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The significant recovery after direct nerve injuries in regional anesthesia

Nawfal Ali Almubarak[1*], Shaymaa Jasim Mohammed[2]

Abstract

Direct nerve injury is one of the important complications of peripheral nerve blockade that was reduced to a significant degree by ultrasound guide and nerve stimulator. his retrospective study was done in different private and public electrophysiological clinics. Patients participated in this study were 60, 40 males and 20 females. Patient's age range was 1 to 55 year. Two nerves were examined; the median nerve and the common peroneal nerve because they are most susceptible to trauma. This study depends on 3 variable physiological parameters regarding nerve physiology: latency, amplitude and conduction velocity to assess nerve healing after trauma. The results showed a highly significant recovery from nerve injury after 3 weeks with a p-value of 0.001 regarding all the 3 physiological parameters in both injured nerves.

Keywords: Nerve injury; Common peroneal nerve; Trauma

*Corresponding author email: nawfalmubarak@yahoo.com
[1]Department of Surgery, College of Medicine, University of Basrah, Basrah, IRAQ
Department of Physiology, College of Medicine, University of Basrah, Basrah
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Introduction

Regional anesthesia may be associated with preventable nerve damage in the recent presence of ultrasound guided nerve block with stimulator. Nerve injury may only become evident up to 1-week after regional anesthesia which can be missed in normal clinical practice as the anesthesiologist may not check the patients after a nerve block, when the neurological signs will become obvious. In addition to local anesthetic toxicity, peripheral nerves can be wounded by needle, compression, stretching, ischemia, and nerve cut [1, 2]. Direct trauma by needle can be related with considerable nerve injury, especially if the needle penetrates the perineurium and enters the fascicles. Injection of local anesthetic into the fascicle not only causes direct axonal damage from needle and local anesthetic chemical damage, but also increases intra-fascicular pressure to the degree that endoneurial blood flow may be jeopardized. The needle may harm neural blood vessels causing extra- or intra-neural hematoma. The use of blunt atraumatic echogenic needles has been an option because they can help in recognizing tissue planes and needle position. When evaluating a patient with neurologic symptoms following a peripheral nerve block, the provider must be able to anatomically localize the region of the pathology and the nerves involved. History determine whether the neurologic deficit existed before the anesthesia or surgery can help in preventing false assumptions associated with peripheral nerve block as the underlying cause of the deficit. Documentation of a normal neurologic examination prior to the nerve block procedure is very important. Pre-existing severe peripheral neuropathy from medical conditions such as diabetes may predispose the patient to postoperative nerve injury with or without a peripheral nerve block. A careful physical examination of the patient with possible nerve injury may reveal unrecognized explanations for the nerve injury and it should include evaluation of strength, pin prick, fine touch, position sense, and reflexes. Sensory-motor nerve conduction studies and Electromyography are the basic techniques used in electro-diagnosis to aid in determining the location and type of nerve lesion. Nerve conduction studies can be performed on either sensory or motor nerves. The latencies, amplitudes, conduction velocities are recorded. Needle EMG is performed using a small needle electrode inserted into the muscle. Obvious muscle denervation happens after 10-14 days of nerve injury. Nerve conduction studies (NCS) and topical lectromyograms (EMG) [4] are non-invasive tests that have a diagnostic role in the delayed setting (3-6 weeks later) when fibrillations in denervated muscle are present, but not immediately after injury. Therefore, there is no non- invasive diagnostic test that can diagnose the presence or severity of nerve injury in the first week after injury. Fibrillations from denervated muscle may not be apparent until 3-6weeks after injury, depending on how proximal the nerve injury is [5]. For that reason, the optimal diagnostic timing of EMG will depend on the injury site. There are three parameters used in determining whether a conduction study is normal or abnormal. These

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parameters are amplitude, latency of the response, and conduction velocity [6].

Evaluation of recovery

The results of peripheral nerve injury vary and depend on the type and extent of the injury, surgical factors and patient characteristics. The British Medical Research Council Nerve Injury Committee classification scheme for sensory and motor recovery [7] and the Medical Research Council Grading System for Nerve Recovery [8] are helpful grading systems for determining the results of nerve injury. Furthermore, younger patients have shorter regeneration time, improved healing and greater capacity for cortical reorientation [9, 10]. Generally, pure sensory or pure motor nerve repair have better outcomes than mixed nerve repair, as do early repairs, short nerve grafts and clean nerve transactions.

Patients and methods

This study included 60 patients with median and common peroneal nerve injuries, they were 40 males and 20 females. Age ranged from 1 to 55 year. All the patients had EMG study by surface and needle electrodes. The first nerve examination was done during the first week following the injury. The second nerve examination was done during the third week after the trauma. The study included the measurement of latency, amplitude and conduction velocity. Data was analyzed statistically using SPSS program and a P value below 0.001 was considered highly significant

Results

The results in tables 1 and 2 shows the mean changes in latency, amplitude and conduction velocity of median and common peroneal nerves in different age groups. There was a highly significant improvement in all tested parameters of median and common peroneal nerves between the first and second visits.

