COUNCIL ON PATIENT SAFETY
IN WOMEN'S HEALTH CARE
safe health care for every woman

Friday, July 17, 2015

12:30 p.m. Eastern

Dial In: 888.863.0985

Conference ID: 72740336

Safety Action Series

Blood Pressure Basics

Speakers

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Disclosures

- John Barton, MD, MS, FACOG serves on the Data Monitoring Board for rEVO Biologics

  (study for preeclampsia treatment)

- Nancy Peterson, MSN, RNC-OB, PNNP, IBCLC has no real or perceived conflicts of interest to disclose

Objectives

- Discuss the clinical issues regarding inaccurate blood pressure measurement.
- Review standard methods for accurate measurement and assessment of blood pressure and urine protein in pregnant and postpartum women.
- Provide tips for the successful implementation of standard blood pressure measurement guidelines within an organization, including strategies for developing a provider education program.
- Provide guidance on establishing a skills assessment program to facilitate regular, ongoing training for clinical leaders on appropriate blood pressure measurement techniques.

We take a lot of BP measurements

- BP q 15 min
  - Post epidural placement
- BP q 30 min
  - Oxytocin infusion
- Automated BP q 30 min for
  - 24 hours= 48 measurements
  - 48 hours= 96 measurements

Accurate Blood Pressure
Why Should We Care?

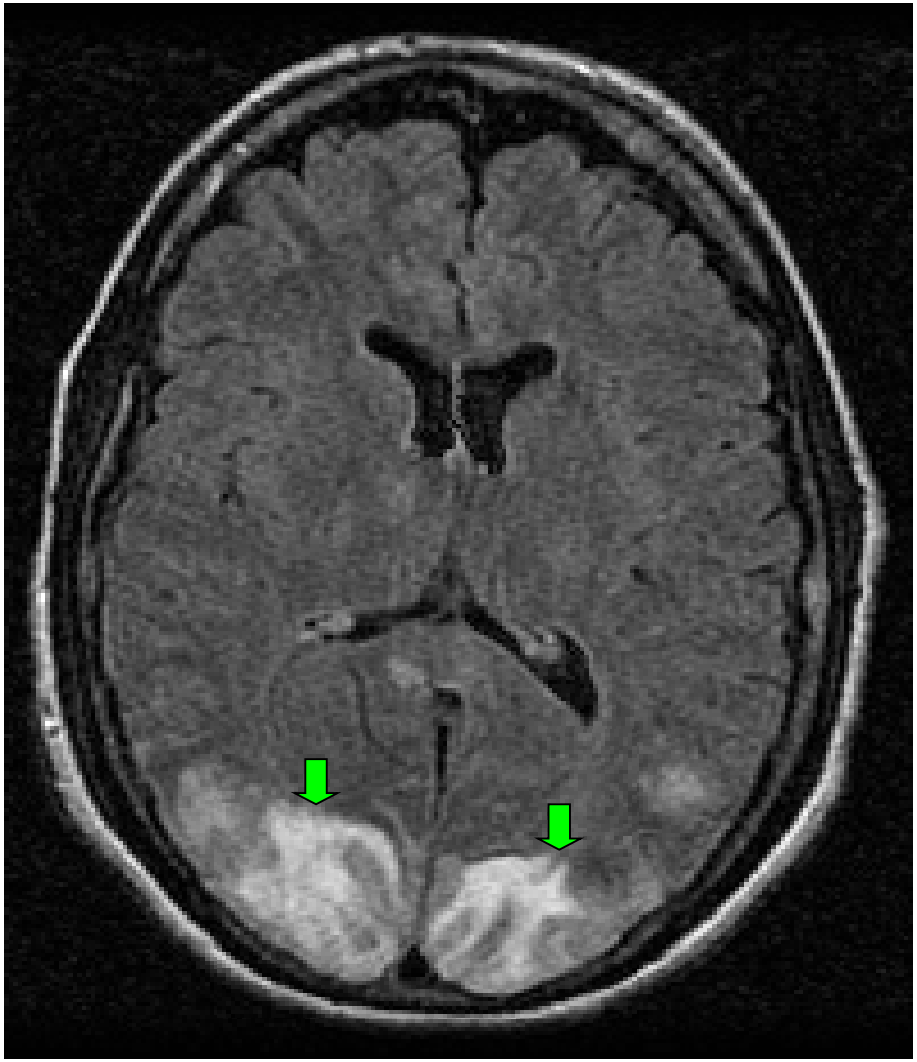
- Diagnosis of preeclampsia
  - Mild
  - Severe
- Antepartum management
- Timing of delivery
- Risk of complications
- Long term maternal outcome

