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Sciatic nerve injury, an interventional study

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Abstract
The sciatic nerve (S. N) is composed of fibers from L4. L5. S1. S2 and S3. The anterior primary rami of these spinal nerve converge and split into anterior and posterior divisions. The trunk formed by the posterior divisions gives off the superior and inferior gluteal nerves and proceeds toward the sciatic notch as the common peroneal part of the sciatic nerve. The trunk formed by the anterior divisions becomes the tibial part of the sciatic nerve and also proceeds toward the notch. This sciatic nerve (largest nerve in the body) emerges from the pelvis through the lower part of the greater sciatic foramen. The nerve appears below piriformis muscle and curves downward and laterally. Lying successively on the root of the ischial spine, the superior gemellus, the obturator internus, the infenor gemellus, and the Quadratun femoris to reach the back of the adductor magnus muscle. It's related posteriorly to the posterior cutanous nerve of thing and the gluteus maximus. It leaves the buttock region by passing deep to the long head of the biceps femoris to enter the back of the thing. The sciatic nerve usually gives no branches in the gluteal region. In the thing it is overlapped posteriorly by the adjacent margins of the biceps femoris and semimembranosus muscle. It lies on the posterior aspect of the adductor magnus muscle. In the lower third of the thing it ends by dividing into the tibial and common peroneal nerves. Occasionally the sciatic nerve divides into its two terminal parts at a higher level in the upper part of the thing, the gluteal regions or even inside the pelvis.

Keywords: sciatic, nerve, injury

Introduction
Anatomy of sciatic Nerve:- The S. N. is composed of fibers from L4. L5. S1. S2 and S3. The anterior primary rami of these spinal nerve converge and split into anterior and posterior divisions. The trunk formed by the posterior divisions gives off the superior and inferior gluteal nerves and proceeds toward the sciatic notch as the common peroneal part of the sciatic nerve. The trunk formed by the anterior divisions becomes the tibial part of the sciatic nerve and also proceeds toward the notch. This sciatic nerve (largest nerve in the body) emerges from the pelvis through the lower part of the greater sciatic foramen. The nerve appears below piriformis muscle and curves downward and laterally. Lying successively on the root of the ischial spine, the superior gemellus, the obturator internus, the infenor gemellus, and the Quadratun femoris to reach the back of the adductor magnus muscle. It's related posteriorly to the posterior cutanous nerve of thing and the gluteus maximus. It leaves the buttock region by passing deep to the long head of the biceps femoris to enter the back of the thing. The sciatic nerve usually gives no branches in the gluteal region. In the thing it is overlapped posteriorly by the adjacent margins of the biceps femoris and semimembranosus muscle. It lies on the posterior aspect of the adductor magnus muscle. In the lower third of the thing it ends by dividing into the tibial and common peroneal nerves. Occasionally the sciatic nerve divides into its two terminal parts at a higher level in the upper part of the thing, the gluteal regions or even inside the pelvis [1].

Branches
Muscular branches
To the long head of the biceps femoris, the semitendinosus, the semimembranosus, and the hamstring part of the adductor magnus. These branches arises from the tibial component of the sciatic nerve and run medially to supply the muscles.

Tibial nerve
A terminal branch of sciatic nerve enters the popliteal fossa lying first on the lateral side of the popliteal artery and then posterior to it, and finally medial to it.
It supply skin of calf and the back of the leg by sural nerve and with sural communicating nerve it supply lateral border of foot and lateral side of little toe.
Muscular branch to both head of Gastrocnaemius, plantaris, soleus, a popliteus. Flexor hallusis long, Flexor digitorum longus, tibialis posterior. and all muscles of foot.

Common poroneal nerve
The small terminal branch, It pass behind the head of fibula, winds laterally around neck of the bone, pierces the peroneus longus muscle and divided into two terminal branches 1) deep peroneal N. 2) superfical P. N.

