OUTCOMES OF IATROGENIC FEMORAL ARTERY LESIONS – TREATMENT RESULTS VALUATION

ALEKSANDER ŁUKASIEWICZ', WITOLD HRYNCEWICZ', MARCIN RYCHTER², STANISŁAW MOLSKI¹

Department of General and Vascular Surgery, CM UMK in Toruń¹
Kierownik: dr hab. S. Molski, prof. nadzw. UMK
Department of Cardiology and Internal Diseases, CM UMK in Toruń²
Kierownik: prof. dr hab. J. Kubica

Percutaneous cardiac interventions are nowadays the most common cause of the femoral artery injury. In these cases, surgical intervention was for many years considered the treatment of choice. Satisfactory results of conservative and minimally invasive treatment has changed the state of art.

The aim of the study was the analysis of treatment results in patients with iatrogenic femoral aneurysm.

Material and methods. In the period of 3 years between 2004 and 2006 in 66 patients an iatrogenic, spure femoral artery aneurysm was recognized. There were 36 women and 30 men in this group. The mean age was 68.8 years. All patients were included prospectively in the study. According to aneurysm morphology, compression pliability and patient choice 45 individuals were assigned to OT group, remaining 21 were treated conservatively: US-guided compression in all patients and thrombin injection if compression failed.

Results. There was one death in OT group due to underlying coronary disease and in our opinion unrelated to surgical treatment. Other major adverse events were one postoperative stroke in OT group and superficial femoral artery thrombosis in NT group. 8 patients experienced minor events and they all were operative wound complications. No other complications were observed in NT group. Postprocedural stay was longer for the OT group (8.7 vs 3.8 days, p<0.05). Length of hospital stay was also significantly correlated with presence of complications (5.5 days for patients without complications and 16.9 days for the complicated cases, p<0.001). The procedure was successful in 95.2% and 100% in the groups of NT and OT respectively.

Conclusions. Utilized criteria of patients’ assignment to conservative and operative treatment allowed plausible treatment results. OT and complications significantly increase the length of hospitalization. It is mandatory to remember of possible thrombotic complications related to thrombin injections.

Key words: vascular surgery, PTA, complications

Periarterial pulsating hematoma, named in the medical literature as femoral artery spure aneurysm (FSA) is one of frequent complications after endovascular cardiac procedures. Although this term is not correct (it takes about 2 weeks till the spure aneurysm develops) it is so popular that authors of this report decided to use it as well. The frequency of FSA after cardiac percutaneous procedures varies, depending on author and investigated population, between 0.2% and 7.7% (1, 2). It depends on many factors: type of procedure, antiplatelet and anticoagulant drugs, the size of the sheath and time of maintaining vascular access, multiple puncture of atherosclerotic vessel, obesity, time and adequacy of postprocedural compression (3, 4).

Until the 80-ties of the past century surgery was a standard treatment in cases of spure aneurysm at the puncture site. This method though effective carries relatively high risk of complications (usually delayed
wound healing) and prolongs patient’s in-hospital stay (5).

In the 1991 a method USG-guided compression of pseudoaneurysm was proposed (6). The pressure is induced by USG head that receives the Doppler signal from the blood stream. The compression grade depends on the loss of the intraneurysmal blood flow signal and is continuously monitored. Procedure ends when permanent aneurysm exclusion is achieved. USG-guided compression application is limited by few factors. It is time consuming and requires continuous medical staff monitoring. A need for constant USG control excludes the possibility of performing other diagnostic activities at the time of compression. Some patients do not tolerate such long lasting procedure and require intravenous pain relief. Compression can lead to skin lesions especially in cases of large aneurysm with skin destruction (7). Large and multilobular aneurysms are not prone to this type of therapy (8). All the above factors limit this method efficacy to 60-75% (9, 10).

In the 90-ties a method of local injections of thrombin solution into the spure aneurysm lumen was developed. Most authors observed better clinical results than USG-guided compression and low complications rate (11, 12). Sometimes however recurrences after initially successful procedure are observed and occasionally acute limb ischemia occurs due to uncontrolled propagation of thrombus into the native artery lumen (13). All mentioned above modalities are utilized in the author’s center.

The aim of the study was to analyze results treatment in patients with inguinal spure aneurysms after cardiac endoluminal procedures.

