

# OH NO! WHAT TO DO!!....

## A GUIDE TO SUSPECTED POST BLOCK NEUROLOGICAL INJURY

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### Introduction

Neurological deficit after peripheral nerve block (PNB) is a function of multifactorial aetiology ranging from patient's factors, surgical technique and factors related to the procedure itself<sup>1</sup>. Some of the identified possible factors that can lead to nerve injury are those from direct mechanical or chemical nerve insult. Mechanical trauma include direct nerve injury from inadvertent needle puncture or impalement<sup>2</sup>, pressure/hydrostatic effects of local anaesthetic injection or ischemic, from haemorrhagic compression of the fascicles or the use of epinephrine causing vasoconstriction of vasa nervorum<sup>1,3</sup>. Various prior studies have also implicated varying potential degrees of chemical neurotoxicity in several commonly used local anaesthetic solutions and its adjuvants in vitro<sup>4-8</sup>. It has to be noted however, that most of the knowledge on the possible causes of nerve injury were obtained from animal experiments and cut cadaveric human nerve specimens making its interpretation in relation to actual clinical practice difficult to equate<sup>1,2</sup>.

### Incidence

The incidence rate of neuropathy after Peripheral Nerve Blocks (PNB) is generally estimated to be around 0.9 to 18 per 1000 block cases with different rates quoted for different block approach.<sup>9,10</sup> Fortunately, permanent neurological injury after PNB is rare in contemporary anaesthetic practice with even lower incidence of permanent damage.<sup>11</sup> Auroy's landmark study in 1999 yielded the oft-quoted risk of 1:4185 for a neurological deficit attributable to the block – and 1:7175 for a deficit lasting more than 6 months,<sup>12</sup> Barrington et al.'s more recent study suggests marginally higher risks of 1:2300 and 1:3578,

respectively.<sup>13</sup> However, the incidences quoted were mixed PNB techniques ranging from landmark-based to peripheral nerve stimulators and ultrasound guidance.

### **What to do if there is prolonged neural block?**

It has always been strongly stressed upon that all post block patients is to be followed up for periodic quantitative or qualitative assessments of post-operative analgesia. Apart from monitoring block regression within these parameters, the extent and the return of motor function must be ensured especially in limb blocks. Persistent sensory and motor deficit beyond the expected duration of a given local anaesthetic load is an ominous sign and prompt management is prudent. This should herald the first suspicion of neurological injury and subsequent management would have a low threshold for such.

Patients who are suspected to have neurologic injury are expected from criteria such as, but not limited to;

- Received nerve blocks/regional as either analgesia or as sole anaesthetic technique.
- Received Local Anaesthetic (LA) or its adjuvants.
- Received a known load of LA agents with symptoms persisting beyond the expected duration of action for such loads.
- Symptoms or distribution of deficits are consistent with anatomical distribution of specific nerves or regions (dermatomes, myotomes or osteotomes) consistent with the location of the given block.
- Neurological symptoms may be persistent or evolve to include

adjacent distributions which, was not present prior to post block assessment or involves worsening grades of neurologic deficit as compared to baseline.

#### **What are our further plans of action?**

#### **Management of Peripheral Nerve Injury (PNI)**

Management of patients with suspected nerve injury would involve;

- a) History taking
- b) Physical Examination and neurological assessment
- c) Investigation

#### **History taking**

Ensuring tactful communication from the beginning is important as this would help in subsequent care of the patient, in terms of relieving anxiety secondary to reduced function and also to instill trust in helping patients to better understand subsequent course of disease and requirements of management.

History taking also needs to involve further investigation into the perioperative procedural events with detailed information from the staff who performed and assisted in the blocks, looking through the various forms of block documentation or saved images of the said block, also the surgeons and surgical notes for any possible reasons for the observed deficits encountered.

Points of note that would need further clarification include, but not exclusive to;

#### **a. Preexisting diseases**

Presence of underlying prior neurological deficit, Diabetes Mellitus with neuropathy or whether patient is on anticoagulation or antiplatelet therapy.

