

An investigation into the practice of concurrent chronic ambulatory peritoneal dialysis catheter insertion and arteriovenous fistula formation in patients needing dialysis

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To review the practice of concurrent chronic ambulatory peritoneal dialysis catheter insertion and arteriovenous fistula formation in patients needing dialysis, we retrospectively assessed the results of arteriovenous fistula procedures, the risk factors for fistula failure, and the selection strategy used to choose which patients with end-stage renal disease would be given dialysis. We analysed the medical records of 136 patients who had first-time arteriovenous fistulae created between 1 July 1986 and 1 May 1994 at a public hospital in Sydney, Australia. As many as 36% of fistulae were never used (24.5% due to primary failure) and 30.1% of the fistulae used had to be abandoned for various reasons. In addition, 22.8% of patients experienced complications, the most common being thrombosis and stenosis. None of the factors associated with fistula formation were significant in terms of fistula patency rates, but smokers and female patients had inferior fistula patency rates. Whereas the overall results were satisfactory, the practice of concurrent chronic ambulatory peritoneal dialysis catheter insertion and arteriovenous fistula formation to give vascular access for dialysis is questionable.

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Introduction

In Hong Kong, 58% of patients with end-stage renal disease (ESRD) are treated with long-term continuous ambulatory peritoneal dialysis (CAPD)¹ via a Tenckhoff catheter. However, complications of CAPD frequently occur and necessitate temporary or permanent conversion to haemodialysis.² Thus, for patients with ESRD who require CAPD, some nephrologists would advocate simultaneous Tenckhoff catheter insertion and arteriovenous fistula (AVF) formation as a reserve measure, should CAPD need to be temporarily or permanently abandoned. This study reviews the overall outcome of AVF procedures performed in a single centre over an

eight-year period examines the value of concurrent AVF formation.

Methods

Between 1 July 1986 and 1 May 1994, 136 patients had their first AVF created for haemodialysis purposes at Westmead Hospital, Sydney, Australia. Patient medical records were reviewed retrospectively. Preoperative clinical venous assessments had been performed for 112 of the 136 patients. To obtain missing data, patients were interviewed by telephone and nephrologists were also contacted. The AVF site, anastomosis type, anaesthesia used, and concurrent procedures performed were all recorded. The AVF outcome and any complications were assessed.

Arteriovenous fistula outcomes were assessed clinically by the consultant surgeon who performed all the procedures in this series. The reasons for fistulae never being used and for ceasing usage were assessed. Fistula complications were also recorded. Patency rates were calculated by using Kaplan-Meier actuarial survival analysis, and risk factors for AVF

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Table 1. Causes of end-stage renal disease in the study group

Diagnosis	Patients, n=136 No. (%)
Glomerulonephritis	33 (24.3)
Analgesic nephropathy	22 (16.2)
Diabetes mellitus	15 (11.0)
Polycystic kidney disease	14 (10.3)
Chronic pyelonephritis	11 (8.1)
Renovascular disease	4 (2.9)
Hypertension	3 (2.2)
Unknown	9 (6.6)
Others	25 (18.4)

failure were assessed by using Cox regression analysis. The cut-off level for statistical significance was taken as $P=0.05$.

Results

Demographics

There were 82 male patients and 54 female patients in this series. Their mean age was 49 years (range, 13-75 years). The mean follow-up period of assessment was 26.4 months (range, 0.1-92.2 months). The causes of ESRD in the study group are shown in Table 1. The most common cause of ESRD was glomerulonephritis. Of the 33 patients with glomerulonephritis, 11 (33.3%) had immunoglobulin A nephropathy, nine (27.3%) had focal segmental glomerulosclerosis, five (15.2%) had crescentic glomerulonephritis, and five (15.2%) had chronic glomerulonephritis. The remaining three (9.1%) patients had membranoproliferative glomerulosclerosis, membranous glomerulonephritis, and mesangiocapillary glomerulonephritis.