Sensory branches
It gives sural communicating branch and lateral cutaneus nerve of the calf supplies the skin on the lateral side of the back of the leg.

Muscular branches
Branches to short head of biceps femoris and anterior compartment muscle of leg and lateral compartment muscle of leg Anterior compartment (tibialis anterior, extensor, hallusis longus, extensor digitorum longus) Lateral compartment (Tertious longus, peroneus longus, peroneus brevis) [2].

Histology of Nerve

Peripheral nerves are comprised of axons and associated schwann cells enclosed in a basement membrane.

Schwann cells ensheathe individual axons in myetinated fibers and groups of axons in unmyelinated fibers.

The basement membrane is surrounded by thin collagen fibers called the endoneurium. The axon and schwann cell composite are termed the endoneurial or schwann tube. Endoneurial tubes are grouped together, forming a variable number of fascicles. Perineurium surrounds each fascicles. Perineurium is composed of collagen fibers and concentric layers of closely packed flattened cell, united by tight junctions. The perineurium creates a diffusion barrier against the surrounding environment, similar to the blood brain barrier. Epineurium surrounds the layers of the perineurium. There are internal and external epineurium and internal epineurium functions as a cushion for the fascicles.

The blood supply to peripheral nerves usually is via the mesoneurium or suspending mesentery.

The vasa nervorum is a longitudinal system of vessels within the nerve that allows circulation to continue even after some freeing of surrounding tissue.

Etilogy (Mechanism of injury) the peripheral nervous system may be involved by a diverse number of disease processes. Common pathologic mechanisms can be grouped into the following categories; metabolics, entrapment, traumatic and mass lesions.

Here we focus in this section on traumatic mechanisms of nerve injury. Common mechanisms are following.

Missile (gunshot wounds)

Which remain a relatively frequent cause of N. injury. In the vast majority of situations, the missile or bullet does not actually divide the nerve, but rather produces intraneural damage secondary to shock, blast or cavitation effects.

Laceration

Sharp or blunt instruments may lacerated may lacerated nerves, sharp objects include glass, scalpel, knife and razor blades. Blunt causes of laceration include chainsaw injuries, metal and auto shrapnel, industrial accidents.

Compression and ischaemia

While the pathophysiology of chronic nerve entrapment involves likely both compressive and ischaemic mechanism acute nerve injury occurs infrequently under these type of pathophysiologic circumstances. Relatively focal compression usually results in reversible nerve injury, whereas diffuse and longer duration compression, exceeding 8 hours can lead to irreversible damage.

Some patients developed palsy after falling a Sleep seated in a car. Or fall from high, other patients have a complete peroneal nerve palsy with foot drop and incomplete tibial nerve involvement after undergoing general anesthesia in a lethiotomy position.

Injection injury

Injury to peripheral N. secondary to injection is a serious complication of intramuscular drug administration. At gluteal region sciatic nerve are prone to injury. Damage may occur from the needle itself, but mostly is secondary to the toxic effects of the drugs or agent being instilled in the intraneural. The history associated with nerve injections is quite characteristic, needle placement results in an immediate electric – like shock sensation down the extremity

Thermal and electrical injuries

This mechanism relatively infrequent, as in each of there circumstances there can be severe and widespread damage to underlying nerve structures.

Hip fracture and dislocation

Patient with buttock (gluteal) – level sciatic nerve palsy related to hip fracture and / or dislocation were evaluated. Almost half of these patients also had suffered severe pelvic fractures and involvement of the lumbosacral plexus, with damage to more proximal femoral shaft as will as sciatic outflow.

Hip Arthroplasty

The incidence of overt sciatic N. dysfunction is reported as 0.5.3% following primary hip replacement and about twice as high after revision, however, subclinical electromyographic changes are quite common and intraoperative electrical test have detected abnormalities in 18% of patients (mostly women) undergoing routine hip replacement, the vast majority of these resolve fairly quickly and do not manifest as postoperative nerve lesions.

