Original paper

Haemorrhagic complications of femoral artery pseudoaneurysms caused by interventional cardiology procedures – a large-population retrospective study

Krwotoczne powikłania tętniaków rzekomych tętnicy udowej spowodowanych zabiegami kardiologii inwazyjnej – badanie retrospektywne

Małgorzata Zachura[1], Marcin Sadowski[1], Magdalena Chrapek[1], Adam Wiewióra[2], Łukasz Zandecki[1], Marianna Janion[1], Jacek Kurzawski[3]

[1]Collegium Medicum, Jan Kochanowski University, Kielce, Poland
[2]Provincial Combined Hospital, Kielce, Poland
[3]2nd Department of Cardiology, Świętokrzyskie Cardiology Centre, Kielce, Poland

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Key words: anaemia, interventional cardiology, haemorrhagic complications, femoral pseudoaneurysm.

Słowa kluczowe: anemia, kardiologia inwazyjna, powikłania krwotoczne, tętniak rzekomy, tętnica udowa.

Abstract

Introduction: For many years femoral access was the preferred approach in interventional cardiology. Still, due to its large size, which allows for the use of larger catheters, the femoral artery remains the preferred access for many procedures. Femoral pseudoaneurysms are the most common and most severe complication of this access.
Aim of the research: To evaluate haemorrhagic complications of femoral pseudoaneurysms induced by interventional cardiology procedures.
Material and methods: From the patients treated with percutaneous intervention between 2006 and 2022 in the Second Department of Cardiology, Świętokrzyskie Cardiology Centre, Kielce, Poland, we registered and analysed 621 cases of femoral pseudoaneurysms. Of these patients, 537 had their haemoglobin tested before and after the procedure, and they constitute the population thoroughly analysed in the study.
Results and conclusions: The occurrence of a pseudoaneurysm statistically significantly increased the chance of any decrease in haemoglobin (HGB) (OR = 3.26, 95% CI: 2.26–4.7, $p < 0.0001$), as well as a decrease in HGB by more than one unit (OR = 6.34, 95% CI: 4.87–8.26, $p < 0.0001$), a decrease in HGB by more than 2 units (OR = 7.54, 95% CI: 5.18–10.96, $p < 0.0001$), or a decrease in HGB by more than 3 units (OR = 20.31, 95% CI: 9.35–44.1, $p < 0.0001$). Among patients who had any decrease in HGB after the procedure, significantly greater average decreases were observed in the group of patients with a pseudoaneurysm. Men were significantly more likely to be anaemic before the procedure. Among the patients with femoral pseudoaneurysm whose HGB levels dropped the most after percutaneous intervention, STEMI was the most common primary condition. The occurrence of a pseudoaneurysm significantly increased the risk of anaemia.

Streszczenie

Wprowadzenie: Przez ostatnie dekady tętnica udowa była powszechnie stosowanym dostępem w zabiegach kardiologii inwazyjnej. Jej rozmiar, a także możliwość użycia większych cewników powodują, że nadal pozostaje preferowanym dostępem dla wybranych procedur. Najczęstszym i najcięższym powikłaniem nakłucia tętnicy udowej jest tętniak rzekomy.
Cel pracy: Ocena powikłań krwotocznych związanych z tętniakami rzekomymi tętnicy udowej.
Materiał i metody: Wśród pacjentów po zabiegach kardiologii inwazyjnej w latach 2006–2022 w II Klinice Kardiologii Świętokrzyskiego Centrum Kardiologii w Kielcach stwierdzono 621 przypadków tętnicy udowej powikłanej tętniakiem rzekomym. Populację szczegółowo analizowaną w prezentowanym badaniu stanowi grupa 537 pacjentów, którzy mieli zbadane stężenie hemoglobiny przed zabiegiem i po zabiegu.
Wyniki i wnioski: Wystąpienie tętniaka rzekomego istotnie zwiększało ryzyko jakiegokolwiek zmniejszenia stężenia hemoglobiny (HGB) (OR = 3,26, 95% CI: 2,26–4,7, $p < 0,0001$), a także redukcji HGB o więcej niż jedna jednostka (OR = 6,34, 95% CI: 4,87–8,26, $p < 0,0001$), zmniejszenia HGB o więcej niż 2 jednostki (OR = 7,54, 95% CI: 5,18–10,96, $p < 0,0001$) lub redukcji HGB o więcej niż 3 jednostki (OR = 20,31, 95% CI: 9,35–44,1, $p < 0,0001$). Wśród pacjentów, u których po zabiegu stwierdzono jakiekolwiek zmniejszenie HGB, istotnie większe średnie spadki zaobserwowano u pacjentów z tętniakiem rzekomym. Mężczyźni znacznie częściej mieli anemię przed zabiegiem. Zawał serca z uniesieniem odcinka ST był najczęstszym

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schorzeniem wśród pacjentów z tętniakiem rzekomym i największą anemizacją. Wystąpienie tętniaka rzekomego istotnie zwiększało ryzyko wystąpienia anemii.

