Isolated thumb interphalangeal flexor weakness after total hip arthroplasty

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ABSTRACT
We describe the unique presentation of partial anterior inter-osseous nerve palsy with isolated thumb flexor pollicis longus weakness after total hip arthroplasty. We recommend particular attention be paid to the intra-operative positioning of the hand and forearm in order to prevent this rare complication.

KEYWORDS
Complication, thumb, weakness, hip, arthroplasty.

INTRODUCTION
Perioperative peripheral nerve injuries presenting as a complication of anaesthesia and surgery have an estimated incidence ranging from 0.03% - 1.4% for permanent damage. Nerve injuries are the second most common cause of litigation against anaesthetists in Australia [1,2]. While many nerve injuries under general anaesthesia may be multifactorial, without clear singular cause, careful positioning of the patient under anaesthesia is an important method to help avoid nerve injury. We present a partial inter-osseous nerve palsy with isolated thumb flexor pollicis longus weakness after total hip arthroplasty.

CASE REPORT
A 57-year-old right hand dominant Registered Nurse presented with progressive deterioration in function and increasing pain attributable to left hip osteoarthritis despite non-operative measures. The patient was otherwise well of health with a history of mild asthma managed with...
intermittent inhalational agents. She had previously undertaken a hysterectomy, hernia repair and breast augmentation without complications observed after the previous administration of general anaesthesia. On the basis of persistent symptomatic articular hip pathology, the patient was recommended for treatment by total hip arthroplasty.

Surgery was conducted under general anaesthesia using the direct anterior inter-muscular approach. For this procedure, we position the patient supine on a standard operating table without the application of traction. Typically, both arms are placed onto padded boards with partial abduction at the shoulder (approximately 70 degrees), partial flexion at the elbow (approximately 10 degrees) and with the forearms in partial supination to protect the ulnar nerve at the elbow. Particular attention is made to avoid excessive abduction at the shoulder to prevent brachial plexus injury and also for provision of adequate padding of bony prominences, particularly about the elbow. Depending on a patient’s natural resting upper limb posture under general anaesthetic, the arm may be secured to the padded board to prevent inadvertent movement of the arm during conduct of hip replacement surgery (Fig. 1).

Induction and maintenance of general anaesthesia was achieved by the use of intravenous Midazolam, Fentanyl and a Propofol infusion. For the conduct of a left side hip replacement procedure, the patient’s intravenous line is placed on the dorsum of the contralateral right hand or forearm. The patient was administered Cefazolin antibiotic prophylaxis. The patient was paralysed and continuously monitored, including regular surveillance of upper limb posture in case of movement during the surgical procedure. During the conduct of the hip replacement (duration approximately 65 minutes) wide infiltration of local anaesthesia into the peri-articular tissues was conducted by the surgeon using a mixture of Naropin 0.2% 150ml, Ketorolac 30mg, Morphine 5mg and Adrenaline 1:1000 1ml. An infusion catheter was placed into the wound for later administration of a further 40mls of Naropin 0.2% at 12 hours post intervention. Surgery proceeded in an uneventful manner with the successful implantation of uncemented femoral and acetabular components using Biolox Delta ceramic bearings.

At day 1 post surgery, the patient noted isolated inability to perform active flexion at the inter-phalangeal joint of the left thumb. Functionally, the patient described difficulty in holding a glass of water. All other hand and upper limb movements were maintained, in particular active flexion of all fingers and the wrist was normal. No sensory dysfunction was noted. The patient reported no pain about the hand, wrist, forearm or upper limb. No abrasions, bruising or marks were noted and passive motion of the thumb was unrestricted and pain-free. Flexor pollicis longus (FPL) tendon was palpable and on examination no discomfort was noted during extension at the thumb interphalangeal joint. Median nerve sensation was maintained and flexion of flexor digitorum profundus (FDP) to the index and all other fingers was noted to be normal.

On the basis of persistent thumb weakness at 2 weeks post surgery the patient was referred for MRI scan of the forearm and hand that demonstrated no irregularity in the muscle or

Figure 1. With the patient in a supine position, securing the position upper limb to prevent inadvertent movement during surgery in this manner places the forearm into supination whilst simultaneously placing the thumb on stretch with combined extension and adduction.

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tendon of FPL. Nerve conduction study conducted at 6 weeks post surgery by needle electromyography (EMG) demonstrated frequent fibrillations and no voluntary activity of the left FPL muscle, consistent with isolated denervation but not affecting FDP to digits 2 and 3. The pronator teres and abductor pollicis brevis demonstrated normal EMG activity. These findings were consistent with partial injury to the Anterior Inter-osseous Nerve (AIN) affecting only the isolated branch supplying FPL.

