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### *The obtention of vascular access on the arm for hemodialysis*

Patients with irreversible end-stage renal disease have two ways of replacing the lost kidney function, chronic dialysis or kidney transplantation. Despite the fast development of transplantation a lot of people are still waiting for transplant organ. Vascular access is the vital lifeline. The providing of the comfortable hemodialysis vascular access seems to be a very important problem for patients with chronic renal insufficiency. The effective dialysis requires a continuous flow through the dialyzer. The minimal value of this flow is 200 ml/min and the optimal value — 250-300ml/min. In 1960 *Quinton* and *Scribner* used the surgically created external arteriovenous fistula (13). Clinical practice shows that the period of the fistula use is limited. Usually, the period of normal function of this anastomosis was shorter than 12 months.

In most cases, dialysis access failure remained the most frequent cause of hospitalization for patients with end-stage renal disease (5). In chronic dialysis patients the last choice was the development of subcutaneous arteriovenous anastomosis for the multiple use (3). Actually, end-to-side and side-to-side fistulas between the radial artery and cephalic vein were usually performed. In some cases it is not possible to make the fistula on the forearm. In this difficult situation the anastomosis was followed on other vessels of the upper limb (9). Furthermore, the way of solving the problem can be the homograft obtained by transplantation of the cephalic vein or bovin heterograft (4, 8). Polytetrafluorethylene (PTFE) graft, received by *Baker* and *Kaplan*, has been commonly employed. Other anastomoses like axillo-axillary and ilio-axillary ought to be surgically created when all possibilities are run out (2, 7).

#### MATERIAL AND METHODS

In the years 1989-1999, 53 dialysis accesses were followed on the arm. All subcutaneous fistulas were created by the junction of the cephalic vein with brachial artery, just above the cubital fossa. In patients, in whom the usual sites for arteriovenous fistula had been exhausted or in whom very poor vessels encountered on the forearm, the arm's fistula was followed after earlier premedication.

All anastomoses were created in the operating room under local anesthesia. During the surgery the 1% solution of Lignocainum or Bupivacainum were used. The preferred route for exposure of the cephalic vein was making the single incision along the arm. When the distal part of the cephalic vein

has been ligated and divided, the adequate space for the graft in the tunnel was performed. According to some authors, interrupted longitudinal incisions were made over the course of the vein to ligate and divide the tributaries, preferably on the medial side of the arm (1). Usually, after mobilization and preparation for anastomosis of the cephalic vein, the temporary occlusion was achieved. The using of the heparinized 0.9% solution allows to restore potency of small tributaries. Next, on the anterior side of the arm the tunnel was developed with blunt finger dissection. In the midway of the arm and above the tunnel, the extra, more interrupted longitudinal incision was followed. It secured the perfect haemostasis. End-to-side anastomosis between the distal end of vein and the side of the brachial artery was completed using the suture material like Prolen – 6.0 or Ticron – 6.0. In the place of the dissected free vein, the suction drain was located for 24 or 48 hours.

One of the important complications is infection. In this situation the preventive antibiotic therapy is indispensable, especially in patients with the diagnosis uraemia. For many years Claforan was administered intravenously 2 hours before the surgery. Actually, before the creation of the arteriovenous fistula, patients receive the Vancomycin in a dose of 750mg. This antibiotic therapy decreases the costs of the treatment. After arterialization of the vein, the first injection was performed. It usually occurs after lapse of 4 or 6 weeks. During our experiment, in sporadic cases arteriovenous fistula was used after 15 or 17 days since the day of surgery. Furthermore, the patients did not allow to cannulate the access and to institute the catheter for dialysis.

## RESULTS

In 50 hemodialysed patients the regular flow through the arteriovenous fistula was observed. Fistula thrombosis was the most frequent and most dangerous complication making proper dialysis therapy impossible. After weeks of fistula occlusion, thrombus within the fistula lumen becomes organized on the level of axillary fossa in one patient. In the other two cases this complication was visible just above the created anastomosis. The irregular blood flow was noted in vein branch of the fistula in all the examined cases. In these cases, the vessel was shortened and the new fistula was surgically created. Furthermore, the observed breakdown of the vessel was moderated.

During the postoperative period, in 4 examined patients we observed blood extravasation in the subcutaneous tissue, where the tunnel was created. The reason for the above described complications was imperfect haemostasis. The organized haematoma required no reoperation. In 5 patients, in the place after removal of the suction drain, the local cellulitis was observed. Haemostatic interrupted cutaneous suture and pressure dressing were sufficient therapeutic method in all these cases. It is necessary to underline that no thrombosis was noted in the early postoperative period.

Irrespective of the type of anastomosis used in the formation of the subcutaneous arteriovenous fistula, late complications associated with vascular access represent one of the most frequent and significant problems encountered in a chronic hemodialysis center. The late vascular complications were evaluated in 15 cases. Aneurysms were noted clinically in 3 patients. The aneurysm and aneurysmal dilations were formed in the areas of venous branch. The aneurysms were 2-5 cm long. Above the aneurysm the venous stenosis was observed. The described complications required no surgical correction. No specific therapy was undertaken except to avoid using of these areas for cannula insertion. Abnormal fistula needle placement was required in 1 patient. In this case the large haematoma was developed and surgical intervention was needed. The patient was subjected to evacuation of haematoma with revision of the fistula. After this surgical intervention the fistula flow was adequate. In the performed study, in 2 patients the false aneurysm in the venous branch was found. In these cases, we noted the decreased arterial flow and increased venous resistance so that

adequate dialysis could not be achieved. The surgical removal of aneurysm provided adequate fistula flow rates.