Introduction

For many years femoral access was the preferred approach in interventional cardiology. Due to its large size, which allows for the use of larger catheters, the femoral artery remains the preferred access for many procedures such as transcatheter aortic valve replacement (TAVI) or high-risk percutaneous coronary interventions (PCI). However, during routine coronary angiography and angioplasty, a transradial (TR) approach significantly decreases the chance of cardiac-death, bleeding, and haematoma formation [1, 2] and is widely preferred over the femoral one [2–4]. It is also worth noting that during the procedure, conversion from radial to femoral access may occur, e.g. due to catheterization failure because of anatomical factors, as well as the need to use a specific technique of angioplasty. Moreover, operator preferences and skills also play a major role in the choice of vascular access. A survey conducted in 2016 among 987 academic interventional cardiologists worldwide revealed that 18% of them still preferred mainly the transfemoral (TF) approach [5]. This high percentage is most likely explained by the fact that the TR approach requires more operator experience and a higher learning curve. In other words, the TF approach seems to be an easier and more operator-friendly technique for catheterization and angiography along with shorter duration of procedure and lower radiation exposure [3]. Bleeding and haematomas are the most common complications in both vascular accesses. However, one of the crucial disparities between TF and TR methods of catheterization is the probability of pseudoaneurysm formation, which is extremely rare for radial artery access [6, 7]. It is also worth noting that pseudoaneurysms may also form during other procedures, such as during ablation by inadvertent puncture of the femoral artery [8]. This potentially life-threatening condition requires urgent treatment, especially in the case of large and growing pseudoaneurysms. Its embolization can be performed in several ways including thrombin injection, operative suturing, ultrasound-guided compression, or stenting [9].

Aim of the research

The aim of the presented study is to assess a degree of anaemia and to investigate possible gender differences in patients suffering from femoral artery pseudoaneurysm following interventional cardiology catheterization (mainly due to angiography, but also after electrophysiological procedures and after intraaortic balloon pumping (IABP)). Most of the patients were successfully treated with an ultrasound-guided thrombin injection. Our research is based on a large population of patients with femoral artery pseudoaneurysm. The data were collected during 16 years, and there has not been similar research investigating that deeply the level of anaemization of patients with post-catheterization pseudoaneurysms. We have taken into account a large group, measuring the level of anaemization and analysing correlating factors, making our study unique.

Material and methods

All data were gathered in the Second Department of Cardiology, Świętokrzyskie Cardiology Centre, Kielce, Poland. In the patients who underwent femoral vascular catheterization in the course of cardiological procedures in the period 2006–2022, control ultrasound examinations were performed in all 21,946 patients. We registered 621 cases of femoral pseudoaneurysms. Most of the participants underwent a procedure of TF approach coronarography. Among them 146 (23.5%) were treated because of ST-segment elevation myocardial infarction (STEMI), 115 (18.5%) because of non-ST-segment elevation myocardial infarction (NSTEMI), 223 (35.9%) because of other acute coronary syndromes (ACS), 35 (5.6%) underwent coronarography for other reasons, 20 (3.2%) had a scheduled angioplasty, 53 (8.5%) because of ablation, and 29 (4.6%) for other reasons. Since 2014, as the frequency of radial access in coronary angiography has increased, we have observed a downward trend in the incidence of femoral artery aneurysms. However, in later years it began to rise slightly with the increase in the frequency of electrophysiological procedures, and since 2016 it has remained at a similar level, i.e. approximately 20 cases per year.

There were 580 (93.4%) cases of femoral artery pseudoaneurysm caused by direct artery catheterization and 38 (6.1%) caused by unintended puncture while obtaining venous access.

Most of the femoral pseudoaneurysms were found immediately after the procedure during the first hospitalization (587 (94.5%)), while 24 (3.9%) cases were diagnosed during another hospitalization, and 10 (1.6%) were out-of-hospital diagnoses.

