Investigation of the embolic foci through echocardiographic evaluation in patients undergoing urgent femoral embolectomy

Acil femoral embolektomi uygulanan hastalarda ekokardiyografik değerlendirme ile emboli odağının araştırılması

Ufuk Yetkin, Burçin Abud, Orhan Gökalp, Berkan Özpak, Aykut Şahin, Tayfun Göktoğan, Ali Gürbüz

Department of Cardiovascular Surgery, İzmir Atatürk Training and Research Hospital, İzmir, Turkey

ABSTRACT

Objective: The determination of the source of embolism in patients with lower extremity arterial emboli is a major clinical problem. A review of the literature focusing on large patient series showed that the heart is the embolic source in 78% of these patients. The aim of this study was to determine the role of early postoperative echocardiographic investigations in the determination of embolic origin.

Methods: This retrospective study group consisted of 57 patients in whom we performed 63 unilateral and bilateral urgent femoral embolectomies. Bilateral urgent femoral embolectomy was performed in 6 of the 57 patients included in the study and unilateral intervention was performed in the rest. Besides the features regarding age and sex, the cardiac rhythms of the patients during their application to our clinic were evaluated. In order to determine the origin of the acute peripheral arterial occlusion, transthoracic echocardiography was performed in all patients in the first 24 hours after the embolectomy.

Results: In 6 patients who underwent bilateral femoral embolectomy, distinct heart valve pathologies were determined. As for the 51 patients who underwent urgent unilateral femoral embolectomy, it was determined that 28 (55%) had serious cardiac pathologies. Among these 28 patients, 14 (50%) underwent the required open-heart surgery interventions after the completion of further examinations. It was determined that, in our series, 14 (64%) of the 22 patients with serious mitral valve pathologies had a history of acute joint rheumatism.

Conclusion: Regardless of whether the interventions are bilateral or unilateral, we believe that echocardiographic investigation should be performed in all patients during the early postoperative period in order to prevent recurrence by the determination of the thromboemboli source. Thus, accompanying serious intracardiac pathologies can be treated and the development of additional peripheral emboli can be prevented.
(Anadolu Kardiyol Derg 2009; 9: 37-40)

Key words: Peripheral arterial embolism, femoral embolectomy, echocardiography, mitral stenosis

ÖZET

Amaç: Alt ekstremite arterlerine yönelik embolik bir olay geçirmiş hastalarda önemli bir sorun da emboli kaynağının araştırılmasıdır. Fazla sayıda olgu içeren seriler incelendiğinde %78'inde emboli kaynağının kalp olduğu göze çarpar. Bu retrospektif çalışmada tek ve çift taraflı 63 adet acil femoral embolektomi uyguladığımız 57 olgunun postoperatif erken dönem ekokardiyografik incelemelerinin, embolik orijinin belirlenmesindeki rolünü araştırmayı amaçladık.

Yöntemler: Çalışmaya dahil edilen 57 olgunun 6'sına bilateral acil femoral embolektomi uygulanırken diğerlerine unilateral girişim gerçekleştirildi. Olgularımızın yaş ve cinsiyet özelliklerinin yanında kliniğimize başvuruları esnasındaki kardiyak ritimleri de değerlendirildi. Akut periferik arteryel tıkanıklık orijinini araştırmak üzere, tüm hastalar, embolektomi sonrasında ilk 24 saat içinde transtorasik ekokardiyografi ile incelendi.

Bulgular: Bilateral femoral embolektomi girişimi gerçekleştirilen toplam 6 olgumuzda belirgin kalp kapak patolojileri saptandı. Tek taraflı acil femoral embolektomi uygulanan 51 olgumuzun 28'inde (%55) ciddi kardiyak patolojiler bulgulandı. Bu ciddi kardiyak patoloji bulgulanan 28 olgunun 14'ünde (%50) gerekli ileri incelemelerinin tamamlanmasının ardından gerekli açık kalp cerrahisi girişimleri uygulandı. Serimizde önemli derecede mitral kapak patolojisi bulgulanan toplam 22 olgunun 14'ünde (%64) geçirilmiş akut eklem romatizması anamnezi de saptandı.

