

INTRACRANIAL PRESSURE (ICP) MONITORING VIA RICKHAM'S RESERVOIR OR CODMAN MONITOR PROCEDURE[®]

KEY POINTS

- This document provides details for Intracranial Pressure (ICP) monitoring using the following devices:
 - Rickham's reservoir
 - Codman wire
 - Codman monitor
 - Philips monitor
- This document is intended for use in the Children's Hospital at Westmead (CHW) and Sydney Children's Hospital (SCH). Differences in ICP monitoring between these two sites are stated within this document.
- This document excludes ICP monitoring via an external ventricular drain or lumbar drain device. In CHW, such monitoring is done only in the Paediatric Intensive Care Unit (PICU) (see [Intracranial Pressure Monitoring Systems: Management - PICU](#)). In SCH, such monitoring is rarely performed on ward areas, under instructions from the Neurosurgical Consultant.
- When accessing a Rickham's reservoir for ICP monitoring, the **Neurosurgical Registrar** must use aseptic technique to insert the butterfly needle into the Rickham's reservoir. Nursing staff are NOT to perform this procedure.
NOTE: If the butterfly needle is already placed in the Rickham's reservoir, a Registered Nurse (RN) may then connect the patient to ICP monitoring (using assistance from Biomedical Engineering as required, if in CHW).
- When a patient has a Codman wire in situ, the RN may connect the patient to ICP monitoring (using assistance from Biomedical Engineering as required, if in CHW).
- When ICP monitoring has ceased, the RN may remove the butterfly needle from the Rickham's reservoir, or the Codman wire of a patient, with assistance from the Neurosurgical Registrar as required in CHW. In SCH, the Clinical Nurse Consultant (CNC), Neurosurgical Resident or Registrar must remove the devices.

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 September 2017	Review Period: 3 years
Team Leader:	Clinical Nurse Educator	Area/Dept: Commercial Travellers Ward CHW

CHANGE SUMMARY

- Revision of CHW document to become a network document
- Clarification of devices used for ICP monitoring
- Removal of "ICP monitoring via lumbar drain" section, as no longer routinely performed on wards.
- Addition of Appendix of instructions for ICP monitoring connection using Codman monitor and Philips monitor, with pictures.
- Minor grammatical corrections, rearranging of information.

READ ACKNOWLEDGEMENT

- Medical and nursing staff involved in the care of a patient undergoing ICP monitoring must read and acknowledge they understand the contents of this document.

TABLE OF CONTENTS

Intracranial Pressure Monitoring	3
Rationale	3
Scope of this document.....	3
Complications of ICP monitoring	3
1 ICP Monitoring via Rickham's Reservoir	4
2 ICP Monitoring via Codman Monitor	6
Procedure.....	6
"Re-zeroing" or re-calibration of ICP monitoring via Codman monitor	6
3 Clinical Observations during ICP Monitoring	7
In the event of a CSF leak.....	7
4 Removal of Butterfly Needle from Rickham's Reservoir	8
Procedure.....	8
5 Removal of Codman Wire	9
6 Post Removal Observations.....	10
7 References	10
8 Appendix: Instructions for connecting ICP monitoring via Codman monitor	11

Intracranial Pressure Monitoring

Rationale

The purpose of Intracranial (ICP) monitoring is to investigate the cerebrospinal fluid (CSF) dynamics of a patient, and evaluate any possible disturbance or change in ICP. Some applications include confirming hydrocephalus, idiopathic intracranial hypertension, and determining possible causes of increasing head circumference or shunt system malfunction.

There are two different ways to obtain ICP monitoring outlined in this document:

- 1) A patient has a Rickham's reservoir in situ, which is accessed using a butterfly needle then connected to a transducer and Philips monitor.
- 2) A patient has a Codman wire in situ, which is then connected to a transducer, Codman monitor, and Philips monitor.

