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Weak Links in the Early Chain of Care of Acute Lower Limb Ischaemia in Terms of Recognition and Emergency Management

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WHAT THIS PAPER ADDS

This research paper provides current data on the early chain of care for patients with acute lower limb ischaemia focusing on lead times and emergency management and linking this data to treatment outcome. Several weak links in the management of these patients were identified, and predictors for a poor treatment outcome were explored in a multivariate analysis.

Objectives: Acute lower limb ischaemia (ALLI) is a potentially fatal, limb threatening medical emergency. Early treatment is essential for a good outcome. The aim was to describe the early chain of care in ALLI focusing on lead times and emergency management in order to identify weak links for improvement.

Methods: This was a retrospective, descriptive case study. This study analysed the medical records of all patients with a main discharge diagnosis of ALLI between January 2009 and December 2014. Predetermined emergency care data on lead times, diagnosis recognition, presenting symptoms, emergency care treatment and outcome were collected for patients who were transported by the Emergency Medical Service (EMS) and those who were not.

Results: In total, 552 medical records were audited of which 195 patients fulfilled the inclusion criteria and were analysed. Among them were 117 (60%) transported by the EMS. The median time from symptom onset to revascularisation was 23 (interquartile range [IQR] 10–55; EMS transported) and 93 (IQR 42–152, not EMS transported) hours ($p < .01$). The time from symptom onset to arrival in hospital was 5 (IQR 2–26; EMS transported) and 48 (IQR 6–108; not EMS transported) hours. After arrival in hospital, the median time to first doctor evaluation was 51 (IQR 28–90; EMS transported) and 80 (IQR 44–169; not EMS transported) minutes, $p = .01$. Low molecular weight heparin (LMWH) was given to 72% of patients in the emergency department (ED) and a multivariate analysis showed that the use of LMWH was associated with a more favourable outcome.

Conclusions: Both the time spent in the ED and the time from the onset of symptoms to revascularisation were considerably longer than optimal. Time delays in the early treatment chain can mainly be attributed to "patient delay" and a considerable time spent in hospital before revascularisation. The use of LMWH as an integral part of ED management was associated with a better outcome.

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INTRODUCTION

Acute lower limb ischaemia (ALLI) is rare compared with other types of peripheral arterial disease. The overall incidence of ALLI is uncertain, but has been estimated to be around 14 cases per 100,000 patient years.[1] Acute lower limb ischaemia is a serious medical condition that often requires immediate medical attention. It is defined as a rapid decrease in blood supply to the lower extremity, threatening limb viability.[2,3] In cases of complete arterial occlusion and absence of collateral perfusion, irreversible damage can occur within 4–6 h.[4,5] The clinical presentation varies depending on the aetiology behind the ischaemia.[4,6]

Supportive measures such as fluid therapy, correction of acidosis, and pain management are important in ALLI. Moreover, to mitigate secondary thrombosis, recent review articles state that heparin should be administered as soon as the diagnosis of ALLI is made, unless there are contra-indications.[2,4] The mainstay for definite treatment of ALLI is revascularisation. Revascularisation is either performed

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endovascularly, where a thrombolytic agent is delivered directly into the thrombus through a catheter positioned from a Seldinger groin puncture,[4,7,8] or by an open surgical approach, most commonly as a thrombo-embolectomy.[2]

Despite recent technical advancements in revascularisation treatment options, amputation and mortality rates remain high in ALLI.[2,9] The time passed from the onset of ALLI symptoms to revascularisation has been linked to patient outcome.[10] It was hypothesized that the current early chain of care in the management of ALLI is suboptimal in terms of lead times, recognition of the condition, and supportive treatment measures, and that this might contribute to the poor prognosis for this patient group. The aim of this study was to audit the early chain of care of ALLI patients primarily admitted to a tertiary referral centre in Sweden, starting from symptom onset, continuing through the dispatch centre, ambulance, emergency department (ED), and operating theatre and ending at the 30 day follow-up. The main purpose was to identify where the major delays in terms of early diagnosis and management were, and to shed light on possible areas for improvement. A secondary aim was to explore the impact of any treatment chain time delays on outcome at 30 days and 1 year after revascularisation.

MATERIALS AND METHODS

Study design

This was a retrospective, descriptive case study based on medical records for patients with a defined final diagnosis. The study cohort was admitted to the hospital between January 1, 2009, and December 31, 2014. The study was approved by the regional ethical review board of Gothenburg (reference number 853-15).

Study area

Sahlgrenska University Hospital is in the municipality of Gothenburg. The Sahlgrenska University Hospital organisation consists of three separate hospitals serving a population approaching 1 million inhabitants (Gothenburg region). Sahlgrenska University Hospital is also the tertiary referral hospital in the west of Sweden, with a catchment area totaling 1.7 million. The Emergency Medical Services (EMS) and ambulances use a priority system ranging from 1 to 4. Priority 1 is used for life threatening medical emergencies, priority 2 for non-life threatening medical emergencies, priority 3 for patients who need medical attention but not emergency care, and priority 4 implies no need for medical care, and that the transportation does not need to be carried out by an ambulance. The ambulances and the ED both use RETTS (Rapid Emergency Triage and Treatment System) as their triage method.[11] There are five different priority levels: red, orange, yellow, green, and blue; red is the most urgent and blue the least. The hospital organisation also has a vascular surgical department, located in one of the three hospitals, with 24/7 emergency services for both endovascular and open vascular procedures.

Study population

Patients were identified through the administrative hospital database using the International Classification of Diseases, 10th revision (ICD-10) code "embolism and thrombosis of arteries of lower extremities," I74.3. All patients with a final discharge diagnosis of I74.3 who had sought primary emergency care at one of the three emergency wards within the Sahlgrenska University Hospital organisation were included in the study. Patients with an incorrect diagnosis of ALLI, patients primarily seeking primary medical attention in another hospital, and patients receiving the ALLI diagnosis during a non-emergency visit were excluded, as were patients developing ALLI in hospital while being treated for another condition.

Data collection

The hospital records for all patients meeting the inclusion criteria were retrospectively reviewed and assembled in a predesigned worksheet. For patients transported by ambulance, the electronic medical record (EMR) created by the ambulance staff was used to obtain the time of symptom onset and arrival in hospital, medical priority attached by the dispatch centre and the ambulance staff, vital parameters and leg symptoms, pre-hospital treatment arrangements and whether the ambulance staff documented a suspicion of ALLI.

For all patients, the medical administrative database was used to find priority level in the ED, door to doctor time, and the total time the patient spent in the ED. The same database was also used to assemble data on hospital arrival time for patients not transported by ambulance.

The hospital's EMR software was used to collect the time of symptom onset for walk in patients, vital parameters on arrival, medical assessment by the triage nurse, documented suspicion of ALLI by the triage nurse, symptoms at first medical evaluation by a doctor in the ED, treatment arrangements in the ED, primary diagnosis and presumed aetiology, time to and type of revascularisation procedure, and patient outcome at 30 days and 1 year.

Definitions

Type and time of symptom onset were defined according to written information in the available databases. Suspicion of ALLI by ambulance staff or the triage nurse was assumed if the ambulance or hospital notes indicated such a suspicion. Baseline risk factors and comorbidity were retrieved from the EMR. Time to revascularisation was defined as the start of alteplase infusion for patients treated with thrombolysis, and time for wound closure for patients undergoing open surgery.

Statistical methods

Statistical analyses were performed with IBM SPSS Statistics software version 24 (IBM Corp. Armonk, NY, USA). For continuous variables, means and standard deviations were calculated, and for categorical variables absolute numbers and percentages were calculated. The Student *t* test was

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