Sonuç: İster bilateral ister unilateral olsun acil femoral embolektomi girişimi uygulanan tüm olgularda tromboemboli kaynağının belirlenerek tekrarlamasının önlenebilmesi açısından tüm olgulara postoperatif erken dönemde ekokardiyografik incelemenin yaptırılarak eşlik eden ciddi intrakardiyak patolojilerin de sağaltımının gerçekleştirilebileceği ve oluşabilecek başka periferik emboliler açısından küratif değere sahip olacağı düşüncesindeyiz.
(Anadolu Kardiyol Derg 2009; 9: 37-40)

Anahtar kelimeler: Periferik arteriyal emboli, femoral embolektomi, ekokardiyografi, mitral darlık

Address for Correspondence/Yazışma Adresi: Doç. Dr. Ufuk Yetkin, İzmir Atatürk Training and Researh Hospital, Cardiovascular Surgery, Izmir, Turkey
Mobile: +90 505 312 49 06 Fax: +90 232 243 48 48 E-mail: ufuk_yetkin@yahoo.fr

Introduction

The term 'embolus' originates from the Greek word 'embolos', which means stopper or plug. The term was first used by Virchow in 1854 (1). Although numerous surgeons attempted arterial embolectomy since 1895, the first successful intervention was made by Georges Labey in 1911 and the first article on a successful intervention was published by Mosny and Dumont. One of the important phases in the clinical treatment is the use of heparin before and after the surgical intervention. The introduction of the balloon catheter to the surgical treatment of thromboembolism by Fogarty marked the start of a new era (2). Since this catheter allows urgent radical treatment in peripheral thromboembolism, it has a crucial role in decreasing mortality and morbidity. Arterial emboli are the most common cause of acute peripheral arterial occlusions and mostly, they originate from the heart. A review of the literature shows that the origin is heart in 78% of the arterial emboli (2). Cardiac sources are classified into two groups as definite and potential sources. Definite sources include cardiac pathologies, of which the relation with embolism is definite. These include atrial and ventricular thrombi; thrombi on prosthetic valves tumors and endocarditis. On the other hand, potential sources are cardiac anomalies, which may also be detected in healthy individuals and, of which the role in arterial emboli is not definitely proved. These sources include patent foramen ovale, ring of prosthetic valve, spontaneous echocardiographic contrast (SEC), atheromatous plaques in the aorta and dystrophy and calcification of the foramen ovale orifice (3).

In this study, we investigated the role of echocardiographic investigation results obtained in the early postoperative period in the determination of the embolic source in 57 patients who underwent unilateral and bilateral urgent femoral embolectomies.

Methods

Fifty-seven patients who underwent 63 urgent femoral embolectomies between January 2001 and January 2006 with the preliminary diagnosis of acute peripheral arterial occlusion were included in this retrospective, single-center study. Patients who required direct amputation due to muscle necrosis, stiffness and other irreversible findings determined during their first application to the hospital and those with iatrogenic occlusions were excluded from the study.

Of the 57 patients, 21 (36.8%) were men and 36 (63.2%) were women and the mean age was 64.73±12.17 years (range 36 to 98 years). Definite diagnoses of acute lower extremity arterial embolus in all patients were made with the determination of the classical 6P findings as well as Doppler ultrasound examination. After the age and sex features of the patients were determined, we obtained their cardiac rhythm at admission and the rates of acute and chronic emboli were determined. While previous myocardial infarction was present in 5 (8.7%) patients, none of the patients underwent prosthetic heart valve operation. Intraarterial DSA examination was also performed in 8 (14%) of our patients who were thought to have acute arterial occlusion on a chronic basis due to a medical history of previous claudication.

All patients underwent urgent femoral embolectomy for the first time and bilateral femoral embolectomy was performed in 6 (10.5%) patients. The materials obtained from all patients were sent for histopathological examination.

In order to investigate the origin of the arterial occlusion, all patients were examined via transthoracic echocardiography in the first 24 hours following the embolectomy. In case of a pathological finding obtained after this examination, transesophageal echocardiography was carried out. If indicated, cardiac catheterization was also performed while planning the treatment modality. Transthoracic echocardiography was done for about 10 minutes for each case using Vivid 3, GE 2.5 MHz transthoracic probe. To assess left atrial and ventricular thrombi, parasternal long axis and apical 2- and 4-chamber views were obtained. To detect a defect in interatrial septum (atrial septal defect (ASD) or patent foramen ovale (PFO)), some amount of saline was injected through left antecubital vein and apical 4-chamber and substernal views were obtained. While assessing the thoracic aorta, parasternal long axis and suprasternal views were obtained.

