St.JosephHealth

Mission • Mission Laguna Beach

Clinical Guidelines: Pupillometer in Critical Neuro Patients, Use of

Code: CPC-2018Jan-2.P.5
Orig Date: 2003 Feb
Rev Date: 2015 June

I. RESPONSIBILITY

Executive Director, Critical Care Services

II. GENERAL INFORMATION OF DOCUMENT

The following clinical guideline provides the team with recommendations for monitoring pupillary reaction in patients suspected of developing increasing intracranial pressure (ICP). Guidelines are recommendations that assist the team in making clinical decisions on assessing, planning, intervening, and evaluating clinical care. Clinical judgment of the nurse using physical assessment and objective tools of monitoring neurologic function are vital in monitoring for neurologic deterioration in patients at risk for brain injury.

III. CLINICAL DIAGNOSIS/CONDITION

Minor/Moderate/Severe Brain Injured Patients; Neurosurgical Patients; Post Cardiac Arrest Patients

Patients with neurological insult requiring close monitoring: post -operative neurosurgery, hypothermia after cardiac arrest (HACA), acute stroke- Ischemic and Hemorrhagic, Brain tumors, and any clinical situation where an objective accurate assessment of pupillary reaction is required.

IV. TARGET POPULATION

Patients at risk for neurologic deterioration related to cerebral edema and increasing intracranial pressure

V. PRIMARY CLINICIANS

Primary Clinicians: Surgical Intensive Care Unit, Emergency Department, Coronary Intensive Care Unit, Pediatric Intensive Care Unit

VI. PURPOSE

Patients sustaining neurologic insult are at risk for cerebral edema and increased intracranial pressure. Accurate assessment of the neurologic system is imperative in order to detect increases in ICP. One of the most important parameters is pupillary size and reaction to light. The pupillometer is a hand-held instrument which provides quantitative pupillary measurements by taking 30 pictures per second of the pupil's response to light stimulus. The most significant data obtained from the quantitative analysis include neuro papillary index (NPI), pupillary size prior to the light stimulation (MAX), pupillary size after a light stimulus (MIN), percent change of pupil (CON), and constriction velocity (CV).

NOTE: A trend of a decrease in CV less than 0.81 mm /sec or a NPI < 3 or a difference in NPI of ≥ 0.7 between the two eyes may be indicative of increasing ICP. Data from the pupillometer should be correlated with the clinical exam and other objective data.

VII. OBJECTIVES

1. Identify accurate pupil size and reaction
2. Anticipate potential increases in ICP related to changes in pupillary size and delays in constriction velocity or decreases in NPI.

VIII. CONTENT OF GUIDELINE

1. Assessment
    a. The neurologic pupillary exam in newly diagnosed and critical neurologic patients should have the pupillary reation monitored with the pupillometer. The following diagnoses may benefit from pupillary analysis via a pupillometer:
        i. Minor head injury (GCS 13-15)
        ii. Moderate head injury (GCS 9-12)
        iii. Severe head injury (GCS 3-8)
        iv. Subarachnoid hemorrhage from aneurysmal rupture or vascular malformation
        v. Intracerebral hemorrhage
        vi. Ischemic stroke
        vii. Craniotomy patients post-op
        viii. Multisystem trauma patients presenting to the ED unconscious or in extremis* (*Red trauma designation)
        ix. Cardiac Arrest Patients including HACA and other treatment modalities
        x. Any patient requiring close monitoring of pupillary assesment
    b. Findings of the pupillometer which should be noted as correlating with increases in ICP include:
        i. Change in pupil size of < 10% between before and after light stimulation
        ii. Constriction velocity < 0.8 mm/s suggestive of increases in brain volume < 0.6 mm/s suggestive of ICP elevation > 20 mm Hg or will be elevated within 15-30 minutes
        iii. Unequal pupils > 1 mm in size difference
        iv. NPI value <3 means the ICP is either >20mmHG or will elevate within 16 hours.
        v. NPI difference between two eyes ≥0.7
2. Plan
    a. Patients with head injury (minor, moderate, or severe) or other neuro pathology without an ICP in place should have pupillary reaction checked with the pupillometer while in the early stages of diagnosis and in the ICU q 1-2 hours or as indicated. If patient is neurologically changing, more frequent (every 30 minutes) assessment of the pupils may be warranted to monitor a rapidly changing sitation. Notation of NPI, MAX, MIN, CON, and CV for right eye and left eye will be documented. In the event the patient is unable to cooperate with the pupillometer assessment, assess pupils using the manual flashlight method.

b. Patients with an ICP monitor in place and ICP readings < 20 mm Hg should have pupillary reaction checked with the pupillometer q 1 hours.
c. Patients with an ICP monitor in place and ICP readings > 20 mm Hg requiring treatment should have pupillary reaction checked with the pupillometer hourly or more often as indicated. If time permits, re-assessment of pupil dynamics with the pupillometer 30 minutes after intervention may be beneficial to evaluate the response to the therapy.