MATERIAL AND METHODS

66 patients with inguinal post-catheterization spure aneurysms recognized at The Department of General and Vascular Surgery, Collegium Medicum (CM), Nicolaus Copernicus University (NCU), Toruń and The Department of Cardiology and Internal Diseases CM NCU were prospectively enrolled to this study. Women dominated the group (54.4%). Average age was 68.8 years (SD ±11.4 years). Ischemic heart disease and it complications was the initial indication for arterial catheterization. Coronarography was performed in all the patients and further endovascular procedures were conducted in 36 (54.4%) individuals (angioplasty with stent placement in 34 patients and plain angioplasty in 2 others). In the whole group vascular access point compression was performed, manually at first. Absence of the blood flow through the puncture site and lack of subcutaneous hematoma in the inguinal region (estimated visually and by palpation) confirmed initial hemostasis. Further puncture site compression was carried out with elastic bandages for another 8 hours. Visual control and palpation of the region of catheterization was performed at the moment of elastic dressing removal, during further hospital stay daily and additionally when patient’s complaints occurred. If a clinical suspicion of spure aneurysm arose, duplex-scan was performed (Sonoline Elegra, Siemens, linear head 7.5 MHz). Following parameters were analyzed: the level of arterial defect, presence of flow in the lumen of aneurysm, its diameters, number of lobes, neck width and length and compression pliability. The condition and flow parameters in the vessels of origin were assessed by means of B-mode and duplex presentations. Patients were assigned to two treatment arms: operative and nonoperative treatment (OT, NT respectively). Criteria of qualification for OT were as follows: hemodynamic instability, largest diameter over 4 cm, multilobular aneurysm, uncompressible aneurysm, pain at compression that precluded its efficacy, patients’ will to undergo operation. The rest of the group was assigned to NT.

Operation was usually performed with local or spinal anesthesia depending on intake of anticoagulant drugs. General anesthesia was used in patients with large aneurysm if spinal procedure was contraindicated. Antibiotic prophylaxis was administered in all operated patients with 1.5 g cefuroxime (Zinacef®, GSK, UK). Through longitudinal inguinal incision common femoral artery or distal portion of external iliac artery over the aneurysm was exposed to control possible bleeding. Then the aneurysm was opened and intraluminal thrombus was evacuated. Arterial lesion was identified taking care to precisely visualize the vessel wall. It was then closed with interrupted vascular suture (Prolene® 5-0). After bleeding control the operation site was irrigated with
saline, suction Redon drain was set in place. The wound was closed by layers. Suction drain was removed when the daily fluid collection was lower than 50 ml. Antibiotic prophylaxis (cefuroxime 1.5 g 2xd) was continued until drain removal. Operation site control was performed daily since the 2nd postoperative day. If operation site infection was suspected swabs for culture were taken and local treatment was implemented (wound opening, hydrogen peroxide or aqueous acetic acid solution (Octenisept®) lavage was done) aided by intravenous antibiotic according to culture. Patient was discharged after wound condition improved and ambulatory treatment was continued until wound was closed.

Patients from NT group were all at first subjected to USG guided compression. The projection of the arterial lesion on the skin was marked during ultrasonography and its compressibility was assessed. Then pad of a truss (8x4 cm) was placed at the marked point. It was fixed with elastic bandage. Blood flow in the superficial femoral artery distally to the compression site was assessed by means of duplex-scan. Distal perfusion with peripheral pulse palpation and vascular tone was performed every two hours. When needed, patients with pain received intravenous drugs (ketoprophen and tramadol). Every 4-6 hours duplex-scan was performed to monitor the aneurysm thrombosis progression. The compression was continued if the flow in the aneurysm persisted. After 48-hour ineffective compression further treatment with injection of thrombin into the lumen of the aneurysm was conducted. Under USG guidance a solution of thrombin in saline (100 u/ml) was injected. The blood flow in the native artery and aneurysm was monitored during the injection to control thrombosis of the aneurysm and patency of the artery. After another 20 min and 48 hours duplex-scan was done to confirm the thrombosis of the aneurysm. If the flow reoccurred another dose of thrombin was injected. Lack of aneurysm thrombosis after triple injection was considered as indication for operative treatment.

The results of treatment were analyzed in both groups considering treatment efficacy, rate of complications and post procedural in-hospital stay.