Out of the total 621 patients with femoral pseudoaneurysm a group of 537 patients had their haemoglobin tested before and after the procedure, and they constitute the population thoroughly analysed in the study. This group of 276 (51.4%) females and 261 (48.6%) males was compared to the control group without femoral pseudoaneurysm comprising 606 patients – 271 females and 335 males. The average age of patients participating in the research was 68 years.

The main method of embolization was an ultrasound-guided thrombin injection. A single thrombin injection was successful in as many as 510 (82.1%) patients, and another 88 (14.2%) required re-injection (Table 1).

The study has been approved by the Bioethics Committee of the Swietokrzyska Chamber of Physicians in Kielce.

Statistical analysis

Continuous data were described by means (with standard deviations) and range (minimum and maximum). Normality of distributions was checked by Shapiro-Wilk test. Categorical data were summarized by frequencies and percentages. Group comparisons were performed using the χ^2 or Fisher exact test for categorical variables, and the *t*-test or Mann-Whitney

Table 1. General characteristics of the study population

Parameter	Women (*n* = 327)	Men (*n* = 294)	Total (*n* = 621)
Primary condition:			
STEMI	71 (21.7%)	75 (25.5%)	146 (23.5%)
NSTEMI	56 (17.1%)	59 (20.1%)	115 (18.5%)
ACS	126 (38.5%)	97 (33.0%)	223 (35.9%)
Coronarography caused by other reasons	19 (5.8%)	16 (5.4%)	35 (5.6%)
Scheduled coronary angioplasty	10 (3.1%)	10 (3.4%)	20 (3.2%)
IABP	1 (0.3%)	1 (0.3%)	2 (0.3%)
Electrophysiological procedures	27 (8.3%)	26 (8.8%)	53 (8.5%)
Other procedures	17 (5.2%)	10 (3.4%)	27 (4.3%)
Age:			
Mean (SD)	70.2 (10.2)	65.7 (11.2)	68.0 (10.9)
Range	24.0–89.0	20.0–90.0	20.0–90.0
Cause:			
Artery catheterization	304 (93.0%)	276 (93.9%)	580 (93.4%)
Vein catheterization	22 (6.7%)	16 (5.4%)	38 (6.1%)
Other	0 (0.0%)	1 (0.3%)	1 (0.2%)
Diagnosis:			
During the first hospitalization	308 (94.2%)	279 (94.9%)	587 (94.5%)
During the following or other hospitalization	12 (3.7%)	12 (4.1%)	24 (3.9%)
Out-of-hospital diagnosis	7 (2.1%)	3 (1.0%)	10 (1.6%)
Clinical symptoms:			
None	13 (4.0%)	15 (5.1%)	28 (4.5%)
Pain	196 (59.9%)	195 (66.3%)	391 (63.0%)
Pulsing	26 (8.0%)	19 (6.5%)	45 (7.2%)
Pain + pulsing	92 (28.1%)	65 (22.1%)	157 (25.3%)
Treatment:			
Single thrombin embolization	270 (82.6%)	240 (81.6%)	510 (82.1%)
Subsequent thrombin embolization	50 (15.3%)	38 (12.9%)	88 (14.2%)
Surgery	3 (0.9%)	7 (2.4%)	10 (1.6%)
Ultrasound-guided compression	0 (0.0%)	3 (1.0%)	3 (0.5%)
Spontaneous coagulation	3 (0.9%)	6 (2.0%)	9 (1.4%)

STEMI – ST-segment elevation myocardial infarction, NSTEMI – non-ST-segment elevation myocardial infarction, ACS – acute coronary syndrome, IABP – intra-aortic balloon pump.

Table 2. Decrease in haemoglobin (HGB) among patients with or without pseudoaneurysm

Variable	No pseudoaneurysm (n = 606)	Pseudoaneurysm (n = 537)	P-value
HGB decrease after the procedure	472 (77.9%)	494 (92.0%)	< 0.0001
HGB decrease by more than one unit	121 (20.0%)	329 (61.3%)	< 0.0001
HGB decrease by more than 2 units	38 (6.3%)	180 (33.5%)	< 0.0001
HGB decrease by more than 3 units	7 (1.2%)	7 (1.2%)	< 0.0001

HGB – haemoglobin.

