

**THE ORGANISATION AND DELIVERY OF THE VASCULAR ACCESS
SERVICE FOR MAINTENANCE HAEMODIALYSIS PATIENTS**

AUGUST 2006

REPORT OF A JOINT WORKING PARTY

The Renal Association

founded 1950

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SUMMARY AND RECOMMENDATIONS

Vascular access is essential for haemodialysis and its quality determines patient outcomes. Problems with vascular access are the commonest causes of infections and hospital admissions. The provision of vascular services in units in the UK is, with a few exceptions, suboptimal. This is a consequence of both resource limitations and poor organisation of services.

This document attempts to describe the volume of the workload, the resources needed and models of service organisation to improve and shorten the patient pathway. This will require co-operation between nephrologists, surgeons, radiologists and other health professionals. The tasks and procedures should be done by those with the appropriate skills and not according to professional group.

Current UK situation

1. Approximately 100 new patients/pmp start RRT in the UK each year of whom 70 will start on haemodialysis. The minority of those known to renal services for >6months start with functioning access. We believe that ~70% should do so.
2. In the UK 69% of prevalent HD patients use either a fistula or a graft. We believe that ~80% should do so. The problem is multifactorial, caused by late presentation to renal services, mistiming the referral for surgery and delays in the surgical pathway.

Capacity requirements

3. The best form of access for chronic haemodialysis is an autogenous arteriovenous fistula
4. 135 procedures are needed a year per 100 new haemodialysis patients and 30 per 100 prevalent patients.
5. There is a need for one dedicated access surgical list per 120 dialysis patients (prevalent and incident), assuming 3-4 cases per list.
6. 75% of procedures are suitable for day case surgery under local anaesthetic.
7. There is a need for 2 radiology sessions/week per 100 haemodialysis patients.

Service Organisation

8. All access referrals should be routed via a proforma through an access co-ordinator to a single waiting list.
9. Only patients requiring complex procedures need to be directed to a specific practitioner
10. Outpatient assessment should be by a competent practitioner. Surgeons need only see patients in advance of surgery when there is uncertainty about the appropriate procedure.
11. A date for surgery should be given at the time of the assessment.

Clinical practice

12. Surgery should be performed 16-24 weeks before the anticipated start of haemodialysis.
13. Doppler mapping of the venous system is not mandatory in all cases. Units that have a policy of mapping all patients should ensure that this does not delay surgery.
14. New fistulae should be assessed within 2 weeks of surgery to ensure early intervention to prevent delay in maturation or outright failure.
15. We recommend that the placing of central venous dialysis catheters be performed as a formal surgical procedure by trained practitioners who are not necessarily medically qualified.
16. When venous catheters are required, they should be locked with anti-bacterial solutions.
17. We recommend regular monitoring of access in use to allow pre-emptive treatment of complications to prevent failure.
18. We suggest a set of audits of incident and prevalent patients, assessing both clinical outcomes and service provision.

INTRODUCTION

Reliable safe vascular access is the “sine qua non” for successful haemodialysis and is a key determinant of outcome. Problems with vascular access are the commonest cause of admission to hospital, infection and under-dialysis in the maintenance haemodialysis population.

The establishment, care and maintenance of vascular access are a team effort requiring the contributions of doctors, nurses and other health professionals. Access procedures are performed principally by vascular surgeons, but also by renal transplant surgeons, nephrologists, interventional radiologists and other health care professionals depending upon competence, local custom, enthusiasm and availability.

REMIT

The responsibility for providing the vascular access service and the resources needed have never been properly defined or described.

In response to the requirements of the National Service Framework [1] and concerns of dialysis staff, The Renal Association, The Vascular Society of Great Britain and Ireland and the British Society of Intervention Radiology charged a working party to

- Quantify the volume of vascular access work
- Quantify the resources needed to deliver this service
- Suggest coherent and sustainable models of service provision and organisation.

The aim of this document is to propose a framework to improve and shorten the patient pathway. The Societies intend to foster an innovative and modern approach to the problem emphasising co-operation between teams, questioning traditional practice and advocating skill mix.

DEFINITION OF VASCULAR ACCESS

Vascular access is defined as the portal by which blood can be directed from and to the circulation of a patient via the dialyser or haemofilter.

Vascular access has to be created in:

- i) New patients to Renal Replacement Treatment (RRT) who have chosen haemodialysis (HD).
- ii) Patients switching from peritoneal dialysis to haemodialysis.
- iii) Patients whose renal transplants have failed and are to (re)start haemodialysis.

Ideal Vascular Access

Ideal access provides a means to effective renal replacement therapy (RRT) with little associated morbidity and has the following characteristics:

- i) It delivers a blood flow sufficient to allow adequate dialysis. This requires a flow of 300 to 500mls/min through the dialyser returnable to the circulation at a pressure of <200mm of Hg.
- ii) Attachment to blood lines should be simple, safe and difficult to disconnect accidentally.
- iii) Low infection risk.
- iv) Low thrombosis risk.
- v) Low rate of blood vessel stenosis or vascular obstruction.
- vi) Easy to monitor with a low need for intervention to revision or rescue.

Types of Access – In order of preference

i) Arteriovenous Fistula

Fistulas are the commonest and safest access.

The basic principle is to start with the most distal site on the non-dominant arm moving to the dominant arm and legs as access sites are exhausted.

They are formed by a surgical anastomosis between an artery and a vein. Once large enough (usually over 5 mm in diameter), the vein can be needled safely and repeatedly. Fistulas are most commonly created at the wrist or elbow (radio-cephalic or brachio-cephalic) but other sites are also used.

