

NEUROVASCULAR ASSESSMENT

PRACTICE GUIDELINE[®]

DOCUMENT SUMMARY/KEY POINTS

- Definition of neurovascular assessment
- Criteria for neurovascular assessment
- The general principles of neurovascular assessment to upper and lower extremities:
 - Sensory function
 - Motor Function
 - Pain
 - Swelling
 - Capillary refill
 - Presence of peripheral pulses
 - Temperature
 - Colour
 - Muscle Strength
- Documentation
- Potential complication associated with peripheral circulation and peripheral neurologic integrity
- Management of neuromuscular impairment

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1 st January 2019	Review Period: 3 years
Team Leader:	Clinical Nurse Consultant	Area/Dept: Orthopaedics

CHANGE SUMMARY

- CHW Neurovascular Observations Practice Guideline updated and converted to a SCHN Practice Guideline.
- Reference List updated.
- Slight change to Flow chart: added arrow to highlight pain assessment.

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.
- Nursing staff are to complete the neurovascular competency assessment prior to caring for patients that require neurovascular observations. Completion of competency assessment is to be entered into the staff transcript in HETI.
- At CHW, in-services are provided regularly for areas such as ED.

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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. ^{1,2}

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. ^{1,2,3}

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.

Spinal surgery

- Hourly observations for 48 hours. Then every 4 hours until discharge.

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)

Note: Neurovascular observations are taken hourly for 24 hours, however the child needs to be monitored until the stability of the extremity is attained and maintained. ^{1,2,3}

1 General Principles - Neurovascular Assessment

Note: Always compare affected limb with unaffected limb when assessing neurovascular status. Take into account child's history, eg Spina Bifida or existing nerve damage. ^{2,3}

1.1 Peripheral Neurologic Integrity

Upper Extremities

Sensation Function

Movement Function

<p>Radial Nerve: Able to feel touch with the 1st web space of the hand, between the thumb and index finger.</p>		<p>Radial Nerve: Able to hyper-extend thumb and fingers.</p>	
<p>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.</p>		<p>Ulnar Nerve: Able to abduct all fingers, especially little finger.</p>	
<p>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.</p>		<p>Median Nerve: Able to oppose thumb and small finger and flex wrist.</p>	

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

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

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.** ^{3,4,5}
- 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. ⁴

1.2 Pain

- 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. ^{3,4,5}

An increasing need for analgesics for pain management is an indicator of possible compartment syndrome.^{3,4,5}

- Pain that is greater on passive extension and flexion of an extremity should be further investigated.^{3,4,5}

1.3 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		<ul style="list-style-type: none"> • 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.

2 Documentation

- Neurovascular observations are documented hourly on the Neurovascular Observations paper and/or 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.

3 Complications

3.1 Compartment Syndrome

Definition:

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.^{4,5,6,7}

Signs and Symptoms of Compartment Syndrome

- **Pain:** not relieved by simple analgesics (non-narcotic) and excessive pain on passive extension and flexion of extremity^{3,4,5,6}. 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 eg, numbness, tingling of extremity^{4,5,6,7}
- **Pressure:** skin is tight and shiny, pressure in muscle compartment is greater than 30-40mmHg (pressures are measured in theatres)^{3,4,5,6,7}
- **Pallor:** can indicate an arterial injury, is a late sign^{4,5,6,7}
- **Paralysis:** caused by prolonged nerve compression or muscle damage, is a late sign^{4,5,6,7}
- **Pulselessness:** Can indicate death of a tissue, check general colour of the extremity^{4,5,6,7}

Management:

- Elevate limb above the level of the heart
- Notify orthopaedic medical staff for urgent review.
- Split plaster cast / backslab or full plaster
- Place child on Nil By Mouth
- Temporarily cease narcotic infusion to assess neurovascular status especially flexion and extension of extremity.
- Organise theatre time for measurement of muscle compartments and or fasciotomy

