

# Acute lower limb ischaemia: the challenges of patient care

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## Abstract

Acute limb ischaemia (ALI) can be described not only as limb-threatening but also as life threatening. This case study examines the many challenging aspects of caring for a patient with acute distal lower limb ischaemia which led to bilateral lower limb amputations. The specific issues that will be addressed in this case study are wound management, pressure ulcer prevention and pain management, and the importance of psychological support. In most instances, nurses like to be interactive with wound management, in this instance it is a case of wait and see!

Angel D. *Acute lower limb ischaemia: the challenges of patient care*. *Primary Intention* 2003; 11(1):38-44.

## Introduction

### Literature review

Acute limb ischaemia (ALI) refers to the sudden interruption of arterial blood supply. The affected artery becomes totally occluded by thrombi or an embolus which prevents blood flow to the tissue beyond the obstruction; it is a vascular emergency that is life-threatening and limb-threatening<sup>1-3</sup>. Regardless of the aetiology, ALI differs from chronic arterial occlusion; in the latter a collateral blood supply is established in chronic situations, whereas in ALI this is lacking<sup>2</sup>.

Embolism, thrombosis and trauma are the primary causes of acute arterial occlusion in the lower extremity. Venous outflow obstruction, including phlegmasia crurea dolens and compartment syndrome, and low flow states may also result in acute occlusion<sup>4</sup>. Usually the aetiology is thromboembolic<sup>5</sup>. Patients with ALI present with the six classical Ps: the limb is extremely painful, pale or mottled; pulses are not palpable or

audible on Doppler ultrasound; paralysis; paraesthesia; and the limb is perishingly cold<sup>1,6</sup>.

The extent of the paraesthesia and paralysis is a good indicator of the degree of ischaemic injury to nerves and muscle and correlates with the ultimate prognosis. Preservation of sensitivity to light touch is often the best guide to tissue viability. Paralysis and the absence of sensitivity to light touch are grave signs and ALI in these circumstances is potentially irreversible<sup>7</sup>.

Treatment of an arterial occlusion will depend on how quickly the patient presents to an accident and emergency department. Depending on the extent of tissue ischaemia, the patient may be suitable for thrombolysis or an embolectomy. Irreversible ischaemia, however, will necessitate amputation<sup>1</sup>. The following case study illustrates the many challenging aspects of caring for a patient following a thromboembolic event.

## Case study

'Mr Wilson', a 54 year old gentleman, presented to our accident and emergency department in August 2000 with acute bilateral critical limb ischaemia. He had a past medical history of non-insulin dependent diabetes mellitus, alcohol abuse with related cardiomyopathy, congestive cardiac failure, ischaemic heart disease, hyperlipidemia and depression. A year prior to this admission he had suffered a pulmonary embolus. He ceased taking his warfarin as prescribed of his own volition. Mr Wilson, who had a documented history of poor compliance with taking medication, did not realise the severe consequences of his

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actions especially as an echocardiogram at that time determined that he had a small LV apical thrombus. Mr Wilson's social history revealed that he lived in a shed on a friend's property and although he had a son and daughter, there was little interaction with them.

### On admission

On admission, Mr Wilson's feet were cold, mottled, pulseless and the capillary return to his feet was diminished. Both femoral and popliteal pulses were absent, his HR was 100 BPM, his BP 120/80, his BM 7.1, which was confirmed with a BSL of 7.1. His temperature was 37.6°C. The nursing notes also described his feet as being cold, mottled, purple and extremely painful.

An urgent diagnostic angiogram was performed which demonstrated distal occlusions of the left superficial femoral and popliteal artery, with extensive collateral vessels, bilateral three vessel run off and no anatomical vessels to the foot. The superficial artery on his right side was irregular, with no discrete area of stenosis; the popliteal artery was within normal limits, trifurcation intact, three vessels run off, with no vessels across the ankle to supply the foot. It was concluded that Mr Wilson had bilateral thromboembolic disease. Ankle brachial pressures (ABP) were not done because this was deemed too painful a procedure for the patient to undertake.

