Eur J Vasc Endovasc Surg (2016) 51, 718–723

Safety of Intra-arterial Catheter Directed Thrombolysis: Does Level of Care Matter?

L. Koraen-Smith [a,*], M. Wängberg [a], C. Montán [a], P. Gillgren [b], C.-M. Wahlgren [a]

[a] Department of Vascular Surgery, Karolinska Institutet and the Karolinska University Hospital, Stockholm, Sweden
[b] Section of Vascular Surgery, Department of Surgery, Södersjukhuset, Institution of Clinical Science and Education, Karolinska Institutet, Stockholm, Sweden

WHAT THIS PAPER ADDS

This study has demonstrated that care on a general vascular ward is not associated with a significantly increased risk of adverse outcomes in patients undergoing catheter directed thrombolysis for acute limb ischaemia or dialysis access occlusion. Patient age and comorbidity increased the probability of transfer to a higher level of care. Further investigations into the cost-effectiveness of catheter directed thrombolysis are warranted.

Objectives: The aim was to assess whether the level of care influenced the safety related outcomes of catheter directed thrombolysis (CDT) for patients presenting with limb ischaemia and dialysis access thrombosis.
Methods: This was a retrospective cohort study. All consecutive patients at two tertiary referral centres for vascular surgery undergoing CDT for limb ischaemia and dialysis access thrombosis ($N = 252$) between 2012 and 2014 were included. Patients at Centre 1 were cared for on a general vascular ward and patients at Centre 2 were kept on a post-operative recovery unit with an increased level of care including invasive haemodynamic monitoring. Patient medical records were retrospectively scrutinised and data collected on comorbidities, anti-thrombotic medication, indications for CDT, technical success of CDT, bleeding and non-bleeding related complications, and transfer to a higher level of care.
Results: There were no differences in the frequency of non-bleeding related complications between Centre 1 and Centre 2. Patients on the vascular ward had a higher frequency of minor bleeding ($p = .002$) but there was no difference in major bleeding ($p = .12$). Eleven patients on the ward required an increased level of care for medical reasons and six were moved for a lack of resources. The presence of cardiac disease was an independent risk factor for patient transfer (OR 3.2; 95% CI 1.04–9.8, $p = .04$).
Conclusions: CDT may be undertaken outside of a high dependency setting without a significantly increased risk of complications. Pre-existing cardiac disease was an independent risk factor for transfer to a higher level of care. These findings could have an implication for the clinical cost-effectiveness of CDT.

Article history: Received 31 October 2015, Accepted 31 January 2016, Available online 14 March 2016
Keywords: Thrombolytic therapy, Patient selection, Haemorrhage

INTRODUCTION

Intra-arterial catheter directed thrombolysis (CDT) has become increasingly common in the treatment of acute and subacute vascular surgical conditions over the past 20 years.[1–4] CDT is used in the treatment of an acute thrombotic or embolic arterial occlusion, and acute limb ischemia is one of the most common indications. Furthermore, the method is increasingly used for the treatment of dialysis access occlusion.[5]

Complications of thrombolysis include bleeding and distal embolisation, with frequencies up to 13% for significant bleeding (requiring transfusion or surgery) and 12% for distal embolisation.[6] In addition, another severe complication is haemorrhagic stroke, with a reported frequency of up to 2.5%.[7]

However, the less invasive nature of a catheter based approach compared with open surgery can result in reduced mortality and morbidity.[6,8] CDT may be considered to be the first line treatment for acute limb ischaemia if symptoms have been present for less than 2 weeks; the severity of ischaemia allows a certain time delay until restoration of vascular patency, and if there are no absolute contraindications to thrombolysis.[7,8]

Traditionally, patients undergoing intra-arterial thrombolysis have been cared for in an intensive care/high dependency setting to ensure adequate monitoring of clinical parameters including signs of bleeding. However, in some

* Corresponding author. Department of Vascular Surgery, Karolinska University Hospital, SE-171 76 Stockholm, Sweden.
E-mail address: linn.smith@karolinska.se (L. Koraen-Smith).
1078-5884/
http://dx.doi.org/10.1016/j.ejvs.2016.01.023

centres patients undergo observation on a general surgical/vascular ward during CDT. It is unclear whether this confers a greater risk of complications and adverse events than a high-dependency setting. Therefore, the aims of this study were (a) to assess the influence of the level of care on the safety related outcomes of CDT, and (b) to identify any factors associated with the need for an increase of the level of care that may predict patient transfer.