#### **b. Pattern and grades of encountered neurological deficit**

Whether there is a presence of sensory deficit only, for example numbness, paresthesia or dysesthesia or concomitant motor weakness. Is there a mixed sensory and motor deficit pattern or whether there is association with pain? Evolving symptoms or grades of symptoms are danger signs that would require prompt intervention.

#### **c. Questions related to the actual block procedure**

The **type of block** given – whether there was any difficulty encountered during block procedure.

Was the block performed **under ultrasound guidance** or using landmark technique?

Was **nerve stimulator used** and what were the modes and settings? If it was used, what was the threshold current before LA injection?

Whether the patient was **under general anaesthesia** or heavily sedated during the block performance?

What was the **image quality of both the target nerve and needle**?

Was there an inadvertent **intra-neural** injection? Any saved still images or videos can substantiate this and can be reviewed. Did the patient **complain of paresthesia** during block?

#### **d. Type of local anaesthetic (LA) used.**

**Type of LA** used whether short or intermediate to long acting, and what was the anaesthetic load- concentration and volumes?

**Any mixing** of LA?

If there was mixing of LA what was the volume and final concentration?

Usage of **adjuvant** whether with or without vasopressors?

#### **e. Questions related to the surgical procedure.**

Was the **surgery difficult**?

**Any neural complication expected** from the surgery; from surgical manipulation or traction or expected nerve oedema?

Was **tourniquet** used and what was the pressure and duration of tourniquet used?

**Abnormal limb position** during surgery?

Was **excessive traction** applied to the limb?

Usage of **cast** postoperatively?

**Post-operative monitoring** of the blocked limb- for limb compartment syndrome, for example when indicated

### Physical examination

The aim is to ascertain the pattern and grades of neural deficit present whether there is mono or polyneuropathy. This is to give some indication as to the most likely probable site of neural injury. Assessment would involve clues from general inspection and also through specific evaluation tools of grades of neuropathy.

### **General Inspection**

Whether there is any hematoma at the block site.

Look for clues like abnormal posture or position of the limb for example clawing of hand (median or ulnar claw).

Check for scar, skin changes and muscle wasting or signs of reflex sympathetic dystrophy.

**Specific assessment** of motor power and sensory testing must be done to provide grading of neurological severity at baseline and also a basic level for which future assessment scoring can be compared against to evaluate progression.

**Motor power** - Assess the force of the muscles against the Medical Research Council (MRC) scale:

- 0; no movement
- 1; flicker of movement
- 2; moves with gravity eliminated

3; moves against gravity but not resistance

4; reduction of movement against resistance

5; full muscle power

Using upper limb dermatomes as an example, specific score for each dermatome can be allocated based on the assessment;

- o Shoulder abduction – C5
- o Elbow flexion – C5, C6
- o Elbow extension – C7, C8
- o Wrist flexion – C7
- o Wrist extension – C7
- o Intrinsic muscles of hand e.g. finger ab/adduction – T1

Alternatively, a composite scoring for muscle groups can also be used and compared with the post-block baseline scores as an indicator of block regression.

### **Sensory testing**

Dermatomal skin testing should be done using a standardized temperature and pain stimuli. Effort must be made to map area of deficiency and elucidate whether the sensory deficit correlates with specific root / nerve dermatomal distribution.

### Investigation

Diagnosis or suspected presence of neural injury are mainly based on clinical grounds, but certain investigative tests may be considered to further evaluate the extent of injury. Two aspects of importance would be to ascertain the **SEVERITY** and **LEVEL** of nerve damage.

Severity of injury affects the prognosis and is primarily determined by the residual integrity of the axons, classified into neuropraxia, axonotmesis and the most severe form, neurotmesis.<sup>14</sup> Tests to be done would depend on the benefits of the various modalities whether a structural or

functional cause is suspected. Available tests would include;

1) MRI – Referral to radiologist and discussion regarding the urgency and capability of appropriate radiological investigation to aid diagnosis process depending on the nature of suspected injury. MRI nerve setting would be an appropriate test if a structural type of injury is suspected.

