula and AV graft (n=362).**

Variable	Number	Non-PTA	PTA	p value
AV fistula	312	280 (89.7%)	32 (10.3%)	<0.001
AV graft	50	29 (58.0%)	21 (42.0%)	
Total	362	309 (85.4%)	53 (14.6%)	

Chi-square test; *p*<0.05 indicates statistical significance

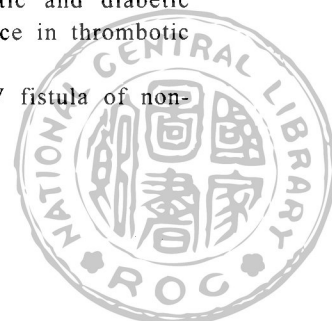
passageway between an artery and a vein is used for patients whose blood vessel is not suitable for arteriovenous fistula. According to the literature, the average life span of AV fistula is three years and AV graft is two to three years[3,4].

Thrombosis is the main reason for the failure of hemodialysis vascular access[5]. In addition to congenital structural problems of vessels, the reasons for thrombosis include low blood pressure, rotational puncture that causes narrowing of vascular access or obstruction caused by compression of vascular access[2]. We would like to know whether the probability of thrombotic rate of AV fistula and AV graft of diabetic patients is the same as the non-diabetic patients. As the statistics of Astor et al. suggests, the thrombotic rate of AV graft is 1.8 times higher than AV fistula (0.71 times/vessel/year to 0.39 times/vessel/year). The thrombotic rate of AV graft is obviously higher than AV fistula (*p* <0.001)[6]. With the progress of PTA technology[7,8], enhancement of hot compress for fistula, suggestion

of gripping balls movement and health education, the life span of fistula is prolonged. According to NKF-KDOQI Guidelines 2006, the best patency rate of AV fistula is four to five years, and comparing to other types of fistulas, it requires fewer medical interventions[9]. Our survey shows the same results that the life span of AV fistula is 4 to 4.5 years and AV graft is 3.5 to 4 years. Therefore AV fistula remains the first choice for hemodialysis patients.

Miller et al. monitored 450 patients on dialysis for at least six times a month and measured their blood flow for two years. Blood flow equal to or greater than 350 mL/min is defined as sufficient. The ratio of sufficient blood flow of diabetic to non-diabetic patients is 35.0 % to 54.1 %, *p* = 0.061[10]. The thrombotic rate of fistula of diabetic to non-diabetic patients in our survey is 17.2 % to 13.2 %, *p* = 0.99. It indicates that non-diabetic and diabetic patients have no difference in thrombotic rate.

The life span of AV fistula of non-



diabetic patients is significantly higher than that of diabetic patients ( $1,787 \pm 1,051$  days to  $1,410 \pm 929$  days,  $p = 0.007$ ), but there are no differences between the life span of AV graft of non-diabetic and diabetic patients ( $1,473 \pm 853$  days to  $1,366 \pm 984$  days,  $p = 0.873$ ). In this study, the life span of AV graft and AV fistula of the diabetic patients is  $1,366 \pm 984$  days and  $1,473 \pm 853$  days respectively. The life span of AV fistula is still longer than AV graft. However, AV graft forms adequate vascular diameter more easily. Therefore, for patients with diabetes or poor vascular condition, whether to give priority to AV fistula or not needs further investigation.

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# 糖尿病血液透析患者血管通路之使用年限調查

陳建文、賴麗英、蕭淑惠、李仁慈、楊恩智、蕭善良  
財團法人屏東基督教醫院腎臟科

**目的：**尿毒症患者血管通路主要是提供血液透析時有足夠的血流量，有良好的血管通路才能提供足夠的清除率，避免因透析不足而引發尿毒症的各種合併症。末期腎衰竭常見的原因中糖尿病佔約40%，而糖尿病會造成動脈粥狀硬化，同樣為瘻管阻塞或狹窄之原因。

**方法：**利用HOPE資料庫分析某院362位常規血液透析病患的瘻管使用年限，調查糖尿病患者之透析瘻管存活天數及阻塞率是否有異於非糖尿病。

**結果：**自體瘻管使用年限，在非糖尿病患者明顯高於糖尿病( $1,787 \pm 1,051$  vs.  $1,473 \pm 853$ 天； $P = 0.007$ )。而在

人工瘻管使用年限，非糖尿病患者與糖尿病患者並無差異( $1,410 \pm 929$  vs.  $1,366 \pm 984$ 天； $P = 0.873$ )，且根據本研究顯示糖尿病患者的人工瘻管與自體瘻管使用年限相當( $1,366 \pm 984$ 天 vs.  $1,473 \pm 853$ 天)無統計學上差異。

**結論：**因人工瘻管的成形度佳，對於糖尿病患者或當本身血管條件不佳，是否應優先考慮人工瘻管，值得進一步研究。

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**關鍵詞：**血液透析、自體動靜脈瘻管、人工植入瘻管、血管通路、經皮穿腔血管成形術。