For statistical analysis SPSS 12.0 PL® for Windows (SPSS Inc., USA) software was utilized. $\chi^2$ test and Fisher exact test were performed for categorical values, while numeric values were analyzed with t-student test. $p<0.05$ was considered statistically significant.

RESULTS

Using above criteria 45 patients were assigned to the OT and remaining 21 patients to NT group. The groups did not differ significantly in terms of age, sex, BMI, co-morbidity, kind of endovascular procedure, kind and number of antiplatelet drugs, administered unfractioned heparin, the time of aneurysm recognition and initial compression. Low-molecular weight heparin therapy was more frequent in the OT group (47% vs 14%, $p<0.05$). The mean time of initial compression was 9 min 24 sec. The mean initial procedure/treatment onset interval was for the whole group 5 days and for OT and NT 4.9 and 5.2 days, respectively. The mean aneurysm volume for the whole group was 38.6 ml$^3$ and it was larger for OT- 49.8 ml$^3$ than for NT group -14.5 ml$^3$ (tab. 1).

In the group of 66 patients the permanent aneurysm closure was achieved in 65 (98.5%). Multiple thrombin injections (3 times) were not effective in one patient. This patient although qualified for OT refused further treatment and was released home on demand. His fate is unknown

There was one death in the post procedural course. It occurred on the 2nd postoperative day, with signs of cardiogenic shock complicating waste myocardial infarction. For the patient the indication for OT was circulatory instability with significant hemoglobin level drop.

Serious nonfatal complications affected two patients. One stroke occurred during the postoperative course in patient with previous cerebral ischemia, with intracranial arteries disease and extracranial arteries lesions. The patient was transferred to neurology department at our hospital where partial regression of symptoms was achieved (slight brachio-fascial paresis and motoric aphasia). Another patient suffered from femoral artery thrombosis after thrombin injection. The complication was discovered during the procedure and considering low degree of ischemia (I° Rutherford scale) conservative treatment with intravenous heparin was implemented. The affected
Outcomes of iatrogenic femoral artery lesions – treatment results valuation

Limb quickly improved and no symptoms worsening were reported in the ambulatory follow-up.

Other complications (8 patients, 17.8%) involved surgical site: three marginal wound necrosis, three superficial wound infections and two postoperative lymphorhea. All patients were managed conservatively and wound healing was achieved.

In 12 of 21 patients managed conservatively an aneurysm thrombosis was achieved by compression therapy (57.1%). Average compression time was 26.8 hours (SD ±14.6; range 4-48). In the further 9 individuals injection of average 412 U (SD ± 304; 200-900) of thrombin was performed. In 8 of 9 patients (88.9%) complete aneurysm thrombosis was achieved by single injection. The mean postprocedural hospitalization was 7.1 days for the whole group. It was for the OT and NT groups 8.7 days (2-29) and 3.8 days (2-9) respectively, (significant difference, p<0.05). Length of hospital stay was also significantly correlated with presence of complications (5.5 days for patients without complications and 16.9 days for the complicated cases, p<0.001). Even after exclusion of patients with complications longer hospitalization was related to operative treatment (OT- 6 days, NT- 3.1 days, p<0.05)

Table 1. Comparison of patients in groups of operative and nonoperative treatment