2) Electro-neurodiagnostic tests - Nerve conduction study (NCS) and electromyography (EMG) are two important functional tests. Besides obtaining information on the severity of the nerve lesion, these tests would also be able to pin-point the level of insult based on the recorded amplitude and velocity changes obtained. A neurologist / neurophysiologist consult for these tests is required and more often than not it is done after 4 to 6 weeks, as the neurophysiological changes are more distinctly defined after this period.

### **Principles of Management;**

#### **A suggested approach**

When faced with the dilemma of whether there is an occurrence of PNI, the attending anaesthetist must have answers to these questions;

- Should there be a **resolution of block** at this point of contact?
- Is there any **presence of evolving neural signs or symptoms**?
- Are the symptoms and signs present **persisting beyond the expected duration of the known load of LA and its adjuvants**?
- Is the deficit **reversible**?
- Is there any **motor component** present?

Objective **resolution of block** is the ideal end-point that we should strive for, but in real practice, it is made difficult by the various inter and intra-individual pharmacologic variability in clinical response that we routinely encounter. Hence, routine periodic audit of practice is of importance to highlight the spectrum and patterns of clinical behaviour of the various loads of LA and its adjuvants towards the multitudes of surgical procedures that we perform. A **persisting block that extends beyond the predicted duration of the concerned load of anaesthetic**, should provide a warning sign of impending injury.

In an acute setting if there is presence of **evolving neural deficit or the presence of weakness**, a remediable cause must be identified early, for example a tight cast/dressing, or an expanding hematoma compressing on the nerve. In the presence of such aetiology, always have a low index of suspicion and seek urgent surgical and neurology consult.

When there is a suspected neuropathy –

#### 1. Sensory only

If the deficit involves **sensory** component only and is resolving during the period of observation, conservative management is the mainstay of therapy. Patients need to be explained regarding course of disease if not already being done during earlier point of contact. Counselling and assurance need to be re-enforced. A large majority of signs and symptoms will resolve within 6 months in 95% of patients with neuropathy and 99% will usually resolve within a year. Fortunately, permanent deficit is rare.

#### 2. with motor involvement

If there is associated **motor deficit**, there must be an urgent referral made to radiologists (referral for radiological investigation), neurologist or neuro-

physiologists to determine whether there is a structural or physiological basis for the extent of injury. Further consultation with neurosurgeon / hand and microsurgery surgeon are also indicated if there is any evidence of possible surgical reversibility.

3. Treat **neuropathic pain early and aggressively** when present.
4. **Rehabilitative therapy** must be instituted as early as possible to help reduce secondary functional restriction as a result of disuse myopathy or fixed deformity.

#### Follow up management

Management at subsequent follow-up would have to be an extension of prior pillars of therapy.

- There should be an objective **ongoing assessment of neuropathy**.
- Tinnell sign is a clinical tool used to estimate progression of nerve recovery.
- **Physiotherapy/ Occupational therapy** referral, if not already done at an earlier point of contact.
- **Review investigation findings** (MRI, NCS/EMG) to confirm severity and the level of lesion to **prognosticate recovery**.
- **Splinting** of the affected limb to avoid further complications related to