3. Intervention
    a. Pupillary assessment with the pupillometer will take place as indicated above in the Plan section.
    b. Gather the appropriate equipment: NPI 200 pupillometer system, NPI 200 SmartGuard headrest, NPI 200 Pupillometer power supply and Charging Station, Barcode Scanner, and SmartGuard Reader Plate *(future application for uploading data into EMR).*
    c. To operate the device, the following procedure should take place.
        a. Connect the NPI 200 Pupillometer Power Supply to the NPI 200 Charging Station and plug into a power outlet. The green light at the base of the Charging Station will indicate power has been established.
        b. Place the NPI 200 into its charging station. After powering on, the touchscreen will display a blue battery icon indicating the NPI 200 is charging. The battery icon will turn green when fully charged.
        c. To modify the date and time, from the main screen, select the **Settings** icon and then select **Set Date and Set Time.** Follow the prompts to input the proper date and time using the 24 hour time configuration and select **Accept.**
    d. Turning on the NPI 200:
        . When not in use, the NPI 200 should be kept in the Charging Station. If the NPI 200 is not in the charging station, to conserve battery life the Pupillometer will:
            I. Go into sleep mode after 5 minutes. Touch the screen to turn on.
            II. Power down after 30 minutes. Press and hold the UP arrow to turn on.
    e. Scan the Patient ID:
        . Open the new SmartGuard for the NPI 200. Gently squeeze the SmartGuard side tabs to position onto the NPI 200. There will be an audible click when the SmartGuard is properly positioned.
        a. Select either **Barcode Scanner** or **Manual ID** to indicate the patient ID entry method used. This must be done for the first patient use, in order to properly input the patient ID into the SmartGuard.
        b. Pairing the NPI 200 to the Barcode Scanner
            I. Connect the Neuroptics Barcode Scanner and Charging cradle to the power supply and plug into a power outlet. Turn on the Barcode Scanner until an audible beep is heard and a blue light on the device flashes.
            II. Position the Barcode Scanner next to the NPI 200.
            III. Select **Barcode Scanner** on the NPI 200. The NPI 200 will display "**Connecting..."** on the touchscreen. Once successfully paired, the touchscreen will prompt when the device is ready to scan the patient ID barcode. When the patient ID appears on the NPI 200 touchscreenh, Confirm the patient information is correct and select **Accept**.
            IV. The NPI 200 will display the patient ID number and will read "Ready to Scan".

c. Pairing the NPI 200 Manually
    I. Press **Manual Entry**.
    II. Using the touchscreen, press **Patient ID.**
    III. Select **Shift** to toggle from alpha to numeric as required. When the patient ID number has been manually entered, check for accuracy and press **Enter.**
d. Place a patient sticker on the SmartGuard. The SmartGuard chip will hold approximately 168 pairings. Once full, a new SmartGuard must be paired to the patient's ID and used for further pupillometer measurements.
e. Keep the headrest at the patient's bedside for further use. The headrests are for single patient use.

f. Measuring the Pupils with the NPI 200 Pupillometer
    . Lift the pupillometer out of the charger
    a. The pupillometer should turn on automatically, If the device was not placed in the charger, then you will need to hard start it by pressing the upper arrow for 10 seconds.
    b. Place the paired headrest on the pupillometer by gently squeezing the SmartGuard tabs and snapping it in place.
    c. Position the NPI 200 with SmartGuard at a right angle to the pateint's axis of vision, mininizing any tilting of the device.
    d. Press and hold the button (RIGHT) to start a scan of the right pupil. Place the white foam rest below the right eye and press the RIGHT button and continue holding the pupillometer steady. Center the patient's pupil in the center of the field of view. The pupil is marked with a green circle around its perimeter. The user can now release the button, while keeping the pupillometer firmly in place for the entire duration of the recording which lasts 3 seconds. Once the measurement is complete, the results will appear on the bottom of the screen. At this point the device can be removed from the eye area. If the measurement was affected by a tracking problem (e.g., extensive blinking or motion of the user's hand or the patient's head) then the measurement results are displayed in red font on the results screen. In this case, the measurement results should not be relied upon and the measurement should be repeated.
    e. Press the button (LEFT) to start the scan of the left pupil. Place the white foam rest below the left eye and press the LEFT button. Follow the same procedure as explained for the right eye.
    f. Look at the screen where the papillary analysis has been recorded. Both the right and left pupillometer values are displayed on the screen side by side and differentiated by color. The right pupil is displayed in green, and the left pupil is displayed in yellow. If too much time has elapsed between the analysis of the right eye and left eye, then the values will not appear on the same screen. Toggle betwen Pages 1 and 2 to display the results of the pupil measurement values and waveform. Document the NPI, MAX, MIN, CON, and CV in the Ventriculostomy/Pupillometry Assessment in Meditech.
    g. To print off the values push the down arrow key and a green box will highlight the first symbol (arrow). Push the right sideways button and the green box moves

