



Delayed Treatment and Missed Opportunities for Limb Salvage in Patients with Peripheral Arterial Embolism

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Abstract

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BACKGROUND: The peripheral arterial embolism (PAE) is a sudden decrease in limb perfusion due to acute occlusion of peripheral artery which leads to ischemic tissue damage, that can threaten the limb of a patient and requires immediate revascularization. It is estimated that the incidence of acute limb embolism in the general population is around 14/100,000 inhabitants per year. Accurate and timely diagnosis is crucial to salvage the patient's limb and sometimes the patient's life. In cases of complete arterial occlusion and absence of collateral perfusion, irreversible damage can occur within 4 to 6 hours. The fundamental definition for treatment of acute peripheral arterial embolism is revascularisation. Revascularisation is either performed endovascularly or by an open surgical approach. A suspicion of acute ischemia based on history and physical examination warrants heparin administration and vascular surgery consultation. Delays in the management of acute peripheral arterial ischemia due to an embolism are common and associated with poor limb - salvage outcomes.

AIM: Our study aims to identify medical consultations and cardiovascular assessments undergone by patients in the period prior to being hospitalised, in order to evaluate for missed or delayed opportunities for diagnosis.

METHODS: Retrospective cohort study, utilising the medical documentation and previous outpatiently or in-hospital consultations. Adult patients undergone treatment due to peripheral arterial embolism were identified and analyzed. Patients were identified through the administrative hospital database using the International Classification of Diseases. Hospitalised patients with those medcodes between 1st January 2010 - 1st March 2020 were recorded.

RESULTS: Following exclusion, 424 patients (mean age 68.5 ± 5.85 years) were included. 159 patients (66.8%) had visited their family doctors or other medical specialist before admission and in all of the cases was initiated therapeutic approach. The rest of the cohort 79 patients (33.2%) presented lately due to other social reasons. The group of 159 patients that admitted lately due to medical indications - diagnostic, healthcare - administrative or treatment related problems are subject of our study. The largest group including 113 (71%) patients were treated outpatiently by vascular surgeons with preventative medications. 17 patients (10.6%) were directed outpatiently to orthopaedic surgeon due to suspicion of trauma. 15 patients (9.4%) were treated by their family doctors with pain relief medications. The rest of the 14 patients (8.8%) were treated by neurosurgeons or neurologists due to a suspicion of cauda equina and other neuropathies. The majority of the patients 108 (67.9%) were free of complains at the discharge, 11.3% of the studied cohort were with minimal post-treatment complains (numbness, coldness, absent peripheral pulsations, insignificant claudicatio). Amputation rate was 14.4%, incidence of rethrombosis 8.8% and recurrent embolism frequency around 3.7%. Death was registered in 21 cases (13.2%).

CONCLUSION: The consequences of acute limb embolism such as prolonged hospitalization, major limb amputation, and/or death have a profound socioeconomic impact. Unrecognition of this vascular pathology and differential diagnosis difficulties are possibly leading factors for delayed or missed treatment.

Introduction

The peripheral arterial embolism (PAE) is a sudden decrease in limb perfusion due to acute occlusion of peripheral artery which leads to ischemic tissue damage that can threaten the limb of a patient and requires immediate revascularization. It is estimated that the incidence of acute limb embolism in the general population is around 14/100,000 inhabitants per year [1].

Accurate and timely diagnosis is crucial to salvage the patient's limb and sometimes the patient's life.

In cases of complete arterial occlusion and absence of collateral perfusion, irreversible damage can occur within 4–6 h [2], [3], [4].

The fundamental definition for the treatment of acute PAE is revascularization. Revascularization is either performed endovascularly, where a thrombolytic agent is delivered directly into the thrombus through a catheter positioned from a Seldinger groin puncture [2], [5], [6], or by an open surgical approach, most commonly as a thromboembolectomy [8].

Despite recent technical advancements in revascularization treatment options, amputation and mortality rates remain high in patients with PAE [7], [8]. The time passed from the onset of symptoms to revascularization has been linked to patient outcome [8], [9].

A suspicion of acute ischemia based on history and physical examination warrants heparin administration and vascular surgery consultation [10].

Delays in the management of acute peripheral arterial ischemia due to an embolism are common and associated with poor limb salvage outcomes.