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Operative treatment</th>
<th>Nonoperative treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>68.8</td>
<td>69.8</td>
<td>66.8</td>
</tr>
<tr>
<td>Sex (women%)</td>
<td>54.5%</td>
<td>56.5</td>
<td>50</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>28.3</td>
<td>29.1</td>
<td>27.7</td>
</tr>
<tr>
<td>PTCA</td>
<td>54.5%</td>
<td>53.3%</td>
<td>57.1%</td>
</tr>
<tr>
<td>Stent</td>
<td>51.5%</td>
<td>48.9%</td>
<td>54.5%</td>
</tr>
<tr>
<td>ASA</td>
<td>92%</td>
<td>93%</td>
<td>90%</td>
</tr>
<tr>
<td>Ticlopidin</td>
<td>42%</td>
<td>47%</td>
<td>33%</td>
</tr>
<tr>
<td>Clopidogrel</td>
<td>55%</td>
<td>53%</td>
<td>57%</td>
</tr>
<tr>
<td>LMWH*</td>
<td>35%</td>
<td>47%</td>
<td>14%</td>
</tr>
<tr>
<td>UFH</td>
<td>48%</td>
<td>42%</td>
<td>62%</td>
</tr>
<tr>
<td>No antiplatelet drug</td>
<td>6.1%</td>
<td>6.7%</td>
<td>4.8%</td>
</tr>
<tr>
<td>1 antiplatelet drug</td>
<td>37.9%</td>
<td>37.8%</td>
<td>38.1%</td>
</tr>
<tr>
<td>2 antiplatelet drugs</td>
<td>16.7%</td>
<td>11.1%</td>
<td>28.6%</td>
</tr>
<tr>
<td>3 antiplatelet drugs</td>
<td>39.4%</td>
<td>44.4%</td>
<td>28.6%</td>
</tr>
<tr>
<td>Initial compression time (min)</td>
<td>9.4</td>
<td>9.7</td>
<td>8.9</td>
</tr>
<tr>
<td>Interval procedure-recognision (days)</td>
<td>5</td>
<td>4.9</td>
<td>5.2</td>
</tr>
<tr>
<td>Aneurysm volume (cm³)</td>
<td>38.6</td>
<td>49.8</td>
<td>14.5</td>
</tr>
</tbody>
</table>

ASA – acetylosalicic acid, BMI – body mass index, LMWH – low-molecular weight heparin, PTCA – percutaneous transluminal coronary angioplasty, UFH – unfractioned heparin, * – p<0.05

Table 2. Treatment results – comparison

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Operative treatment</th>
<th>Nonoperative treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment success</td>
<td>98.5%</td>
<td>100%</td>
<td>USK 95.5% IT 88.9%</td>
</tr>
<tr>
<td>Major complications/deaths</td>
<td>4.5%/1.5%</td>
<td>4.4%/2.2%</td>
<td>4.8%/0</td>
</tr>
<tr>
<td>Other complications</td>
<td>12.1%</td>
<td>17.8%</td>
<td>0%</td>
</tr>
<tr>
<td>Complications together</td>
<td>16.7%</td>
<td>22.2%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Postprocedural stay (days)</td>
<td>7.1</td>
<td>8.7</td>
<td>3.8</td>
</tr>
<tr>
<td>No complications (days)*</td>
<td>5.5</td>
<td>6</td>
<td>3.1</td>
</tr>
</tbody>
</table>

TI – thrombin injection, USK – ultrasonography-guided compression, * – p<0.05
DISCUSSION

Among imaging modalities, duplex-scan is the most popular in diagnostic of such lesions due to its accessibility, accuracy and low costs. It allows not only for recognition of aneurysm, but also its diameters, morphology, point of origin and neck width. These data are indispensable to properly choose treatment modality (14). In our study, duplex-scan results were important factor influencing further treatment. Some authors advocate use of duplex-scan for mapping femoral artery bifurcation prior catheterization, to gain access to the common femoral artery which is according to some reports less prone to aneurysm formation (15).

During last two decades the role of operative treatment was gradually diminishing in favor of non- or minimal invasive procedures. Of these, two have gained wide acceptance: compression under USG control and injection of thrombin into the lumen of aneurysm. In our study we have modified the compression method, ultrasonic head compression was replaced by pad of a truss placed under USG control. This allows for continuous compression, eliminates influence of staff exhaustion and frequent USG controls (every 10-15 min). The proposed clinical control protocol is efficient and safe for the patient. Observed success rate was almost 60% which is result comparable with other observations (12, 16, 17). Frequent distal perfusion assessment protects from negative results of possible limb ischemia.

Thrombin injection efficacy is in our material high, approximating 90%, result comparable with other authors (4, 12). However, it is obligatory to remember of rare but possible thrombotic complications caused by propagation of thrombus through the neck of aneurysm or unintentional intraarterial injection of the drug (13). This may require surgical intervention or even cause limb loss. Risk factors for this complication are large thrombin dose, small aneurysm volume and wide aneurysm neck. According to this, fractioned doses of thrombin should be injected and adequate duplex supervision is mandatory. Sometimes combination of thrombin injection with artery exclusion (intraarterial balloon from another access) is utilized (18).