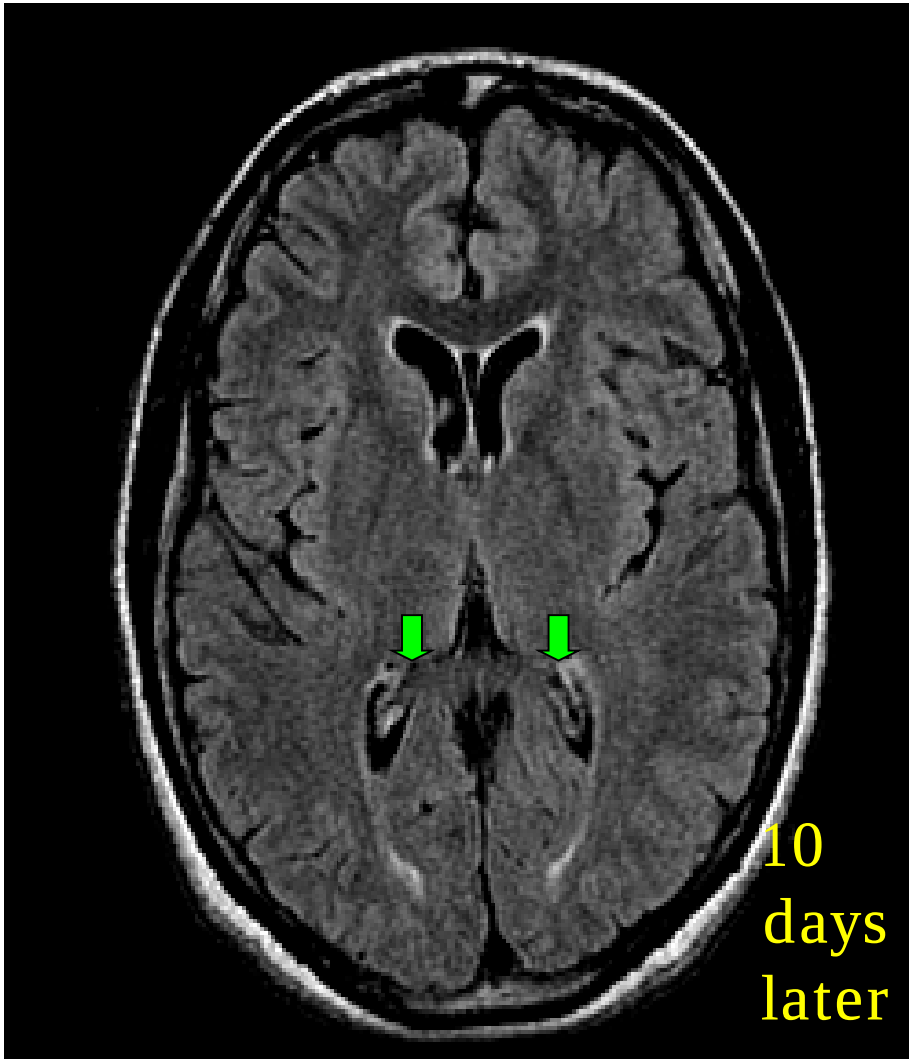
Gestational Hypertension

- Development of hypertension after 20 wks
  - Previously normotensive
  - SBP ≥ 140 mmHg

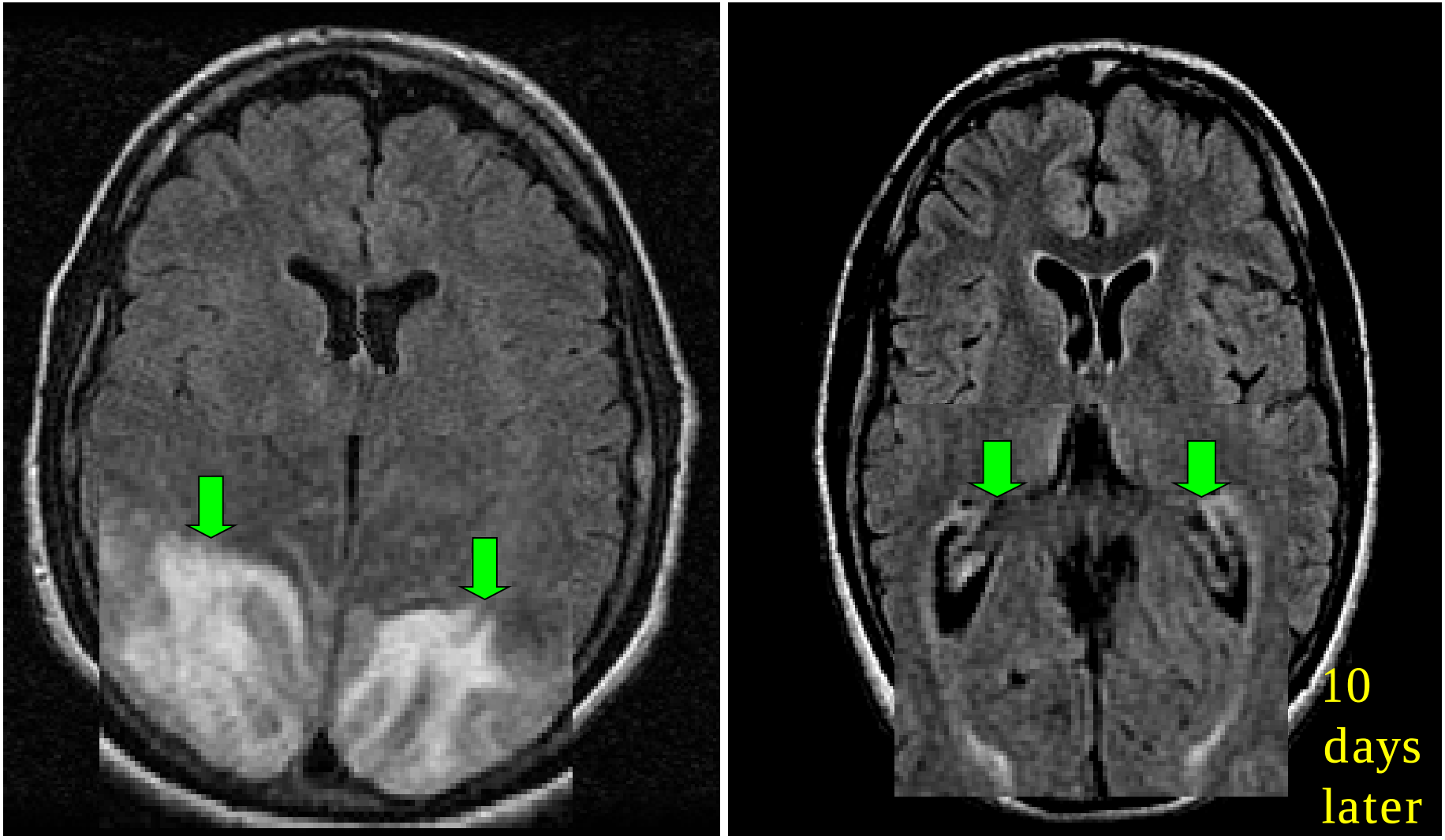
    or (*not* and/or)
  - DBP ≥ 90 mmHg
  - Persistent for 4 hrs

