Universitätsklinikum
Tübingen

ICP overnight dynamics of pediatric patients

hydrocephalus - macrocephaly - craniostenosis

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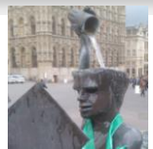

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more insights due to new concepts

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don’t believe in bulk flow theory (from CP to AG)

intra-ventricular obstruction AND extra-ventricular obstruction

distortion/loss of CSF pulsatility in basal cisterns leads to HC

many ways of CSF absorption - forget Paccioni granulations

venous system: important role in primary disease & overdrainage

hydrocephalus is a low compliance disease

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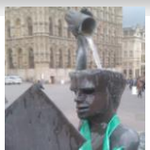

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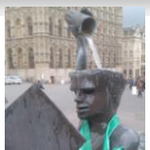
sexy **other** means of investigation: ultrasound, telemetry, **computerized ICP analysis**



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transfer of new concepts into clinical practice

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majority of neurosurgeons not interested in understanding

acknowledgment of pressure compensated hydrocephalus

accept responsibility for 70-80 y of life influenced by our Tx decisions

new books need to be written

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- compliance, pulsatility & ICP dynamics based **objective physiology criteria** for **indication** of treatment and its **success**

- routine **quantitative** assessment of **shunt function - SIS**

- non-invasive assessment of ICP and compliance/reserve capacity : **ONSD**

- US assessment of ventricles after fontanel closure

need for improvement - diagnosing compensated HC

Ventriculomegaly
Macrocephaly
S&S of raised ICP
=
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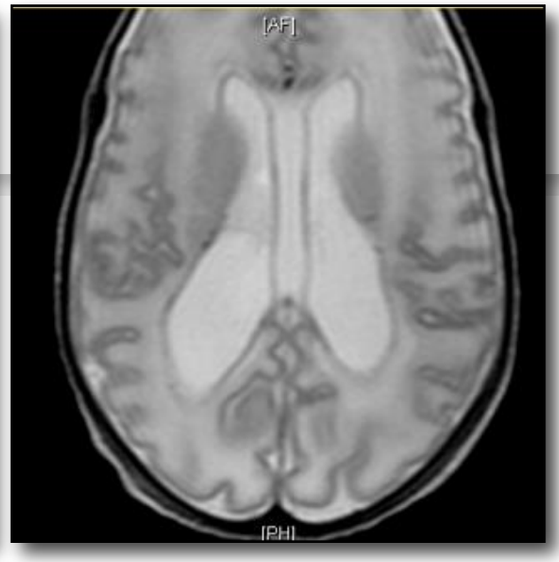
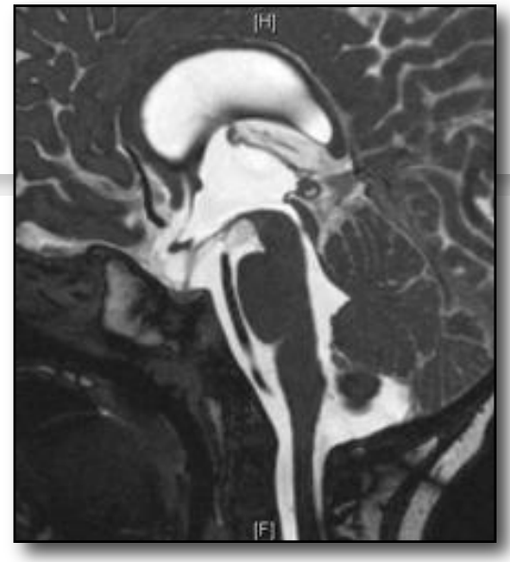
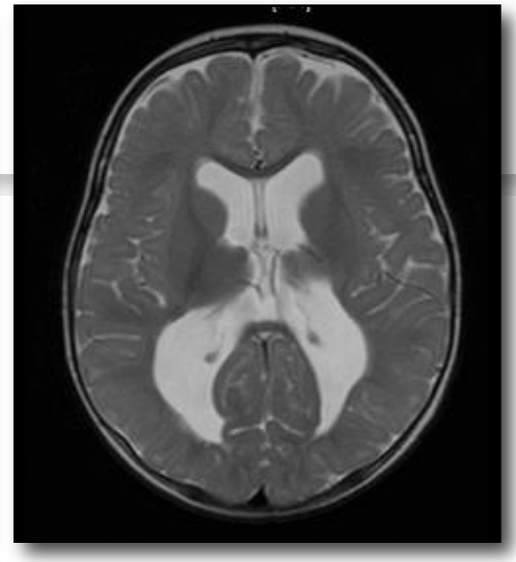
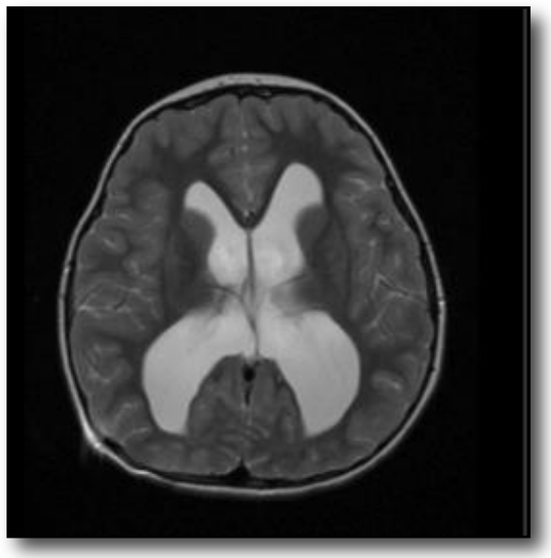
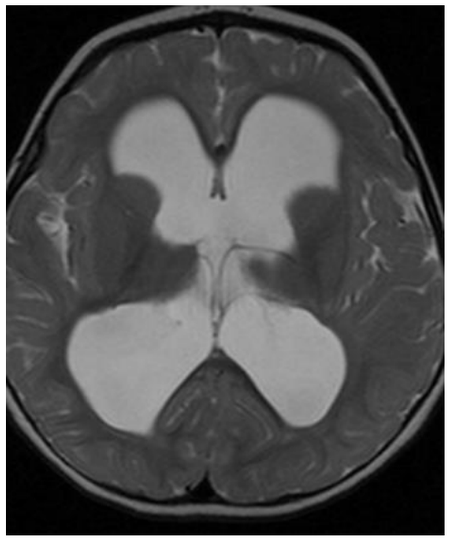
(relative) brain atrophy

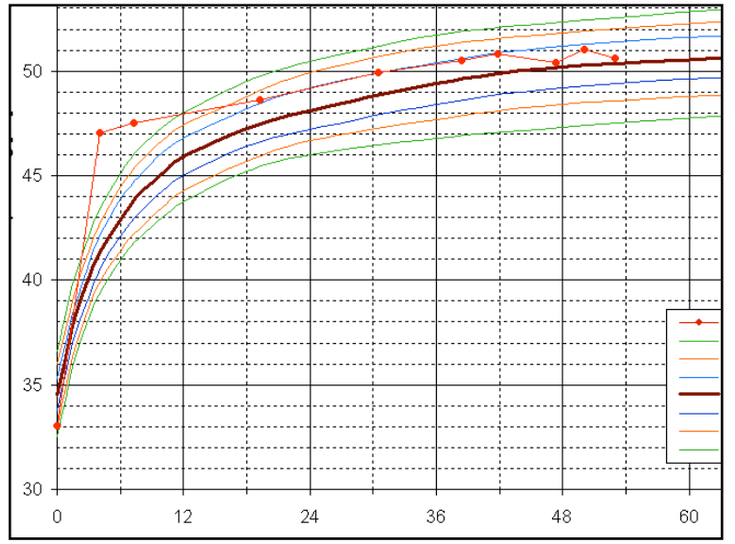


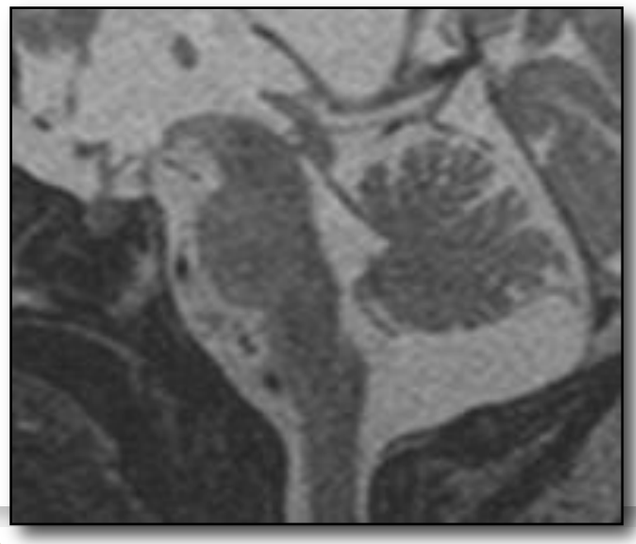


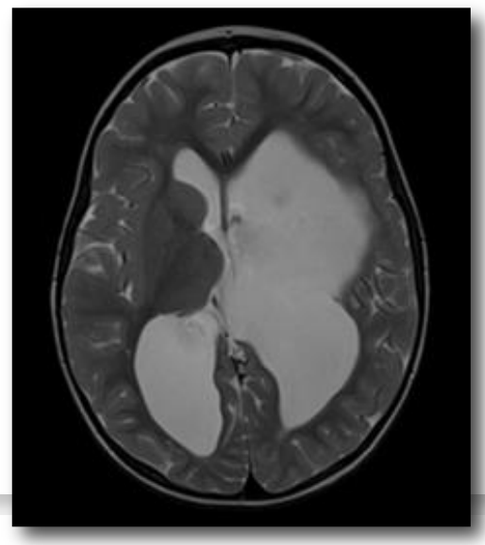












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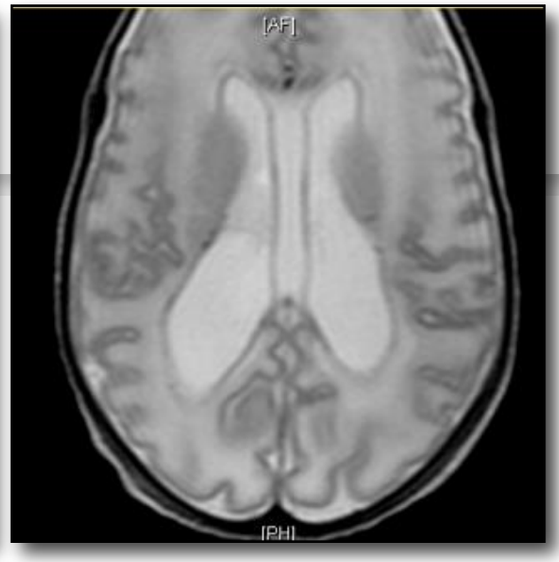
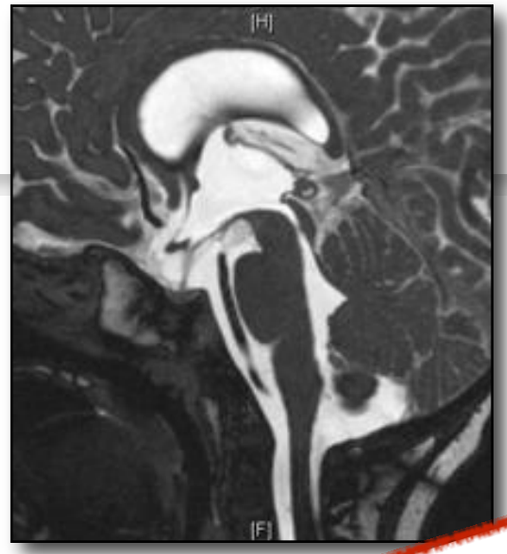
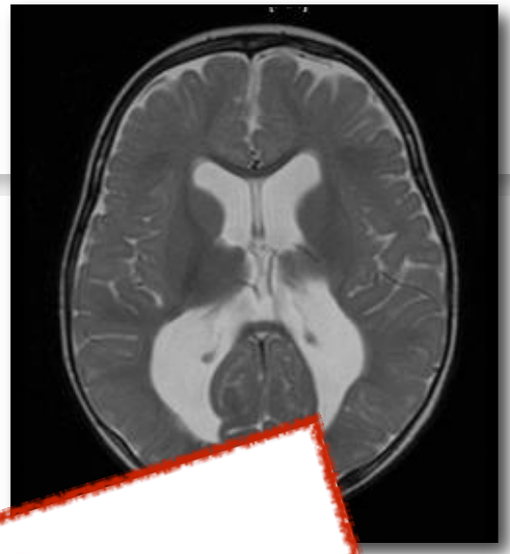
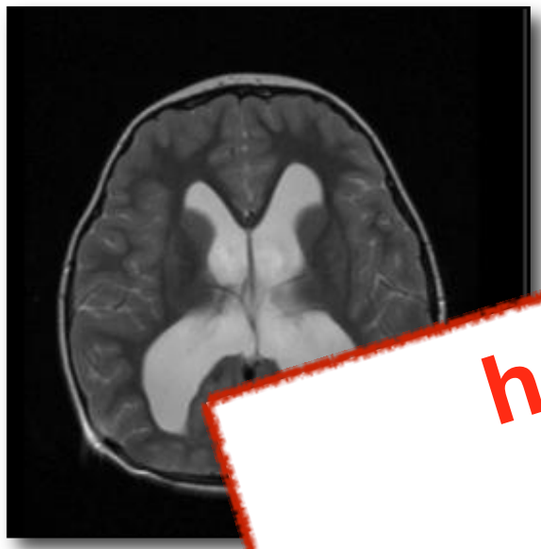
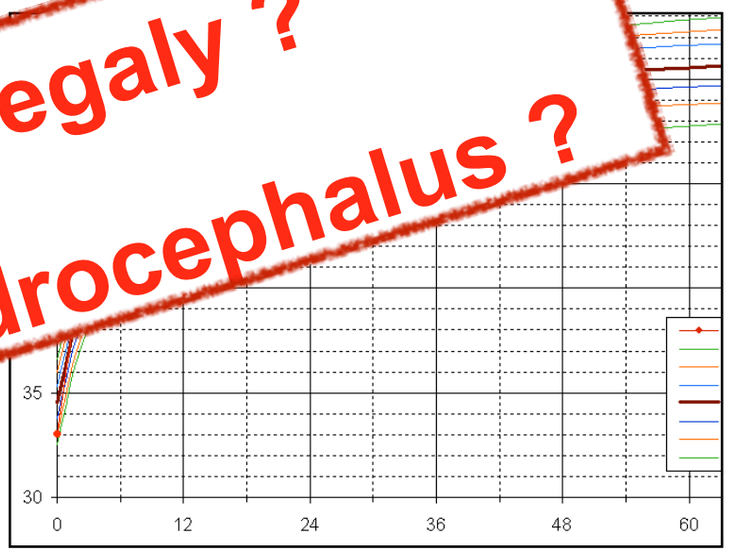
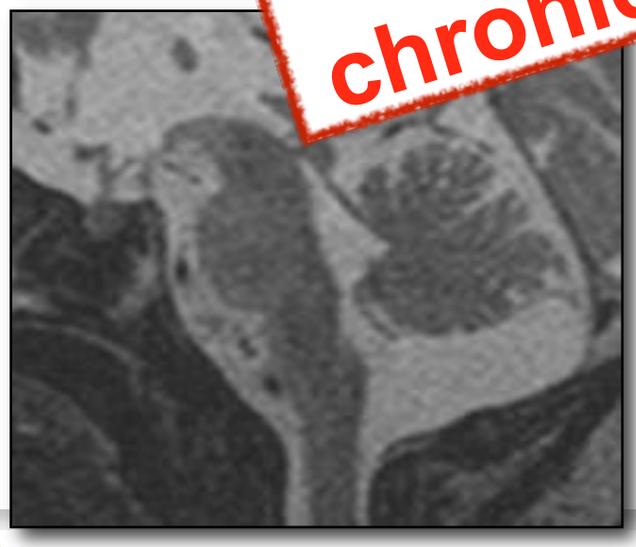
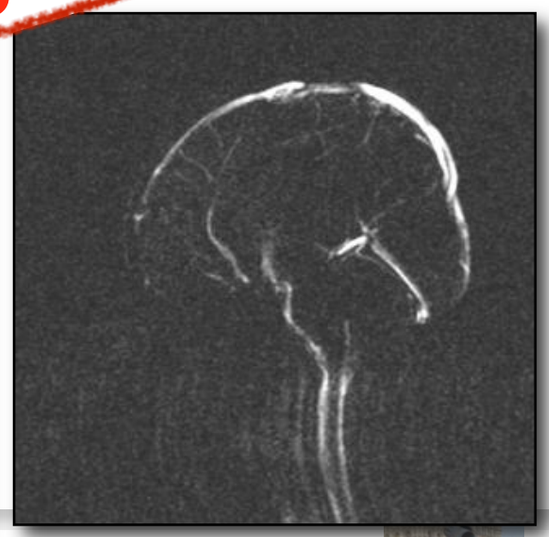
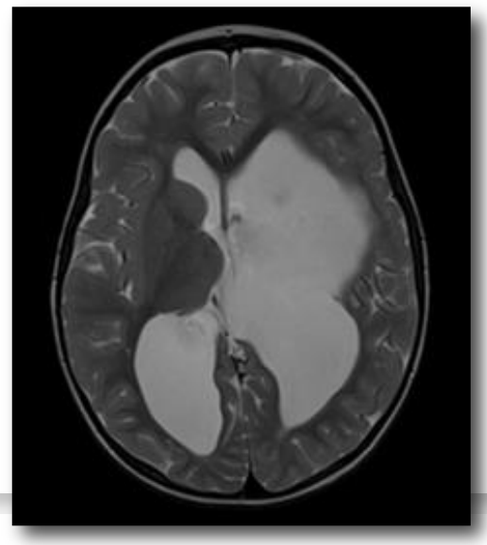
Kinder NCH TÜ