Late thrombosis, in patients with poor fistula flow rates, was associated with venous stenosis. Mild and severe stenosis represents the complication arising from the chronic use of the subcutaneous fistula. It may also result from wrong surgical technique like incorrect vein or prosthesis placement in the subcutaneous tissue leading to its torsion or bending or wrong selection of vessels. Actually, iatrogenic stenoses resulting from the abnormal use of needles during dialysis are very rare. The responsibility of the dialysis nurse is also considered. In some cases, the caused of the described complications remain unclear. During the study period, which lasted from 1 month to 10 years, the adequate fistula flow and no complications were noted.

## DISCUSSION

Well functioning vascular access is the prerequisite for chronic hemodialysis treatment. During the last decade renal transplantation became highly therapeutic. The theoretical progress and new technical possibilities can improve the quality of the patient life. The access problems remain the major difficulty associated with chronic hemodialysis. Despite recent recommendations by the Dialysis Outcomes Quality Initiative (DOOI) that arteriovenous fistulas are the optimal form of vascular access grafts and central catheters are used by a lot of patients (6).

Arteriovenous fistula, between the radial artery and cephalic vein on forearm, used for hemodialysis, were usually performed. In patients, in whom the usual sites for fistula have been exhausted or in whom very poor vessels were encountered, the vascular fistula on the arm was placed. On the basis of the above investigations it can be stated that the best place for the arm's fistula is anastomosis place of the cephalic vein with the brachial artery on the anterior side of the arm and above the cubital fossa. During clinical trials we observed the benefits of the arteriovenous arm fistula such as: a technically simple way of surgical creation, a size that will allow for cannulation, and a long period of fistula potency.

To address this issue, 53 patients with end-to-side arteriovenous fistulas on the arm were studied. The early failures have been found in 12 cases. In these patients no complicated methods of reparation were required. The late complications were noted in 15 cases. Wrong nephrological management could be responsible for iatrogenic complications. Stenosis of central veins due to the introduction of a double-lumen catheter poses separate problems (10, 11, 12).

## CONCLUSIONS

1. The anterior side of the arm is the best place for arteriovenous access used for hemodialysis in patients without the possibilities of surgical creation of the forearm's fistula.
2. The prophylactic and parenteral administration of antibiotic in the minimal dose allows to avoid the infectious complications.

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## SUMMARY

The chronic dialysis is the way of replacing the lost kidney function. Well functioning vascular access is the prerequisite for chronic hemodialysis treatment. The arteriovenous fistulas are the optimal form of vascular access. In patients, in whom the usual sites for fistula have been exhausted the vascular fistula on the arm was placed.

53 dialysis accesses were performed on the arm between 1989 and 1999. All subcutaneous fistulas were created by the junction of the cephalic vein with brachial artery, just above the cubital fossa on the anterior surface of the arm. All anastomoses were created in the operating room under local anesthesia. The preferred route for exposure of cephalic vein was making the single incision along the arm. When the distal part of cephalic vein has been ligated and divided, the adequate space for the graft in the tunnel was performed. End-to-end anastomosis between the distal end of vein and side of brachial artery was completed using the suture material.

In 50 hemodialysed patients the regular flow through the arteriovenous fistula was observed. Fistula thrombosis occurred in 2 cases. In 4 examined patients we observed blood extravasation in the subcutaneous tissue, where the tunnel was created. In 5 patients the local cellulitis was noted. The late vascular complications were evaluated in 15 cases. Aneurysms were revealed clinically in 3 patients and false aneurysm occurred in 2 patients. The described late complications required no surgical correction.

The anterior side of the arm is the best place for arteriovenous access used for hemodialysis, in patient without the possibilities of surgical creation of the forearm's fistula.

#### Wytworzenie dostępu naczyniowego na ramieniu dla celów hemodializy

Uzyskanie dobrego dostępu naczyniowego do celów hemodializy stanowi istotny problem w leczeniu chorych z przewlekłą niewydolnością nerek. U chorych dializowanych w przypadku braku możliwości wytworzenia klasycznej przetoki tętniczo-żylniej (AV) na przedramieniu można wykonać dostęp naczyniowy na ramieniu. Wykonuje się to przemieszczając podskórnie żyłę odłokciową na przednią powierzchnię ramienia i dokonując jej zespolenia do boku tętnicy ramiennej, powyżej zgięcia łokciowego.

W pracy zbadano 53 pacjentów, u których wykonano przetoki na ramieniu. Przedstawiono również powikłania, które wystąpiły w różnym okresie. Dobry dostęp naczyniowy uzyskano we wszystkich przypadkach. W trzech przypadkach obserwowano utrudniony przepływ przetokowy, który był spowodowany załamaniem światła żyły powyżej miejsca zespolenia. Po skróceniu naczynia i wytworzeniu nowego zespolenia uzyskano prawidłową hemodynamikę przepływu. Popelnione błędy techniczne zostały naprawione natychmiast w czasie trwania zabiegu. W odległym okresie po operacji najczęstszym powikłaniem był zakrzep w części żylniej przetoki. Główną przyczyną późnych powikłań były błędy popelnione w trakcie użytkowania przetoki.

Wytworzenie dostępu naczyniowego na ramieniu jest standardem dla chorych, u których wykorzystano możliwości wytworzenia przetoki tętniczo-żylniej na przedramieniu.

