

Treatment of local complications that develop after catheterisation through the femoral artery puncture

Perkutaninio šlaunies arterijos kateterizavimo vietinių komplikacijų gydymo taktika

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Objective

To determine what is the rate, type, and the best treatment of local femoral access complications after interventional cardiology catheterisation procedures through percutaneous femoral artery puncture.

Materials and methods

Retrospective analysis of 166 patient medical records was carried out. All the patients underwent coronarography for the suspected coronary artery disease. All of them from 2007 to 2011 developed local femoral access complications. All complications were diagnosed and treated by vascular surgeons.

Results

The study group consisted of 96 (57.8%) women and 70 (42.2%) men. The average age of the patients was 69.1 years (± 11.4 years). Limb ischemia was determined in 63 patients (38%). After catheterisation due to cardiovascular pathology, femoral artery pseudoaneurysm developed in 162 patients (97.6%), arteriovenous fistula in 3 patients (1.8%), and massive hematoma in 1 patient; 111 patients (66.9%) were treated conservatively and 55 (33.1%) surgically. The surgically treated group consisted of 37 women (67.3%) and 18 men (32.7%). The average age of surgically treated patients was 69.9 (± 10) years. Pseudoaneurysm removal and venous patch plasty were performed in 33 patients (60%). The removal of blood clots and direct suture of arterial defects were performed in 22 patients (40%).

Conclusions

166 patients (0.706%) developed local vascular complications after cardiovascular interventions through the femoral artery. Pseudoaneurysm was the most common complication after femoral artery catheterisation. Conservative treatment was successful in 111 patients (66.9%). Local vascular complications of the puncture site were more common in patients with a peripheral arterial disease ($p < 0.01$).

Key words: iatrogenic femoral artery damage, pseudoaneurysm

Darbo tikslas

Nustatyti po intervencinių kardiologinių procedūrų per šlaunies arteriją susidariusių vietinių komplikacijų dažnį, pažeidimo vietos tipą ir optimalų gydymo metodą.

Tyrimo medžiaga ir metodai

Atlikta 166 pacientų, 2007–2011 metais patyrusių vietinių komplikacijų po kateterizavimo dėl įtariamos vainikinių arterijų patologijos, ligos istorijų duomenų retrospektyvi analizė. Vietinės kraujagyslių komplikacijos diagnozuotos ir gydytos kraujagyslių chirurgų.

Rezultatai

Tiriamąją grupę sudarė 96 (57,8 %) moterys ir 70 (42,2 %) vyrų. Vidutinis pacientų amžius buvo 69,1 metų ($\pm 11,4$ metai). 63 pacientams (38 %) nustatyta sutrikusi kojų arterinė kraujotaka. Po kateterizavimo, atlikto dėl širdies kraujagyslių sistemos patologijos, šlaunies arterijos pseudoaneurizma išsivystė 162 (97,6%), arterioveninė fistulė – 3 (1,8 %), didelė hematoma – 1 pacientui. 111 (66,9 %) pacientų gydyta konservatyviai. Chirurginio gydymo prirėikė 55 (33,1 %) pacientams. Operuotos 37 moterys (67,3 %) ir 18 vyrų (32,7 %). Vidutinis operuotų pacientų amžius buvo 69,9 (± 10) metai. Pseudoaneurizmos pašalinimas ir arterijos plastika venos lopus atlikta 33 (60 %) pacientams, pašalinti krešuliai ir užsiūti arterijos defektai 22 (40 %) pacientams.

Išvados

Vietinių kraujagyslių komplikacijų po intervencinių kardiologinių procedūrų per šlaunies arteriją įvyko 166 pacientams (0,706 %). Dažniausia komplikacija po šlaunies arterijos kateterizavimo – pseudoaneurizma. Pseudoaneurizmos sėkmingai gydytos konservatyviai 111 pacientų (66,9 %). Punkcijos vietos kraujagyslių komplikacijos buvo dažnesnės ligoniams, kuriems buvo periferinių arterijų aterosklerozinis pažeidimas ($p < 0,01$).