harmless ventriculomegaly ?

chronic compensated hydrocephalus ?

ICP analysis of nocturnal dynamics

no shunt - no reservoir - ventriculomegaly - ± macrocephaly - no obvious symptoms

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no shunt - no reservoir - ventriculomegaly - ± macrocephaly - no obvious symptoms

- ICP transducer at hairline, no shaving, short intubation/sedation
- 5 mm burrhole, screw, intraparenchymal sensor
- children run around all day, go to bed, when asleep parents connect

previous work in symptomatic children with shunts

Pediatric Neurosurgery

Original Paper

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🟡	**20%**	ICP_B o.k.	ICP_p <25	RAP_p > 0,6
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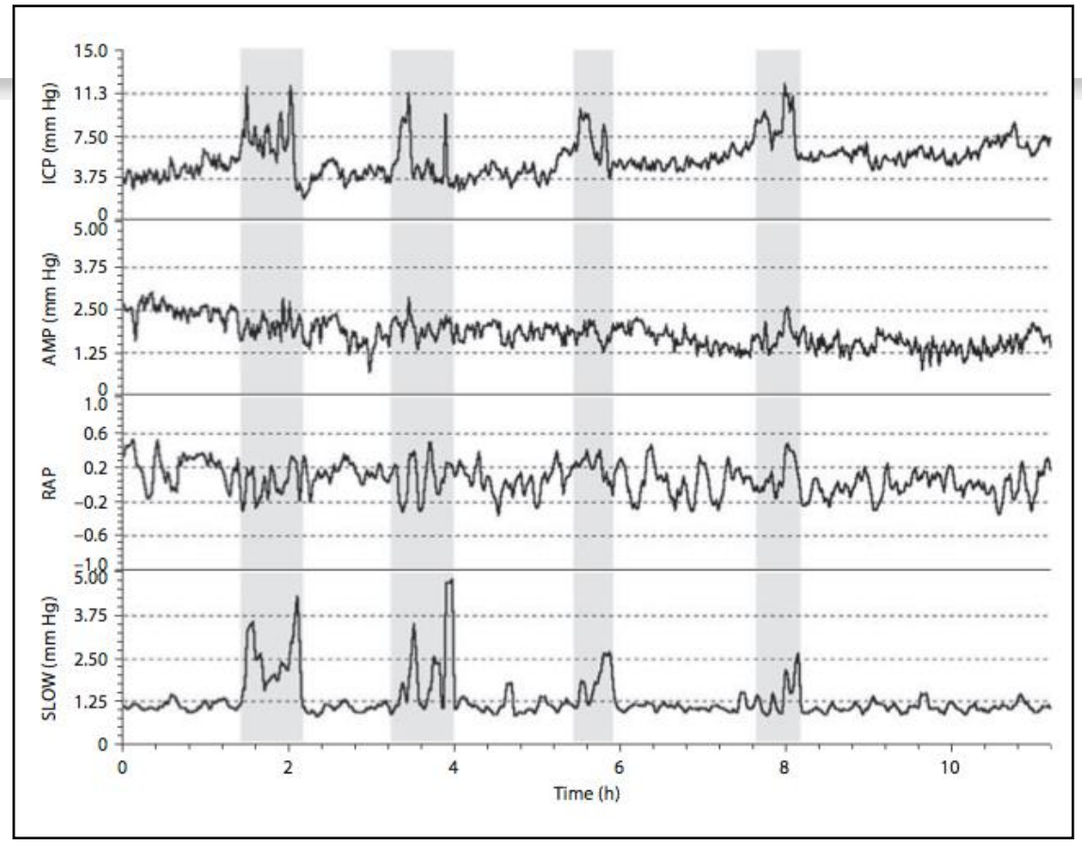

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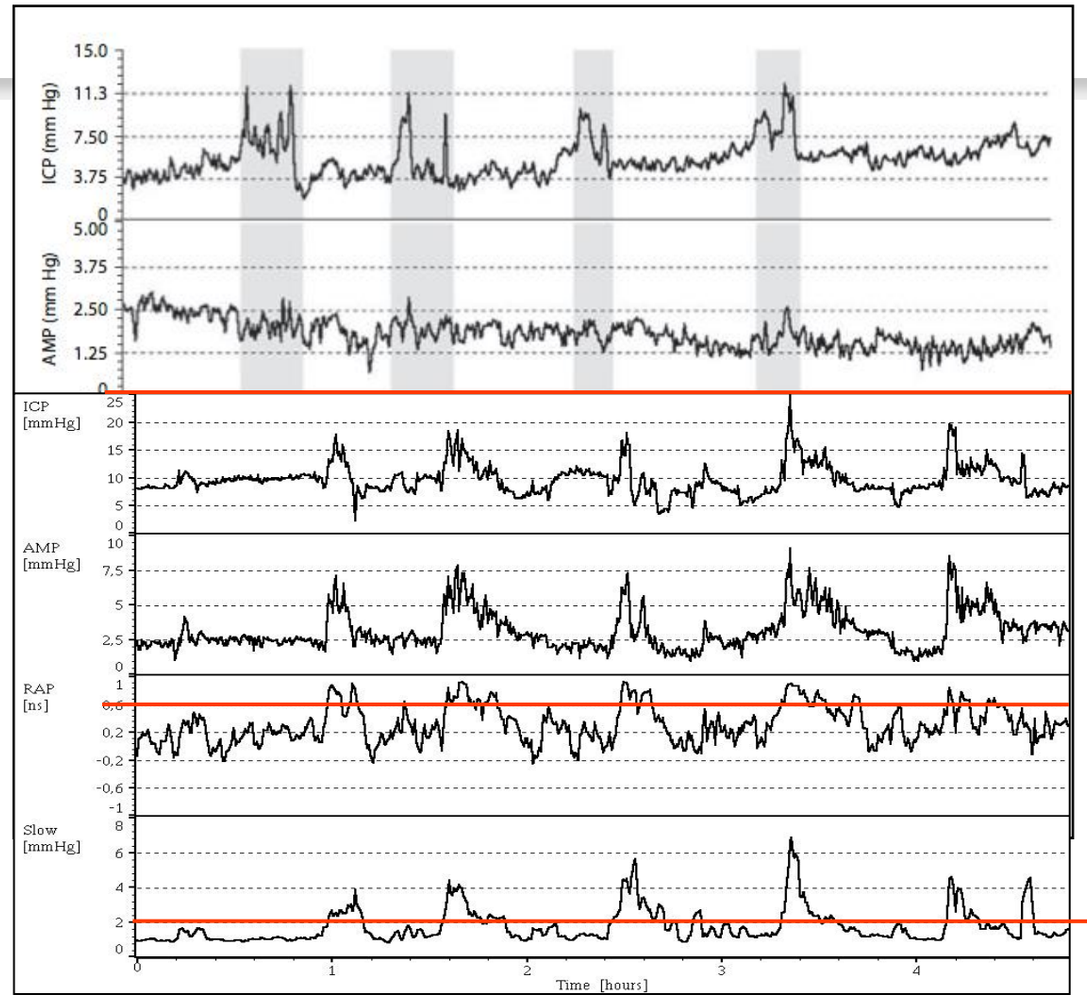

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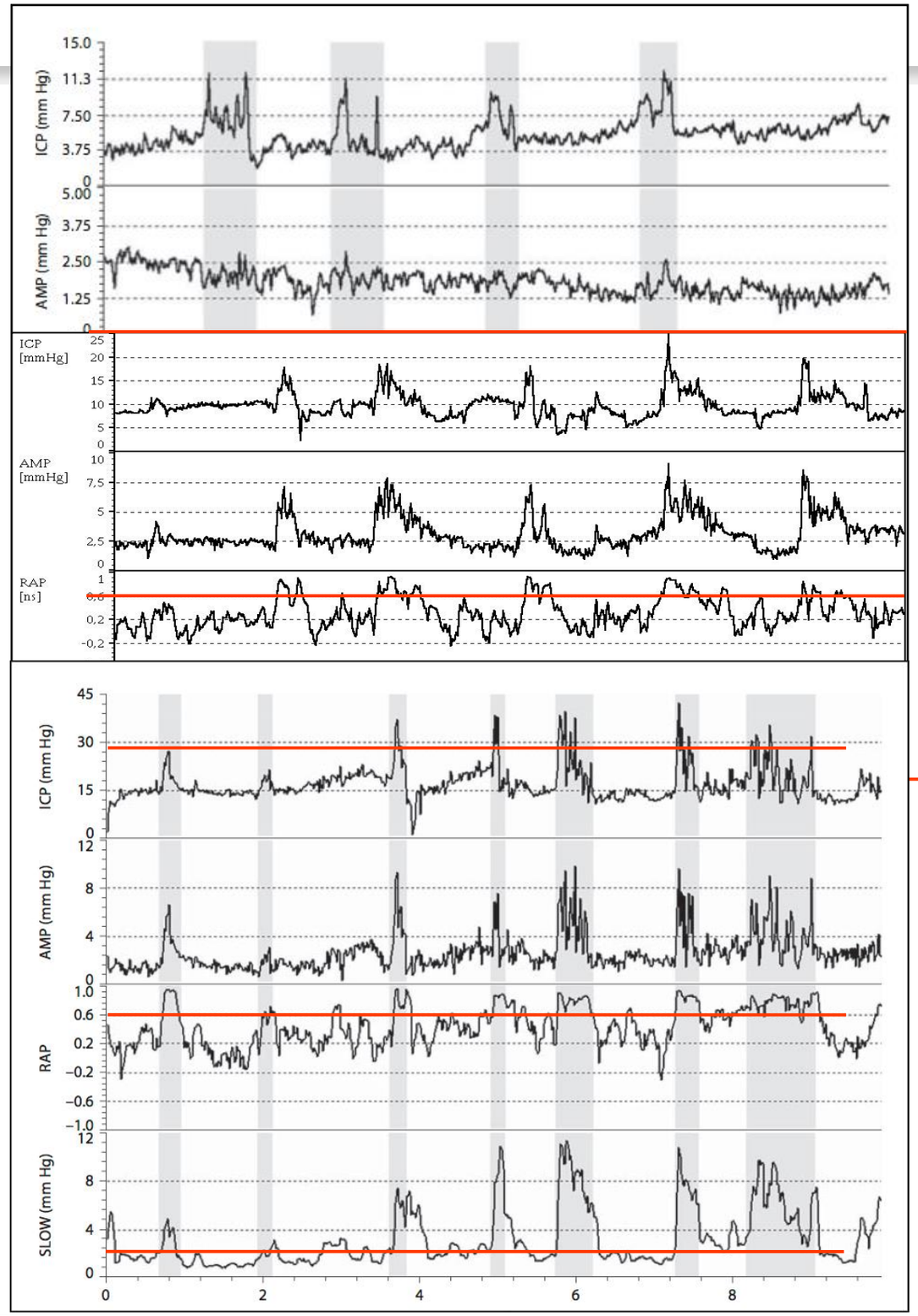