Posterior Reversible Encephalopathy Syndrome

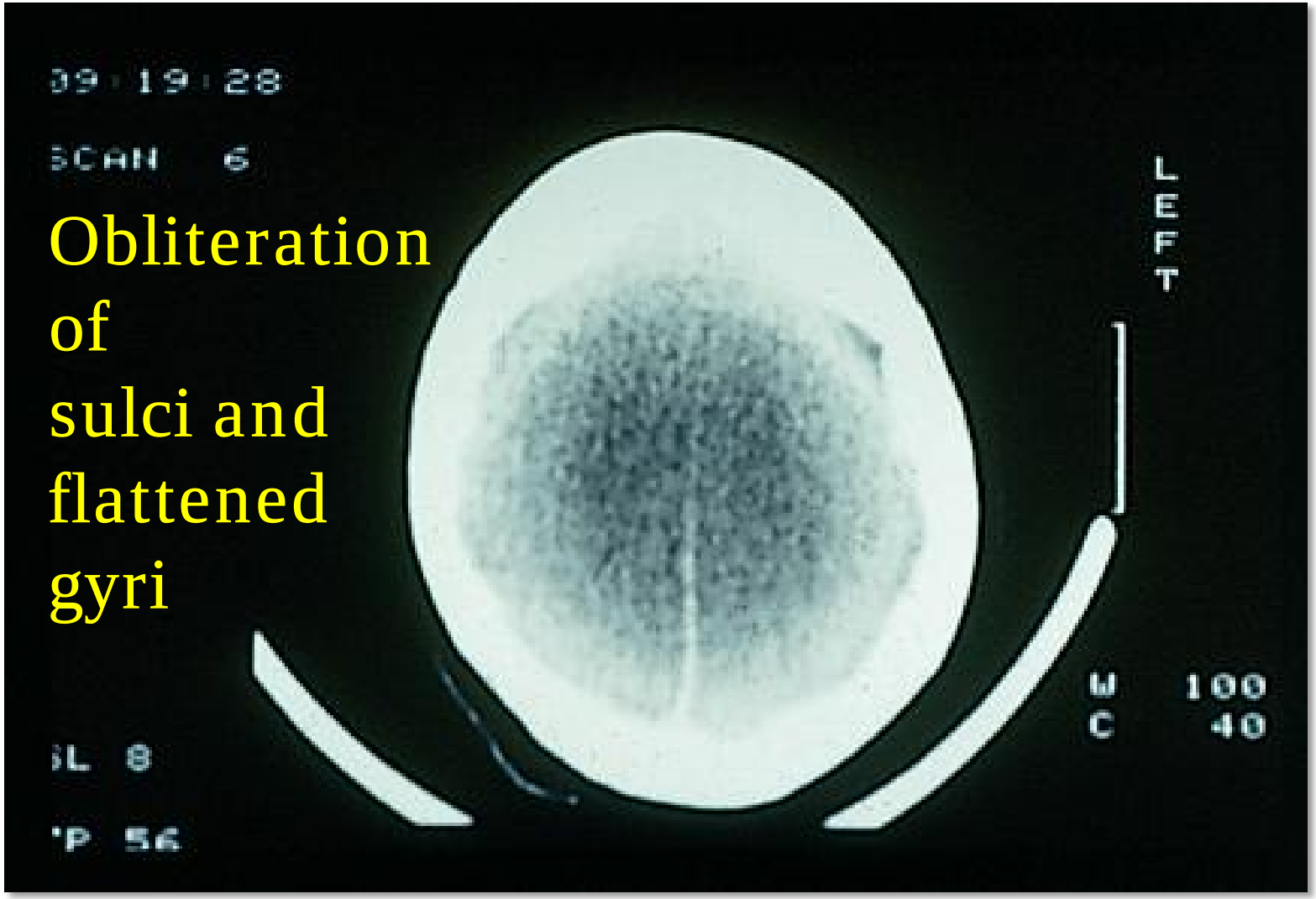




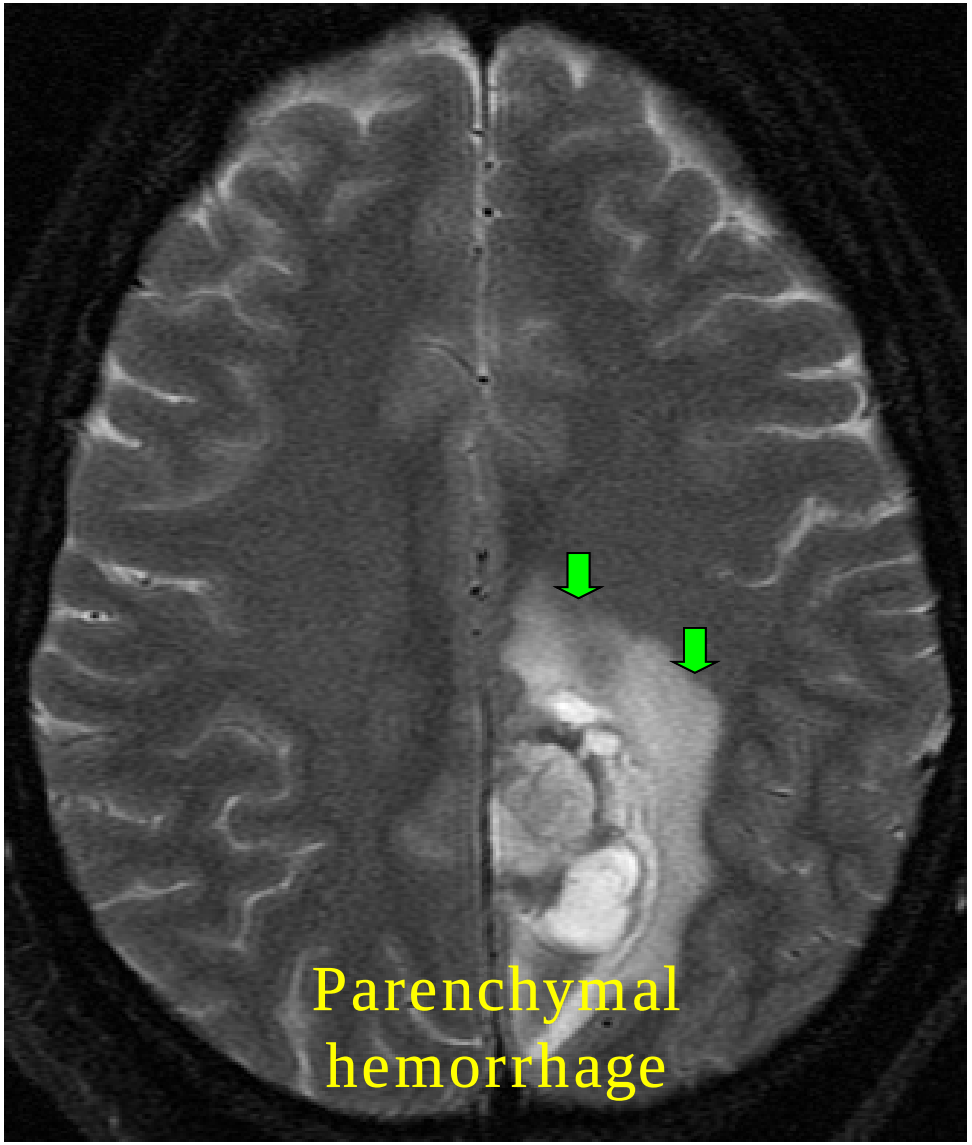
Posterior Reversible Encephalopathy Syndrome