Advantages:

Native vessel fistulas:

- are long lasting
- are reliable (revision rate 15% per year)
- have low infection rates
- have low thrombosis rates.

Disadvantages:

- They take time to “mature”. The fistula short circuits the arteriolar and capillary microcirculation causing a fall in peripheral resistance markedly increasing flow rates in the afferent artery and efferent vein. The arteriolarised draining vein enlarges in response to increased flow. This process typically takes 2 months hence a fistula is not the solution when dialysis is required acutely.
- Failure or delayed maturation to a useable state.
- The “steal” of blood from the limbs causing digital ischaemia is rare with wrist fistulas, and seen uncommonly with elbow fistula.
- Development of stenoses at sites of needling of the draining vein.

ii) **Arteriovenous Grafts**

Advantages:

- They can be used earlier than natural fistulae because they do not have to mature. They need a few days to “bed-in” to the tissues, otherwise large haematomas can form around them crushing the graft or acting as a source of infection.

Disadvantages:

- High thrombosis rates most commonly due to stenoses at the venous anastomosis
- High infection rates
- Higher rates of intervention and revisions required to maintain patency (about 80% per year)
- Occasional steal syndrome.

iii) **Central Venous Access**

This is provided by dialysis catheters inserted into major veins typically the central veins. Preferred access is from the internal jugular vein but other upper, or lower limb veins can be used. If intended for use beyond 2 weeks they are tunnelled subcutaneously away from the entry point to the vein in order to minimise the risks of infection and line displacement.

Advantages:

- They can be used immediately after placement making this the first choice in the acute situation.
- They are almost always an option.

Disadvantages:

There are immediate risks of insertion, these are minimised by utilising ultrasound guidance to puncture the vessel and fluoroscopy to ensure correct line position.

- Damage to adjacent structures including arteries and the pleura causing pneumothorax or haemothorax .
- Malposition and kinking

Longer-term problems include:

- Central venous stenosis, a fibrotic response to the presence of the catheter causing venous obstruction.
- Fibrin cuff formation causing the line flow to be inadequate for dialysis
- Infections
- Cosmetic concerns and local discomfort.

Summary

In chronic renal failure the preferred access is an autogenous AV fistula, this should be formed as early as practically possible. The most expedient access for patients requiring dialysis acutely is by central venous dialysis catheters. The majority of patients $\geq 80\%$ on long-term haemodialysis should have either a fistula or a graft.

THE CURRENT SITUATION IN THE UK

Approximately 100 new patients per million population start RRT in the United Kingdom each year [2]. 5 to 10% of these will have a pre-emptive renal transplant so that access is not required, ~25% will choose peritoneal dialysis as their first treatment, ~70% will start haemodialysis and of these a quarter will have come to the attention of the renal unit less than 90 days before RRT is needed. Thus about 50% of new patients will be suitable for elective vascular access placement. Of these just less than half will need second procedures to modify the access or a second primary procedure. Those patients referred late to a renal service will have to rely on central venous catheters but if they elect to stay on haemodialysis they need urgent natural access.

Predicted initial mode of RRT		Appropriate Access	
Haemodialysis	~70%	Fistula	~60%
		Catheter	~15%
Peritoneal dialysis	~25%	PD catheter	~25%
Pre-dialysis transplant	~5%	None	~0%
TOTAL	100%		100%

~80% of prevalent haemodialysis patients should have fistulae or grafts.

Because of concerns that these predictions were not being met in the UK The Renal Association, in partnership with Kidney Research UK, completed a census of dialysis patient vascular access in 2005 [3]. This census, analysed by the Renal Registry, included 62 of 72 UK renal centres, and provided information on prevalent patient modality and access, markers of morbidity, and prospectively collected data on incident patients for April 2005.

Data on the staffing of vascular access services was also collected and is being analysed. It was not available to the Working Party.

Prevalent population

For the *prevalent* population of the 62 centres 69% of patients on haemodialysis used either an AV fistula (AVF) or AV graft (AVG) but there was a wide variation in individual centres. Rates varied from 44% to 94%.

Incident population

For the *incident* population (457 patients), 55% had been referred to the renal centre more than 12 months before initiation of RRT, 35% less than 6 months before RRT and 30% less than 3 months. Only 31% commenced with either an AVF or AVG, (predicted ~ 70%) and for those known to a nephrologist for more than a year the figure was still only 50% (predicted >85%). [Table 1 and 2]

Table 1

Access at first RRT for HD starters April 2005

Taken from 8th UK Registry Report [3]

Access type	Frequency	Percentage of patients
AVF	104	30
AVG	6	2
Non-tunnelled catheter	126	36
Tunnelled catheter	115	33
Total HD	351	

Table 2Access at first RRT for HD starters April 2005, with time from 1st contact with nephrology to first RRTTaken from 8th UK Registry Report [3]

Months from 1st contact	AVF	AVG	Non-tunnel	Tunnelled line	% catheter	Total
<3m	6	1	65	36	94	108
3 - <6m	4	0	5	9	78	18
6 - <9m	8	0	3	10	62	21
12 - <24m	22	1	13	10	50	46
≥24m	58	4	25	36	50	123
Total	100	6	114	108	68	328

The reasons that a minority of patients starting haemodialysis do so without definitive access include:

- i) *Late referral to a renal specialist:*
One-third of patients commencing dialysis for end stage renal failure are referred less than 3 -months before they need to start treatment.
- ii) *Delays in the low clearance stage.*
33% of patients known to nephrologists for more than 6 months were not referred for a procedure before starting RRT. This suggests that referral to a surgical service was mistimed by the nephrologists. This implies a need to measure and react appropriately to the rate of decline of renal function.
- iii) *Delays in the surgical pathway:*
Waiting times for surgical outpatients, diagnostic procedures and operating slots cause delay in formation of vascular access. This results in failure of access formation, or inadequate time for maturation prior to the need for haemodialysis. This is a problem not just for patients starting haemodialysis (incident patients), but also for those established on dialysis (prevalent patients) whose access fails.