Scope of this document

- This document provides details for Intracranial Pressure (ICP) monitoring on ward areas in the Children's Hospital at Westmead, using the following devices:
 - Rickham's reservoir
 - Codman wire
 - Codman monitor
 - Philips monitor
- This document excludes ICP monitoring via an external ventricular drain or lumbar drain device. In the Children's Hospital at Westmead (CHW), such monitoring is done only in the Paediatric Intensive Care Unit (PICU) (see [Intracranial Pressure Monitoring Systems: Management - PICU](#)). However, in Sydney Children's Hospital (SCH), such monitoring may rarely be done on ward areas under instructions from the Neurosurgical Consultant.

Complications of ICP monitoring

Parents/carers and/or the patient must be briefed on possible complications by the Neurosurgical team prior to commencement of ICP monitoring.

- CSF infection is the greatest complication.
- Accidental dislodgement by child/parent/staff.
- Secondary and less common complications include equipment malfunction, air leaks and damage to the monitoring equipment which can all contribute to false recordings.

1 ICP Monitoring via Rickham's Reservoir

General Principles

- Accessing a Rickham's reservoir for ICP monitoring requires aseptic technique using an alcohol-based preparation, and is performed by the Neurosurgical Registrar. It is outside the nursing scope of practice to perform this procedure.
- Neonates and infants under 6 months of age require full cardiorespiratory monitoring whilst the butterfly needle is in situ.
- Observe the patient's level of consciousness throughout the procedure and document accordingly.

Equipment required

- X 1 Sterile Drape
- Sterile gloves
- X 1 Dressing pack
- 2% Chlorhexidine gluconate and 70% isopropyl alcohol solution
- X 1 Transducer pack
- X 1 Sterile CSF tube
- X 1 25 gauge butterfly needle + 1 spare
- X 2 large occlusive transparent dressings
- X 1 packet sterile gauze swabs
- X 1 10mL syringe
- X 2, 2mL syringes
- IV luer lock cap
- X 1 three way tap
- X 2 crepe bandages
- 7.5 cm white Elastoplast tape
- X 1 razor
- X 1 normal saline ampoule

Procedure

1. Neurosurgical Registrar to explain the procedure to the patient and/or parent/carer.
2. The procedure is done at the patient's bedside, ensuring privacy is maintained. Equipment prepared but not opened until the Neurosurgical Registrar is ready to scrub (with Biomedical Engineer present as needed, if in CHW).
3. The Rickham's reservoir site may need to be shaved by the Neurosurgical Registrar.
4. Infants and toddlers can be wrapped in a blanket or draw sheet to briefly minimise movement.
5. For neonates, administer a dose of sucrose prior to the insertion of the butterfly needle.
6. The Neurosurgical Registrar primes the 3-way tap and 25G butterfly needle with 0.9% normal saline, and then cleans the skin over the Rickham's reservoir with 2% Chlorhexidine gluconate and 70% isopropyl alcohol solution.
7. An occlusive transparent dressing is placed over the Rickham's Reservoir site to promote a sterile field.

8. The butterfly needle is inserted into the Rickham's Reservoir and a CSF specimen may be collected at this point.
9. The 3-way tap and transducer are connected to the end of the butterfly tubing, which in turn is connected to the Philips monitor, which records the ICP.
10. The Neurosurgical Registrar "zeros" or calibrates the machine while the 3-way tap is open to air (with assistance from Biomedical Engineer as required, if in CHW). The 3-way tap is then turned on to the patient and a luer lock cap is applied.
11. The second occlusive transparent dressing is then used to secure the butterfly needle onto the scalp. The transducer is taped to the side of the head and then 1-2 crepe bandages are applied to the patient's head and secured with white Elastoplast tape.
12. Dispose of equipment appropriately.
13. If a CSF specimen has been collected, label this with appropriate patient details, place in a biohazard bag and send to Pathology department immediately.

