Original Article

นิพนธ์ต้นฉบับ

Comparison of Results of Radialcephalic Arterio-venous (RCAV) Fistulas for Long Term Hemodialysis Patients between Original Technique and Pongsapak Modified Technique

Pongsapak Promchot

Plastic and Reconstructive Surgery Unit, Department of Surgery, Phrae Hospital

Abstract Since the radialcephalic arterio-venous fistula is proved to be a safe and effective mean of gaining access to the circulation for maintenance chronic hemodialysis, the incidence of fistula failure or complication has been extremely low. The main purpose of this research was to compare the effectiveness and complications between the Pongsapak modified technique and the original technique. Eighty arteriovenous fistulas from January 2002 to October 2005 were performed in chronic renal failure patients at Phrae hospital, with half of them being performed with the original technique and the other half with Pongsapak modified technique. The recording form was used to collect demographic data, blood flow rate, duration of function, thrombotic complication, infection, number of operation and cost. The data were analyzed and compared statistically by using Mann-Whitney U test and t-test for two independent groups. The results of this study revealed that the Pongsapak modified technique was significantly more effective and had lower complication rate than the original technique ($p \leq 0.01$).

Key words: **radialcephalic arterio-venous fistula, chronic hemodialysis, Pongsapak modified surgical technique**

Introduction

The two major problems of radialcephalic arteriovenous fistula are early thrombosis of the fistula and failure of the venous run off system to develop adequately. These complications not only cause shunt failure, but also result in higher cost and longer time of treatment. Obstructed venous flow, nidus of thrombus formation, compression by surrounding swelling tissue or hematoma, the small size of the draining vein, calcified atherosclerotic vessels, decrease in blood pressure, increasing blood viscosity, tension cause poor flow, excessive angulation either single or in combination are the major causes of these problems. To

overcome these problems, the technique of arteriovenous fistula has been modified.[3-5,11,15,17,20,21]

The maintenance of life in patients with end stage renal failure is possible with the development of efficient mean of artificial kidney systems. In order to maintain successful long-term hemodialysis, the maintenance of patent vascular access capable of providing a blood flow of at least 200 ml/min is essential.[13,14,23] The discovery of an indwelling Silastic -Teflon cannula by Quinton et al,[1] provides a convenient means of gaining access to the blood vessel for repeated hemodialysis, so that such patients may not only be kept alive but also be returned to a useful and economically productive life. Successful repeated dialysis also depends on the reliability and efficiency of modern dialyzer. Frequent clotting, infection, and restricted use of the operated extremity, however, are the major disadvantages of this technique,as pointed out by Ramirez et al.[16] For this reason, Brescia et al,[1] advocated a surgically created subcutaneous arteriovenous fistula at the wrist as a substitute for the Silastic-Teflon cannula. In this type of shunt, the radial artery and an adjacent superficial vein were anastomosed. A side to side arteriovenous anastomosis was originally described by Brescia and his associates[1] and subsequently used by the others,[2,8-10,14] but an end of vein to side of artery is the more preferable technique because there is high blood flow through vein and the radial artery is preserved to prevent venous hypertension and steal phenomenon.[9,15,17,22,25,26] Although the initial failure rate for native arteriovenous fistula may be as high as 15 to 25 percent,[7,17] once the fistula is established and successfully used for dialysis, the incidence of late failure is low, being less than 5 percent after six months of dialysis.[7,17] To date, many patients can be maintained on dialysis for more than five years with the same native arterio-venus fistula.[7]

Nowadays, an effort is made to create an internal AV fistula in every patient who is expected to undergo long-term hemodialysis.

Recently, the prosthesis vessel grafts have frequently been used for arteriovenous fistula but the native arteriovenous fistula is more beneficial than arteriovenous graft fistula (lower cost, less complication, higher patency, easier self care).[13,15,17,23-25] The radial arteriovenous fistula has proved to be safe and effective means of gaining access to the circulation for maintenance of hemodialysis and it has been proved that end of vein to side of artery is the best surgical technique.[7,15,17,21,23,25] The national Kidney Foundation Dialysis Outcomes Quality Initiative (K/DOQI) suggested that the first choice arteriovenous fistula is radialcephalic fistula because it can be placed distally at the wrist, saving proximal sites for the future use, it is performed under local anesthesia and hospitalization can be avoided, the infection rate is lower than the synthetic grafts and can be more successfully treated. The second choice is native brachial-cephalic fistula. If the two native fistulas cannot be performed, arteriovenous graft or transposed native brachial - basilic fistula is another choice.