### Ward management

The immediate nursing interventions, on transfer of the patient to the vascular ward, were aimed at protecting Mr Wilson's legs from any type of shear forces or mechanical trauma as this would result in additional tissue necrosis. Mr Wilson was placed on an air mattress which is routine preventative practice in this ward. A formal pressure risk assessment is not documented as having been undertaken. Heel protection, however, was provided in the form of foam booties. A bed cradle was placed in situ because the weight of bed sheets can cause extreme pain. He was given 'rest in bed status'.

Intravenous heparin was commenced to preserve any collateral circulation and to prevent any propagation of the thrombus. Hydration was commenced for circulatory support. The patient was written up for p.r.n. intramuscular morphine and oral analgesia. Two doses of i.m. morphine were administered within 6 hours of admission; however, the extent of any relief from his pain is not well documented. Although it is presumed that Mr Wilson would have been

## Definitions

**ALI**<sup>3</sup>: ALI may be defined as the sudden cessation of blood flow to the limb i.e. the affected artery becomes totally occluded by thrombus or an embolism which prevents blood flow beyond the obstruction. This causes acute ischaemic pain at rest; if blood flow is not rapidly restored, the tissues of the limb quickly become necrotic. Unlike chronic ischaemia, the suddenness of the acute occlusion does not allow time for the formation of collateral blood vessels, which can otherwise reduce ischaemia and limit tissue damage.

Classic features of acute or chronic occlusion are known as the six ps<sup>6</sup>: pain, pallor, pulselessness, paraesthesia, paralysis and perishing cold

**Thrombembolism**<sup>15</sup>: Thrombembolism is a vascular obstruction by a dislodged thrombus. The most common source of arterial thrombi to the systemic system is the heart. Mitral or aortic valvular disease, especially that associated with the abnormal heart rhythms (atrial fibrillation and flutter), causes thrombus formation on roughened vascular surfaces and atrial blood as a result of stasis. More than half of these thromboemboli lodge in the lower extremities. Arterial thrombi form in the arterial system under conditions of high blood flow and are composed mostly of platelet aggregates held together by fibrin strands.

**Gritti Stokes amputation**<sup>16</sup>: Involves transection of the femur above the adductor tubercles. This allows attachment of the patella over the end of the cut femur to allow weight bearing. However, as the union of the fracture takes a long time and the distal end of the femur often retracts, this level of amputation is now rarely used.

**Gangrenous necrosis**<sup>15</sup>: This is the death of tissue, and results from severe hypoxic injury commonly caused by arteriosclerosis or blockage of the major arteries, especially in the lower leg. With hypoxia and subsequent bacterial invasion, the tissues can undergo necrosis. Dry gangrene is usually the result of coagulative necrosis, where the skin becomes very dry, resulting in wrinkles, and its colour changes to dark brown or black. Wet gangrene develops when neutrophils invade the site, causing liquefactive necrosis. This usually occurs in internal organs, causing the site to become old, swollen and black. A foul odour is present, produced by pus, and if systemic symptoms become severe, death can result.

given psychological support, inpatient case notes do not confirm whether this was indeed carried out.

The vascular registrar reviewed the patient the following day and booked Mr Wilson for a left popliteal embolectomy. The vascular consultant who later reviewed Mr Wilson's angiogram decided that an embolectomy would be of no benefit because irreversible tissue death had already occurred. The embolectomy was cancelled, and Mr Wilson was advised that the only option available to him would be bilateral lower limb amputations. The vascular consultant explained that the surgery could not be performed straight away because they would have to wait until the lines of demarcation between viable and non-viable tissue became evident. The line of demarcation would determine if the amputations would be performed above the knees or below the knees.

During the next week, a cardiologist confirmed the diagnosis of a thromboembolic event leading to bilateral ischaemic legs. Echocardiogram illustrated an apical thrombus, dilated left ventricle with severe global dysfunction and mildly dilated right ventricle with severe systolic dysfunction, severe mitral regurgitation and moderate pulmonary hypertension. The thrombus was attributed to being the source of the embolic event. The cardiology team recommended a review by the medical physicians to manage his many medical problems (alcoholic cardiomyopathy,

chronic liver disease, raised creatinine, high INR, and NIDDM).