Preoperative evaluation

Venous assessment was performed on 112 patients to determine the feasibility and optimal site for fistula formation. Both wrists and antecubital fossae were examined as possible fistula sites. Fistula formation had been considered clinically feasible if the venous return of the cephalic vein was palpable and patent from the wrist to the antecubital fossa; Allen's test was performed to confirm arterial patency in the radial and ulnar vessels. Co-morbid conditions such as coronary artery disease, diabetes mellitus, previous cerebrovascular accidents, and peripheral vascular disease were present in 111 (81.6%) of the 136 patients.

Operative technique

Most of the fistulae performed were radiocephalic (117/136; 86.0%) and 15 (11.0%) were antecubital brachiocephalic. No suitable upper-limb fistula sites were identified in four (2.9%) patients, who subsequently received thigh fistulae. Most fistulae

(103; 75.7%) were formed on the non-dominant side. The types of anastomoses used were side of vein to side of artery (88; 64.7%), end of vein to side of artery (43; 31.6%), and anastomoses using polytetrafluoroethylene grafts (5; 3.7%). In side-to-side anastomoses, the vein distal to the anastomosis was usually ligated to prevent venous hypertension in the hand and to encourage the development of the fistula in a proximal direction. The procedures were performed using general anaesthesia in 55 (40.4%) patients, nerve block in 75 (55.1%) patients, and local anaesthesia in six (4.4%) patients. Many of the procedures that were performed under general anaesthesia (39/55; 70.9%) had a concurrent procedure performed, of which 33 (84.6%) were for a Tenckhoff catheter insertion; the remainder (6/39; 15.4%) were performed for vascular catheter insertion. The 33 patients who had concurrent Tenckhoff catheter insertion were given AVF formation in case they experienced CAPD complications.

Success and use of fistulae

At the end of the study, with a mean follow-up period of 26.4 months, 44 (32.4%) of the 136 fistulae were still in use. A further 41 (30.1%) had been used, but their use had been abandoned for various reasons. Many AVFs (49; 36.0%) had never been used. The status of the remaining two fistulae was not known. The causes for abandoned use and non-use are shown in Table 2.

Complication rate and need for revision surgery

Nearly one quarter (31; 22.8%) of all patients had complications secondary to their AVF. Among these 31 patients, the most common complications were thrombosis (16; 51.6%) and stenosis (7; 22.6%). Rarer

Table 2. Causes of abandoned arteriovenous fistula use and non-use

Cause	Patients No. (%)
Abandoned use	
renal transplantation	16 (39.0)
fistula failure	8 (19.6)
conversion to CAPD*	7 (17.1)
death	6 (14.6)
renal recovery	2 (4.9)
fistula complication	2 (4.9)
Subtotal	41
Non-use	
uninterrupted CAPD therapy	28 (57.1)
fistula failure	12 (24.5)
renal recovery	4 (8.2)
renal transplantation	1 (2.0)
severe fistula complication	1 (2.0)
death	3 (6.1)
Subtotal	49