Since 2003 the number of patients with end-stage renal disease maintained on chronic hemodialysis has been increasing progressively in Phrae Hospital. These patients need to have a patent and functioning access to the circulation during their hemodialysis. The two major problems of radialcephalic fistula are early thrombosis (non function) and inadequate blood flow (access blood flow < 200 cc/min). These complications have led to hospitalization, repeated surgical procedures and decline in patient morale. Subsequently, a modified technique was created to solve

these problems.[4,5,18-21] From the author's experience, these problems have also been observed. In order to avoid these problems the author has modified the shunt procedure. In this paper the technique was described for creating this type of AV fistula and compared the results and the advantages of the modified technique with the original technique.

Methodology

From January 2002 to October 2005, 80 chronic renal failure patients were admitted into the Phrae Hospital for creation of 80 AV fistulas. Fourty AV fistulas were created with original technique (from Jan, 2002 to Jan, 2003) and the rest with Pongsapak modified technique (from Feb, 2003 to Feb, 2004) by the author without selection criteria.

The following data were obtained from the patient's medical record and hemodialysis record:

1. Age
2. Sex
3. Technique of AV fistula
4. Access blood flow rate through created AV fistula (the fistula that delivers blood at flow rate < 200 cc/min is mean of inadequate blood flow, > 200 cc/min is mean of adequate blood flow)
5. Access failure : Fistulas that never function or that thrombosed (no thrill, no bruit of anastomosed vein) and including those that continue to flow but do not dilate to a size adequate for convenient cannulation, require a new access (blood flow rate <200 cc/min). Access failure was defined as the need for replacement of a failed access by a new one. Early failure means failure within 30 days after surgery and late failure means failure after 30 days.
6. Patency rate of arteriovenous fistulas at 3, 6, 9, 12, 18 months after surgery. The duration of the patency of the fistulas was determined from the date of the procedure until flow decreased to the point when hemodialysis was not possible or until the date of transplantation. Patency rates for all vascular accesses were analyzed by life-table analysis.
7. Number of operations (and revisions)
8. Cost.

Statistical comparison between the two techniques was made by using Mann-Whitney U test for two independent variables or by the student's t -test, whatever appropriate.

Technique of creation AV fistula

1. Original technique of Brescia-Cimino (radialcephalic): Original technique is the autogenous side to side radialcephalic AV fistula technique for chronic renal failure patients and has provided long-term hemodialysis. End vein to side artery is the best technique that has produced adequate blood flow, least complication for long-term hemodialysis. The usual vessels chosen for end vein to side artery are the radial artery and distal cephalic vein in the non-dominant extremity just above the wrist.

Surgery is performed under local anesthesia. A 4-5 cm incision is made longitudinal or transverse over the area of the radial pulse (Figure 1a, 1b). A fistula is created between the radial artery at the wrist and the largest adjacent vein. A longitudinal incision 0.5-1.0 cm. is made in the corresponding lateral surface of the artery (Figure 2a, 2b). The adjacent vein slanting segment is anastomosed end to side to the artery by continuous suture to prevent subsequent enlargement of the fistula (Figure 3a, 3b).

1.1 Incision : longitudinal or transverse (Figure 1a, 1b)

1.2 Longitudinal incision (arteriotomy) 0.5-1.0 cm at lateral surface of radial artery. (Figure 2a, 2b)

1.3 End vein to side artery. (Figure 3a, 3b) with running suture (6-0 prolene)

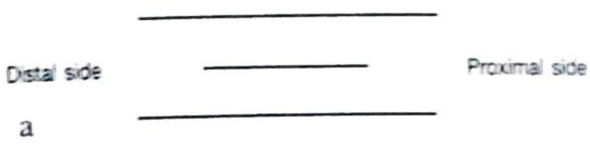
2. The Pongsapak modified technique: this technique is modified from the original technique incision is made in the shape of S-plasty over the radial pulse and cephalic vein. (Figure 4a, 4b)

An oval shape excision 0.5 cm long and 0.3 - 0.4 cm wide (1/3 width of diameter of artery) is made in the lateral side of radial artery.

2.1 Oval hole of artery (Figure 5a, 5b)

2.2 Slanting segment of vein (Figure 6a, 6b)

The slanting segment of adjacent vein is anas-



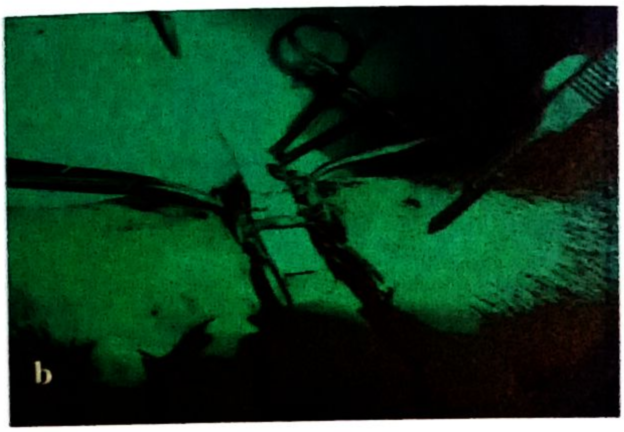


Figure 2 a. Diagram showing longitudinal incision of artery
b. Photograph of longitudinal incision of artery