Picture 1. ICP monitoring via Rickham's reservoir – patient set up



“Re-zeroing” or re-calibration of ICP monitoring via Rickham’s reservoir

- Ideally, once the transducer is in place, it should not be disconnected. However bathroom breaks are an exception once confirmed with the Neurosurgical team.
- If a patient’s transducer is disconnected from the Philips monitor, to recommence ICP monitoring, the RN must:
 - 1) Reconnect the transducer to the Philips monitor
 - 2) Open the 3-way tap to air
 - 3) Touch the ICP waveform on the Philips monitor and touch “ZERO ICP”
 - 4) Open the 3-way tap back to the patient.

2 ICP Monitoring via Codman Monitor

General Principles

- The Codman wire and transducer are inserted and calibrated in the Operating Suite. The Codman wire may be secured with a suture and these require placement of a sterile occlusive dressing over the insertion site.
- Once the patient arrives post-operatively to the ward, an RN may connect the ICP monitoring (with assistance from Biomedical Engineering as required if in CHW).

Equipment required

- Codman (ICP Express) monitor
- IV pole to hold Codman monitor if required
- Transducer
- Philips monitor

Procedure

On arrival of the patient to the ward post-operatively, follow the instructions in [Appendix](#).

“Re-zeroing” or re-calibration of ICP monitoring via Codman monitor

See [Appendix](#) – [Step 13](#) onwards.

3 Clinical Observations during ICP Monitoring

- ICP monitoring is an invasive procedure and this carries potential risks of CSF infection and/or neurological complications such as low pressure headaches.
- For all patients, obtain **vital signs at least every 4 hours** during the ICP monitoring, unless frequency otherwise specified by the Neurosurgical team. These results are recorded using the Between the Flags protocol (see [Between the Flags – Clinical Emergency Response System – SCHN Procedure](#)).
- **Neurological observations at least every 4 hours** should also be obtained and recorded for all patients, unless frequency otherwise specified by the Neurosurgical team.
- Report any changes in vital signs or the neurological condition of the patient to the Neurosurgical Registrar immediately.
- Neonates and infants under 6 months of age require **full cardio-respiratory monitoring** during ICP monitoring.
- There must be a sterile, occlusive dressing applied to the insertion site around the butterfly needle for a Rickham's reservoir, or around the Codman wire.
- **Hourly site checks** for signs of CSF leakage, disconnection from the transducer or monitor, and infection must be obtained and documented on a Supplementary Observation Chart (M36C). In addition, document the current **ICP value for each hour and the patient's activity**.

In the event of a CSF leak

- If a CSF leak is identified, inform the Neurosurgical Registrar immediately and apply a pressure bandage.
- A CSF leak may occur due to raised ICP, a loose connection or dislodged catheter.
- The dressing may need to be taken down to investigate the leak and possibly tighten a loose connection. In the event that the dressing needs to be removed and reapplied, an aseptic technique is required by the Neurosurgical Registrar.
- In the event of equipment malfunction, contact Biomedical Engineering/Codman Representative.

ICP monitoring usually continues for 12-24 hours. DO NOT cease recording or disconnect the patient until the Neurosurgical Registrar has reviewed the patient and checked the data obtained.

4 Removal of Butterfly Needle from Rickham's Reservoir

Can be performed by the Registered Nurse with assistance from the Neurosurgical Registrar (CHW), or by the Clinical Nurse Consultant (SCH)

Equipment required

- Sterile Gloves
- X 1 goggles
- X 1 packet sterile cotton balls
- X 1 sterile occlusive dressing