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2) borderline
n=13

3) pathological
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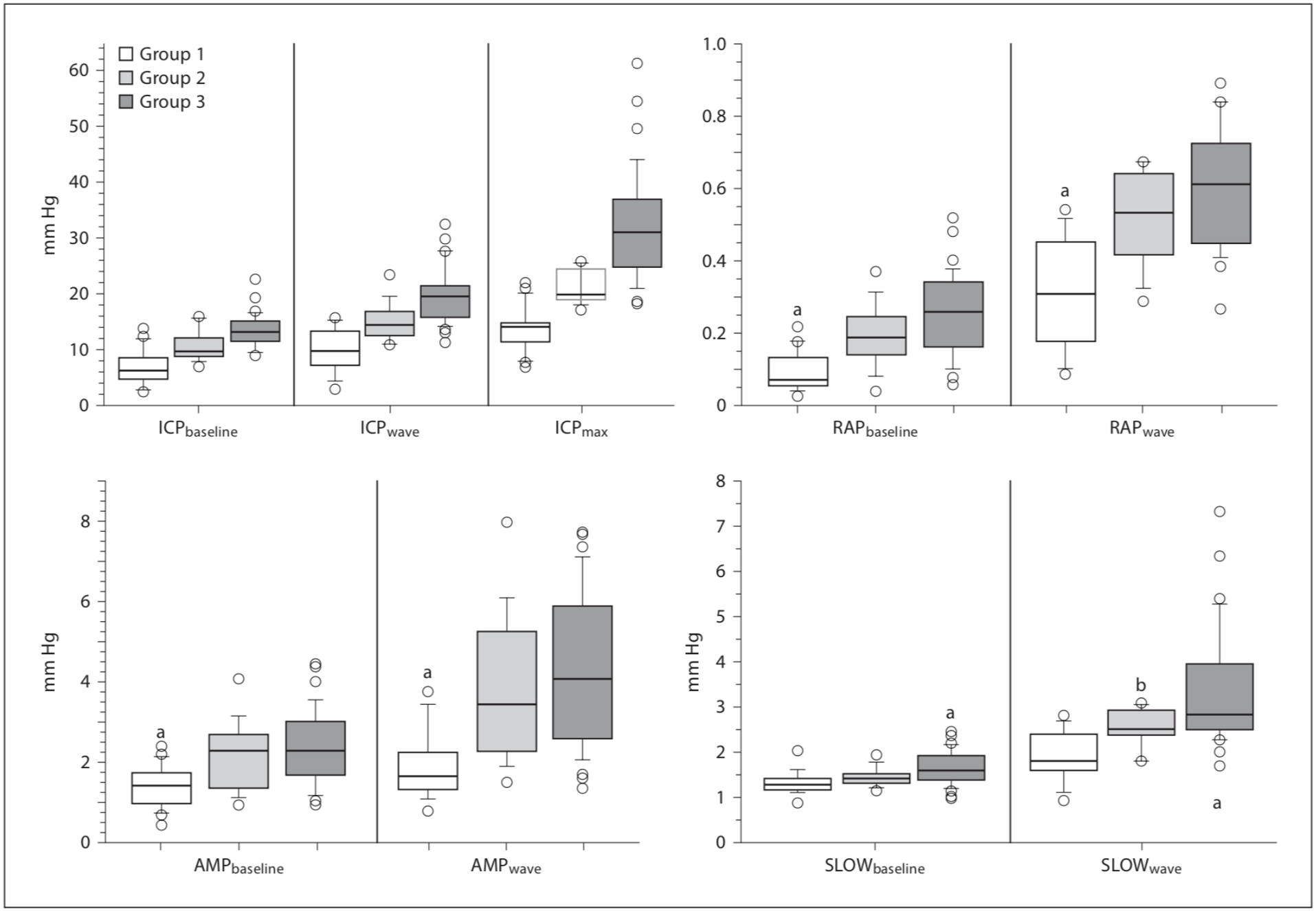

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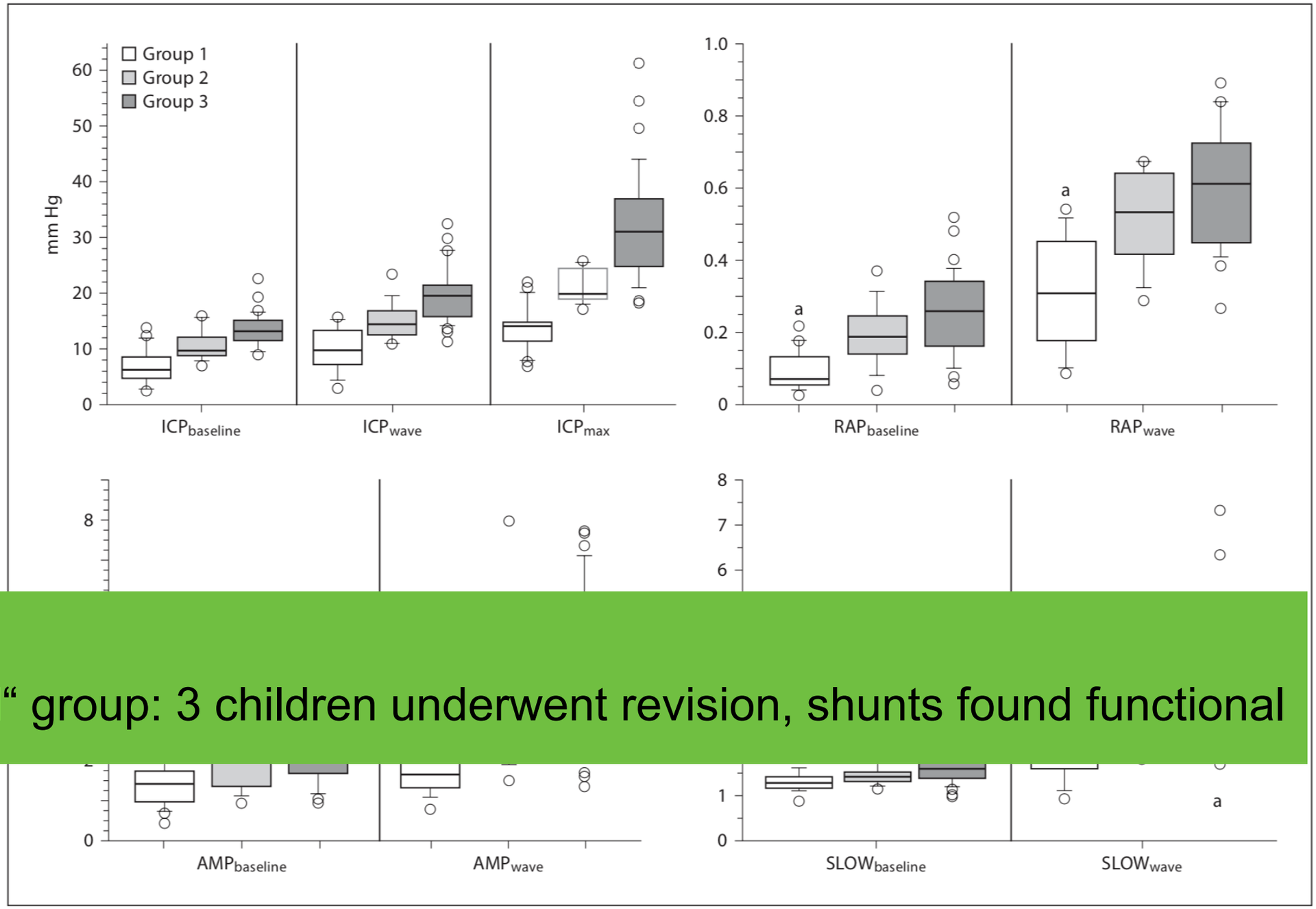

„Functional“ group: 3 children underwent revision, shunts found functional

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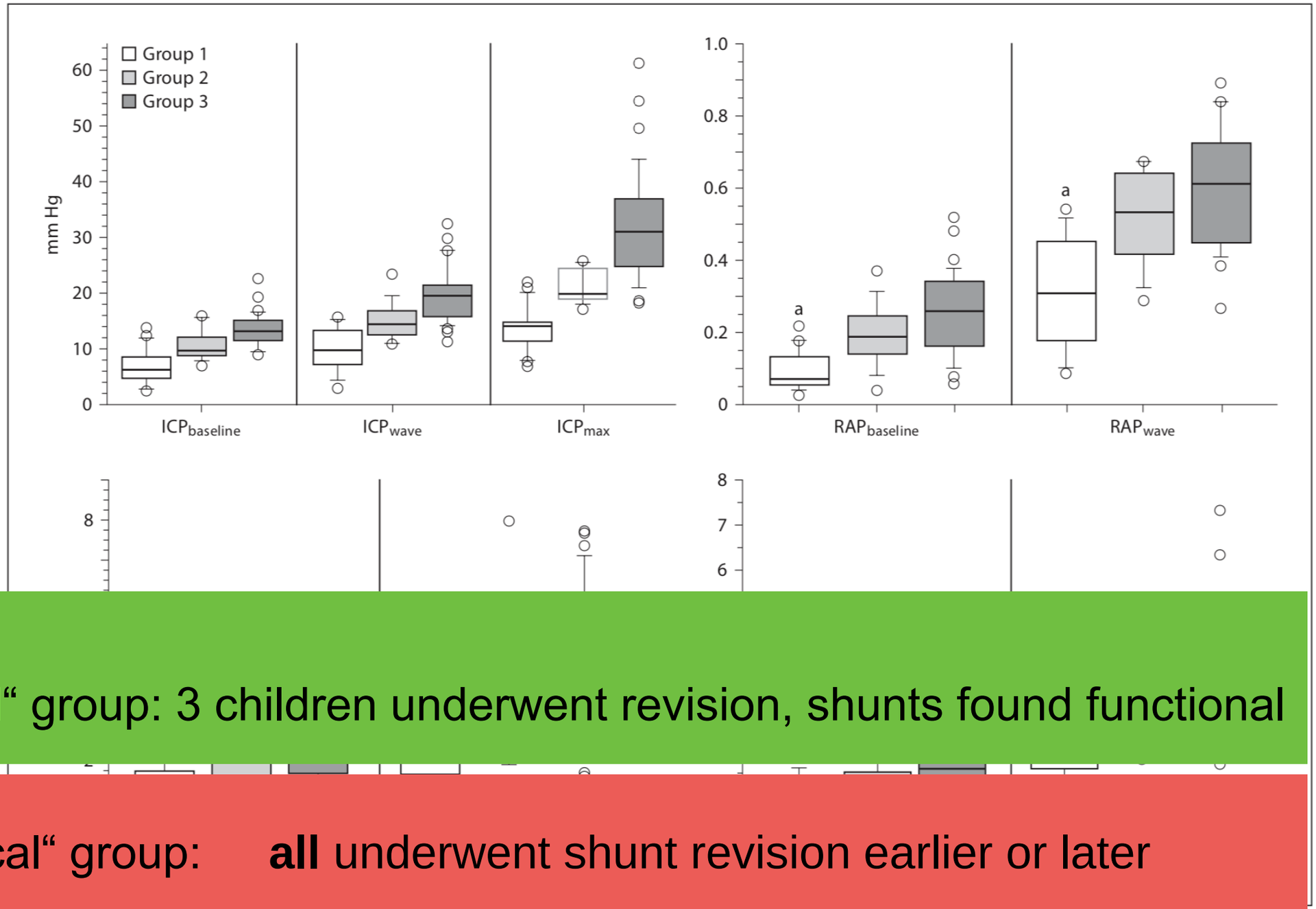

„Functional“ group: 3 children underwent revision, shunts found functional

„Pathological“ group: **all** underwent shunt revision earlier or later

all shunts exchanged

ICP dynamics definition of having pressure compensated hydrocephalus

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normal or borderline baseline ICP

(normal < 10 mmHg, borderline <15 mmHg, raised > 15 mmHg)

(adult iNPH: < 17.6 mmHg baseline)

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PLUS 2 of the following

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normal or borderline baseline ICP

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(adult iNPH: < 17.6 mmHg baseline)

PLUS 2 of the following

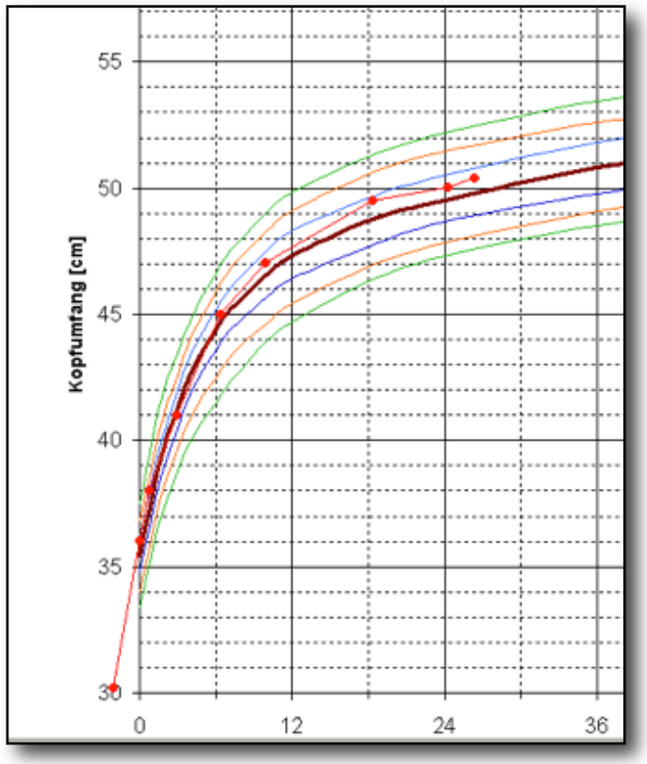
- ↑ ICP peaks during nocturnal vasogenic episode (≥25 mmHg)
- ↑ frequency of VE (>5 in 8h)
- indices of decrease in intracranial compliance and reserve capacity
  - ↑ baseline and peak amplitude (AMP >1 and > 1.5 mmHg)
  - ↑ RAP during vasogenic episode (>0.6)
  - ↑ ICP slow wave magnitude during vasogenic episodes (>2 mmHg)

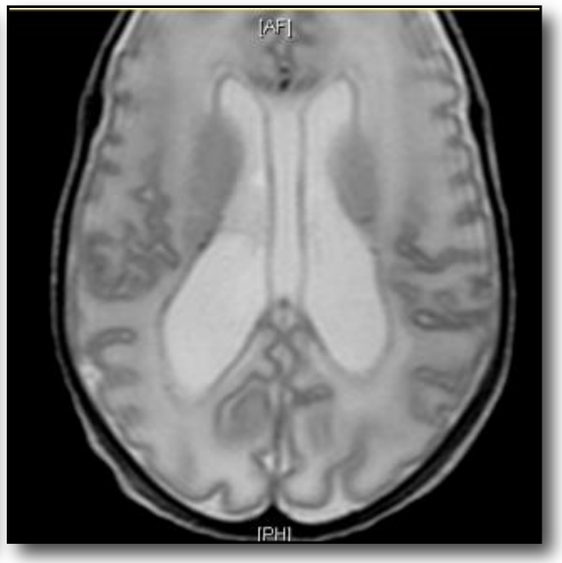
ICP analysis of overnight dynamics

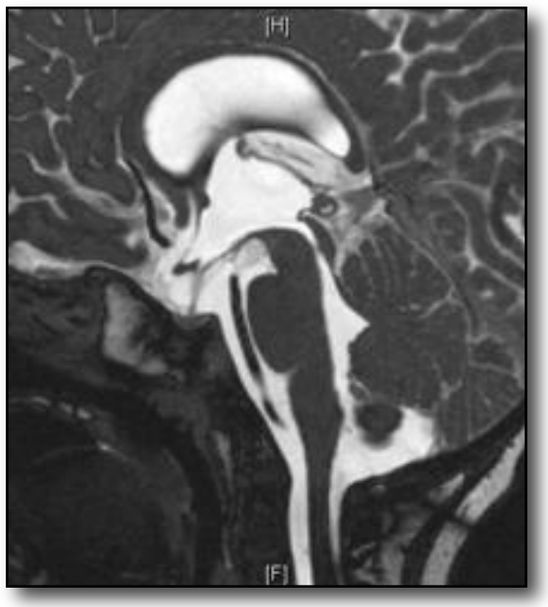
1 y old known, IVH as premature birth

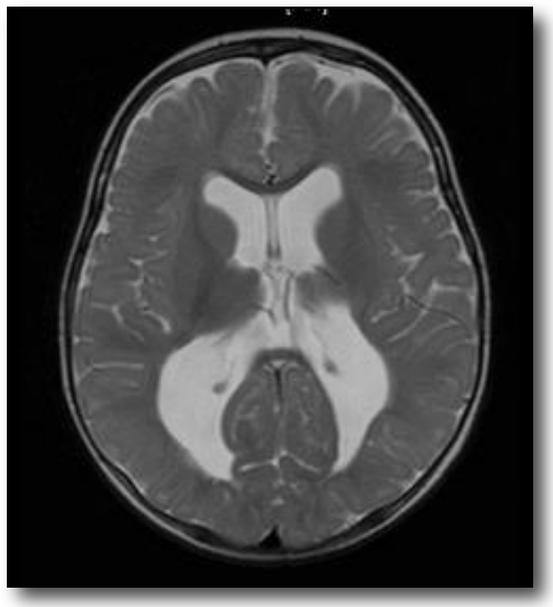
ventricles too large, AS on intial HR- MRI, HC normal, repeat MRI at 1y: AS resolved