Morbidity

Data on morbidity were also collated. Units provided data on *Staphylococcus aureus* bacteraemias during 2004 for haemodialysis patients (including the proportion due to MRSA) and a census of in-patient haemodialysis patients was taken. *Staph. aureus* infection rates varied between centres. The mean was 13 per 100 prevalent HD patients (range 2.3 – 33.8). For MRSA the mean was 4 per 100 prevalent HD patients (range 0-21.5). *The number of Staphylococcal bacteraemias in a unit was related to the number of dialysis catheters in use.* Crude extrapolation also suggested that 30% of the 320,000 bed days per annum spent in hospital by haemodialysis patients were related to vascular access complications.

Summary

Practice in the UK is highly variable and overall is unsatisfactory. Some units are able to achieve excellent natural vascular access rates, but too few patients in the UK commence RRT with optimal vascular access. Delays at all stages in the referral process have been identified and should be addressed. Many patients require hospitalisation for complications related to vascular access and the over-reliance on dialysis catheters is the cause of the high incidence of staphylococcal infections.

PROVISION OF VASCULAR ACCESS SERVICES: RESOURCE IMPLICATIONS

The demand for vascular access is rising in the UK and is predicted to continue doing so until at least 2020. Modelling by the Renal Registry in 2004 suggests that the dialysis population in the UK will rise from about 33,600 to 42,000 – 51,000 by 2010 [4]. The acceptance rates over the same period are also predicted to rise as are the number of dialysis patients with diabetes.

The provision of dialysis treatment is a challenge in itself but there is a substantial associated and unrecognised extra workload for the surgical, radiology and nephrology teams involved in the provision and maintenance of vascular access. Apart from the creation of vascular access for patients requiring haemodialysis there are additional procedures needed in patients with complications – thrombosis, infection, stenosis and unsatisfactory access performance.

Quantifying the workload

We recommend estimating and predicting the number of surgical and radiological procedures as:

- 1) Number of new vascular access creations, per 100 new patients starting haemodialysis.
- 2) Number of vascular access procedures, per 100 patients on dialysis i.e. including peritoneal dialysis.

Vascular Access co-ordinator/ nurse specialist

We strongly recommend that units wishing to provide vascular access should appoint a dedicated vascular access co-ordinator [5], whose responsibility it is to ensure smooth progress through the patient pathway. In large units providing a regional service this post is essential.

In addition to the role in access planning and organisation of operating lists, many access nurses are fully trained in the insertion of central venous dialysis catheters so that they can perform the majority of such procedures. However, it is important that the medical teams do not become deskilled and that trainees continue to be trained in line placement as they may be required to insert lines for emergency dialysis outside normal working hours.

The access nurse also has a valuable role in access monitoring or surveillance, so that failing fistulae and grafts can be detected and revised before occlusion occurs. He/she can also advise on patients with needling problems so that appropriate action can be taken.

The acquisition of ultrasound imaging skills may form part of the competencies of a renal access specialist. Local agreements should clarify roles and responsibilities as well as providing appropriate training and assessment of competence.

Surgical workload

Best estimates suggest that about 135 procedures are needed per 100 new (incident) haemodialysis patients [6]. This is explained by approximately 75% initial success falling to 55% at a year. Durable access should be achievable in over 80% with two procedures, with only a minority needing three or more procedures.

At least 30 surgical vascular access procedures will be required, per 100 established (prevalent) haemodialysis patients per year.

Units planning to provide a vascular access service should aim to provide 1 operating list a week for 120 (allowing for a mix of incident and prevalent) dialysis patients served by a renal unit [7]. This should allow for both vascular and peritoneal dialysis workload. In 2010 we estimate that this will equate to approximately 1 list per 256,000 of the UK population.

This workload assumes that most patients will come forward for AV fistula surgery with 1:8 or less having AV grafts. Grafts require more surgical and radiological interventions to maintain patency and units with a high graft rate will require more surgical time.

Theatre Lists

Theatre lists should be organised to permit time for teaching and training. 3-4 de-novo cases per 4-hour operating list would represent a reasonable workload for most surgeons. At least 75% of workload should be manageable through local anaesthetic day case lists, with 25% provision for general or regional anaesthesia. In units with a small volume of work, it may be preferable to plan general anaesthetic operating on routine vascular surgical lists.

All operating sessions should be staffed to conform to guidelines and standards laid down by the Royal Colleges of Surgery and Anaesthesia. [8,9]

Surgical Emergencies

Emergencies are rare in vascular access surgery. Uncontrollable bleeding from a fistula or graft is arguably the only complication requiring immediate surgery. Graft sepsis requires early drainage within a few hours. Ideally a surgeon trained in access surgery would perform such operations but cannot always be available. However, the necessary surgical techniques should be within the expertise of any on-call vascular or general surgeon trained in vascular surgery.

