COLLATERAL CIRCULATION IN FEMORAL ARTERY DISEASE

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Summary

21 cases (42 extremities) of stenosis of the superficial artery of the hip are described. The most struck zones of the femoral artery, which are subject to occlusion, are defined, most often owing to formation of atherosclerosis (32 extremities). Sexual and age features come to light at stenosis manifestation, allowing us to draw a conclusion that the men, and also the people who have reached 60 years and more are exposed to atherosclerosis of a superficial femoral artery. Also is given an assessment of a collateral blood circulation of a hip, depending on quantity of neogenic collateral vessels for providing cells with oxygen.

Rezumat

Circulaţia colaterală în ocluzia arterei femurale

Au fost descrise 21 de cazuri (42 extremităţi) de stenoză a arterei femurale superficiale. În lotul de studiu, cele mai frecvente afecţiuni ale arterei femurale care determină o ocluzie sunt preponderent consecinţa unui proces de aterogeneză (32 extremităţi). Caracteristicile de gen şi vârstă reprezintă determinanţii esenţiali în manifestarea clinică a stenozei, sugerând concluzia precum bărbaţii şi, în special, persoanele care au atins vîrsta de 60 de ani sau mai mult, sunt expuse preferenţial unei ateromatoze a arterei femurale superficiale. Evaluarea circulaţiei colaterale în regiunea coapsei, în funcţie de cantitatea de vasele colaterale neoformate, indică grade diferite de compensare distală a extremităţii.

Actuality

Today there is actual to study the arterial course of the hip which detailed research helps to define an alternative location of collateral vessels at an occlusion of a femoral artery.

Atherosclerosis and the related diseases are the actual national problem. Over the last 50 years was changed for the worse not only the rate of development of atherosclerosis (from lipidic spots to an occlusive plaque), but also a pathology of target organs [22]. So, defeat of vital organs became frequent already at young faces, women and even representatives of active professions. Usually the incidence of atherosclerosis increases with age, men after 40 years are more predisposed to it.

Atherosclerosis is diagnosed with two external manifestations: this is lameness and existence or lack of pulse in arteries of the low extremities [11, 20].

The organism often starts forming roundabout ways of organ supply at long existence of plaques, thus are formed new vessels round the struck site. And therefore simplification comes in patients who have atherosclerosis for a long time. The unstable, recently formed plaques of are most dangerous that they less dense and quickly break up. They are the reason of sharply proceeding vascular diseases at rather young people [17].

According to WHO definition, atherosclerosis is a variable combination of changes of arterial intima, and namely, accumulation of the lipids, difficult carbohydrates, fibrous tissue, blood components, calcification and accompanying changes of media [13]. One of the most frequent manifestations of atherosclerosis is the obliterating diseases of arteries of the bottom extremities (ODABE). Prevalence of ODABE in the developed countries is rather high – from 3 to 10% [5]. According to epidemiological researches, occurrence of atherosclerosis of arteries in the low extremities at persons after 70 years constitutes from 15 to 20% [5].

Development of collateral blood circulation occupies an important place in compensation of blood circulation at ODABE. Formation of new collateral vessels is mediated by a vascular endothelial growth factor (VEGF) [2,8, 22]. It plays the role of alarm protein participating in

vasculogenesis (formation of embryonic vascular system) and angiogenesis (growth of vessels from already existing vascular system). It is the part of system which restores the supply of oxygen to tissues when blood circulation is insufficient. The normal VEGF functions — creation of new blood vessels in an embryonic development or after a trauma (collateral blood circulation) to bypass the blocked vessels; strengthening of muscles growth after physical exercises [8].

Production of VEGF can be caused in the cells which don't receive enough oxygen. When the cell is in oxygen deficiency, it makes HIF [3], a hypoxia -induced factor of a transcription. HIF stimulates VEGF release among its other functions. VEGF circulates in a blood-groove and contacts a VEGF receptor on cells of endothelium, causing tyrosine kinase, which provokes the processes of angiogenesis [26]. Alpha HIF and beta HIF are constantly produced, but alpha HIF is extremely unstable to oxygen [1], thus, in aerobic conditions it collapses. When the cell suffers from hypoxia, alpha HIF remains in blood much longer, and the complex of alpha-beta HIF stimulates VEGF release [8,16].

R. ascendens a. circumflexae femoris medialis, *a. circumflexa femoris lateralis, a. circumflexa ilei superficialis, a. pudenda externa* [7] take part in roundabout blood circulation of a hip, in case of occlusion of a femoral artery beyond of the separation of a deep artery of a hip.