now: ventricles still enlarged, no S&S of raised ICP

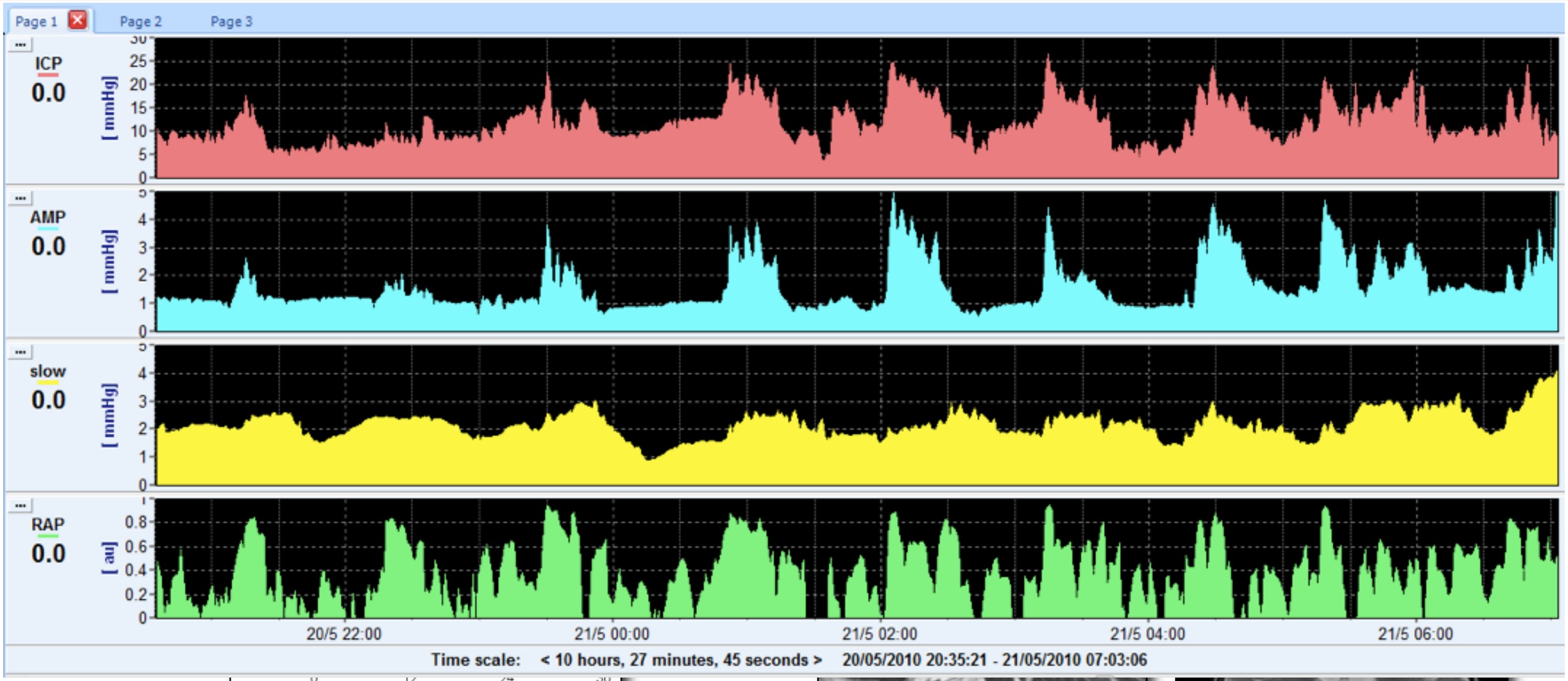


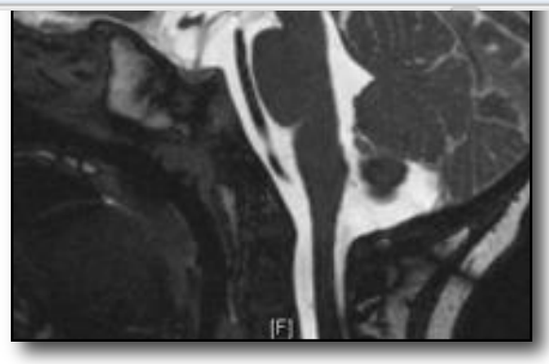


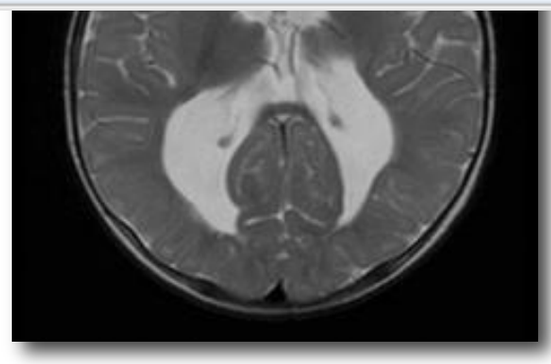




ICP analysis of overnight dynamics







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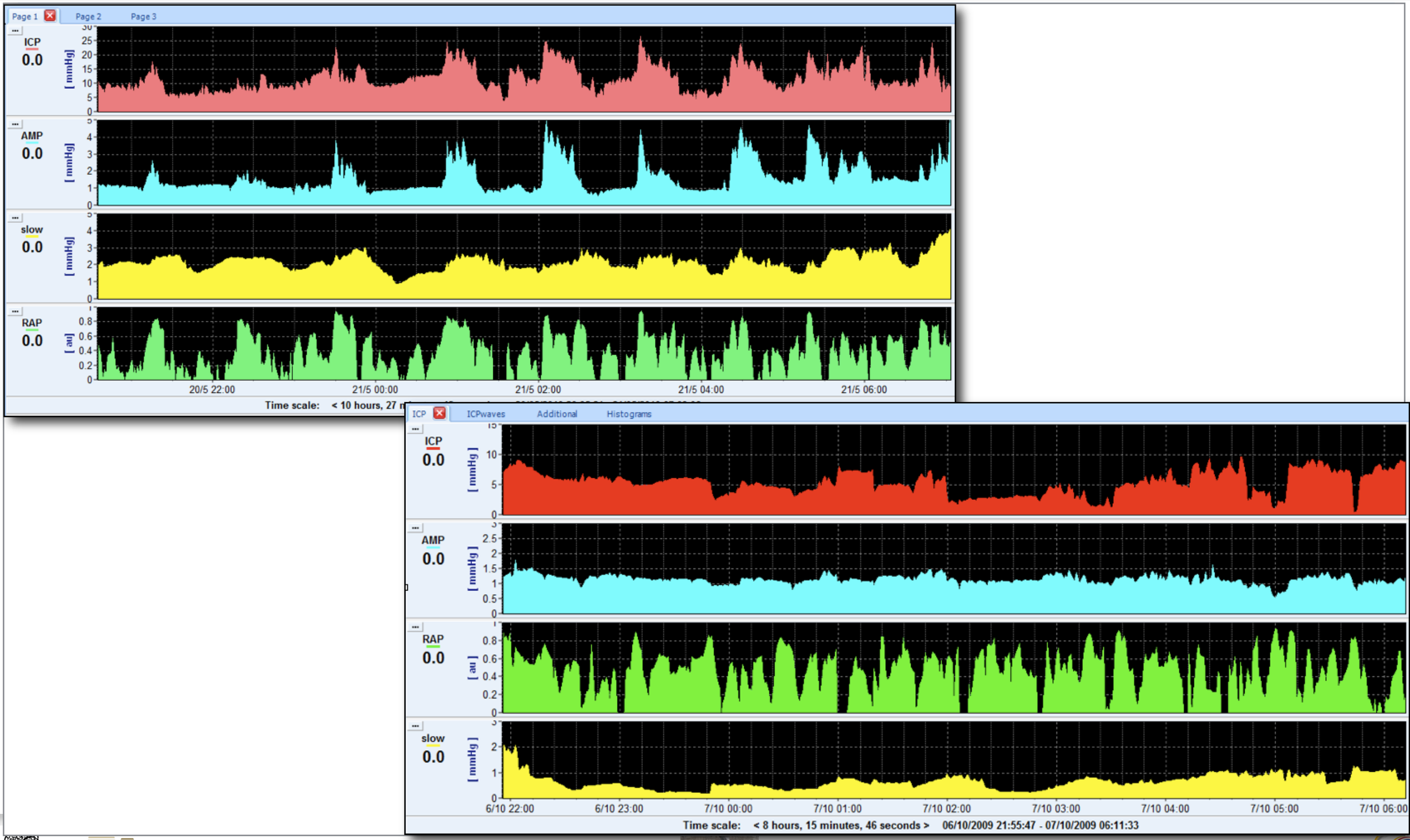
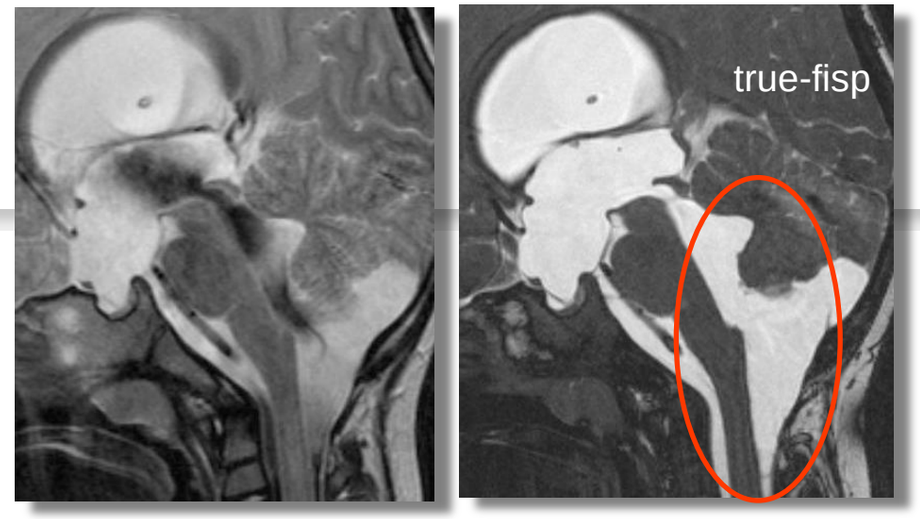


ETV re-closure - shunt ?



5 y old, shunt as newborn, perfect development, smart
prox. cath obstructed, large vents, NO S&S at all.
MRI: Blake‘s Pouch,
1) ETV, 2) Re-ETV, re-reclosure of stoma

Parents: does he need treatment (shunt revision) at all ?

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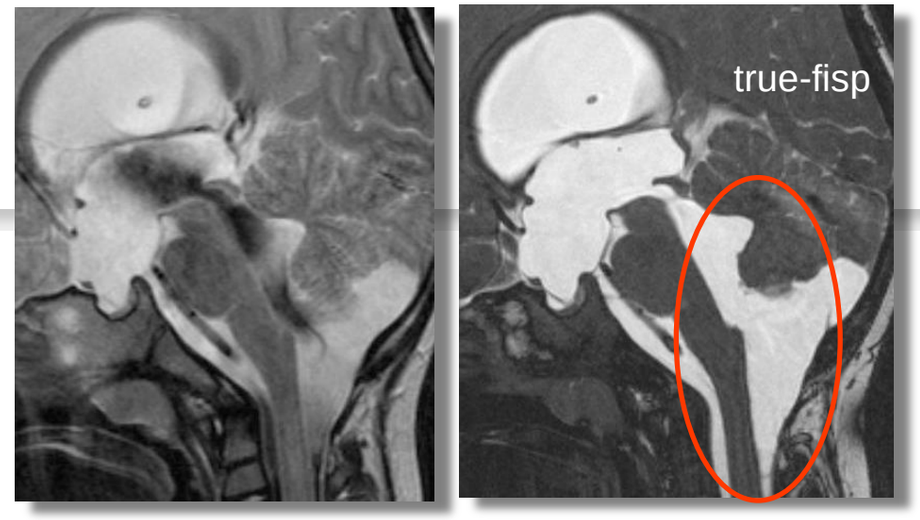

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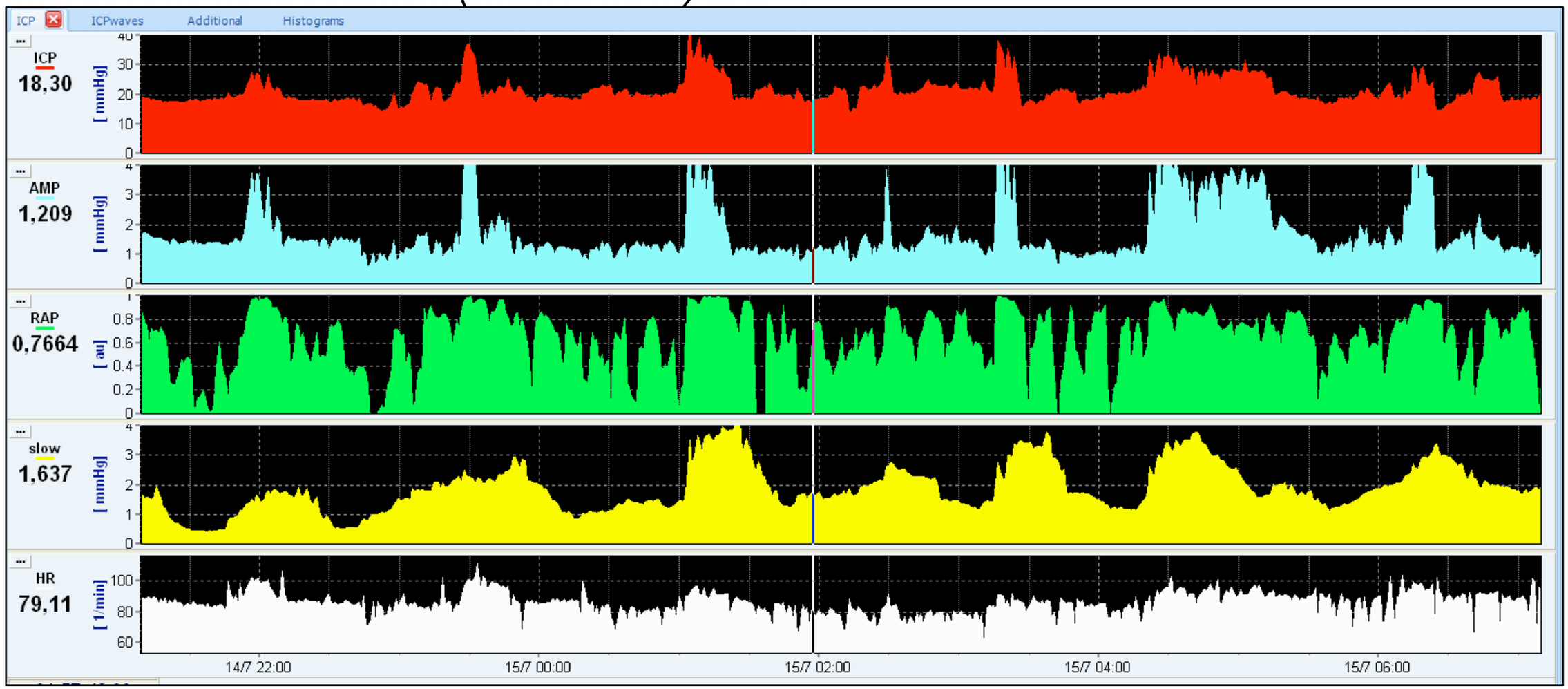