* CAPD continuous ambulatory peritoneal dialysis

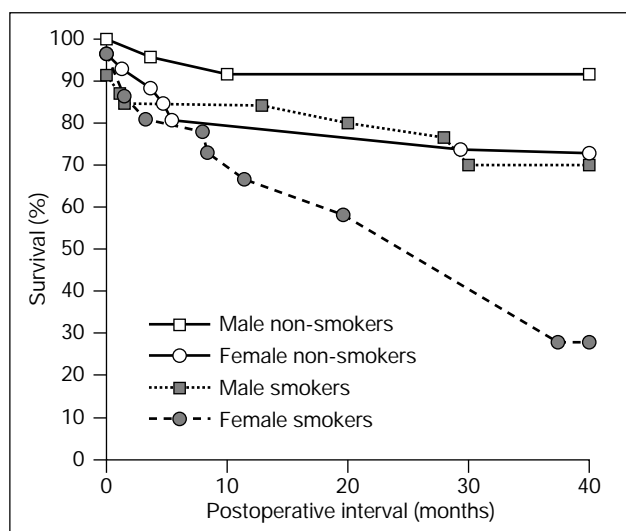


Fig. 1 Fistula survival curve for males, females, smokers, and non-smokers

complications included aneurysm formation (3; 9.7%), infection (2; 6.5%), venous hypertension (1; 3.2%), ischaemia (1; 3.2%), and steal (1; 3.2%). Revision surgery, which included thrombectomy, angioplastic balloon dilatation, flow reanastomosis, and flow improvement exploration, were performed on 24 (17.6%) patients, 19 (79.2%) of whom had their fistula function restored.

Statistical analysis

Among factors that were analysed using the Cox regression model, the fistula site, side, anastomosis type, anaesthesia used, and concurrent procedures were not significant in terms of AVF patency rates. The only adverse significant factors linked to fistula failure were smoking ($P=0.024$) and sex ($P=0.041$). Smokers and females had an overall lower AVF patency rate compared with non-smokers and males, respectively (Fig).

Discussion

The AVF patency rate at approximately 2 years was 75%. This figure compares favourably with other similar studies in which patency rates of 55%³ and 50%⁴ at 3 years, and 30%⁵ and 50%⁶ at 5 years, have been reported. However, another study obtained patency rates as high as 90% at 2 years.⁷ The reasons for the high patency rate in this study include the comparatively small proportion of diabetic patients (11.0%) and the fact that only first-time AVFs were included in this study. As with other studies, most failures occurred within 30 to 40 days of AVF formation.^{8,9}

The identification of female sex and smoking as significant risk factors, as well as the results of

previous studies that have established a radial artery diameter of less than 4 mm,¹⁰ diabetes mellitus,⁵ and age⁵ as risk factors for AVF failure, will enable fistula patency to be more accurately predicted in certain patient groups. The presence of risk factors can also be used to select patients for different dialysis modalities and vascular access.

Although CAPD is a well-established form of treatment in patients with ESRD, it is associated with a number of serious complications. In particular, peritonitis is a common problem, which necessitates the removal of the Tenckhoff catheter and temporary or permanent haemodialysis. According to the United States National CAPD Registry, 60% of patients have at least one episode of peritonitis in their first year of CAPD, and a total of 1.4 episodes of peritonitis occur per patient-year of observation.² Overall, 8 days per patient-year are spent in hospital as a result of complications due to CAPD treatment.² The incidence of peritonitis has recently decreased substantially in patients undergoing CAPD, as greater improvements have been made in CAPD delivery systems and connectors.¹¹ With current systems, a peritonitis rate of one episode every 2 to 3 years can be achieved.¹² These results, however, show that haemodialysis is still often necessary. The best way to prepare for this eventuality is contentious^{5,13} and some nephrologists have a policy of requesting 'back-up' AVF formation at the time of CAPD catheter insertion.

It should be remembered that not all patients who use CAPD will require haemodialysis, and that all patients with AVFs are at risk of the occurrence of complications. In this study, 17 (51.5%) of the 33 patients had an AVF that was used as 'back-up'; nearly as many (16; 48.5%) patients had an unnecessary operation. On the whole, AVF patients have a 22.8% (31/136) risk of developing complications related to their AVFs. In addition, 36 (26.5%) of the 136 patients who required haemodialysis developed a primary or secondary fistula failure. These two risks contradict the justification for creating AVFs simply for 'back-up' purposes.

Conclusion

The overall AVF outcomes obtained are satisfactory but the practice of concurrent CAPD catheter insertion and AVF formation as 'back-up' vascular access is a questionable practice. Smokers and female patients tend to have worse fistula patency rates and this fact should be taken into consideration when assessing patients with renal failure for analysis therapy.

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