3.2 Peripheral Nerve Injury

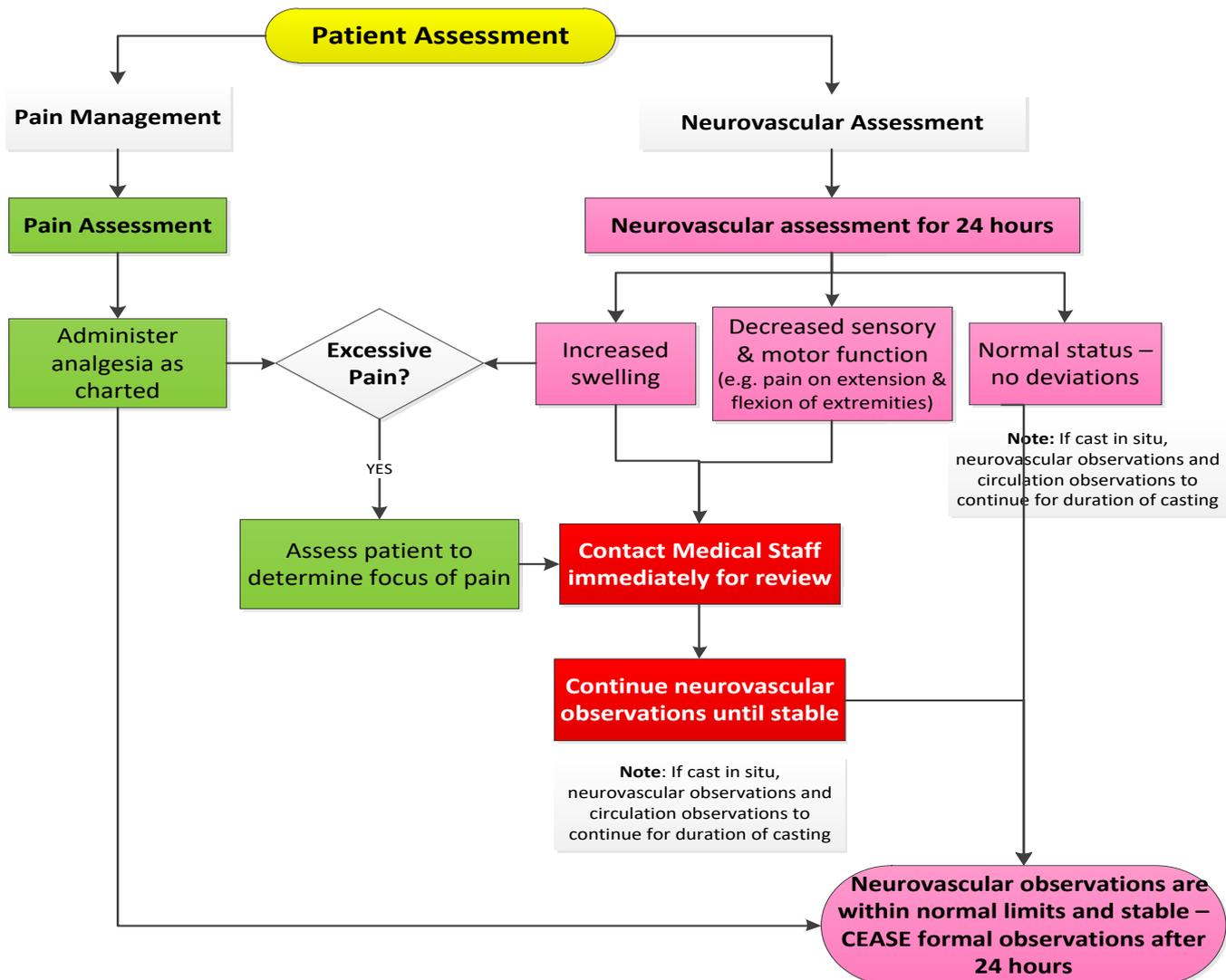
- Can result from fractures, and insertion of hardware such as pins and wires that have the potential to stretch or sever the nerve.⁸
- Fractures to the elbow can frequently affect nerve function. The anterior interosseous nerve is the most common nerve injured with extension type supracondylar fractures.⁸
- Most peripheral nerve injuries will improve over an 8 to 12 week period.⁸
- 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.⁸

3.3 Vascular Injuries

- Can result from severely displaced fractures.³
- Ischemic limbs associated with fractures require immediate closed reduction to remove tension on the neurovascular structures, usually circulation to the limb is restored.³
- If circulation does not return the child needs to be taken to theatre for fracture stabilisation and vascular exploration.³
- Revascularisation should be achieved within 6 to 8 hours.³

- Vascular complications can occur after cardiac catheterization, to the lower extremities. The site of the catheter needs to be checked 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 on the Orthopaedic Ward.

Management of orthopaedic patient post-operatively/ post injury



References

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3. Herring, J. A. Compartment Syndrome: Vascular Injuries. 4th ed. Tachdjian's pediatric orthopaedics, from the Texas Scottish Rite Hospital for Children. 2008;Vol 3: pp. 22374-22377.
4. Shields, C. J. & Clarke, S. Neurovascular observation and documentation for children within accident and emergency: A critical review. International Journal of Orthopaedic and Trauma Nursing. 2010;Vol 15. 3-10.

5. Wright, E. Neurovascular impairment and compartment syndrome. Paediatric Nursing. 2009; Vol.21 (3). 26-29.
6. Smith, J. S. Compartment syndrome. Journal of the American Academy of Physician Assistants. 2013; Vol 26 (9): pp48-49.
7. Mauser, N. Gissel, H. Henderson, C. Hao, J. Hak, D. Mauffrey, C. Acute lower leg compartment syndrome. Orthopaedics Trauma Update. 2013; Vol 36(8):pp 619-624.
8. Herring, J. A. Upper extremity injuries. (4th ed.), Tachdjian's pediatric orthopaedics, from the Texas Scottish Rite Hospital for Children. 2008: Vol 3, pp. 2476-2479.
9. Smith, M. A., Walsh, C., Levin, B., Eten, K. L., & Yager, M., Orthopaedic Snafus: When Adverse Events Happen in Orthopaedics. Orthopaedic Nursing. 2017; Vol 36(2), pp. 98-109
10. Schreiber, M. L. Neurovascular Assessment: An Essential Nursing Focus. Medsurg Nursing. Vol. 25 (1), pp. 55-57.

Further Information

1. NAON: Blogs Free to View – NAON's Neurovascular Assessment Video. Link:
<http://www.orthonurse.org/p/bl/et/blogaid=805>
2. [\\mcfs36.nch.kids\users\40033429\Desktop\Peroneal Nerve Precautions Chart.pdf2 \(1\).pdf](\\mcfs36.nch.kids\users\40033429\Desktop\Peroneal Nerve Precautions Chart.pdf2 (1).pdf)

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