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Ulnar nerve neuropraxia after extracorporeal shock wave lithotripsy: a case report

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A case is presented that illustrates and discusses the clinical presentation, diagnosis and chiropractic management of a 50-year-old male presenting with a case of ulnar neuropraxia following extracorporal shockwave lithotripsy. Onset is believed to be due to the patient's arm position in full abduction and external rotation during the lithotripsy procedure. Motor abnormalities related to the ulnar nerve were noted in the absence of distinct sensory findings. Chiropractic treatment focused on relief of the patient's pain during the course of the condition. Treatment may have helped in the rapid and complete resolution of his symptoms in this case. Poor patient positioning on hard surfaces, for extended periods may place pressure on superficial nerves resulting in nerve injury. In this case, the outcome was excellent, with complete resolution of symptoms less than one week later. The prognosis for this type of neuropraxia is usually good with conservative management. The patient history and chronological clinical course strongly suggest a causal association between the patient's position during the procedure and the development of the ulnar neuropraxia.
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KEY WORDS: nerve compression syndromes, diagnosis, ulnar nerve, shoulder pain, chiropractic.

Le cas présenté illustre et examine les manifestations cliniques, le diagnostic et la gestion chiropratique d'un patient mâle âgé de 50 ans souffrant de neurapraxie cubitale à la suite d'une lithotripsie extracorporelle par ondes de choc. On croit que l'apparition de cette condition serait causée par la position du bras du patient en pleine abduction et en supination durant la procédure de lithotripsie. Des anomalies motrices relatives au nerf cubital ont été notées en l'absence de constatations sensorielles distinctes. Les traitements chiropratiques ont été principalement axés sur le soulagement de la douleur du patient durant la période où la condition était présente. Le traitement peut avoir contribué à la disparition rapide et complète des symptômes dans ce cas. Un mauvais positionnement du patient sur des surfaces dures, pendant des périodes prolongées, peut causer une pression sur les nerfs superficiels, entraînant une blessure au nerf. Dans le cas présent, le résultat a été excellent, les symptômes ayant complètement disparus moins d'une semaine plus tard. Le pronostic de ce type de neurapraxie est habituellement bon dans le cadre d'une gestion conservatrice. L'historique du patient et la chronologie de l'évolution clinique suggèrent fortement un lien de causalité entre la position du patient durant la procédure et l'apparition de la neurapraxie cubitale.
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MOTS-CLÉS : syndromes de compression nerveuse, diagnostic, nerf cubital, douleur dans l'épaule, chiropractie.

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Introduction

The first-line treatment of choice for renal calculi is extracorporeal shockwave lithotripsy (ESWL).[1] Treatment of renal calculi with ESWL has replaced more invasive open procedures with obvious benefits and fewer side effects.[2] Although treatment is generally well tolerated, side effects of extracorporeal shock wave lithotripsy are occasionally reported.[2] This paper presents a rare case of ulnar nerve neuropraxia at the shoulder following ESWL. The possible mechanism of injury as well as the diagnosis and management are discussed. Ulnar neuropathies at the shoulder are rare.[3] To the author's knowledge, no cases of ulnar neuropathy related to ESWL have been reported.

Case report

A 50-year-old right-handed male presented to a chiropractic clinic complaining of left shoulder and left arm, forearm and hand pain two days after receiving ESWL for renal calculi. He stated that this pain started approximately 24-hours earlier and had been steady since the onset. He also reported "increased clumsiness" in his left hand.

Immediately, prior to his visit to the chiropractor, he attended and was examined in the emergency department at a local hospital. He stated that AP, lateral and oblique x-rays of his cervical spine were taken. All were negative. The medical doctor who examined him noted the decreased "co-ordination" of the left fourth and fifth digits as described by the patient. A computed tomography scan of the patient's cervical spine was ordered and was negative. He was referred for a neurological consult that day. The neurological consult failed to determine a cause for the patient's condition. Reports from the physicians were not available. The physicians elected to monitor the condition. Due to the patient's complaint of severe pain he was discharged with analgesics and a referral for chiropractic evaluation.

The following day, at the chiropractors office, the patient stated that the pain was worsening. The patient found that resting in a sitting position while cradling his arm close to his body with his elbow bent at 90 degrees caused the pain to be somewhat relieved. The patient rated the pain as "10/10" on a verbal analog scale. He reported that at night his arm pain was so severe that he had been unable to sleep more than one hour total over the last two days.