METHODS

Study population

All consecutive patients who underwent intra-arterial thrombolysis with an indwelling infusion catheter for either lower limb ischaemia, dialysis access thrombosis, or arm/hand ischaemia at the two participating centres between January 1, 2012, and December 31, 2014, were included.

The Karolinska University Hospital (Centre 1) and the South General Hospital (Centre 2) are tertiary referral centres for vascular surgery in the Stockholm area with a combined catchment population of approximately 2 million people.

Ethics approval was granted by the Regional Ethics Committee in Stockholm.

Data collection

Medical records for each patient were scrutinised and data for age, sex, diabetes (if on either oral hypoglycaemic medications and/or insulin), cardiac disease (defined as either previous myocardial infarction, angina pectoris, previous cardiac surgery, or heart failure), smoking (current or previous), hypertension (blood pressure in excess of 140/90 mmHg or on antihypertensive medication at the time of admission to hospital), renal insufficiency (defined as a serum creatinine exceeding 150 μmol/L), and cerebrovascular disease (defined as either previous haemorrhagic or thrombotic stroke or transient ischaemic attack [TIA]) were collected.

Additionally, data for the use of antithrombotic medication (aspirin, thienopyridines such as clopidogrel, warfarin, or novel oral anticoagulants) at the time of hospital admission were collected.

Patients treated by pharmaco-mechanical thrombectomy without subsequent continuous recombinant tissue plasminogen activator (rt-PA) infusion were excluded.

Onset was classified as acute if symptoms were of less than 2 weeks duration or chronic if exceeding 2 weeks.[9]

The severity of lower limb ischaemia and the viability of the extremity was classified according to the Rutherford classification.[10]

Data on the thrombolytic treatment included duration of the thrombolytic infusion, vascular access site (groin, dialysis access, arm artery), number of indwelling catheters, and use of the pulse spray technique.

Intra-arterial thrombolysis

Intra-arterial CDT was performed in a standard fashion by vascular surgeons and/or interventional radiologists working at either centre. The only significant difference between the treatment protocols at the vascular centres was the level of care. All patients were screened for the absence of contraindications for thrombolysis that included the following: active/ongoing gastrointestinal bleeding <10 days previously, stroke or TIA <2 months previously, and neurosurgery or intracranial trauma <3 months previously.

In general, patients with acute lower limb ischaemia resulting in motor and sensory deficit were treated by open surgery and patients with underlying atherosclerotic disease and those without neurosensory loss were treated by thrombolysis.

At Centre 1, patients undergoing CDT were cared for on a 16 bed general vascular ward. There were five to six patients per fully qualified registered nurse. Patients were cared for either in a two or three bed room except for carriers of multi-resistant pathogens (for example methicillin-resistant *Staphylococcus aureus*), who were provided with separate single-bed rooms. There was no continuous monitoring of haemodynamic parameters or electrocardiogram (ECG). Patients undergoing lower extremity thrombolysis were provided with a urinary catheter, and all patients received a peripheral venous cannula. There were no restrictions on oral intake. The introducer site was checked once every 30 minutes. Blood pressure, heart rate, and oxygen saturation were monitored very 8 hours (but more frequently if required). Distal circulation (in the case of lower limb ischaemia) was monitored every 3 hours (unless otherwise requested from the physician in charge) and included assessment of limb colour, motor and sensory function, temperature, pain, and Doppler signals.

At Centre 2, patients were housed on the Post-operative Recovery Unit for the duration of the thrombolysis. There were six bed spaces in total and four patients per qualified nurse. Patient beds were located in an open plan room where they were in constant view of the nursing staff. Patients were allowed free liquids but no solids during thrombolysis. Blood pressure was continuously monitored through an arterial line connected to the introducer and there was also continuous monitoring of ECG and pulse oximetry. A urinary catheter was inserted for the duration of thrombolysis. Monitoring of the distal circulation was done hourly.

In both hospitals, thrombolysis was performed using continuous infusion of rt-PA (Actilyse®, Boehringer, Ingelheim, Germany) with or without an on -table bolus through one or more catheters with multiple side holes placed within or as close to the thrombus as possible. The pulse spray method was not in regular use. Infusion rates of rt-PA varied between 0.5—2 mg/hour (5—20 mL of infusate of 0.1 mg/mL Actilyse per hour). During thrombolysis, low molecular weight heparin was given subcutaneously every 6 hours to prevent sheath thrombosis. Check angiograms were performed every 6—24 hours as required, depending on previous angiographic findings, clinical status, and the occurrence of any bleeding complications. Plasma fibrinogen levels and activated partial thromboplastin time (APTT) were checked every 10 hours or at least 2 hours