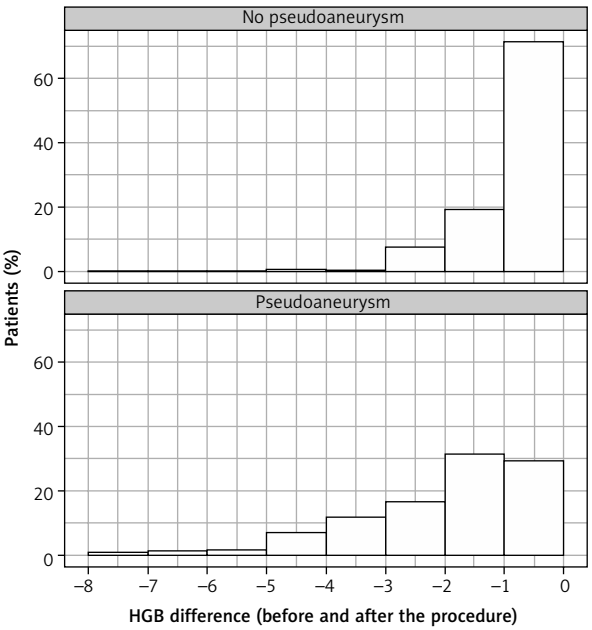

Figure 1. HGB difference before and after the procedure

test for normally or non-normally distributed continuous variables, respectively. Haemoglobin difference was defined as haemoglobin after the procedure minus haemoglobin before the procedure. Due to significant non-normality of analysed variables, Spearman rank correlation coefficients were calculated to assess the strength of monotonic association between variables of interest (volume, canal length, time from procedure to diagnosis of pseudoaneurysm, and haemoglobin difference).

Separable logistic regression models were created to examine the relationship between decrease of haemoglobin difference (any decrease, a decrease of more than one unit, a decrease of more than 2 units, and a decrease of more than 3 units) and the patient's status according to pseudoaneurysm. Odds ratios (OR) and 95% confidence intervals (95% CI) were calculated for these models.

A 2-tailed p-value < 0.05 was considered statistically significant. All statistical analyses were performed using the R software package version 4.0.3.

Results

The occurrence of a pseudoaneurysm statistically significantly increased the chance of any decrease in haemoglobin (HGB) (OR = 3.26, 95% CI: 2.26–4.7, $p < 0.0001$), as well as a decrease in HGB by more than one unit (OR = 6.34, 95% CI: 4.87–8.26, $p < 0.0001$), a decrease in HGB by more than 2 units (OR = 7.54, 95% CI: 5.18–10.96, $p < 0.0001$), or a decrease in HGB by more than 3 units (OR = 20.31, 95% CI: 9.35–44.1, $p < 0.0001$). Similar changes were observed in both sexes (Table 2).

Among patients who had any decrease in HGB after the procedure, significantly greater decreases on average were observed in the group of patients with a pseudoaneurysm. Similar changes were observed in both women and men (Figure 1).

Men were significantly more likely to be anaemic before the procedure (Table 3).

Among the patients with femoral pseudoaneurysm whose HGB levels dropped the most after percutaneous intervention, STEMI was the most common primary condition (Table 4).

The magnitude of HGB decrease correlates positively with pseudoaneurysm canal volume and length in women (Table 5).

Noteworthy is the higher incidence of aneurysms and anaemia in patients on dual antiplatelet therapy. The main antiplatelet drug, apart from acetylsalicylic acid (ASA), was clopidogrel. Dual antiplatelet treatment based on ASA with clopidogrel was significantly more frequently used among patients with aneurysm comparing with those without: 336 (62.6%) compared to 206 (34.0%), respectively. We did not observe

Table 3. Incidence of anaemia in patients with aneurysm vs. the control group

Pseudoaneurysm	Women (n = 276)	Men (n = 261)	Total (n = 537)	P-value
	20 (7.2%)	84 (32.2%)	104 (19.4%)	< 0.0001
No pseudoaneurysm	**Women (n = 271)**	**Men (n = 335)**	**Total (n = 606)**	***P*-value**
	36 (13.3%)	103 (30.7%)	139 (22.9%)	< 0.0001