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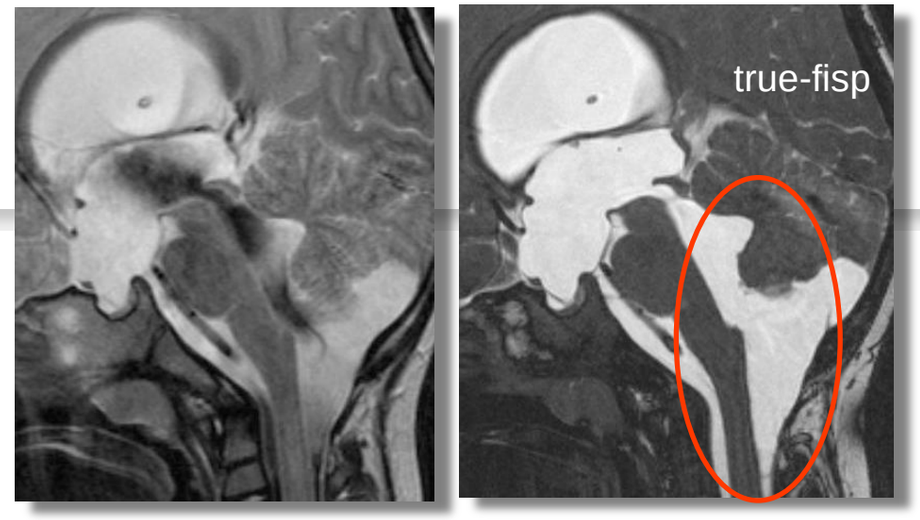

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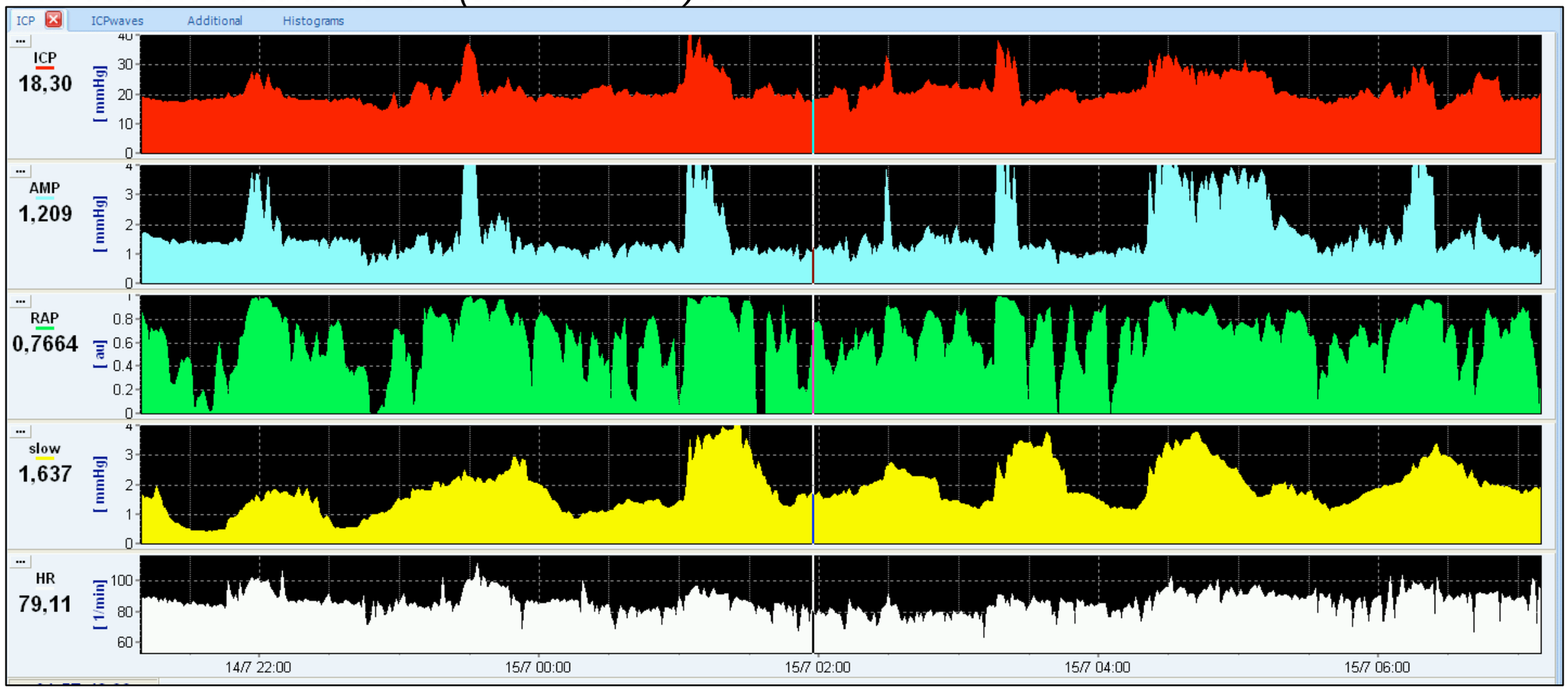

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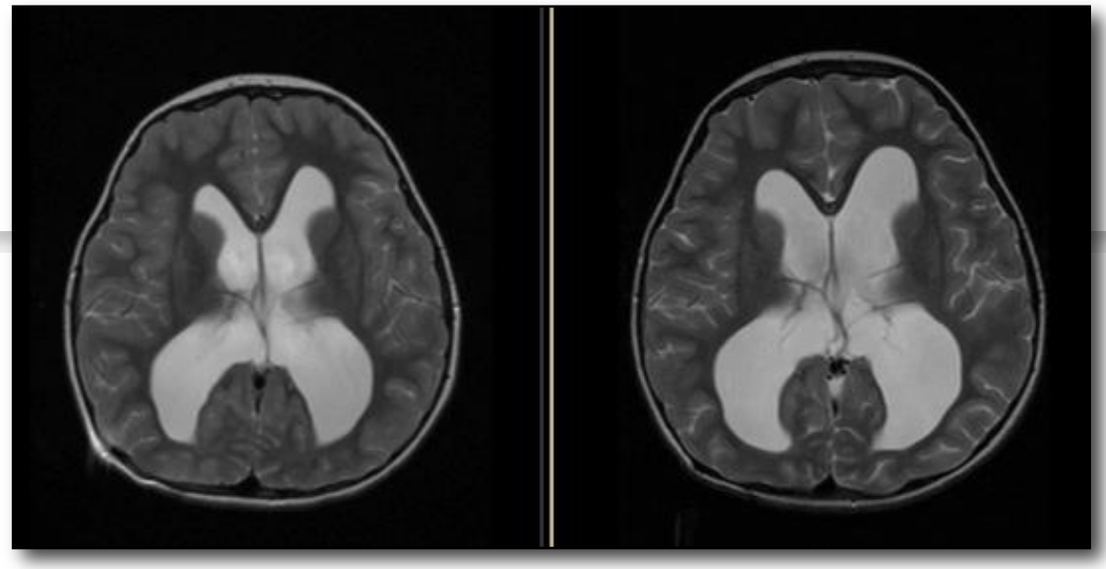

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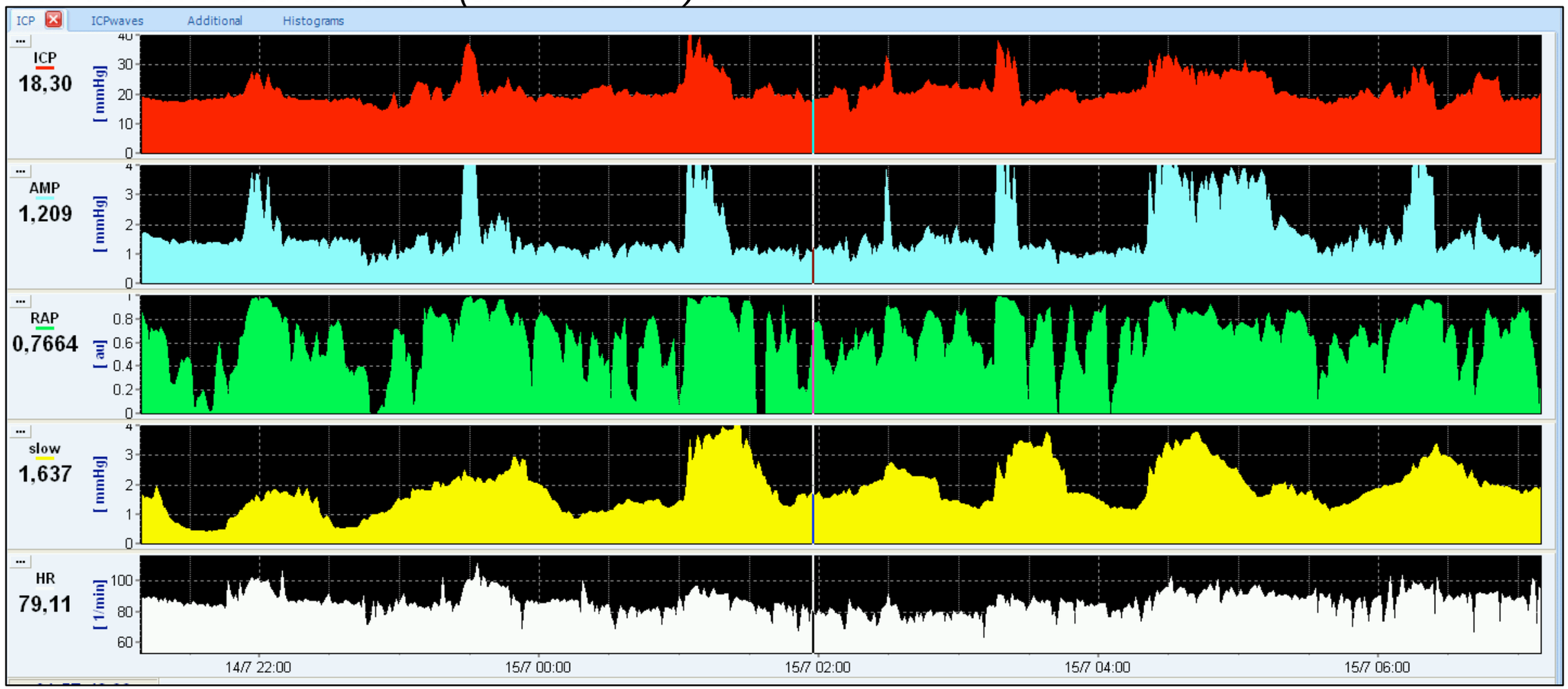

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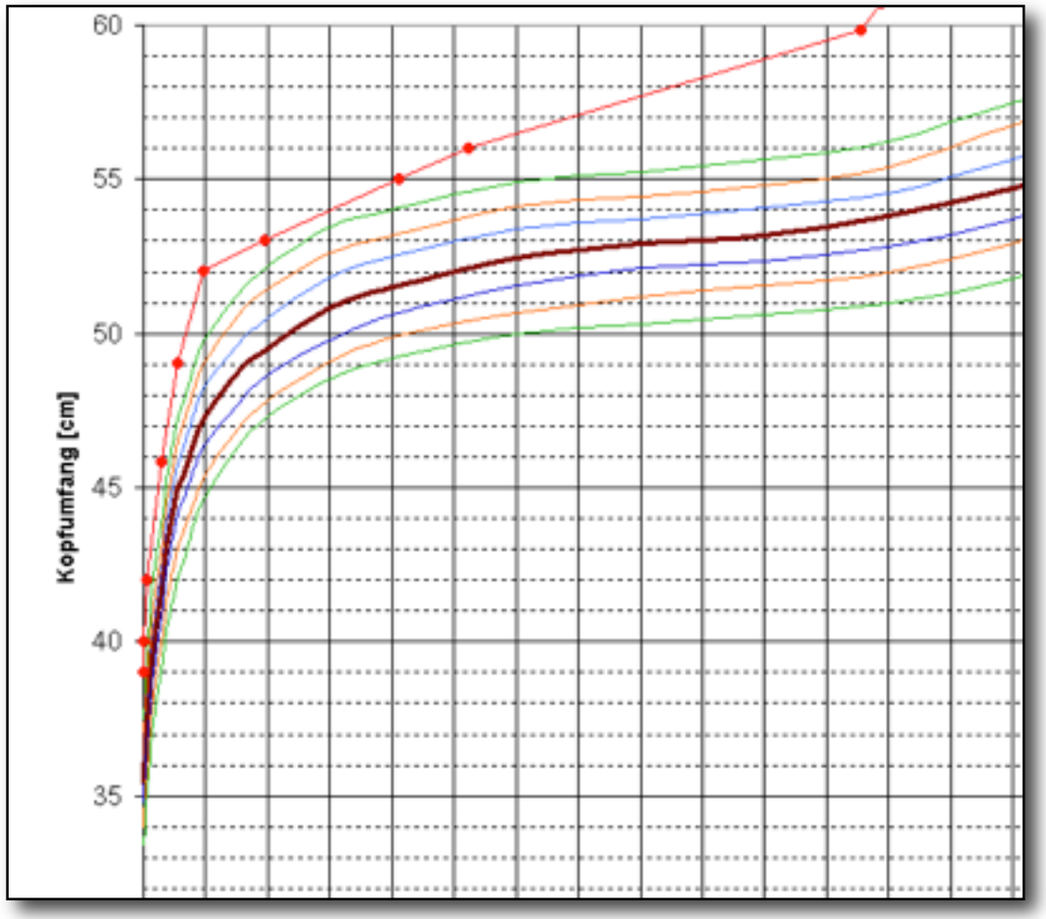
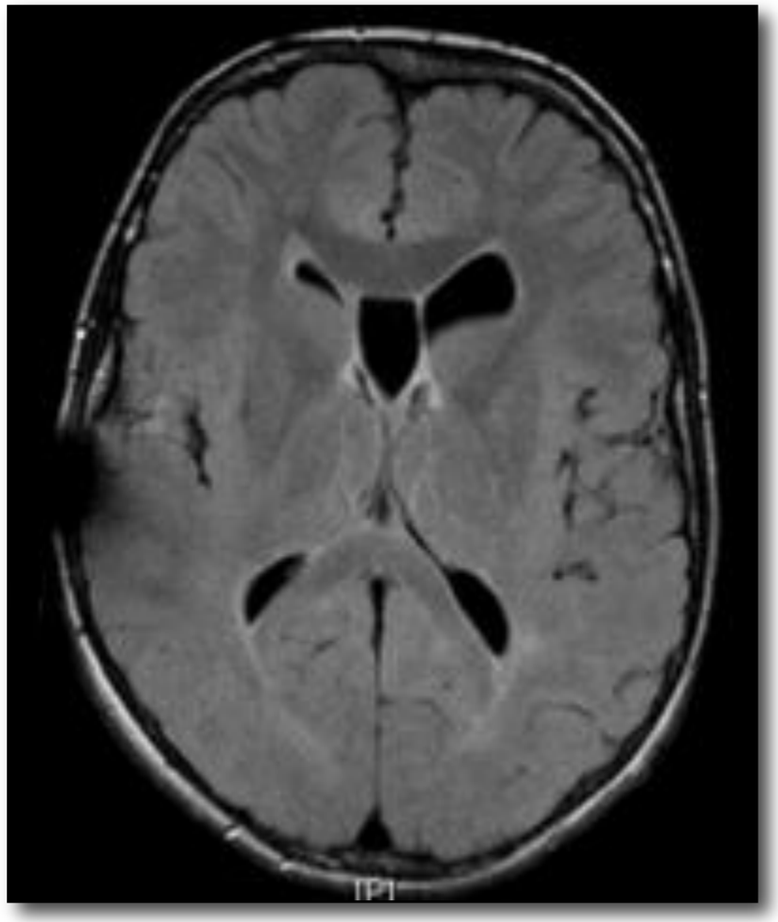
macrocephaly, ventricles normal, unchanged in last 5 years
AS on HR- MRI, old shunt in place , no capsule to pump/puncture