The patient complained of significant pain localized to the left forearm and hand primarily involving the fourth and fifth digits, in a distribution similar to the C8 dermatome. He protected his arm by holding it in flexion and abduction close to his body. The patient's active shoulder and cervical ranges of motion were performed cautiously, but had no significant limitations in any direction except for active left shoulder extension which was reduced by approximately 50 percent compared to the right due to pain. The active movement of the shoulder into extension increased the arm and hand pain. Passive movement of the shoulder in the same direction did not reproduce the same symptoms.

Neurological examination of the upper limbs demonstrated normal sensation along the left arm and hand. Vibration, light and crude touch as well as sharp/dull were tested and the patient reported that he could feel all the sensations. Deep tendon reflexes of C5–7 were equal and brisk, without any clonus. Muscle strength of shoulder, elbow and wrist were strong and equal when compared bilaterally. Flexion, extension, abduction and adduction of the second, third and fourth fingers were strong and equal bilaterally.

On the left hand, during opposition of the first and fifth fingers as well as first and second fingers in both "tip to tip" and "pad to pad" pinching positions the patient was repeatedly unable to bring the digits into correct position without assistance. This finding suggested a localized loss of fine motor control. If assistance was given, with the examiner bringing the fingers into the correct position for the patient, strength of pinching the first and second fingers "tip to tip" and "pad to pad"was tested as slightly weaker due to pain, but still +5/5. Holding the thumb and second finger flat together in adduction however, demonstrated slight weakness in adduction of the thumb and tested as +4/5. Opposition of the thumb and fifth finger was also tested which demonstrated the similar decrease in fine motor control. In addition, the patient demonstrated difficulty holding the thumb and fifth fingers "pad to pad" in opposition, and showed a tendency to hold the tip of the fifth finger to the pad of the thumb and the strength was rated as +4/5. The patient appeared to be substituting fifth finger flexion for adduction. Abduction and adduction of the left fifth finger tested individually was also slightly weaker, testing +4/5. This was compared to the right hand, which demonstrated none of the abnormalities found in the left hand. Radial and ulnar pulses at the wrist were strong and equal. Cervical compression, cervical distraction, brachial stretch, carpal tunnel, cubital tunnel and thoracic outlet tests did not alter the patient's symptoms. The right upper extremity and both lower extremities did not reveal any neuromuscular abnormalities.

Palpation of the shoulder girdle and upper thorax found marked posterior axilla tenderness. Direct deep pressure on the area of the posterior axilla, lateral to the upper scapula reproduced and aggravated the patient's arm and hand pain. He denied having any neck, or chest symptoms, but did feel that he had mild localized pain over the left lower thoracic region close to where he had the ESWL treatment. Examination showed restriction of motion of the left lower ribs at T9–10. He did report some blood in the urine, due to the ESWL treatment, but was told prior to the procedure, that short-term hematuria was a usual and expected side effect of the procedure.

A tentative diagnosis of ulnar neuropraxia due to compression or traction in the area of the axilla was made, but the precise mechanism that affected this peripheral nerve was not clear. The possibility of co-existing myofascial referral from the latissimus dorsi, which may refer pain to the hand, was also considered. However, due to the decrease in fine motor control in the hand, a potential injury to the ulnar nerve was given greater consideration.

Treatment

Initial treatment consisted of three components to address the muscular, articular and pain aspects of the patient's condition. The patient received treatment daily for three days. Supine thoracic spine diversified manipulation[4] was used to increase the mobility of the patient's hypomobile lower left ribs. The patient was positioned in a comfortable supine position, with his arms crossed, holding onto his opposite shoulders. The treating doctor's closed hand was placed between the table and the patient's back, laterally to the T9–11 spinous processes and just medial to the angle of the ribs. A high velocity, low amplitude thrust coupled with pressure through the patient's crossed arms and torso was applied to the lower ribs on the left hand side. The thrust was along an oblique sagittal plane in a posterior to anterior and inferior to superior direction.[4] Audible cavitations were heard.

Myofascial release[5] was also performed to the latissimus dorsi and posterior axilla. The myofascial release used in this case involved the doctor applying moderate digital pressure to the involved tissue in a direction proximal to distal while passively moving the muscle though it's range of motion in both eccentric and concentric contraction phases. This action was performed two to three times per treatment session to the patient's tolerance.

The patient was also taught proprioceptive neuromuscular facilitation (PNF)[6] exercises of the latissimus dorsi, shoulder external rotators and triceps muscles to facilitate neuromuscular re-education. The patient was instructed to do the exercises with five repetitions for three sets. The patient was to incorporate breathing exercises to enhance relaxation of the muscles. The patient was taught "hold-relax" PNF exercises which involved an isometric contraction of the muscle and "contract-relax" PNF, when isotonic resistance was employed. Contractions were held for six seconds and followed by a very brief period of relaxation, then advancing the exercise, increasing the range of motion slightly.