Iatrogenic injuries

Medico – legal circumstances can cloud and sometimes interfere with evaluation. It is of great importance to undertake a careful, detailed and sequential history from the patient and seek collateral forms of information from family members, medical notes or record and any other investigations.

Pathophysiology [3]

A stimulus to the human body elicits a response-appropriate or not, If the stimulus is injury to human tissue, the body's response is repair.

Damage varies in severity from transient and quickly recoverable loss of function to complete interruption and degeneration.

Transient Ischaemia

Acute nerve compression causes numbness and tingling within 15 minutes. Loss of pain sensibility after 30 minutes, muscle weakness after 45 minutes. Relief of compression is followed by intense parasthesia lasting up to 5 minutes (the familiar ' pins and needles' after a limb ' goes to sleep.

This changes are due to transient anoxia and they leave no trace of nerve damage.

Neuroproxia

Seddon (1942) coined the term ' neuropraxia ' to describe a reversible physiological nerve conduction block in which there is loss of some types of sensation and muscle power followed by spontaneous recovery after few days or weeks. It's mechanical pressure causing segmental demyelination.

Axonotmesis

This is a more severe form of nerve injury, seen typically after closed Fractures and dislocation, the term means, literally, axonal interruption. There is loss of conduction but the nerve is in continuity and the neural tube are intact. Distal to the lesion, and for few millimeters retrograde, axon disintegrate and are resorbed by phagocytes. This wallerian degeneration

takes only a few days and is accompanied by marked proliferation of schwann cells and fibroblasts lining the endoneurial tubes. The denervated target organs (motor end – plates and sensory receptors) gradually atrophy, and if they are not reinnervated within 2 years they will never recover.
Axonal regeneration starts within hours of nerve damage, probably encouraged by neurotropic factors produced by schwann cells distal to the injury. From the proximal stumps grow numerous fine unmyelinated tendrils, many of which find their way into the cell – clogged endoneurial tubes. These axonal processes grow at a speed of about 1 mm per day, the larger fibers slowly acquiring a new myelin coat. Eventually they join to end – organs, which enlarge and start functioning again.

Neurotmesis
It meant division of the nerve trunk such as may occur in an open wound. It is now recognized that severe degrees of damage may be inflicted without actually dividing the nerve. If the injury is more severe, whether the nerve is in continuity or not, recovery will not occur. here the endoneurial tubes are destroyed over a variable segment and scarring thwarts any hope of regenerating axons entering the distal segment and regaining their target organs. Instead, regeneration fibers mingle with proliferating schwann cells fibroblasts in a jumbled knot, or ' neuroma' at the site of injury. Function may adequately but is never normal [4].

Classification of Nerve injuries
Classification is based on the damage sustained by the nerve components, nerve functionality at the ability for spontaneous recovery. Seddon (1943) published his classification of nerve injuries of Sunderland (1951) expanded this grading system. The significance of seddon's 3 – grade classification system is it's clinical relevance in predicting functional outcome and formulating an appropriate treatment plan.
The mildest grade is nenropraxia and then axanotmesis, worst are neurotmesis.
Sunderland categorized nerve injuries into 5 grades, grade 1 and 2 correspond to seddon's neuropraxic and axonotmetic grades of injury.
Sunderland further divid seddon's category of neurotmesis injuries into grades, and based on the extent of damage to the axonal supporting structures.
In grade injuries, axon continuity is disrupted by loss of endoneurial tube (the neurolemmal sheaths) but perineurium is preserved.
In grade; nerve fasciculi (ie, axon, endoneurium, Perineurium) are damaged but nerve sheath continuity is preserved.
In grade injuries, the endoneurium, perineurium and endoreurium which make up the entire nerve trunk, are completely divided. Substantial perineural hemorrhage and scarring occur in this grade of injury grade corresponds to seddon's classification of a neurotmesis lesion. In A 1988 Mackinnon and Oellon presented a grade injury that represented a complex peripheral nerve injury [5].