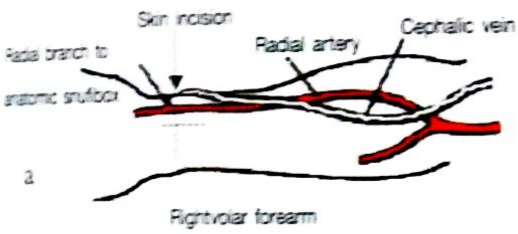


Figure 1 a. Diagram showing longitudinal or transverse incision over the area of the radial pulse.
b. Photograph of longitudinal or transvers incision above the wrist

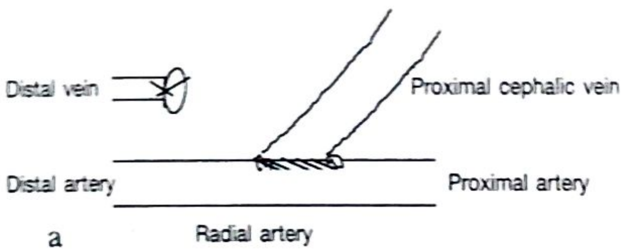


Figure 3 a. Diagram showing end vein to side artery by continuous suture
b. Photograph of end vein to side artery by continuous suture

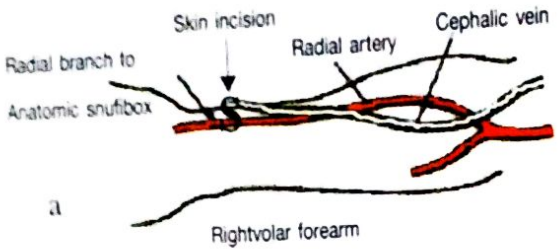


Figure 4 a. Diagram showing S-plasty incision
b. Photograph of S-plasty incision above the wrist

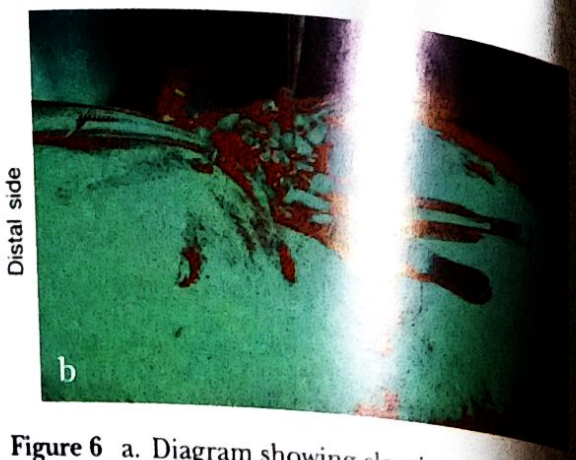


Figure 6 a. Diagram showing slanting segment of
jacent vein
b. Photograph of slanting segment of ad
cent vein

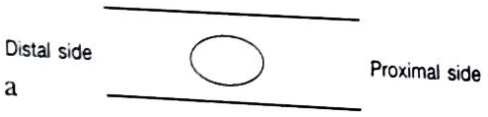
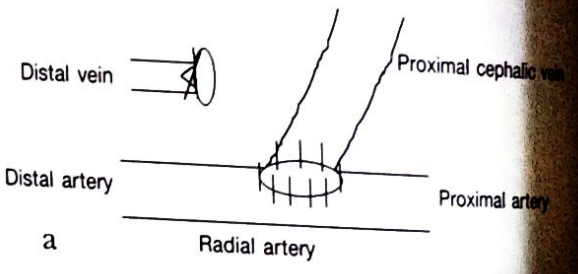


Figure 5 a. Diagram showing oval hold of artery
b. Photograph of oval hold of artery



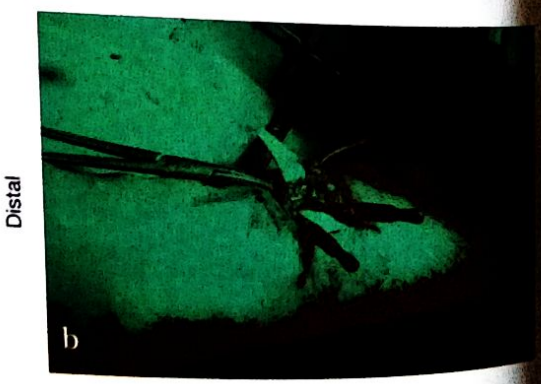


Figure 7 a. Diagram showing anastomosed end
to the hold of artery with interrupted
ture
b. Photograph of anastomosed end vei
the hold of artery

tomosed end to the hole in side to the artery with interrupted suture. (Figure 7a, 7b) (6/0 prolene)

The accuracy of suture placement is clearly improved by the use of magnifying glasses (or surgical loupes).

