BLOOD PRESSURE MANAGEMENT AMONG ACUTE BRAIN INJURIES?

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Different Specialties....Different Strokes
What is your BP Goal?

It depends???
To understand the principles behind the BP goals among patients with acute brain injuries

Suggested approach to BP Management
Introduction
Ischemic stroke
Hemorrhagic stroke
Elevated ICP
Recommendations
COMMON QUESTIONS AMONG PATIENTS WITH ACUTE BRAIN INJURIES:

1. How should we manage the BP?
2. What factors will affect the BP goals? (ICP inc?)
3. How low or how high should we aim for the BP?
4. How fast or how slow should we achieve the BP goal?
O.C., 52 y/o R-handed male from Zamboanga, Hypertensive for 15 years (usual BP 150 / 90), with known CAD, ARI, Dyslipidemia and Diabetes

Chief complaint:
Slurred speech with right sided weakness of 3 hours duration
Physical Examination
BP 200/80 (MAP = 120)
CR = 95
RR = 24
Temp = 37.0 C
PE = unremarkable (no carotid bruits)

MAP = systolic + 2(diastolic)

Neurological Examination:
Patient was awake, alert, follows command, mild dysarthria, preferential gaze to the right but crosses midline, left hemianopsia, (+) Shallow left nasolabial fold
Left motor weakness (arm and leg) at 3/5,
(+) 70% sensory deficit over the left upper and lower extremity, hyperreflexia on the left side, (+) Babinski, left
Diagnostics:

CBG = 168 mg/dl
Bleeding parameters – within normal limits
Blood chemistries – within normal limits
12 L ECG : Normal sinus rhythm
Chest x-ray : No infiltrates

What do you want to know that will help you decide what BP goal you want for O.C.?
What do you need to know?

1. Stroke subtype: Ischemic vs Hemorrhagic
2. Age of stroke: Acute, Subacute or Chronic Stroke
3. Stroke mechanism: Athero, Embolic or Hemodynamic
4. Stroke severity: (+/- increase ICP)
5. History of chronic hypertension
6. Other factors that increase BP
7. rTPA candidate: Yes or No
Penumbra:

- Ischaemic core: (brain tissue destined to die)
- Penumbra: (salvageable brain area)

Penumbra: <35 ml/100 gm/min

Let’s go back to O.C.…….

CT SCAN = NORMAL

MRI

MRA

Right M1 proximal occlusion

Right MCA infarction
EMERGENCY ROOM

- Admitted
- Plain NSS IVF
- ASA 80 mg, Statins given
- Oral anti-HPN meds on hold
- O₂ supplementation
- flat or 15° elevation of the head
- NVS, CBG, temp, fluid status monitored
- Insert NGT if needed – start feeding
When will you intervene?

A. 4th hour – BP 160 / 80  (MAP = 106)
B. 5th hour – BP 180 / 100  (MAP = 126)
C. 6th hour – BP 210 / 90  (MAP = 130)
D. 7th hour – BP 210/110  (MAP = 143)

Recommend: SSP Guidelines

MAP = systolic + 2(diastolic)
Acute Ischemic stroke: first 5-7 days

1. In Ischemic stroke: Goal is to salvage the **Penumbra**

   ✓ **Treat only** if with any of the ff:
   
   **SBP > 220** or **DBP > 120** or **MAP > 130 mmHg**

   \[
   \text{MAP} = \text{systolic} + 2(\text{diastolic})
   \]

2. Use easily titratable IV or short acting oral antiHPN meds

   \[
   \text{MAP} = 110-130 \text{ mmHg}
   \]
3. STOP! Permissive Hypertension if patient has the ff:

- Acute MI
- CHF
- Aortic dissection
- Acute pulmonary edema
- Acute renal failure
- Hypertensive encephalopathy

*Permissive HPN but with cardiac and renal protection!*
4. Bring down BP to:
   Not more than 10-15% of the MAP in the first 24 hours

   **EXAMPLE:**

   \[
   \text{BP} = 210/110 \quad \text{MAP} = 143 \text{ mmHg}
   \]

   \[
   15\% \text{ of } 143 = 21
   \]

   **Compute for the desired MAP** = \[143 - 21 = 122\]

   The desired BP should not be lower than 180/90.

\[\text{MAP} = \text{systolic} + 2(\text{diastolic})\]
STOP NEUROLOGIC IMPAIRMENT WITH PERMISSIVE HYPERTENSION

Ischaemic core (brain tissue destined to die)

Penumbra (salvageable brain area)

Penumbra: <35 ml/100 gm/min

1. In acute ischemic stroke, autoregulation is paralyzed in the affected tissues with cerebral blood flow (CBF) passively following MAP.