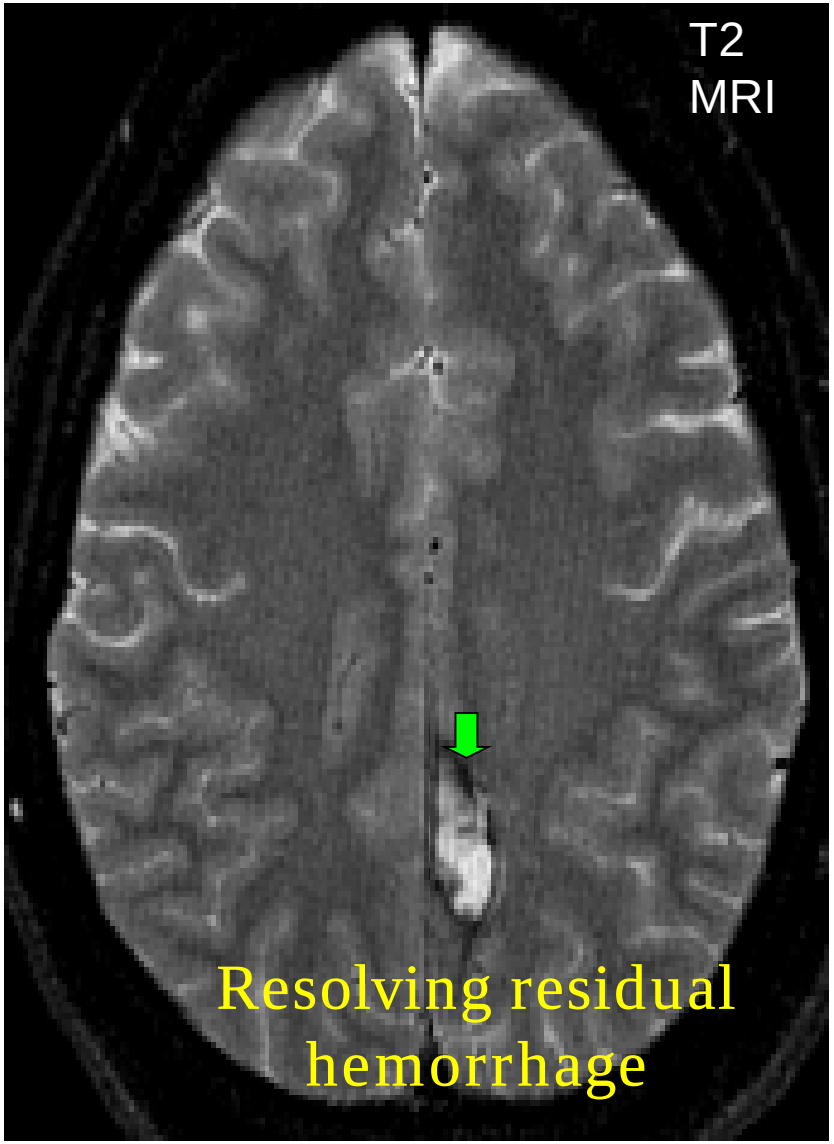


Massive Cytotoxic Cerebral Edema with Uncal Herniation

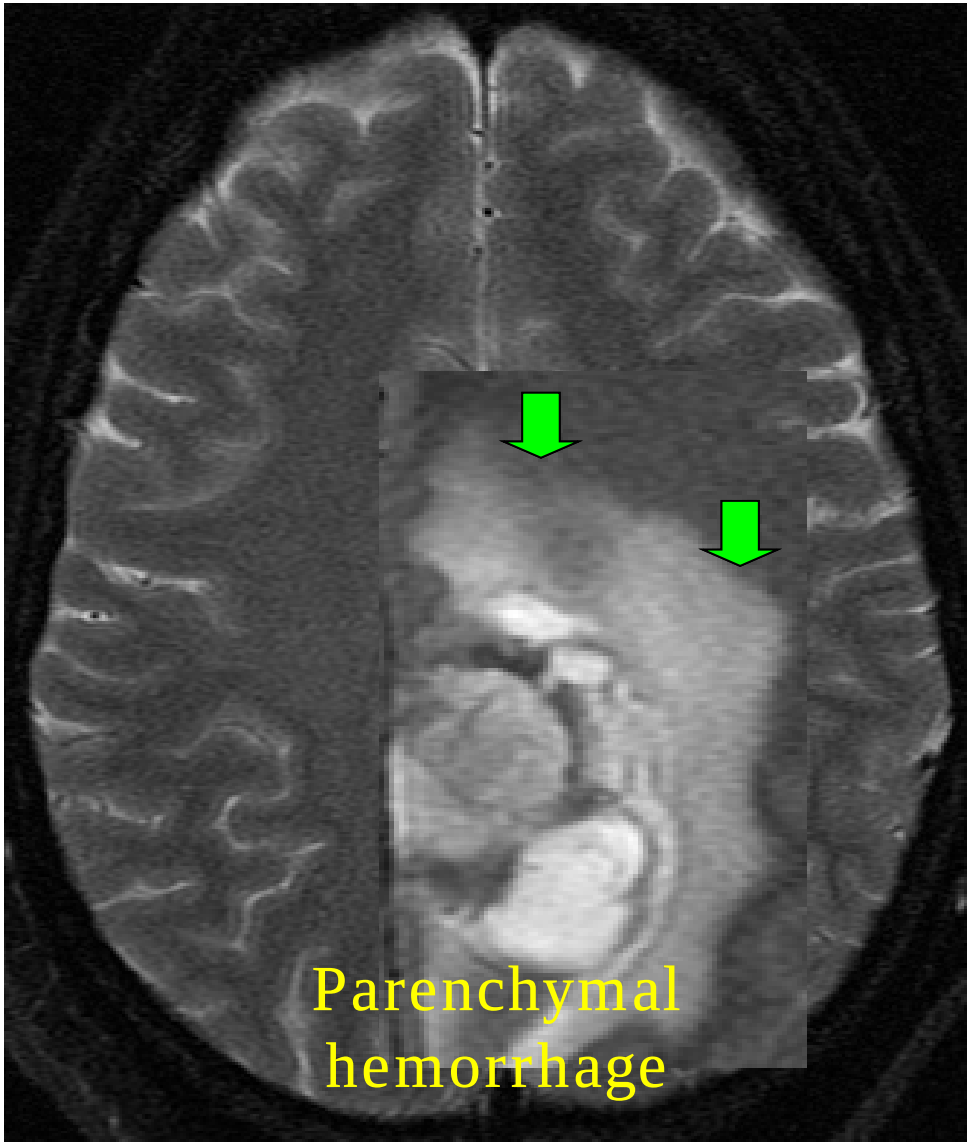


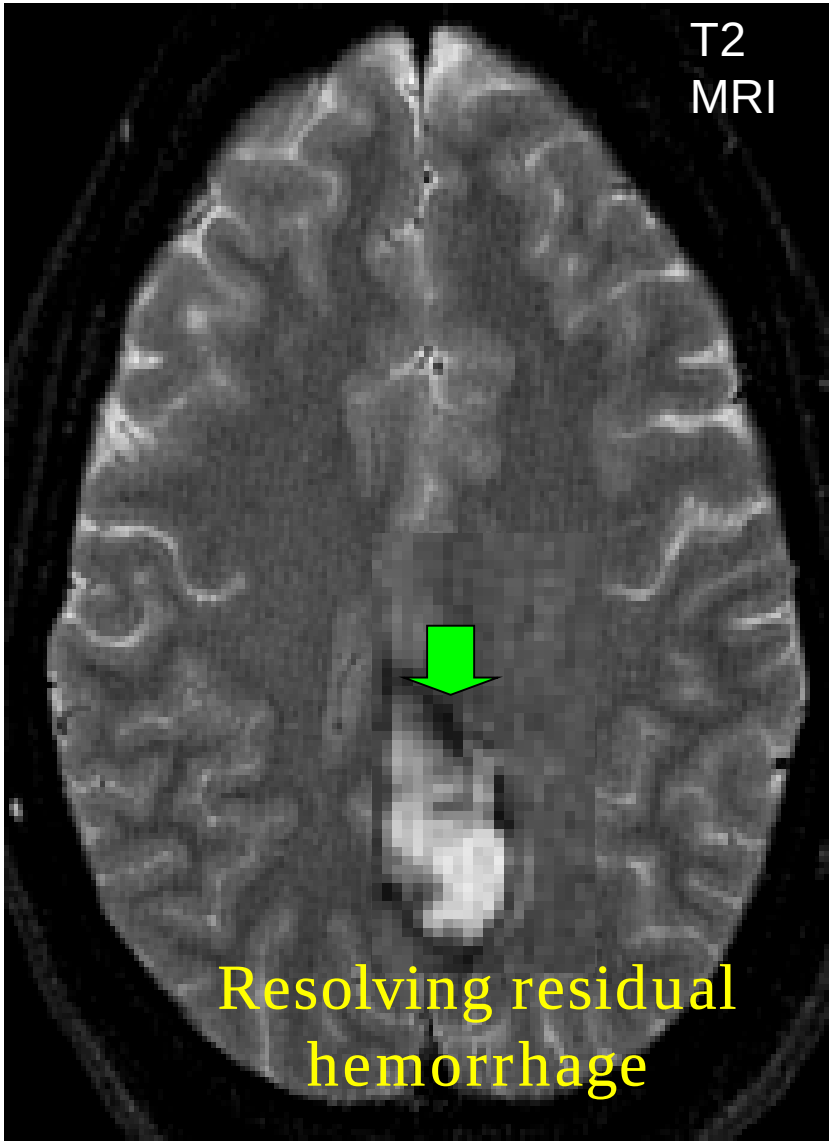
Parietal Hemorrhage



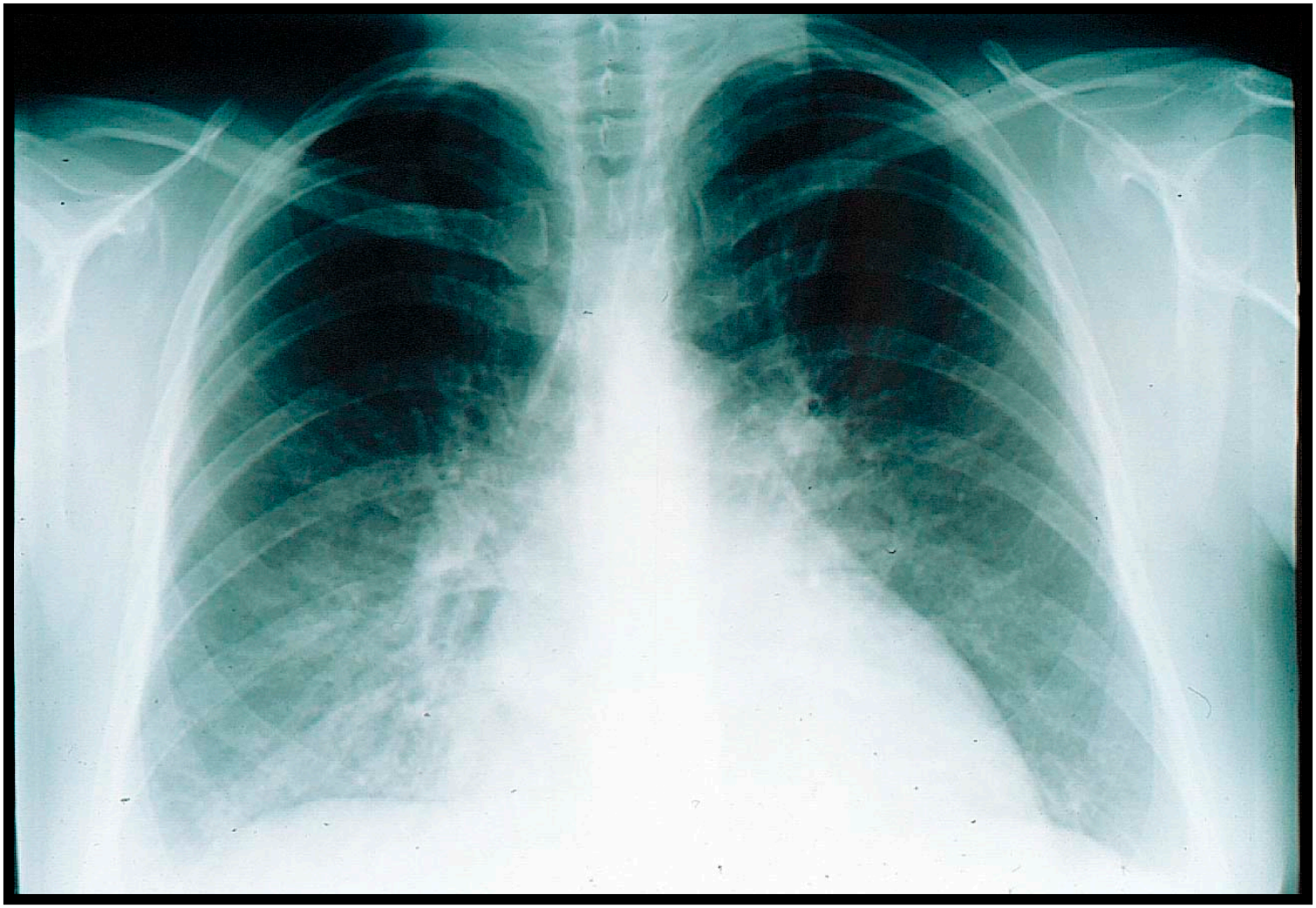


Parietal Hemorrhage

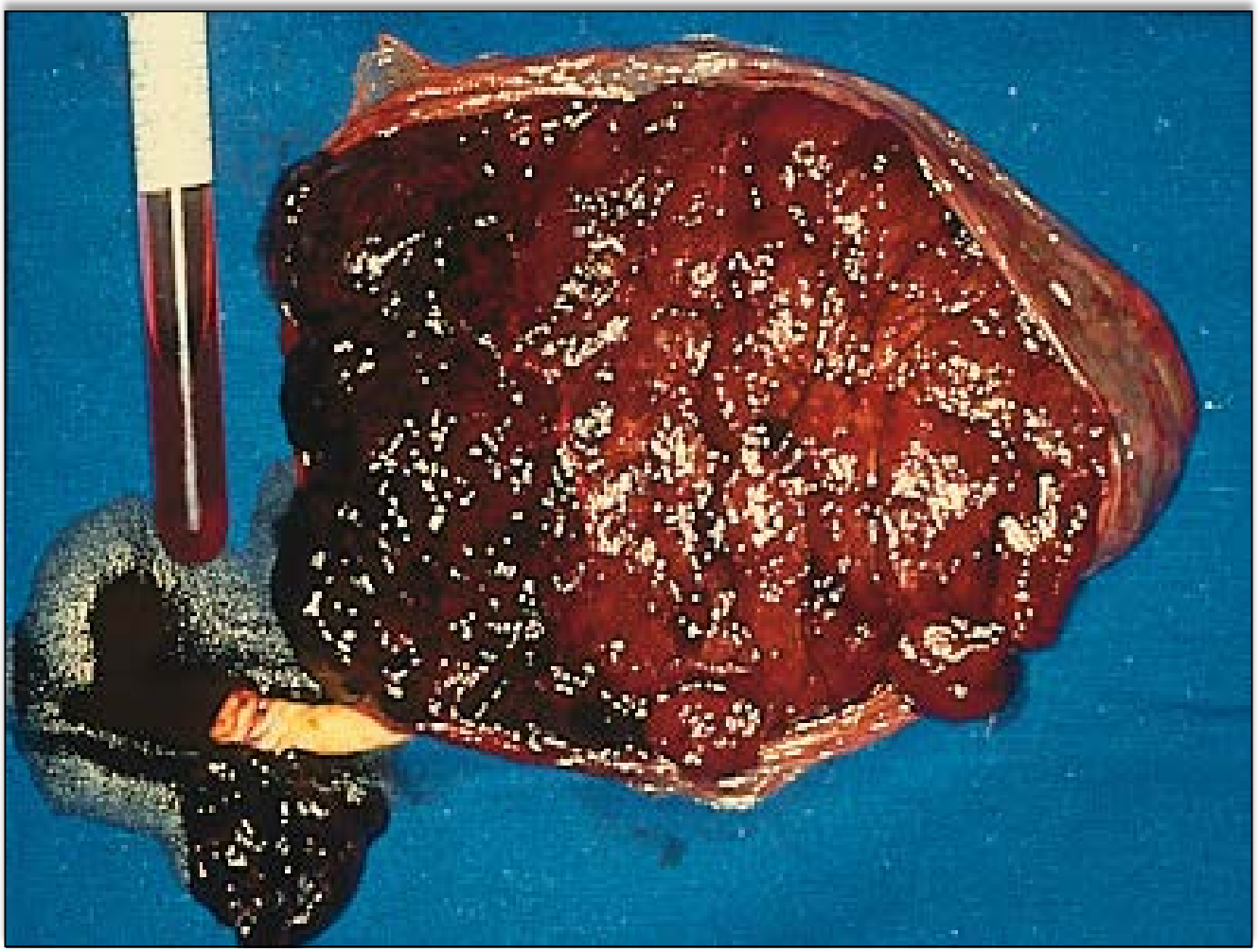




Afterload reduction reduces pulmonary edema



Abruptio Placentae



Blood Pressure Basics

BP measurement is one of the most important basic clinical assessments that we do, yet it is often one of the most inaccurately performed assessments, leading to delays in diagnosis and treatment

Case in Point

- 31 y.o., G1 P0 at 36 4/7 weeks presented to L&D with HTN (BPs ranging from 148/94 - 156/86)
- Induction of labor begun and when BP (in side lying position) was normal, induction discontinued and pt sent home
- Three days later (37 weeks) pt presented to L&D for scheduled follow up. BP 137/89 (semi-fowlers) and 121/76 (R. lateral) with trace of protein
- Sent home on bedrest

Case Study, Continued

- Pt returned to same hospital at 42 wks for "cervical ripening with hx of preeclampsia"
- C/S at 8 cm for failure to progress
- VS stable with BPs in 111/65 – 152/97 range
- At 11 hrs post-op, BP 152/99
- On post-op day 2, she C/O severe headache with BPs ranging from 176/86 – 240/120.

Case Study, Continued