Reikšminiai žodžiai: jatrogeninis šlaunies arterijos pažeidimas, pseudoaneurizma

Introduction

According to the medical literature, complications after interventional catheterisation procedures through percutaneous femoral artery puncture occur in the range of 0.05 to 3.6 % [1, 2] (Table 1). Local iatrogenic vascular

complications can be false aneurysm (pseudoaneurysm), arteriovenous fistula, hematoma, bleeding from the puncture site, occlusion of the artery (dissection, thrombosis or peripheral embolisation), and venous thrombosis. Pseudoaneurysm is the most common iatrogenic

Table 1. Rate of complications after catheterisations through femoral artery due to cardiovascular pathology (various authors' data)

Author	Year	Number of catheterisations	Rate of complications
Brener BJ	1971	?	0.05% (n=?)
Messina LM	1985–1989	6912	0.8–2.2% (n=106)
Oweida SW	1985–1988	4988	1% (n=52)
Ricci MA	1994	7690	1% (n=111)
Chatterjee T	1996	9051	1% (n=41)
Ralf Zahn	1998	8715	1% (n=86)
Perna L	1998–1999	16276	0.3% (n=70)
Lenartova M	2003	?	3.6% (n=?)
Ohlow MA	2006–2009	18165	1.8% (n=334)
Santariškių klinikos	2007–2011	23514	0.5–1.7% (n=166)

vascular complication. Pseudoaneurysm develops in the site of vessel wall damage due to inflammation, trauma or malignancy [3, 4]. Iatrogenic pseudoaneurysm develops when after surgical intervention or percutaneous puncture the arterial defect does not heal, and the arterial blood leaks through the defect to the surrounding tissue, forming a pulsatile hematoma. Arteriovenous fistula is a connection between the artery and the vein with the blood from the artery bypassing the capillary network and flowing directly to the vein.

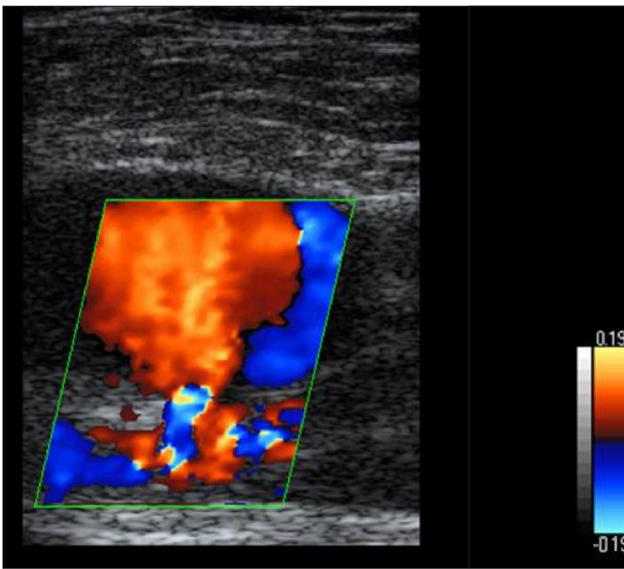


Figure 1. Ultrasound image of pseudoaneurysm

We attributed all the causes of local complications after interventions through the femoral artery puncture to two groups. The first group consists of patient-related factors such as peripheral artery disease, female gender, advanced age, obesity, arterial hypertension, hemorrhagic diathesis, and the use of anticoagulants. The second group consists of risk factors not related to the patients and comprises a large diameter of introducers ($\geq 9F$), long duration of the procedure, and the puncture site distal from the common femoral artery [5]. According to the medical literature, the puncture site at the left groin and the use of anticoagulants predispose to arteriovenous fistula formation [6]. Local complications are usually diagnosed by the ultrasound. When a false aneurysm is present, turbulent blood flow outside the

lumen of the artery and the typical “back-and-forth” phenomenon at the pseudoaneurysm’s neck will often be registered during the ultrasound examination (Figure 1). Computed topographic angiography can be performed in cases when the ultrasound is not informative enough (due to obesity, large subcutaneous hematoma, or when an arteriovenous fistula is suspected).