Throughout his admission, Mr Wilson's co-morbidities proved difficult to manage. He had several episodes of documented fluid overload secondary to CCF and CLD. His deteriorating liver, renal, and cardiac function along with the physiological effects of the gangrenous process was a constant challenge. Advice was indeed sought from the physicians about the management of the patient's medical problems in order to optimise Mr Wilson's condition for surgery.

A wound management plan was formulated, with instructions to paint Mr Wilson's feet with betadine and apply betadine soaked gauze between his toes; the aim being to keep his feet as dry as possible. There were strict orders not to apply any interactive dressings. The condition of his feet changed gradually from being dusky coloured to being black and blistered (Figures 1-3).

Over the next few days, Mr Wilson's condition deteriorated. He complained of increasing pain, and he was noted to have abdominal distension, bilateral pitting oedema of the lower limbs, rigours, hypotension, pyrexia, tachycardia and tachypnoea. A medical registrar reviewed the patient; his impression was that Mr Wilson had bi ventricular failure and sepsis, the source of which was most likely his feet or pneumonia. The vascular registrar, however, thought that because his feet were dry and demarcated, they were not the

Figures 1-3.



source of his sepsis and that it was probably his chest. By this stage, Mr Wilson's prognosis was not good, and he was no longer fit for surgery. He was assessed by the intensivist on call and was transferred to the high dependency unit (HDU).

Mr Wilson spent the next 5 days in the HDU, over which time his condition was stabilised. He was treated with intravenous antibiotics and a strict fluid restriction was imposed. Nursing documentation stated that the patient now had a small skin tear on his left buttock. This may have been a stage two pressure area, although this is not recorded formally as such. A hydrocolloid dressing was applied. Whilst the patient was not on a pressure relieving mattress, while in the HDU, it was documented that he was being nursed from side to side.

Betadine and gauze continued to be applied to his feet and a charcoal dressing was obtained for odour control. Pain control remained an issue and was never properly addressed. During his HDU admission, Mr Wilson (after a frank discussion with a medical registrar) requested to speak to a social worker in order to revise his will. He also requested that his friend be contacted in order to do this.

Mr Wilson's condition stabilised and he was transferred back to the ward and booked for elective bilateral amputations later on that week. By this stage, the lines of demarcation were evident (Figures 4 & 5). During the next few days the main issues for Mr Wilson included pain management, psychological support and wound management. His friend had still not arrived to assist him to change his will, therefore

the social worker was asked to contact the public trustee to do this.

The following day, Mr Wilson had an acute episode of LVF and was treated with IV lasix, morphine and maxalon. He also started to have panic attacks.

Bilateral Gritti Stokes through knee amputations were performed two days later. During the post-operative period, he remained unwell and on 4 September, almost a month after his admission to hospital, he had a gastro intestinal bleed and succumbed to his illness.

## Discussion

### Treatment priorities

A limb with critical ischaemia will not heal without surgical revascularisation. If this is not possible then the patient will face amputation. The primary aim of management is conservative care until the cause and the extent of ALI can be established. Treatment should focus on wound management inclusive of the prevention of infection, skin care, pain management and psychological support.

### Wound management

When microemboli lodge in the distal microcirculation, it causes areas of cyanosis and gangrene. Ulceration and gangrene develop when tissue perfusion cannot meet the metabolic demands of the tissue. Gangrene of the toes occurs and distal perfusion reduces<sup>8</sup>. Management priorities will be based on the arterial status of the patient's legs. Skin assessment and the status of tissue necrosis should be undertaken at least once per shift, because changes in the tissues can be rapid.

Figures 4 & 5.



Accurate documentation in either the integrated or medical and nursing notes is essential and allows for progressive clinical tracking and better management. Any ulcerated lesions or wounds should be measured, be described clinically, and ideally be photographed to provide baseline information and documented evidence of the progress of the wound and the care provided<sup>6</sup>.