Shunt revision ?

subtle: school performance deteriorating, need to sleep in afternoon, pressure feeling in head





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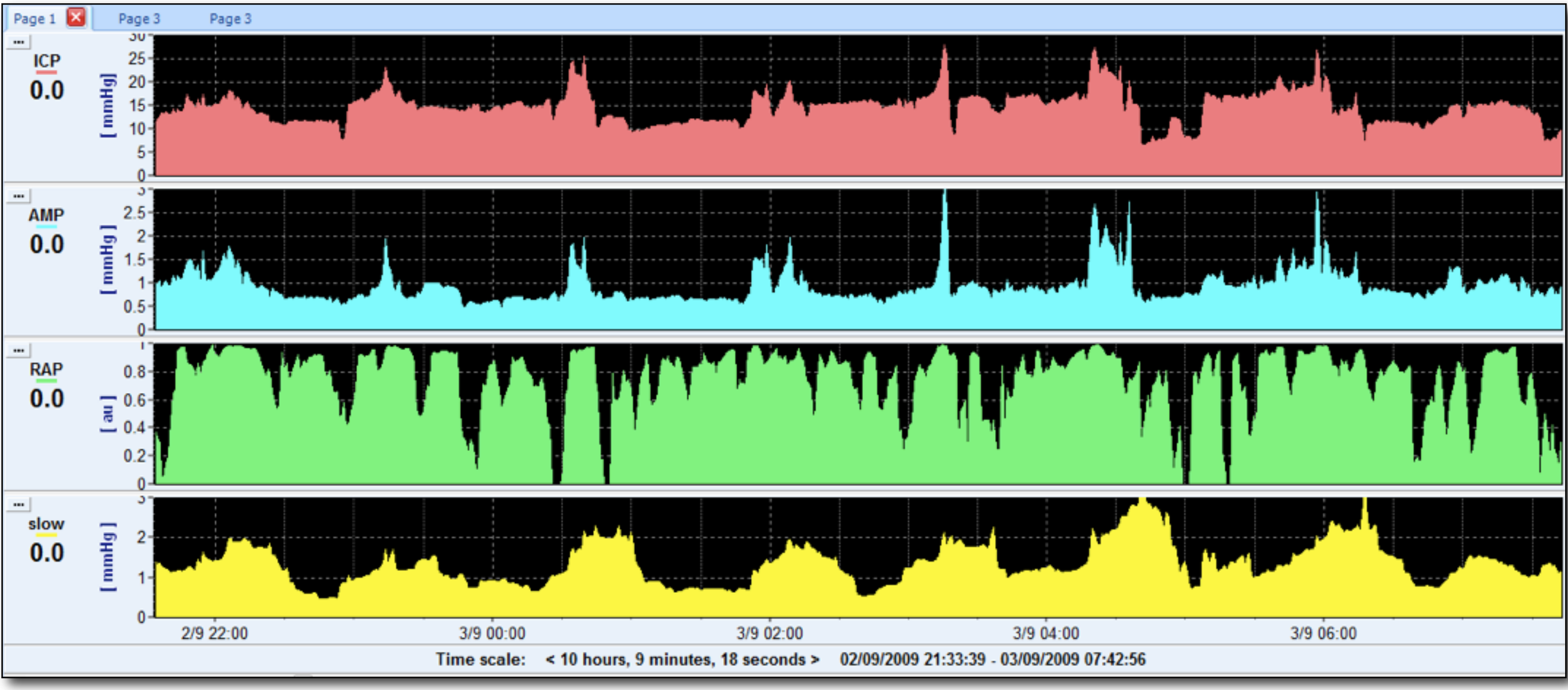

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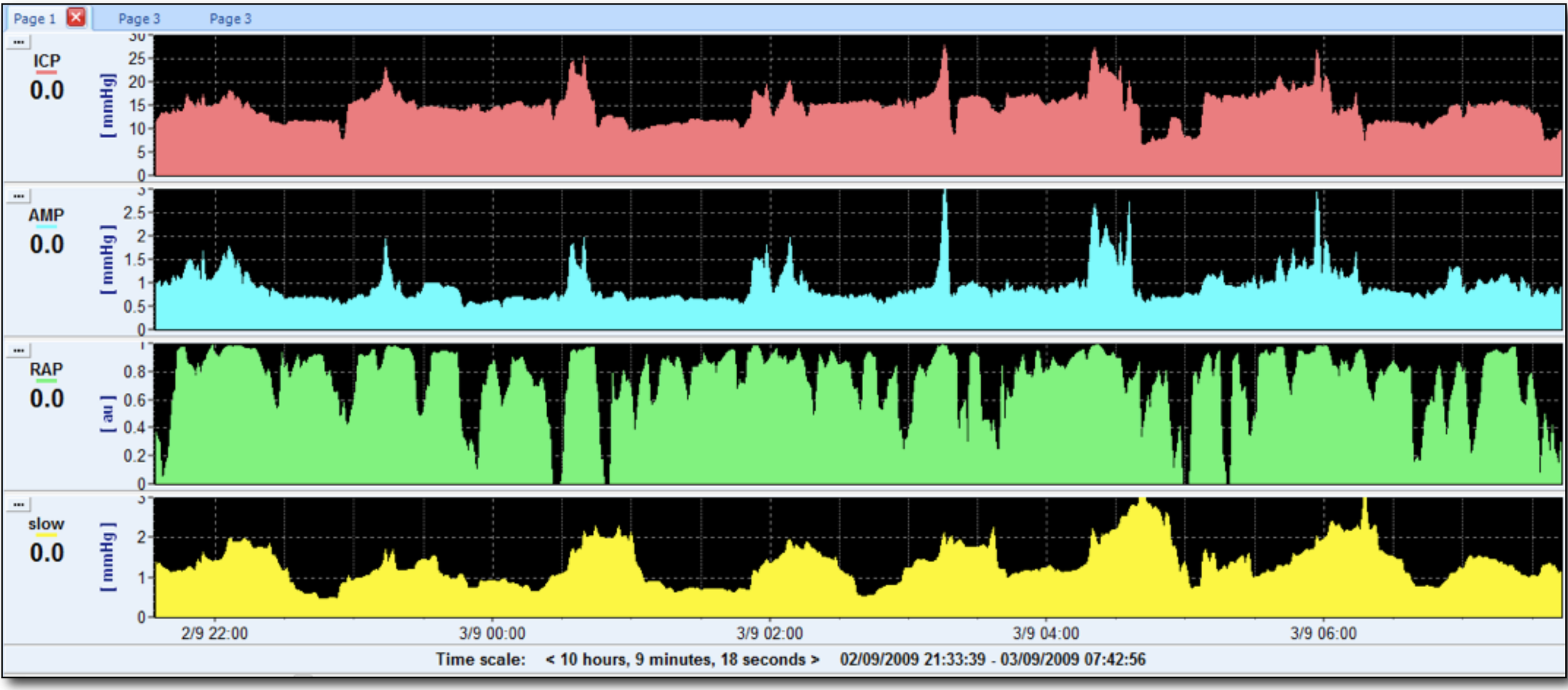

shunt valve partially obstructed
post-op: school performance improved no afternoon sleeps, pressure feeling gone

ICP analysis of nocturnal dynamics

37 kids without ? HC (or with non-puncturable shunt)

Sandra F. Dias et al, manuscript in preparation

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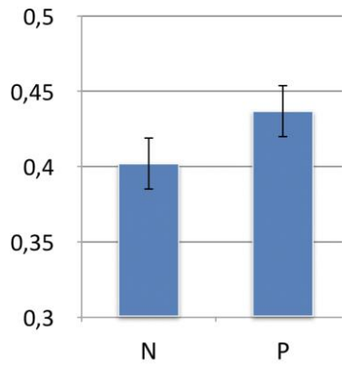
no difference in age

difference in Evans/**FOHR**



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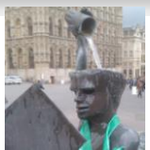

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Group 1: 71% (10/14) showed positive development in FU

Group 2: 96% (22/23) showed positive development in FU

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- 2 relatively distinct groups regarding nocturnal dynamics
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shunted pathological group shows higher rate of **positive development** in FU than non-treated „normal“ group.

- treatment of pathological patterns seems to be indicated and beneficial

ICP analysis of questionable craniostenosis (CS)

secondary CS with intracranial hypertension

- 6,2% in nonsyndromic single suture synostosis
- 10-37% in syndromic synostosis

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overall 6,9%

89% additional coronal synostosis after sagittal suture repair

Universitätsklinikum Tübingen

Neurochirurgie Uniklinik Tübingen

Kinder NCH TÜ

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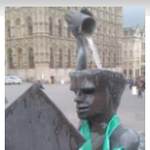
unspecific symptoms & signs

head x-ray : ongoing discussion
if copper beaten skull is indirect
sign of ↑ ICP or due to dysplasia

bony changes are a continuum
hard to cluster



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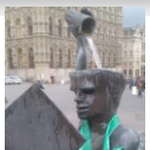

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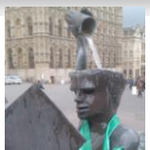
ICP-Overnight monitoring

- 25 cases in Würzburg
- 9 cases in Tübingen



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- AMP baseline 1.15

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- maximum ICP 38.28 mmHg (19-70, 9.72)
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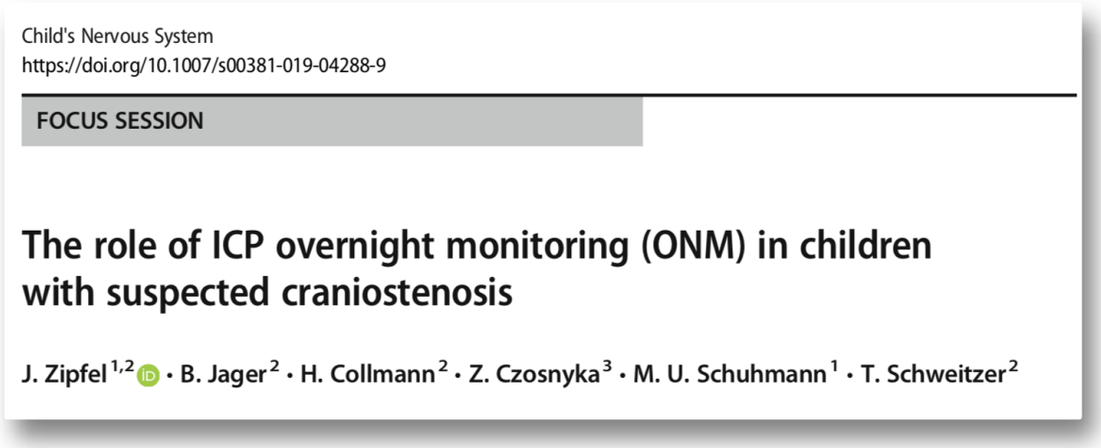
Child's Nervous System
https://doi.org/10.1007/s00381-019-04288-9

FOCUS SESSION

The role of ICP overnight monitoring (ONM) in children with suspected craniostenosis

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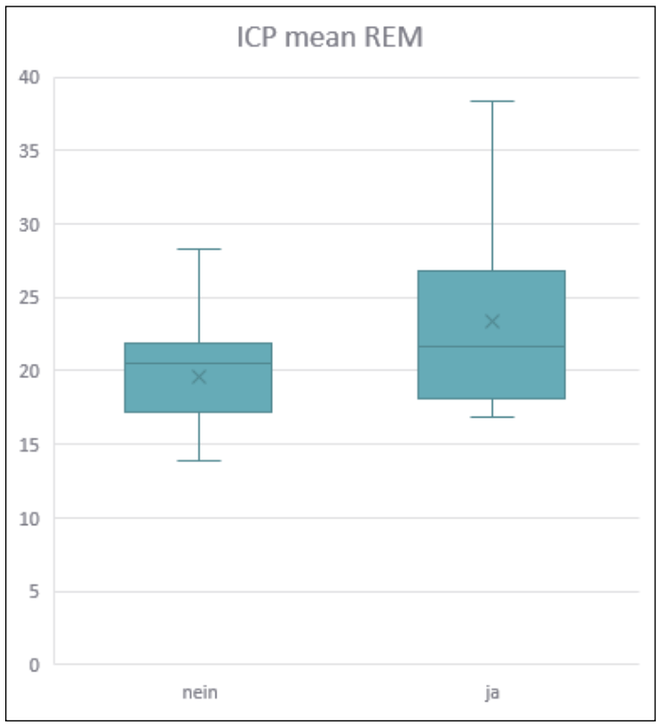

