NEUROVASCULAR ASSESSMENT

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- Neurovascular assessment includes the assessment of the peripheral circulation and the peripheral neurologic integrity. Neurovascular impairment is usually caused by pressure on the nerve or altered vascular supply to the extremity.
- Delayed recognition of neurovascular compromise can result in permanent muscle and nerve damage.
- Always compare affected limb with unaffected limb when assessing neurovascular status. Take into account child's history, e.g. Spina Bifida or existing nerve damage.
- Neurovascular observations are taken hourly for 24 hours, 4 hourly thereafter unless clinically indicated or specified by treating team. Increase frequency to half hourly if deficit identified.
- Altered neurovascular status requires written documentation in the child's medical records and immediate notification to the orthopaedic registrar.
- Compartment syndrome is considered an Orthopaedic emergency. Signs and Symptoms of compartment syndrome include: pain, paraesthesia, pressure, pallor, paralysis and pulselessness. Elevate limb at the level of the heart and keep child nil by mouth.
- Any complaints of increasing pain, especially on passive stretch and unrelieved by analgesia must be reported to the orthopaedic/treating team registrar immediately. If unavailable, contact VMO.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1st April 2022	**Review Period**: 3 years
Team Leader:	Clinical Nurse Consultant	**Area/Dept**: Orthopaedics

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CHANGE SUMMARY

- Removed spinal surgery because spinal observations are different from neurovascular
- Added additional criteria for neurovascular observations; added after cardiac catherisation.
- Corrected management for compartment syndrome from 'elevate limb above the heart' to 'elevate limb at the level of the heart'
- Moved 1.1 Peripheral Neurologic Integrity to 1.3 in order of assessment
- Added to Documentation and communication: Any neurovascular deficit, nurses should perform a neurovascular assessment together at bedside during handover.
- Neurovascular is considered a basic nursing skill that does not require any clinical skill assessment. Education and assessment as per individual department.

READ ACKNOWLEDGEMENT

- Medical and Allied Health staff are to read the document.
- All nursing staff are to read and acknowledge they understand the contents of this guideline.

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Definition

Neurovascular assessment includes the assessment of the peripheral circulation and the peripheral neurologic integrity. Neurovascular impairment is usually caused by pressure on the nerve or altered vascular supply to the extremity. [5,7]

Rationale

To ensure that neurovascular status of the child is not compromised, and prevent permanent damage to the affected limb, thus promoting maximal healing. Delayed recognition of neurovascular compromise can result in permanent muscle and nerve damage. [1,5]

Criteria for Neurovascular Observations

Neurovascular observations are performed when the following occur:

Trauma to an extremity

- Fractures – hourly observations
- Crush injuries – hourly observations

Application of traction

- Hourly observations for 24 hours
- Bucks traction requires 6 hours of observation.

Application of plasters/back slabs

- Hourly observations for 24 hours, then observations to continue every 4 hours for duration of cast in situ
- Note: If a cylindrical immobiliser/cast is in-situ, then neurovascular observations should continue to occur every 4-6 hours while the child is in hospital.
- Note: For discharge patients, monitor neurovascular observations hourly. Contact the orthopaedic team to review the patient prior to discharge and educate parents on monitoring neurovascular status for the remaining 24 hours.

Post operatively

- Application of External fixation device
- If tourniquet applied in theatre for over 20 minutes
- Hourly observations for 24 hours.

Burns patient

- Hourly observations, Doppler to be used to check pulses. Cardiac Catheterisation
- Hourly observations, and wound checks for 24 hours. (refer to 3.3 vascular injuries)

Interstitial oedema of limbs/massive intravenous fluid infusion

- Hourly for 8 hours, then second hourly for 24 hours, then fourth hourly up to 60hrs.

Prolonged immobility, Envenomation & Anticoagulant therapy

- Hourly for 8 hours, then second hourly for 24 hours, then fourth hourly up to 60hrs.