Results

The following data were collected:

1. Age: the patients' age ranged from 26-80 years old, mean age was 58, almost half (39/80) of the patients were over fifty years old. This reflects the broadened indication for long term dialysis. (Table 1)

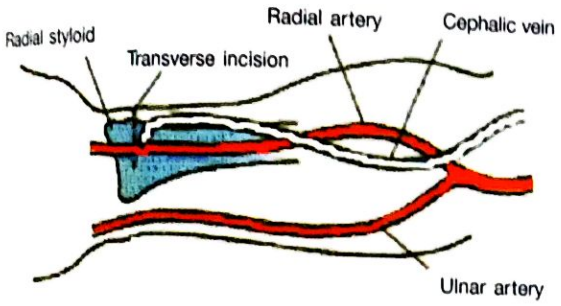


Figure 8 Diagram showing end to side Brescia Cimino Fistula

2. Sex: there were 43 males and 37 females and the sex ratio was male : female =4.5:3.5 (Table 1)

3. Technique of A-V fistula: there were 40 in the original technique, 40 in the Pongsapak modified technique.

4. Access blood flow: The success of the original technique that provide access blood flow of at least 200 ml/min was 15 from 40 created fistulas (success ratio = 3:8). The success of the Pongsapak modified technique was 40 from 40 created fistulas (success ratio = 1:1)

4.1 Initital flow rate: initial flow rate through radialcephalic fistula was measured after the fistula matured (a period of three to six weeks) and hemodialysis was begun, at 1 month by using dialyzer flow meter. In the original technique, flow varied from 0 (non-function fistula = thrombosis) to 350 ml/min (average 238 ml/min), whereas in the Pongsapak modified technique, blood flow

Table 1 Demographic data of the patients

	Original Technique (n = 40)	Pongsapak (n = 40)	Total (n = 40)
	Frequency (%)	Frequency (%)	Frequency (%)
Age (year)			
26-40	4 (10.0)	5 (12.5)	9 (11.2)
41-55	13 (32.5)	11 (27.5)	24 (30.0)
56-70	20 (50.0)	15 (37.5)	35 (43.8)
71-85	3 (7.5)	9 (22.5)	12 (15.0)
	$\bar{\chi}$ = 58.0 (SD = 10.6)	$\bar{\chi}$ = 58.3 (SD = 14.3)	$\bar{\chi}$ = 58.2 (SD = 12.5)
	Min = 26.0	Min = 26.0	Min = 26.0
	Max = 72.0	Max = 80.0	Max = 80.0
Sex			
Male	21 (52.5)	22 (55.0)	43 (53.8)
Female	19 (47.5)	18 (45.0)	37 (46.3)

Table 2 Comparison of access blood flow between the original technique and the Pon ak modified tec nique.

Technique	Number of patient	$\bar{x}$	S.D.	Min.	M	t	Sig
Original	40	238.75	111.00	0.00	3	8.80	0.00
Pongsapak	40	375.00	18.26	350.00	4		

Table 3 Comparison of surgical failure between the original technique and the Pongsa dified technique

Surgical failure	Original Technique (n = 40)	Pongsapak (n = 40)	Total (n = 80)
	Frequency (%)	Frequency (%)	Frequency (%)
Non function	5 (12.5)	0 (0.0)	5 (6.3)
Inadequate	5 (12.5)	0 (0.0)	5 (6.3)
Adequate	30 (75.0)	40 (100.0)	70 (87.5)

rate varied from 330 - 400 ml/min (average 375 ml/min)

Adequate blood flow was higher in the Pongsapak modified technique ($p<0.01$) (Table 2).

There were five early thrombosis fistulas and five inadequate flow fistulas in the original technique whereas there was no surgical failure in the Pongsapak modified technique (Table 3).

4.2 Late fistula flow rate (6 months after surgery)

The flow was at least 400 ml/min of all functional AV fistula with the original and the Pongsapak modified technique. These data suggest that fistula flow will increase with time as the artery and vein dilate.