Procedure

1. Explain the procedure to the patient and/or parent/carer. The procedure is performed at the patient's bedside. Ensure privacy is maintained.
2. Switch monitor power off at the wall.
3. Position the patient on their side or supine, and minimise patient's movement during procedure to ensure uncomplicated removal, e.g. wrapping with blanket if required.
4. All clinicians perform hand hygiene as per Hand Hygiene Policy.
5. Prepare equipment and ensure patient is ready.
6. All clinicians wash hands with Chlorhexidine gluconate 2% as per Hand Hygiene Policy. Don gloves and goggles.
7. Assistant firstly removes the head bandage, then gently lifts edges of occlusive dressing, being careful not to dislodge needle haphazardly (the wing of butterfly needle will remain stuck to a section of the occlusive dressing).
8. The clinician who has prepared for asepsis gently lifts the butterfly needle in an upward direction and immediately applies pressure to puncture site with sterile cotton swab for 1-2 minutes.
9. Cover the puncture site with a sterile occlusive dressing once it is ensured that there is no CSF leakage.
10. The butterfly needle is disposed of in the sharps bin.
11. Place (blue) absorbent sheet under head of patient and monitor for CSF leaks.
12. Leave patient clean and comfortable.

5 Removal of Codman Wire

Can be performed by the Registered Nurse with assistance from the Neurosurgical Registrar (CHW), or by the Clinical Nurse Consultant (SCH)

Equipment required

- Sterile Gloves
- X 1 dressing pack
- X 1 goggles
- X 1 packet sterile cotton balls
- X 1 sterile occlusive dressing
- X 1 stitch cutter (for Codman wire)
- X 1 forceps (for Codman wire)
- X 1 small Primapore dressing

Procedure

1. All clinicians perform hand hygiene as per Hand Hygiene Policy.
2. Prepare equipment.
3. All clinicians wash hands with Chlorhexidine gluconate 2% as per Hand Hygiene Policy. Don gloves and goggles.
4. Remove anchoring suture and gently withdraw catheter. Immediately apply pressure to insertion site with cotton swab/gauze for 1-2 minutes.
5. After ensuring there is no CSF leakage, place Primapore over the puncture site.
6. If CSF leakage is evident after removal of the catheter, apply a pressure dressing and notify Neurosurgical Registrar.
7. Disconnect transducer from machine and dispose appropriately into contaminated waste bin, together with Codman wire.
8. Leave patient clean and comfortable.

6 Post Removal Observations

- For at least 24 hours post removal, vital signs and neurological observations must be obtained and recorded hourly for first 4 hours, then every 4 hours, or as per Neurosurgical instructions.
- An elevated temperature must be reported to the Neurosurgical Registrar on-call, as this may be the first indication of CSF infection.
- Monitor the site closely for the first hour then every 4 hours, to assess for presence of CSF leak.
- If a CSF leak has occurred, the patient's head may be elevated at a 30 degree angle and the Neurosurgical Registrar must be notified immediately.
- The patient may also require analgesia or encouragement of oral fluids to minimise low-pressure headache.

7 References

1. Alarcon JD, Rubiano AM, Okonkwo DO, Urrutia G, Bonfill Cosp X (2012). Elevation of the head during intensive care management in patients with severe traumatic brain injury. *Cochrane Database of Systematic Reviews*, Issue 7: 1-9.
2. Bass J.K., Bass T, Green G.A, Gurtner P, White L.E. (2003) Intracranial pressure changes during Intermittent CSF Drainage. *Pediatric Neurology*, Vol.28 No.3.173-177.
3. Carney N, Totten AM, O'Reilly C, Ullman JS, et al. (2016). Intracranial Pressure Monitoring, In *Guidelines for the Management of Severe Traumatic Brain Injury (4th edition)*, Brain Trauma Foundation, pp 132-144
4. Czosnyka M, Pickard J.D (2004) Monitoring and interpretation of Intracranial pressure. *Journal of Neurology, Neurosurgery & Psychiatry*, 75 (6):813-821,
5. Eide P.E, Assessment of childhood intracranial pressure recordings using a new method of processing intracranial pressure signals. *Pediatric Neurosurgery*; 41, 121-130.
6. Kochanek PM, Carney N, Adelson PD, Ashwal S. et al. (2012). Indications for Intracranial Pressure Monitoring, in *Guidelines for the Acute Medical Management of Severe Traumatic Brain Injury in Infants, Children and Adolescents (2nd edition)*, *Pediatric Critical Care Medicine*, 13:S11-S17.
7. Manual of Nursing Practice (2006) pages 481-484 Lippincott Williams and Wilkins, Philadelphia.
8. Poca M.A, Sahuquillo J, Barba M.A, Anez J.D, Arian F. (2004). Prospective study of methodological issues in intracranial pressure monitoring in patients with hydrocephalus. *Journal of Neurosurgery*, 100:260-265.
9. Raboel PH, Bartek Jr J, Andresen M, Bellander BM, Romner B (2012). Intracranial pressure monitoring: Invasive versus non-invasive methods – A review, *Critical Care Research and Practice*, 1-14.
10. Sahuquillo J. (2006). Decompressive craniectomy for the treatment of refractory high intracranial pressure in traumatic brain injury. *Cochrane Database of Systematic Reviews*, Issue 1: 1-41.
11. Lee, A.G., Wall, M. (2017) Idiopathic intracranial hypertension (pseudotumor cerebri): Clinical features and diagnosis, Up To Date, via CIAP.

