Brachial Plexus Lesion Due to Malpositioning During Thyroid Surgery: A Case Report

Tiroid Cerrahisi Sırasında Kötü Pozisyonlamaya Bağlı Gelişen Brakial Pleksus Lezyonu: Bir Olgu Sunumu

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ABSTRACT

Peripheral nerve lesion is a rare complication during surgical operations which require general anesthesia. It may occur at anytime in the perioperative period. Its real incidence is still not clear and probably underreported. It may result from nerve blockage, direct nerve injury due to surgery and intraoperative malpositioning as well and may result with severe functional loss. Here we present a case which has brachial plexus lesion due to malpositioning during total thyroidectomy surgery. After a comprehensive rehabilitation program a significant increase is achieved in the patient's muscle strength. *(J PMR Sci 2011;14: 80-4)*

Key words: Brachial plexus lesion, thyroid surgery, rehabilitation

ÖZET

Periferik sinir lezyonu, genel anestezi gerektiren operasyonlar esnasında nadiren gelişen bir komplikasyondur. Perioperatif dönemde herhangi bir zamanda oluşabilir. Gerçek insidansı hala kesin değildir ve muhtemelen var olandan daha az bildirilmektedir. Sinir blokajı veya cerrahiye bağlı direkt sinir hasarı ile oluşabileceği gibi intraoperatif kötü pozisyonlamaya bağlı olarak da gelişebilir ve önemli oranda fonksiyonel kayıplara yol açabilir. Bu yazıda total tiroidektomi operasyonu esnasında kötü pozisyonlamanın neden olduğu brakial pleksus lezyonlu bir vaka sunulmuştur. Uygulanan kapsamlı rehabilitasyon programı sonucunda hastanın kas gücünde belirgin bir artış elde edilmiştir. *(FTR Bil Der 2011;14: 80-4)*

Anahtar kelimeler: Brakial pleksus lezyonu, tiroid cerrahisi, rehabilitasyon

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Introduction

Peripheral nervous system (PNS) injuries such as brachial plexus lesion (BPL) and peripheral nerve lesion (PNL) are neurological injuries which lead to significant functional loss in the upper extremity. There are numerous causes for PNS injuries. Besides causes like toxic nerve blockade or direct nerve injury due to the surgery, hard operating table or pressure injury due to pneumatic tourniquet, malpositioning and nerve stretch due to excessive maneuvers of the extremity, pressure of the vital equipments for the surgery (e.g. airway) are the rare sources of nerve injury. Branches of the brachial plexus, the ulnar, radial and common peroneal nerves, lumbosacral roots and sometimes the facial nerve are the commonly injured nerves during general anesthesia (1-3). Bilateral hypoglossal nerve injury due to larengeal mask airway use is also reported (3).

Medical history and physical examination play a significant role in clinical diagnosis. BPL may result in

complete or partial motor paralysis according to the severity of the injury. C5 and C6 (upper brachial plexus) lesion involves spinal nerves leads to paralysis of the shoulder muscles and biceps. When the damage extends to spinal nerve C7, some of the wrist muscles are also impaired. C8 and T1 (lower brachial plexus) lesion involves spinal nerves and incurs paralysis of the forearm flexor and the intrinsic muscles of the hand. Injuries to the stellate ganglion or cervical sympathetic trunk cause Horner syndrome (4). Here we present a case of BPL and concomitant radial nerve lesion, following a total thyroidectomy operation. Our aim is to call attention to a BPL due to positioning and stretch during general anesthesia which may cause function loss in the patient and can leave the surgery's success in the shade and to the comprehensive rehabilitation management which reduces the functional loss.

Case Report

A 20-year-old man was seen for weakness in extension in the right hand fingers that was eventually diagnosed with radial nerve paralysis. He declared that weakness started just following a surgical operation. He mentioned a total thyroidectomy operation (40 days prior) after which his complaints had started and that he was laid supine on the operating table with his right arm 90º abducted, and fixed on an arm board. He claimed that he had numbness on the lateral aspect of right forearm on the operation day but not anymore. The medical history was otherwise unremarkable but he was diagnosed with goitre. History of neoplasia, radiation, trauma and rheumatic disease was absent. On detailed questioning, the medical and parental histories were unremarkable. On the physical examination there was remarkable weakness (manual muscle test) in active extension (2/5), flexion (4/5) and abduction of the fingers and the thumb at the metacarpophalangeal joints on the right side. There was mild hypoesthesia in the 4. and 5. fingers of the right hand. The strength of pronation and flexion of the forearm was 4/5. There was no remarkable weakness in the right shoulder muscles. The biceps and brachioradial reflexes on the right were normoactive but triceps reflex was hypoactive. Horner syndrome was not present. Upon visual inspection, no swelling, redness, ecchymosis, deformity, spontaneous muscle activity (i.e. fibrillations), or muscle wasting of the forearm when compared to the left arm was observed. Active cervical ranges of motion and cervical compression test were unprovocative. The contour, trace and signal intensities of the roots, trunks and cords were normal in the brachial plexus and cervical magnetic resonance imaging (MRI) (Figure.1.2.3). The electromyography and nerve conduction tests revealed whole brachial plexus lesion (panplexopathy) and concomitant partial radial nerve lesion (Table.1). There was no finding that indicates motor neuron disease or radiculopathy in nerve conduction studies. Differential diagnostic considerations of pathology afflicting the forearm were ruled out on the basis of the history, physical examination and nerve conduction study. The patient received a comprehensive physiotherapy (5 days a week, 6 weeks total), including electrical stimulation and strengthening exercises and his state has been significantly improved (4/5) after 6 weeks from the first application to our clinic. In the 6th month examination, almost complete recovery was achieved in the muscle strength of the patient with continuing the exercise program.