Through times the anastomosed veins had become even more prominent and thick - walled, making venipuncture easier; this "arterialization" is caused by prolonged exposure to arterial pressure and flow (Figure 9). Differences of sizes of scars between the two techniques were

Figure 9 Arterialization caused by prolonged arterial pressure and flow.

apparent. Transverse and/or longitudinal incision usually has painful hypertrophic scar but not in S plasty incision (Figure 10, 11).

5. The early failure: the early failure was found in the original technique but not in the Pongsapak modified technique. Most failure (25%, 10/40) occurred during the first month after surgery. Generally, it was necessary to replace a failed original fistula either with new fistula at a more proximal location or with synthetic graft.

At the completion of the operation, a strong thrill should be palpable in the arterialized

Figure 10 Mark hypertrophic scar after transverse and/or longitudinal incision.

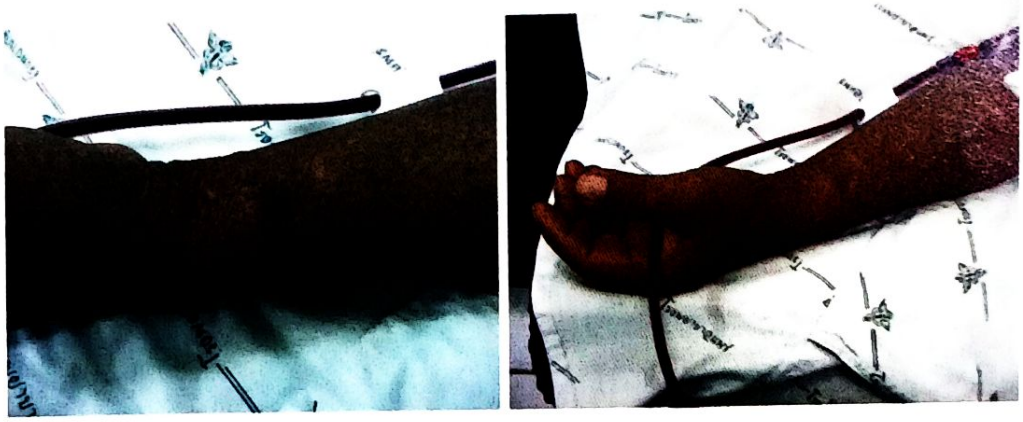


Figure 11 Minimal scar after using S plasty incision.

Table 4 The cumulative patency rate for 80 radial-cephalic fistula

Time of follow up (months)	Patency of Fistula (%)	
	Original technique n=40	Modified technique n=40
0 (1 wk)	90	100
1	75	100
3	75	100
6	75	100
9	75	100
12	70	100
15	65	97.5
18	60	95

vein, for a pulsating vein without thrill usually indicates insufficient flow.

6. Patency of fistula: patients follow up periods range from 3 months to 18 months.

Life table analysis of patency of fistula (Table 4, Figure 12) showed that the lower patency rate of original technique fistula was from early failure (<30 days) but there was no difference in late failure (>30 days).

7. Number of operations or surgical revisions: this study showed that multiple interventions were required in 10 of 40 with the original technique versus none of 40 patients in the Pongsapak modified technique ($p < 0.001$) (Table 5-6)

8. Cost: It was shown that a higher cost was found in the original technique because there have been surgical revisions but no revision in the Pongsapak modified technique ($p < 0.01$). (Table 7)

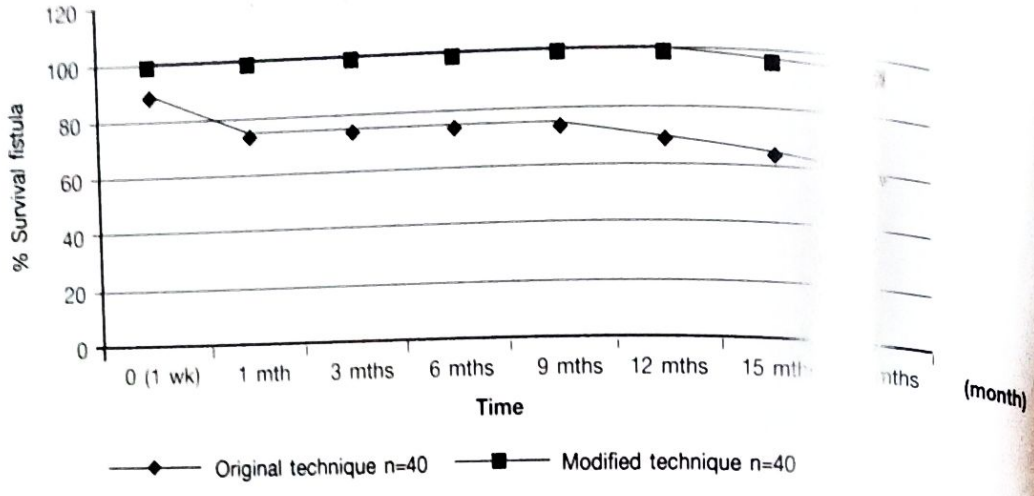


Figure 12 The cumulative patency rate of fistula.