Thrombosed AV fistulae or grafts rarely require immediate attention and in most cases can be treated within the next few days. Early treatment may allow resumption of dialysis without the need to place a central venous dialysis catheter. The preferred technique for thrombectomy will depend on available resources. Ideally most units will offer both surgical and interventional techniques. Early thrombolysis can be undertaken by direct puncture and infusion of thrombolytic agents on the ward but

radiological guidance is preferable as this allows fistulography and angioplasty of any underlying stenosis following successful clearance of clot. [7,10-11].

If operative thrombectomy and revision is the preferred option, it may safely be left until the next available list but in the case of distal AV fistulae it may be better to perform a new fistula just proximal to it following a duplex scan of the vessels. If revisional surgery has to be delayed beyond the next dialysis, a temporary dialysis catheter should be inserted. In a small number of patients with limited potential for further access, early revision before the next dialysis may be necessary.

Radiology Workload

With the rapid development and expansion of endovascular techniques there has been a huge increase in the demand for radiological services in patients on haemodialysis. Patients need access to both high quality vascular imaging and dedicated interventional radiology time for investigation and management. Radiology offers two distinct services viz. diagnostic imaging and image-guided intervention.

The report from the NHS Modernisation Agency published in 2005 identifies radiology as one of the “bottlenecks” in the vascular access patient pathway [5]. In some cases it may be possible to train “radiology assistants” to provide part of the imaging/intervention service but this will not lessen the pressure on the angiography suite. The further recommendation for 3 monthly trans-sonic measurements of flow and recirculation will generate further demand for radiological investigation and intervention.

Radiological Activity Data

These data are based on activity figures from two large renal units in Leeds and Glasgow from 2004-5. Accurate workload planning is difficult because not all imaging and interventional procedures need to be performed by radiologists. For example in some centres (Glasgow) over 80% of the uncomplicated central lines are placed by radiology nurses with a 98% success rate (personal communication). In other centres (Leeds) radiological involvement in line placement is limited to complex patients with difficult venous access; the figure below reflects this practice.

Imaging

Imaging can also be divided into pre-operative assessment, routine access surveillance and assessment of failing access. It is not important whether the scanning is performed in the radiology department or in the vascular laboratory as long as there is sufficient local resource and expertise.

Pre-operative imaging Venous Doppler USS: this provides detailed assessment of both veins and arteries Pre-operative conventional contrast venography MR venography
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Imaging of patients needs to be organised to minimise the number of hospital visits. Most pre-operative assessment can be performed using ultrasound in the radiology

department or vascular laboratory. Ideally patients should be scanned at the same time as their clinic visit to permit complete access planning in a single trip to hospital. Where suspicion of central vein stenosis arises (due to multiple previous central venous lines, or dilated chest wall veins), venography may be required.

(i) Imaging of the malfunctioning fistula / graft

Routine assessment of normally functioning access is seldom performed. Investigation is indicated if clearance or flow decrease, or venous pressures increase, or if there is difficulty needling a fistula. It is essential that the study is performed by someone who understands the manifestations of fistula malfunction. This will ensure an adequate test and appropriate recommendations.

Assessment of the failing fistula / graft
Doppler ultrasound
Angiographic assessment (fistulography)

Imaging technology continues to evolve and access to newer techniques (e.g. MR venography) may be currently restricted in some units. The venous anatomy can be imaged in several different ways so that unnecessary delays may be avoided by performing an alternative more expediently.

(ii) Diagnostic imaging workload

Procedure	Procedures/100 dialysis patients/year	Procedures/100,000 population served/yr
Venous ultrasound	104	12
Fistula ultrasound	46	9
Fistulogram	16	3

Radiological Intervention

A significant proportion of fistulae that fail to mature or subsequently malfunction will come to some form of radiological intervention.

Radiological Interventions
Balloon angioplasty
Stenting
Thrombectomy
Thrombolysis
Embolisation
Central line placement

These techniques complement surgical techniques such as thrombectomy, revision and patch angioplasty. The most appropriate method will often depend on local expertise and facilities and there is little good evidence to help choose between them. However it is essential to have both surgical and radiological expertise available.

Although endovascular procedures have high restenosis rates they are usually repeatable with respectable secondary patency rates. This however increases the radiological workload significantly. Other interventional procedures such as central venous stenting and fistula thrombectomy are often complex and time-consuming procedures that again may need to be repeated. Evidence from the literature suggests that dialysis grafts require considerable extra radiological input with a population of 600 patients experiencing 1281 graft thromboses in 2.5 years. [11]

Central venous line placement is one of the most frequently requested interventional procedures.

Therapeutic imaging workload

Procedure	Procedures/100 dialysis patients/year	Procedures/100,000 population served/yr
Fistuloplasty	25	5
Line insertion	36	2
Fistula thrombectomy	16	1

Radiological Resource

It is difficult to be precise about the radiological workload given different local arrangements but a suggested workload for a typical list is given below

Procedure	Average Patients/List
Ultrasound	8
Fistulogram	5
Fistuloplasty	3
Line insertion	1.5-4*

*the higher figure would be typical of uncomplicated central lines, the lower figure reflects complex and unconventional venous access procedures

Radiology Staffing

The above figures suggest the need for roughly 2 sessions/week of radiology time/100HD patients.

Organisation of work

Local practice will vary from dedicated dialysis imaging and interventional lists to a more likely ad hoc scenario where the patients are slotted into existing working sessions (which will obviously need to be expanded). Nurse or radiographer led lists are more likely to be dedicated lists.