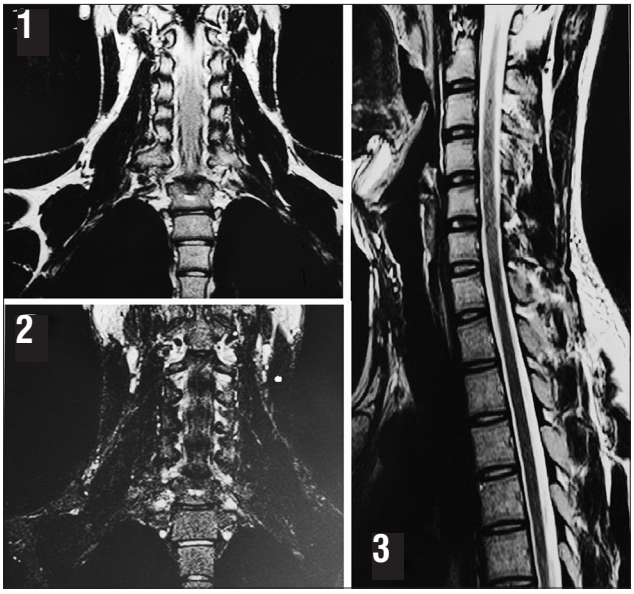

Figure 1, 2, 3. The contour, trace and signal intensities of the roots, trunks and cords were normal in the brachial plexus and cervical MRI.

Discussion

Intraoperative positioning or excessive maneuvers can cause compression, stretch and ischemia of the peripheral nerves. Depending on the severity of the injury, disruption of the intraneuronal blood vessels (vaso nervorum) or tear of the connective tissue may lead to nerve ischemia, intraneuronal hemorrhage and/or necrosis (5). The degree of paralysis depends on the degree of injury. Sustained pressure leads to Schwann cell damage and myelin displacement. As damage to the myelin progresses, segmental or paranodal demyelization is the result.

Nerve damage is usually the result of compression or stretching of the nerve due to intraoperative positioning. In a few cases, nerves are damaged due to direct trauma caused by needles or extravasated drugs. Generally, compression accompanied traction injuries cause intraoperative nerve lesions. Several factors might be associated with intraoperative nerve lesions, including concomitant disease (e.g. diabetes mellitus, hypothyroidism, alcoholism), anatomical variations (e.g. cervical rib, scalene muscle hypertrophy, posttraumatic deformity of shoulder region), positioning of the patient (steep trendelenburg, shoulder

Table 1. EMG was obtained nearly 6 weeks after the surgery. Electrophysiologic findings were corelated with right brachial plexus panplexopathy and partial radial nerve lesion