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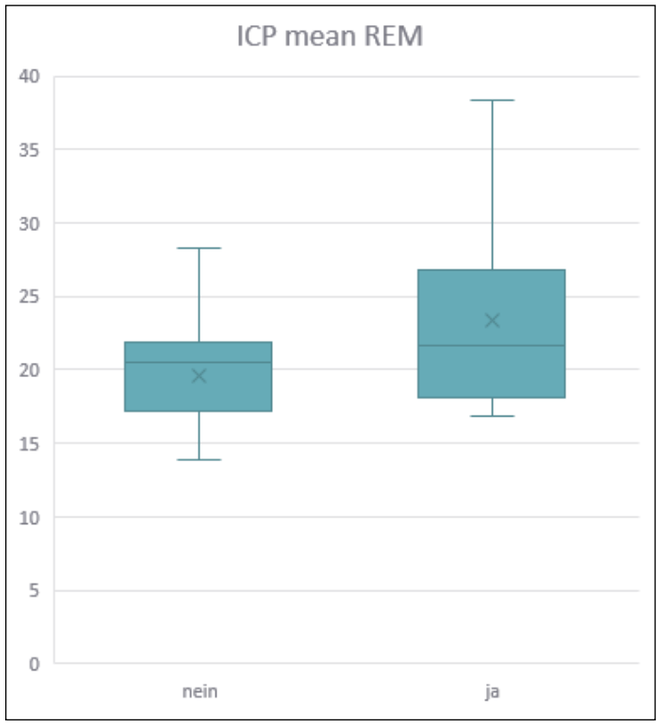

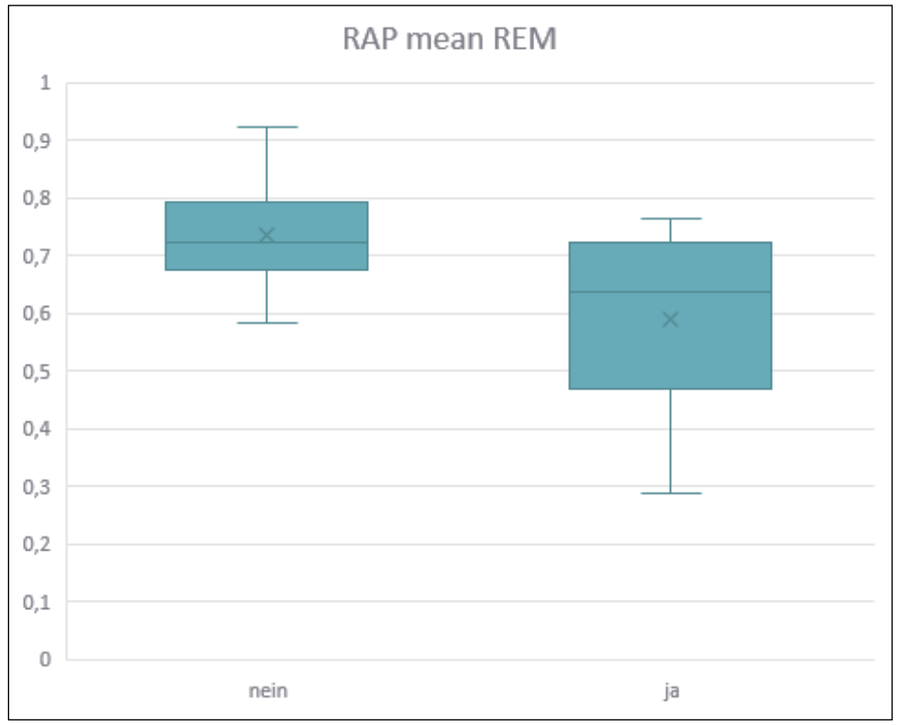

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mild

moderate

severe

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ICP analysis of questionable craniostenosis (CS)

No significant difference in all mean ICP (baseline, REM, peak)
with very heterogeneous data distribution

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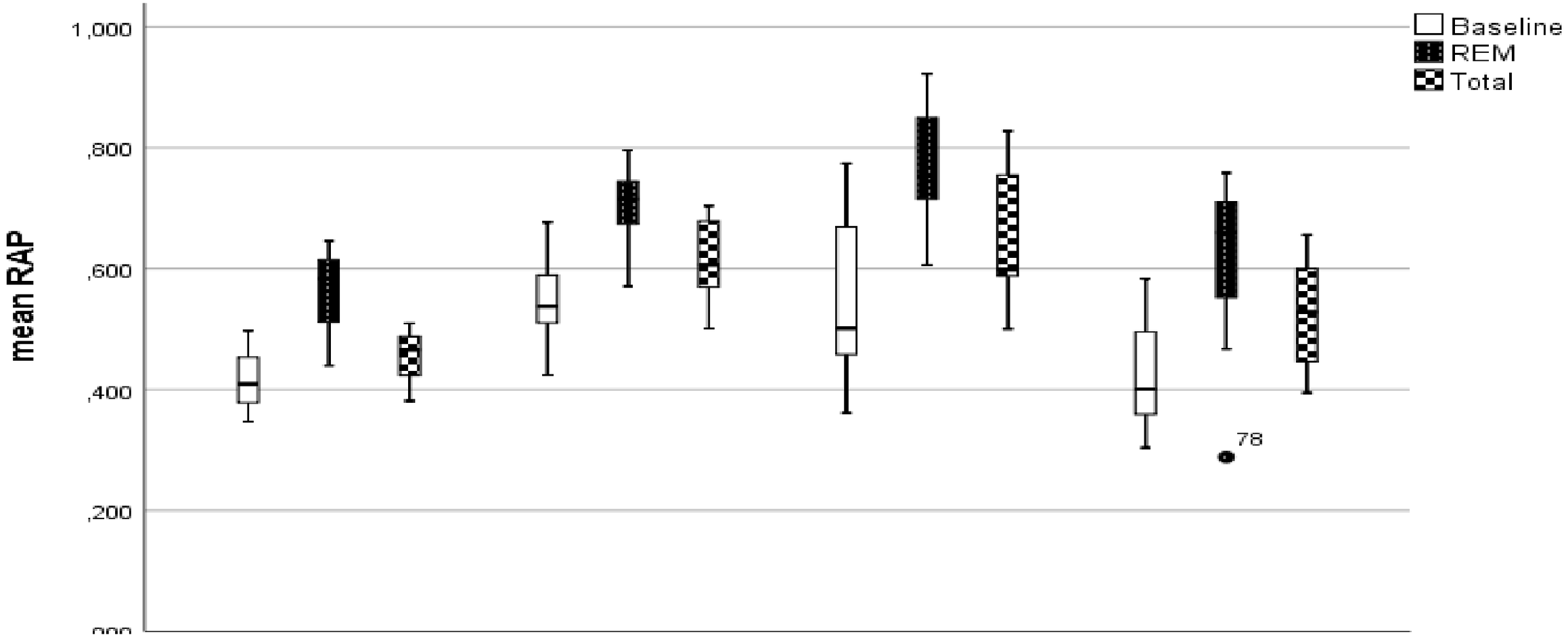

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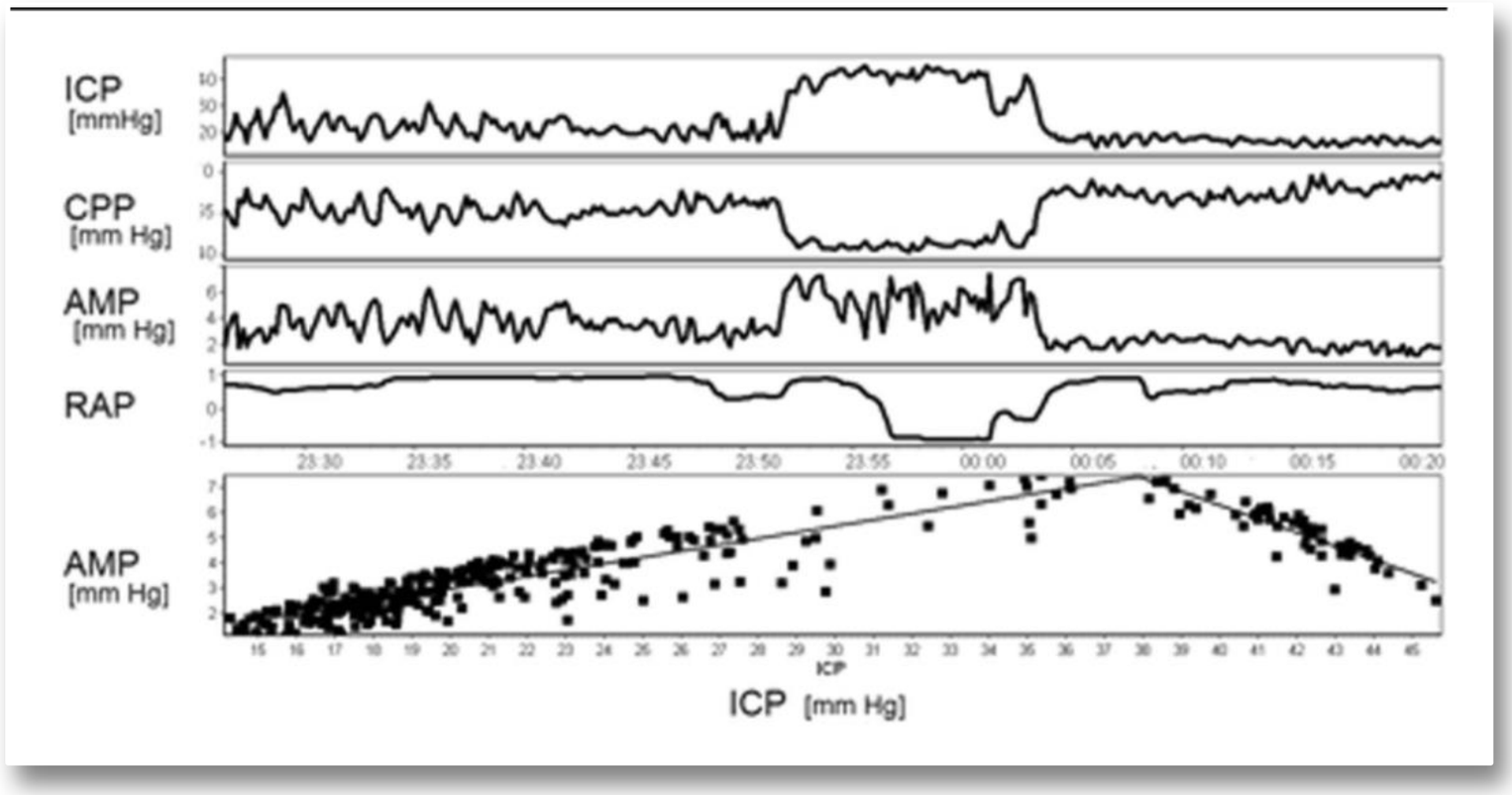
upper breakpoint of ICP/RAP correlation: loss of autoregulation



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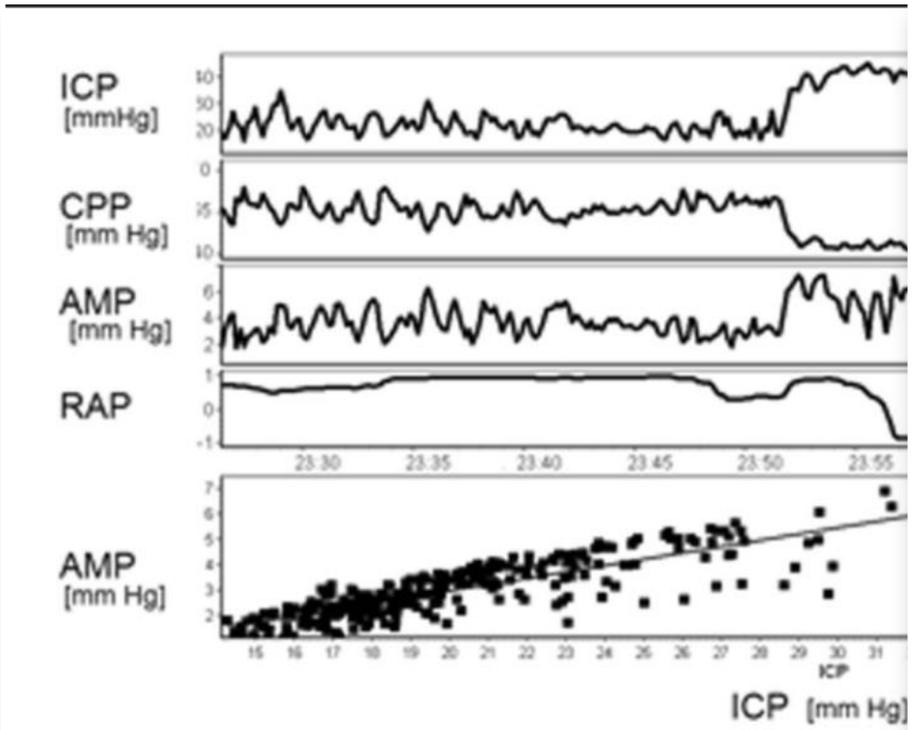