The patient noted immediate improvement in pain levels and improved hand dexterity immediately following the first treatment. During re-evaluation the following day, the patient stated that he was able to sleep six hours the night after the treatment and he rated the pain in the arm and hand as "7/10" on a verbal analog scale. He also noted increased dexterity of his hand and fingers and noticed that his hand symptoms had decreased. The improvement continued the next day. Later after the second treatment, it was observed that the patient had improved hand dexterity. After the second treatment, the patient rated his pain as "3/10" on a verbal analog scale. The patient noted he only had pain in his fourth and fifth digits of the left hand when he had his hand positioned above and behind his head. On the fourth day, on the morning after a third treatment, the patient reported that he no longer had pain and that he felt very comfortable holding objects between his thumb and fifth finger. Re-evaluation of the hand at this time found that the patient was able to pinch "tip to tip" and "pad to pad" rapidly and without any assistance. Left shoulder range of motion was equal to the right and pain free. At this time treatment frequency was decreased to one time per week to monitor patient progress. He was seen one time per week for two weeks to monitor his condition. After the third week, he was still asymptomatic and was released from treatment. In total, the patient received five treatments.

Discussion

In this case, two potential mechanisms of injury to the ulnar nerve were considered. Both mechanisms were investigated and are discussed below. Although it is less likely, the patient's presentation may have been an isolated side effect of the shockwave treatment on the muscles and nerves during the ESWL procedure. More likely, the patient's shoulder position in full abduction and external rotation, combined with elbow flexion, could have resulted in a compression or traction injury to the ulnar nerve due to the duration of the ESWL procedure. In addition to an ulnar nerve injury, strain to the ipsilateral latissimus dorsi muscle, resulting in referral down the arm to the hand may also account for some of the presentation.

ESWL is commonly performed as an outpatient procedure. The majority of procedures performed now use the "second-generation" lithotripter machines that no longer require that the patient be submersed in water.[7] The patient is positioned on the lithotripter on a treatment table in the supine position, with their arm abducted, extended and externally rotated which places their hand behind their head. Patients need to lie completely still during the procedure to minimize internal movement of the stone.[7]

Side effects of extracorporeal shock wave lithotripsy are reported in the literature. Gronau et al.[8] reported an overall complication rate of ESWL to be 10%. Most complications are minor such as hematuria, fever, and mucosal injury.[2] The most common significant complication reported were subcapsular renal hematomas, which can be found in 1% of the normal population.[2] Single cases of acute pancreatitis,[9] the rupture of a severely calcified abdominal aorta[1] and cauda equina syndrome[10] have also been reported.

Available studies[1,2,7,8,11–13] provide little evidence that nerve injury of such rapid onset as in this case could be due to ESWL. The reported complications of ESWL mentioned above tend to be an effect of the shockwaves on the patient.[11] The effect of the shockwaves on muscle and nervous tissue is less clear. In an experiment on frog sciatic nerves, Schelling et al.[12] were able to demonstrate that ESWL could produce action potentials in the nerve in a mechanism similar to cavitation within the nerve tissue. Deliveliotis et al.[13] showed that ESWL was able to stimulate the obturator nerve in humans. Kabalin et al.[7] found that spinal cord injury patients experienced uncontrolled skeletal muscle spasms that were elicited by the shock waves. These three studies[7,12,13] suggest that the treatment shockwaves have the potential to effect nervous and muscle tissue. However, in a later study, Rompe et al.[14] studied the effects of ESWL on the sciatic nerve of 82 rabbits and found that peripheral nerve damage was unlikely. After two to four weeks some vacuolic swelling of the axons was noted. However, none of the rabbits demonstrated any disruption of the nerve's continuity. In addition, they did not observe any neuropraxia.

It was more likely that the cause of this patient's symptoms was due to the position of the patient's left arm held behind his head, during the ESWL treatment. To support this, Kabalin et al.[7] noted one disadvantage of the second-generation lithotripters compared to the first generation machines: Because patients are no longer slightly supported by water, the hard, dry treatment surfaces of the lithotripters require padding on a patient's pressure points to prevent compression injury to their skin and tissues.

The potential for compressive injury during ESWL is complicated by the position of the patient's arm in this procedure as well as the duration that the arm was held there. Pei-Hsun[15] described a case during thoracic surgery where a patient was in the supine position with his arm hyperabducted above 100 degrees for over an hour that resulted in nerve injury. It was suggested that the prolonged hyperabduction resulted in excess traction and/or compression of the brachial plexus against bony prominences. This resulted in microvascular and/or local mechanical injury of the nerve.