Agreed maximum waiting times should be laid down so that these patients are investigated expeditiously. Suggested maximum wait times are

- Fistulography 2 weeks
- Venous USS 2 weeks
- Fistula thrombectomy 2 days
- Tunnelled line 1 week

Emergencies

The need for emergency radiological procedures for dialysis patients is very rare. Thrombectomy of a clotted fistula is probably the most urgent and can almost always wait until the following day.

Summary

Dialysis access imaging and management can utilise a considerable imaging and interventional radiology resource.

All radiology departments should recognise and encourage the concept of role extension and tunnelled line placement is an excellent example freeing up medical time and expertise for more complex procedures.

THE ORGANISATION AND DELIVERY OF SERVICES FOR PATIENTS NEEDING AND DEPENDING ON VASCULAR ACCESS

Our chief recommendation is that patients are assessed in a timely and systematic manner by experienced healthcare professionals with the appropriate competence. The traditional pattern of referral between medical and surgical specialists serves kidney failure patients poorly. This is due to the inevitable inefficiencies and delays involved in making referrals, clinic attendance and organisation of investigations. This is one of the main reasons for the low rate of permanent access in incident patients in the UK.

Patient Pathway

Two pilot sites (QEH, Birmingham, and Exeter) provided a report on the redesign of the workforce and patient pathway with the aim of improving the provision of elective dialysis access [5]. Key points which emerged included:

- Day case surgery should be used for the majority of patients (75% or more)
- The patient pathway should be accelerated by improving access to diagnostic tests
- Unnecessary follow up attendance should be avoided
- Bottlenecks in care provision should be identified and dealt with.

We recommend that vascular access should be organised along a clearly defined patient pathway an example of which is shown in [Figure 1]. This needs to define both the sequence and timing of events leading to successful access placement. It should also embody standards against which performance can be audited. It is the responsibility of the team involved in care to ensure that such pathways are put in place. Managers should support clinicians in constructing pathways of care and in re-configuring services to optimise care for patients. Such pathways have been shown to increase the number of patients commencing dialysis with permanent vascular access [12].

Renal Vascular Access Pathway

Multidisciplinary Approach.

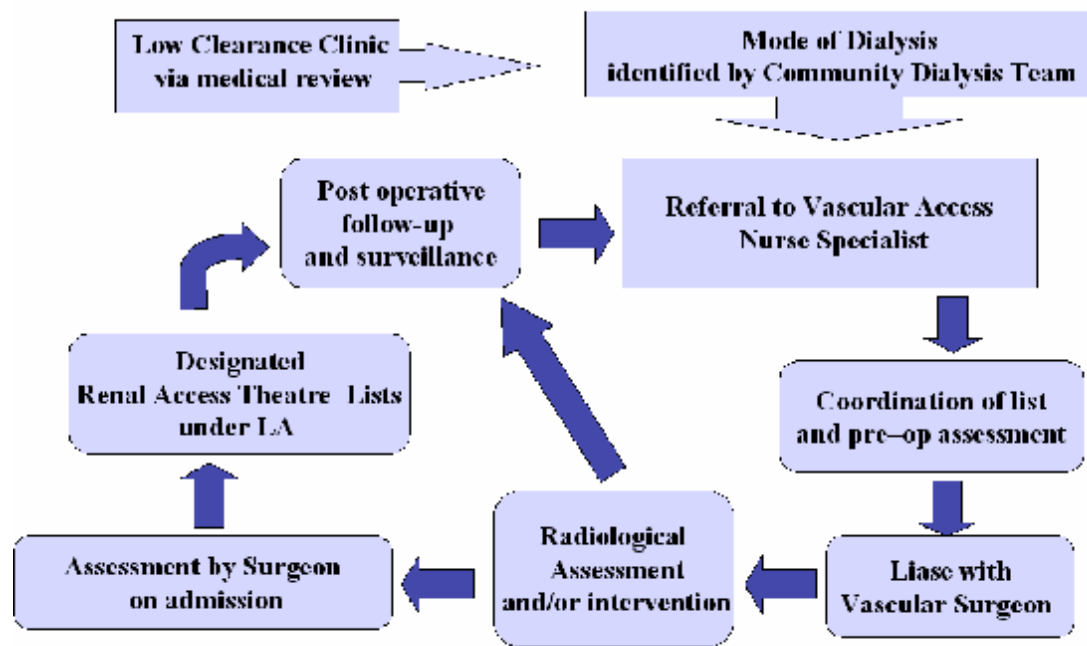


Figure 1 Renal Vascular Access Pathway

Where should services be located?

Vascular access surgery should be performed as near to the patient's home as is practically possible. Most primary access surgery is straightforward and can be performed under local anaesthesia. While the operation requires a high level of vascular surgical skill, it does not require a complex infrastructure in the majority of cases. Where the routinely available sites for fistula formation have been exhausted, careful planning and more complex surgery is required. Patients requiring tertiary access procedures will need to be treated in units able to undertake both ultrasound and complex vascular radiological imaging and intervention.