1 General Principles - Neurovascular Assessment

Neurovascular observations are taken hourly for 24 hours; 4 hourly thereafter unless clinically indicated/specified by treating team. Increase frequency to half hourly if deficit detected. If unable to assess due to plaster cast/dressings please consult with treating team and where possible monitor other clinical signs e.g. pain and sensation.

Patients who are not admitted for duration of recommended frequency of assessment are exempt from frequency outlined above. However, patients must be provided written information/instructions about neurovascular compromise prior to discharge. [1, 4,10]

Always compare affected limb with unaffected limb when assessing neurovascular status. Take into account child's history, e.g. Spina Bifida or existing nerve damage.[4, 10,9,10]

1.1 Pain

- Assess patient's level of pain using appropriate pain scale for age.
- Pain is a crucial indicator that there is a potential problem associated with a child's neurovascular status. Be alert if the pain experienced by the child is out of proportion to the injury. [2, 3, 6,7,11]
  Increasing need for analgesics for pain management is an indicator of possible compartment syndrome. [2,3,6,7,11]
- Record pain at rest and whether there is pain on active or passive movement. Pain that is greater on passive extension and flexion of an extremity should be further investigated. [2,3,6,7,11]

1.2 Peripheral Vascular Integrity

Parameters	Normal	Inadequate Arterial Supply	Inadequate Venous Return
Colour	Pink (natural)	Pale or white	Blue, mottled
Temperature	Warm	Cool	Hot
Capillary refill	1-2 seconds	>2 seconds	Immediate
Swelling	Full	Hollow or prune like	Distended or tense, tissues feel hard
Pulses	• Check for presence of peripheral pulses, especially children with fractures involving the elbow • If pulses are not palpable due to plaster casts, assess closely above parameters. • If pulse is not present, document and notify medical officer, observe colour, capillary refill and temperature.		

Table adapted from and cited in Maher, A.B., Salmond, S. W., & Pellino, T. A. 2002. Orthopaedic Nursing. 3rd edition. Chapter 8. p.200. W.B. Saunders, Philadelphia.

1.3 Peripheral Neurologic Integrity

Upper Extremities

Sensation Function		Movement Function	
Radial Nerve: Able to feel touch with the 1st web space of the hand, between the thumb and index finger.		**Radial Nerve:** Able to hyper-extend thumb and fingers.	
Ulnar Nerve: Able to feel touch at the anterior and posterior aspects of the little finger and mid-ring finger, down to the palm and dorsum aspect of the hand.		**Ulnar Nerve:** Able to abduct all fingers, especially little finger.	
Median Nerve: Able to feel touch at the distal aspects of the thumb to mid-ring finger. Sensation should also be present on the surface of palm, extending to the thumb and mid-ring finger.		**Median Nerve:** Able to oppose thumb and small finger and flex wrist.	

Table adapted from and cited in Schreiber, M. L. 2016. Neurovascular Assessment: An Essential Nursing Focus. Medsurg Nursing. Vol. 25 (1). 55-57.

Anterior Interosseous Nerve: Injury is associated with extension-type supracondylar fractures. The child should be able to flex the interphalangeal joint of the thumb.

Lower Extremities

Sensation Function		Movement Function	
Peroneal Nerve: Able to feel touch on dorsal aspect of foot (1st web space for deep peroneal nerve).		**Peroneal Nerve:** Able to dorsiflex ankle and extend toes at the metatarsal phalangeal joints.	
Tibial Nerve: Able to feel touch at the medial and lateral surfaces of the sole of the foot.		**Tibial Nerve:** Able to plantar flex ankle and toes.	

Table adapted from and cited in Schreiber, M. L. 2016. Neurovascular Assessment: An Essential Nursing Focus. Medsurg Nursing. Vol. 25 (1). 55-57.