In aging population, primary major amputations (AMP, below-knee or above-knee) continue to be performed despite advances in revascularization. A hypothesis that not only patient comorbidities but also the system of health-care delivery affected the treatment of patients with acute arterial limb ischemia could be eligible [11].

At present, there are suspicions whether opportunities for timely recognition in general practice and other more specialized medical practice exist and are potentially being delayed or missed. Our study aims to identify medical consultations and cardiovascular assessments undergone by patients in the period before being hospitalized, to evaluate for missed or delayed opportunities for diagnosis.

Methods

Retrospective cohort study utilize the medical documentation and previous outpatient or in hospital consultations. Adult patients undergone treatment due to PAE were identified and analyzed.

Patients were identified through the administrative hospital database using the International Classification of Diseases, 10th revision (ICD-10) codes “Embolism and thrombosis of arteries of upper extremities,” – I74.2, I74.3 – “Embolism and thrombosis of arteries of the lower extremities,” I74.5 – “Embolism and thrombosis of iliac artery,” and I74.0 – “Embolism and thrombosis of abdominal aorta.”

Hospitalized patients with those medcodes between January 1, 2010, and March 1, 2020, were recorded.

Gama CodeMasters – an administrative hospital database was used to exclude patients treated due to acute post-traumatic arterial ischemia or acute ischemia due to peripheral arterial disease (PAD).

The total number of outpatient examinations, hospital treatment, and their latest consultation before admission was identified.

Results

Following exclusion, 424 patients (mean age 68.5 ± 5.85 years) were included. About 45.9% of the cohort were recorded as having arterial hypertension as most common comorbidity followed by atrial fibrillation

in 33.5% of the cases. About 56% (238 patients) presented in our clinic more than 12 h after onset of the symptoms, 159 patients (66.8%) had visited their family doctors or other medical specialist before admission and in all of the cases was initiated therapeutic approach. The rest of the cohort 79 patients (33.2%) presented lately due to other social reasons.

The group of 159 patients that admitted lately due to medical indications – diagnostic, health care – administrative or treatment-related problems is subject of our study. The largest group including 113 (71%) patients was treated outpatient by vascular surgeons with preventative medications as followed: Antiplatelet (79.6%), vasoactive (76.1%), analgetics (62.8%), and lipid lowering agents (31.8%) with poor outcome. This group represented major interest for our study to analyze and investigate the reasons for late referring to vascular surgery department and, respectively, delays in treatment. Physical state and clinical stage of the extremity in all of 113 cases treated outpatient by vascular surgeons are presented in Table 1 based on clinical stage according to the Rutherford recommended standards for reporting lower extremity ischemia.

Table 1: Distribution of the stages

Stages	113 patients
I stage (Viable ischemia)	18 (15.9%)
II-a stage (Threatened marginal)	27 (23.9%)
II-b stage (Threatened: Immediate)	35 (31%)
III stage (Irreversible)	33 (29.2%)

The largest number of patients referred lately to our clinic was with threatened marginal ischemia, 24 of them 68.5% had PAD as a primary comorbidity. In all of the cases, treatment approach was initiated with vasoactive medications due to suspicion of CLI.

Age, comorbidities, risk factors, and medication use of the 113 patients treated outpatient by vascular surgeons are presented in Table 2.

Table 2: Age, comorbidities, risk factors and medication use

Variables	113 patients
Age >70 years	76 (67.2%)
Hypertension	68 (60.1%)
Diabetes	43 (38.05%)
Smokers	42 (37.1%)
Peripheral arterial disease	64 (56.6%)
Cardiac pathology (AF, CAD, CHF, and incl. past myocardial infarction)	52 (46.01%)
Cerebrovascular disease	39 (34.5%)
Medication use (before admission)	90 (79.6%)

Seventeen patients (10.6%) were directed outpatient to orthopedic surgeon due to suspicion of trauma, after reviewing medical documentations and clinical data provided by patients in all of the cases history of trauma were absent.

Fifteen patients (9.4%) were treated by their family doctors with pain relief medications.

The rest of the 14 patients (8.8%) were treated by neurosurgeons or neurologists due to a suspicion of cauda equina and other neuropathies, all 14 patients of these group were treated in hospital. In these group was registered worse mortality rate 28.5% (4 of 14), all 4 death cases were with aortic

saddle embolism untreated at least 15 h from onset of the symptoms.