Small pseudoaneurysm (up to 1 cm in diameter) can thrombose and heal spontaneously within 2 to 4 weeks if the patient does not take any anticoagulants. Such patients can be managed by follow-up surveillance only. The management of large pseudoaneurysms should be given a more active approach. According to the medical literature, there are three methods of their conservative management: applying pressure selectively to the pseudoaneurysm’s neck by the ultrasound probe, i.e. controlled compression ultrasound (CCU), injection of thrombin to the pseudoaneurysm’s sack at the ultrasound guidance, i.e. ultrasound-guided thrombin injection (UGTI), or injecting 25–60 ml of saline solution near the pseudoaneurysm and around its neck. These approaches are not always feasible. Sometimes surgical treatment is necessary. Indications for surgical treatment of false aneurysms and other iatrogenic vascular lesions are the following: surrounding tissue necrosis, rapid enlargement, infection, bleeding, compressive neuropathy, hemodynamic instability, or failure of conservative treatment [7].

Materials and methods

In 2007–2011, due to a suspected cardiovascular pathology 23 514 catheterisations using femoral artery access were performed. We accomplished the retrospective analysis of 166 case histories with local complications following catheterisations using femoral artery access. All the local complications were diagnosed and treated by vascular surgeons. The conservative management of pseudoaneurysms and arteriovenous aneurysms by applying pressure to the pseudoaneurysm’s neck with the ultrasound probe was considered successful when a turbulent “back-and-forth” blood flow outside the lumen of a blood vessel was no longer registered on the ultrasound following the procedure. When the blood flow outside the lumen of a vessel persisted following three compression and short release cycles with the

ultrasound probe, the treatment was considered unsuccessful. When the conservative treatment was unsuccessful, local complications developed rapidly or reached large dimensions. As a result, the surgical treatment was performed, such as the removal of pseudoaneurysm and venous patch plasty or removal of blood clots and a direct suture of the arterial defect was performed.

Before and after the surgery, the limb was evaluated for the signs of ischemia: palpable pulses were noted, and the ankle-brachial index (ABI) was registered. The condition of peripheral arteries was considered bad when the ABI was at 0.8 or below, and good when the ABI was above 0.8. The data were statistically analyzed using the SPSS v20 statistical package.

Results

The study group consisted of 96 (57.8%) women and 70 (42.2%) men. The average age of the patients was 69.1 years (± 11.4 years).

All the complications were revealed by coronarography; 87 patients (52.4%) underwent coronary stenting and 79 patients (47.6%) underwent percutaneous transluminal coronary angioplasty.

After catheterisation due to cardiovascular pathology, femoral artery pseudoaneurysm developed in 162 patients (97.6%), arteriovenous fistula in 3 patients (1.8%), and massive hematoma in 1 patient. The diameter of pseudoaneurysms ranged between 1 and 7 cm.

111 patients (66.9%) were treated conservatively and 55 (33.1%) surgically. The surgically treated group consisted of 37 women (67.3%) and 18 men (32.7%). The average age of surgically treated patients was 69.9 (± 10) years. Pseudoaneurysm removal and venous patch plasty were performed in 33 patients (60%). The removal of blood clots and direct suture of arterial defect were performed in 22 patients (40%).

Pseudoaneurysms of the common femoral artery were encountered in 38 patients (69.1%) and those of superficial femoral artery in 13 patients (23.6%). Arteriovenous fistulas were located between the common femoral artery and the femoral, epigastric, or great saphenous vein. Patients were operated on average 5 (± 4) days after the diagnosis had been made. The average hospital stay was 12 days (range, 2–64).

Limb ischemia was determined in 63 patients (38%) of whom 43 underwent surgical treatment. The condition of peripheral arteries was determined to be good in 103 patients (62%) of whom only 12 patients had to be treated surgically.