Table 4. Anaemization depending on the initial cause of catheterization

Primary condition	Men				Women			
	HGB in reference range before and after the procedure (*n* = 78)	HGB in reference range before the procedure, below the reference range after the procedure (*n* = 99)	HGB below the reference range before and after the procedure (*n* = 80)	Total (*n* = 261)	HGB in reference range before and after the procedure (*n* = 148)	HGB in reference range before the procedure, below the reference range after the procedure (*n* = 108)	HGB below the reference range before and after the procedure (*n* = 18)	Total (*n* = 276)
STEMI	19 (24.4%)	32 (32.3%)	17 (21.2%)	70 (26.8%)	19 (12.8%)	30 (27.8%)	8 (44.4%)	58 (21.0%)
NSTEMI	17 (21.8%)	19 (19.2%)	22 (27.5%)	58 (22.2%)	29 (19.6%)	24 (22.2%)	3 (16.7%)	56 (20.3%)
ACS	30 (38.5%)	24 (24.2%)	22 (27.5%)	77 (29.5%)	63 (42.6%)	22 (20.4%)	3 (16.7%)	88 (31.9%)
Coronarography for other reasons	5 (6.4%)	7 (7.1%)	5 (6.2%)	17 (6.5%)	11 (7.4%)	4 (3.7%)	0 (0.0%)	16 (5.8%)
Planned PCI	0 (0.0%)	2 (2.0%)	3 (3.8%)	5 (1.9%)	3 (2.0%)	5 (4.6%)	1 (5.6%)	9 (3.3%)
IABP	0 (0.0%)	0 (0.0%)	1 (1.2%)	1 (0.4%)	0 (0.0%)	1 (0.9%)	0 (0.0%)	1 (0.4%)
Electrophysiology	7 (9.0%)	12 (12.1%)	5 (6.2%)	25 (9.6%)	18 (12.2%)	12 (11.1%)	0 (0.0%)	30 (10.9%)
Other reasons	0 (0.0%)	3 (3.0%)	5 (6.2%)	8 (3.1%)	5 (3.4%)	10 (9.3%)	3 (16.7%)	18 (6.5%)

HGB – haemoglobin, STEMI – ST-segment elevation myocardial infarction, NSTEMI – non-ST-segment elevation myocardial infarction, ACS – acute coronary syndrome, PCI – percutaneous coronary angioplasty, IABP – intra-aortic balloon pump.

a higher incidence of aneurysms in patients using other antiplatelet and anticoagulant drugs (Table 6).

Discussion

Pseudoaneurysms could be a serious consequence of cardiovascular procedures, clinically presenting usually as painful, throbbing haematoma [10]. When comparing the occurrence of radial and femoral pseudoaneurysm, it was found that femoral pseudoaneurysms are 4 to 8 times more frequent than radial ones [8, 11, 12]. Although the recommended percentage of femoral artery catheterization complicated with pseudoaneurysm is < 0.2%, the widely accepted target occurrence nowadays is < 1% [13]. According to most of the publications available so far, the femoral pseudoaneurysm prevalence is usually between 0.2% and 8% of all patients treated using interventional procedures [14, 15]. In our study, the incidence of femoral artery pseudoaneurysm was 2.8%, which is consistent with literature data. The compilation of data from a large population of patients with femoral artery pseudoaneurysm is a great strength of the presented study.

The data we gathered clearly confirms that the presence of pseudoaneurysm correlates with a higher risk of anaemization. As stated by a significant amount of research, high pseudoaneurysm occurrence is a femoral access characteristic and is rarely present when using transradial intervention [16, 17]. The tendency of bleeding and haemoglobin drop themselves also seem to be strongly connected with transfemoral access catheterization, as was proven by the MATRIX investigators [18]. As was found in our study, patients with pseudoaneurysm who became anaemic after the procedure had lower HGB levels on admission and therefore fell below normal HGB levels more easily. These observations were consistent with literature data, as low red blood cells count (RBC) and HGB levels were found to be predictive factors for pseudoaneurysm formation [18]. This statement could be explained by the impaired rheological properties of blood caused by the reduced interaction of RBC and HGB with the platelets and endothelial cells. It is known that RBCs promote the transport of platelets to the site of vessel wall injury [18, 19]. Therefore, patients with baseline low haemoglobin are more likely to develop an aneurysm and thus become anaemic.

Apart from baseline anaemia, other risk factors for femoral pseudoaneurysm formation are incorrect procedure technique as well as older age, puncture of surrounding veins, hypertension, and artery calcification [13]. Moreover, some research indicates that post-catheterization pseudoaneurysm may develop more often in women [20]. It has also been argued that women have a higher risk of bleeding and anaemia when undergoing PCI compared to men, with female sex being an overall bleeding risk factor [21].