- She coded within minutes and was transferred to a higher level of care secondary to acute coma with subdural hematoma and midline shift
- She died 18 hrs after transport on PP day 3

Steps for Obtaining Accurate Blood Pressure Measurements

Step 1: Prepare equipment	a. Mercury sphygmomanometer is gold standard, can use validated equivalent automated equipment b. Check cuff for any defaults c. Obtain correct size cuff: width of bladder 40% of circumference and encircle 80% of arm (See Figure 1)
Step 2: Prepare the patient: 	a. Use a sitting or semi-reclining position with back supported and arm at heart level b. Patient to sit quietly for 5 minutes prior to measurement c. Bare upper arm of any restrictive clothing d. Patients feet should be flat, not dangling from examination table or bed, and her legs uncrossed e. Assess any recent (within previous 30 minutes) consumption of caffeine or nicotine. If blood pressures are at the level that requires treatment, consumption of nicotine or caffeine should not lead to delays in instituting appropriate anti-hypertensive therapies
Step 3: Take measurement	a. Support patients arm at heart level, seated in semi-fowlers position b. For ausculatory measurement: use first audible sound (Kortokoff I) as systolic pressure and use disappearance of sound (Kortokoff V) as diastolic pressure c. Read to the nearest 2 mm Hg d. Instruct the patient not to talk e. At least one additional readings should be taken within 15 minutes f. Use the highest reading g. If greater than or equal to 140/90, repeat within 15 minutes and if still elevated, further evaluation for preeclampsia is warranted. **Do not reposition patient to either side to obtain a lower BP. This will give you a false reading.**
Step 4: Record Measurement	Document BP, patient position, and arm in which taken

Adapted from Peters RM (2008) High blood pressure in pregnancy. Nursing for Women's Health, Oct/Nov, pp. 410-422. Photo courtesy of and printed with permission by Kristi Gabel, RNC-OB, C-EFM, MSN, CNS, Sutter Roseville Medical Center 2013.

Equipment

- Ausculatory
  - Mercury Sphygmomanometer
    - Gold Standard
  - Aneroid (clock face)
    - Needs to be calibrated with a mercury sphygmomanometer every 6 months

- Oscillometric (automated devices)
  - AHA recommends that these devices be validated with mercury sphygmomanometer readings with every patient

Automated BP Measurements

What variance is clinically acceptable?

- The International Standards Organization ISO 81060-2:2009 is used by manufacturers of noninvasive blood pressure devises to test against mercury sphygmomanometers.