Important notes on movement and sensation of an extremity

- Active Movement: able to voluntarily extend and flex an extremity, digit.
- Passive Movement: parent/nurse/doctor is able to extend and flex an extremity, digit
- A child should be able to demonstrate active movement of an extremity
- If a child has increased pain on passive extension or flexion of fingers or toes, this **may indicate compartment syndrome**. [2,6,11]
- Not all children can verbally express variations in sensation, such as numbness and pins and needles and pain. When assessing neurovascular parameters closely monitor pain, on **passive** flexion and extension of upper and lower extremities. Observe the colour, warmth and swelling, of limb. Involve the parents/carers in the assessment process; they are more familiar with the child's/infants responses to pain. Always compare the affected limb with the other limb. [3]

2 Documentation and Communication

- Neurovascular observations are documented in eMR as required on the Neurovascular electronic chart.
- Documentation of the child's neurovascular status needs to be also described in the child's medical records
- Altered neurovascular status requires written documentation in the child's medical records and immediate notification to the orthopaedic registrar.
- Any neurovascular deficit, nurses should perform a neurovascular assessment together at bedside during handover. [6,7]

3 Complications

3.1 Compartment Syndrome

Definition:

Compartment Syndrome is an increase of pressure within a muscle compartment, there is an increase of interstitial pressure within the osseofascial compartments. If the pressure is not relieved, necrosis of the soft tissues will occur, leading to permanent contracture deformities.[2,3,6,7]

Signs and Symptoms of Compartment Syndrome

- **Pain:** not relieved by simple analgesics (non-narcotic) and excessive pain on passive extension and flexion of extremity [2,3,6,7]. Narcotics can mask pain from compartment syndrome. This should not preclude appropriate analgesia, but rather indicate a need for a higher index of suspicion.
- **Paresthesia:** abnormal sensations e.g., numbness, tingling of extremity [2,3,6,7]
- **Pressure:** skin is tight and shiny, pressure in muscle compartment is greater than 30-40mmHg (pressures are measured in theatres) [2,3,6,7]
- **Pallor:** can indicate an arterial injury and is a late sign [2,3,6,7]
- **Paralysis:** caused by prolonged nerve compression or muscle damage and is a late sign [2,3,6,7]
- **Pulselessness:** Can indicate death of a tissue, check general colour of the extremity[2,3,6,7]

Management

- Do not elevate limb above the level of the heart [2,6]
- Notify orthopaedic medical staff for urgent review.
- Split plaster cast / backslab or full plaster
- Place child on Nil By Mouth [2,6]
- Temporarily cease narcotic infusion to assess neurovascular status especially flexion and extension of extremity.
- Orthopaedic Team to complete theatre booking for measurement of muscle compartments and or fasciotomy