Table 5. Correlation between the decrease in hemoglobin and the size of a pseudoaneurysm in women and men

Parameter	Women			Men		
	Spearman's rank correlation coefficient			Spearman's rank correlation coefficient		
	Canal length	Time	HGB difference	Canal length	Time	HGB difference
Volume	0.249 ($p < 0.0001$)	0.032 ($p = 0.6022$)	–0.302 ($p < 0.0001$)	–0.027 ($p = 0.6631$)	0.028 ($p = 0.6576$)	–0.150 ($p = 0.0149$)
Canal length		–0.124 ($p = 0.039$)	–0.182 ($p = 0.0024$)		–0.060 ($p = 0.335$)	0.045 ($p = 0.4662$)
Time		–	–0.131 ($p = 0.0291$)			–0.053 ($p = 0.3973$)

Table 6. Comparison of pharmacotherapy between patients with aneurysm and the control group

Parameter	No pseudoaneurysm ($n = 606$)	Pseudoaneurysm ($n = 537$)	Total ($n = 1143$)	*P*-value
ASA	460 (75.9%)	477 (88.8%)	937 (82.0%)	< 0.0001
Acenocoumarol	15 (2.5%)	21 (3.9%)	36 (3.1%)	0.0963
Clopidogrel	263 (43.4%)	352 (65.5%)	615 (53.8%)	< 0.0001
NOAC	164 (27.1%)	35 (6.5%)	199 (17.4%)	<0.0001
Ticagrecol or prasugrel	93 (15.3%)	19 (3.5%)	112 (9.8%)	< 0.0001
Ticlopidine	0 (0.0%)	16 (3.0%)	16 (1.4%)	< 0.0001
Specific combinations:				0.0005
ASA monotherapy	107 (17.7%)	89 (16.6%)	196 (17.1%)	
ASA + clopidogrel	206 (34.0%)	336 (62.6%)	542 (47.4%)	
ASA + clopidogrel + NOAC	38 (6.3%)	6 (1.1%)	44 (3.8%)	
ASA + NOAC	10 (1.7%)	8 (1.5%)	18 (1.6%)	
ASA + ticagrecol or prasugrel	93 (15.3%)	18 (3.4%)	111 (9.7%)	
NOAC monotherapy	103 (17.0%)	21 (3.9%)	124 (10.8%)	

ASA – acetylsalicylic acid, NOAC – novel oral anticoagulants.

Although in our study femoral pseudoaneurysms were more common in women, the difference was insignificant. We found that men were more likely to be anaemic before the intervention. This observation differs from the results of the study of Ahmed *et al.*, in which occurrence of anaemia was similar in both sexes, and elevated haemoglobin levels in most acute coronary syndromes were connected to male sex [21]. Undoubtedly, the incidence of anaemia is also related to the age of the patients. It has been found that the incidence of anaemia increases with age in men, while it decreases in women [22]. The average age of patients participating in the research was 68 years; however, the range was from 20 to 90 years.

Based on the collected data, we found that STEMI, while not being the most common cause of femoral artery catheterization, was the most common primary condition among the anaemized patients. This result is in cotrast to the research by Bhavanadhar *et al.*, in which anaemia was more common in unstable angina patients than in NSTEMI or STEMI groups [23]. However, the mentioned study included a general population of patients with acute coronary syndromes without considering specific bleeding complications. Regarding our study, the possible explanation of the higher incidence of femoral pseudoaneurysm and anaemia among patients with STEMI is the fact that this population usually demands simultaneous stenting of the infarct-related artery. Hence, therapeutic interventions require sheaths larger in calibre, more frequent device changing, and more time to perform the procedure. All these together increase the risk of both aneurysm and anaemia [8, 24]. Another factor increasing the risk of anaemia in this group of patients is the use of dual antiplatelet therapy at the time of the procedure [24]. On the other hand, there are also studies indicating that the absolute decrease in platelet reactivity after the clopidogrel load is significantly less in anaemic patients compared to patients with normal HGB [25]. The above observa-

tion may suggest that patients with anaemia both before and after stenting, e.g. in connection with a pseudoaneurysm, are at risk of recurrent ischaemic events.

Another potentially important finding of our trial is the statement that the magnitude of the decrease in HGB correlates with pseudoaneurysm canal volume and length, especially in women. These are factors that not only increase the risk of anaemia the larger they are, but also have an impact on the choice of pseudoaneurysm treatment. Management includes observation, ultrasound-guided compression, ultrasound-guided thrombin injection, and surgery [15]. Surgical methods are usually necessary in the case of complicated pseudoaneurysms. It is also a second choice after initial failure of other methods. Observation is still used for stable and small pseudoaneurysms that are less than 2 cm [24]. In our study spontaneous resolution was observed in 1.4% of patients. Only fever patients from the study population were treated with ultrasound-guided compression because in our centre the leading method of treating uncomplicated pseudoaneurysms is ultrasound-guided thrombin injection. This is consistent with literature data in which it has been proven that percutaneous thrombin injection is more effective in achieving primary pseudoaneurysm thrombosis and thus shortens the hospitalization time compared to ultrasound-guided compression [12, 19, 26].