On the basis of these findings non-operative management with continued observation was advised. Gradual return of function was noted in flexion strength and at 6 months after surgery the patient fortunately was noted to have complete recovery of motor function of FPL with substantial improvement in flexion strength at the inter-phalangeal joint.

DISCUSSION

Anterior Inter-osseous Nerve (AIN) palsy is an uncommon peripheral nerve injury, most commonly associated with local trauma to the forearm or anatomic variants causing compression upon the nerve such as a fibrous band or anomalous muscle. AIN palsy after general anaesthetic is exceedingly rare.

The AIN is a branch of the median nerve that arises 5-8 cm distal to the medial epicondyle of the humerus. The nerve runs along the volar aspect of the inter-osseous membrane terminating at the pronator quadratus muscle at the level of the wrist. The AIN nerve has an exclusively motor function, innervating the pronator quadratus, the flexor digitorum profundus of the index and middle fingers, and the flexor pollicis longus.

In regard to anatomic variations, the Martin-Gruber anastomosis is a neural connection between the median and ulnar nerves occurring at the level of the forearm, that is present in 10-30% of the population [3].

In an injury to the AIN supplying the FPL, the patient demonstrates an inability to flex the interphalangeal joint of the thumb. The “Pinch Test” demonstrates this characteristic deformity, whereby the interphalangeal joint of the thumb cannot perform active flexion in performing a pincer action [4]. Importantly, flexion of the flexor digitorum profundus of the index and middle fingers must be examined to determine the level of injury to the AIN. It is difficult to clinically examine the pronator quadratus reliably as it is a weak pronator of the forearm that only partly contributes to this movement [5].

In evaluating for loss of flexion strength at the thumb, patency of the flexor pollicis longus tendon may be clinically determined by the tenodesis effect [6].

Electro-diagnosis is a primary investigation in the evaluation of peripheral nerve injuries. This testing modality is useful since it can assess and define the level of the nerve lesion, confirm normal function of associated nerve structures and is capable of excluding polyneuropathy or other pathologic diagnoses. This investigation is also able to monitor neurological recovery following injury [4].

In considering the differential diagnosis for this patient, clinical evaluation and investigation identified an isolated

Figure 2: Patient in supine position with forearm and hand in relaxed posture.
partial injury to the AIN affecting only the branch supplying FPL. Brachial plexus lateral cord injury, global AIN palsy or FPL tendon injury were excluded.

Kiloh-Nevin syndrome [5] is a condition whereby the AIN is compressed by the arcuate ligament of Fearn and Goodfellow [7] at the ante-cubital fossa. Additional compressive neuropathies have been identified in the setting of forearm fractures [8], blunt trauma, the use of plaster casts and the use of crutches [9]. Neuropathies of the AIN can also occur following penetrating trauma.

In the case of an isolated compressive or non-penetrating neuropraxia to the AIN branch supplying the FPL, recommendations are to await spontaneous recovery over a 12 – 18 month period. In the majority of cases, spontaneous recovery will occur [4,5,8].

We present the highly unusual diagnosis of a partial AIN palsy of the forearm manifesting as profound isolated weakness of FPL function of the thumb after total hip replacement. The patient presented no risk factors for peripheral neuropathy factors such as pre-existing neuropathic disease, vascular pathology, diabetes or smoking. In addition, hip replacement surgery would be considered as low risk for the development of such a nerve injury, in the absence of local surgical dissection or regional anaesthesia of the limb.

We conclude the mechanism of injury was a traction neuropraxia to an isolated the branch of the AIN supplying FPL as a result of positioning whilst under general anaesthesia. We note that with the patient in a supine position, preventing inadvertent arm movement by securing the hand (as demonstrated in Figure 1) may place both the forearm into supination whilst simultaneously placing the thumb into combined extension and adduction. In this way, particularly in patients with anatomic variants that may prevent normal excursion of the AIN, an isolated palsy of the branch supplying the FPL may be sustained.

CONCLUSION

We describe the unique presentation of partial anterior inter-osseous nerve palsy with isolated thumb flexor pollicis longus weakness after total hip arthroplasty. We recommend attention be paid to the intra-operative positioning of the hand and forearm in order to prevent this rare complication. In particular, a relaxed posturing of the hand without combined extension and adduction of the thumb is recommended as shown in Figure 2.

REFERENCES