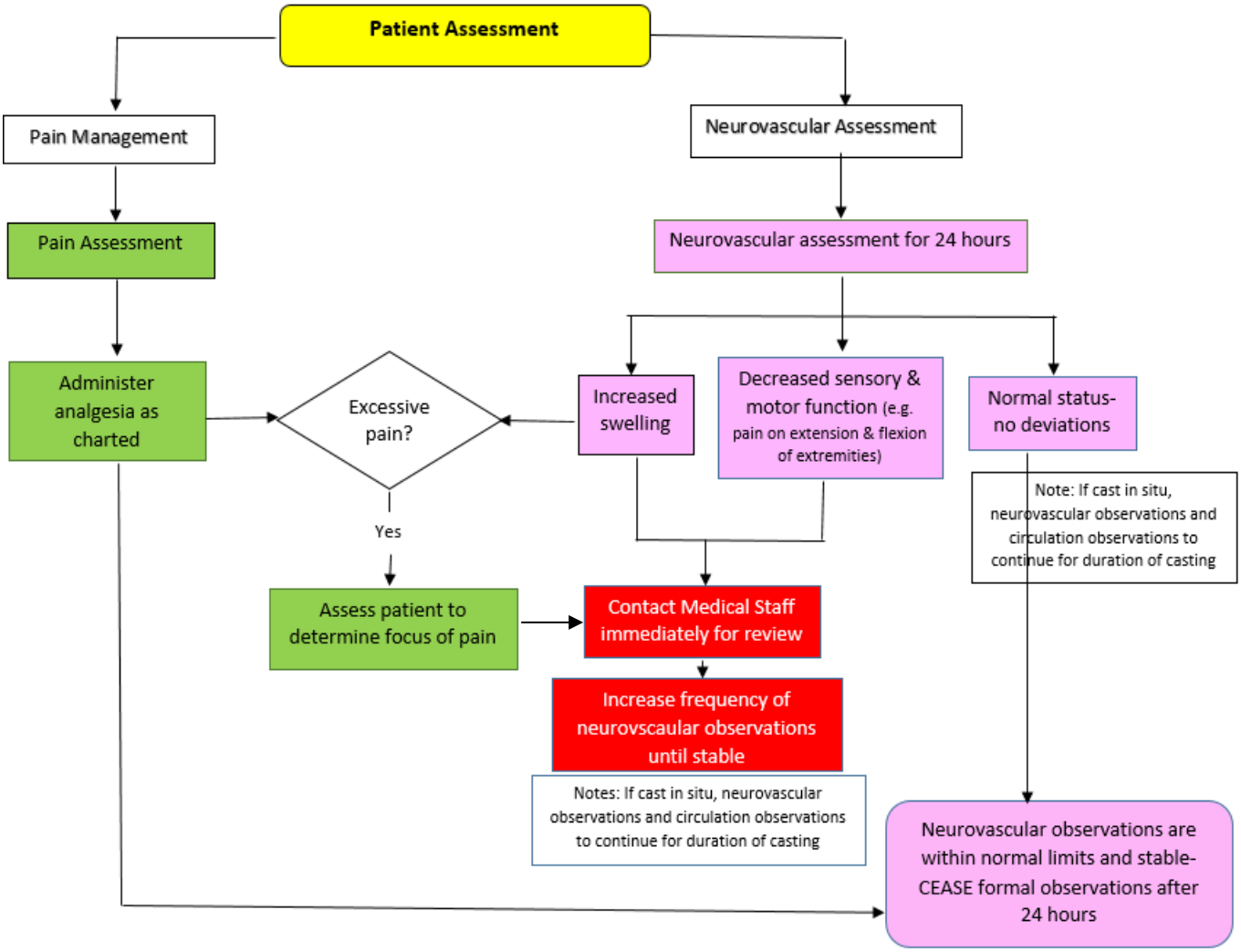
3.2 Peripheral Nerve Injury

- Can result from fractures, and insertion of hardware such as pins and wires that have the potential to stretch or sever the nerve. [4]
- Fractures to the elbow can frequently affect nerve function. The anterior interosseous nerve is the most common nerve injured with extension type supracondylar fractures.[4]
- Most peripheral nerve injuries will improve over an 8 to 12 week period. [4]
- Close monitoring of a nerve injury in outpatients is required. If nerve function does not improve within 8 to 12 weeks a nerve conduction study needs to be performed. [4]

3.3 Vascular Injuries

- Can result from severely displaced fractures. [4]
- Ischemic limbs associated with fractures require immediate closed reduction to remove tension on the neurovascular structures, usually circulation to the limb is restored. [2,4]
- If circulation does not return the child needs to be taken to theatres for fracture stabilisation and vascular exploration.[2,4]
- Revascularisation should be achieved within 6 to 8 hours. [7]
- Vascular complications can occur after cardiac catheterization, to the lower extremities. The site of the catheter needs to be checked 15 minutely for the first hour post operatively and neurovascular assessment performed hourly for 24 hours.
- In the occurrence of a pulseless limb, a Doppler may be used to identify a pulse. The Doppler is located in Todman recovery and Orthopaedic Ward at CHW and at SCH, Paediatric Recovery and CICU should it be required.

Management of orthopaedic patient post-operatively/ post injury



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Further Information

- NAON: Blogs Free to View – NAON's Neurovascular Assessment Video. Link: http://www.orthonurse.org/p/bl/et/blogaid=805