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Abstracts

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L1

Insight into Vascular Access Surgery: 35 Years of Experience

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Purpose: Evaluate the use of different techniques gauging their success, failures, and complications that occur with the evolution and changes in vascular access surgery over the past thirty-five years. Complications and treatment of bleeding, thrombosis, infection, and prolonged patency will be discussed.

Methods: We reviewed our experience of 10,000 procedures looking at the causes and treatments of complications ranging from Scribner shunts, central double-lumen catheters, autologous arteriovenous fistulas (AVF), bovine grafts, umbilical vein grafts, polytetrafluoroethylene (PTFE) grafts, as well as grafts made with polyetherurethaneurea. We further looked at the rate of maturation of autologous fistulas.

Results: AVF proved to be superior as an access despite 30% failure to mature. Central double-lumen catheters have a high incidence of infection and stenosis of central veins. Although PTFE grafts have an average patency of two and a half years (2.5 years), anecdotally we have some PTFE grafts lasting 6, 7, and 8 years without intervention. Furthermore, in the future there will be a large use of stents and there are some companies experimenting with glue for anastomosis.

Conclusion: Vascular access procedures are becoming the most common surgery performed in the United States. Vascular access should be a multidisciplinary effort. Vascular access surgery encompasses many difficult problems and should only be done by those dedicated to its success. A greater effort should be made to create more arteriovenous fistulas than prosthetic grafts to comply with the National Kidney Foundation Dialysis Outcome Quality Initiative (KDOQI) guidelines.

L2

Vascular Access for Hemodialysis: When, How and Where?

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Purpose: Long-term survival and quality of life of patients on dialysis is dependent on the adequacy of dialysis via an appropriately placed vascular access. For hemodialysis access, autogenous

arteriovenous fistula (AVF), prosthetic arteriovenous graft or tunneled central venous catheters may be used. Aim of this talk is to point out the importance of early AVF creation, at the adequate location chosen on the base of clinical and non-invasive evaluation of vessels, and the necessity of strict monitoring of AVF function and timely correction of problems.

Methods: Late referral to a nephrologist substantially increases the likelihood of catheter use for the initiation of hemodialysis therapy. Late referral is also associated with prolonged catheter use. Placement and adequate maturation of an AVF before the initiation of hemodialysis therapy requires timely patient advice and education, selection of the preferred renal replacement modality, selection of an access type and location, and creation of the access at least several weeks to months in advance of its expected need. Late referral to a nephrologist is not the only factor contributing to a high rate of catheter use and a low rate of AVF use. Efforts to improve the vascular access experience of patients in the initial stages of hemodialysis therapy need to focus on all persons involved pre-dialysis care, including patients, referring physicians, surgeons, and nephrologists. Early constructed AVF could also have beneficial effect on rapidity of worsening of kidney failure.

The immediate success and flow rate of a newly constructed AVF is dependent on several hemodynamic factors affecting its inflow and outflow. In order to select the most appropriate approach, preoperative assessment of the veins and the arteries is important. In addition to clinical assessment, non-invasive investigations can guide the surgeon to select the most appropriate site and technique for the creation of an AVF. The consequent use of duplex imaging has been suggested to evaluate all patients prior to surgery.

Results: The most frequent complications of hemodialysis vascular accesses are the development of stenosis and thrombosis. Occurrence and severity of access problems can be modified by ongoing monitoring and prompt intervention to pro-actively correct evolving problems. In recent years, increasing attention is being paid to screening techniques designed to detect vascular access stenosis prior to thrombosis. Aggressive screening coupled with percutaneous interventional techniques, such as PTA, to treat the underlying stenosis may reduce the incidence of graft thrombosis. Stenosis detected prior to access thrombosis is more responsive to therapy than stenosis detected post thrombosis.

Conclusion: A multi-disciplinary approach is presented including early vascular access planning and preoperative assessment as well as specialist service to increase the number of patients with AVF at start of hemodialysis treatment. The increased use of vascular imaging for surveillance is recommended in order to improve patency rates for both autogenous AVF and synthetic grafts.

L5

Microscopic Findings of Insufficient Arterio-Venous Fistulae in Hemodialysis Patients

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Purpose: The purpose of the study was a retrospective analysis of insufficient arterio-venous fistulae in hemodialysis patients. It is well known, that the occurrence of fistula aneurysms, thrombosis and stenosis complicate the outcome of these patients. An accurate light-microscopic examination of insufficient fistulae is necessary to understand the etiopathogenesis of these complications.

Methods: 11 patients (8 men and 3 woman) with a mean age of 58.4 years (range 50 to 81 years) underwent a surgical therapy for insufficient arterio-venous fistulae. Clinically, 8 patients had aneurysmatic fistulae associated with thrombosis. 2 patients showed a stenotic vascular access and 1 patient presented with thrombosis. Operative specimen of insufficient arterio-venous fistulae were analyzed with the light-microscope using standard histological and immunohistochemical techniques.

Results: The following microscopic findings of the arterio-venous fistulae were documented: arterIALIZATION, atrophy, calcifications, ossifications, healed perforations caused by needle puncturing, foreign body reaction, intimal and adventitial fibrosis, early atherosclerotic lesions and abnormalities of the vasa vasorum.

Conclusion: Histopathologic analysis of insufficient arterio-venous fistulae helps to clarify the underlying changes in the structure of the vessel wall.

L6

ESRD 2005 – A Worldwide Overview – Facts, Figures and Trends

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End-stage renal disease (ESRD) is a steadily growing disease around the world. For the patients, renal replacement therapy (RRT) with either HD, PD, or kidney transplantation is the only possibility to survive. While in 1996 approximately 1,000,000 patients received RRT and about 200,000 new patients started with RRT (Schena, 2000), in the end of 2001 1,500,000 patients have been estimated to be on RRT world-wide (Moeller, 2002).

International Comparisons: International comparisons allow to display epidemiological data and the world-wide status of RRT, its incidence and prevalence in different countries at a certain date or time period. This allows for better interpretation and understanding of national data, but also for an estimation of the worldwide burden of the disease.

Unfortunately international comparisons do also have their drawbacks in validity, as registration of ESRD and its modality of RRT is not mandatory in most of the countries. It has to be noted that there is a bias in the registration of the ESRD due to various factors. Especially those patients who are not treated are not taken into

account, so the published figures do not represent the real occurrence of the disease. We also only see how ESRD and RRT have been in the past. Depending on the registries only data for the years from 1999 through 2003 are available in the first quarter of 2005.

Excellent response rates have been obtained from the US (USRDS) with its mandatory system, but also from Japan (JSDT) or Malaysia, with more 99% coverage. Canada (CORR), Australia and New Zealand (ANZDATA) and Germany (Quasi-Niere) do have excellent voluntary reporting systems with response rates exceeding 90%. Good response rates have been obtained from some countries in the Middle East, Asian Pacific and Latin America (SLANH) and from the European Renal Association organisation registry (ERA-EDTA), but some European countries still do not contribute to this registry. Unfortunately no good data are available from other large populations like from China, India, Russia, Indonesia, Bangladesh and from developing countries from the African continent. Thus only rough estimations can be made, but it has to be mentioned that reporting of ESRD data has improved and more data are available now.

Underlying Disease: There are large differences in the underlying diseases reported. While diabetes was the most common cause of ESRD in the US in 1996, glomerulonephritis was the main cause in other regions. This might be caused by differences in life-style and nutrition. When looking at recent data, an increasing number of incident diabetic ESRD patients are noted around the world especially in Asia. (Frei, 2004, USRDS 2004, ANZDATA 2003, CORR 2002).

Incidence: A mean annual increase of ESRD between 3% and 13% has been reported from various countries. The highest incidence rates have been reported from the US with 336 per-million population (pmp), from Taiwan with 365 pmp, from Qatar (272 pmp) and from Japan (265 pmp) (USRDS 2004). The highest incidence rates in Western Europe have been reported from Germany (186 pmp), Czech Republic (163 pmp), Belgium (160 pmp), Spain (132 pmp) and Greece (165 pmp) (Frei, 2004).

Prevalence: ESRD prevalence rates show the burden of the disease in the respective countries. Table 1 shows an estimate of ESRD patients around the world in 2001 by regions with largest prevalence rates in Japan, North America and the European Union. These data were collected by Moeller et al. (NDT 2002) from a survey over 120 countries.

Actual data show a worldwide increase of ESRD. Highest point prevalence rates are reported from Japan with more than 1.862 pmp (JSDT 2003), from Taiwan (1.548 pmp) and from the US (1.446 pmp, USRDS 2004). Some developing countries like Brunei (1.067, USRDS 2004) and Puerto Rico (989 pmp; SLANH 2002) do also report high prevalence rates. The highest prevalence rates in Europe are found in Germany and Spain (950 pmp), followed by Belgium (891 pmp), Italy (864 pmp) and Greece (841 pmp). Most patients in Europe are treated in the 5 countries Germany, Italy, Spain, France and UK (255,000 pat.). Other very large ESRD populations exist in North America (460,000 pat.) and Japan (237,000 pat., dialysis only).

RR Treatment Modalities: Worldwide 69% of the ESRD patients are treated with HD, while 23% have received a kidney transplant, and only 8% of the patients undergo PD (Moeller, 2002). There are large differences in the distribution of treatment modalities between the countries. While in Japan, Israel and other mainly developing countries in the Middle and Far East there are very low transplantation rates, we can find a very high prevalence in Northern European (DEN, SWE, NOR, ICE) with 55 to 75% and Commonwealth countries (UK, NZ, AUS, CAN), but also in the Netherlands

Table 1. Global and regional overview of ESRD patients at year-end 2001 (reproduced from Moeller, NDT 2002). (GDP = Gross Domestic Product)

Region	Population (10 ⁶)	GDP per capita (US\$)	ESRD		Dialysis (HD & PD)	
			Patients (10 ³)	Prevalence pmp)	Patients (10 ³)	Prevalence (pmp)
European Union	380	21,700	298	790	196	520
Total Europe	804	12,000	393	490	269	330
Middle East	271	3,200	40	150	29	110
Africa	833	1,000	46	55	43	50
Latin America	512	3,800	156	310	131	260
Asia (excluding Japan)	3,316	1,100	177	55	146	45
Japan	127	37,600	232	1,830	220	1,730
North America	311	29,500	436	1,400	304	980
Global	6,190	5,400	1,479	240	1,141	185

(52%), Belgium (43%) or Spain (43%). Compared to that, the transplantation prevalence in the US and Germany is rather low with 29% and 25%, respectively. Kidney donor sources are widely variable depending on legal, ethical and religious considerations in the different countries (Barsoum, 2002).

PD does not play a major role as treatment option (far below 10%) in most of the countries except in HKG (64%), MEX (56%), GUA (47%), COL (39%) and NZ (28%), and in some other countries like UK, SIN, KOR, AUS, NL or CAN (~15%).

In most countries HD is the treatment option of choice. The two largest HD populations live in the USA (n = 281,000) and Japan (n = 238,000) (USRDS & JSDT). Next largest HD population is Germany with 'only' 55,000 patients (Frei, 2004), Brazil and Italy follow with about 45,000 pat. each (SLANH, SIN). These 5 countries account for almost 60% of the world HD population with less than 12% of the world population. Unfortunately not much data are available from other very large populations like from China or India.

The Future: At the end of 2005, around 2 million patients will be under RRT. Out of the 6 largest countries of the world (CHN, IND, USA, IDN, BRA, RUS = 50% of the world population) the US are the only reporting a significant treatment of ESRD. For the future it can be expected that and in 2010 more than 2.5 million patients undergo RRT. The Asian-Pacific area with its large population and other developing countries will contribute growing numbers of treated ESRD patients (Moeller, 2002, Woods, 2000). The WHO estimates an increase of the prevalent diabetic population between 2000 and 2030 from 171 up to 366 million patients (www.who.org). More than half of the new diabetic population is estimated to live in the South-East Asian and Western-Pacific region. In consequence ESRD will also increase dramatically in this area. With an estimated future annual growth rate of 5%, 7 million patients will be on RTT in 2030. With an annual growth rate of 8%, this number will increase to 14 million patients. In most countries the HD proportion is slightly increasing while the number of transplantations and PD is rather stable. Only in some Asian countries (e.g. China) there seems to be a growth in the use of PD.

In order to maintain HD, a permanent access has to be created and maintained. For the future also a huge increase in the workload for the creation and maintenance of the vascular access can therefore be expected.

Conclusions:

- ESRD is a steadily increasing disease around the world, with differences in the underlying diseases. Diabetic nephropathy increases all over the world. In consequence especially in Asia a dramatic increase of ESRD can be anticipated.

- Incidence and prevalence rates, but also treatment modalities (HD, PD, TX) differ around the world due to various reasons (mainly financial). It is important to set up mandatory RRT registers and other sources to get better and timelier information about the burden of the disease. To give best possible RRT to the patient a constant development of dialysis therapy and kidney donor- and transplant programs is necessary.
- It is important to hold national and international congresses on ESRD and vascular access to exchange experiences regarding the different treatment modalities and to discuss new methods of creating and maintaining vascular access. Vascular access must be included into the standard surgical, nephrological, and interventional radiology training programs to get ready for the future. There will be large workload of creating and maintaining vascular access for patients on HD in the future.

Preoperative Evaluation

A1

Contrast Enhanced-MR Angiography of Upper Extremity Arteries and Veins Prior to Vascular Access Surgery

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Purpose: To develop a contrast enhanced magnetic resonance angiography (CE-MRA) protocol for selectively imaging and diameter measurement of both the arterial and venous vasculature of the entire upper extremity in a single exam prior to arteriovenous fistulae (AVF) placement.

Methods: 21 renal failure patients scheduled for AVF placement underwent CE-MRA of the upper extremity. Gd-DTPA (Magnevist, Schering, Berlin) contrast media was administered intravenously, contra- and ipsilateral in a dorsal hand vein for arterial and venous imaging respectively. Distal superficial veins were imaged using a proximal pressure cuff (60 mmHg). Image quality was subjectively assessed (scale 0 = not visible to 4 = very good). CE-MRA diameter measurements were compared with those obtained by preoperative duplex ultrasonography (DU). Intra operative (IO) diameter measurements served as standard of reference.

Results: Upper extremity arteries and veins were depicted successfully by CE-MRA and yielded high quality images in all subjects for both arteries and veins (mean subjective image quality score 3.7 ranged 3.5–3.9). CE-MRA (4.0 ± 0.8 , $p < 0.01$) and DU (4.4 ± 1.2 , $p < 0.01$) both overestimated arterial diameters (mm) significantly compared to IO (3.4 ± 0.6). DU (3.1 ± 1.4 , $p < 0.001$) significantly underestimated the venous diameter compared to IO measurements (4.8 ± 1.5). Venous diameter measurements by CE-MRA (4.6 ± 1.3 , $p = 0.4$) did not differ significantly compared to IO measurements (4.8 ± 1.5).

Conclusion: 3D CE-MRA provides high-quality images of upper extremity arteries and veins. The cause for the discrepancy between CE-MRA and DU in comparison to IO diameter measurements needs to be further explored.