Copyright notice and disclaimer:

The use of this document outside Sydney Children's Hospitals Network (SCHN), or its reproduction in whole or in part, is subject to acknowledgement that it is the property of SCHN. SCHN has done everything practicable to make this document accurate, up-to-date and in accordance with accepted legislation and standards at the date of publication. SCHN is not responsible for consequences arising from the use of this document outside SCHN. A current version of this document is only available electronically from the Hospital. If this document is printed, it is only valid to the date of printing.

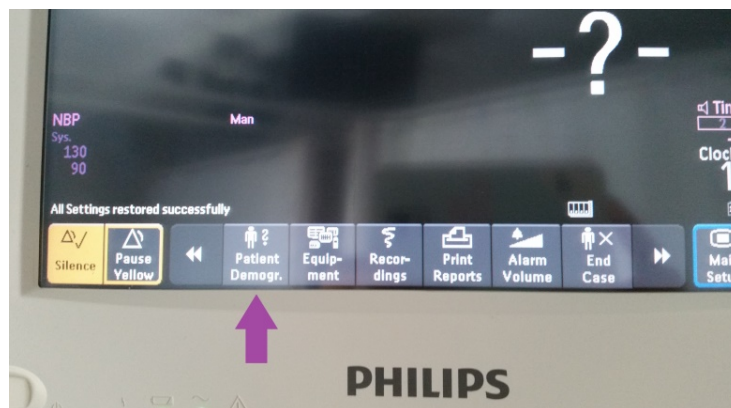
8 Appendix: Instructions for connecting ICP monitoring via Codman monitor

Step 1. Turn on the Philips Monitor. The screen displaying is the main screen.