Discussion

The number of diagnostic and therapeutic procedures performed through femoral artery puncture is increasing annually. The number of complications is growing mainly due to the increasing number of coronarographies. Interventions could be performed through the radial artery, but it is usually not chosen due to its insufficient diameter. The diameter of the catheters used ranges from 4F to 10F. Even though larger catheters are convenient to use, they are seldom chosen because of the potential damage to the peripheral and coronary vessels. The benefit of small catheters (4F–6F) is a faster post-procedural hemostasis, but the quality of the examination may be lowered by a small diameter not providing a rapid enough contrast flow to the coronaries.

The arterial wall defect immediately after the puncture can be closed using special devices such as clips, seams, or collagen “plugs” [8]. The use of these devices can cause certain complications, such as artery tear, dissection, etc. These devices are seldom used because of their high cost.

In 2007, the number of iatrogenic vascular complications at the Vilnius University Hospital “Santariškių Klinikos” was the highest in five years and reached 1.7% (Figure 2). After the evaluation of complication growth, the following measures were taken and were successful in the stabilization and even reduction of the complication rate: catheters with the diameter 5F–6F started to be used for cardiac catheterisation, the compression duration at the puncture site using weight was increased, and the condition of peripheral arteries before catheterisation started to be evaluated. From 2007 to 2011, the local complication rate after interventions performed through femoral artery puncture at the Vilnius University Hospital “Santariškių Klinikos” is 0.706%. A comparison of our data with the literature data shows that the rate of complications at this hospital is very low.

When the measures taken to avoid iatrogenic vascular complications were unsuccessful, the conservative

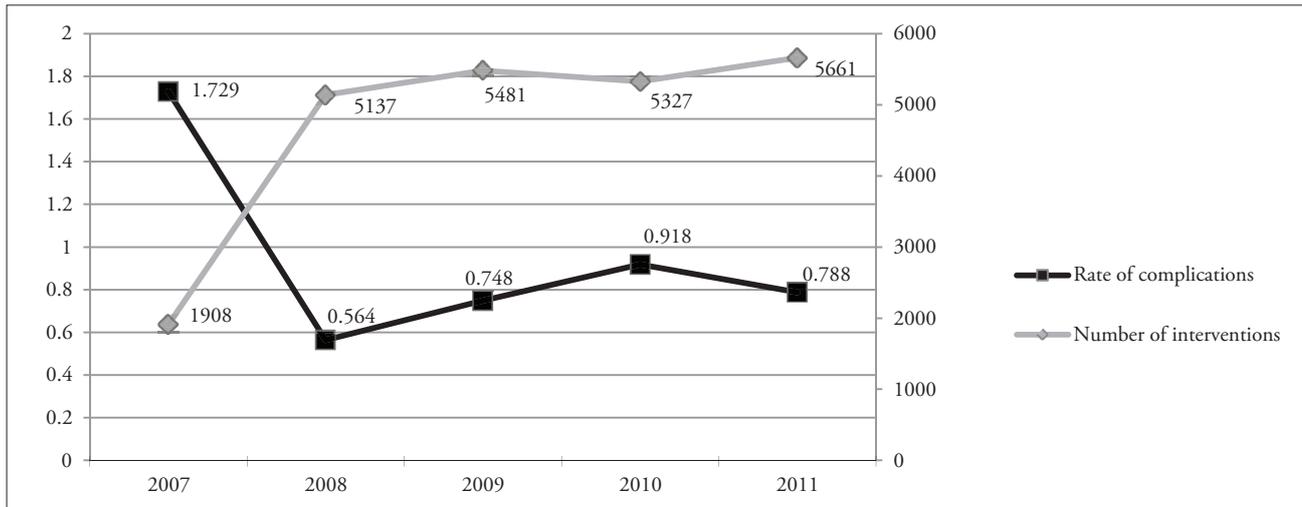


Figure 2. Number of interventions through femoral artery at Vilnius University Hospital Santariškių Klinikos

treatment was carried out. The method of choice was the controlled compression ultrasound (CCU). Its effectiveness, according to various sources in the medical literature, reaches 71–91% [9, 10]. Now, in many cases CCU replaces surgical treatment which was the only feasible method of treatment in many cases of femoral artery pseudoaneurysms in the past. CCU is a safe and economical method of pseudoaneurysm treatment [11]. Within the time period under investigation (2007–2011), the CCU effectiveness was almost 67%, i.e. of the total of 166 pseudoaneurysms 111 were closed successfully. The CCU effectiveness numbers that we calculated are a little lower than those given in the medical literature, though.