- This standard calls for a difference of ±5 mm Hg with a standard deviation of no more than 8 mm Hg.

Appropriately Sized BP Cuff

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Cuff size and placement

- Correct cuff size (width of bladder 40% of circumference and encircle 80% of arm.
- Measure at the midpoint of the upper arm.
- Place cuff directly on skin with bladder over brachial artery and lower end of cuff 2-3 cm above the antecubital fossa

Arm Circumference (cm)	Cuff Size
22-26	"Small Adult": 12x22 cm
27-34	"Adult": 16x30 cm
35-44	"Large Adult": 16x36 cm
45-52	"Adult Thigh": 16x42 cm

Consequences of Mis-Cuffing

Overestimation of BP	Underestimation of BP
Cuff too small (Systolic ↑ by as much as 15 mm Hg)	Cuff too large
Cuff not placed over brachial artery	Brachial artery above heart level
Cuff applied over clothing or too loose	
Arm positioned below heart level and not supported	
Deflation of cuff too slow	Deflation of cuff too fast

Patient Preparation & Positioning

- Use a sitting or semi-reclining position with arm at heart level, legs uncrossed and feet flat, not dangling.
- The back should be supported.
- Patient should sit quietly for five minutes before BP is taken.
- Assess any recent (within 30 min) consumption of caffeine or nicotine.
- Background noise and talking can all affect BP accuracy.