The source of formation of the arteries which bend around a femur depends on a place of the departing of the deep artery of the hip. There was defined the regularity when at the low level of the departing of a deep artery of a hip (lower than 5,5 cm from an inguinal sheaf), the arteries which are bending around a femur, were formed from the femoral artery. If the deep artery of a hip departed above level of 4,5 cm, bending-around arteries departed from it in 97% of cases [6].

A. circumflexa femoris medialis connects with system of branches of *a. hypogastrica*, namely with *aa. gluteae superior et inferior*, besides, with *a. obturatoria* system. At an occlusion of a femoral artery throughout its average third the roundabout blood circulation for distal part of the artery will be carried out at the expense of *a. circumflexae femoris medialis et a. circumflexa femoris lateralis* which give a large number of muscular branches for bringing and bending groups of muscles, *a. circumflexa femoris lateralis* for unbending group of muscles of a hip. At the expense of *aa. perforantes, prima, secunda et tertia* can be formed the roundabout blood circulation for distalny department of a femoral artery where *a. obturatoria*, *aa. circumflexa ilei superficialis et profunda, aa. gluteae superior et inferior* will take part in this forming through connecting [6,18].

The same arteries and also *a. genus descendens* take part at an occlusion of a femoral artery in the lower third of a hip in roundabout blood circulation, which connect with the vessels participating in formation of *rete articulationis genus* [15].

Purpose

Definition of the zones of a femoral artery which are most struck by ODOBE, detection of sexual and age features in stenosis manifestation, and also estimation of collateral blood circulation of a hip.

Material and methods

The data made on the basis of the analysis of 21 angiograms (42 extremities) of patients with a clinical picture which were made during the period from 2008 to 2012 in office of vascular surgery of Republican Clinical hospital are put in the stem of work, and also there were dissected one fresh and one fixed corpses. Occlusion localization was studied in various parts of a femoral artery, an alternative arrangement of a stenosis in relation to the left and right extremities was defined, sexual and age features were investigated, and also was made a gradation in the development extent of the collateral vessels on a scale from 1 to 5. The obtained data were exposed to the statistical processing.

For the research were used the following accesses:

1. At the bent knee, on a medial surface of a hip, over a medial epicondyle of a hip, in the field of Jober pole was performed a section of 10 cm long.
2. On a forward surface, within a femoral triangle was made a section on the line of Ken of 10 cm long which began with 1 cm below than a Pupart ligament. The branches of a femoral artery and it connectings were allocated consistently.

We dissected a male corpse of 56 years old (1957).

The foot was bent a little in a knee. We made a section of the skin, hypodermic fatty cellulose and a superficial fascia along a tendon of a big bringing muscle up from internal epicondyle of a hip. Then we dissected a wide fascia over an interval between muscles: big bringing in front and semitendinosus, semimembranosus and thin behind. We allocated a popliteal artery in fatty cellulose of a popliteal pole, having moved apart the mentioned muscles with hooks, without injuring the vein of the same name and the tibial nerve, arranged more externally. Then we bared a femoral artery up in the line of Ken, separated an artery and its branches from surrounding tissues, recorded it (Fig.1). After all we drew conclusions about the state of development of collateral vessels in this area and performed the same manipulations on the second extremity.

Fig. 1. The branches of the femoral artery.

Further we opened the femoral artery longitudinally for cholesteric plaques and blood clots detection. We noticed a small plaque at one extremity (Fig.2), at a department place of a deep artery of a hip from a femoral artery. On the second extremity the plaque was already larger, but in the same place.

Fig. 2. Atherosclerotic plaque in the femoral artery.

Results

In the analysis of angiograms in 32 cases (76%) the stenosis of a femoral artery was noted. In 20 cases (63%) the stenosis was situated on the top third of a femoral artery (t.t.), in 7 cases (22%) – on an average third (a.t.) and in 5 cases (15%) – on the bottom third (b.t.) .

It is established that in 11 patients the occlusion of the femoral artery occurred on both feet, in 3 patients – on the left foot (l.f.) and in 7 patients – on the right foot (r.f.).

Here we completely came into conformity with statistics. Both extremities suffer much more often from the manifestation of atherosclerosis than one of them.

Women (W) are less predisposed to stenosis of the femoral artery (9,5%), while men (M) suffer from it in a much bigger measure (90,5%).