In many hospitals abroad, ultrasound-guided thrombin injection (UGTI) is the method of choice [12]. Different authors give different data on the UGTI treatment success. Erik K. Paulson et al. presented an ultrasound study showing the UGTI effectiveness of 90% following the first procedure and 96% following the second

procedure [13]. The study by C. Schneider et al. showed the UGTI to be well tolerated, safe, and effective in 97% of patients following the first procedure [14]. The complication rate after this procedure is very low. The UGTI is most effective if performed within two weeks. Applied in conjunction with compression, it successfully cures partially thrombosed pseudoaneurysms [15]. However, thrombin injection in exceptionally rare cases can cause serious complications. There was one case when, after two unsuccessful CCU, the UGTI was performed, and leg ischemia followed and resulted in amputation [16]. Both bolus and slow thrombin injection are equally effective and safe, even in groups of patients with no pseudoaneurysm neck [17]. Presently, the UGTI is not an approved method in the Vilnius University Hospital Santariškių Klinikos. Despite a large volume of studies showing success of treatment with UGTI, some authors argue that there are clinical benefits of treatment with CCU [18]. It is recommended that pseudoaneurysms smaller than 2 cm should be treated by CCU and those

Table 2. Comparison of treatment methods at Vilnius University Hospital Santariškių Klinikos

Treatment	Complication	Result
Controlled compression ultrasound	Pseudoaneurysm did not close (33%)	Procedure successful in 67% of cases
Removal of pseudoaneurysm and venous patch plasty	Suppuration of the wound (6%), tissue necrosis (1.5%)	All pseudoaneurysms completely removed
Removal of blood clots and direct suture of arterial defect	Massive postoperative hematoma (4.7%)	All pseudoaneurysms completely removed

larger than 2 cm by UGTI. Large pseudoaneurysms should be treated surgically, because the risk of femoral artery thrombosis is high [19]. Another method described in the medical literature is injection of saline solution into tissues surrounding the pseudoaneurysm. A. Finkelstein et al. point out that by this method 92% of pseudoaneurysms can be successfully cured [20]. At the Vilnius University Hospital Santariškių Klinikos vascular surgery department, 55 patients (33.1%) were treated surgically for massive pseudoaneurysms or unsuccessful CCU. All patients were on anticoagulants. The most common method of repair was venous patch plasty (33 patients, i.e. 19.9%), and significantly less common was a direct suture of the arterial defect (22 patients, i.e. 13.3%). According to the medical literature, the most common method of repair is the direct suture of arterial defect, venous patch plasty being less common [21]. After reviewing the intraoperative findings (arterial defects), we came to the conclusion that even though catheters with a smaller diameter had been used, the femoral artery was punctured several times. The surgical tactics used at the Vilnius University Hospital Santariškių Klinikos correlate with the

medical literature data. According to B. A. Perler, peripheral pseudoaneurysms of 31 patients were treated surgically, and 77% of them underwent intervention through the femoral artery because of a cardiovascular pathology. The patients' age ranged between 38 and 89 years (average, 68.1 years). Surgery was performed within 1 to 47 days following catheterisation [22]. The surgical treatment of iatrogenic vascular lesions may lead to certain complications of its own; nevertheless, it is an effective and reliable method for patients who use anticoagulants after interventions because of a cardiovascular pathology.

Conclusions

166 patients (0.706%) developed local vascular complications after cardiovascular interventions through the femoral artery. Pseudoaneurysm was the most common complication after femoral artery catheterisation. The conservative treatment of pseudoaneurysms was successful in 111 patients (66.9%). Local vascular complications of the puncture site were more common in patients with a peripheral arterial disease ($p < 0.01$).

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