PROPHYLAXIA OF COMPLICATIONS IN THERAPEUTIC ARTERIOVENOUS FISTULAE

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Summary: The most important causes of failed arteriovenous fistulae are stenosis, thrombosis, infections, hand edema, aneurysms, haematoma and arterial stealing. That is why we should put into practice the necessary and effective prophylactic measures in order to prevent complications that could totally or partially compromise functionality of fistula. This could be achieved by choosing the proper vessels for making the shunt, by using a faultless surgical technique, by exposing the anatomical elements via an adequately-located and adequately-sized access way, by total control of distal and proximal blood flow, by perfect suture and haemostasis and by strict asepsis and antisepsis conditions. The undertaken study on 972 patients who presented 86 complications after undergoing therapeutic arteriovenous fistulae showed an 8.8% rate. Early complications were represented by thrombosis (1.7%) and the late complications by infections (1.2%) and aneurysms (3.1%).

Keywords: therapeutic arteriovenous fistulae, complications.

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Introduction

Therapeutic arteriovenous fistulae (AVF) represent the best ways of performing haemodialysis in patients with renal insufficiency in uremic stage. In order to accomplish this goal they should function well for a long time. This could be achieved by using a faultless surgical technique, by manipulating the fistulae on conditions of perfect asepsis and by preventing haemodynamics and clotting disturbances/disorders. The most important cause of failed arteriovenous fistulae are stenosis, thrombosis and infections. That is why we should put into practice all the necessary prophylactic measures in order to prevent complications that could compromise totally or partially functionality of fistula.

Material and method

The study was undertaken on 972 patients who presented 86 complications (representing 8.8%) after undergoing therapeutic arteriovenous fistulae. 77 cases with complications (7.9%) out of 86 required a second surgical procedure/readmission and 9 cases (0.9%) required a conventional conservative treatment. Complications occurred early in time during the procedure or on the first days after the surgery in 25 cases (2.5%) and late in 61 cases (6.3%).

Tables 1 and 2 show the occurrence of complications. The data have been collected and systematized after studying the medical records and surgical protocols. The patients have been followed-up and examined during haemodialysis sessions and cross-examinations required by nephrologists or when patients were readmitted.

Results and discussions

Hematomas occur early or late in time. They represented 0.7% of complications that occurred after performing arteriovenous fistulae in our lot of patients. The early hematoma occurs when there is a deficit in
Haemostasis, deficit in blood clotting or when there are damaged tissues. Preventing the hematom could be done by preoperative detection of clotting disorders and anaemia and by correcting them and making tight shunts correct surgical haemostasis and protecting the superficial vessels in cases of necessary decollement and tunneling for prosthetic fistulae. Late hematomas can occur at fistula’s puncture site, when the artery is accidentally punctured after dilation or trombectomy manoeuvres. The methods of prevention consist in: avoiding repeated punctures in the same place and puncture of artery and forced tractions of Fogarty catheter in cases of stenosis or thrombosis (they could cause breaking of the wall).

Infections are defined as severe complications of arteriovenous fistulae that can totally compromise the fistula and endanger patient’s life through sepsis. In our lot it was reported a frequency of 1.4%. When performing a vascular abord you should make use of an aseptic manipulation technique and if there are any signs of infection you should begin treatment as soon as possible. The risks of infecting the arteriovenous fistulae are higher in the puncture site and when the vascular prosthesis are used. In order to prevent these you should put into practice measures such as: correct disinfection of skin in the puncture area; reducing of needle manipulation manoeuvres, avoiding the contamination of teguments in fistula area during body hygiene; avoiding the contamination of vascular prosthesis and decollement of skin wound.

Thrombosis is one of the most frequent complications of vascular abord(2,4%) and could be classified into early and late thrombosis. The main causes for acute thrombosis are: dehydration, hipotension, the increase in haematocrit, infection, hiperoagulability. Acute thrombosis of fistula could occur during the surgery or in the first hours after performing the surgery. In order to prevent its occurrence you should perform a complete pre-operative clinical exam/screening and a set of lab tests that could highlight fluido-coagulant balance disorders or could show an anaemic syndrome that is frequently encountered in cronic renal insufficiency. Cardiovascular diseases with thrombogenous and emboligenous potential, arterial hipertension or hipotension have been reported, dehydration and hemoconcentration, which can cause thrombotic complications. All these diseases and pathological conditions should be balanced before making a decision regarding the performing an arteriovenous fistula.During the surgery thrombosis of fistula can occur and it can be caused by stenoses of anastomoses, the incorrect angle of vessels, tension of vein, intraluminali thrombs,

### Table 1. Early complications of AVF

<table>
<thead>
<tr>
<th>Complications</th>
<th>No. of cases</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>External haemorrhage</td>
<td>4</td>
<td>0.4</td>
</tr>
<tr>
<td>Hematom</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Infections</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Early thrombosis</td>
<td>17</td>
<td>1.7</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>2.5</td>
</tr>
</tbody>
</table>