A2

Arteriovenous Fistulas for Hemodialysis: Predictors of Maturation

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Purpose: The aim of this study was to analyze predictive values of demographic, clinical and laboratory markers in regard to maturation of arteriovenous fistulas for hemodialysis. Furthermore the correlation between the primary disease that resulted terminal renal insufficiency and fistula maturation was analyzed.

Methods: There were 106 patients included in this prospective study. Patients participating were all hospitalized in Nephrology and Dialysis Department, Urology and Nephrology Clinic, Clinical Hospital Center in Kragujevac (Serbia and Montenegro), between 2003 and 2004, in order to create permanent blood access. Patients were divided in two groups, a group with non-maturing fistula (NMF) and a group with successful fistula maturation (MF).

Results: 75% of matured 25% did not. There was no statistically significant difference in sexual structure among both groups ($p > 0.05$). There is statistically significant difference in age distribution of patients among groups (57.9 ± 13.9 vs. 63.8 ± 12.1 ; $p = 0.0494$). Concerning the primary disease there were more patients with glomerular diseases among patients with maturing fistulae, and a dominant category among non-maturing fistulae was hypertensive nephropathy. There is statistically significant difference between examined groups of patients in regard to sedimentation speed (94.1 ± 29.5 vs. 69.9 ± 36.0 ; $p = 0.0051$) and the diameter of the vein used for anastomosis (1.8 ± 0.5 vs. 2.4 ± 0.7 ; $p = 0.014$). There was no significant difference in other examined clinical-biochemical parameters among groups.

Conclusion: Younger patients have higher incidence of AV fistula maturation, glomerular diseases are prevalent in patients with maturing fistulae, patients with higher venous segment diameter of AV fistula have higher rate of arteriovenous fistula maturation.

A3

Preoperative Parameters Influencing Radiocephalic Fistula Outcome

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Purpose: Sufficient arterial inflow is a major challenge in radiocephalic fistula creation. We investigated arteries preoperatively by ultrasound and analyzed patient characteristics that were

thought to influence vascular function and therefore radiocephalic fistula outcome.

Methods: 51 patients were enrolled into this prospective study. Clinical and demographic data obtained were age, gender, diabetes, coronary heart disease and atherosclerotic occlusive disease. Color Doppler-ultrasonography was performed before fistula placement to assess reactive hyperemia and diameter of the access feeding arteries and in the follow-up period to determine blood flow. Ideal fistula function after six months was defined as primary patency and access flow >400 ml/min.

Results: Preoperative parameters, worsening access outcome, included diabetes ($p = 0.025$), age > 65 years ($p = 0.041$) and resistance index > 0.75 at reactive hyperemia in the radial artery ($p = 0.035$). While female gender ($p = 0.069$) and coronary heart disease and/or atherosclerotic occlusive disease ($p = 0.069$) tended to inferior results, preoperative arterial parameters like brachial and radial artery diameter showed no association with access outcome. Baseline diameters in the access feeding arteries were equal in diabetics and even larger in those patients >65 years compared to non-diabetic and younger patients, respectively. However the increase in diameter after fistula formation in these subgroups of patients was considerably lower.

Conclusion: The study underlines that not the initial arterial diameter but the functional quality of the arterial wall and its ability to dilate influence access outcome. These results may help to identify patients who are suitable for a distal radiocephalic fistula, but other adequate diagnostic parameters for vascular function are still to be determined.

A4

Prospective Evaluation of Factors Associated with Early Failure of Arteriovenous Fistulas in Hemodialysis Patients

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Purpose: Recent guidelines have recommended performing arteriovenous (av) fistulas rather than av grafts whenever possible in hemodialysis patients. However, early failure of av fistulas may reach up to 50%. The purpose of this study is to assess factors that associated with early failure of such procedures in hemodialysis patients.

Methods: 126 patients with end stage renal disease (ESRD) in whom av fistulas were created were included in this study. Upper limb venography was done for all patients except in those who required primary access and had visible veins. Data including age, sex, body mass index (BMI), history of smoking, diabetes, hypertension, hyperlipidemia, other systemic diseases and type of av fistula were recorded. The internal diameter of the vein and artery and intraoperative blood flow using a hand-held flow probe were measured. Patients were followed up until failure of the fistula or 3 months after the procedure.

Results: Early failure was noted in 14 patients (9%). Fistula blood flow was significantly lower in the failure group than in the patent group (109 ± 35 ml/min vs. 350 ± 47 ml/min, $p < 0.01$). The incidence of failure was significantly higher in fistulas with a

flow <120 ml/min ($p < 0.01$). Internal diameters of the vessels were also marginally lower in the failure group (veins: 2 ± 0.3 mm vs. 3.1 ± 0.6 mm, $p = 0.092$; arteries: 1.7 ± 0.2 mm vs. 2.5 ± 0.6 mm, $p = 0.076$) Obese patients (BMI >30%) had a marginally higher incidence in the failure group ($p = 0.072$). The failure rate was not significantly associated with the other parameters.

Conclusion: Our data show that intraoperative blood flow is a reliable parameter that determines the early patency of av fistula.

A5

Is Intraoperative Blood Flow Measurement Predictive of Very Early Failure of Arteriovenous Fistulas?

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Purpose: To determine whether intraoperative blood flow measurement is predictive of very early failure of arteriovenous fistulas.

Methods: Between January 2004 and November 2004, 75 intraoperative mean blood flows were measured with a transit time-based ultrasound flowmeter in 60 patients. These measurements were made immediately following construction of 41 autogenous and 34 prosthetic arteriovenous fistulas (AVFs). Duplex scans were performed in all AVFs seven days after the operation with measurements of the mean blood flows. The follow-up was defined as the period of time until the first dialysis (1 month).

Results: During follow-up 4 AVFs thrombosed (5.3%): 3 autogenous fistulas and one graft. Most of these failures appeared in AVF with blood flows <100 ml/min. They resulted from surgical problems at the anastomosis or undetected venous stenoses. Duplex scans performed postoperatively showed a large (2–3 fold) increase of the flows both in AVF and AVG in comparison to the intraoperative measurements.

Conclusion: These results suggest that intraoperative flow measurement could be a useful tool for vascular surgeons to assess during the operation the quality of their vascular accesses as no other objective and non-invasive test is available.

A6

Intraoperative Doppler Flowmetry for Quality Assessment During Shunt Surgery

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Purpose: Doppler flowmetry uses a bidirectional Doppler probe with defined diameter which is intraoperatively placed around the

vessel. In addition, CO₂ angiography offers the possibility to avoid nephrotoxic contrast medium. The aim of this analysis was to find out whether Doppler flowmetry can predict insufficient morphologic results.

Methods: Between 1/1993 and 12/2003 a total of 2,428 access procedures including revisions were performed. In 12,7% (n = 308) of the cases, regular angiography was performed, whereas in 4,5% (n = 110) CO₂ angiography and in 47% (n = 1,141) Doppler flowmetry was used. In a subgroup of 109 patients, Doppler flowmetry and CO₂ angiography was directly compared to diagnose stenosis or other morphological alterations.

Results:	Group	flow ml/min	regular	stenosis
	I	>200	65	2
	II	>150	3	8
	III	<150	2	29

Conclusion: Doppler flowmetry can predict stenosis by simple flow determination and curve analysis. If the flow is less than 150ml/min, the probability of stenosis was 94% in our series. CO₂ angiography can be used to confirm and localize proximal or distal stenoses which can be then corrected during the same operative session.

Creation of Vascular Access

A7

Radiocephalic Fistulae for Diabetics – A Procedure to Be Encouraged

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Purpose: Radiocephalic fistulae have traditionally been avoided in diabetics due to perceived poor patency and function. We have offered the procedure to diabetics if the cephalic vein measures >3mm at the wrist and no significant calcification is present in the radial artery on Doppler ultrasound. We report our experience under this policy.

Methods: The results of 73 consecutive radiocephalic fistulae were analyzed retrospectively. Patients were classified as diabetic (DM) if diabetic nephropathy was present and as non-diabetic (NDM) if not. Survival rates were computed by the Kaplan-Meier method.

Results: Of the patients studied, 38 were classified as DM and 35 as NDM. Some 10.1% of the DM and 14.2% of the NDM fistulae (p = ns) failed to achieve patency. Interventions to ensure patency numbered 4 each in the DM and NDM groups respectively. There were 5 complications recorded in the DM group (2 blowouts and 3 post-needling hemorrhages) compared to 4 in the NDM group (2 blowouts and 2 hemorrhages). The mean time to fistula maturity was 102.5 ± 16.87 days in the DM group compared to 86.3 ± 11.25 days in the NDM group (p = 0.002). The cumulative 1 and 5 year survival rates for diabetic fistulae were 67.4% and 44.5% versus 49.7% and 39.2% for non-diabetic fistulae (p = ns), respectively.

Conclusion: Radiocephalic fistulae in diabetic and non-diabetic patients have comparable rates of long term survival. They do however take longer to mature in the diabetic.

A8

Optimum Vascular Access in Diabetic Population: A Lesson Learnt

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Purpose: Vascular access for chronic hemodialysis is a life line and an 'Achilles' Heel'. Prompt availability of a well functioning and stable vascular access remains a disturbing problem especially in diabetic population. We report this study to highlight the necessity of a proximal arterio-venous fistula in the diabetic fraternity.

Methods: This study consists of 86 diabetic patients between January 2003 and December 2004. We analyzed 33 cases in 2003 retrospectively and 53 cases in 2004 prospectively. Males dominated the study and most of the patients belong to the fifth and sixth decade. In the prospective group all the 53 patients were subjected to radiograph of the forearm and duplex scan in a few cases where radiograph was negative for calcification.

Results: Among the retrospectively analyzed 33 cases in 2003, 23 cases had undergone radio-cephalic fistula. Fifteen cases were available for follow-up. At six months to one year follow-up only two patients had a working fistula. All the five proximal fistulas were functional optimally. In the prospective group of 53 cases in 2004, all were subjected to proximal fistula i.e. forearm and elbow, all of whom are doing well in the ongoing follow up.

Conclusion: Vascular access in a diabetic patient remains a frustrating affair for vascular surgeons and nephrologists. Carefully planned access with a preference for proximal fistulas seems to be encouraging in this preliminary study of ours.

A9

Proximal Radial Artery Arteriovenous Fistula – A Successful Alternative to the Brachiocephalic AV Fistula

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Purpose: To assess the functional outcome of arteriovenous fistulae using the proximal radial/ulnar artery as inflow, instead of the brachial artery, with regards to long-term patency and avoidance of steal syndrome.

Methods: Between October 2002 and December 2004, 201 arteriovenous fistulae were performed under one surgeon. Proximal radial (n = 29) and ulnar (n = 2) arteries were used as arterial inflow in 31 patients. PTFE graft was used in one case, while native veins at the

elbow were used in the remainder. Only one patient was diabetic. In 18 patients, the operation was performed as a primary access procedure whilst in 13 patients the fistula was a secondary procedure.

Results: Out of 31 patients (M/F: 18/13, mean age: 54 ± 3 yr), 24 (77%) had primary fistula patency. Two (6%) patients required ligation of collateral veins to improve fistula flow. Thrombosis complicated 5 AVF (16%), of which successful thrombectomy and revision of anastomosis was done in 2 cases, while 2 were converted to brachiocephalic fistulae. In one patient, the AVF was not salvaged. At a mean follow-up of 14.8 months, 28 (90%) patients had patent AVF. None of the patients had hemorrhage, pseudoaneurysm formation or steal syndrome. Currently, 19 fistulae are being used for hemodialysis, 4 are recent and awaiting maturation, 4 are mature in predialysis patients and one patient has received a renal transplant.

Conclusion: Arteriovenous fistulae using proximal radial/ulnar artery as inflow vessels offer long-term patency without risk of steal syndrome, although revision may be necessary to enable successful hemodialysis.

A10

Antecubital Arteriovenous Anastomosis

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Purpose: Assuring of more numerous arterialized veins for cannulation and possibility of basilic vein transposition fistula.

Methods: In the last two years, we created 20 arteriovenous anastomoses between brachial artery and perforating vein at the antecubital fossa in 20 patients. In 15 cases the left upper limb was used. In 12 cases it was the first choice while in the remaining 8, it was second. The venous branch to basilic vein had been closed in 6 cases, in 5 the ulnar venous branch was thrombosed while in 10 cases the venous valve was clearly distal.

A side to end arteriovenous anastomosis between the brachial artery and superficial part of perforating vein after its deep ligation and cross-cutting was created at the antecubital fossa without any other intervention.

Results: The vascular access was cannulated earlier than three weeks in the cases where the antecubital arteriovenous anastomosis was second choice except for two cases. In one case there was conversion to side to side brachial-mesobasilic arteriovenous anastomosis due to thrombosis. In one patient skin necrosis developed and forearm edema in two. In one case the basilic vein was transposed and in another a bridge bovine mesenteric vein graft was used due to malfunction of antecubital arteriovenous anastomosis. In all the cases the accesses are used for hemodialysis for four hours, three times a week.

Conclusion: Creating an antecubital arteriovenous anastomosis by using the perforating vein preserves the superficial forearm veins for distal cannulation. Later basilic vein transposition and the implantation of a graft still are possible.

A11

Results of Arterio-Venous Fistula Formation are Comparable in Non-Caucasian and Caucasian Patients

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Purpose: End-Stage Renal Failure (ESRF) is common in Non-Caucasian populations. There is a perception that it is more difficult to establish native AV fistulae (AVF) in Non-Caucasians, partly because of the higher incidence of diabetes.

Methods: We have retrospectively examined the outcome of vascular access procedures in an ESRF population with a high percentage of Non-Caucasians. In 178 patients (63% Caucasian, 24% Indo-Asian, 13% Afro-Caribbean) 249 unselected access procedures were undertaken over 2 years.

Results: No significant difference was seen in primary surgical success (defined as patients with functioning AVF 24 hours post-operatively) between Caucasians 117/146 (80%), Indo-Asians 47/65 (73%) and Afro-Caribbeans 33/39 (84%), $p = 0.39$. Secondary success (defined as maturation such that the AVF could be successfully needled) was not significantly different between the 3 groups: Caucasians 79/146 (54%), Indo-Asians 31/64 (48%) and Afro-Caribbeans 15/39 (38%). There was a higher rate of diabetes in Indo-Asians (59%) and Afro-Caribbeans (35%) compared to Caucasians (28%), $p = 0.001$.

Similarly, when first surgical procedures only were analyzed, primary and secondary success rates were not affected by ethnicity. Primary success was achieved in 60/77 (78%) Caucasians, 26/30 (87%) Indo-Asians and 12/12 (100%) Afro-Caribbeans, $p = \text{NS}$; and secondary success in 45/77 (58%) Caucasians, 17/30 (57%) Indo-Asians and 5/12 (42%) Afro-Caribbeans, $p = \text{NS}$.

Conclusion: Non-Caucasian populations have an equal likelihood of successful outcome for native vascular access procedures as Caucasians, despite the significantly higher incidence of diabetes.