Statistical analysis

All the statistical evaluations were carried out using SPSS 10.0 for Windows Statistical Package programs (Chicago, IL). Statistical comparison analyses were not carried out and therefore no statistical significance (p value) value was given. Descriptive statistics are given as numbers and percentage whereas the age was summarized as mean±standard deviation.

Results

In 4 (66.7%) of our 6 patients who underwent bilateral femoral embolectomy atrial fibrillation (AF) was prominent. In this group of patients, distinctive heart valve pathologies were determined (Table 1).

The mean age of our 51 patients undergoing urgent femoral embolectomy was 64.88±12.21 years (ranging from 38 to 98). In 28 (54.9%) of these patients serious cardiac pathologies were determined (Table 2). In 24 (85.7%) of these 28 patients AF, and in 22 (78.6%) SEC were determined (Fig. 1). All of these 22 cases possessed moderate or severe SEC in left atrium. In 10 of them transposition of SEC from left atrium into the ventricle was seen. Left atrial thrombus was determined in only one patient (Fig. 2). After the required examinations were completed the required open-heart surgery interventions were applied.

Eight of the 51 patients who underwent unilateral femoral embolectomy were aged 80 years and above (ranging from 80 to 98). Of these 8 patients, 7 (87.5%) were female. While cardiac pathologies requiring medical follow-up were determined in 4 patients, valvular pathologies were determined to be at minimum level in the remaining four. Another interesting finding was that AF was determined in three (75%) of the four patients with more serious valvular pathologies while it was dominant in only 1 (25%) of the 4 patients with nonsignificant pathologies.

After the urgent femoral embolectomy, valve replacement interventions including the mitral valve were made in 11 (19.3%) of the 57 patients. In addition to the standard valve replacement technique, unipolar or bipolar Surgical Ablation Device (Medtronic) aimed at AF and left atrial appendage ligation procedures using standard radio frequency ablation were applied. Fourteen (64%) of the 22 SEC(+) patients had a history of acute rheumatic fever.

Table 1. The clinical and echocardiographic features of the 6 patients who underwent bilateral urgent femoral embolectomy

Patient no	Gender	Age	Cardiac Rhythm	TTE Findings	Additional Intervention
1	F	36	AF	Severe MS (MVA= 0,5 cm^2), 3.^{o} AR, 2.^{o} TR, PAP= 50 mmHg	MVR +AVR
2	F	65	AF	Severe MS (MVA= 1.1 cm^2), 2-3.^{o} TR, PAP=65 mmHg	MVR
3	F	56	AF	Moderate MS	Follow-up with medical therapy
4	M	67	NSR	Aneurysmatic dilatation of ascending aorta (38 mm)	Follow-up with medical therapy
5	F	75	AF	2-3.^{o} TR	Follow-up with medical therapy
6	F	72	NSR	2.^{o} TR	Follow-up with medical therapy

AF – atrial fibrillation, AR - aortic valve regurgitation, AVR - aortic valve replacement, F - female, M - male, MS - mitral stenosis, MVA- mitral valve area, MVR - mitral valve replacement, NSR – normal sinus rhythm, PAP - pulmonary arterial pressure, TR - tricuspid valve regurgitation, TTE – transthoracic echocardiography

Table 2. The clinical and echocardiographic features of the 51 patients who underwent unilateral urgent femoral embolectomy