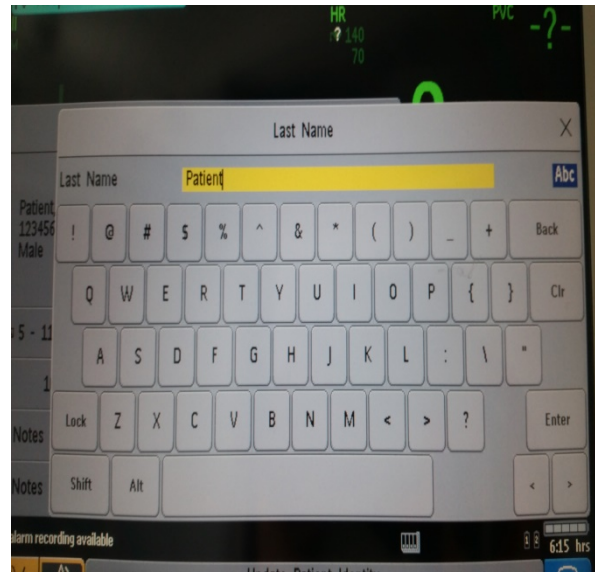
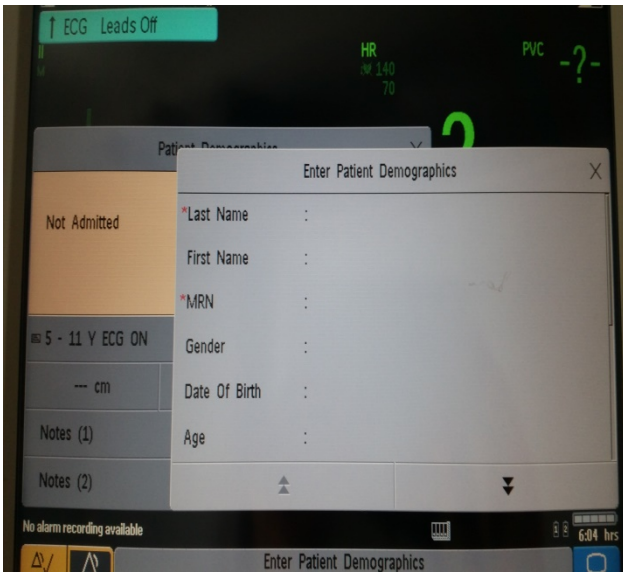
Step 2. Touch the PATIENT DEMOGRAPHICS button at the bottom of the main screen, and select the following:

NEW PATIENT → YES to begin monitoring on a new patient → NOT ADMITTED

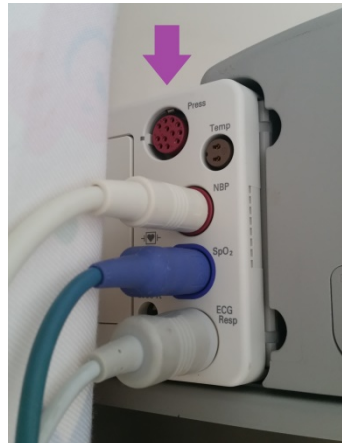


Step 3. Enter the patient's details, pressing ENTER after each detail, including:

- Last name
- First name
- MRN
- Gender
- DOB
- Age

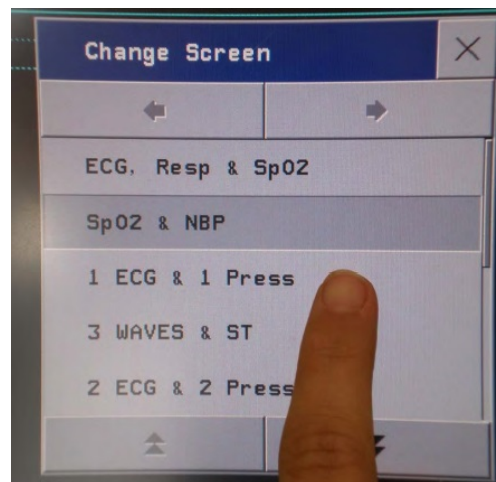


Step 4. Plug the Codman monitor into the “Press” port on the Philips monitor.

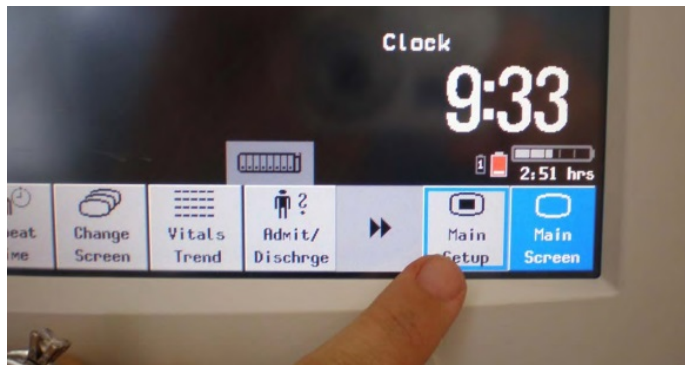


Step 5. If the ICP waveform is not showing on the screen, press the CHANGE SCREEN button on the bottom of the main screen.