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Table I.

Median nerve conduction study in first and second visits

Age group	Number	%	Variable	Mean		P value
				Visit 1	Visit 2	
Up to 5 years of age	20	33.3%	Latency (msc)	7.936	5.173	<0.001
			Amplitude (MV)	1.391	3.664	<0.001
			CV (M/sec)	23.427	37.436	<0.001
>5-20 years	8	13.3%	Latency (msc)	8.140	4.040	0.02
			Amplitude (MV)	1.840	4.360	0.01
			CV (M/sec)	24.680	41.200	0.23
>20 years	32	53.3%	Latency (msc)	7.122	4.439	<0.001
			Amplitude (MV)	2.278	3.594	<0.001
			CV (M/sec)	24.633	32.981	<0.001

Table 2.

Common peroneal nerve conduction study in first and second visits

Age group	Number	%	Variable	Mean		P value
				Visit 1	Visit 2	
Up to 5 years of age	20	33.3%	Latency (msc)	7.356	5.000	<0.001
			Amplitude (MV)	2.400	3.478	<0.001
			CV (M/sec)	22.911	46.289	<0.001
>5-20 years	8	13.3%	Latency (msc)	8.600	5.667	0.09
			Amplitude (MV)	2.500	3.900	0.20
			CV (M/sec)	19.467	42.933	0.02
>20 years	32	53.3%	Latency (msc)	7.122	4.439	<0.001
			Amplitude (MV)	2.278	3.594	<0.001
			CV (M/sec)	24.633	33.45	<0.001

The median and common peroneal nerves are retrospectively studied in relation to healing after injury. The tables showed that recovery of injured nerves following trauma was highly significant (p value <0.001) after three weeks following the first visit. The neurophysiologic study showed the following results; latency during the first visit was prolonged while during the second visit, it was shorter that means the nerve become excited faster after stimulus and there was improvement in the nerve healing. Amplitude also was improved after nerve injury as it increased in the second visit in comparison with the first one which mean an efficient nerve impulse.

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Conduction velocity is increased in the second visit in contrast to the first visit, which is correlated with improvement of nerve action potential transmission and nerve recovery.

Discussion

Regarding the mean latency and conduction velocity of all age groups; the improvement in these two was evident in this study and the p values were <0.001. If the nerve injury is caused by a demyelination process of the nerve, an active re-myelination can be gained within six months and a nerve function can be resumed within this period. So as far as most studies [2, 6, 7] assumed that the predictable pathophysiology behind nerve injury due to regional anesthesia is an acute demyelination process whether due to direct trauma to the epineurium and perineurium or indirect irritation of nerve tissues by the injected anesthetic drug and the reactive inflammatory course might result. Our results clarify an encouraging and positive prognosis with a highly significant improvement in conduction velocity of an injured nerve for all age groups. This study emphasizes the importance of advancing the field of regional anesthesia since it is a safe method specially for patients with contraindications to general anesthesia or those who have a psychological issue. Also, the regional procedure has less cost and provide good postoperative analgesia with no loss of consciousness during surgical procedure. This study showed a highly significant improvement in amplitude of median and common peroneal nerves because the amplitude stands for the cumulative recruitment of axons in a specific nerve and as the results showed a highly significant progress in amplitudes of the compound muscle action potentials gained from the tested nerves so there was a perfect re-innervation and axonal regeneration whether by growing of damaged nerve terminals or by reactivation of injured axons that showed acute impairment in function with preserved neuronal integrity. Since the improvement was not limited to a specific nerve and both median and common peroneal nerves show highly significant progress in all tested parameters, we can assume from results obtained that a possible nerve injury which might result from the use of regional anesthesia in upper or lower limbs would show a good prognosis and normal neurological functions can be

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resumed within less than one year period. Most nerve injuries after regional anesthesia are temporary and will recover over a period of time. Everlasting nerve injury is uncommon. With the increasing use of regional anesthesia, this study was done to prove the safety of regional anesthesia specially by using ultrasound guided insulating needles and nerve stimulator to precisely inject the local anesthetics in epineurial space and to avoid intraneural intrafascicular injection. Associated neurological complications are relatively rare and the majority of these complications noted after regional anesthesia are not secondary to the block but may result from pre-existing conditions, patient positioning, or from the surgery itself. If they occur, a spontaneous recovery is expected with minimal risks of permanent nerve damage.

Conclusion

The best protection against nerve injury induced by regional anesthesia is to follow the correct procedure and using ultrasound and nerve stimulator, careful needling, use of blunt atraumatic needle, fine and short-beveled needle.

Competing interests

The author declare that he has no competing interests.

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