Initially, Mr Wilson's legs were blue and the best one could offer was pain control, a pressure relieving mattress, a bed cradle and foam booties. As his legs started to blister, it was important not to inadvertently cause the blisters to burst. The aim here was to protect his legs and keep them dry in order to minimise the possibility of infection. Infection may cause rampant gangrene to develop in these patients due to the synergistic effect of polymicrobial infection and a failing microcirculation<sup>8</sup>.

In most instances nurses like to be active in wound management and, where appropriate, feel comfortable in facilitating the removal of necrotic tissue. However, in the presence of gangrene, the feet and toes should be kept dry as moisture may increase the risk of superimposing infection<sup>8</sup>.

As his legs demarcated, Betadine™ was applied to any necrotic tissue to keep these areas dry and to minimise the potential for infection. Betadine soaked gauze was placed between his toes.

Occlusive or interactive dressings such as hydrocolloids are not advocated in patients with ALI. Occlusive dressings in general should not be used to debride gangrenous areas<sup>9</sup>. They may in fact prove to be detrimental if applied as they have the potential to turn dry gangrene into moist gangrene. Occlusion of ischaemic wounds may also lead to overriding levels of pathogen accumulation, the development of clinical infection and an increase in local pain. The concept of moist wound healing relies on the ability of the dressing to create the best environment to allow healing to occur. It is not clear what effects occlusive or interactive dressings have on the blood supply of wounds where the blood supply is already greatly diminished.

Just prior to Mr Wilson having his legs amputated, they became malodorous and a charcoal dressing was applied. There are a number of charcoal impregnated dressings available on the market which can be utilised for reducing odour. The variations between these products were highlighted in a study by Thomas *et al.* in 1998<sup>10</sup> who

compared five different charcoal dressing products. They concluded that those products that combined a physical absorbent element with a charcoal component are better at reducing odour. A tubular retention dressing was used to keep the charcoal dressings in place rather than adhesive tapes. The use of adhesive tapes must be avoided, as they can strip the epidermis on removal. Tubular dressings have the unique benefit of not exerting inappropriate compression or causing tissue damage<sup>11</sup>.

A wound management plan with the goal of care clearly defined will help medical and nursing staff understand best practice in this instance.

### *Skin care*

Skin care issues are very important as these patients are generally at high risk of infection.

Patients with critical limb ischaemia should never have the limb immersed in warm water because the sudden rise in temperature will increase the metabolic rate within the limb. Because of the ischaemia, further oxygen cannot be supplied to the area and this may exacerbate the tissue ischaemia<sup>8</sup>. Patients with areas of gangrene on the foot and toes should keep the area dry as moisture may increase the risk of superseding infection. Gauze should be placed between the patients' toes to keep them dry and separated.

Patients with ALI are at an increased risk of pressure ulcer development to the sacrum and heels. A formal assessment of pressure ulcer risk should be undertaken on admission and at regular intervals during admission. A pressure relieving mattress and heel protectors should be utilised.

### *Psychological support*

Considerable psychological support is necessary for patients facing amputation. Acute arterial occlusion caused by thromboembolism is a life and limb-threatening situation<sup>1-3</sup> so it is important that realistic outcomes are discussed with the patient and family or friends. During the initial stage of admission it is imperative that medical and nursing staff ascertain the patients' understanding of the seriousness of the problem.

It is also important that the patient be encouraged to express their feelings and fears, and be given the opportunity to identify any other relevant social factors that may impact on the decisions they make such as cultural issues. Staff should be aware that patients faced with this situation will be frightened

and in pain, and should take appropriate steps to address these issues. Ideally, the relief of pain, accompanied by a brief explanation of treatment plans, would be the first goals of psychological support to be achieved. Once pain control is achieved, patients are likely to be more receptive to allowing a thorough physical assessment in order to provide holistic care unique to each individual as was the case for Mr Wilson.

### *Pain management*

This case illustrates the challenging nursing and medical aspects of caring for a person with ALI. In order to optimise the best outcome for the patient, it is imperative that a multidisciplinary approach is taken. In most large organisations there will be an acute pain service and advice should be sought from the outset from a pain specialist in order to maximise effective pain management.