### Table 2. Late complications of AVF

<table>
<thead>
<tr>
<th>Complications</th>
<th>No. of cases</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematom</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Infections</td>
<td>12</td>
<td>1.2</td>
</tr>
<tr>
<td>Late thrombosis</td>
<td>7</td>
<td>0.8</td>
</tr>
<tr>
<td>Anevrism</td>
<td>26</td>
<td>2.7</td>
</tr>
<tr>
<td>Pseudoanevrism</td>
<td>4</td>
<td>0.4</td>
</tr>
<tr>
<td>Edema of the upper limb</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
<td>6.3</td>
</tr>
</tbody>
</table>
obstacles by intima decollement, trauma of tissues, short hemostazis. In order to prevent these complications useless and extended decollement and shear on tissues should be avoided. A hemostasis that is rigorous through ligatures and electrocoagulation will be performed and adventitia at the level of anastomosis ends will be carefully removed, in order to get the shunts tight, without taking over tissue fragments that can generate a thrombosis. In order to prevent stenoses or obstructions which can cause thrombosis an adequate selection of vessels in terms of wall quality and vessels caliber should be done. In patients with diabetic angiopathy or hipertension, who show/present rigid arteries at palpation, the forearm radiography is recommended with the purpose of highlighting calcification degree of the arterial wall which can technically affect the anastomosis. The veins which were repeatedly injected and swollen/festered should not be used anymore. Coagulation of venous line could be prevented by ensuring an adequate blood flow and heparinization.

In contrast with postsurgery period, thrombosis at fistula level in a few years' time is unlikely to develop. Thrombosis can occur after infections when a hematom develops in the puncture site, the tromb migrates on puncture needle and scars develop and intima thickens. Aneurysmal dilation and stenosis of arteriovenous fistula determine hemodynamic disorders and stasis and as a result thrombosis occurs. Prophylaxis of late thrombosis is done by avoiding repeteated punctures in the same place, by preventing infections in the puncture site, dehydation and hipotension, by ensuring an adequate heparinization and surgical removal of stenoses and aneurysms.

Aneurysms are frequent complications of arteriovenous fistulae (3,1%). They include arteries, veins and grafts. Aneurysmal dilations could be classified into true and false. The major cause of aneurysms occurrence is increasing in intravascular tension due to stenosis or thrombosis of the vein next to anastomosis site. Inflammation in the puncture site of an arteriovenous fistula can determine swelling dilation of aneurysm. In addition to this, stenosis and thrombosis of cephalic vein secondary to inflamation, could often cause increasing of distal venous tension and vein dilation. In case of side-to-side anastomosis, turbulences/disorders that develop in the junction between mediane dorsal vein of the hand and cephalic vein determine thickening of intima and cause varicous dilation of venous distal segment. Repeteated punctures in the same place represent a major cause for aneurysmal dilation, that is why veins must be punctured on a large area. Aneurysms occur more frequently in fistulae with grafts insert than in common fistulae. In order to prevent aneurysms the following prophylactic measures should be put into practice: maintaining a rigorous/strict asepsis during puncture and after to prevent infection, doing punctures in various places and performing hemostazis in the puncture site. Repeteated punctures are done in the same place when the brachial artery gets superficial. In order to avoid this situation extensive superficialization is recommended. In these cases superficialization of both brachial arteries is necessary for an alternative use. Complete hemostazis at the puncture level must be achieved by an adequate compression. Large caliber needles should not be used because hematom caused by their usage tend to communicate with vascular lumen in the puncture site, this way creating a false aneurysm.

Edema of the upper limb is a symptom that occurs frequently after performing a arteriovenous fistula. If the edema is discreet with no subjective signs, surgery is not necessary but if it is increased and accompanied by pain, ulceration and skin pigmentation (0,5%), it should be treated promptly. General and local conditions involved in developing hand edema are the following: side-to-side anastomosis with a distal segment of cephalic vein that is permeable, thrombosis or stenosis of venous proximal segment forcing distal segment, inversed fistula in cubital fossa, arterial hypertension. Patients with synthetic grafts (teflon, E-PTFE) show frequently hand edema secondary to exudate from the graft level and venous hypertension caused by the increased blood flow. Hand edema in the case of arteriovenous fistulae could be prevented by choosing a mounting/assembling which is different from side-to-side anastomosis in cases when venous hypertension occurs in hand/arm. Insufficiency of venous valves, which is secondary to valve lesions caused by repeteated punctures represents a cause factor in the developing of symptomatology. If thrombosis occurs in proximal segment of efferent vein, the draining will be done through distal segment of cephalic vein that communicates with basilic vein through the hand venous network.

Stealing syndrome (Sindromul de furt) occurs in anastomoses that were created in proximal segment of large arteries. Most of the blood that flows through the artery goes through fistula too, (the part with the lowest peripheral resistance), causing a dramatic decrease in blood flow in distal part of artery. Short peripheral circulation caused by diabetic arteriosclerosis is
considered to be a triggering factor for the occurrence of stealing syndrome. The prevention of stealing syndrome consists in decreasing in shunting blood and ensuring a sufficient flow for peripheral tissues. It should be considered the following methods: when the lateral side of arteries is used, the distal arterial segment should be ligatured, reducing the arterial inflow or venous outflow by vascular narrowing, creating a shunt with poor flow.

**Conclusions**

The prophylaxis of arteriovenous therapeutic fistula complications is essential for a good and long-lasting functioning of a valuable mounting/assembling and for the access to hemodialysis of patients with renal insufficiency in urismic stage.

The successful outcome of arteriovenous fistula surgery depends on the accuracy of surgical technique. An accurate surgical technique is achieved after basic training in vascular surgery and a vast professional experience.

The major prophylactic measures comprise the following:

- perfect exposure of anatomical elements, adequate instruments and non-invasive surgical manoeuvres
- achieving tight shunts with the help of adequate material, permeable mounting/assembling, perfect hemostasis
- intima to intima suture, without any tensions and angulation
- maintaining good hemodynamic conditions from volemic, tensional and vasomotor point of view
- rigorous asepsis and antisepsis conditions.

**References:**