Table 5 Comparison of number of operations between the original technique and the Pongsapak modified technique (Mann-Whitney U test)

Number operation	Original (n = 40)	Pongsapak (n = 40)	Total (n = 40)
	Frequency (%)	Frequency (%)	Frequency (%)
1	30 (75.5)	40 (100.0)	70 (87.5)
2	7 (17.5)	0 (0.0)	7 (8.8)
3	3 (7.5)	0 (0.0)	3 (3.8)

Table 6 Comparison of surgical revision between the original technique and the Pongsapak modified technique (Mann-Whitney U test)

Technique	Number of patient	Mean of rank	Sum of rank	Mann	Z	Sig.
Original	40	35.50	1,420.00	600.00	-3.352	0.001
Pongsapak	40	45.50	1,820.00			

Discussion

The number of patients with end-stage renal disease maintained on chronic hemodialysis is increasing progressively.[13,15] The increasing prevalence of diabetic patients and elderly patients among the new hemodialysis patients is a recent worldwide trend.[13,17]

The arterio-venous fistula must be regarded as the link to the life live of hemodialysis. Any complication is, therefore, potentially life-threatening. Careful attention to surgical detail and the recognition and prevention of problems that lead to fistula failure contribute to the quality and length of life of patients with chronic uremia.

Clotting in the vein precipitated by venous punctures occurs frequently at the start, but the incidence decreases with time as the fistula enlarges and the operator acquires more experience

Table 7 Comparison of cost between the original technique and the Pongsapak modified technique

Technique	Number of patient	Baht $\bar{\chi}$	S.D	Min.	Max.	t	Sig.
Original	40	6625.00	3677.52	5000.00	15000.00	3.34	.001
Pongsapak	40	5000.00	0.00	5000.00	5000.00		

Delay in thrombosis can occur because of extensive thrombosis in the vein secondary to the repeated puncture.[7]

The most important parameter in assessing the viability of an arteriovenous fistula is the presence of a palpable venous thrill. When present, prior to or immediately after skin closure, the fistula will probably function. If such a thrill is not present, the fistula may fail. For this reason, the causes of an absent thrill must be localized and corrected before the patient leaves the operating room.[5,17,18]

The author's experience with the original radialcephalic fistula is similar to those reported by others showing a high early (<30 days) failure rate.[7,14,17] Late failure (>30 days) is rare. Early access failures, including those which continue to flow but do not dilate to a size adequate for convenient cannulation, require a new access. Vasospasm is a common cause of immediate clotting of the fistula and should be treated vigorously by locally administered xylocaine.

The various accepted procedure as well as some radialcephalic fistula modifications for solving early thrombosis had been previously reported.[4,5,20,21] Haimov M, Singer A, Schupak had modified technique by dilatation cephalic vein with uterine or Baker's dilators and flushing with heparinized saline, an experience with 87 patients, with 10 revisions.[5] Ehrenfeld W K, Grausz H, Wylie JE had modified radialcephalic fistula by transecting the cephalic vein at the site of its bifurcation and anastomosing the resulting bell-shaped end to the site of the adjacent radial artery. In these patients, early closure of the fistula occurred in 3 of 32 radialcephalic fistula. Twenty seven fistulas have remained patent for period varying from two to eighteen months(mean thirteen months).[4] Thompson BW, Barbour G, Bissett J had modifies radialcephalic fistula by using trunk cephalic vein to form Y shaped at the end of cephalic vein for larger anatomosis junction of sixty - three patients in this research, 17 patients had revised operation, only 46 patients had single operation.[21] Sung T W D, Woods E J had also modified radialcephalic fistula by dilatation cephalic vein, using Fogathy catheter but incision for exposure cephalic vein was too large (8 cm.).[20]

Choosing a technique for creation of AV fistula for long-term hemodialysis that will give adequate access blood flow, easy and inexpensive, no complication and high patency rate is a difficult problem therefor a comparative study between two techniques of creation of AV fistula for long-term hemodialysis at Phrae Hospital was done. A good patency rate was obtained in the modified technique at short term, but the long term patency rates of both techniques were not difference. The major problem of original technique was low blood flow and non-functioning fistulas caused by narrowing and thrombosis in fistulas. The other cosmetic problem was the scar of skin from longitudinal or transverse incision at the wrist. (Figure 10)

Pongsapak modified technique: the major ad-

Table 8 Comparison of scar at wrist between transverse or longitudind incision and S-plasty incision.