A12

Autogenous Radial-Cephalic or Prosthetic Brachial-Antecubital Forearm Loop AVF? A Randomized Multicenter Study of the Patency of Primary Vascular Access for Hemodialysis

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Objective: A well-functioning vascular access remains the life-line of end-stage renal disease patients needing chronic intermittent

hemodialysis. DOQI and European guidelines propose the construction of an autogenous radial-cephalic direct wrist access (RCAVF) as the primary and best option. However, a high percentage of RCAVF failure may be anticipated in patients with small or diseased vessels. These patients probably benefit from the creation of a prosthetic brachial-antecubital forearm loop access. Therefore a randomized study comparing primary RCAVF vs. prosthetic (PTFE) implantation in patients with poor vessels was performed.

Methods: Preoperative duplex-derived parameters and physical examination were used for patient selection. When the wrist cephalic vein diameter was <1.6 mm and the diameter of the radial artery between 1 and 2 mm, patients were randomized either for a RCAVF at the wrist or a forearm loop PTFE-AVF. The number of complications and interventions were registered and primary and secondary patency rates were calculated by the life-table method.

Results: During a 2½ yrs period, a total of 129 patients (62 men/67 females; mean age 59 yrs) were randomized for a RCAVF or prosthetic graft implant. Seventy-eight percent of the RCAVF (22% non-maturation) and 95% of prosthetic graft AVF were functional for dialysis treatment. Patients with RCAVF developed a total of 53 vs. 67 complications in the prosthetic AVFs. A successful salvage of the vascular access was accomplished in 27 RCAVF and 39 prosthetic grafts. Primary and secondary one-year patency rates were 29% vs. 57% and 49% vs. 84% for RCAVF and prosthetic AVF, respectively.

Conclusion: From these results we conclude that patients with poor forearm vessels benefit from implantation of a prosthetic graft and this may be a better option than a primary autogenous radial-cephalic direct wrist access.

A13

The Use of Interrupted Clips in the Creation of Arteriovenous Fistulas

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Purpose: This study shows using the data from two independent studies that the interrupted clip anastomosis is superior to that of a running suture anastomosis. The data will demonstrate a statistically significant improvement in maturity, patency, and dialysis availability of autologous arteriovenous fistulas (AVF). By prolonging patency, this should decrease the number of interventions and thus reduce system wide costs.

Methods: We have two studies using different types of interrupted clip anastomosis. Both studies were prospective randomized studies comparing the clip anastomosis to a running suture anastomosis. The first study was the Vascular Closure System (VCS), which contained 81 patients for AVF and 92 patients for arteriovenous grafts (AVG). The second study was for only AVF using the U-Clip Anastomotic Device (Coalescent Surgical Inc, Sunnyvale, CA), which contained 208 patients at 10 centers in the United States. All data was collected for complications, interventions, revisions, replacements, and death.

Results: The VCS clip was associated with shortened operating time, less blood loss, and improved patency over a two year observation

period. A primary patency of 54% for the clipped group and 47% for the sutured group at two years was described with a secondary patency of 90% and 72%, respectively. The U-Clip anastomosis achieved statistical significance and was associated with a reduction in early graft failure, improvement in AVF maturity and patency, increased dialysis availability, and reduced event-related morbidity per patient year.

Conclusion: The interrupted clip anastomotic technique should be considered the standard of care when creating autologous fistulas.

A14

Comparison of Maturity, Patency in AVF. A Controlled, Prospective Trial Comparing Interrupted to Running Anastomosis

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Purpose: Prospective randomized, controlled, multicenter study to examine the effect of anastomotic technique on the outcomes of forearm AVF in terms of maturity, patency by comparing an interrupted clip anastomosis to a continuous suture.

Methods: 220 AVF were randomized to either continuous polypropylene suture or interrupted clips (U-Clips). Maturity, patency and event data from 10 sites were analyzed. Statistical comparisons using log rank tests for time-to-event data, t-tests to compare means of quantitative data and chi-square tests for unordered data.

Results: There were no differences in gender, race, diabetic status, age, weight, vein diameter and anastomotic time between the two groups. The clipped group demonstrated improved access maturity (71% vs. 57%, $p = 0.035$) and improved access primary ($p = 0.045$) and secondary ($p = 0.03$) patency. Six month patency equaled for the clipped group 64% vs. 53% for the continuous group. The interrupted group had reduced requirements for revision.

Conclusion: We have demonstrated that an interrupted technique facilitated by the use of clip anastomosis achieved improved AVF maturity and patency with reduced requirements for revision. This technique should be considered the standard of care when creating autogenous fistulas.

A15

Two-Stage Basilic/Brachial Vein Transposition Technique for Autogenous Vascular Access

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Purpose: Maintaining long-term patency of vascular access is absolutely important for the hemodialysis patient. Autogenous vein access is superior to a prosthetic graft, but it can be hard to construct in patients who have had repeated access operations, in diabetic

patients, and long-term hospitalized patients. Often the only preserved vein in these patients is the basilic or the brachial vein of the upper arm, which is accessible only after subcutaneous transposition. A diameter of the vein under 4 mm has been associated with poor outcome.

Methods: Since October 2002 we have performed two-staged basilic/brachial transposition (BT) technique in 72 patients. Pre-operative ultrasonographic evaluation of major veins from the axilla to the superior vena cava was done. Three to five weeks before transposition a brachio-basilic or brachio-brachial arteriovenous fistula was created just below the elbow. After maturation of the basilic/brachial vein, the second part of the operation was performed. Under general or regional anesthesia the basilic/brachial vein was exposed through a medial long arm incision. After mobilization with branch ligation the vein was transposed subcutaneously to the volar aspect of the arm and anastomosed to the side of brachial artery.

Results: All patients were well accessible during a mean follow-up period of 13 months except two patients who were unable to maintain access in spite of patent fistula because of arm swelling resulting from subclavian vein stenosis not detected before access creation. There was no major surgical complication but three cases showed delayed wound healing.

Conclusion: We can conclude that two-staged BT is a safe method to get adequate autogenous vascular access for the poorly vascularized patient and compares favorably with the patency rates of synthetic grafts.

A16

Two Stage Brachio-Basilic Arterio-Venous Fistula

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Purpose: Our experience with the two stage brachio-basilic (BB) arterio-venous fistula (AVF) was reviewed to assess the outcome of this hemodialysis (HD) access device.

Methods: Between 8/99 and 10/04, 90 BB AVF were formed in 87 patients, 55% of whom were already on HD. 3 AVF failed due to early thrombosis. Second stage operations transposed the arterialized basilic vein anteromedially from beneath the deep fascia to beneath the skin. 88 AVF were superficialized at a median (range) of 73 (32–1827) days after formation.

Results: Primary and secondary patency was 87% and 89% at 1 year and 78% and 84% at 2 years respectively. Early complications (8%) included wound infections and hematomas. Late complications included thrombosis (15%) and stenosis (13%).

Conclusion: The two stage BB AVF has good patency and is valuable as both a primary and secondary access device in HD patients, and allows use of native veins for HD access rather than the generally more complicated and expensive synthetic grafts.

A17

Excellent Performance of One-Staged Brachial-Basilic Arteriovenous Fistula Creation for Hemodialysis Vascular Access

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Purpose: According to the National Kidney Foundation – Dialysis Outcomes Quality Initiative (NKF-DOQI) and the European Guidelines first and second choice vascular access are the radial-cephalic and brachial-cephalic arteriovenous fistula (AVF). Auto-genous fistulas have a longer functional lifetime, less thrombotic complications and a lower infection risk compared to prosthetic implants. When there is an impossibility to create or after failure of a brachial-cephalic AVF, there is no consensus about creating either a brachial-basilic AVF or a prosthetic forearm loop graft. To determine the performance of brachial-basilic (BB) AVF we retrospectively surveyed the results of this type of vascular access.

Methods: All BB-AVF data issue records of a six year period were subtracted from a computer. Primary failure and Primary, Assisted Primary and Secondary Patency rates were calculated with the Kaplan Meier method. Sex, diabetes mellitus (DM), preoperative vessel diameters, complications and interventions were recorded and correlated with the patency rates.

Results: A total of 31 brachial-basilic arteriovenous fistulas were created in an one-stage surgical procedure. Of the patients 36% were male and 19% had DM. Thirty (97%) of the BB-AVF could be used for dialysis. Only 1 patient had a primary AVF failure. Four patients died within one year after the operation, one of them from a catheter sepsis. Primary, Assisted Primary and Secondary Patency rates after one year were, 58%, 83%, and 90%, respectively. Patients' characteristics and preoperative duplex parameters did not influence patency rates.

Conclusion: From these results we conclude that the brachial-basilic AVF is an excellent third choice option for vascular access.

A18

Transposed Basilic Vein as the Ultimate Autogenous Arm Access Before Graft Implantation

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Purpose: Assessment of transposed basilic vein (TBV) as the ultimate autogenous hemodialysis arm access before prosthesis implantation.

Methods: Retrospective review and outcome comparison of 117 arteriovenous fistulas (AVF) created for hemodialysis in the arm region: 49 TBV (one stage procedure), 46 transposed cephalic veins (TCV) and 22 brachial prosthetic grafts (BPG). To estimate patency life table method and Kaplan-Meier survival curves with log-rank test of significance were used according to SVS/AAVS reporting standards.

Results: Demographic data and comorbidity were not statistically different in patients receiving TBV, TCV and BPG. Twenty TBV (41%) were used as ultimate autogenous arm access before graft implantation. Failure rate of basilic veins used for AVF construction was significantly ($p < 0.05$) lower than that of cephalic veins: 8% and 22%, respectively. No statistical differences were observed between TBV and TCV maturation rates. Complication rates for TBV = 18%, TCV = 24%, BPG = 32% ($p > 0.05$). TBV required 15 secondary procedures, TCV 21, BPG 16 ($p > 0.05$). Acute access thrombosis as indication for secondary procedure was significantly more frequent in the group of BPG than in TCV and TBV, whereas incidence of stenosis was significantly higher in TBV than in BPG. One-year and 2-year primary, assisted primary and secondary patency was not statistically different between TBV, TCV and BPG.

Conclusion: The use of TBV as ultimate autogenous AVF improves utilization of arm access sites before graft implantation with acceptable clinical outcome. This policy permits to avoid disadvantages typical for prosthetic access.

A19

New Endoscopic Technique for an Arteriovenous Fistula in the Arm

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Purpose: The conventional transposed brachio-basilic fistula requires a long incision in the upper arm. We present a new endoscopic technique for basilic vein harvesting and creation of an arteriovenous fistula.

Methods: By a small incision in the antecubital fossa, the basilic vein is exposed and dissected under endoscopic vision up to the axilla. Then, the vein is pulled out through a small incision in the axilla and checked for leakage or injury. Next, the vein is tunneled separately and anastomosed to the brachial artery.

Results: In the two video-documented cases, no complications occurred in the early postoperative course.

Conclusion: General feasibility of our new endoscopic technique for basilic vein harvesting was proven. A study including all patients with indication for a basilic fistula is currently taking place.

A20

Results and Complications of Transposed Superficial Femoral Veins

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Purpose: In the last seven years I have studied and dedicated myself to the performance of vascular access. Among 8000 interventions I have performed during these 7 years, 38 were transposed superficial femoral veins. I report here technique, results and complications.

Methods: This report includes 36 patients who had 38 AV fistula constructions using the superficial femoral vein from December 2000 to October 2004. Obstruction of central veins, superior and inferior vena cava, were the main indication.

Results: Primary patency was 85% and 72% at 1 and 2 years, respectively. Complications were leg edema (5 patients), acute venous thrombosis (1), acute infection (1), late infection (2), puncture site aneurysm (1), amputation (1), steal syndrome (1), and death (3).

Conclusion: The construction of AV fistulas using the transposed superficial femoral vein is associated with a high rate of complications. Phlebography should routinely be performed in pre-operative evaluation.

A21

The Autogenous AV Fistula for Hemodialysis Access: Patency Rates and Limiting Factors

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Purpose: Without doubt the hemodialysis access of first choice is the autogenous av fistula, mostly carried out as Brescia-Cimino fistula. Primary patency rates and limiting factors shall be presented.

Methods: In nine years 242 direct av-fistulae were created in 207 end-stage renal disease patients.

Results: Mean cumulative primary patency was 1,058 days (almost three years). Mean cumulative secondary patency was 1,457 days (almost four years). Immediate failure occurred in 15%, early failure in 11% and late failure in 13%. The most frequent complications were thromboses and stenoses.

Risk factors for early failures were hypotension and peripheral arterial occlusive disease, especially when combined with diabetes mellitus or with preceding peripheral arterial reconstruction. The most important factor for long-term patency turned out to be the vessel calibers (the greater the better) and the time interval between access creation and first puncture (best results after four weeks or more).

Conclusion: Knowledge and consideration of the factors influencing patency rates helps to improve the results of hemodialysis access surgery. These factors are similar to those reported for arteriovenous PTFE interpositions.

A22

Taper Grafts – Good Patency with Low Steal Rate

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Purpose: Theoretical benefits of taper grafts include prevention of steal and reduction of neointimal hyperplasia at the venous anastomosis. However the smaller graft diameter may increase risks

of thrombosis and subsequent graft failure. We have audited our results in using these grafts to ensure they provide equivalent patency.

Methods: Teaching hospital serving a population of 507,000 with approximately 170 patients on hemodialysis (central line rate 6%; 83.5% native fistulae; 9.5% grafts).

Patients who received a PTFE taper graft from July 2002 to December 2004 were identified from a prospectively collected computerized database. Primary outcome measures were primary and secondary patency.

Results: 20 patients (4 male) were identified with a total of 21 grafts, median age 64 (26–91). Six upper arm grafts were inserted as a primary reconstruction and 6 upper arm and 9 thigh loops as secondary reconstructions. Median follow up was 5.3 months. Primary patency was 85% (SE 8%) at 30 days, 44% (SE 14%) at 6 months and 29% (SE 15.3%) at 1 year. Secondary patency was 90% (SE 7%) at 30 days, 73% (SE 12%) at 6 months and 62% (SE 15%) at 1 year. Three (14.3%) of the grafts were not used due to steal ($n = 1$), immaturity ($n = 1$) and early thrombosis ($n = 1$).

Conclusion: Synthetic fistulas are used as a fistula of last resort in our institution. Taper grafts give acceptable patency figures in these circumstances with a low complication rate.

A23

Advances in Implantation and Revision of Vascular Access Grafts

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Purpose: Expanded polytetrafluoroethylene (ePTFE) grafts have an external ring system to minimize kinking. However, the rings may interfere with cutting and suturing of the graft. To explore a possible improvement in handling of dialysis grafts, we began to use an ePTFE stretch graft that has radially supported segments inside the graft wall. The Intering graft can be cut through at desired angles and sutured with minimal resistance. We retrospectively reviewed our experience of this graft in 81 patients and prospectively followed 21 patients ($n = 102$).

Methods: From June 2002, a 4–6 mm tapered Intering graft was implanted in patients with end-stage renal disease. Implantation sites were the arm ($n = 71$), the upper arm ($n = 9$), and the thigh ($n = 14$); the remaining 8 received a jump graft for revision of a previously implanted graft. All patients were followed by the same surgeon (LCT).