Operative treatment was successful in all cases (100%), but the incidence of complications was also highest (22.2%). 4/5 (17.8%) of these involved surgical site. Lower complications rate in the NT group (4.8%) was in our opinion related to the fact that patients selected to the OT were in worse general condition and had larger aneurysms. Mean postoperative stay was significantly longer for patients with complications. Further analysis also revealed that even in patients without complications the length of stay in the patients in the both NT and OT groups differed significantly (3.1 and 6 days respectively, p<0.05). This observation must be treated with caution since both groups differed in number and the inclusion criteria. In this case only a randomized trial might give a fully acceptable result.

Although sometimes questioned, at our center it is mandatory to gain proximal control of the operated vessel prior the aneurysm closure. It allows for safe exploration especially in obese patients with large aneurysm in which direct access may be difficult and increase the risk of bleeding. Even if aneurysm originates high in the groin, distal external iliac artery control can be gained easily through small incision above inguinal ligament. The same attitude we found in the literature (19).

In this study we did not utilized stent-graft method to exclude the aneurysm as in some other studies (20). The need for advanced angiographic equipment and stent-graft itself causing costs increase and unknown distant results convince us that such a method might be considered in cases resistant to standard treatment (compression, thrombin injections) in patients who cannot undergo operation.

CONCLUSIONS

Utilized criteria for nonsurgical and operative treatment of the inguinal region spure aneurysms provided excellent treatment efficacy. Longer postprocedural stay was associated with operative treatment and complications. Proposed modification of compression therapy might be an alternative for USG head compression. It is mandatory to remember of possible thrombotic complications related to thrombin injections.
REFERENCES


COMMENTARY

The presented study deserves special attention, due to the significant clinical problem connected with the development of pulsating hematomas and false aneurysms after arterial puncture. The increased frequency of the above-mentioned complications is definitely connected with the dynamic development of intravascular techniques, and increasing number of diagnostic examinations and intravascular procedures, which are being more performed not only by radiologists, but also by interventional cardiologists and nephrologists.

The lecture of the study leads towards the following practical remarks and observations: the title of the study should mention that treatment analysis concerned early results. An unsatisfied feeling arises connected with the language used in the study, and the significant incoherence between the title and content of the study. The typical and commonly observed complication (puncture of the artery) should not be considered as iatrogenic.

Additionally, the term “false aneurysm” in relationship to the presented complication just
doesn’t seem right. According to most Authors, in order one can observe the development of the false aneurysm wall enabling its morphological distinction, a period of at least two weeks is required. Considering the presented study the average period following the intravascular procedure, both in case of patients subjected to surgical intervention, and those treated conservatively was much shorter, amounting to 4.9 and 5.2 days, respectively. In the introduction the Authors also mentioned the inaccuracy of the terminology, which is unfortunately permanently repeated in the study. The Authors used the term „false aneurysm” instead of „pulsating hematoma”.

It is commonly known that the development of pulsating hematomas after puncture of the artery is conditioned by the following: short compression time or improper compression after the withdrawal of the vascular catheter, obesity (significant amount of fat tissue can be a mechanical obstacle in case of compression), the use of thicker vascular catheters, as well as intensive antithrombotic and antiplatelet therapy. The risk of pulsating hematoma development is also connected with the type of procedure performed. Many studies demonstrated the more frequent occurrence of the above-mentioned complication in case of patients after angioplasty with stent implantation, as compared to those subjected to diagnostic catheterization, which is probably connected with the use of larger catheters, and thus, greater vascular trauma. The percentage of pulsating hematomas after coronarography or angioplasty with stent implantation (PTCA, percutaneous transluminal coronary angioplasty) would be considered as valuable data, if mentioned. Catheters used in case of coronarography are usually thinner, as compared to those used in case of PTCA. Thus, the duration of the intravascular procedure and the diameter of the catheter have significant influence on the occurrence of complications.

The proposed operative method consisting in the exposure of the femoral or external iliac arteries from an additional approach above the hematoma seems to be a good and safe method. In case of large hematomas and false aneurysms reaching above the inguinal ligament, an additional incision above the inguinal ligament seems fully justified. However, most pulsating hematomas and false aneurysms, which developed after artery puncture, can be fixed from the inguinal approach. The injured artery can be reached directly through the cavity of the hematoma, and the compression of the vascular wall above and below the opening after the cannula enables to place sutures. One must remember that the efficacy of the procedure depends on the good visualization of the artery and suturing through all the layers of the above-mentioned.

