Letter to the Editor

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Brachial plexus injury following median sternotomy

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Brachial plexus injury during median sternotomy is a rare complication with good prognosis, but the dysfunction can be intractable in some cases. We report one diabetic patient who had prolonged pain, tingling sense and motor weakness in his left hand following a median sternotomy for open heart surgery.

A 55-year old man received a coronary artery bypass graft through a median sternotomy using cardiopulmonary bypass. He was diagnosed with diabetes mellitus eight years ago and his blood sugar level was not strictly controlled with insulin. Six years ago, he had an episode of headache and was diagnosed with stroke.

For the operation, the patient was placed in the supine position and a soft block 5 cm in height was placed under his shoulder with his arms at the side. The patient's head was extended in the midline. The saphenous vein of the right leg was dissected and was anastomosed side to side with the left circumflex and obtuse marginal artery. The left internal mammary artery (LIMA) was grafted to the left anterior descending artery. The two halves of the sternum were retracted constantly during the operation. The operation took 6 hours and was finished without specific problems. The cardiopulmonary bypass was of 2 hours 50 minutes duration.

At postoperative day one, the patient complained of pain and a tingling sensation in his left fourth and fifth digits and the ulnar border of the left hand extending up to the ulnar area of the elbow. The pain gradually spread to the axilla and adjacent chest wall with radiation to the neck. The pain was severe enough (visual analogue scale [VAS] 8) to disturb sleeping and was uninfluenced by posture. Sensory abnormalities such as numbness, tingling, cold and mechanical allodynia and tightness were present. He had a difficulty clenching the fist and opposing the 4th finger with the thumb on the affected side. The biceps and triceps tendon reflexes were normal. Position and vibration sense were intact in the affected hand and arm. There was no clinical or radiological evidence of a cervical rib. According to the nerve conduction study, slow sensory nerve conduction velocities (NCVs) were demonstrated in his left ulnar nerve below the elbow. Motor NCVs were normal in the bilateral median and ulnar nerves. He received NSAID and morphine (20 mg) but they were not effective. Twenty days after the operation, he was referred to the pain clinic. He received 8 rounds of pain treatment including intercostal and suprascapular nerve blocks, trigger point injection and prolotherapy over 2 to 5 day intervals. The pain improved to VAS 4.5. Two months after the surgery, a fentanyl patch (12 ug/hr) was applied, which was very effective for pain relief (VAS was nearly 0), but it was stopped due to the patient experiencing dizziness, nausea and vomiting. Two months after the operation, the patient received a right femoral artery bypass operation with saphenous vein graft due to arteriosclerosis obliterans. Wound debridement was performed as wound infection was suspected in the graft harvesting area of the right leg. His blood glucose level was variable (79−353 mg/dl) with insulin. Three months after the operation, the pain was limited to the left third to fifth digits and ulnar border of the left hand, with a VAS of 7. The motor impairment was not improved. Six months following the operation, the sensory abnormalities and motor weakness were not changed.

Brachial plexus injury following median sternotomy can be seen in two various forms. One form is characterized by the predominance of sensory deficits in areas innervated by the lower roots of the plexus and the other by the predominance

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of motor deficits in areas innervated by the upper and middle roots. The first type of injury is far more frequent than the latter, with an excellent prognosis for recovery [1]. Our case is related to the first type but the prognosis of our case was poor as the sensory abnormalities and motor weakness experienced by the patient were prolonged, lasting longer than 6 months after the operation.

Several factors have been associated with brachial plexus injury during open heart surgery, including concomitant patient disease with neurologic involvement (alcoholism, diabetes mellitus, periarteritis nodosa, and herpes zoster), positioning of the patient, and surgical factors [1]. In the present case, diseases such as DM and arteriosclerosis obliterans, adduction of the arm and constant sternal traction during the preparation for the LIMA may have contributed to the brachial plexus injury.

Ben-David and Stahl [1] suggested that the prognosis of postoperative brachial plexopathy after non-cardiac surgery may be worse in males, diabetics, those with injury to all roots of the plexus and, those with sensory loss, pain or dysesthesia in addition to motor deficit. Most of these conditions existed in the present case.

Direct traction of the plexus or compression of the plexus between the clavicle and first rib during retraction of the sternal halves have been postulated as the main mechanism of brachial plexus injury. The constituent nerve roots of the plexus are fixed proximally at their points of exit from the vertebral canal, and distally the nerves are tethered to the axillary fascia. Excessive spreading of the sternal halves will increase the distance between these fixation points and thus stretch the brachial plexus [2]. Preparation of the internal mammary artery requires both a wide opening of the retractor and asymmetric traction of the sternal halves to allow visualization of the costosternal junctions [3].

Jackson and Keats [4] demonstrated that arm abduction of 90° or more, external rotation, and posterior shoulder displacement stretch the brachial plexus. They reported that the plexus was relaxed when the shoulder girdle was elevated as occurs during shrugging of the shoulders and also when the arms are in the "hands up" position, which elevates the elbow 6 inches above the level of the table, thereby preventing injury to the plexus.

In conclusion, the most important measure to minimize brachial plexus problems in patients undergoing median sternotomy would be to avoid prolonged, excessive unilateral sternal retraction, and the use of the hands-up position.

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