Peripheral Nerve Injury

Peripheral nerves are bundles of *axons* conducting efferent (motor) impulses from cells in the anterior horn of the spinal cord to the muscles, and afferent (sensory) impulses from peripheral receptors via cells in the posterior root ganglia to the cord. They also convey sudomotor and vasomotor fibres from ganglion cells in the sympathetic chain. Some nerves are predominantly motor, some predominantly sensory; the larger trunks are mixed, with motor and sensory axons running in separate bundles.

Pathology and Classification:

Nerves can be injured by ischaemia, compression, traction, laceration or burning. Damage varies in severity from transient and quickly recoverable loss of function to complete interruption and degeneration. There may be a mixture of types of damage in the various fascicles of a single nerve trunk.

Seddon described three different types of nerve injury (*neurapraxia*, *axonotmesis* and *neurotmesis*) served as a useful classification for many years. Increasingly, however, it has been recognized that many cases fall into an area somewhere between axonotmesis and neurotmesis. Therefore, ***Sunderland*** classification (1978) more practical.

Neurapraxia

It is a reversible physiological nerve conduction block in which there is loss of some types of sensation and muscle power followed by spontaneous recovery after a few days or weeks. It is due to mechanical pressure causing segmental demyelination and is seen typically in crutch palsy, pressure paralysis in states of drunkenness *('Saturday night palsy'*) and the milder types of tourniquet palsy.

Axonotmesis

This is a more severe form of nerve injury, seen typically after closed fractures and dislocations. The term means, axonal interruption. There is loss of conduction but the nerve is in continuity and the neural tubes are intact. Distal to the lesion, and for a few millimetres retrograde, axons 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.These axonal processes grow at a speed of 1‑2 mm per day.

Neurotmesis

It means division of the nerve trunk, such as that which occurs in an open wound(e.g:bullet or knife injuries), if the injury is more severe, whether thenerve is in continuity or not, recovery will not occur.

As in axonotmesis, there is rapid wallerian degeneration, Even after surgical repair, many new axons fail to reach the distal segment, and Function may be adequate but is never normal.

Signs and Symptoms:

Peripheral nerve injury may result in some of the following symptoms depending on the severity and extent of injury:

- Pain.
- Numbness or Loss of sensation.
- Muscle weakness.
- Paralysis of some or all of the muscles of the limb.

Diagnosis:

Due to the complex spectrum of peripheral nerve injuries, a detailed and comprehensive understanding of the exact nature of injury in each patient is required for proper management.

Multiple modalities are utilized to diagnose a Peripheral nerve injury including:

- History and clinical examination
- Electrodiagnostic studies (EMG, Nerve conduction study)
- Imaging studies (X-rays, CT, MRI)

Some of these evaluations may need to be repeated on a regular basis to track the progression of recovery of function, including information about the severity of the injury and prognosis.

Treatment:

Treatment depends on several factors including the severity of injury, the type of injury, the length of time since the injury and other existing conditions and it includes:

Conservative Treatment:

Nerves that have only been stretched may recover without further treatment. Physical therapy is required to keep the joints and muscles working properly, maintain the range of motion, and prevent joints stiffness. There is a role for *transcutaneous electrical nerve stimulation* (TENS) to stimulate nerve recovery.

Surgical Treatment:

The healing process sometimes forms scar tissue that must be removed surgically to improve the nerve's function. Surgical repair is often required for nerves that have significant surrounding scar tissue or that have been cut or torn.

Surgical treatments include :

Nerve exploration

Closed low energy injuries usually recover spontaneously and it is worth waiting until the most proximallysupplied muscle should have regained function.Exploration is indicated:

(1) if the nerve was seen to be divided and needs to be repaired;
(2) if the type of injury suggests that the nerve has been divided or severely damaged; (e.g. a knife wound or a high energy injury).
(3) if recovery is inappropriately delayed and the diagnosis is in doubt.

Vascular injuries, unstable fractures, contaminated soft tissues and tendon injuries should be dealt with before the nerve lesion.

Primary repair is best done as soon as this can be feasible during wound toilet and delayed repair i.e. weeks or months after the injury, maybe indicated.

Nerve grafting

Free autogenous nerve grafts can be used to bridge gaps too large for direct suture. The sural nerve ismost commonly used; up to 40 cm can be obtainedfrom each leg. Because the nerve diameter is small, several strips may be used (cable graft). Vascularized grafts are used in special situations.

Tendon transfers

Motor recovery may not occur if the axons, regenerating at about 1 mm per day, do not reach the muscle within 18‑24 months of injury. This is most likelywhen there is a proximal injury in a nerve supplying distal muscles. In such circumstances, tendon transfers most of the time is considered.

Care of paralysed parts

PROGNOSIS:

The prognosis is depends on the following factors:

Type of lesion Neurapraxia always recovers fully;axonotmesis may or may not; neurotmesis will not unless the nerve is repaired.

Level of lesion The higher the lesion, the worse the prognosis.

Type of nerve Purely motor or purely sensory nerves recover better than mixed nerves, because there is less likelihood of axonal confusion.

Size of gap.

Age Children do better than adults. Old people do poorly.

Delay in suture This is a most important adverse factor.The best results are obtained with early nerve repair. After a few months, recovery following suture becomes progressively less likely.

Associated lesions Damage to vessels, tendons and other structures makes it more difficult to obtain recoveryof a useful limb even if the nerve itself recovers.

Surgical techniques Skill, experience and suitable facilities are needed to treat nerve injuries. If these are lacking, it is wiser to perform the essential wound toilet and then transfer the patient to a specialized centre.

Complications:

Given enough time, many peripheral nerve injuries heal with no lasting damage. But some injuries can cause temporary or permanent problems include:

- **Stiff joints.**
- **Pain.** This results from nerve damage and may become chronic.
- **Loss of feeling.**-neuropathic ulcer.
- **Muscle atrophy.**
- **Permanent disability.**
- **Deformities.**