Consequences of Improper Positioning

- If back is unsupported: Diastolic may be higher by 6 mmHg (Pickering TG et al; Circulation 2005)
- If the legs are crossed: Systolic may be higher by 2-8 mmHg (Pickering TG et al; Circulation 2005)
- If the arm is allowed to hang down, unsupported: the BP will be elevated by 10-12 mm Hg (O'Brien E. J Hypertension, 2003)
- If patient is talking: BP may increase by 8-15 mm HG

Pickering TG, Hall JE, Appel LJ, et al. Recommendations for blood pressure measurement in humans and experimental animals: part 1: blood pressure measurement in humans: a statement for professionals from the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. Circulation 2005; 111:697.
O'Brien, E. Ambulatory blood pressure measurement is indispensible to good clinical practice. J Hypertens 2003; 21(suppl 2):S11.

Take Blood Pressure Measurement

- Support patients arm at heart level
- For ausculatory measurement: use first audible sound (Kortokoff I) as systolic pressure and use disappearance of sound (Kortokoff V) as diastolic pressure
- Deflate cuff slowly, 2-3 mm Hg per heartbeat
- Read to the nearest 2 mm Hg

Take Blood Pressure Measurement

- Retake in other arm, use the highest reading
- If ≥ 140/90, repeat within 15 minutes
- Auto BP cuffs overestimate systolic by 4-6 mmHg and underestimates diastolic by up to 10 mmHg
- DO NOT reposition patient to either side to obtain a lower BP

Record Measurement

- Document blood pressure
- Patient position
- Location BP taken (Arm, forearm, right or left)
- Cuff size

Choose an Arm

- Upper arm = lower BP
- Lower arm = higher BP

Arm above the heart: Even lower BP

Blood pressure recording without a patient

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Automated BP measurements irrespective of:

- Position
  - Maternal
  - Cuff
- ± Contractions
- ± Epidural
- Pushing

Key Points

- Be Consistent
  - Same arm
  - Same position
  - Same cuff size
- Evaluate BP trends vs. isolated values
- If using automatic BP monitors, do not "auto-cycle". Be present to confirm appropriate BP technique criteria have been met

What if the BMI = 70 kg/m^2 ?

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Challenges in BP Measurement in Obese Women

- Size of arm
- Shape of arm
- Length of arm
- Cuff sizes and shapes

For Example

- When the arm circumference near the shoulder is much > the arm circumference near the elbow=poor cuff fit=inaccurate BP
- A large arm circumference + a short humeral length = an inaccurate BP utilizing a cylindrical thigh cuff due to cuff extension past the elbow

Mis-cuffing in an Obese Patient

- Using a cuff that is too small can overestimate blood pressure by up to 30 mm Hg whereas using a cuff that is too large can underestimate blood pressure by 10-30 mm Hg

  – Palatini P, Parati G. Blood pressure measurement in very obese patients: a challenging problem. Journal of Hypertension 2011, 29 (3) 425-429.

Original Article

Rectangular cuffs may overestimate blood pressure in individuals with large conical arms

Paolo Palatini, Elisabetta Benetti, Claudio Fania, Giacomo Malipiero, and Francesca Saladini

Journal of Hypertension 2012, 30:530-536

Objectives: Although the upper arm has the shape of a truncated cone, cylindrical cuffs and bladders are currently used for blood pressure (BP) measurement. The aim of this study was to ascertain whether cylindrical and tronco-conical cuffs provide different readings according to arm size and shape.

near the elbow, a cylindrical (rectangular) cuff will expand irregularly over the lower part of the upper arm, making it difficult to perform a reliable measurement. Cone-shaped arms can be frequently encountered in obese patients, and may be an important source of inaccurate BP measurement [1–3]. Recent anthropometric data document an increased prevalence of obesity among adults [4], resulting in a

Conclusion: In obese people, the upper arm may have a pronounced tronco-conical shape and cylindrical cuffs may overestimate BP. Troco-conical cuffs should be used for BP measurement in individuals with large arms

Conclusion: Use of cylindrical cuff in combination with an oscillometric automatic device, overestimated SBP in patient with arm circumference > 30 cm, but when a conical cuff was used, the device provided accurate readings

Hypertension Research (2010) 33, 1186–1191

www.nature.com/hr

ORIGINAL ARTICLE

Accuracy of a single rigid conical cuff with standard-size bladder coupled to an automatic oscillometric device over a wide range of arm circumferences

Elisa Bonso, Francesca Saladini, Ada Zanier, Elisabetta Benetti, Francesca Dorigatti and Paolo Palatini

AHA BP Measurement Recommendations

- If upper-arm circumference is more than 34 cm, large adult cuffs or thigh cuffs can be used.
- For upper-arm measurements greater than 50cm, the AHA recommends using a cuff on the forearm and feeling for the appearance of the radial pulse at the wrist to estimate systolic BP. The accuracy however is not as reliable.

So What Can We Do to Improve BP Measurement Accuracy?

Education Strategies

- Ensure proper training of staff:
  - Incorporate accurate BP measurements in annual “skills day”
  - Develop a facility specific module
  - NEJM BP Training: http://www.nejm.org/doi/full/10.1056/NEJMvcm0800157
  - Poster Boards
  - Laminate “Steps to Obtain Accurate Blood Pressure” and post on units

BP Kit

- Selection of cuff sizes
- Sphygmomanometer
- Measuring tape
- Stethoscope
- Laminated instructions for cuff measurements and key actions
- Optional: Reflex hammer, debrief tool

Strategies for Implementation of Accurate BP Measurements

- Create your “Burning Platform”
- Inventory your equipment to and make sure that it is regularly inspected, calibrated and validated
- Ensure that all staff are trained in standardized BP measurement technique
- Update protocol to reflect current recommendations and guidelines

Q&A Session

Press ***1** to ask a question

You will enter the question queue

Your line will be unmuted by the operator for your turn

A recording of this presentation will be made available on our website:

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Next Safety Action Series

Using the Revised Severe Maternal Morbidity Review Forms

Thursday, August 20, 2015 | Noon ET

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Maimonides Medical Center

Sarah Kilpatrick, MD, PhD, FACOG
Chair, Department of Obstetrics & Gynecology
Associate Dean, Faculty Development
Cedars-Sinai Medical Center

Sandra McCalla, MD, FACOG
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