The main limitation of our study is that it is a single-centre, retrospective study. Moreover, due to the large number of cases the patient population was heterogeneous. Due to the very good experience of our centre in closing femoral pseudoaneurysms with ultrasound-guided thrombin injection, the vast majority of patients were treated exclusively with this method. We did not observe a higher incidence of aneurysms in patients using antiplatelet drugs other than ASA and clopidogrel and new anticoagulants, although the number of these patients in the studied population was relatively small due to the long period of the study and only recent widespread use of these drugs.

Conclusions

The occurrence of a femoral artery pseudoaneurysm significantly increased the risk of anaemia, which is higher in patients with STEMI and on dual antiplatelet therapy.

Conflict of interest

The authors declare no conflict of interest.

References

1. Kolkailah AA, Alreshq RS, Muhammed AM, Zahran ME, El-Wegoud MA, Nabhan AF. Transradial versus transfemoral approach for diagnostic coronary angiography and percutaneous coronary intervention in people with coronary artery disease. Cochrane Database Syst Rev 2018; 4: CD012318.
2. Bhat FA, Changal KH, Raina H, Tramboo NA, Rather HA. Transradial versus transfemoral approach for coronary angiography and angioplasty – a prospective, randomized comparison. BMC Cardiovasc Disord 2017; 17: 23.
3. Anjum I, Khan MA, Aadil M, Faraz A, Farooqui M, Hashmi A. Transradial vs. transfemoral approach in cardiac catheterization: a literature review. Cureus 2017; 9: e1309.
4. Di Santo P, Simard T, Wells GA, Jung RG, Ramirez FD, Boland P, Marbach JA, Parlow S, Kyeremanteng K, Coyle D, Fergusson D, Russo JJ, Chong AY, Froeschl M, So DY, Dick A, Glover C, Labinaz M, Hibbert B, Le May M. Transradial versus transfemoral access for percutaneous coronary intervention in ST-segment–elevation myocardial infarction. Cardiovasc Interv 2021; 14: e009994.
5. Damluji AA, Nelson DW, Valgimigli M, Windecker S, Byrne RA, Cohen F, Patel T, Brilakis ES, Banerjee S, Mayol J, Cantor WJ, Alfonso CE, Rao SV, Moscucci M, Cohen MG. Transfemoral approach for coronary angiography and intervention: a Collaboration of International Cardiovascular Societies. JACC Cardiovasc Interv 2017; 10: 2269-2279.
6. Saleem T, D'Cruz JR, Baril DT. Femoral Aneurysm Repair. 2023 Apr 26. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan.
7. Prakash B, Mukhopadhyay S, Singodia P, Shah MM. Radial artery pseudoaneurysm following cardiac catheterization: a case report. Cureus 2021; 13: e19284.
8. Sarkadi H, Csőre J, Veres DS, Szegedi N, Molnár L, Gellér L, Bérczi V, Dósa E. Incidence of and predisposing factors for pseudoaneurysm formation in a high-volume cardiovascular center. PLoS One 2021; 16: e0256317.
9. Norwood MGA, Lloyd GM, Moore S, Patel N, Panditi S, Sayers RD. The changing face of femoral artery false aneurysms. Eur J Vasc Endovasc Surg 2004; 27: 385-388.
10. Tulla K, Kowalski A, Qaja E. Femoral Artery Pseudoaneurysm. 2022 Dec 19. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan. 2022 Dec 19.
11. Jolly SS, Yusuf S, Cairns J, Niemelä K, Xavier D, Widimsky P, Budaj A, Niemelä M, Valentin V, Lewis BS, Avezum A, Steg PG, Rao SV, Gao P, Afzal R, Joyner CD, Chrolavicius S, Mehta SR. Radial versus femoral access for coronary angiography and intervention in patients with acute coronary syndromes (RIVAL): a randomised, parallel group, multicentre trial. Lancet 2011; 377: 1409-1420.
12. Kurzawski J, Piątek Ł, Zandecki Ł, Piątek K, Turek Ł. Ultrasound-guided thrombin injection as a preferable method of treatment for iatrogenic pseudoaneurysms after invasive cardiovascular procedures – a single-center experience. Adv Interv Cardiol 2021; 17: 376-380.
13. Stone PA, Campbell JE, AbuRahma AF. Femoral pseudoaneurysms after percutaneous access. J Vasc Surg 2014; 60: 1359-1366.
14. Lenartova M, Tak T. Iatrogenic pseudoaneurysm of femoral artery: case report and literature review. Clin Med Res 2003; 1: 243-7.
15. Madia C. Management trends for postcatheterization femoral artery pseudoaneurysms. JAAPA 2019; 32: 15-18.
16. Lee SH, Jeong MH, Han KR, Sim DS, Yoon J, Youn YJ, Cho BR, Cha KS, Hyon MS, Rha SW, Kim BO, Shin WY, Park KS, Cheong SS; Korean Transradial Coronary Intervention Registry Investigators. Comparison of transradial and transfemoral approaches for percutaneous coronary intervention in patients with acute coronary syndrome and anemia. Am J Cardiol 2016; 117: 1582-1587.