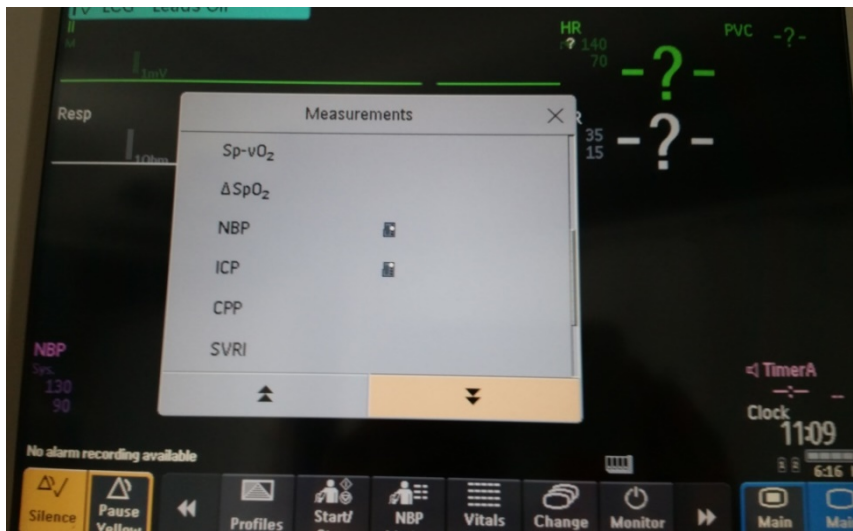
Step 6. Touch 1 ECG and 1 PRESS.



Step 7. Touch MAIN SETUP



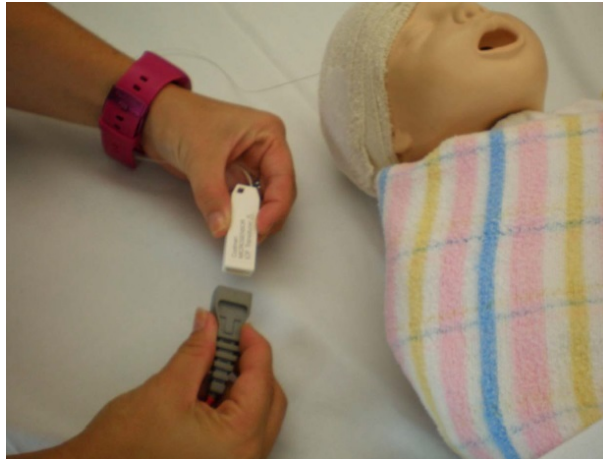
Step 8. Touch MEASUREMENTS and scroll down using the arrow button to find ICP



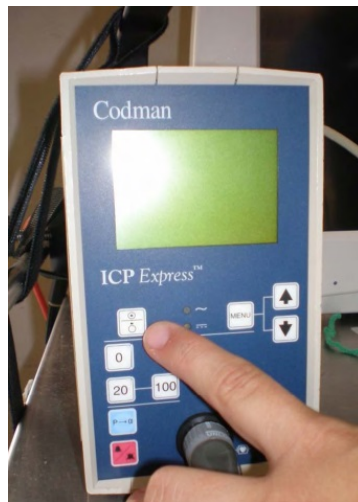
Step 9. Touch ICP. The following screen will display:



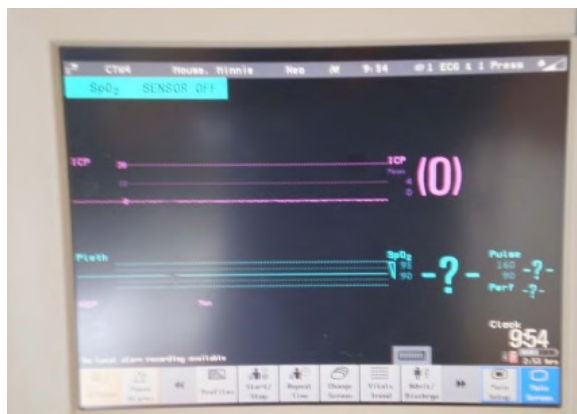
Step 10. Connect the transducer from the patient to the Codman monitor.