On the figure 3 it is obviously illustrated age influence as natural risk factor.

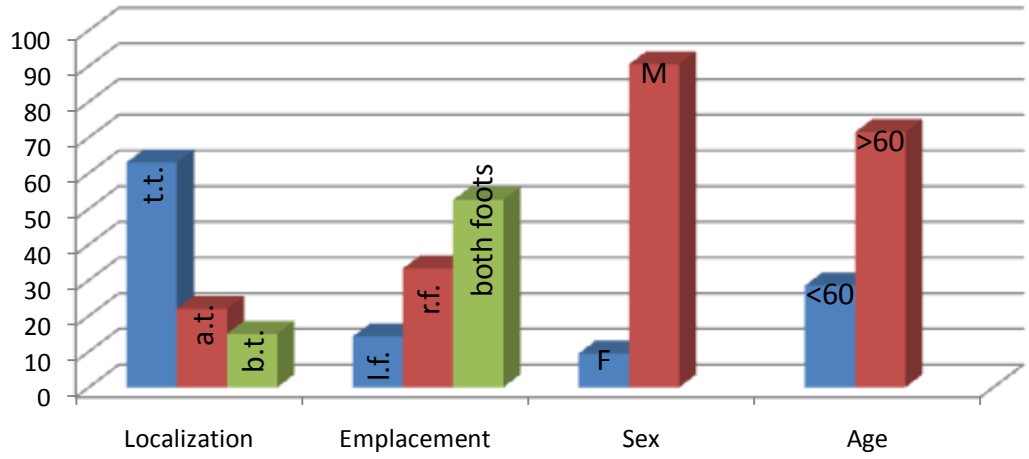

Fig. 3. Diagram.

It was defined, that not at all the good roundabout course is observed and the assessment on a scale from 1 to 5 was therefore given (Table 1).

The scale	1	2	3	4	5
The number of extremities	8	5	9	5	5

Table 1.

Fig. 4. Angiograms are estimated on 1, 3 and 5, respectively.

Intake of blood to peripheral departments of an extremity is reduced at the injury of a femoral artery on any of its sites because of need of its bandaging for the stopping of bleeding or because of blood clot formation. Viability and function of peripheral department of an extremity significantly isn't broken sometimes thanks to good development of collateral vessels which compensate the lost source of a blood supply for tissues (Fig.4). The necrosis (gangrene) of distal part of an extremity develops owing to ischemia at insufficient existence of additional vessels.

Fig. 5. Injury of the femoral artery. Open wound.

It is possible to cite as an example some clinical cases.

Case 1. The man was traumatized on production. In inguinal area was formed the superficial open wound which strongly bled because of injury of a femoral artery (Fig.5). The deep artery of a hip came off as a result of strong blow in the place of the separating of femoral artery. In a place of damage was probed a dense pulsing painful formation which was regarded as aneurism (Fig.6). In department of angiosurgery was alloyed the deep artery of a hip, was sewn up in a damage place the general femoral, the cavity of aneurism was drained. Formation of collateral arteries is important for replacement of functions of the alloyed deep artery of a hip in further recovery. Rotting of tissues began owing to age of the victim (62 years) and a lack of blood supply, there was a necrosis, was required the amputation. The patient remained without a foot.

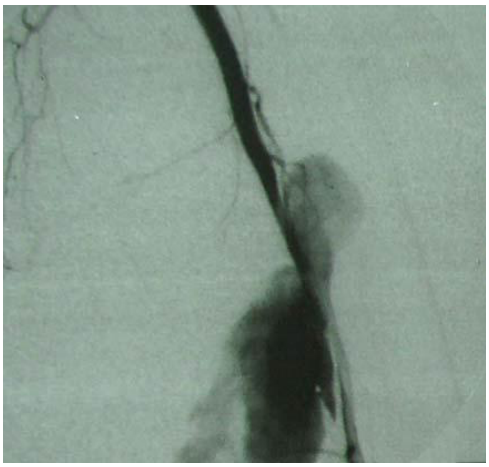

Fig. 6. Aneurism of the femoral artery.

Case 2. The patient of 23 years old arrived in section of angiosurgery of RKB 22.09.2000 with pain in the right inguinal area, lack of active movements, existence of an open purulent wound on the right in inguinal area. It is known that he used drugs injections in the femoral vein, as a result was formed the hematoma which was operated earlier. There the hematoma was drained and was fitted a prosthesis of the right femoral artery. In a week there was a volume painful formation which increased in sizes in Skarp's triangle. He was operated repeatedly, an prosthesis was removed and the femoral artery was alloyed. Extremity ischemia began to progress, wasn't probed pulse on peripheral arteries. An anatomic ilio-femoral connecting from

left to right was made, having bypassed the damaged site (Fig.7). The blood-groove in the extremity was restored. Functions of the right foot were kept. The superficial wound was healed. He was wrote out at 2.10.2002.