Results: Primary patency rates were calculated using survival analysis and were 76% (95% CI, 66%–86%) at 6 months and 73% (95% CI, 63%–84%) at 1 year. The primary patency rates achieved with the Intering graft were similar to those in previously reported series of patients given a standard stretch graft for vascular access (71%–78%).

Conclusion: Our experience suggests that the Intering graft offers easier surgical manipulation without a decrease in patency. Additional studies are needed to determine whether the graft has superior long-term patency, perhaps related to its radial support system, which may decrease the risk of thrombosis resulting from graft compression after cannulation needle removal.

A24

Clinical Outcomes of a Depopulated Bovine Ureter (SynerGraft Vascular Graft Model 100) Used as an Arteriovenous Access

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Purpose: Synthetic grafts and cross-linked xenografts are used for arteriovenous access but have significant limitations. The SynerGraft Vascular Graft (SGVG Model 100) is bovine ureter that has been depopulated using tissue-engineering technology and non cross-linked. The objective of this study was to assess the patency and durability for this graft in patients where conventional access was not possible.

Methods: Between April 2002 and November 2004, 23 SGVG were implanted in 21 patients. The mean age was 59 ± 15 years. Mean time on dialysis prior to implant was 4.2 ± 1.6 years.

Results: Mean follow-up was 396 days. There were no thromboses or infections within the first 30 days. Only two patients did not convert to dialysis via the graft. 12 SGVG have suffered a total of 19 occlusions. The mean time to occlusion was 215 ± 141 days. Surgery to re-establish patency was successful in 14 of 18 attempts to save the access. 11 SGVG underwent 26 interventional procedures (angioplasty) to treat luminal stenosis. Two grafts in the series showed early signs of dilation, but both continue to be dialysed at last reported follow-up with no further changes in graft size. Primary patency, secondary patency, and freedom from infection were 32%, 79% and 94% at 1 year. Histology confirmed recipient cellular infiltration and endothelialisation.

Conclusion: This is the first detailed study reported and shows that the SGVG is a stable conduit and provides a suitable alternative when autologous vein is not available. More follow-up data are needed to determine the long-term durability of the graft.

A25

ProCol™ Vascular Bioprosthesis for Complex Vascular Access: Analysis of Midterm Results

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Purpose: The aim of this study was to evaluate the safety and efficacy of the ProCol™ vascular bioprosthesis as vascular access material.

Methods: From January 2002 to January 2005, 22 arteriovenous bovine vein grafts (ProCol™) were placed in 22 hemodialysis patients as vascular access. In 15 cases we performed bridge grafts between brachial artery and axillary vein with straight configuration, in 7 cases between axillary artery and vein with loop configuration.

Results: Graft placement was successful in all patients, with no procedure-related complications.

All patients could be followed-up from 6–24 months. Life table-analysis showed primary patency rates of 95.2%, 80.9% and 71.4%,

at 6, 12 and 24 months. In one case we removed the graft due to infection 5 months after placement.

Conclusion: The midterm results of the ProCol™ prosthesis show good patency and low complication rates and demonstrate that the ProCol™ vascular bioprosthesis is a promising material for vascular access surgery. Safety and long-term results need to be further investigated in controlled randomized trials.

A26

Performance of a Polyurethane Vascular Access Graft Compared to Tunneled Central Venous Dialysis Catheters and Tertiary Vascular Access

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Purpose: To evaluate the performance of polyurethane grafts in comparison with tunneled central venous catheters (TCVC) and brachio-basilic arterio-venous fistulas (BBAVF).

Methods: Retrospective review of all polyurethane grafts, all BBAVF's and age and sex matched controls with a tunneled central venous access catheter in a 27 month period. Patency, defined as time used for dialysis, was analyzed using live table analysis methods.

Results: The study groups consisted of compared 22 grafts, with 41 TCVC and 21 BBAVF's. The groups were similar in terms of age, sex, diabetes and causes of renal failure. Six out of 21 BBAVF (29%) failed to mature. Patency of the polyurethane grafts, TCVCs and BBAVF's were similar (log-rank test $\chi^2 = 0.34$, $p = 0.84$). The overall infection rate in the TCVC group and the graft group was similar. However, more than half of the infections occurred in only 5 leg grafts. This was significantly higher than in the arm. $\chi^2 = 4.7$, $p = 0.03$). No serious infection, requiring ligation of the fistula, was seen in the BBAVF group.

Conclusion: The polyurethane graft is a useful alternative to the tunneled central venous catheters in patients who need urgent dialysis access when the options for simple arterio-venous fistulas are exhausted.

A27

Prospective Randomized Multicenter Study on Conventional Versus Hooded Access Graft-to-Vein Anastomosis

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Purpose: The high frequency of venous anastomotic stenoses is the main reason for the low patency rates of hemodialysis access grafts. In-vitro studies showed optimized flow patterns in hooded

anastomoses. Results of a clinical prospective randomized multicenter study comparing both patterns of anastomosis are presented.

Methods: Beginning in July 1999, 418 ESRD patients were randomized after informed consent, when an upper arm bridge graft had to be implanted for initiation or maintenance of hemodialysis therapy, i.e., when autologous superficial veins with sufficient caliber for successful access creation were absent on both arms. Following randomization either a conventional carbonized ePTFE prosthesis or a hooded graft was implanted. Patients have been followed-up at regular intervals for up to two years. Primary, primary assisted and secondary patency rates were calculated according to the Kaplan-Meier method.

Results: The run-in phase ended in June 2002, when 418 patients (207 vs. 211) had been enrolled (62% female, 38% male, mean age 64.4 years). Most of the patients (75%) had had one or more access procedures on the same arm before implantation of the graft under study. The epidemiological data did not differ significantly between the two study groups. Final patency results are being calculated and will be presented at the meeting.

Conclusion: Even with the optimized anastomotic design, failure rates of graft access still are high. Grafts therefore remain a secondary access option for patients with exhausted superficial veins unsuitable for creation of autologous arteriovenous access.

A28

The Venaflo II™ Graft – Adaptation to the Vein Diameter

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Purpose: The basic idea of the Venaflo™ graft is to decrease the unphysiological flow at the venous anastomosis achieved by a bulb-like enlargement of the anastomotic space. The aim is the reduction of subendothelial intimal hyperplasia caused by abnormal hemodynamics. The adequate cuff adaptation to the vein diameter is an essential problem of the Venaflo™ graft.

Methods: Different transparent silicone models of arteriovenous Venaflo™ grafts were produced with cuff forms adapted to different vein diameters (3–6 mm, 6–8 mm, >8 mm). The investigations were performed in a pulsatile flow system at different flow rates using a Newtonian fluid with blood viscosity. Direct dye injection or hollow glass spheres illuminated by laser light allowed for flow visualization.

Results: The avoidance of dead water region and flow return as well as the increase of impact area were the criterions for optimization of cuff design. Based on our test results, the newly developed Venaflo II™ graft has a cuff, which is trimmed to the largest vein diameter tested in this series. On the cuff there are two printed lines for the trimming, which should be used to correct the cuff form for smaller vein diameters.

Conclusion: The developed cuff design leads to the reduction of unphysiological flow at the venous anastomosis. The incidence of venous stenosis should be reduced.

A29

The Importance of Correct Trimming of Venaflo™ Grafts Proven by CFD

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Purpose: The positive functional properties of the Venaflo™ vascular graft are closely correlated to the correct design of its venous anastomosis. A not or wrong trimmed Venaflo™ graft results in a hooded anastomotic design. Fluid dynamics of a hooded and a correctly cut Venaflo™ anastomosis were compared.

Methods: By using Computational Fluid Dynamics (software CFX 5.6, ANSYS Ltd. USA), the flow patterns and the wall shear stresses were calculated. A time-dependent mass flow profile with flow rates of 1500 ml/min (systolic) and 120 ml/min (diastolic, mean 700 ml/min) was specified as the inlet boundary condition. The use of a non-Newtonian incompressible fluid considered the effect of shear-thinning.

Results: In the hooded Venaflo™ anastomosis, the velocity levels near the floor are higher compared to the correct Venaflo™ anastomosis. A large region of boundary layer separation is observed at the inner wall. The retrograde flow movement forms a vortex in both forms of anastomosis, but it is more developed in the correct Venaflo anastomosis, where it exists during 85% of the cardiac cycle. In the diastole, very slow velocities are seen in the hood region of the hooded Venaflo™ anastomosis. At the vein floor, the areas exposed to high shear stress larger and its duration longer in the hooded Venaflo™ anastomosis.

Conclusion: The correctly trimmed Venaflo™ graft performs significantly better, whereas the impact of the blood stream at the vein floor caused a stagnation point in hooded anastomoses thus increasing the risk of thrombosis in the dead water region.

A30

Efficiency of Hirudin-Iloprost Coated Arteriovenous Dialysis Grafts in an Animal Model

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Purpose: To evaluate the efficiency of a Hirudin-Iloprost graft coating to prevent the formation of prosthetic pseudointima and improve patency rates of conventional PTFE dialysis grafts and of arteriovenous patch-prostheses (Venaflo™) in an animal model.

Methods: Arteriovenous PTFE dialysis grafts were implanted unilaterally in 31 female domestic pigs (Deutsche Landrasse) between the left iliac artery and vein (length 20 cm, diameter 7 mm). Biodegradable poly-(D,L)-lactid acid (PDLLA) was used for graft coating. The PDDL A layer served as carrier medium for Hirudin-Iloprost, providing a long-term, local drug release from the graft surface.

Standard PTFE grafts were implanted either uncoated (group 1, n = 8), or treated with a Hirudin-Iloprost coating (group 2, n = 7). Analogously, Venaflo™ grafts were tested uncoated (group 3, n = 8) and coated (group 4, n = 7). Grafts were assigned after randomization.

The follow-up period was 6 weeks. Dialysis grafts were excised following perfusion fixation applying a perfusion pressure of 100 mm Hg. Patency rates were calculated and the development of pseudointima was noted.

Results: Patency rates for uncoated conventional PTFE dialysis grafts was 25%, and increased to 62,5% when pretreated with Hirudin-Iloprost coating. The patency of uncoated Venaflo™ grafts was 63%. A 100% patency rate was achieved in the Hirudin-Iloprost coated Venaflo™ group.

Marked differences between uncoated and coated PTFE surfaces were already noted at macroscopic examination. Hirudin-Iloprost pretreated grafts showed a smaller layer of prosthetic pseudointima, compared to uncoated PTFE dialysis grafts.

Conclusion: Hirudin-Iloprost™ coating improves patency rates of arteriovenous dialysis grafts in a pig model. Arteriovenous cuffed patch-prostheses (Venaflo™) showed a significant improvement of patency rates compared to the standard PTFE graft. Best results were achieved by the use of a Hirudin-Iloprost coated Venaflo™ graft.

Vascular Access in Theory and Praxis

A31

Prevalance and Survival of Hemodialysis Vascular Access in End-Stage Renal Disease (ESRD) Patients of Tehran, Iran

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Purpose: Vascular access use is an important aspect of hemodialysis treatment provided for patients with ESRD. Studies from various countries have reported different prevalence and survival rates of vascular access types. Since there is a lack of epidemiological data from Iran, the present study was performed.

Methods: This cross-sectional retrospective study was conducted in ESRD patients who underwent hemodialysis in hemodialysis centers of Tehran, Iran in December 2004. 700 hemodialysis patients and 198 accesses (from 100 patients) were studied. Data were collected by using recall method, interview and check lists. The analysis was performed using SPSS v.12. Life tables, Kaplan Meier procedure, Cox Regression and Log Rank test were used in survival analysis.

Results: Arteriovenous fistulae (AVF) and grafts (AVG) were used by 93.4% and 3% of Iranian hemodialysis patients, respectively. The mean survival time of AVF was 144.52 (95%CI 118.67 to 170.36) months compared with 32.43 (95%CI 18.83 to 46.03) months for AVG. The results of Log Rank test demonstrated that this difference was highly significant ($p < 0.001$). The estimated one, three and five

year survival probability for AVF were 76.42%, 61.54% and 56.86%, respectively. Moreover, access survival was significantly associated with the access site.

Conclusion: The prevalence of AVF differs from 24% in the United States, 80% in Western Europe to 93.4% in Iran. Similar to several other studies, our findings showed better survival of AVF when compared to AVG and catheters. These results suggest that applying highly skilled surgical techniques may have a positive effect on access survival, patient satisfaction and expenses.

A32

Problems and Controversies in Patients Undergoing AVF for Hemodialysis: Indian Scenario

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Purpose: Hemodialysis is a life saving procedure in renal failure patients. An adequate permanent, trouble free vascular access is essential for long-term management of renal failure before transplantation or for maintenance in ESRD patients. Although various guidelines have been put forward (e.g. DOQI, CARI, USRDS) since long, still we fail to achieve good results due to multiple problems and controversies particularly in our country.

Methods: We analyzed 110 cases done at our institute, from Jan 2003 to Dec 2003 in a retrospective study and the problems we came across. Male are dominating (86%) with their maximum in the 50–60 y age group (35%). All were hypertensive, 35% were diabetic and 14% had CAD.

Results: We found late referral to us being the most common problem as can be judged with their high creatinine levels (more than 6 in 82% of patients), presence of neck-line (40%) and damaged peripheral veins.

Radio-cephalic fistula in a non-dominating limb was the preferred option (68%), whereas brachio-cephalic fistulas were also considered for diabetic patients. In a short follow-up only 24% are getting dialysis via AVF after maturation and another 28% are lost to follow-up which seems to be another big problem. Maturation of AVF in diabetics seems to take longer time than the mean of 45 days in non-diabetics.

Conclusion: Late referrals, significant dropouts during follow-up and diabetic overload are the main problems in our country. Radio-cephalic fistula in the non-dominant arm is still the preferred site, whereas brachio-cephalic fistula should be considered in the diabetic population.

A33

Human Values and Trust in the Surgeon-Hemodialysed Patient Relationship

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Purpose: Presentation of the significance of humanistic relationship, emotional bonds and trust between the surgeon and the patient with end-stage renal disease requiring repeated vascular access.

Methods: The subject of this presentation was based on the clinical case of a patient, W.K., aged 59, who had eleven vascular accesses made between December 1, 1995 and December 7, 1998 by one surgeon. Contacts with the patient were unlimited so the patient could be fully informed about the aim and method of the vascular access, and possible complications. The patient's personal and family situation was taken into account during the observation of the relationship.

Results: Radical change in the patient's attitude to hemodialysis and vascular access was observed – from lack of trust in the sense of this treatment to its full acceptance and all possible vascular accesses. This evaluation is based on the patient's declarations of growing trust to the surgeon. These declarations were confirmed by the patient revealing her most intimate private and family affairs. This relationship was of great importance when another vascular access needed accepting.

Conclusion: 1) A special bond based on mutual trust and similar values between the patient and his surgeon is possible. 2) To create this bond it is essential that the patient be looked after by one surgeon. 3) A positive relationship between the patient and the surgeon has a beneficial influence on the treatment.