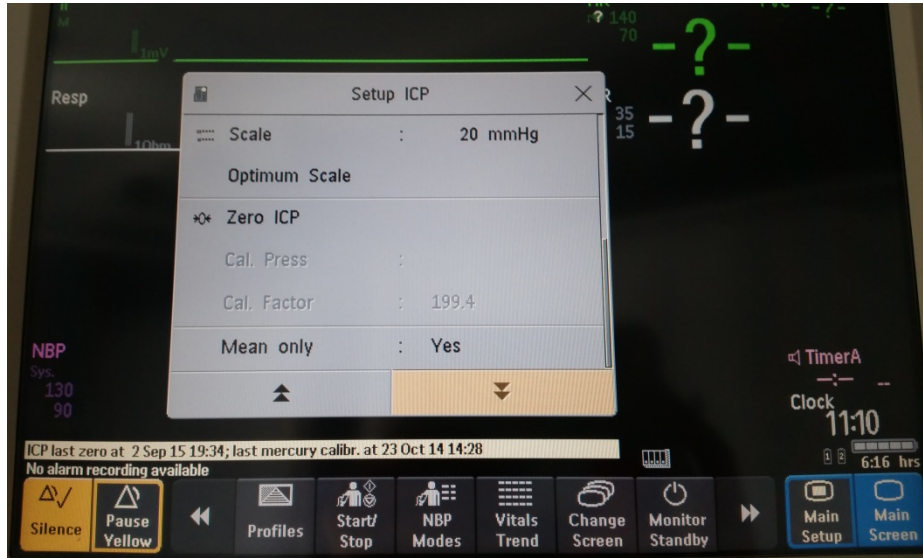
Step 11. Turn the Codman monitor on.



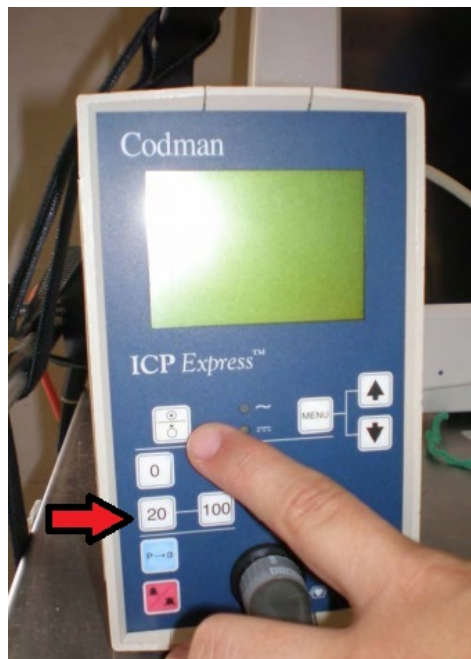
Step 12. When Philips monitor reads 0, press MENU on Codman monitor (this may take a few seconds).



Step 13. Touch the ICP waveform on the Philips Monitor and touch the ZERO ICP option in the SETUP ICP menu.



Step 14. To test if the zeroing process has been performed correctly, press 20 on the Codman monitor. The waveform on the Philips monitor should then also move up to 20.



Step 15. Press MENU on the Codman monitor to return the waveform to normal. The Philips monitor and Codman monitor should now be calibrated and show the same values.

NOTE: If a patient's transducer is disconnected from the Codman and Philips monitors (e.g. bathroom break), the nurse will be prompted to *accept the reference number* on the Codman monitor by pressing MENU. The reference number should be found in the patient's post-operative documentation or on an MRN label stuck on the Codman monitor.