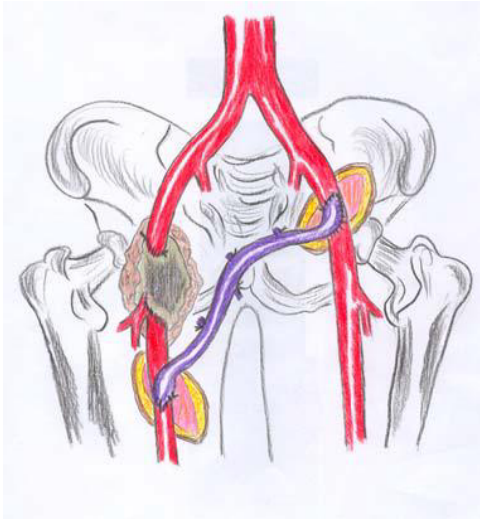

Fig. 7. Intervention scheme: ilio-femoral by-pass.

Discussion

It is possible to draw a conclusion that the essential role in the mechanism of aterogenesis is played by a hemodynamic factor from everything which was stated. It is shown in damaging local influence of current of blood on vessel endothelium, in places of physiological or pathological bends of vessels and places of division into branches [24]. In these sites the peripheral resistance and hydrodynamic pressure upon vessel walls increases, that leads to endothelial damage, conducts to violation of its permeability, to penetration of various components of plasma of blood into an internal cover of arteries, and to a local thickening of an internal cover, subsequently to a stenosis [9,10,21].

We confirmed a certain regularity that women suffer from ODABE more frequently than men. Lipoproteins of the high density (LPVP) participate in the removing of cholesterol from struck vessel intim, providing so-called return transport of cholesterol. Accurate inverse relationship between concentration of LPVP cholesterol and risk of IBS is proved. At women of genital age concentration of LPVP cholesterol is higher, than at the male contemporaries, and women have atherosclerosis less often in many respects thanks to it. Therefore, our patients are not a deviation from general statistics, and we can really confirm the important influence of lipoproteins of the high density on formation of atherosclerotic plaques [12].

The age also plays an important role in formation of atherosclerosis of a femoral artery. It's the natural risk factor. Atherosclerotic manifestations are aggravated with age. Statistical data confirm our researches, after all the age really aggravates all possible pathological conditions in a human body [12].

The lost vessel is replaced by the next, smaller one. The replacing vessel (collateral) develops to the necessary sizes in some hours or days. Thus the lumen of the vessel can increase in 10 times in comparison with its initial size [19]. According to other data, collaterals develop in 3 months after emergence of blood clot (for the case of the retina vein thrombosis) [23]. Collaterals weren't strongly developed in our case, and the exact reason of it can't be defined. It is possible to assume that to cells of tissues the metabolic exchange was rather at this level of development and functioning [14].

Some researches prove that when the vessel is overlapping at a certain level sometimes happens its natural anastomoses are enough for providing with blood the corresponding tissues [23]. There is no need for construction of new vessels, only the diameter of existing roundabout ways increases a little [15,18]. It can explain to a certain extent why in our researches, even despite existing atherosclerosis, sometimes there is no existence of the collaterals.

Conclusions

1. The top third of the femoral artery is exposed to a stenosis most often in places of physiological or pathological bends of vessels or its divisions into branches (63%).
2. Occlusion of a femoral artery is more often shown on both extremities (52,5%) and one less often (47,5%).
3. Men are exposed more often to a stenosis of a femoral artery (90,5%), than women (9,5%).
4. People who have reached 60 years and more (71,5%) are more subject to a stenosis of a femoral artery.
5. Development of collateral vessels of a hip varies depending on an arrangement of a stenosis of the femoral artery, and also from age and a sex of the patient.

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ANATOMICAL VARIATIONS OF AXILLARY ARTERY WITH CLINICAL IMPLICATIONS

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Summary

Axillary artery is frequently injured due to the trauma of the shoulder region. Nevertheless the management of such injury is often controversial and several techniques have been developed in vascular surgery in the last years. The variations of the axillary artery can