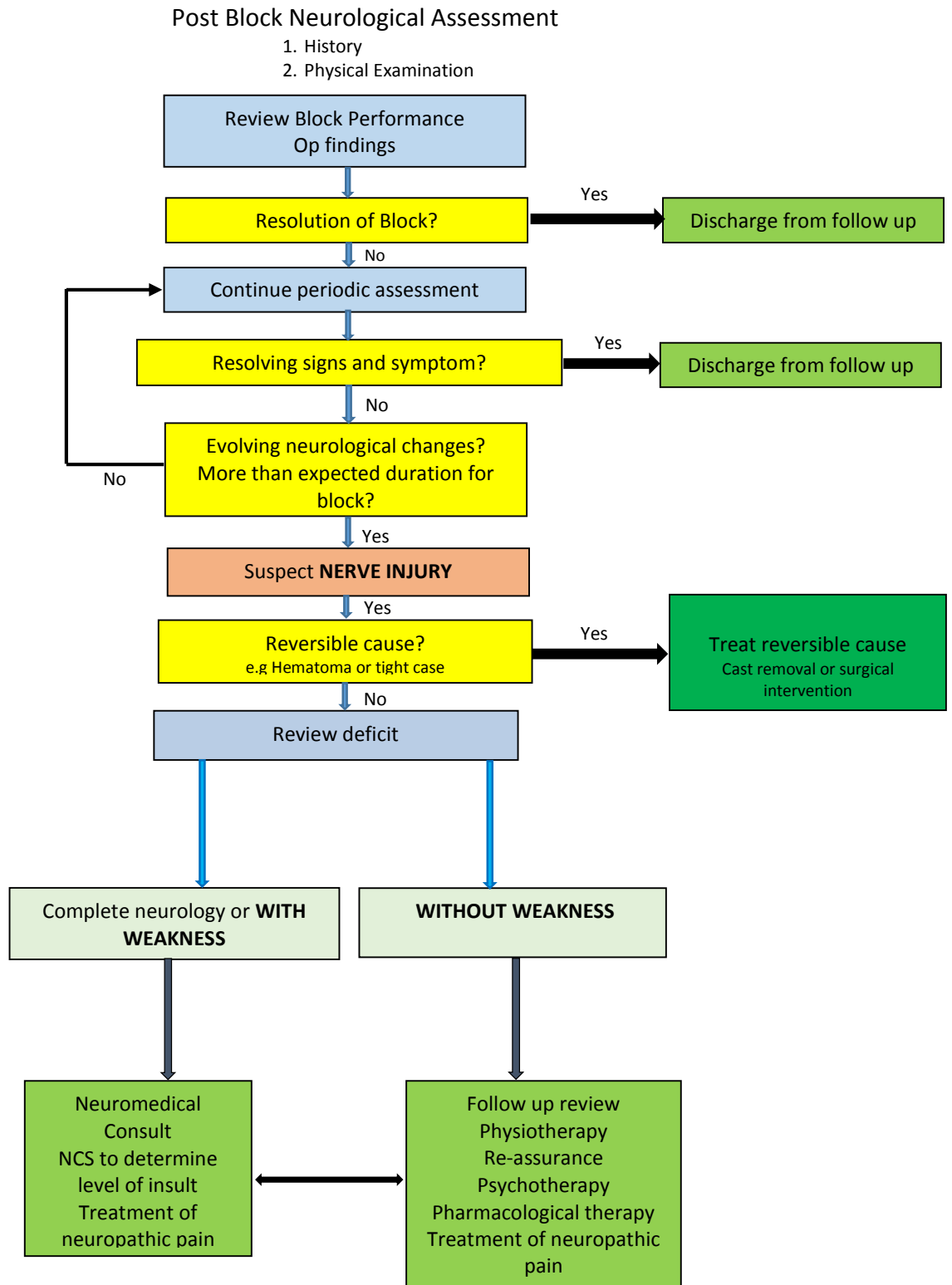
primary pathology may be required; for example avoidance of foot-drop or immobilization to reduce neuropathic pain due to reflex sympathetic dystrophy.

- **Review of neuropathic pain and symptoms**. Escalation of therapy may be required if existing analgesic modality is inadequate. Multimodal treatment using various groups of available analgesic drugs may be required depending on severity of symptoms.
- Prescriptions of **vitamins** for example neurobion or methylcobalamin may be controversial.

#### **Conclusion**

Periodic objective neurological assessment and early detection are the core fundamentals in managing suspected PNI. Its aetiology may be multifactorial and establishing a cause requires systematic evaluation, hence the need for a formalized guideline on principles of management based on current understanding. Neuropathy may not be totally eradicated but should it occur, therapeutic and supportive treatment must be instituted responsibly and with empathy. Medico-legal implications may ensue, but managing the patient should always be prioritized, whatever the consequences.

# ALGORITHM FOR SUSPECTED POST PERIPHERAL NERVE BLOCK NEUROLOGICAL DEFICIT



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