Access Surveillance

A34

Is Early Postoperative Duplex Control Useful in Detection of Early Dysfunction in Hemodialysis Access Fistulas?

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Purpose: To evaluate the impact of early postoperative duplex control in the first three months after forearm fistulas for hemodialysis access.

Methods: All patients who will have a hemodialysis access fistula created in our department have a duplex mapping of the arm arteries and veins before the operation. After the operation a follow-up duplex is done at 1 week, 1, 3, 6 and 12 months, and than once a year. Between January 2001 and December 2004, 110 native fistulas (Brescia-Cimino) and 90 prosthetic forearm fistulas were performed.

Results: During this period of 48 months all patients were followed-up clinically and duplex-sonographically. During the first three months, 11 patients (5%) with patent fistulas had a second operation based only on the results of postoperative duplex controls. The indication for re-intervention was stenosis in 4 patients and non-maturation of the fistula in 7 patients. The mean interval until re-intervention was 42 days (7–82). All 11 fistulas were native fistulas (10%). Two patients had a venous patch and 9 patients had a proximalisation of the fistula.

Conclusion: Early postoperative duplex seems to be accurate in detection of early dysfunction (stenosis or non-maturation) in native fistulas and allows re-intervention to preserve the primary patency. In prosthetic forearm fistulas a clinical control is accurate and only one duplex should be done before use.

A35

Evaluation of Color Duplex Ultrasonography for Surveillance of Prosthetic Arteriovenous Access for Hemodialysis

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Purpose: Prosthetic arteriovenous access (PAVA) is the usual alternative for hemodialysis patients who lack suitable veins for autogenous access construction. Almost all PAVAs will eventually occlude due to neointimal hyperplasia at the venous anastomosis unless prophylactic intervention is undertaken. Less frequent but not less important problems such as intragraft stenosis and stenosis at the arterial anastomosis may also cause access failure. In our access center all PAVAs undergo close surveillance with color duplex ultrasonography (DUS). We assessed the efficacy of DUS in detecting these problems by correlation with subsequent angiography.

Methods: DUS and angiography findings were correlated for 160 consecutive patients utilizing criteria to identify PAVA's at risk previously developed at our center. DUS criteria for hemodynamically significant stenosis requiring angiography were:

- Pulsatility index greater than 0.7
- Peak systolic velocity at the venous anastomosis greater than 6.00 m/sec
- Graft peak systolic velocity less than 1.00 m/sec
- Access flow less than 600 ml/min

We determined the sensitivity, specificity and accuracy for each criterion alone and in combination.

Results: A close correlation between DUS and angiography findings was noted, with a sensitivity of 100% and a specificity of 75% for indications for endovascular therapy. The positive predictive value of DUS for stenosis greater than 50% was 91.6% and the accuracy was 91.9%.

Conclusion: DUS is an accurate method for surveillance of prosthetic arteriovenous accesses. It provides physiologic data combined with accurate anatomic localization of stenotic lesions. This enables the interventional radiologist to tailor the endovascular procedure for each patient.

A36

Prevalence and Functional Profile of Radial Artery Stenosis Detected by Native Radiocephalic Fistula Flow Monitoring

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Purpose: To know the prevalence and functional profile of radial artery (RA) stenosis in radiocephalic fistula (RCF) dysfunction.

Methods: We prospectively monitored the blood flow rate (Q_a) by the delta-H method (mean Q_a 1,193.4 \pm 490.3 ml/min) of 116 vascular accesses (VA): 81% arteriovenous fistulas and 19% grafts in 102 ESRD patients (pts) (mean age 63.0 \pm 13.0 yr; 15.5% diabetes) over a 4 yr period. Forty-three VA (37%) had a positive result ($Q_a < 700$ ml/min: 48.8%; $\Delta Q_a > 20\%$: 51.2%) and were referred for angiography (AG). Most VA explored by AG showed stenosis $> 50\%$ (36/40, 90%) that were mainly located in RCF (25/36, 69.4%: RA 11/25, arterialized vein AV 14/25).

Results: Eleven cases of RA stenosis (prevalence: 30.5%; mean degree: 83.5 \pm 15.8%) were found in 11 RCF of 11 pts (mean age 67.5 \pm 11.5 yr; 18.2% diabetes). Mean Q_a before AG: 532.9 \pm 99.8 ml/min. Elective intervention (int): 36.4% by surgery. Mean Q_a tended to increase after surgery (547.0 \pm 100.6 vs. 872.3 \pm 526.5 ml/min) ($p = 0.068$). Comparative study with 14 AV stenosis in 11 RCF of 11 pts (mean age 64.3 \pm 10.5 yr; 50% diabetes): higher prevalence of int (85.8%) compared to RA stenosis ($p = 0.011$); without differences in degree of stenosis ($p = 0.12$) and Q_a before AG ($p = 0.78$) or surgery ($p = 1.00$); mean Q_a increased significantly after surgery ($n = 6$ AV, 549.8 \pm 86.4 vs. 1,033.0 \pm 216.6 ml/min; $p = 0.028$).

Conclusion: 1) One third of cases of VA dysfunction were related to RA stenosis. 2) No differences in functional profile were found between RA and AV stenosis before AG and surgery. 3) The functional results of elective surgery in RA stenosis were worse compared to AV stenosis.

A37

Correlation of Intra-Access Blood Flow with Characteristics of Stenoses Found During Diagnostic Angiography

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Purpose: To determine if measurements of intra-access flow correlate with radiographic findings observed in angiograms for patients with renal insufficiency.

Methods: This was a retrospective review of 310 patients. All had decreased intra-access blood flow (< 500 ml/min) in patent hemodialysis accesses and underwent diagnostic angiogram/angioplasty. An ultrasonic dilution technique was used to measure the intra-access blood flow. Images of the angiograms were reviewed and anatomic

characteristics of all stenoses were recorded. These characteristics were correlated with the intra-access blood flow values.

Results: The mean intra-access blood flow was 345 ml/min (range, 55–500 ml/min). Angiograms revealed a total of 587 stenoses and all 310 patients had at least one lesion with >50% stenosis. There was no correlation between the intra-access blood flow and the location, length, or number of stenoses. There was an inverse correlation between the intra-access blood flow and the degree of stenosis ($P = 0.06$). Five hundred eighty stenoses were treated with angioplasty. Mean post-angioplasty blood flow was 614 ml/min (range, 100–1,870 ml/min). Mean change in blood flow after angioplasty was an increase of 224 ml/min (range, 10–1,238 ml/min). There was no association between change in blood flow after angioplasty and number, length, or degree of residual stenoses.

Conclusion: The presence of significant stenosis can be predicted with intra-access flow values <500 ml/min. An inverse correlation was observed between intra-access blood flow and degree of the stenosis. There was no association between location, length, or number of stenoses and intra-access blood flow.

A38

Association of Vascular Access Blood Flow with Thrombosis and Inflammation in Hemodialysis Patients

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Purpose: Monitoring of access blood flow is an important clinical tool to detect access dysfunction. The aim of this paper was to evaluate the relationship between vascular access blood flow with thrombosis and inflammation in hemodialysis patients.

Methods: Vascular access blood flow was measured in a group of 51 hemodialysed patients by recirculation measurement using the thermodilution technique (BTM) consistent with Krivitsky theory. Thrombotic events were recorded during the twelve months of the study duration. Albumin, hematocrit, calcium phosphorus serum product, fibrinogen and CRP were measured monthly.

Results: A total of 9 thrombotic events (0.18 events per patient/year) were documented over the study period. A statistically significant difference was noted in vascular access blood flow ($p < 0.001$) and CRP ($p < 0.026$) of the patients with thrombosis versus those who did not thrombose. No statistically significant difference was noted for albumin, hematocrit, calcium phosphorus serum product and fibrinogen. Nevertheless only fibrinogen correlated with thrombosis ($r = 0.7$; $p < 0.03$). There was an estimated 4.8-fold (95% confidence interval 3.8–6.1) increase in the relative risk of thrombosis for access with vascular access blood flow <800 ml/m. The accesses that thrombosed had a 30% decrease in vascular access blood flow with an estimated 10.8-fold (95% confidence interval 8.6–13.4) increase in the risk of thrombosis.

Conclusion: Vascular access blood flow correlates with thrombosis and inflammation in hemodialysis patients.

A39

Early Results with Transonic® Device in Detecting Access Stenosis

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Purpose: To assess the efficacy and cost effectiveness of the ultrasound dilution device (Transonic®) in detecting vascular access stenosis and preventing access failure.

Methods: In this observational study data were collected prospectively. From August 2004–January 2005 317 ultrasound dilution measurements were carried out in 102 consecutive patients using Transonic® (HD02). These included 165 access flow and 152 recirculation measurements.

Results: There were 61M and 41F with an age range of 24–85 years. Access types were 111 fistulas and 5 PTFE grafts. Transonic® predicted a stenosis in 6 (5.8%) patients (all av fistulas) correctly and resulted in radiological intervention (5 angioplasties and one thrombectomy) and access salvage. There was one false positive measurement. Flow range was 110–4,000 ml/min in av fistulas and 540–1,160 ml/min in PTFE grafts. In 16 measurements the flow was <600 ml/min while it was >1,600 ml/min in 13.

Conclusion: This observational study does seem to suggest that regular surveillance of dialysis access can help identify access stenosis leading to earlier radiological interventions, fewer surgical interventions and fewer access failures. The saving made by avoiding surgical intervention and access failure seems to be significant. However a randomized trial is needed to verify these results.

A40

Access Blood Flow Measurements Using the Transonic® Method, a Helpful Link Between Nephrologists and Vascular Surgeons?

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Purpose: Thrombosis counts for the majority of vascular access complications. We evaluated the impact of regularly performed monitoring of vascular access blood flow rates over a period of five years.

Methods: From 01/1999 to 12/2004, the access blood flow rate of 42 chronic hemodialysis patients was followed with the Transonic® HD01 Hemodialysis Monitor. Flow rates below 500 ml/min led to a shortened control interval or initiated further diagnostic steps such as duplex ultrasonography or angiographies.

Results: In 42 patients with 13 (30%) grafts and 31 (70%) fistulas 294 measurements were made. In 3 (23%) grafts and in 9 (29%) native fistulas, flow rates below 500 ml/min were determined over the years. 5 (38%) grafts and 8 (26%) fistulas showed flow rates exceeding 2,000 ml/min. 8 (62%) grafts and 11 (35%) fistulas underwent surgical revision. In two out of 31 av fistulas (6%), an increased blood flow rate

was surgically reduced. Only one unexpected acute thrombotic event was observed.

Conclusion: Regularly performed blood flow monitoring in hemodialysis patients with fistulas or grafts provides benefits in long-term surveillance of vascular access function. Further diagnostic steps in cases with blood flow rates exceeding 2,000 ml/min and in accesses with less than 500 ml/min, help to avoid acute thrombosis, thus substantially reducing the rate of temporary catheters, hospitalizations and expenditures.

A41

Cost Effectiveness of Monitoring and Preemptive Intervention of Hemodialysis Vascular Access

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Purpose: Vascular access failure is the greatest source of morbidity and hospital admission for hemodialysis patients. Monitoring by monthly measurement of access flow may be of importance in preventing access clotting. The aim of this study was to analyze the cost effectiveness of a vascular access surveillance program, which may reduce the incidence of thrombotic occlusion of the vascular access.

Methods: The number of vascular access interventions (surgery and radiology) in the period 2001 to 2003 (Transonic® measurement period, TMP; 63 patients) were compared with a reference period (RP, 1996 to 1998) during which no access flow was measured (58 patients). All measurements were done with Transonic® flowmetry and interventions performed according to the guidelines of K/DOQI.

Results: During the RP, 123 vascular access operations (0.71 per patient/year) were performed because of thrombotic occlusions, compared to 58 vascular access operations (0.3 per patient/year; $p < 0.05$) in the TMP. During the TMP 298 angiographic procedures with additional percutaneous transluminal angioplasties (PTA) were executed (1.6 per patient/year) versus 177 (1.0 per patient/year) in the RP. In the TMP a total of 1,652 access flow measurements were performed; 21 access flow measurements were needed to prevent one access occlusion. The total costs of access salvage in the TMP (costs of angiography, PTA, hospitalization days and surgery) were reduced by 31% in comparison to the RP; costs per patient/year in RP was € 2,315. The costs per patient/year in TMP was € 1,606.

Conclusion: By means of a vascular access surveillance program (based on access flow measurements), with additional preemptive interventions, it is possible to reduce the number of vascular access clotting episodes. Although a surveillance program increases the workload for the dialysis nurses, the beneficial effects, lower costs and reduced morbidity for the patients, outweigh this effort.

A42

Adequacy of Flow Within a Fistula Does Not Mean Adequacy of Dialysis

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Purpose: Adequate flow rates within a fistula are assumed by many vascular surgeons to mean successful establishment of access for dialysis. For patients with end stage renal failure, it is the ability of the fistula to provide adequate dialysis that is a measure of its success. We analyzed the correlation if any between these two measures of fistula function.

Methods: 66 primary vascular access procedures were analyzed retrospectively for the relationship between flow rate, dialysis adequacy and primary survival. A minimum urea reduction ratio of 65% and/or a fractional urea clearance (Kt/V) of 1.2 was taken to mean adequate dialysis. Access flow rate and adequacy were measured at 6 months after access placement, and Kaplan-Meier analysis and log-rank tests used to compare survival.

Results: Forty-three brachial, 11 radial, 3 basilic vein transpositions and 9 forearm prosthetic grafts were analyzed. Dialysis adequacy was present in 62% of patients (NA). Mean flow rate was 756.2 ml/min in adequate fistulae and 779.2 ml/min in those not adequate respectively ($p = ns$). Adequate fistulae had 1 and 2 year primary survival rates of 92% and 89% compared to 76% and 25% in the inadequate group respectively ($p < 0.0001$). No correlation was found between flow rate and dialysis adequacy.

Conclusion: Dialysis adequacy at 6 months strongly predicts fistula survival and does not correlate with the flow rate within a fistula. It should be included as a measure of the quality of an access program along with patency rates and flow parameters.

Stenosis & Thrombosis

A43

Malfunctioning Native Hemodialysis Fistulae: Efficacy of Percutaneous Treatment

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Purpose: To evaluate the efficacy of percutaneous intervention in stenosed and thrombosed Brescia-Cimino (BC) shunts in comparison to non-BC native AV fistulae.

Methods: 136 patients with native dialysis shunts referred for angiography and percutaneous intervention were included in this study for a total of 563 interventions. 80 patients presented with original distal radio-cephalic, i.e. Brescia-Cimino fistulae and 56 patients with native non-distal radio-cephalic arteriovenous shunts, accounting for 329 and 234 interventions, respectively.

Results: The median annual intervention rates were 0.14 for AV fistulae and 0.18 for BC shunts. Secondary patency after 6, 12, 24, 36 and 48 months, were 91, 86, 78, 67 and 56 percent for BC shunts, and 91, 89, 74, 66 and 56 percent for non-BC AV fistulae. Early re-thrombosis within 7 days occurred in 17/239 (5.2%) BC cases and 4/234 (1.7%) AV cases.