Motor nerve conduction study											
Site	**Latency (ms)**	**Amplitude**	**Area**	**Segment**	**Distance (mm)**	**Interval (ms)**	**NCV (m/s)**				
Radial forearm / L	2,22 ms	6,75 mV	17,67 mVms	Forearm		2,22 ms					
Elbow / L	3,12 ms	7,30 mV	18,49mVms	Forearm-elbow	70mm	0,90ms	77,8m/s				
Axilla / L	5,58 ms	7,30 mV	18,51mVms	Elbow-Axilla	150mm	2,46ms	61,0m/s				
Erb's point / L	6,44 ms	8,33 mV	20,11mVms	Axilla- Erb's point	70mm	0,86ms	81,4m/s				
Forearm / R	3,64 ms	58,00µV	23,10uVms	Forearm		3,64ms					
Elbow / R	4,76 ms	693,00 µV	2,22mVms	Forearm-elbow	70mm	1,12ms	62,5m/s				
Axilla / R	7,28 ms	644,00 µV	2,08mVms	Elbow-Axilla	150mm	2,52ms	59,5m/s				
Erb's point / R	8,66 ms	518,00 µV	2,65mVms	Axilla- Erb's point	70mm	1,38ms	50,7m/s				
Sensory nerve conduction study											
Median wrist / R	2,94ms	13,80 µV	1,71 uVms	Wrist	150 mm	2,94ms	51,0m/s				
Ulnar wrist /R	2,32ms	21,70 µV	22,57 uVms	Wrist	120 mm	2,32ms	51,7m/s				
Radial forearm / L	2,36ms	15,60 µV	1,01 uVms	Forearm	120mm	2,36ms	50,8m/s				
Radial forearm / R	1,92ms	10,60 µV	0,83uVms	Forearm	100mm	1,92ms	52,1m/s				
Needle EMG											
Muscle/Side	**Inc Act.**	**Fibs.**	**Pos. Wave**	**Fasc.**	**MYO Disch.**	**Normal MUP**	**Poly**	**Low Amp.**	**High Amp.**	**Dur.**	**Recruit**
Biceps Brachii / R	Normal	+2	+2	0	0	0	0	0	0	Long	Mild reduced
Triceps/ R	Normal	+2	+2	0	0	0	0	0	0	Long	Reduced
1. Dorsal Inter / R	Normal	+	+	0	0	0	0	0	0	Long	Reduced
Extn. Digitorum com / R	Normal	+2	+2	0	0	0	0	0	0	Long	Reduced
Extn indicis pro / R	Normal	+2	+2	0	0	0	0	0	0	Normal	Reduced
Abd. Pollicis brevis / R	Normal	+	+	0	0	0	0	0	0	Long	Mild reduced
Deltoid/ R	Normal	+	+	0	0	0	0	0	0	Long	Mild reduced
Paraspinal, cervical / R	Normal	0	0	0	0	0	N	0	0	Normal	Full
Deltoid/ L	Normal	0	0	0	0	0	N	0	0	Normal	Full

braces, wrist suspension, excessive abduction of arm >90 degree dorsal extension at shoulder, posterior displacement, external rotation of arm, excessive rotation of head), surgical factors (long operative time) and physiological factors (hypothermia, hypotension) (6). Our case had a total thyroid surgery in supine position and long surgical time. Regarding the surgical procedure, we think that the hyperabduction and posterior displacement of the shoulder (fixed on an arm board and for a long time) caused BPL as seen in figure 4 and 5.

Physical examination plays a significant role in the diagnosis. Symptoms of brachial plexus injury may include varying degrees of upper extremity pain, weakness (paresis or paralysis), sensation changes (anesthesia, paraesthesia, hypo-hyperaesthesia), and diminished reflexes (7). Upper plexus injury produces deranged shoulder joint movements, whereas the lower ones result in deranged motion at the small hand joints. Imaging studies play an essential role in differentiating preganglionic injuries from postganglionic lesions, a differentiation that is crucial for determining the management of BPL. Signal intensity changes are observed in the spinal cord in approximately 20% of patients with preganglionic injuries. Hyper intense areas on T2-weighted images suggest edema in the acute phase and

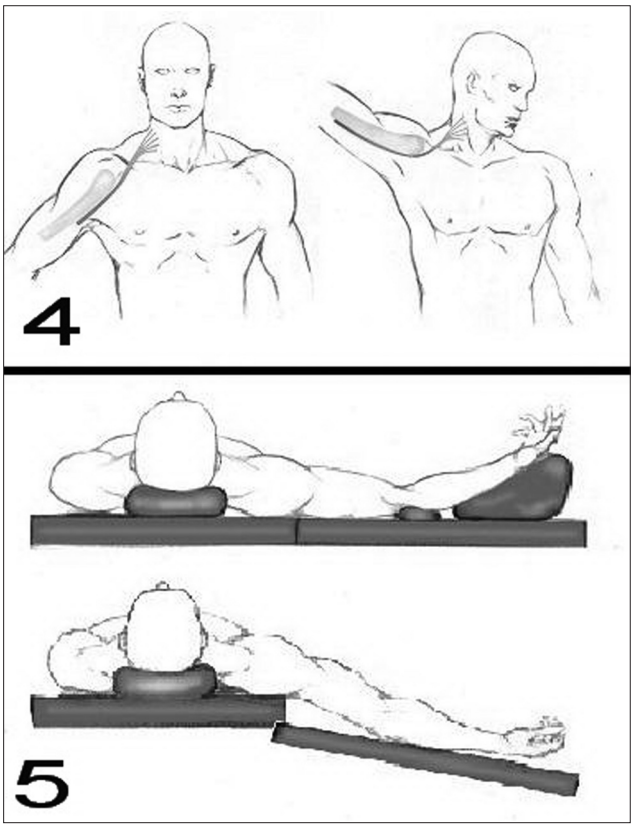

Figure 4, 5. Brachial plexus stretch due to hyperabduction and posterior displacement of the right shoulder in supine position.

myelomalacia in the chronic phase. Hypo intense lesions on T2-weighted images reflect hemosiderin deposition on account of hemorrhage. MRI could demonstrate other causes of brachial plexopathy after trauma, such a hematoma (4, 8).

