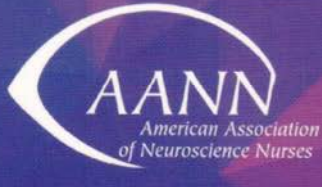
SIXTH EDITION

AANN Core Curriculum for

NEUROSCIENCE NURSING



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TECHNOLOGY

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Objectives

1. Differentiate the techniques in monitoring intracranial pressure (ICP).
2. Identify the use and types of surgical drains used in neurosurgery.
3. Discuss the use of external cerebrospinal fluid (CSF) drains.
4. Discuss the methods used, locations of placement, and indications for CSF shunts.
5. Discuss the methods used for assessing brain oxygenation.
6. Discuss the methods used for assessing brain perfusion and cerebral blood flow.
7. Identify the indications for use of transcranial Doppler (TCD) monitoring.
8. Discuss the monitoring of intracranial metabolites.
9. Discuss the indications and usage of electroencephalogram (EEG) and signal-processed EEG.
10. Differentiate methods used for monitoring neuromuscular blockade.
11. Discuss the indications for use of implantable stimulators.
12. Identify the indications for use of implantable infusion pumps.
13. Describe automated pupillary assessment.

Intracranial Pressure Monitoring

A. Historical perspective (Srinivasan, O'Neill, Jho, Whiting, & Oh, 2014)
   1. Guillaume and Janny first described indwelling cerebral-monitoring devices in the form of ventricular puncture in 1951. Their use became routine after Lundberg's 1961 publication that described their accuracy in reading normal and abnormal intracranial pressure (ICP) waves. Since then, ICP monitoring has become the standard of care in the intensive care unit (ICU). Despite its widespread use, controversy exists regarding proof of improved patient outcomes with ICP monitoring and ICP targeted therapy (Chesnut et al., 2012; Raboel, Bartek, Andresen, Bellander, & Romner, 2012).

B. Indications (Raboel et al., 2012)
   1. Traumatic brain injury
   2. Intracerebral hemorrhage
   3. Subarachnoid hemorrhage
   4. Hydrocephalus
   5. Malignant infarction
   6. Cerebral edema
   7. CNS infection
   8. Hepatic encephalopathy

C. Placement (see **Figure 7-1** for types of ICP monitoring devices; see **Table 7-1** for advantages and disadvantages of different types of monitors)
   1. Intraventricular
      a. A catheter is placed aseptically in the emergency department, operating room, or ICU by the neurosurgeon (or other credentialed practitioner) through a burr hole.
      b. Anatomic landmarks anterior to the coronal sutures, 3–4 cm off the midline, are used to place the catheter in the anterior horn of the lateral ventricle (usually the nondominant hemisphere). Tip will be near the foramen of Monro.
      c. The catheter may be tunneled subcutaneously, or a bolted catheter may be inserted.
         (1) If tunneled, the catheter exits from the scalp through a separate surgical stab wound.
      d. Catheters may be externally transduced via a strain-gauge transducer (similar to a transducer used with hemodynamic monitoring). Hybrid catheters also have an internal strain-gauge microchip or fiberoptic transducer.
      e. Risks and complications (see the section "Cerebrospinal Fluid Drains," below)
      f. Intraventricular monitoring remains the gold standard of ICP monitoring. It allows measurement of ICP and drainage of cerebrospinal fluid (CSF). When used for drainage of CSF, the system is known as an

