Ischaemic monomelic neuropathy (IMN) following vascular access surgery for haemodialysis: an under-recognized complication in non-diabetics

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Abstract
Ischaemic monomelic neuropathy (IMN) is an infrequently recognized type of neuropathy, produced after acute arterial occlusion or reduced blood flow to an extremity. In the upper limb, it usually occurs after vascular access surgery for haemodialysis. IMN has been reported largely in diabetics with peripheral neuropathy and atherosclerotic vascular disease. We report a case of IMN following arteriovenous (AV) fistula formation in a patient with advanced chronic renal failure, who did not have diabetes mellitus and symptoms of peripheral neuropathy or features of atherosclerotic vascular disease. Symptoms improved immediately after the distal revascularization and interval ligation procedure to the AV fistula.

Keywords: arteriovenous fistula; chronic renal failure; ischaemic neuropathy; non-diabetic

Background
Ischaemic monomelic neuropathy (IMN) is a distal axonopathy involving sensory and motor branches of multiple nerves in an extremity. Adequate blood supply to the nerves is vital to maintain their structure and function [1]. IMN develops due to under-filling of the vasa nervosum after shunt surgery or proximal occlusion of a major artery in an extremity [2, 3]. It has been reported largely in diabetic patients with peripheral neuropathy and evidence of atherosclerotic peripheral vascular disease [4, 5].

We report a case of IMN that occurred following the creation of a left brachiocephalic fistula in a patient with advanced chronic renal failure secondary to chronic interstitial nephritis. She did not have diabetes mellitus, peripheral neuropathy or signs of peripheral vascular disease.

Case report
A 70-year-old female with advanced chronic renal failure secondary to chronic interstitial nephritis was admitted with left hand pain, paraesthesia and reduced hand function. The symptoms started 24 h after the formation of a left brachiocephalic arteriovenous (AV) fistula as a vascular access for haemodialysis in the near future. The surgeon chose the brachial artery for this AV fistula as the wrist cephalic vein was damaged as a result of previous venous cannulations. The patient’s symptoms were of severe neuropathic pain, a cold hand and loss of function. These symptoms could not be controlled with analgesia, amitriptyline and GTN patches.

Examination revealed a palpable radial pulse, a cold hand, without cyanosis, ulceration, necrosis or gangrene. Hand grip was impaired but it was difficult to assess motor function due to severe pain. She had sensory impairment in the distribution of median, ulnar and radial nerves in the hand. Blood pressure and systematic examination were normal.

Nerve conduction studies (NCSs) showed absent sensory responses from the left median, ulnar and radial nerves. The left median and ulnar motor responses were also significantly attenuated (Figures 1 and 2). This indicates severe axonal degeneration in the sensory and motor branches of these nerves. Ischaemia is a well-recognized cause for such neuropathy and with the clinical history, the diagnosis of IMN was made. Incidentally, NCS also showed evidence of bilateral median nerve neuropathy at the wrists manifested by prolonged distal motor latencies. However, the patient did not express any symptoms of a carpal tunnel syndrome at any point.

Electromyography (EMG) showed fibrillation potentials and positive sharp waves in the small muscle of the left hand, which indicates active denervation in keeping with an acute nerve lesion.

The patient underwent distal revascularization and an interval ligation (DRIL) procedure to reduce the blood flow in the AV fistula and to improve the distal blood supply. Her symptoms of pain improved immediately.

When the patient was reviewed in the clinic, she did have ongoing neuropathic symptoms with paraesthesia and hypoaesthesia. These symptoms were not as severe as witnessed prior to the DRIL procedure.

Given the findings of a bilateral carpal tunnel syndrome on NCS, the patient was reviewed by the orthopaedic team and underwent left carpal tunnel release surgery, 3 months after the DRIL procedure.

When last reviewed (8 months following the DRIL procedure), the patient had regained physical function of her hand.
The symptoms of hypoaesthesia and paraesthesia had improved significantly. A further NCS was performed 10 months following the DRIL procedure that showed significant improvements in the sizes of the left median and ulnar motor responses (Figures 3 and 4). It was also possible to record small sensory responses from the left radial nerve. EMG showed evidence of chronic partial denervation in the small muscles of the left hand, but there was no evidence of active denervation.

Doppler ultrasound 1 year after the DRIL procedure showed very satisfactory flow in the brachial artery, widely patent anastomosis and no evidence of stenosis in the draining vein. The radial artery measures 1.2 mm in diameter and the ulnar artery 0.6 mm.

Discussion

The differential diagnosis of hand pain following vascular access surgery includes vascular steal syndrome, nerve compression due to local wound haematoma and IMN.

The incidence of IMN is rarely described, possibly due to under-diagnosis of the entity. The published literature with IMN noted patients with diabetes mellitus suffering from pre-existing neuropathy in association with peripheral arterial occlusive disease [3, 4] being at risk.

IMN develops after acute arterial occlusion or low blood flow to an extremity. In the upper limb, it is most commonly reported as post-vascular access surgery for haemodialysis [3–6]. Nerve damage occurs due to under-perfusion of vasa nervosum. Nerve conduction studies show axonal damage. IMN affects multiple distal nerves in an extremity, involving sensory and motor branches. In general, sensory complaints are more prominent than motor. Symptoms occur along the distribution of radial, ulnar and median nerve resulting in poor wrist extension and reduced thumb apposition. The forearm muscles may be relatively spared compared to the intrinsic hand muscles resulting in a profound loss of grip. Radial pulse is commonly palpable.

The recommended treatment of IMN is an immediate correction of ischaemia by fistula/graft ligation or narrowing plaque to reduce the blood flow in the shunt [5, 6]. Delay in diagnosis and therapeutic intervention reduces the chances of recovery.

In contrast to the cases of IMN reported in the literature, this patient did not have diabetes mellitus and has no known peripheral neuropathy or atherosclerotic peripheral vascular disease.

IMNs occurrence is unpredictable and diagnostic delay is common. Unfortunately, no current pre-operative assessments as a screening measure or differing surgical techniques can be used to avoid such a complication.

IMN represents a significant diagnostic dilemma. Improved awareness of the presentation of this infrequent vascular access-related disorder and a high level of clinical suspicion provides the clinician with the greatest chance of a timely diagnosis with an optimal patient outcome.

Conflict of interest statement. None declared.

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Received for publication: 3.5.11; Accepted in revised form: 6.2.12