Conclusion: Interventional therapy in obstructed dialysis fistulae has proven to be a fast, safe and effective treatment modality. In this large patient collective, re-thrombosis and secondary patency rates of BC and non-BC shunts did not significantly diverge.

A44

Cutting Balloon Fistuloplasty in Native Fistulas: 3 Year Experience in the East of Scotland

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Purpose: To determine the effectiveness of the peripheral cutting balloon (PCB, Boston Scientific) as the primary treatment of resistant venous stenoses in native hemodialysis fistulas.

Methods: At 3 centers in the East of Scotland (Queen Margaret Hospital, Dunfermline; Ninewells Hospital, Dundee; Royal Infirmary of Edinburgh) over 3 years, 45 PCB fistuloplasties were performed in 41 patients, 27 male/14 female; average age 59 years (26–82). Indication for procedure was primary stenosis in 21, recurrent lesion in 15 and immature fistula in 5. One procedure failed. The PCB was used alone in 15, but was followed by standard larger balloons in 30 cases.

Results: Overall, 2 balloon burst and 4 leaked. One fistula occluded and 6 had residual stenosis of >30%. Follow-up of between 2 and 27 months (mean 9.5 m) with ultrasound, flow studies and URR measurements showed 7 fistulas non-functioning at 5 to 19 months. Six patients have died. Only 4 have required repeat intervention. One patient has been transplanted.

Conclusion: PCB fistuloplasty is effective in the treatment of venous stenoses, with a low complication rate and reduced re-intervention rates. A randomized study in comparison to high pressure balloons is planned.

A45

Surgical Salvage of Thrombosed Arteriovenous Fistulas and Grafts

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Objective: To present our clinical experience with surgical salvage of thrombosed arteriovenous fistulas and grafts, performed by skilled interventional nephrologist.

Methods: 286 surgical interventions were performed in 246 chronic hemodialysis patients aged 55 ± 16 years (12–87), 268/286 (93.7%) in AV fistulas and 18/286 (6.3%) in grafts, and analyzed retrospectively. A subgroup of 61 procedures was analyzed prospectively. Type of the procedure, immediate success and patency after surgery were evaluated.

Results: Thrombectomy with reanastomosis was performed in 197/286 (68.9%) and simple thrombectomy in 89/286 (31.1%) of the procedures. Time from thrombosis to surgery was 1–60 days (3.7 ± 8.1). Immediate success was achieved in 258/286 (90.2%) of surgical procedures, 95.5% (189/198) in thrombectomies with reanastomosis, 77.5% (69/89) in simple thrombectomies.

Primary and secondary patency rates for arteriovenous fistulas after surgical salvage at 3, 6, 9, 12 months were 93.1%, 84.0%, 78.3%, 75.0% and 96.6%, 88.0%, 78.3%, 77.3%, respectively. 1.15 surgical procedures per AV fistula were needed in order to maintain secondary patency.

Time to thrombosis in grafts was in average 10.2 months, primary and secondary functioning time from thrombectomy (until the end of observation period) was from 1 to 19 months (average 6.9 ± 6.3 months) and from 5.5 to 19 months (average 9.1 ± 5.6 months), respectively. In 7/16 (43.8%) surgical procedures transluminal angioplasty was performed and in 3/16 an endovascular stent was placed after angioplasty. 2.3 surgical procedures per graft were needed to maintain secondary patency.

Conclusion: Surgical salvage of thrombosed arteriovenous fistulas and grafts, performed by skilled interventional nephrologist, is successful in short and long-term.

A46

Survival After Reconstruction of Failed Arteriovenous Fistulae: A Comparison with Primary Fistulae

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Purpose: Optimal management of failing arteriovenous fistula (AVF) remains controversial. Although primary AVF survival is well documented, limited data is available regarding survival after reconstruction of the primary AVF. This study aims to compare survival of primary and reconstructed AVF and determine factors predictive of AVF failure.

Methods: A prospective analysis of all AVF formed from 1997–2003 was performed. Primary endpoints were spontaneous or surgical AVF closure or construction of a new vascular anastomosis. Factors predictive of primary and reconstructed AVF survival were determined.

Results: 259 primary AVF were formed in 201 patients (69% male, mean age 52 years). Of these, 56 underwent reconstruction (73% autogenous vein, 23% PTFE). Primary AVF patency was 99%, 80%, and 69% at 1, 12, and 24 months respectively. Reconstructed AVF patency was 93%, 73%, and 66% at 1, 12, and 24 months, $p = 0.7$. Women experienced more primary AVF failures than men, OR 2.0 (95% CI 1.1–3.7), $p = 0.02$. Compared with primary fistula, reconstructions were required more often in women (45% vs 31%, $p = 0.048$) and were more often fashioned using PTFE (27% vs 1%, $p < 0.001$). Mean survival was 52.7 months for autogenous vein

reconstruction and 16.4 months for PTFE reconstruction, $p = 0.032$. Cox proportional hazards analysis controlling for age and gender showed PTFE reconstruction independently predicted decreased survival, hazard ratio 2.8 (95% CI 1.1–7.6), $p = 0.04$.

Conclusion: Reconstructed AVF survival matches that of primary AVF. PTFE reconstruction is a strong prognostic indicator of poor AVF outcome. Reconstruction of the primary AVF should be considered as an alternative to new AVF formation, to prolong vascular access for haemodialysis.

A47

Veno-Venous Bypass Grafting in Patients Undergoing Long-Term Hemodialysis

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Purpose: We retrospectively reviewed results achieved with veno-venous (VV) bypass grafting to improve the function of arteriovenous (AV) fistulas and mitigate manifestations of venous hypertension in patients undergoing long-term hemodialysis.

Methods: Between 1998 and 2002, we implanted 58 VV bypass grafts to treat either venous stenosis with poor AV function (66% of cases), venous hypertension (16%), or elevated intravenous pressure due to outflow vein occlusion (18%). Grafts were implanted in the forearm ($n = 17$), between the forearm and the upper arm ($n = 24$), or in the upper arm ($n = 17$).

Results: There were no surgical complications. All grafts could be used for vascular access after implantation, and the symptoms of venous hypertension subsided. Subsequently, percutaneous transluminal angioplasty (PTA) was performed 43 times (23 at an outflow venous site and 20 at an inflow venous site) in 15 patients. Graft bypassing was done in 17 patients. Primary patency rates were 56%, 44%, and 33% at 1, 2, and 3 years, respectively; secondary patency rates were 80%, 78%, and 78%. These results are comparable to those achieved with AV grafts. The VV grafts had more stenoses at inflow venous sites than observed in AV grafts.

Conclusion: A VV bypass graft can alleviate symptoms of venous hypertension and prolong the life of a vascular access. Prophylactic PTA for anastomotic stenosis was required to obtain long-term secondary patency in this series. Turbulence may promote stenosis development in VV bypass grafts, but elucidation of the specific mechanisms involved requires further study.

A48

Thrombolysis in Early Failure of Prosthetic Arteriovenous Access

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Purpose: Early failure (within 6 weeks of construction) of prosthetic arteriovenous access (PAVA) is usually attributed to technical factors related to the surgery and is therefore treated by surgical revision rather than endovascular intervention. To determine the veracity of this premise we decided to attempt endovascular thrombolysis initially, instead of proceeding directly to surgical revision.

Methods: We prospectively studied all patients who had an occlusion of a PAVA within 6 weeks of new fistula creation (early occlusion) from January 1999 through March 2002 to determine the cause of the occlusions. No patients were excluded from the study.

Results: During the 18 months of the study, 327 PAVA's were constructed at our center. Twenty patients had early occlusion. The mean time from creation of the PAVA to occlusion was 16.4 ± 12.6 days and the mean time to intervention was 25.4 ± 12.7 days. Of the 20 patients, 19 underwent successful endovascular thrombolysis. The only patient found to have a technical problem related to surgery had this resolved angiographically. There was one complication in the patient with failed endovascular thrombolysis, who had a hematoma that halted the procedure. This patient had surgical revision in line with the angiographic findings. Secondary patency at six months and one year were 72.3% and 63.9% accordingly.

Conclusion: Endovascular thrombolysis for early occlusion of PAVA is feasible, safe and is associated with a good patency rate. We believe it is a better alternative to surgery in these patients because technical problems related to the surgery were rare.

A49

Results of Percutaneous Transluminal Angioplasty (PTA) for Vascular Access Insufficiency

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Purpose: The purpose of this study is to evaluate the long-term results of percutaneous transluminal angioplasty (PTA) during the last 8 years in our clinic.

Methods: 550 cases of hemodialysis shunt insufficiency (540 in av fistulas, 10 in grafts) were treated with PTA in 8 years in 260 patients (male : female = 157 : 103; average age: 60.8 years). 119 patients (non-DM : DM = 60 : 59) required one or more re-PTA(s) for restenoses and/or reocclusions.

Results: Procedural success was 98.2% (540/550). Primary cumulative patency rates (non-DM/DM) were 94.0%/93.8% at 3 months, 55.2%/42.2% at 1 year, and 34.9%/19.0% at 5 years.

Secondary cumulative patency rates were 82.8%/94.9% at 1 year, and 73.9%/73.4% at 5 years.

Of the 10 unsuccessful cases, 5 had longstanding thromboses prior to treatment, 4 cases had long severe calcifications of the access vein close to the anastomosis. In one case a long and severely curved stenosis at the anastomosis prevented PTA.

Conclusion: There is different primary cumulative patency at 2 and more years follow-up in DM when compared to non-DM. patients, but no different secondary cumulative patency rate. Unsuccessful cases are longstanding occlusions and severe calcifications.

A50

Calcium Antagonists Reduce the Incidence of Restenosis after Percutaneous Transluminal Angioplasty for Dialysis Fistula Stenosis

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Purpose: The main problem with percutaneous transluminal angioplasty (PTA) for stenosis of hemodialysis fistulas is the high incidence of restenosis. The aim of this study was to examine the effects of angiotensin II antagonists, calcium antagonists, and antiplatelet agents on the incidence of hemodialysis fistula restenosis after PTA for stenosis.

Methods: The subjects were 92 patients (54 with stenosis of an arteriovenous fistula and 38 with stenosis of the draining vein of an arteriovenous graft) who received PTA between January 2001 and December 2003. The patency period was defined as the duration from first PTA to second PTA or surgical reconstruction. We excluded patients who received PTA a second time.

Results: The effect of each drug on the patency period of the arteriovenous fistulas or arteriovenous grafts was assessed. Data were analyzed by logistic regression analysis and the Kaplan-Meier method, with $p < 0.05$ indicating a significant difference.

Conclusion: There was a significant difference between the groups with and without calcium antagonist therapy in the patency period of arteriovenous fistulas and arteriovenous grafts. Therefore, calcium antagonists may reduce the incidence of restenosis after PTA for stenosis of a dialysis fistula.

A51

Results of The U.S. Multicenter Randomized Trial of An ePTFE Covered Stent Graft vs. Balloon Angioplasty

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Purpose: To assess safety and efficacy of flared and straight carbon impregnated ePTFE encapsulated stent grafts (Bard Peripheral Vascular) compared with angioplasty for treatment of stenotic venous anastomoses in failing synthetic arteriovenous access grafts.

Methods: Prospective, 13 center, randomized enrollment of 190 patients. Treated lesions were ≤ 7 cm in length. Enrolled upper extremity grafts had diameter stenoses $\geq 50\%$ and obligate hemodynamic, functional, or clinical abnormalities (per DOQI/SIR guidelines). Functional and venographic assessments were performed at 2 and 6 months with independent core lab analysis. Endpoints were analyzed on intention to treat basis with independent event adjudication.

Results: 97 patients received stent grafts (SG) and 93 PTA (control). There were no significant differences between graft and PTA cohorts for all criteria (>20), (e.g. demographics, graft age, location, size, prior treatments, configurations, anticoagulation, dysfunction criteria, presence of remote lesions, etc.). A total of 128 SG were implanted; 25 patients received multiple SG (overlapping). SG delivery success by patient: 99%. Mean total length of SG delivered: 54 ± 28 mm. Anatomic success ($<30\%$ stenosis): SG 94%, PTA 73% ($p < 0.001$). Binary re-stenosis (50% stenosis) at 6 months: SG 17.3%, PTA 65% ($p < 0.001$). No difference in adverse events ($p > 0.1$). The SG group showed a 24.6% 6 month treatment area primary patency benefit (re-intervention/loss of function) over PTA ($p < 0.001$).

- Restenosis 6 months: SG 22.4%, PTA 72.7%; $p < 0.001$ (50% diameter),
- Treatment Area 2 months: SG 80.4%, PTA 76.3%; $p = 0.597$
Primary Patency: 6 months: SG 53.6%, PTA 29.0%; $p < 0.001$
- Access Circuit 2 months: SG 79.4%, PTA 76.3%; $p = 0.727$
Primary Patency: 6 months: SG 41.2%, PTA 25.8%; $p = 0.031$

Conclusion: The Bard ePTFE stent graft is safe and provides clear 6-months primary patency superiority over balloon angioplasty for treatment of venous anastomotic stenoses in arteriovenous access grafts.

Steal Syndrome

A52

Prevalence of Arterial Disease in Hemodialysis Patients – Preliminary Results

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Purpose: Arterial calcification constitutes a limitation for vascular access creation and is also an important marker of cardiovascular morbidity. Its prevalence varies in different series of hemodialysis patients. Determining the prevalence of arterial disease and of associated risk factors, and defining their implications on vascular access performance (2nd phase) are the purposes of our study.

Methods: We performed lower limb arterial duplex-ultrasound in 117 hemodialyzed patients, with an average age of 59.1 ± 14.6 patients (45.3% female and 54.7% male). 21.5% were diabetic, and 24.3% were smokers. Further risk factors were registered: time on dialysis, hypertension, serum Ca/P-product, C-reactive protein, cholesterol, HDL, LDL and triglycerides.

Results: Patients were classified into four groups according to their duplex-ultrasound results:

- group I: without lesions (23.9%)
- group II: medial calcifications (31.6%)
- group III: atherosclerotic plaques with normal distal perfusion (29.1%)
- group IV: peripheral arterial occlusive disease (15.4%)

The severity of atherosclerotic changes was significantly related to age, time on dialysis and serum Ca/P-product ($p < 0.05$).

Conclusion: We conclude that arterial calcification is a frequent finding in hemodialysis patients and may occur in different patterns like medial calcification and atherosclerotic plaques. Its prevalence and severity is related to age, time on dialysis and serum Ca/P-product.

A53

Influence of Autologous Arteriovenous Fistula on Hand's Blood Supply in Very Elderly Hemodialysed Patients

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Purpose: Arteriovenous fistula (AVF) created for hemodialysis may predispose for local arterial insufficiency of the hand (steal syndrome). Patients (pts) with diabetes mellitus, peripheral arterial disease and elderly pts tend to have a higher risk of hand ischemia.