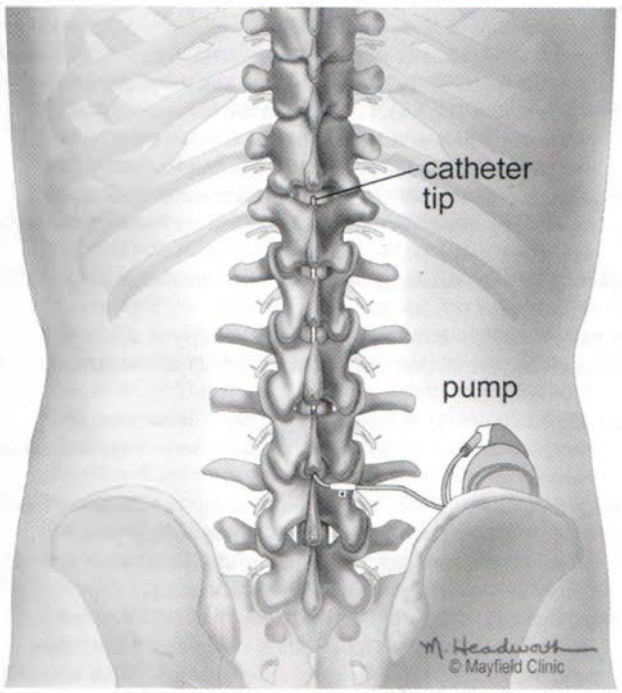


Figure 7-18. Implantable spinal cord pump. Retrieved from http://mayfieldclinic.com. Copyright by Mayfield Clinic. Reproduced with permission.

6. Infection

D. Nursing responsibilities (Barker, 2008)
   1. Perform routine postoperative management.
   2. Adjust medication infusion.
   3. Educate the patient and family about the pump.
   4. Monitor incisions for signs and symptoms of wound infection.
   5. Change dressing as needed.
   6. Monitor neurological condition and notify the neurosurgeon of any changes.

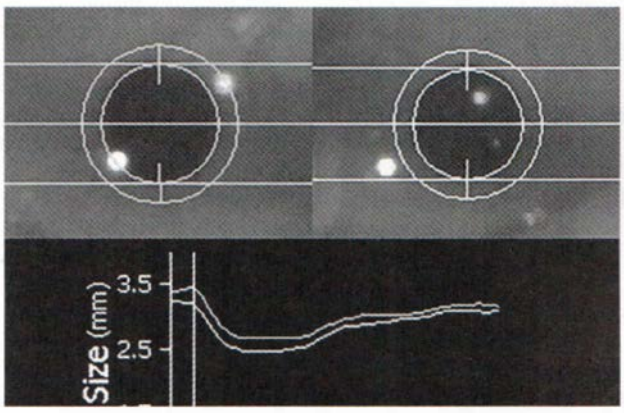
Automated Pupillary Assessment

A. Background
   1. Pupillary examination is a critical component of neurological assessment. Abnormalities of pupillary response or pupil asymmetry are often associated with neurologic deterioration and correlate with poor neurological outcome (Chen et al., 2011).
   2. Manual pupillary assessment is subject to many sources of inaccuracies and inconsistencies and is characterized by high interexaminer variability (Chen et al., 2011; Olson et al., 2015).
   3. Use of an automated assessment device removes subjectivity from the measurement of the pupil size and reactivity and provides a way to track and trend pupillary reactivity in a consistent, objective, and quantifiable way.

B. Description (**Figure 7-19**)
   1. Automated pupillometer is a noninvasive, battery-operated, hand-held device.
   2. Uses light stimulus and rapid live photography to assess pupil dynamics

A

B



C

Figure 7-19. Automated pupillary assessment. A, Hand-held optical scanning system (pupillometer). B, Pupillary measurement parameters displayed on the pupillometer. C, Video capture of pupillary response. Copyright by NeurOptics, Inc., Irvine, CA. Reproduced with permission.

3. Measures maximum and minimum pupil apertures and constriction and dilation velocity of pupils and provides an algorithm-based scale of pupillary response (Cecil et al., 2011)
4. Calculates neurological pupil index (NPi). Values range from 0 (nonreactive or atypical response) to 4.9 (brisk). An NPi less than 3 or a difference in NPi between right and left pupils of more than 0.7 can be considered abnormal (Chen et al., 2011).

C. Indications
1. Adult and pediatric patients with the following:
   a. Mild, moderate, or severe brain injury
   b. Subarachnoid hemorrhage from aneurysmal rupture or vascular malformation
   c. Intracerebral hemorrhage
   d. Ischemic stroke
   e. Postoperative craniotomy
   f. Multisystem trauma
   g. Potential or actual elevation in ICP
2. Baseline assessment as part of neurological examination at time of admission
3. Routine assessment with each pupillary evaluation or as an adjunct to manual assessment

D. Nursing responsibilities
1. Understand the effects of medications and neurological and metabolic disease processes on pupillary size and reactivity.
2. Educate the patient and family about use of the device.
3. Perform assessment using pupillometer according to instructions for use.
4. Interpret values in the context of patient diagnosis and treatments.
5. Record measurement results according to hospital protocol.
6. Report abnormal findings and trends indicating diminished pupillary response to physician or provider.

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