Incision method	Scar at wrist (%)
Transverse or longitudind incision	80 (32 / 40)
s-plasty incision	20 (8 / 40)

vantage of the Pongsapak modified technique is created an oval hole of artery forcing blood into the area of shunt anastomosis and decreasing clot formation at anastomosis site so early thrombosis has not developed and the shunt has adequate blood flow. S plasty incision provided more exposure in the operative field and could decrease scar formation because it could break up the straight linear scar, relax tension, and created realignment of the displaced tissue.[12] (Table 8) Infection has neither occurred in the original technique nor the Pongsapak modified technique as reported by other papers describing radialcephalic fistula.[5,7,15] In the original technique, frequent early thrombosis and inadequate flow are the causes of revised operation so it needs more time and more cost for the operation. The AV anastomosis by interrupted suture avoids narrowing of the anastomotic site so there is no decreased blood flow at anastomosis site. Pongsapak modified technique not only gives the satisfactory results from increasing the size of the fistula but also decreases visible scar by S plasty incision at the wrist with few significant complications which have been well accepted by patients, physicians and dialysis personnel. (Figure 11)

Pongsapak modified technique has proved to be a safe and effective means of gaining access to the circulation for maintenance hemodialysis. Once established, the incidence of fistula failure or complication and thrombosis in fistula has been extremely low and the incisional scar is less [illegible] ceptible.

From these reasons it is recommended that the AV fistulas for long term hemodialysis should be created by using the Pongsapak modified technique. This experience comes from a learning process by adapting from the original technique to improve the results.

References

1. Brescia MJ [illegible] E, Appel K, Hurwich BJ. Chronic hemodialysis [illegible] enipuncture and a surgically created arteri[illegible] stula. N Engl J Med 1966; 275: 1089-92.
2. Cerilli J, [illegible] G. Technique and results of the construction [illegible] iovenous fistulas for hemodialysis. Surg [illegible] Obstet 1973; 137: 922.
3. Conn J, Ro[illegible] Bergan JJ. Venous arterialization for hemodia[illegible] Am J Surg 1968; 116: 813.
4. Ehrenfeld W[illegible] Drausz H, Wylid J E. Subcutaneous arteriovenous fistulas for hemodialysis. Am J Surg 1972; 124:200.
5. Haimov M, Singer A, Schupak E. Access for hemodialysis experience with 87 patients on chronic hemodialysis. Surgery 1971; 69:884.
6. Haimov M, Burrows L, Casey JD, Schupak E. Vascular access for hemodialysis: experience with 914 patients; special problems and causes for early and late failures. Proc Eur Dial Transpl Assoc 1973; 10: 173.
7. Haimov M. Vascular access for hemodialysis. Surg Gynecol Obstet 1975; 141: 619-23.
8. Hanson JS, Carmondy M, Keogh B, O'Dwyer WF. Access circulation by permanent arteriovenous fistula in regular dialysis treatment. BMJ 1967; 4: 586.
9. Hodson JM, Menno AD, McMahon J. Radial arteriovenous fistula as a substitute for the conventional arterial prosthesis in maintenance hemodialysis. J Urol 1970; 103: 5.
10. Kinnaert P, Geens M, Vereerstraeten P, Toussaint C. Experience with arteriovenous fistulas in chronic hemodialysis. Am J Surg 1971; 122: 104.
11. Klauber GT, Belitsky P, Morehouse DD, MacKinnon KJ. Preventable problems with arteriovenous fistulas for hemodialysis. Surg Gynecol Obstet 1971; 132: 457.

