



# Evidence Against Bradycardia and Hypertension as Indicators of Raised Intracranial Pressure

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## LEARNING OBJECTIVES

By the end of this presentation, participants should be able to

1. Understand that cushing's triad is not always present in raised ICP

2. Understand need of direct ICP monitoring in neurosurgical critical care

3. Discuss the ambiguity of effects on cardiac physiology due to raised ICP

## INTRODUCTION

Cushing’s triad

- Universally followed principle
- Bradycardia and hypertension as predictor of raised ICP
- Relied upon in centers with no facilities of ICP monitoring

However controversies exist

Ojective of study

- To find whether bradycardia and hypertension are associated with raised ICP

## MATERIALS AND METHODS

Prospectively conducted observational study

Duration: February 2010 to February 2011

Inclusion: Adults who underwent ICP monitoring

Exclusion: Patients with anemia, cardiac disease, fever/ sepsis, previous neurological disorders or spinal injuries

Procedure: External ventricular drain through frontal burr hole

Simultaneous ICP, BP and PR were recorded

## RESULTS

65 out of 104 patients included

Mean age: 34.9 yrs (range: 19-72 yrs).

Male: 81% patients

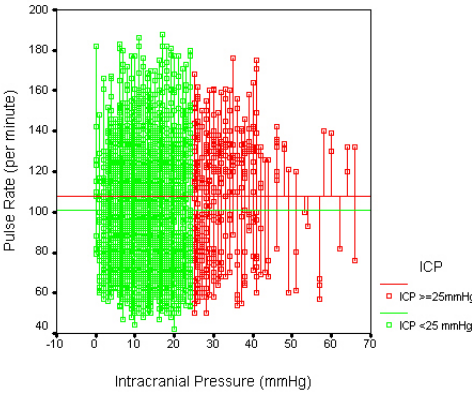
Duration of ICP monitoring: 1-6 days

Number of simultaneous recordings: 3012

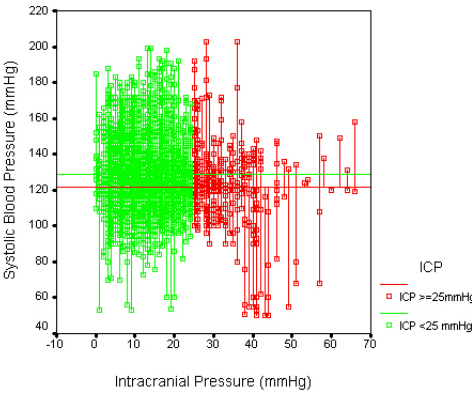
Complications:

- Catheter malposition: 2 (excluded)
- Mortality: 32.3% cases
- Deterioration in GCS: 1.5% cases
- Rise in ICP: 26.2% cases

Scatter plot showing relation between ICP and PR (n=3012)



Scatter plot showing relation between ICP and SBP (n=3012)



## RESULTS

Pearson rank correlation:

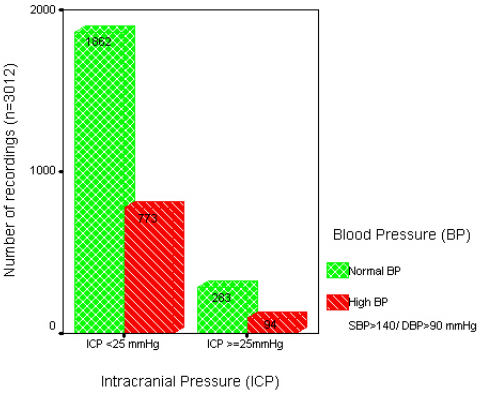
No significant relationship between

- ICP and Pulse rate
- ICP and Blood pressure (SBP/DBP)

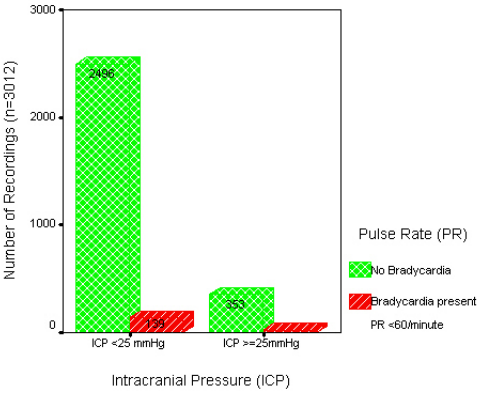
Mann whitney test:

Neither bradycardia nor hypertension significantly associated with rise in intracranial pressure

Graph showing relation between raised ICP and Hypertension



Graph showing relation between raised ICP and Bradycardia



## DISCUSSION

Harvery Cushing: Cushing response (1902)

Wan WH et al, *J Clin Neurosci* 2008

- Despite century of work on the subject, controversy still exist on physiological role of cushing response
- It is not a pre-terminal event

Vander Ark GD, *Surg Neurol* 1975

- Increased ICP adversely affect heart
- BP and Heart rate are not reliable indicator of increased ICP or cerebral disaster

Kalmar et al; *Br J Anaesth* 2005

- Simultaneous onset of hypertension and tachycardia is a better indicator of impaired brain perfusion

Raised ICP cause variable cardiac responses

## CONCLUSIONS

We conclude that bradycardia and hypertension are unreliable indicators of raised ICP

Hence it would be rather appropriate to undertake direct ICP monitoring for patients at risk of cerebral herniation

## ABBREVIATIONS

ICP: Intracranial Pressure  
SBP: Systolic Blood Pressure  
DBP: Diastolic Blood Pressure  
BP: Blood Pressure  
PR: Pulse Rate