2. Rapid BP lowering can lead to further ↓ perfusion in the penumbra
WHY RAPID BP LOWERING IN ACUTE STROKE IS NOT RECOMMENDED

3. HPN is typically present in acute stroke, with spontaneous decline within the first 5 - 7 days

4. ↑ ICP during the acute phase of large infarcts reduces the net CPP
Cerebral Blood Flow (ml/100g/minute)

Mean Arterial Blood Pressure (mmHg)

Normotensive: 110-130 mmHg

Mild Ischemia

Severe Ischemia

Hypertensive
Admission BP & 30 day Mortality

N = 1004 acute ischemic stroke ≤ 24 hours

Spontaneous Decline in BP after Acute Stroke

Mean change 22 mm Hg from adm to D7

Mean change 12 mm Hg from adm to D7

“Several reports document neurological deterioration from significant pharmacologic lowering of BP”

Oliveiria - Filho J. et al. Neurology 2003
Castillo, J et al. Stroke 2004
LET US GO BACK TO O.C. AGAIN.....
AFTER 9 DAYS - DISCHARGED

What will be your BP goal upon follow up?

Initial follow up (BP threshold): 140/90mmHg

Subsequent follow up (Intermediate BP Goal): 130-139/80-85
G.M., 63 y/o R-handed female from Tarlac, known to be hypertensive for 10 years (usual BP 130 / 90). Decided to stop her medications a week before.

Chief complaint:
Left sided weakness
Physical Examination (vomited during examination)
- BP = 220/80 (MAP = 127)
- CR = 120
- RR = 26
- Temp = 37.5 C
- PE = unremarkable except diaphoretic

Neurological Examination:
- Patient was drowsy but still able to follow commands correctly and intact orientation, severely dysarthric, pupils equally reactive at 2-3 mm BRTL, Full EOMs (+) Shallow left nasolabial fold
- Left hemiplegia (arm and leg) with Babinski
Diagnostics:

CBG = 110 mg/dl
Bleeding parameters – Normal limits
Blood chemistries – Normal
12 L ECG : LVH
Chest x-ray : normal

What do you want to know?
IS THIS AN INFARCT OR HEMORRHAGE?

IS THIS PENUMBRA?
When will you intervene?

A. Control BP if SBP < 140
B. Control BP if SBP > 160
C. Control BP if MAP < 110
D. Control BP if MAP > 110

Recommend: SSP Guidelines

MAP = systolic + 2(diastolic)
EXAMPLE OF HEMATOMA EXPANSION IN ICH

• 14%-38% of ICHs expand within 24 hours
• Hypertension may predispose to ICH enlargement

Fuji Y et al Stroke. 1998;29:1160; Ohwaki K et al. Stroke. 2004;35:1364
Acute ICH - first 5 – 7 days

In Hypertensive ICH:
Reduce hematoma expansion

Target MAP ≈ 110 or SBP ≈ 160
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<th>2005</th>
<th>2010</th>
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<tbody>
<tr>
<td><strong>Maintain SBP at 160-180 mm Hg</strong></td>
<td>Maintain SBP at 140-160 mmHg ATACH and INTERACT</td>
<td>Intensive BP lowering = 140 mm Hg SAFE!</td>
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<tr>
<td><strong>Absence of penumbra allows for more aggressive BP management</strong></td>
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<td><strong>Sustained hypertension may alter cerebral autoregulation, promote progression of bleed and increase edema</strong></td>
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<td><strong>Hypotension may result in cerebral hypoperfusion especially in the setting of increased intracranial pressure (ICP)</strong></td>
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When is the best time to resume or start oral antihypertensive medications?

Need to factor in the following in starting oral meds:

1. Neurologic status (stable, fluctuating, progressing)
2. Stroke mechanism (hemodynamic vs embolic)
3. Presence & risk of developing Increased Intracranial Pressure (ICP)
IF WITH ELEVATED ICP ........ WHAT TO DO?
Compliance: \( \Delta \) in volume/pressure

Increasing intracranial volumes:
- A0: Normal ICP
- A1: ICP high normal
- B: ICP rapidly increases
- First CSF, second CBV translocation

Raised ICP:
- \( \rightarrow \) CBF and ischemia
- \( \Rightarrow \) Pressure gradients: herniation
  (compartmental alterations)

- Mariano, Fink, Hoffman & Rosengart, Principles of Critical Care, 4th ed
CEREBRAL PERFUSION PRESSURE (CPP)

CPP = MAP – ICP

Goal CPP = 70-100 mmHg

Raised ICP leads to Depressed Consciousness

↑ ICP => ↓ CPP => cerebral ischemia & encephalopathy => decreased consciousness
CONSEQUENCE OF INCREASED ICP (REDUCTION IN CPP)

Cerebral Perfusion Pressure (CPP) = MAP - ICP
Cerebral Blood Flow (ml/100gm/min)

- Hypoperfusion
- Normal perfusion
- Hyperperfusion

PaO_2 and PaCO_2 levels:
- 0 PaO_2: 17.5, 35, 52.5, 70 mmHg
- 0 PaCO_2: 17.5, 75.8, 151.4, 227 mmHg

Mean Arterial Pressure (mmHg)

Normal CBF: 50 ml/100gm/min

- Mariano, Fink, Hoffman & Rosengart, Principles of Critical Care, 4th ed
Individualize treatment!
Success.

Thank you for your kind attention!