18. Mc Carthy JG. Introduction to plastic surgery. In: Mc Carthy JG, editor. Plastic surgery Vol.1 General principles. Philadelphia: W.B. Saunders; 1990. p.1-68.
19. Mizumoto D, Watanabe Y, Kumon S, Kato H, Haruta Y, Kudo N. Itok the treatment of chronic hemodialysis vascular access by directional artherectory. Nephron 1996; 74: 45-52.
14. Patel R, Lidsky I, Vertes V, Kest, L, Cohen, S., Some experience with the use or arteriovenous fistulae in chronic haemodialysis. BMJ 1968; 1: 414.
15. Palder SB, Kirkman RL, Whittemore AD, Hakim RM. Vascular access for hemodialysis: patency rates and result of revision. Ann Surg 1985; 202: 235-9.
16. Ramirez O, Swartz C, Onesti G, Mailloux L, Brest AN. The winged in line shunt. Trans Am Soc Artif Intern Organs 1966; 12: 220.
17. Rohr MS, Browder W, Frentz GD, McDonald JC. Arteriovenous fistulas for long-term dialysis. Arch Surg 1978; 113: 153-5.
18. Salomon J, Vidne B, Robson M, Rossenfeld J, Levy MJ. Our experience with the use of arteriovenous fistula in chronic dialysis; modified surgical technique. Surgery 1968; 63: 899.
19. Sheil AGR, Stewart JH, Storey BG. Technique for arteriovenous anastomosis at the wrist. Arch Surg 1968; 97: 495.
20. Sung TWD, Woods E J. Modified technique for creation of an arteriovenous fistula for hemodialysis. Am J Surg 1973; 126: 441.
21. Thompson BW, Barbour G, Bissett J. Internal arteriovenous fistula for hemodialysis. Am J Surg 1972; 124: 785-8.
22. เกรียง ตั้งสง่า, ประเสริฐ ธนกิจจารุ, ถนอม สุภาพร, วสันต์ สุเมธกุล; Hemodialysis. กรุงเทพมหานคร: Text and Journal Publication; 2545. หน้า 147-212.
23. เกรียง ตั้งสง่า, ประเสริฐ ธนกิจจารุ, ถนอม สุภาพร, วสันต์ สุเมธกุล;ความรู้ทางทฤษฎีเกี่ยวกับการฟอกเลือดด้วยเครื่องไตเทียม. กรุงเทพมหานคร: ชวนพิมพ์; 2537. หน้า 67-80.
24. ประเสริฐ ไตรรัตน์วรกุล. ศัลยศาสตร์วิวัฒน์ 15 (Vascular Access for General Surgeon). กรุงเทพมหานคร: กรุงเทพเวชสาร; 2540. หน้า 503-37.
25. พยอม เสงี่ยมจิต, เกรียง ตั้งสง่า, เฉลิมศักดิ์ เฉลิงศักดิ์กาญจนะ, สมชาย เอี่ยมอ่อง, ดวงพร ชินวิทย์, สมรัก รอดบ่าย. Practical hemodialysis. กรุงเทพมหานคร: Text and Publication; 2545. หน้า 189-276.
26. วีระวร อริยะจร. Hemodynamics and pathophysiology of arteriovenous fistula (เอกสารอัดสำเนา). เชียงใหม่: ภาควิชาศัลยศาสตร์ คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่; 2546. หน้า 1 - 35.

บทคัดย่อ **การเปรียบเทียบผลของวิธีผ่าตัดเตรียมเส้นเลือดแบบเดิมกับพงศภัคเทคนิคสำหรับการฟอกไตด้วยไตเทียมในผู้ป่วยไตวายเรื้อรัง**

พงศภัค พรมโชติ

งานศัลยกรรมตกแต่งเสริมสวย แผนกศัลยกรรม โรงพยาบาลแพร่

วารสารวิชาการสาธารณสุข **2549; 15:740-52.**

การบำบัดทดแทนไตด้วยการฟอกไตโดยเครื่องไตเทียม วิธีการผ่าตัดเตรียมเส้นเลือด (Vascular access) ที่ดีที่สุดคือ Radial cephalic arterio-venous fistula เนื่องจากมีประสิทธิภาพสูงและข้อแทรกซ้อนต่ำ การศึกษาครั้งนี้ ต้องการเปรียบเทียบประสิทธิภาพและข้อแทรกซ้อนระหว่าง Original technique และ Pongsapak Modified technique โดยศึกษาจากผู้ป่วยไตวายเรื้อรังของโรงพยาบาลแพร่ 80 ราย ในช่วงเวลาตั้งแต่ 1 มกราคม 2545 ถึง 31 ตุลาคม 2548 40 รายแรกใช้การผ่าตัดแบบ Original technique 40 รายหลังใช้การผ่าตัดแบบ Pongsapak Modified technique โดยวัดผลจากข้อมูลพื้นฐานผู้ป่วย (demographic data), อัตราการไหลของเลือด (blood flow rate), ระยะเวลาการใช้งานได้ดีของ fistula (duration of function), การอุดตันของ fistula (thrombotic complication), การติดเชื้อ (infection), จำนวนครั้งของการผ่าตัด (number of operation) และค่าใช้จ่าย (Cost) ผลการศึกษาปรากฏว่า Pongsapak Modified technique มีประสิทธิภาพสูงกว่า, ข้อแทรกซ้อนน้อยกว่าและค่าใช้จ่ายถูกกว่า Original technique อย่างมีนัยสำคัญทางสถิติ ($p \leq 0.01$)

คำสำคัญ: **การผ่าตัดเตรียมเส้นเลือด, การฟอกไตด้วยเครื่องฟอกไตสำหรับผู้ป่วยเรื้อรัง, วิธีของพงศภัค**