to the next icon- printer. Push the center button to aim the pupillometer infrared port on the top of the pupillometer at the infrared port on the black printer.

h. If you would like to watch the simultaneous papillary changes on the device, press the down arrow key until the green outline box appears over the arrow in the lower left hand side of the screen. Push the center button and the video will start.
i. To go back to the main menu, pres the RIGHT or LEFT key and the main screen will appear. Anytime you want to use the icon keys in the lower row of the screen, press the down arrow and the green box will appear around the first icon. Pushing the side button will move the green box along the bottom row.
j. When done remove the headrest and place the pupillometer firmly in the charger. A lightening bolt will appear in the upper right screen, meaning the pupillometer is charging.

g. Abnormal values include:
    . Increase in size between right and left pupil > 1 mm following admission assessment of pupils equal in size
    i. % change of pupil (before/after light stimulus) < 10%
    ii. Constriction velocity < 0.8 mm/second
    iii. NPI <3 or difference of $\geq$ 0.7 between both eyes
h. In the event the patient does not have an ICP in place, assess pupillary response with the pupillometer every one hour (or more frequently) with neurologic exam or as indicated/ordered and report the following changes in values to the neurosurgeon:
    . Difference in pupil size from right to left > 1 mm (change from admission)
    i. % change of pupils < 10%
    ii. Constriction velocity < 0.8 mm/second
    iii. NPI <3 or difference of 0.7 between both eyes
    iv. Note: Conduct a complete neurologic assessment including Level of consciousness (GCS) -eye opening, motor assessment, verbal assessment as well as EOMs
i. After the ICP is removed, check pupils hourly with the pupillometer. If the patient's status changes (decrease level of consciousness), increase the frequency of pupillometer checks.
j. In the case of severe agitation or an uncooperative patient, obtain pupil assessment using a manual flashlight method.

4. Evaluation
    a. Compare and trend the pupil size, % change in pupil size, constriction velocity, NPI, and size between the right and left pupil.
    b. Document on Ventriculostomy/Pupillometry Assessment in computer.
    c. Assess patient's neurologic status as ordered.
    d. Trend NPI, pupil size, percent change in pupil, and constriction velocity with ICP readings
    e. Report any significant change in pupil size/reactivity, decrease in % change in pupil size, and falling constriction velocities to the neurosurgeon immediately

IX. COMMITTEE APPROVAL

Trauma Committee, Critical Care Committee, Collaborative Practice Committee

X. REFERENCES

A. Cecil S, Chen P, Callaway S, et al. Traumatic Brain Injury: Advanced Multimodal Neuromonitoring from theory to clinical practice. Critical Care Nurse 2011: downloaded at www.ccnonline.org.
B. Chen J, Gombart Z, Rogers S, et al. Pupillary reactivity as an early indicator of increased intracranial pressure: The introduction of the Neurological Pupil Index. Surgical Neurology International 2011; 2:82.Downloaded http://www.surgicalneurologyint.com on June 28, 2011.
C. Taylor, WR, Chen JW, Meltzer H, et al. "Quantitative pupillometery, a new technology: Normative data and preliminary observations in patients with acute head injury". Journal of Neurosurgery 98: 205-213. 2003.
D. Neuroptics. NPI 200 Pupillometer System: Quick Start Guide. 2014.
E. Neuropitcs NPI 200 Pupillometer Instructions for Use. 2014.
F. Pupillometry in Critical Care & Emergency Medicine. (2008) Retrieved June 7, 2009 from http://neuroptics.com