There are three options in the UK:

- i) Access surgery can be contracted to a dedicated vascular access surgery service in a major vascular surgical or transplant unit which would be staffed and resourced in proportion to the haemodialysis population served. This model provides for centralised provision but will create an extra transport burden.
- ii) Surgery can be performed in smaller renal units by local vascular surgeons according to their expertise in vascular access. This allows more local provision. Some complex cases may need to be transferred to a larger unit. Protocols for patient transfer need to be agreed between local units and the major centre providing more complex surgery.
- iii) It is possible that independent surgical treatment centres (ISTCs) will be commissioned to undertake routine vascular access procedures. This may have the advantage of freeing hospital based vascular access surgeons from routine work. They may however remove training opportunities and detract from continuity of care. Urgent and emergency surgery cannot be catered for adequately with this system. If such a system is set up, surgeons and nephrologists will want to be reassured that the standard of work is such that access sites will not be lost and there will have to be an agreement that rescue and management of complications, by the central service will be supported and funded.

Timing and Co-ordination of Referral and Surgery

Patients should be referred for permanent vascular access so that surgery can take place at least 16 weeks and preferably 6 months prior to the anticipated start of dialysis. The vascular access needs of all patients whose eGFR has fallen to <20ml/min should be decided at this point and a referral made unless haemodialysis is not intended. This will allow time for fistula maturation and secondary procedures in the event of fistula thrombosis or delayed maturation. Nephrologists will rely on eGFR measurements and 1/Cr plots to time referral. They should also attempt to predict the timing of renal transplant and peritoneal dialysis failure. We do not recommend the formation of fistulae in patients whose first choice renal replacement is peritoneal dialysis or a transplant from a living related donor before the need for dialysis is reached.

The management of waiting lists for surgery should lie with the vascular access co-ordinator whose role should include ensuring that patients do not have prolonged waits for surgery. Because typed referrals and responses to individual surgeons risk being delayed, missed or lost, all patients for vascular access should be routed, using a proforma, through the co-ordinator(s) to ensure that patients have been logged and then appropriately assessed and counselled.

Access surgery should be managed from a single waiting list, with appropriate provision for revisions and other secondary procedures. More complex surgery may be directed to practitioners with special expertise. The patient pathway must clearly state how the non-maturing, failing, infected or thrombosed fistula or graft is to be managed.

Outpatients

Clinic visits should be organised to establish the type of access to be provided in a single visit. Again, patients should be assessed by a competent practitioner. This need not be a surgeon, but where nurse specialists or access co-ordinators are working alone, they must have close working relationships with the surgical team. Occasionally the surgeon may not be able to proceed to fashion access in a patient deemed previously to be straightforward. This will be a rare event and does not justify all patients needing a fistula being seen in outpatients.

The access nurse specialist should counsel patients about the type of procedure to be undertaken during the pre-operative assessment visit. Informed consent should ideally be obtained during the visit to the surgical clinic but may be delayed to allow a period of reflection before attending for surgery. Where this is not possible information about the intended procedure should be made available to the patient in advance of surgery and consent can be obtained immediately pre-operatively

A firm date for surgery should ideally be given at the clinic visit.

There are two opinions on the requirement for mapping of the venous system by Doppler before surgery

The first is that this can be selective and is summarised as follows.

For patients with visible and suitable forearm veins (2.5 mm diameter or above) and a palpable adjacent pulse, further surgical outpatient assessment delays the procedure without adding to the quality of care. Such patients should be listed directly for surgery. In those subjects in whom such veins are not visible, the access co-ordinator should arrange ultrasound assessment and then discuss the surgical procedure required with a member of the surgical team before listing the patient. This approach is supported by a report that fewer than 50% of new patients will require vascular access clinic assessment prior to surgery. [13] There is also disagreement about routinely scanning all patients prior to vascular access surgery [14-15]. Although this may identify all suitable sites, it is both time consuming and expensive and may not be necessary in a large number of patients.

An alternative policy is to perform routine duplex scanning on all patients before surgery. This has been shown to reduce the need for placement of grafts and, in some studies, improve overall access patency rates [15-18]. If this policy is used, very few patients requiring tertiary access procedures will need outpatient pre-assessment by the surgeon because the duplex report will identify problematic cases but the duplex workload is increased. However, routine duplex services are not widely available and scanning may not add to the assessment of straightforward cases with good pulses and adjacent veins.

We do not believe this difference has been resolved and have decided not to be prescriptive. However there is an onus on those who favour the policy of routine assessment to organise it so that it does not create delays in the pathway.

If imaging is necessary it needs to be organised to minimise the number of hospital visits. Ideally patients should be scanned at the same time as their clinic visit to permit complete access planning in a single trip to hospital. This will not be possible for venography in patients in whom there is a suspicion of central vein stenosis (due to multiple previous central venous lines, or dilated chest wall veins). Most pre-operative assessment can be performed using ultrasound in the radiology department or vascular laboratory. Skilled vascular technologists can provide detailed assessment of both veins and arteries in a single study.

Early assessment of access function

As a proportion of arteriovenous fistula will either fail to mature or occlude soon after formation, the patient pathway should incorporate an early review point to ensure that the fistula is continuing to function. Most successful fistulae demonstrate a significant increase in flow within two weeks of formation [19]. Inspection plus ultrasound assessment should enable the detection of fistula with poor or no flow and allow early re-intervention. Such patients should not be placed back on the routine theatre waiting list, but offered early revision to ensure that a functioning fistula is established before the need for dialysis.

Monitoring of established vascular access

The loss of established access is a major problem for dialysis patients and causes avoidable hospital admission and morbidity. There is good evidence that the longevity of vascular access grafts can be extended by regular monitoring of graft function and early intervention in failing grafts [20-22]. The evidence for arteriovenous fistula is not so strong.