Methods: The aim of the study was to estimate influence of AVF on the hand's blood supply in the elderly population and to

identify cases of steal syndrome by means of non-invasive diagnostics (finger photoplethysmography – PPG, pulse volume recording – PVR, Doppler analysis and pulse oxymetry). The evaluation was carried out in 30 random pts (15 women; 15 men) over 75 years of age (78.5 ± 4.7 y), whose functioning autologous AVF had been placed at least 1 month ago.

Results: Mean amplitudes of PPG and PVR did not differ in statistical analysis ($p > 0.05$) between hands with and without AVF. One patient (4%) with end-to-side anastomosis was diagnosed to have steal syndrome (typical manifestation confirmed in PPG, Doppler, pulse oxymetry). Two other pts with high brachio-cephalic anastomoses presented with sub-clinical steal syndrome (only low PPG, PVR).

Conclusion: Even in very elderly pts, AVF formation should be considered due to its generally low influence on the hand's blood supply. Non-invasive diagnostic tests employed by us are helpful in identification of steal syndrome after AVF creation.

A54

Ischemic Steal Syndrome of the Forearm – Best Medical Treatment

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Purpose: The number of chronic hemodialysis patients with severe comorbidity is steadily increasing. Therefore, well functioning brachio-cephalic fistulas can result in a hand ischemia with the symptoms of pain, paresthesia, paleness and in some cases ulceration.

Methods: Exact diagnosis is of decisive importance for choosing the correct surgical strategy. The clinical investigation in combination with a Duplex sonography and in special cases a MRA of the arm informs of the vascular conditions of the forearm and thus, of the actual reasons for hand ischemia.

Results: In the cases of a so-called high-flow fistula with a blood flow of more than 1,500 ml/min and a largely normally calibrated shunt vein the distal revascularization-interval ligation procedure is the method of choice. If, apart from the basic disease leading to chronic renal failure, there exist cofactors such as long lasting diabetes or arteriosclerosis in combination with tobacco abuse that result in changes in the blood flow of the peripheral parts of extremities the by-pass solution should also be chosen.

If steal is caused by aneurysmatic dilation of the fistula vein, the reduction of the diameter with corresponding increase of venous resistance can be performed. Narrowing of the venous caliber can be achieved by applying a PTFE cuff or by suturing a new anastomosis. Intra-operative control of blood flow should be carried out to evaluate the surgical results.

Conclusion: By applying this principle of solving the primary causes of the steal we were able to achieve a far-reaching normalization of the blood flow situation in the acral parts of extremities without pain and restoration of the quality of life in almost all cases observed among our patients with critical hand ischemia.

A55

Extension Technique in the Management of Dialysis Access Associated Steal Syndrome

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Purpose: Vascular access in many patients, especially diabetics, requiring hemodialysis is a problem due to scarcity of veins for access and/or failure of wrist fistulas due to arterial calcification. The alternative procedure, brachiocephalic fistula is commonly associated with disabling steal syndrome. We describe our experience with a simple, yet extremely effective technique in the treatment of steal syndrome.

Methods: In this technique, the cephalic vein is anastomosed to the ulnar or radial artery about 2–3 cm distal to the brachial artery bifurcation by means of a jump vein graft. Between May 01–January 04, 12 patients, who presented with Dialysis access-associated steal syndrome, were managed by using the jump vein graft technique (3 patients did not require a jump graft). 9 of these were diabetics.

Results: In all the patients, the symptoms of steal completely resolved. One fistula thrombosed 3 months later and the same patient died 6 months post op. Another patient was lost to follow-up. The other 10 fistulas are working well after a median of 25.1 months (Range 10–42 months) follow up. Two patients who presented with gangrene required amputation of distal phalanx.

Conclusion: The cephalic vein extension technique with or without a jump graft is a simple technique that has been found to be very effective and safe in the management of Dialysis access-associated steal syndrome. Long term follow-up and trial in other centers is required to validate this technique.

A56

Distal Revascularization – Interval Ligation Technique in the Management of Hand Ischemia after Angioaccess Surgery

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Purpose: Management of hand ischemia after angioaccess surgery often requires ligation of the arteriovenous fistula. Aim of this study is to report our experience with the distal revascularization – interval ligation (DRIL) technique without ligation of the arteriovenous fistula (AVF).

Methods: From January 2002 to December 2004, the DRIL technique was used to treat 10 patients (5 diabetics) with symptomatic steal (finger necroses). The AVF was located at the elbow in all patients. The mean flow distal to the AVF was less than 10 ml/min in 4 patients, less than 5 ml/min in 3, and unmeasurable in 3.

We performed brachio-brachial bypasses in 6 cases, axillo-brachial bypasses in 2 cases, and brachio-radial bypasses in 2 cases. The conduit used for the arterial bypasses was the greater saphenous vein. Finger necroses required amputations in 7 patients.

Results: Symptoms disappeared in 6 patients (60%) and improved in 4 (40%). The time required for healing of finger amputations and trophic alterations ranged from 20 days to 3 months. Mean arterial flow through the DRIL bypass was 50 ml/min.

Primary patency of arterial bypass and AVF as well as limb salvage were 90% after 12 months of follow-up. One patient required major amputation (10%).

Conclusion: The DRIL technique is an effective procedure and should be proposed as first-line treatment for hand ischemia due to AVF. This technique can be used to achieve persistent relief of symptoms with continued access patency.

A57

The Procedure of Proximal Arterial Feeding: An Effective Treatment for Access-Related Ischemia

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Purpose: Ischemia distal to an AV access is a potentially devastating complication that can be difficult to manage. Recommended operative management includes ligation, banding and the increasingly used DRIL method. We present the procedure of proximal arterial feeding as another option. The arterial inflow can be proximalized by extending the AV access to an upper arterial level using a 4 or 5 mm PTFE graft. We see the indication for this method in the treatment of ischemia at a low-flow AV access, which can not be reconstructed by banding.

Methods: A retrospective review was conducted to demonstrate the efficacy and durability in relieving ischemia and maintaining access patency. During reconstruction intraoperative measurements of the arterial flow, access flow, and the distal arterial pressure was performed in 8 cases. An experimental comparison to DRIL procedure using an artificial circuit model was conducted.

Results: Between 1998 and 2004, we performed proximal feeding in 28 cases. 26 patients (93%) had substantial or complete relief of ischemic symptoms. The primary patency rate was 82% at 1 year. Ischemia reappeared in three patients after 21 months in mean. Intraoperative measurements of the distal mean arterial pressure demonstrated an increase of 73% after reconstruction. Results of in vitro investigations support clinical results and demonstrate a larger increase of distal arterial pressure compared to DRIL procedure.

Conclusion: The procedure of proximal feeding is an effective method to treat ischemia. It is less invasive than DRIL procedure and does not sacrifice the natural arterial continuity.

Central Vein Catheters

A58

Temporary Hemodialysis Catheters as a Long-term Vascular Access in Chronic Hemodialysis Patients

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Objective: The aim of this retrospective clinical study was to review our experience with temporary, pre-curved, jugular vein catheters as a long-term vascular access in chronic hemodialysis patients.

Methods: Thirty chronic hemodialysis patients, 14 men, 16 women, aged 65.3 ± 13.5 years (30–90 y), treated by dialysis for 1 month up to 30 years (6.3 ± 8.1 y), had single lumen, ‘temporary’ pre-curved non-tunneled jugular vein catheters (Medcomp, USA) as permanent vascular access, placed into their right internal jugular veins, with 4% trisodium citrate as locking solution and mupirocin at exit site. In case of malfunction, thrombosis or infection, catheters were replaced with the new one ‘over the wire’.

Results: Patients had hemodialysis catheters for an average of 9.1 ± 6.5 months, (1–22.7 mon), for a total of 271.7 months (8151 days). Average functioning time of individual catheters was 3.1 ± 1.9 months (0.5–10). A total of 55 complications were encountered (6.7/1,000 catheter days): 26 thromboses (3.2/1,000 catheter days), 9 ruptures of the catheter (1.1/1,000 catheter days), 15 malfunctions (1.8/1,000 catheter days), 2 exit site infections (0.2/1,000 catheter days), 2 bacteremias (0.2/1,000 catheter days), 1 avulsion of the catheter (0.1/1000 catheter days), and 2 catheters were removed because an av fistula could be used.

In 21 patients single needle hemodialysis was performed, mean blood flow 251 ± 16 ml/minute (250–300 ml/min), mean KT/V 0.96 ± 0.16 (0.72–1.27). In 9 patients double needle hemodialysis was performed (catheter and peripheral vein) with mean blood flow 252 ± 14 ml/minute (200–300 ml/min), mean KT/V 1.63 ± 0.25 (1.21–1.96).

Conclusions: ‘Temporary’ jugular vein single lumen non-tunneled hemodialysis catheters, with 4% citrate as locking solution and mupirocin ointment at exit site were good long-term vascular access with acceptable functioning time and low infection rate. The main reasons for catheter exchange or removal were malfunction and mechanical damage of the catheter.

A59

Risk Factors Associated with Infection and Malfunction of Femoral Catheters: Hospital vs. Ambulatory Patients

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Purpose: To compare survival of femoral catheters (FC) placed in hospitalized and in ambulatory patients on hemodialysis and determine risk factors for complications.

Methods: In a prospective study we looked at the outcome of a group of 460 patients (pts) receiving HD treatment via 501 FC during a 3 years period. Catheters were removed when no longer required (permanent VA was performed) or significant complications occurred (malfunction or infection). 341 pts with 364 FC started with HD – end stage renal disease (group A – hospitalized pts), and 119 pts with 137 FC were on regular ambulatory HD and had a problem with permanent VA (group B – ambulatory pts). In group B FC were inserted ambulatory and pts were sent home with FC. Univariate and multivariate analysis were conducted to examine association of hospital/ambulatory placed FC with sex, comorbidity number of previous catheters, number of previous thrombosed AVF, catheters swab (positive/negative), microbiological analysis of catheter tip (positive/negative), blood culture (positive/negative) as a risk factors.

Results: Duration of FC were: group A 5–120 d (median 32 d) with a cumulative total of 11,818 d; group B 6–199 d (median 45 d) with a cumulative total of 6,132 d. Electively removed FC: group A 320 (88%), group B 130 (95%); malfunction of FC: group A 18 (4.9%), group B 5 (3.6%); suspected catheter-related infection (CRI) group A 18 (4.9%), group B 2 (1.4%). Infection rate: group A 1.52 episodes per 1,000 catheter days, group B 0.81 episodes per 1,000 catheter days. Kaplan-Meier curve of survival shows significant statistical difference between 60 and 80 catheter days between the groups (log-rank test $p = 0.00001$). Univariate analysis does not reveal any significant risk factor in both groups. With multivariate analysis we found these risk factors: group A sex ($p = 0.002905$) and blood culture ($p = 0.006883$); group B number of previous thrombosed AVF ($p = 0.049508$) and comorbidity of diabetes/malignancy ($p = 0.009928$). The infection and malfunction-free survival time was not affected by any other risk factor analyzed.

Conclusion: Recognizing and knowing the risk factors that are associated with infection and malfunction of catheters can prevent complications. We conclude that FC can be used for a longer period of time for ambulatory HD without any problem, with permanent care of a specially educated VA team.

A60

Repair of Damaged Tubes and Connectors of Tunneled Cuffed Catheters by Two-Pieces Adapter for Peritoneal Catheters – New Cost-Effective Method

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Purpose: Long term use of chronic tunneled cuffed catheters (CTCC) can be limited by mechanical complications like a damage of tubes or connectors. Repair sets advised in this situation are expensive and not always offered for every type of CTCC. We present a new, simple and cost-effective method of resolving this problem.

Methods: In 9 ESRD patients hemodialysed via CTCC (Mahurkar/Quinton™, Gamcath™) for 20 ± 9 months, different forms of CTCC's tubes or connectors damage were diagnosed. The most frequent cause was inappropriate removing of a connector's cap.

Using a sterile set of instruments, the clamped tube was cut off proximally to the place of damage or close to the connector. Than the titanium (2 cases) or plastic (7 cases) two-pieces adapter for peritoneal dialysis catheters (Baxter®) was placed. The lumen of a repaired line was aspirated, flushed with saline and filled with heparin, clamped and closed with sterile cap.

Results: No infectious or mechanical complications were observed. The function of a every repaired CTCC was satisfactory.

Conclusion: Replacing a damaged connector or line section with two-pieces adapter for peritoneal dialysis catheters is a safe and cost-effective method of resolving this form of mechanical complication of chronic tunneled cuffed catheters especially when repair set is not offered by the manufacturer.

A61

Insertion of Central Vein Catheters for Hemodialysis via External Jugular Vein

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Purpose: Presentation of external jugular vein as main way for insertion of permanent central vein catheters for hemodialysis.

Methods: A total of 249 permanent central vein catheters for hemodialysis were inserted in 216 patients from December 1999 to November 2004. The patients came to us from various hospitals. They were divided into two groups. Group 1: 102 catheters were inserted from December 1999 to June 2002. External jugular 22 (22%), internal jugular 44 (43%), subclavian 32 (31%), femoral vein 4 (4%). Group 2: 147 catheters were inserted from July 2002 to November 2004. External jugular 73 (50%), internal jugular 58 (39%), subclavian 5 (3%), femoral vein 11 (7%).

Open method for insertion was used in 157 cases. External jugular 95/95 (100%), internal jugular 77/102 (77%), femoral 6/15 (40%), subclavian vein 0/37 (0%). The surgical time for open insertion was: external jugular: 12–20 min, internal jugular: 18–35 min, femoral: 15–35 min. The catheter position was controlled by radioscopy or postoperative roentgenography.

Results: In all the cases of insertion of permanent central vein catheter for hemodialysis via external jugular vein, the catheter blood flow was more than 250 ml/min. There were not any major complications except for 4 cases of catheter deviations which were corrected and 12 cases of minimal bleeding from subcutaneous tunnel which were managed by local compression.

Conclusion: The insertion of permanent central vein catheters for hemodialysis via the external jugular vein is an easy, simple and short in time surgical procedure. It implies no major complications and it offers the possibility of future use of the internal jugular vein.

A62

Percutaneous Treatment of Superior Vena Cava Obstruction in Asymptomatic Patients Before Dialysis Catheter Placement

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Purpose: To report our experience in the percutaneous treatment of superior vena cava (SVC) obstructions in asymptomatic patients who need a central venous catheter for dialysis purpose.

Methods: Eleven patients with a mean age of 61 years (42–78 years) and who were candidate for dialysis catheter placement were enrolled between August 2002 and December 2004. Six patients had stenosis of SVC system (Stanford II) whereas 5 patients presented with occlusion of the SVC (Stanford III/IV). All stenoses and occlusions were confirmed with helical CT or phlebography. All patients were asymptomatic before the procedure (Kishi score <4).

Results: Technical success of percutaneous revascularisation was 91% (10/11 patients). One patient had only venous angioplasty and 10 patients had angioplasty with stent placement. Three patients had two stents. Dialysis catheters were successfully inserted through the re-canalized access in all patients. No immediate complication occurred. No patient developed a superior vena cava syndrome after the procedure. The mean follow-up was 10.5 months. Two patients developed (at 8 and 12 months after catheter placement, respectively) a catheter dysfunction with peri-catheter thrombosis successfully managed by percutaneous endovascular approach.