Method
In our hospital – General Basrah hospital – this study has been done. A long 18 months we check relatively all the patients whose suffering of sciatic nerve injuries, when they admitted to orthopaedic department for any cause.
42 patients checked with proper history and physical examination specialy neurological examination about any sensory or motor deficit, we look for sensory loss, pain sensation, touch, position sense, tinel's sign and we look for active and passive movement, power of muscle groups, tone, reflex and other.
Some patients need immediate surgical interference as those with crush injury, bullet injury with massive damage, and some referred to Al. Saddar teaching hospital if vascular injury of big vessel has been documented.
Investigation we do what are available as plain x-ray, ultrasound, lab. Investigations as biochemistry, haematology, serology and others, but sophisticated tools as M.R.I. C.T. scan for little numbers while EMG study and nerve conduction study that done after 2 or 3 wks for some of patients but not for all.

Discussion
In this study we provide relatively detail information concerning with civilian sciatic nerve injury at a single institution. General Basrah hospital. and some cases in private hospital – Abn – AL – Beetar hospital. Our goal in this study is to provide an out – line for management of patients with sciatic nerve injury based on outcomes. Lower extremity nerve injuries are relatively less common than injuries to upper extremity nerve comprise the largest as well as a very important cripple affection of lower limb. From the whole number of cases – 42 – the predominant sex are male 33 while the female patients are. 9. The predominant level of injury was the thing. 28. while gluteal region. 14. as in table number (2).The age group affected was mostly active age group that is 2nd, 3rd and 4th decade (28). While the No. reduce during childhood and old age. This show what type of causes – that is mostly bullet injury in our locality. as in table number (1). Concerning with mechanism of injury. The major cause that is high missile injury, that may be missile of bumping, rifle, gunshot, mines, motors and other (26) 62%. as in table number (3). Iatrogenic cause which was mostly injection at gluteal region that wrong way of injection by some inefficient medical personnel. 7. (17%). Other cause was road traffic accident that mostly cause fracture of femoral shaft or dislocated hip joint There are many causes of low velocity injury as blunt trauma. But there are 2 strange cases, 1st one a girl 13 years sustained with foot drop and after thoroughly investigation which revealed Hydatid cyst of sacrum, extraction of hydatid cyst had been done by prof. Dr. Thamar Ahmed Hamdan. Other case was sciatic nerve palsy after an anal surgery that may be due to compression effect of lethiotomy position. About associated injury firstly the fracture of shaft femur was the predominantly one and that is make the management so difficult because the interference between treatment of fracture and treatment of N. injury that may need approximation or change position of neighbor joint. as in table number (4). Vascular injury is 2nd one and which need rapid evaluation and resuscitation by plasma expenditure and blood transfusion with referring of patient to vascular department in AL – Saddar teaching hospital Dislocation of hip joint was 3 cases that need emergency reduction of joint and skeletal traction for about 4 wks. as in table number (4).

Examination of patient was so difficult because
1. Most of the patients were un – cooperative and some of them criminal persons, other exaggerate his complaint,

some try to cheated you, and most of patients were uneducated.
2. Facilities that available in our hospital not enough.
3. Experience of evaluation of patient by a doctor was not enough Specially at beginning of study.

What about treatment of injury?

General management and operative technique in sciatic nerve injury should be as following

1. Early aggressive mobilization of the involved limbs.
2. Vigorous physiotherapy.
3. Administration analgesia and other medications such as (tegretol) and / or tricyclic antidepressants for pain control some time narcotics are indicated.
4. a complete or very serious deficit in one or both of the two divisions that failed to improve spontaneously over the course of a few months indicated the need for operation.
5. Partial deficit usually improved with time and did not require surgery.
6. Severe pain that did not respond to pharmaceutical treatment was usually an indication for surgery, even if loss function was partial.
7. gluteal muscle power loss was unusual unless there was proximal, penetrating wound or concomitant pelvic plexus involvement [6].