The access nurse also has a valuable role in access monitoring or surveillance, so that failing fistulae and grafts can be detected and revised before occlusion occurs. He/ she can also pinpoint patients with needling problems so that appropriate action can be taken. The acquisition of ultrasound imaging skills may form part of the competencies of a renal access specialist. Local agreements should clarify roles and responsibilities as well as providing appropriate training and assessment of competence.

We recommend that all units have protocols for monitoring established access during attendance at regular dialysis sessions. The frequency and type of monitoring should be clearly identified within the protocol. We do not wish to prescribe the type of monitoring, as there are many ways of doing this each with advantages and limitations. We feel that units should develop expertise with a particular method to best serve their patient populations. Clearly defined thresholds for further imaging and intervention should form a core part of the monitoring protocol.

Placement of central venous catheters

Central venous catheters are an essential access option required when patients present with end stage renal failure before permanent access can be created, when a fistula or graft fails or when peritoneal dialysis or a renal transplant fail without sufficient warning. The principles of placement apply to both tunnelled and non-tunnelled lines. Radiological advice should be sought early when there is doubt about central venous patency or if there is difficulty obtaining venous access.

The location for performance of the procedure

Line placement must be performed in a facility that provides the same standards of asepsis as for vascular access surgery. Maximal barrier precautions should be employed (hand hygiene, sterile drapes, gown and gloves) as discussed in the Saving Lives Campaign High Impact Intervention No2 [23]. There should be monitoring equipment available if conscious sedation is required or if the patient is physiologically unstable. Emergency equipment including: suction, oxygen and chest drains should be readily available. For the placement of tunnelled lines radiological imaging must be available to allow accurate placement.

The operator

Operators should have the relevant competencies or be undertaking training under supervision. NICE guidance should be followed for the use of US localisation of veins. Trainees should have competencies assessed and signed off, before acting as a primary operator. Interventional radiologists should place lines when the anatomy is complex or stenoses need dilatation before dialysis catheter insertion.

Support staff

A minimum of one designated and trained support person, to monitor the patient and assist with equipment should be present. If conscious sedation is being employed, one individual should be assigned to manage the sedation and monitoring of the patient, and be competent to do so.

Prevention of infection

Infection remains the most important complication of dialysis catheters, as demonstrated in the National Vascular Access survey 2005 [3]. Both exit site and bacteraemia rates are increased in patients dialysed via venous catheters.

Primary prevention requires an attempt to minimize the use of catheters, and is discussed elsewhere. Units should develop policies for the minimisation of exit site infection, based on current evidence. There should be clear policies for the treatment of both exit site and bacteraemias related to catheters. There is persuasive evidence that the 'locking' of lines with antibiotics or with bactericidal agents reduces catheter related infection. [24-25] Their use is strongly recommended.

Record keeping

All access procedures including placement of dialysis catheters must be documented in the patient record using the standard operation sheet for the hospital. The procedure performed, the name of the operator, the site used, the method employed, sedation and anaesthetic required and post-procedure instructions must be clearly described. Ideally a running log of the access procedure that a patient has undergone should be entered into the computer or electronic patient record.

Standards and Audit

Standard 3 of the National Service Framework for Renal Services Part 1 states:

“All children, young people and adults with established renal failure are to have timely and appropriate surgery for permanent vascular or peritoneal dialysis access, which is monitored and maintained to achieve its maximum longevity””.

We recommend the Dialysis Module of the Renal Association Clinical Practice Guidelines Section G “Vascular Access” available on <http://www.renal.org>

We recommend that Renal Networks (commissioners and providers) should audit

- A: Incident patients
- B: Prevalent patients
- C: Morbidity
- D: Surgical audit

A: Incident patient audit markers

There should be a summary statement to include:

- 1) Number and % of patients starting elective haemodialysis with functioning vascular access.
- 2) Number and % of patients on haemodialysis with natural access at 6-months after starting the treatment. (Primary and secondary patency rates)
- 3) Number and % of patients on the transplant waiting list at start of RRT and at 6 months after starting

This information should be obtained from individual data sheets on all new patients starting RRT to include:

- 1) Date of 1st contact with provider (outpatient, inpatient or other)
- 2) Date renal replacement therapy started
- 3) Type of RRT and type of haemodialysis access employed for the 1st RRT (table 3)
- 4) Date of referral for vascular access (or not referred)
- 5) Transplantation status at first RRT (table 4)
- 6) Basic diagnostic and demographic data (ID, DoB, ethnicity, primary renal disease)

Table 3 Access classification for audit

Type of access	Comments
PD	Peritoneal dialysis
AVF (simple)	Wrist or brachial AV fistula
AVF (complex)	Other AVF including transpositions
AVG	AV grafts
Tunnelled line	Cuffed tunnelled access
Non-tunnelled line	
Transplant	
Other	

Table 4 Transplant status

Listed and active
Referred or in work up
Assessed as unsuitable
Not referred
Pre-emptive LD

B: Prevalent patient audit markers

A quarterly return of access of all prevalent patients on dialysis (haemo and peritoneal) should be returned. The classification in Table 3 should be used.

C: Morbidity data

- 1) An annual return of all episodes of in bacteraemia chronic dialysis patients, resulting from Staphylococcus aureus sub-defining the number due to Methicillin Resistant Staphylococcus aureus (MRSA) should be collected.
- 2) Consideration should be given to collecting data on in-patient bed usage by chronic haemodialysis patients. In particular we suggest the number of admissions for vascular access procedures, acute complications or chronic problems, per 100 prevalent dialysis patients.