Patient Number	Cardiac Rhythm	Transthoracic Echocardiography Findings	Additional Intervention
1	AF	Severe MS,2.^{o} AR,1.5x1cm thrombus in left atrium	MVR
1	AF	Severe MS,4.^{o} TR, PAP=60mmHg	MVR+TRA
2	AF	Severe MS+Moderate MR, 2-3.^{o} TR	MVR+TRA
3	AF	Severe MS+Moderate MR, 2-3.^{o} AR	MVR+AVR
2	AF	Severe MS	MVR
1	NSR	Aneurysmatic dilatation of ascendan aorta (54mm)+ 2-3.^{o} AR	Benthall procedure
4	3NSR+1AF	2-3.^{o} TR	Follow-up with medical therapy
5	AF	2.^{o} MR	Follow-up with medical therapy
3	AF	2.^{o} MR+2.^{o} TR	Follow-up with medical therapy
2	AF	2-3.^{o} MR+2.^{o} AR	Follow-up with medical therapy
3	AF	4.^{o} AR	AVR was performed
1	AF	4.^{o} AR+2.^{o} TR	AVR was performed

AF - atrial fibrillation, AR - aortic valve regurgitation, AVR - aortic valve replacement, MR - mitral valve regurgitation, MS- mitral stenosis, MVA- mitral valve area, MVR- mitral valve replacement, NSR - normal sinus rhythm, PAP -pulmonary arterial pressure, TR - tricuspid valve regurgitation,TRA -tricuspid ring annuloplasty

The embolic materials of all patients were histopathologically investigated and no findings indicating myxomatous or malignant cells were observed.

Discussion

Acute peripheral arterial insufficiency mostly demonstrates itself as the occlusion of major arteries with coagulum. Patients with myocardial infarction, mitral stenosis and atrial fibrillation are at greater risk for the development of intracardiac coagulum (1). The most common cause of the embolism (73%) was AF (4). The incidence of arterial embolic diseases has been gradually increasing. The possible causes of this increase include the development in diagnostic techniques, the prolongation of survival in patients with progressed heart diseases and the increased use of cardiac prosthetic devices and invasive diagnosis and treatment interventions (1, 2). Mean age of our cases was 64.73±12.17 years, which confirms that prolonged human life increases the incidence of acute arterial emboli.

In our series, AF was detected in 24 cases that constitute 85% of cases subjected to either medical or surgical therapy. Moreover, all cases with surgical intervention except for Bentall procedure had AF. Another interesting point was that the incidence of AF among cases who underwent bilateral embolectomy was 66.7%. Although such emboli usually involve the lower extremities and mostly the femoral artery, they may also involve iliac and popliteal arteries (2).

Thromboembolic incidents may be seen in every part of the arterial bed, cause high mortality and morbidity and require urgent intervention. Since the problem causing embolus generally originates from the heart, the morbidity and mortality risks increase (5). Arterial occlusions originating from cardiac emboli are generally serious and tend to recur. They have high recurrence and mortality rates (6). Thus, it is imperative to prevent any delay in making a diagnosis and initiating therapy.

Transthoracic echocardiography is the most commonly used monitoring method in the investigation of the potential embolic sources and its cost-efficiency, easy applicability and the significant information that it offers makes the superiority

Figure 1. The echocardiographic image of a patient in whom spontaneous echocardiographic contrast (SEC) was determined

Figure 2. The transthoracic echocardiographic image of a patient with left atrial thrombus

of the echocardiography indisputable (3). Transthoracic echocardiography (TTE) is the cornerstone of noninvasive cardiac imaging in the detection of cardiac source of emboli(7).In the study of Gossage et al. (8), forty-two patients underwent surgical embolectomy, 27 for lower limb ischemia and 15 for upper limb ischemia. Postoperatively, 34 patients (81%) had transthoracic echocardiography (TTE), which demonstrated a source or potential source for thrombus in 19 (56%). TEE did not identify any additional patients with cardiac embolic sources that were not detected by TTE. In our series, serious cardiac pathologies were determined with TTE in 55% (28) of cases. Transthoracic echocardiography is a good screening tool for detecting a potential cardiac source for peripheral embolism, with transesophageal echocardiography being reserved for specific indications (8).