One should not forget about the significant complication following treatment of pulsating hematomas and false aneurysms using thrombin-femoral artery thrombosis, which can lead towards acute ischemia and limb amputation. Considering the presented case of femoral artery thrombosis, Rutherford’s classification was erroneously used, the latter being helpful in case of chronic lower limb ischemia.

In order to reduce the percentage of pulsating hematomas after artery puncture, special grooved probes can be used, which close the opening in the artery following the intravascular procedures. However, their cost might limit their wide application.

Dr hab. Waldemar Kostewicz
Oddział Chirurgii Ogólnej i Naczyniowej
Międzyłódzki Szpital Specjalistyczny w Warszawie
false aneurysms should be published, demonstrating the significant number of such cases connected with diagnostic and endovascular procedures undertaken by different physicians in many centers. The frequency of complications is especially elevated in case of the above-mentioned procedures performed by non-operating physicians. The increasing number of coronarographies and endovascular procedures is inevitably connected with the higher number of complications. In my Department the number of reconstructive operations, due to false aneurysms, especially after coronarographies has systematically increased during the past years. The number of distant complications, such as false aneurysms (post-traumatic) following coronarographies has significantly increased. I am not sure whether these cases were mentioned in the statistics considering complications following invasive procedures in cardiology. The presentation of the number of complications following the above-mentioned procedures would probably have influence on the decreased performance of these procedures, only attributed to life-threatening situations. In my opinion, we will be treating more and more cases of iatrogenic false aneurysms, being connected with the increased indications towards performing endovascular procedures (minimally invasive) in case of vascular diseases. Irrespective of the localization and obturative changes, stents are introduced following the incision of the femoral artery. The compression of the area surrounding the incision performed properly and adequately long enough is often sufficient. Ultrasound control following compression should be a standard, performed by an experienced physician. Lack of ultrasound control with only a physical examination can lead towards the development of complications. Thus, we have a problem. In case of a significant leakage surgical intervention is required. Where? Such procedures should be undertaken in the center performing the above-mentioned. However, patients are often transferred to the Department of Vascular Surgery with significant dissemination, and often to another city. It is obvious that complications are always possible. The only question concerns their number and treatment possibilities (false aneurysms, other surgical complications, such as severed vessel, thrombosis, embolism). Thus, all invasive procedures, especially endovascular, performed by a non-vascular surgeon should be secured by the possibility of angiosurgical intervention on site. These procedures should be performed by a team of physicians comprising vascular surgeons, radiologists, and specific specialists. Only multi-profile centers fulfill these conditions, and thus, should receive accreditation towards performing the above-mentioned procedures.

In my opinion, the physician performing the procedure should be aware of possible complications and help in their treatment. This seems important considering the financial and legal aspects.

The Authors of the study accepted 4cm as the diameter of the aneurysm, qualified towards conservative treatment by means of compression and thrombin injection. In my opinion, this seems risky and requires discussion. The clotting of such aneurysms does not physically eliminate them. Unless it is resorbed and surrounded by a capsule, a cyst results or the lesion becomes fibrotic and then what? It must be resected. It can also suppurate which is a dangerous event in the proximity of a large blood vessel. Personally, I favor this method in the treatment of only small (2 – 3 cm in diameter) pseudoaneurysms, under strict US guidance, not only in the periprocedural period. Generally I accept conservative methods as a treatment alternative for pseudoaneurysms but only in patients with high operative risk, with small aneurysms, small arterial damage and prolonged hospitalization that makes monitoring impossible. These preconditions eliminate the only clear benefit confirmed by the Authors, i.e. shorter patient hospitalization.

As a traditionalist by nature, I approach to any novelty, especially in medical sciences, with caution. Only time will show true benefits and drawbacks of implemented methods. We should use common sense in their implementation and be guided by indications while disregarding nonmedical factors. As we can see, a wonderful and needed diagnostic method, such as coronary angiography as well as more and more commonly used endovascular procedures, are associated with real risk of complications, that can be problems by themselves, such as pseudoaneurysms.

Prof. dr hab. Piotr Szyber
Kierownik Katedry i Kliniki Chirurgii Naczyniowej, Ogólnej i Transplantacyjnej Śl. UM