Throughout Mr Wilson's admission, pain was an ongoing issue, and advice from our acute pain service team may have improved his pain management. It is well known that offering analgesia on a p.r.n basis is poor pain management. Earlier intervention from this service would have meant that the nature of Mr Wilson's pain would have been assessed and medications – either via intravenous, subcutaneous, epidural or transdermal route with adjunctive medication – could have been prescribed. This team would also have taken into consideration Mr Wilson's diminished liver and renal function when choosing the most appropriate therapeutic agent(s).

In Mr Wilson's case, data collection by nursing staff of pain scores and the effectiveness of pain medication given may also have prompted better management of the patient's pain. Mackintosh identified in her study that there were considerable gaps in nurses' knowledge of the assessment and management of pain, and in this case a thorough knowledge of the nature of acute leg ischaemia, along with more thorough documentation, would have eased Mr Wilson's suffering<sup>12</sup>. Stubbing & Chesworth<sup>13</sup> state *"The patient suffering from more severe arterial ischaemia may also describe pain being relieved in their limbs if they sleep in a chair with their legs down or if they hang their legs outside the bed when lying down"*, so lowering the foot of the bed may have assisted in reducing Mr Wilson's pain (depending on any collateral circulation). Ward, in Murray<sup>14</sup>, says *"pain management is a high priority in caring for patients with vascular disease"*, and she adds *"the character of pain, and its severity, location, frequency, duration and temporal pattern are of great importance in treating the problem"*<sup>14</sup>.

Occlusive arterial pain due to embolus or thrombosis is characterised by sudden severe rapidly escalating pain that weakens the limb. The pain may subside quickly depending on the severity of the ischaemia that remains after the initial occlusion. Chronic numbness or weakness, or both, indicate the patient has severe limb threatening ischaemia. Rest pain is also attributed to acute leg ischaemia.

### **Summary**

This case illustrates the devastating consequences to a person faced with ALI. As can be seen from Figures 1 & 2, the process of gangrenous necrosis is not only psychologically devastating for the patient, it also presents as a difficult challenge for the nurse, particularly in the vascular setting. The five main priorities of care are pain management, wound management, infection control, pressure ulcer prevention and psychological support. Another priority is ensuring that the patient remains haemodynamically stable.

From the outset pain management in this case was never fully addressed. Involvement of the Acute Pain Service from the time of admission may have optimised his pain management in the first instance or at least improved his pain management if they had been involved at a later date. The aim of wound management is to minimise infection and prevent further tissue trauma to already compromised tissue. Administration of systemic antibiotics and the use of topical antimicrobial agents can help to achieve this.

In most vascular centres, betadine is used topically. Interactive dressings must never be used in patients with gangrenous necrosis as they have the potential to cause additional tissue trauma.

There are many products available for odour management which are best held in place by a tubular retention dressing rather than tapes or bandages. Bandages can compromise the patient's already deficient blood supply and tapes can cause further tissue loss on removal.

As patients with ALI are at risk of pressure ulcer development, the use of a pressure ulcer risk assessment tool on admission cannot be over emphasised. Mr Wilson should have been assessed on admission and reassessed regularly thereafter. Mr Wilson was placed on a pressure relieving mattress at ward level; however, there was no documentation to state whether he remained on one whilst in the HDU. Similarly there was no documentation reflecting accurate assessment of

the 'sacral pressure tear' or that an assessment of his pressure ulcer risk status was completed after the development of the sacral skin break. Although a hydrocolloid dressing was applied, there was no wound management plan for the ongoing assessment and management of the sacral break. Documentation of assessments, interventions and evaluations of the care provided are a legal requirement.

Sadly in this instance, no formal psychological support was offered to Mr Wilson as he faced this grave, life threatening situation. It is essential that the need for expert psychological support is assessed and provided where appropriate.

The importance of a multidisciplinary team approach to patient care in patients with ALI cannot be overstressed. Had this approach been used in Mr Wilson's case, his quality of life for the duration of his illness may have been improved upon.

The author hopes that this case study will help to provide guidance in the nursing management of patients with ALI.

## Acknowledgments

Keryl Murphy RN RPH and Jenny Prentice.

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