17. Gargiulo G, Giacoppo D, Jolly SS, Cairns J, Le May M, Bernat I, Romagnoli E, Rao SV, van Leeuwen MAH, Mehta SR, Bertrand OF, Wells GA, Meijers TA, Siontis GCM, Esposito G, Windecker S, Jüni P, Valgimigli M; Radial Trialists' Collaboration. Effects on mortality and major bleeding of radial versus femoral artery access for coronary angiography or percutaneous coronary intervention: meta-analysis of individual patient data from 7 multicenter randomized clinical trials. Circulation 2022; 146: 1329-1343.
18. Hamon M, Pristipino C, Di Mario C, Nolan J, Ludwig J, Tubaro M, Sabate M, Mauri-Ferré J, Huber K, Niemelä K, Haude M, Wijns W, Dudek D, Fajadet J, Kiemeneij F; European Association of Percutaneous Cardiovascular Interventions; Working Group on Acute Cardiac Care of the European Society of Cardiology; Working Group on Thrombosis on the European Society of Cardiology. Consensus document on the radial approach in percutaneous cardiovascular interventions: position paper by the European Association of Percutaneous Cardiovascular Interventions and Working Groups on Acute Cardiac Care** and Thrombosis of the European Society of Cardiology. EuroIntervention 2013; 8: 1242-1251.
19. Sciahbasi A, Pristipino C, Ambrosio G, Sperduti I, Scabbia EV, Greco C, Ricci R, Ferraiolo G, Di Clemente D, Giombolini C, Lioy E, Tubaro M. Arterial access-site--related outcomes of patients undergoing invasive coronary procedures for acute coronary syndromes (from the Comparison of Early Invasive and Conservative Treatment in Patients With Non-ST-Elevation Acute Coronary Syndromes [PRESTO-ACS] Vascular Substudy). Am J Cardiol 2009; 103: 796-780.
20. Kassem HH, Elmahdy MF, Ewis EB, Mahdy SG. Incidence and predictors of post-catheterization femoral artery pseudoaneurysms. Egypt Heart J 2013; 54: 213-221.
21. Ahmed B, Dauerman HL. Women, bleeding, and coronary intervention. Circulation 2013; 127: 641-649.
22. Akbarpour E, Paridar Y, Mohammadi Z, Mard A, Danehchin L, Abolnezhadian F, Azadpour S, Rahimi Z, Zamani M, Cheraghian B, Poustchi H, Shayesteh AA. Anemia prevalence, severity, types, and correlates among adult women and men in a multiethnic Iranian population: the Khuzestan Comprehensive Health Study (KCHS). BMC Public Health 2022; 22: 168.
23. Bhavanadhar P, Srinivasan VR, Oruganti SS, Adiraju KP. A prospective study on prevalence and causes of anaemia in patients with acute coronary syndrome. J Clin Diagn Res 2016; 10: OC01-5.
24. Stone PA, Campbell JE, AbuRahma AF. Femoral pseudoaneurysms after percutaneous access. J Vasc Surg 2014; 60: 1359-1366.
25. Toma C, Zahr F, Moguilanski D, Grate S, Semaan RW, Lemieux N, Lee JS, Cortese-Hassett A, Mulukutla S, Rao SV, Marroquin OC. Impact of anemia on platelet response to clopidogrel in patients undergoing percutaneous coronary stenting. Am J Cardiol 2012; 109: 1148-1153.
26. Tisi PV, Callam MJ. Treatment for femoral pseudoaneurysms. Cochrane Database Syst Rev 2013; 11: CD004981.

Address for correspondence

Małgorzata Zachura PhD
Collegium Medicum
Jan Kochanowski University
Kielce, Poland
Phone: +48 413 671 503
E-mail: malgorzata.zachura@wszzkielce.pl