There was no pathological finding in the MRI of our case. The reason might be because it was performed after six weeks of the surgery date which caused the injury and if there were pathological signal changes in that period it may be resolved. Physiological evaluation with electromyography (EMG) and nerve conduction studies should absolutely be performed. Its purpose is to identify and localize nerve lesions. This is accomplished by exploring sensory and motor nerve conduction velocities, the degree of muscle denervation, and the degree of muscle reinnervation. Findings may also discriminate between acute and chronic nerve injury and this may help determine the causality and timing injury. An EMG may be performed in the acute stages of injury to establish whether any preexisting nerve injury is present. Since denervational changes in muscle require 2 to 3 weeks to become apparent on EMG, the presence of these findings acutely suggests a preexisting nerve injury. Electromyography is also performed in a delayed fashion; commonly 3 to 4 weeks post injury, so that denervational changes can be documented (3,9,10). In this case, EMG (Table 1) was obtained nearly 6 weeks after the thyroid surgery. It is primary thought as radial nerve injury since there was remarkable extension loss at the wrist in the foreground of his physical examination and history, but there were also deficits in finger flexion, abduction and adduction; therefore this diagnosis lost its value. Nerve conduction tests revealed remarkably reduced compound muscle action potential amplitude at radial nerve and also the sensory action potential amplitudes of radial and median nerves were reduced. In needle EMG, pathologic spontaneous activity signs (fibrillation and positive sharp waves) were present at all studied right upper extremity muscles, whereas cervical paraspinal and left upper extremity muscles were electrophysiological normal (Table 1). These findings were interpreted as acute partial brachial plexus and concomitant radial nerve lesions which probably caused by prolonged nerve compression and/or traction due to malpositioning of the patient during the surgery.

In the acute phase of BPL, treatment depends on the nature of the symptoms. Motor deficits are treated with physical therapy to maintain joint flexibility and range of motion. Active use of the affected muscles is typically recommended (5). Furthermore, in severe cases splinting may be used to prevent contractures, to protect an extremity from further injury and assist activities of daily living. If there is pain, analgesics or agents that are effective in neuropathic pain can be used. In our case, physical therapy (exercise and electrical stimulation) was performed for 6 weeks, particularly to the muscles that are affected. Examination after nearly 6 month, his muscle strength was almost completely recovered. Generally the prognosis is good. In most cases, recovery (remyelization) occurs in 6–8 weeks, but in some patients recovery is prolonged, and in a few the injury turns to be permanent. It is reported that, in some cases with BPL, even after 50 weeks complete recovery is obtained (6).

A limited number of case reports and clinical studies touch on nerve injuries due to intraoperative positioning. Approximately one third of these cases have ulnar nerve damage, probably because of its relatively superficial course. Radial nerve damage in the upper arm occurs usually as a result of long compression or traction, such as under a pneumatic tourniquet. The sciatic nerve is at risk at slim patients when placed on a hard operating table during a long operation, but may also be damaged by stretching in the lithotomic position (11). Intraoperative BPL mainly occurs in operations that cause the arm being stretched. For example, it can also be a complication of thoracic/cardiac surgery, as a result of stretching during median sternotomy. BPL after cholecystectomy has been reported, probably because of the use of a gall bladder rest that forces the abducted arm into additional extension at the shoulder. The use of Trendelenburg position in gynecologic surgery has been associated with the development of injury to the brachial plexus. The use of Trendelenburg position with shoulder braces causes the plexus to be under severe stretch and compression (5). Brachial plexus injury was also documented

in another report concerned with liver transplantation (12). Lateral decubitus position may also cause BPL. BPL occurred in 4 of 7,150 patients in a series of total hip arthroplasties (13). We could not encounter a BPL case associated with thyroid surgery when we reviewed the literature. The lesion in our case probably occurred due to over abduction and extension of the shoulder similar to other operations that are performed in supine position (Figure 4-5). This maneuver might be done by the surgery crew or it may be a result of a problem that sources from the operating table. An application that could cause compression was not applied.

Careful positioning is required in the prone position to avoid BPL. In preventing BPL, abduction of the arm should preferably be limited to 90 or less. If 90 degrees abduction is necessary, the elbow should not be fully extended. External rotation of the abducted arm, and especially posterior displacement of the shoulder should be avoided because this can stretch and compress the plexus (6,11). Although they account for a small proportion of medico legal claims, they are difficult to defend, being essentially avoidable (7,9).

Early evaluation and diagnosis of these injuries is very important because of the long-term morbidity and disability produced by them. Finally, if these patients are taken under a comprehensive physical medicine and rehabilitation program in the early stages, significant positive results are achieved.

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