Conclusion: Percutaneous treatment of SVC obstructions in asymptomatic patients who need a dialysis catheter is relevant and safe. This technique should be considered as an adjunctive procedure facilitating the placement of dialysis catheters in patients with SVC obstruction, especially in Stanford's types III and IV.

A63**Central Venous Stenosis in Upper Arm Hemodialysis Vascular Access – Is Repeated PTA with Stent Implantation Sensible?**

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Purpose: A clinically relevant stenosis of the subclavian vein is a complication that often appears in upper arm vascular access, particularly in brachio-axillary AV bridge grafts with a high flow. Does a repeated interventional therapy with PTA and stent implantation make sense?

Methods: Within a period of four years 103 stenoses of the subclavian veins were diagnosed in 52 hemodialysis patients. In 21% of the cases one or more central venous catheters had been placed in the affected segment. Flow measurement and angiography were carried out before intervention.

Results: Within a mean follow-up of 21 months, an average of two interventions per patient were necessary. No peri-interventional complications were observed. Stent implantation (min 1, max 6) after PTA had to be performed in 16 patients. Definite central venous occlusions occurred in 8 cases after repeated interventions.

Conclusion: Central venous stenosis complicating av access is a frequent finding in patients on chronic hemodialysis. In our opinion PTA with optional stent implantation is not a permanent solution to this problem. However, the provisional application of this method seems to be effective as a bridging solution until the maturation of an alternative AV fistula.

Access Management

A64**Early Arteriovenous Fistula Construction – Decreased Progression of Renal Failure**

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Purpose: It was noticed that decline of renal function slowed down in patients (pts) with end stage renal disease (ESRD) after early arteriovenous fistula (AVF) construction. The aim of this prospective study was to investigate the influence of AVF on the progression of renal failure.

Methods: Sixty ESRD pts with serum creatinine levels (SCL) between 400 and 500 $\mu\text{mol/l}$ were included and randomized into two groups. One group of pts received AVF and the other not. SCL, creatinine clearance (CC), and mean arterial pressures (MAP) were followed every two months (m) for one year. All pts were clinically evaluated for signs of cardiac insufficiency. HD was started when

SCL was 850 $\mu\text{mol/l}$ or CC ≤ 10 ml/min or when signs of uremia were present.

Results: In group A (30 ESRD pts, 17 males and 13 females, age 61 ± 7.3 yrs, mean SCL 446.4 ± 30.5 $\mu\text{mol/l}$, mean CC 29.3 ± 4.1 ml/min) native forearm AVFs were constructed. AVFs were not constructed in group B (30 pts, 12 males and 18 females, mean age 62.8 ± 8.2 yrs, mean SCL 447.6 ± 37.6 $\mu\text{mol/l}$, mean CC 29.1 ± 4.7 ml/min).

Mean SCL after 12 months was 509.2 ± 50 $\mu\text{mol/l}$ in group A and 660.3 ± 123 $\mu\text{mol/l}$ in group B ($p < 0.01$). After 12 months in group A 4/30 pts (13%) (1 after 6 m, 2 after 8 m, 1 after 10 m) had started with hemodialysis (HD); the remaining 26 pts had mean CC 23.1 ± 4.5 ml/min, MAP was 118 mmHg, no sign of cardiac insufficiency were found. In group B 11/30 (37%) ($p < 0.01$) (1 after 4 m, 5 after 6 m, 4 after 8 m, 1 after 10 m) had started with HD. Central vein catheters were used as vascular access. In the remaining pts mean CC 15.6 ± 4.5 ml/min ($p < 0.01$), MAP was 123 mmHg (NS).

Conclusion: This prospective study confirms our previous observations on the development of renal function after AVF construction. Beside matured AVF before HD benefit of early AVF on progression of renal insufficiency can be important. Reasons are not well known. There are two possibilities: increased cardiac output and decreased resistance of intrarenal vessels. Measurement of renal perfusion and calculation of resistance index by duplex-sonography is planned.

A65**Which is the Best Management for Hemodialysis AV Fistulas in Well-Functioning Renal Transplanted Patients?**

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Purpose: Vascular access for hemodialysis is one of the most important clinical problems in patients with ESRD. Nevertheless, vascular access becomes useless after a successful renal transplant. Thus we wanted to evaluate the natural history of AVF in renal transplanted patients and the possibility of maintaining the fistula patent or not.

Methods: We made a retrospective study of all the patients who received a kidney transplant in our hospital from 1984 to 2004.

Results: There were 365 patients with a well-functioning renal allograft. 85 patients had died, 89 had resumed hemodialysis and 2 peritoneal dialysis. Of the 89 patients who were on hemodialysis again, 49 used the old vascular access and 40 needed a new vascular access. The loss of the old vascular access was caused by thrombotic events in 31 patients.

Conclusion: Several studies showed that high flow fistulas can have hemodynamics effects on the heart. Another study didn't show alterations in cardiac morphology or cardiac function after that the AVF was closed in functioning transplanted patients. Recently a prospective study showed that vascular access is an independent risk factor for left ventricular hypertrophy.

The survival rate of transplanted kidneys in our center is 13 years for 77% of patients. Thus do we have to consider the possibility to leave the fistula patent in well-functioning transplanted patients?

To date there is no evidence about the need to close vascular access in patients with a well-functioning kidney graft. We think that a single patient related choice can be reasonable, taking into account cardiac functionality, age, the likely survival time of the transplanted kidney and the possibility of a new vascular access.

A66

Custom Made Raster Method for Detailed Documentation of Fistula and Graft Problems

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Purpose: Unfamiliarity with fistula and graft characteristics can lead to failed punctures, hematoma and sometimes access occlusion. The Custom-made Raster Method provides detailed shunt visualization and angiographic images together by using photo editing software. Access veins of an individual shunt and an adapted raster are projected on a digital picture of the arm.

Methods: During angiography the shunt arm is fixated and a digital picture is taken from a fixed vertical angle and distance. Reference points are marked on the shunt arm, which serve as a fixation to draw a raster with coordination points. In this way a picture is created like a roadmap with veins. There is complete integration of photographic and radiological images by using software programs (Adobe Photoshop® + Illustrator® and Agfa Web 1000®) under Windows XP®. All illustrations are made fit 1:1 by scaling up or down without distortion. Editing with Photoshop® gives a precise projection of shunt veins on the real colored background of the digital photograph. In this projection the gray angiography background is made completely transparent. The system can contain more detailed information in combination with echo (duplex) images of depth and diameter.

Results: This visualization method is a useful tool for multi-disciplinary access meetings with interventional radiologists, access surgeons and nephrologists. Access malfunction, aneurysms and stenoses can be projected at their exact locations. The system leads to clear and concrete puncture advice. Transfer of access information and communication to other dialysis centers is facilitated.

A67

The Impact of Dialysis Needle Design and Position on Access Graft Hemodynamics

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Purpose: The aim of this novel research is quantification of the impact of needle flow on graft hemodynamics. Two needle geometries are compared.

Methods: In a three-dimensional computational fluid dynamics (CFD) graft access model, validated with in-vitro experiments, access flows of 500 and 1000 ml/min are each combined with an artificial

kidney blood flow of 200 and 500 ml/min. Two 15G needle geometries are considered: a cutting and a blunt needle.

Results: The combination of an access flow of 500 ml/min and a kidney flow of 500 ml/min leads to a 7 mmHg higher mean pressure at the venous anastomosis compared to the arterial anastomosis. This inverted pressure drop is observed only at this flow rate combination. The observed flow patterns at the needles are completely three-dimensional and show complex vortex structures. Wall shear stress (WSS) values far above 400 Pa are always observed at the back eye of the cutting needle. WSS on both, the cutting and blunt edges is maximal 150 Pa.

Conclusion: CFD calculations show that the blunt needle has an improved cat-eye design and resists acute hemolysis (>400 Pa). The blunt edge design however does not show any improvement compared to the cutting edge design concerning WSS.

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The Impact of a Vascular Access Coordinator on Practice Patterns at Dialysis Units in the Netherlands

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Purpose: Functioning vascular access remains the lifeline of dialysis patients. Influencing practice patterns according to KDOQI and European guidelines may probably result in a better outcome of the access and an increased use of autogenous fistulas.

Methods: During the period from 2002–2004 a vascular access coordinator (VAC) was delegated by the Dutch Kidney Foundation to implement protocols and monitoring in 9 dialysis facilities in the southern region of the Netherlands. At the beginning and end of the study period the number and type of vascular accesses in incident and prevalent patients, the number and location of central vein catheters (CVC) and the implementation of monitoring and pre-emptive intervention were registered.

Results: In 9 facilities a total of 709 patients were evaluated. During the study period 823 new vascular accesses were created. The number of new autogenous fistulas (AVF) increased from 68% to 73%, while the percentage of graft implants (AVG) decreased from 30% to 25%. The distribution of accesses in prevalent patients was: AVF 63 and 67%, AVG 17 and 16%, and CVC 19 and 16% (years 2002 and 2004). Monitoring by regular access flow measurement was implemented in 7 out of 9 facilities. In addition the number of pre-emptive PTA and surgery increased significantly by 52%. There was a significant shift from using non-tunneled towards tunneled CVC (23 to 41%) and from the subclavian (34 to 11%) towards the jugular vein position (34 to 56%).

Conclusion: The implementation of structured access care by a VAC results in an increase of autogenous fistulas and a significant higher number of pre-emptive repair of failing accesses. In addition central vein catheter use decreased and catheter location shifted from the subclavian to jugular position. A VAC is of benefit for the outcome of dialysis vascular access.

Multidisciplinary Access Team and Surveillance Reduces Access Thromboses and Need for Acute Intervention

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Purpose: In the late nineties we experienced an increasing number of patients with acute vascular access thrombosis. After creating a multidisciplinary access team including vascular surgeons, clinical physiologists, nephrologists and dialysis nurses we set a goal; to increase the number of native arterio-venous fistulas (AVF) and reduce the number of acute occlusions.

Methods: Starting in the year 2000, we included sonographic vascular mapping in preoperative routines. A surveillance program of Transsonic® blood flow measurements was instituted and an improved access documentation by dialysis staff implemented. Duplex investigation was performed when there was a significant reduction in fistula blood flow, difficulties in cannulation, prolonged bleeding post dialysis or slow maturation of fistula. Access problems, results of duplex investigations and forthcoming revisions or PTA were discussed at weekly meetings between vascular surgeon and nephrologist. Annual follow-up by the multidisciplinary team reviewing statistics and complications including plans for new routines was established.

Results: A consecutive retrospective follow-up of dialysis access surgery (n = 378) from 1999 through 2003 was performed. In 1999 native AVF were created in 51% and this was increased to 87% by 2003. A subsequent reduction of graft accesses was seen from 49% to 13%. Upper arm fistulas became more frequent from 25% of native fistulas in 1999 to 55% in 2003. There was a reduction in acute access thrombosis and acute hospital admissions from 16 in 1999 with a continuous decrease to 3 in 2003, then only in graft access. Planned revisions increased from 11 to 24 during the same period.

Conclusion: A multidisciplinary access team has great impact on quality improvement towards higher incidence of native AVF and a reduction of acute surgical interventions due to vascular access thrombosis.

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Use of Plasma Expander During Arteriovenous Fistula Construction in Patients with Unsuitable Quality of Arteries

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Brachial Plexus Block and Blood Flow in Arteriovenous Access Surgery

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The Influence of Drug Therapy on Outcome of First Native Fistulae Formation

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Ultrasound-guided Brachial Artery Angioplasty Performed While Creating a Radio-cephalic Arterio-venous Fistula

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Use of the Polyetherurethaneurea Graft in the Human Immunodeficiency Virus-Positive Patient

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Arteriovenous Grafts and Hemodynamics – A Temporary Conclusion

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The Avoidance of Perigraft Seromas by Fibrin Glue Application in ePTFE Grafts

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Patency of PTFE Graft is Similar to Autologous Fistulas

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Antebrachial PTFE Access for Hemodialysis

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Brachial PTFE Graft: A two act implantation procedure

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Arteriovenous Access in the Lower Limb: Algorithm, Guideline and Outcomes, for an underestimated Vascular Access

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Salvage Vascular Access: Loop Mid Thigh Grafts an Alternative for Hemodialysis

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A Patch Prosthesis (Venaflow™) Versus Conventional Prosthesis for Dialysis Access – A Retrospective Analysis

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The Blood Flow Volume in the Maturing Arteriovenous Access for Hemodialysis

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Detection of Stenosis by Blood Temperature Monitor (BTM) and Surveillance of Native Fistula Function – A 42-Month Follow-up

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Role of Duplex-Sonography in Detection and Prevention of Early Forearm Access Failure

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Access Flow Measurements with the Transonic® Method after Surgical Revision in Grafts – A Reasonable Quality Control?

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Comparison of Success Rates and Patency Rates of Percutaneous Transluminal Angioplasty Before and After Thrombolysis

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Simple Fistula Thrombectomy: A Waste of Time?

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Mechanical Thrombectomy of Thrombosed Fistulas is Aided by Ultrasound

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Distal Revascularization – Interval Ligation as Elective Treatment of Steal Syndrome in Vascular Access

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Diagnosis and Differentiated Treatment of Access-related Ischemia

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Prospective Registry of DRIL-Procedures

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Sharp Brachiocephalic Vein Recanalization in a Hemodialysis Patient

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A Case of Hemodialysis-Related Central Venous Occlusion Treated with Surgical Bypass and Stent Placement

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Intra-operative Central Vein Angioplasty during Arteriovenous Access Creation

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A Romanian Dialysis Center Experience with Tunneled Cuffed Catheters

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Cervical Compartment Syndrome – Complication of Central Venous Catheterization

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Comparative Study of Femoral Catheters Used as Temporary Vascular Access – Diabetic vs. Non-diabetic Patients

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Prospective Study of Permanent Catheters Placed into Occluded or Stenosed Central Veins: 1-Year Follow-up in 4 Patients

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'Last Chance Saloon' Hemodialysis Access: 13 Cases

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Tunneled Cuffed Venous Hemodialysis Catheters in Chronic Renal Failure

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Serratia Cellulites Complicated with Spontaneous Arterio-Venous Fistula after Permanent Hemodialysis Catheter

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New Technique of Progressive Catheter Traction to Remove Catheters Stuck in the Superior Vena Cava

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What is the Limit of Vascular Access?

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A Study of High Output Cardiac Failure due to Excessive Arteriovenous Fistula (Large Shunt) for Hemodialysis

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Management of Venous Aneurysms in Arterio-Venous Hemodialysis Fistulas

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Experience from a 52-Week Study to Evaluate the Performance of Hemaport, a New Vascular Access Device

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Superficial Transposition of Brachial Artery as Vascular Access

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Vascular Access for Hemodialysis in Elderly Patients

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Three-Dimensional CT Angiography for Preoperative Evaluation of Hemodialysis Vascular Access Complications

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