Treatment approach in all 159 patients is presented in Table 3. About 61% of the patients despite the delay underwent embolectomy alone.

Table 3: Treatment approach

Treatment approach	n = 159
Embolectomy alone	97 (61%)
Embolectomy + other arterial reconstruction (bypass, TEA, etc.)	21 (13.2%)
Embolectomy + minor amputation	9 (5.7%)
Primary major amputation	16 (10%)
MAT	1 (0.6%)
Thrombolysis	1 (0.6%)
Conservative treatment	14 (8.9%)

In 21 cases, embolectomy was insufficient and was amplified by other arterial reconstruction (aorta-femoral bypass in 1 patient, indirect iliac endarterectomy in 6 cases, Common femoral artery (CFA), and profunda femoral artery (PFA) endarterectomy in 9 cases, and in 5 occasions was performed femoropopliteal bypass above the knee). Sixteen patients due to the irreversible ischemia underwent primary major amputation, in 5.7% despite successfully performed embolectomy, the necessity of minor amputation was present. One patient was treated with mechanical aspiration thrombectomy and also one patient underwent thrombolysis.

Fourteen patients due to a viable compensated ischemia and because of very high operative risk were treated conservatively.

Post-treatment outcome and overall mortality are presented in Table 4.

Table 4: Post-treatment outcome and overall mortality

Outcome	n = 159
Free of complains	108 (67.9%)
Minimal complains (numbness, coldness, absent peripheral pulsations, claudication)	18 (11.3%)
Amputation	23 (14.4%)
Rethrombosis	14 (8.8%)
Recurrent embolism	6 (3.7%)
Fasciotomy	19 (11.9%)
Operative site infection	7 (4.4%)
Death (in hospital or 30 deaths post-submission)	21 (13.2%)

The majority of the patients 108 (67.9%) were free of complains at the discharge, 11.3% of the studied cohort were with minimal post-treatment complains (numbness, coldness, absent peripheral pulsations, and insignificant claudication). Amputation rate was 14.4%, incidence of rethrombosis 8.8%, and recurrent embolism frequency around 3.7%. Death was registered in 21 cases (13.2%).

Discussion

Acute PAE is a vascular pathology that can be diagnosed and treated in a short time. Mortality and morbidity are significantly reduced after timely and accurate diagnosis and treatment.

Delayed diagnosis in certain cases may be caused by clinical course of the embolism hidden under

the guise of a post-operative condition or a severe comorbid state [12].

Pre-transfer management decisions by referring hospitals to an academic tertiary care facility for ALI patients occur less frequently than expected and are associated with an increased adverse event [13].

Furthermore, a potential difficulty in differentiating between PAE and acute peripheral arterial thrombosis in patients with pre-existing PAD could be a major cause of delayed treatment in acute emboligenic occlusion [14].

A study showed that the greatest source of delay is time from symptom onset to presentation in the emergency department (ED); an average of 11.35 h. The second largest source of delay was time from recognition of PAE to imaging, with an average delay of 4.75 h. The average ED evaluation time was 40 min, and the average total time to intervention was 10.2 h. While time to symptom presentation may represent a failure of public health, time to imaging was identified as an area of unacceptable delay by the authors [15].

A swede study examined the effect of pre-hospital care on the time to treatment. Persons who were transported through emergency medical services (EMSs) arrived to the hospital at a median time of 5 h after symptom onset, were seen by a physician at a median time of 51 min, and had revascularization at a median time of 23 h. Those not transported by EMS arrived to the hospital at a median time of 48 h after symptom onset, were seen by a physician at a median time of 80 min, and had revascularization at a median time of 93 h [16]. In a condition where minutes matter, expedient action is critical. Time to recognition, imaging, consultation, and intervention all are potential sources of delay [17].

It is uncertain in our study group if the opportunities for timely diagnosis have "just been missed" or it concerns a group of patients being improperly treated due to health-care system problems, poor preparation of medical specialists regarding vascular pathologies or due to a lack of a unified standard for the treatment of vascular diseases.

Conclusion

The consequences of acute limb embolism such as prolonged hospitalization, major limb amputation, and/or death have a profound socioeconomic impact.

Unrecognition of this vascular pathology and differential diagnosis difficulties is possibly leading factors for delayed or missed treatment.

Further research is required to analyze and understand the cause for these opportunities being

delayed or missed and to develop strategies that would prevent future complications and amputations.

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