To facilitate such data collection, the Renal Registry should be supported to develop the IT infrastructure.

D: Surgical audit

The results and complications of surgery should be reported and audited in the standard fashion. This will include the success of surgery as evidenced by access patency and usability, and complications including early thrombosis, haemorrhage and infection.

References

1. The National Services Framework for Renal Services; part one dialysis and transplantation. Dept of Health Jan 2004.
<http://www.dh.gov.uk/assetRoot/04/07/05/25/04070525.pdf>
2. New Adult Patients Starting Renal Replacement Therapy in the UK in 2004 Chapter 3. UK Renal Registry Report 2005. UK Renal Registry Bristol UK.
http://www.renalreg.com/Report%202004/Cover_Frame.htm
3. The National Dialysis Access Survey –preliminary results. Chapter 6. UK Renal Registry Report 2005. UK Renal Registry Bristol UK 2005.
http://www.renalreg.com/Report%202004/Cover_Frame.htm
4. UK Renal Registry Report 2004. UK Renal Registry Bristol UK 2004.
http://www.renalreg.com/Report%202004/Cover_Frame.htm
5. Modernising services for renal patients. Re-designing the workforce and re-engineering elective dialysis access surgery. Dept of Health July 2005.
<http://www.wise.nhs.uk/sites/clinicalimprovcollab/renal/Document%20Library6/1/ModernisingServices.pdf>
6. Rooijens PP, Tordoir JH, Stijnen T et al. Radiocephalic wrist arteriovenous fistula for haemodialysis: meta-analysis indicates a high primary failure rate. *Eur J Endovasc Surg* 2004; 28:583-589
7. Green LD, Lee DS, Kucey DS. A meta analysis comparing surgical thrombectomy, mechanical thrombectomy, and pharmacomechanical thrombolysis for thrombosed dialysis grafts. *J Vasc Surg* 2002; 36 (5): 939-45
8. Raising the standard – section 10 – day care services. Royal College of Anaesthetists 2000. <http://www.rcoa.ac.uk/docs/section10.pdf>
9. Raising the standard – section 10 – day care services. Royal College of Anaesthetists 2000. <http://www.rcoa.ac.uk/docs/section10.pdf>
10. Beathard GA. Thrombolysis versus surgery for the treatment of thrombosed dialysis access grafts. *J Am Soc Nephrol* 1995; 6 (6): 1619-24
11. Beathard GA, Welch BR and Maidment HJ. Mechanical thrombolysis for the treatment of thrombosed hemodialysis access grafts. *Radiology* 1996;200:711-6
12. Owen JE, Walker RJ, Edgell L et al. Implementation of a pre-dialysis clinical pathway for patients with chronic kidney disease *Int J Qual Health Care*, 2006 (pub: 05 Jan 2006): 18 (2); 145-51
13. Wells AC, Fernando B, Butler A et al. Selective use of ultrasonographic vascular mapping in the assessment of patients before haemodialysis access surgery. *Br J Surg* 2005: 92 (11); 1439-43.

14. Jennings WC. Creating arteriovenous fistulas in 132 consecutive patients: exploiting the proximal radial artery arteriovenous fistula: reliable, safe, and simple forearm and upper arm hemodialysis access. *Arch Surg* 2006; 141 (1); 27-32
15. Brimble KS et al. The clinical utility of Doppler ultrasound prior to arteriovenous fistula creation. *Semin Dial* 2001;14:314-317
16. Dalman RL, Harris EJ Jr, Victor BJ, Coogan SM Transition to all-autogenous hemodialysis access: the role of preoperative vein mapping. *Ann Vasc Surg* 2002; 16:624-630
17. Vassalotti JA, Falk A, Cohl ED, Uribarri J, Teodorescu V. Obese and non-obese hemodialysis patients have a similar prevalence of functioning arteriovenous fistula using pre-operative vein mapping. *Clin Nephrol* 2002;58:211-214
18. Brown PWG. Preoperative radiological assessment for vascular access. *Eur J Vasc Endovasc Surg* 2006; 31(1); 64-9
19. Wong V, Ward R Taylor J et al. Factors associated with early failure of arteriovenous fistulae for haemodialysis access. *Eur J Vasc Endovasc Surg* 1996; 12 (2): 207-13
20. Tessitore N, Mansueto G, Bedogna V et al. A prospective controlled trial on effect of percutaneous transluminal angioplasty on functioning arteriovenous fistulae survival. *J Am Soc Nephrol*. 2003;14:1623-7
21. McCarley P, Wingard RL, Shyr Y, Pettus W, Hakim RM, Ikizler TA. Vascular access blood flow monitoring reduces access morbidity and costs. *Kidney Int*. 2001 Sep;60(3):1164-72
22. Lok CE, Bhola C, Croxford R et al. Reducing vascular access morbidity: a comparative trial of two vascular access monitoring strategies. *Nephrol Dial Transplant* 2003; 18 (6); 1174-80
23. Saving Lives Campaign High Impact Intervention No2 (www.dh.gov.uk/assetRoot/04/11/34/73/04113473.pdf)
24. Lambie SH, Hulme LJ, Taal M, et al. Prospective study of gentamicin locking of tunnelled dialysis catheters: the effect on infection rates and CRP. *Kidney Int*. 2004; 66(2): 801-5
25. Weijmer MC et al. Randomised, clinical trial comparison of trisodium citrate 30% and heparin as catheter-locking solution in hemodialysis patients *J Am Soc Nephrol* 2005;16:2769-2777