Spontaneous echo contrast corresponds to an echocardiographic image in the shape of cigarette smoke, which is an indicator of tendency to coagulation and results from the folding of erythrocytes into a roll-like structure due to decreased blood flow (9). Left atrial SEC is seen in 80% of the patients with a history of mitral stenosis and embolus and in 48% of the patients with no history of emboli (10). The presence of SEC in mitral stenosis is an indicator of hypercoagulation (11). Stasis and the development of AF mutually increase their effects in thrombosis formation. Although there has been a great decrease in the incidence of rheumatismal heart disease in developed countries, the disease is still a preventable cause of significant morbidity and mortality in our country. In our series, 64% of cases with SEC had rheumatismal heart disease (mitral stenosis). Rheumatismal heart disease may remain silent for a long time without causing any symptoms and reveal itself with numerous clinical manifestations after many years. These manifestations are mostly heart failure due to the mitral valve stenosis and insufficiency and embolic incidents. Overall, 20 to 25% of acute peripheral arterial occlusions result from rheumatismal heart diseases and most particularly mitral stenosis accompanying AF (2). In our series, 11 (20%) cases underwent mitral valve surgery all of which had AF. In order to prevent these complications, the patients in whom mitral stenosis is detected should receive transthoracic echocardiography follow-up at certain intervals and AF development should be prevented. Transthoracic echocardiography is particularly recommended to determine a patient with cardiac source of emboli and to ensure that diagnosis is not overlooked.

Limitations of the study

Limitations of our study are as follows: it was a retrospective study and therefore a randomization could not be constituted. Echocardiographic evaluations were performed by several different cardiologists, as well. The ages of the subjects showed a wide variety. Thus, prospective randomized studies with larger series of cases are needed.

Conclusion

As a result, the development in the diagnostic and treatment methods and the prolongation of survival in patients with progressed heart diseases increase the incidence of arterial embolism. Since thromboemboli mostly originate from the heart, the cardiac status of the patients becomes much more important. In order to determine the origin of the thromboembolism and prevent its recurrence, urgent transthoracic echocardiography has to be performed on patients in the early postoperative period without fail and the necessary treatment for the detected cardiac pathologies must be initiated without delay.

References

1. Brewster DC, Chin AK, Fogarty TJ. Arterial thromboembolism. In: Rutherford RB, editor. Vascular Surgery. 3rd ed. Philadelphia: W. B. Saunders Company; 1989. p. 546-64.
2. Keçeligil HT, Küsdül M, Gökgözoğlu G, Sarac A, Kolbakır F, Akar H, et al. Acute Peripheral Arterial Occlusions: Review of 179 Cases. J Turkish Thorac Cardiovasc Surg 1999; 7: 319-23.
3. Palazzuoli A, Ricci D, Lenzi C, Lenzi J, Palazzuoli V. Transesophageal echocardiography for identifying potential cardiac sources of embolism in patients with stroke. Neurol Sci 2000; 21: 195-202.
4. Ueberrueck T, Marusch F, Schmidt H, Gastinger I. Risk factors and management of arterial emboli of the upper and lower extremities. J Cardiovasc Surg (Torino) 2007; 48: 181-6.
5. Becquemin JP, Kovasky S. Arterial emboli of the lower limbs: analysis of risk factors for mortality and amputation. Ann Vasc Surg 1995; 9: 32-8.
6. Ferro JM. Cardioembolic stroke: an update. Lancet Neurol 2003; 2: 177-88.
7. Timóteo AT, Branco LM, Galrinho A, Abreu J, Leal A, Santana A, et al. Was transesophageal echocardiography performed, given its superior diagnostic abilities for CVSE? Yes or no? Reasons? Rev Port Cardiol 2007; 26: 993-1006.
8. Gossage JA, Ali T, Chambers J, Burnand KG. Peripheral arterial embolism: prevalence, outcome, and the role of echocardiography in management. Vasc Endovascular Surg 2006; 40: 280-6.
9. Fatkin D, Roy P, Sindone A, Feneley M. Rapid onset and dissipation of left atrial spontaneous echo contrast during percutaneous balloon mitral valvotomy. Am Heart J 1998; 135: 609-13.
10. Sarikamis C, Bozat T, Akaya V. Persistence of left atrial spontaneous echocardiographic contrast alter percutaneous mitral valvulotomy: a study in the Turkish population. J Heart Valve Dis 1997; 6: 160-5.
11. Peverill RE, Harper RW, Geiman J, Gan TE, Harris G, Smolich JJ. Determinants of increased regional left atrial coagulation activity in patients with mitral stenosis. Circulation 1996; 94: 331-9.