Little is known in regards to nerve mechanics due to combined joint postures of the shoulder and arm during treatment procedures.[16] Kleinrensink et al.[17] and Byl et al.[16] both studied the amount of strain placed on the ulnar nerve when the patient's arm is held in abduction and external rotation. This position is described as a tension test for the ulnar nerve by Kleinrensink et al.[17] Byl et al.[16] confirm this, having noted that maximum increases in ulnar nerve strain occur during shoulder abduction and elbow flexion, producing "significant strain" on the ulnar nerve and inferior roots of the brachial plexus.

The position of the patient's arm in this case, on a similar surface may have resulted in a transient compression or traction induced neuropraxia of the C8–T1 components of the ulnar nerve. This caused altered innervation to the muscles responsible for opposition and pinch of the thumb and fifth fingers (See Table 1).[16] To the author's knowledge, no other cases of upper extremity neuropathy related to ESWL have been reported.

This form of muscular weakness, although temporary, can be quite disruptive particularly if hand dexterity and strength are required by the patient's employment. Fortunately, despite rather profound initial muscle weakness secondary to neuropraxia, the majority of patients can be told that they will have a favorable outcome. Unfortunately, this outcome may take up to several months to years.[15]

The manner in which the hand receives its sensory innervation compared to motor innervation is an important factor in this case. Sensory innervation to the fourth and fifth digits is through the ulnar nerve via the lower trunk. Motor innervation to the median sensory supplied thenar muscles, however, is also through the lower trunk. As a result, nerve compression to the ulnar nerve alters sensation to the fourth and fifth digits, while the thenar adductors and all the hypothenar ulnar nerve innervated muscles are affected. Patten[19] and Staal[3] both state that in many cases even severe compression of the ulnar nerve may occur with minimal or absent sensory symptoms or findings as it was found in this case.

The incidence of brachial plexus injury due to patient positioning is likely rare and it's incidence is not known.Ulnar neuropathies at the elbow (UNE) following surgery or anesthesia are relatively common.[20] UNEs account for more than one third of all legal claims involving nerve injury, though the relationship of UNE to surgery is disputed.[20] Staal[3] reports that isolated lesions of the ulnar nerve in the axilla are "extremely uncommon". Very rare causes are attributed to aneurysms of the axillary or brachial arteries, pressure from crutches or tourniquets or isolated sleep paralysis.[3] A patient's presenting with such a problem may report symptoms that are often vague and intermittent. It can be helpful to evaluate the patient while they are doing the activity that produces the symptoms.[21] Most entrapment neuropathies follow acute trauma or repetitive overuse.[21] Electromyography and nerve conduction studies are sometimes useful in diagnosis, but due to the conditions intermittent nature, these studies may also be normal.[21,22]

Table 1 Intrinsic Muscles of the Hand Innervated by the Deep Banch of the Ulnar Nerve (adapted from)[18]

Hypothenar Compartment:

Abductor Digiti Minimi	Deep branch of Ulnar	Abducts & helps flex MCP of 5th. Digit
Flexor Digiti Minimi	Deep branch of Ulnar	Flex MCP of 5th. Digit
Opponens Digiti Minimi	Deep branch of Ulnar	Draws the 5th MCP forward & rotates it laterally

Central Compartment:

Adductor Pollices	Deep branch of ulnar	Adduct thumb & assist in grasping tightly
Palmar Interossei	Deep branch of ulnar	Adduction of 1st., 3rd. and 4th fingers

Summary

A case is presented in which a patient developed ulnar neuropraxia after receiving a course of extra corporeal shockwave lithotripsy treatment. Although a definitive causal relationship was not established, the positioning of the patient during treatment may have contributed to the symptoms that followed. This complication can be prevented by minimizing procedure time and pressure on the posterior axilla, rib cage or the arm.[7] Placing the shoulder into full abduction, and external rotation for a longer periods has been shown to increase tension on the ulnar nerve and may place the patient at risk of a traction or compressive injury.[15–17] In this case, the outcome was excellent, with complete resolution of symptoms less than one week later. The prognosis for this type of neuropraxia is usually good with conservative management.[15] The patient history and chronological clinical course strongly suggest a causal association between the patient's position during the procedure and the development of the ulnar neuropraxia.

Individuals presenting with severe pain in the arm and hand may require diagnostic imaging to rule out a compressive etiology. Clinicians should be aware of the possibility that the mechanism of injury may be the patient's body position held for extended periods resulting in nerve injury. Chiropractic treatment as described above may play a role in reduction of symptoms during the rehabilitative stage of treatment. Practitioners who use treatment benches or tables should be careful to avoid nerve injury due to prolonged patient positioning.

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