The major branches to these muscle exit separately through the sciatic notch but adjacent to the sciatic N. Management of our patient was according to the age of patient, type of injury, mechanism of injury, site of injury and time of presentation with associated injury. Conservative treatment trial with 9 patient 21%, And plaster of Paris used with 3 children, analgesia, NSAID and some sort of Antidepressant which used in addition to rest, the result was encourage, but some patient not respond to conservative treatment and shifted for surgical exploration. In our study most of patients are subjected for surgery in the form of external neurolysis, internal neurolysis, repair injured part, repair of the complete nerve transection with mobilization of neighbor joint, release both ends of nerve. 33 (79%). For sequel of this injury, 2 cases of tendon transfer (Tibialis posterior) transfer to dorsum of foot.3 patient suffering of major causalgia and not responding to conservative or surgical release of nerve, lumbar sympathectomy by prof. Dr. Thamar Ahmed Hamdan has been done, 2 patients respond very well and 3rd one whose psychological unstable response was less than other. The time of surgery that done for our patients is much earlier (3 – 5 months) that what present in other studies and no. of patient that subject to surgical procedures are much more than the conservative treatment [7].

Table 1: Age group

Age / year	0 – 10 y	11 - 20 y	21-30 y	31-40 y	41-50 y	51-60 y	> 60
Number of patiets	3	9	13	6	4	4	3

Table 2: Site of injury

Gluteal region		Thigh region	
Right / 10	Left / 4	Right / 13	Left / 15

Table 3: Patterns of injury

Mechanism	No.	%	
I. Missile injuries	28	67%	67% of cases
High velocity	26	62%	1. lethiotomy position
Low velocity	2	5%	2. Hydatid cyst of sacrum
II. Iatrogenic (injection)	7	17%	
III. Road traffic accident	3	7%	
IV. Fall from high	2	5%	
V. Compression	2	5%	

Table 4: Associated injuries

Item	No	%
Vascular injury	3	7%
Abdominal injury	1	2.5%
Head injury	0	0
Fracture of femoral shaft	15	36%
Dislocation of hip joint	3	7%

Table 5: Nerve division injury

Common peroneal nerve	Tibial nerve	Combined
18	2	22

Table 6: Modalities of treatment Conservative 9 21%

Modality of treatment	No.	
. Rest	9	Most of patients need combination of treatment as rest, analgesia, NSAID and Follow up.
. Analgesia	9	
. NSAID	8	
. Narcotic	4	
. Antidepressent	3	
. Plastar of Paris	3	
. Follow – up	9	

Table 7: Operative 33 79%

Modality of operations	No.	
External Neurolysis	4	10%
Internal Neurolysis	2	5%
Partial nerve repair	11	26%
Complete transsection repair	6	14%
Tendon transfer	3	7%
Lumbar sympathectomy	3	7%
Excision of Hydatid cyst	1	3%
Vascular repair after repair	3	7%

Conclusion and Recommendation

Lesions involving the sciatic nerve comprise the largest as well as a very important cripple affection of lower limbs.

Incidence of injuries increase during the last 2 years and very high comparism with other country, and it more than incidence of poliomyelitis with more damage.

Our recommendation for good management for this challenging problem in our locality.

1. Proper evaluation regarding full physical examination and investigation to all the patients.
2. Preparation of a theater that fully equipped by most of the facility that are needed for neurosurgery of the peripheral nerve injury like loupes, surgical microscopes, and other special instruments.
3. The preparation of electrical instruments for the nerve action potentials intra – operatively and other measures for the out and inpatient study of nerve tissue.
4. The need for specialized center or specialized department included within the orthopaedic department for the surgery of the peripheral nerve injury and not referring any cases under any circumstance.
5. Increase knowledge and care about nerve injury because the incidence of injury is very high at time being in our locality.
6. A minimum follow – up period should be at least three years.

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