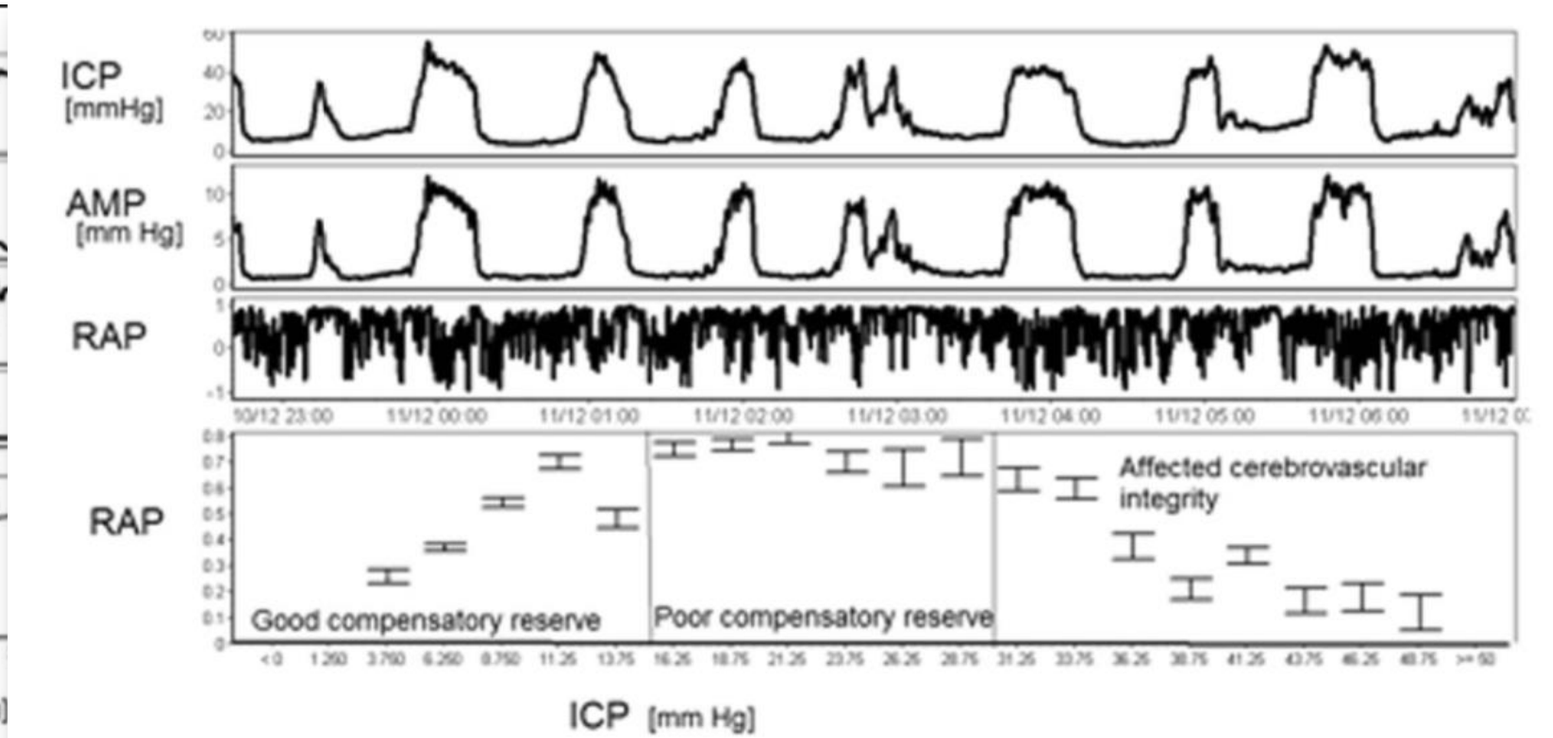

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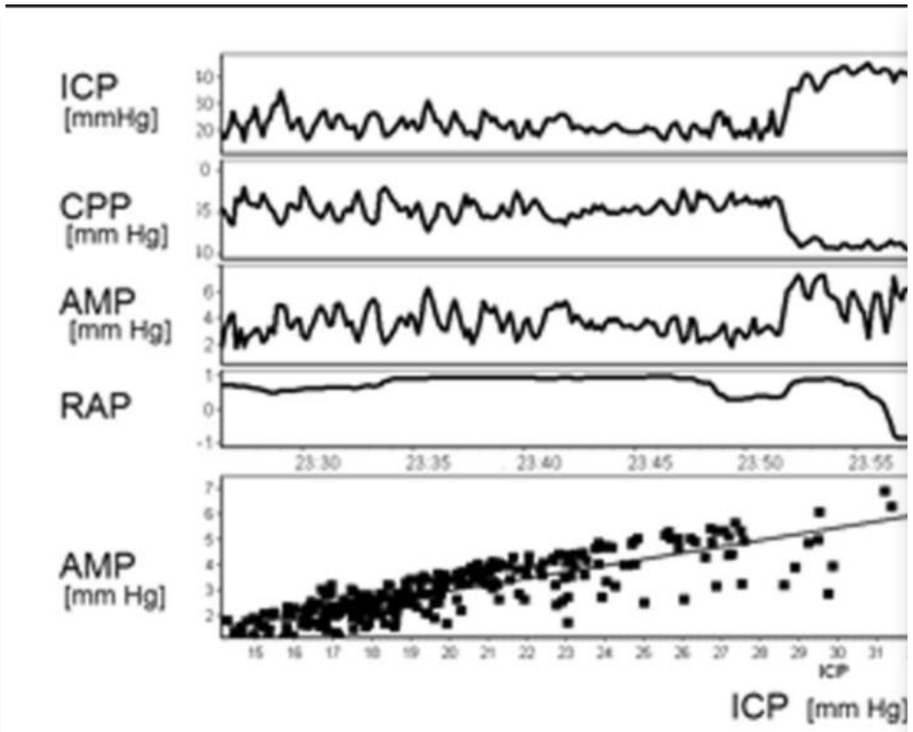

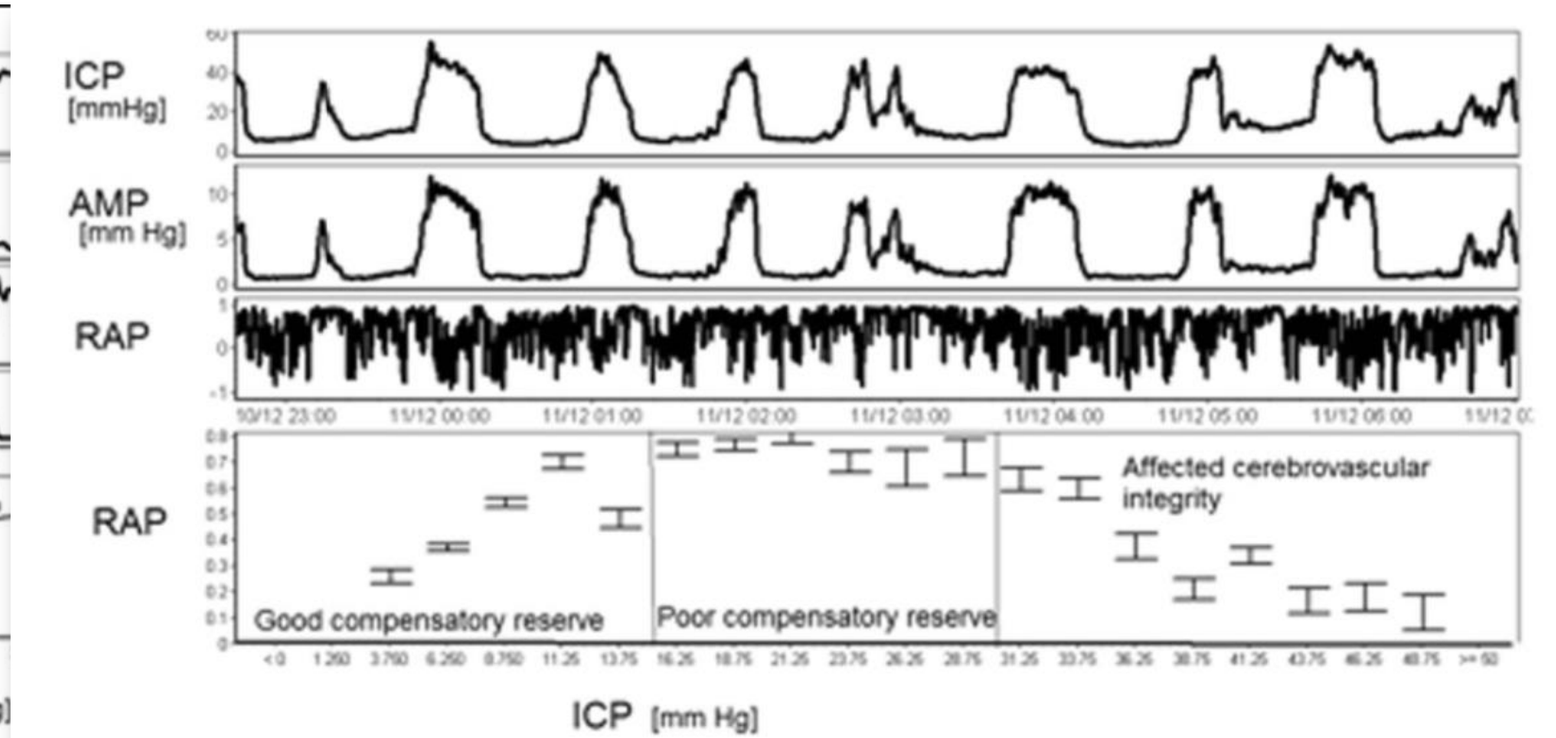

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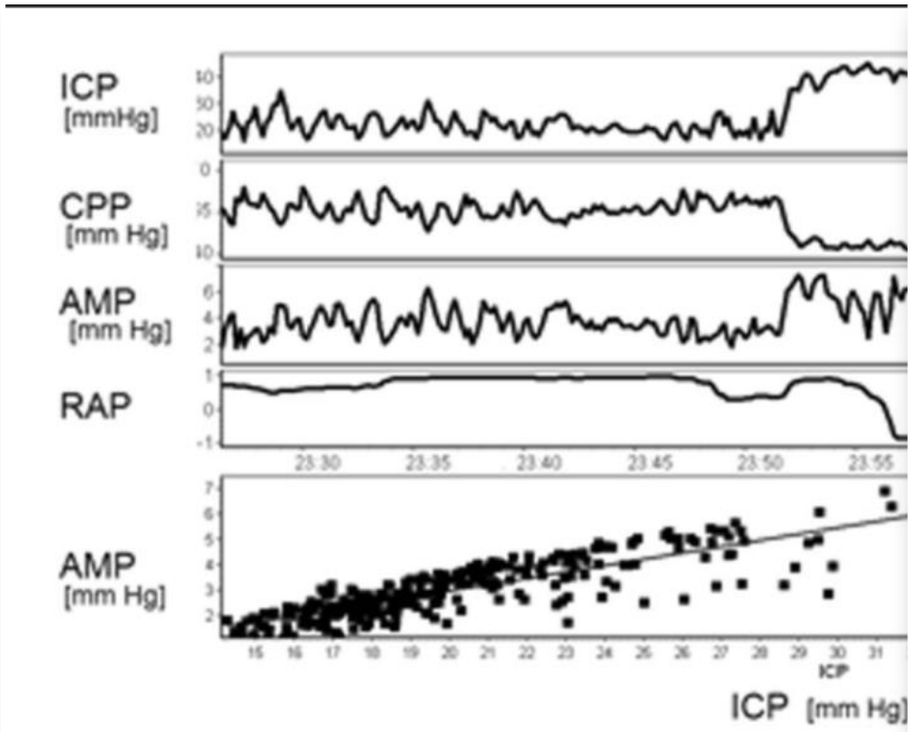

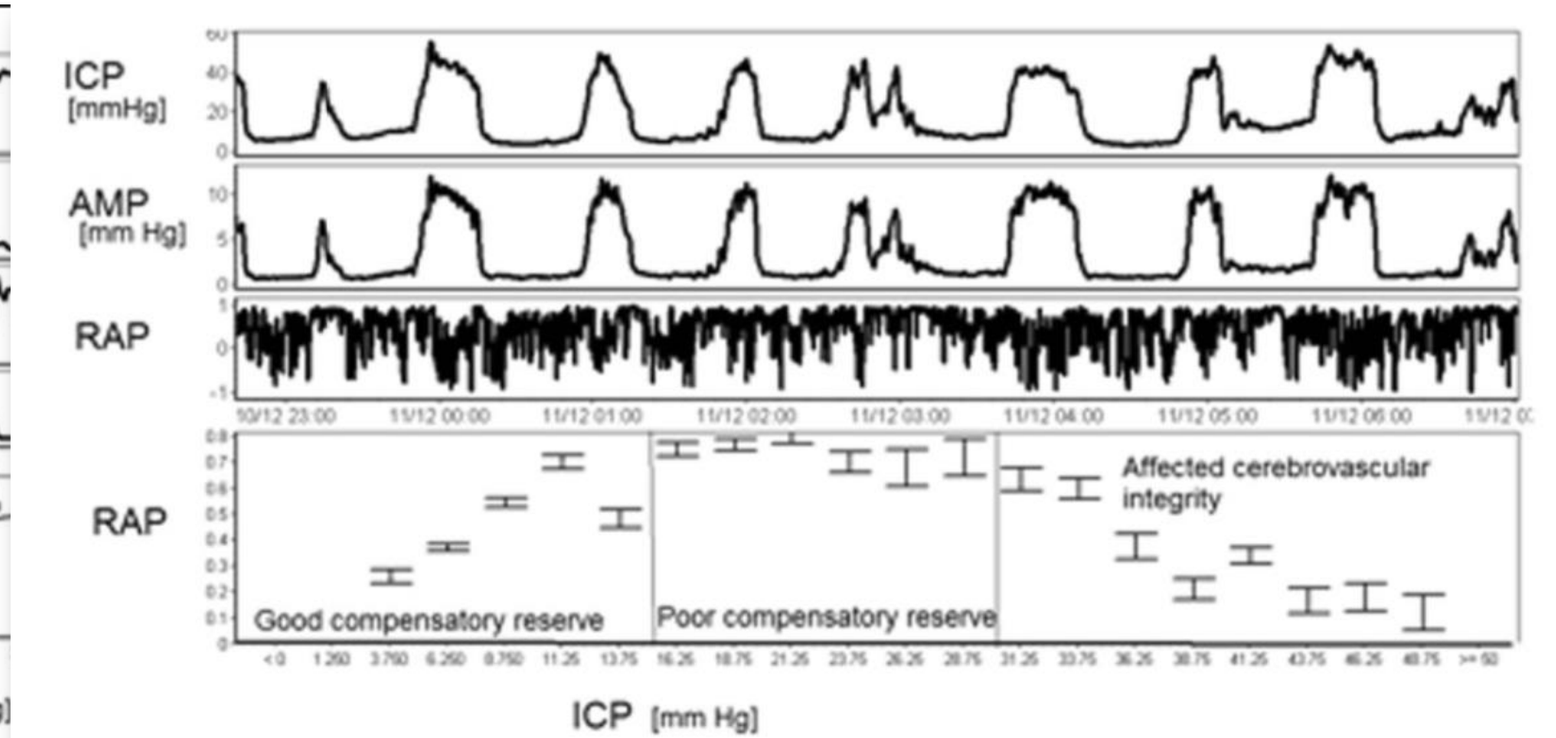

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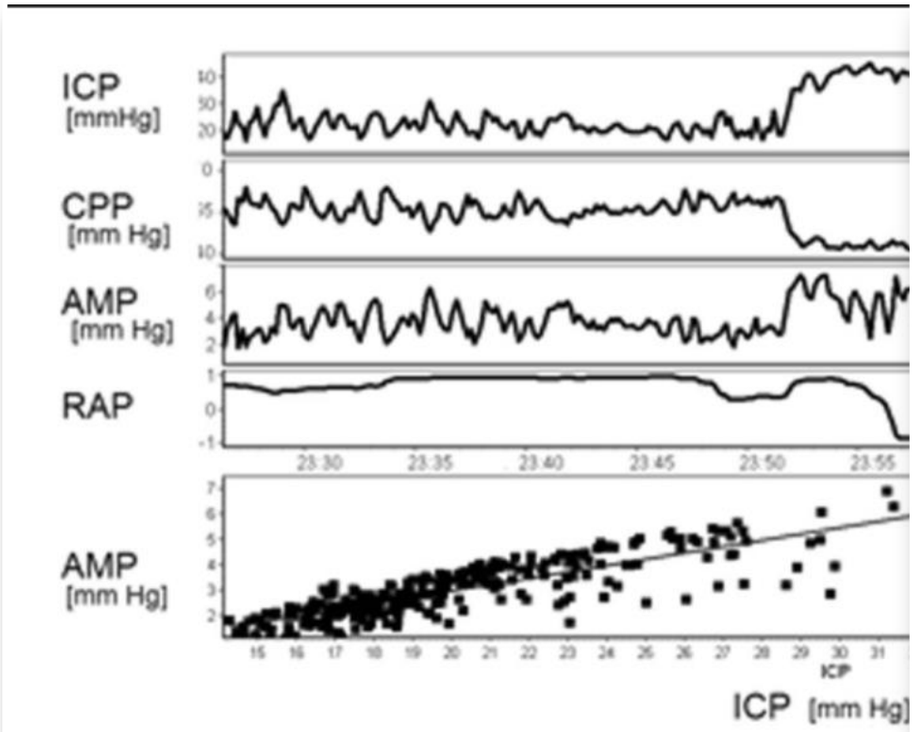

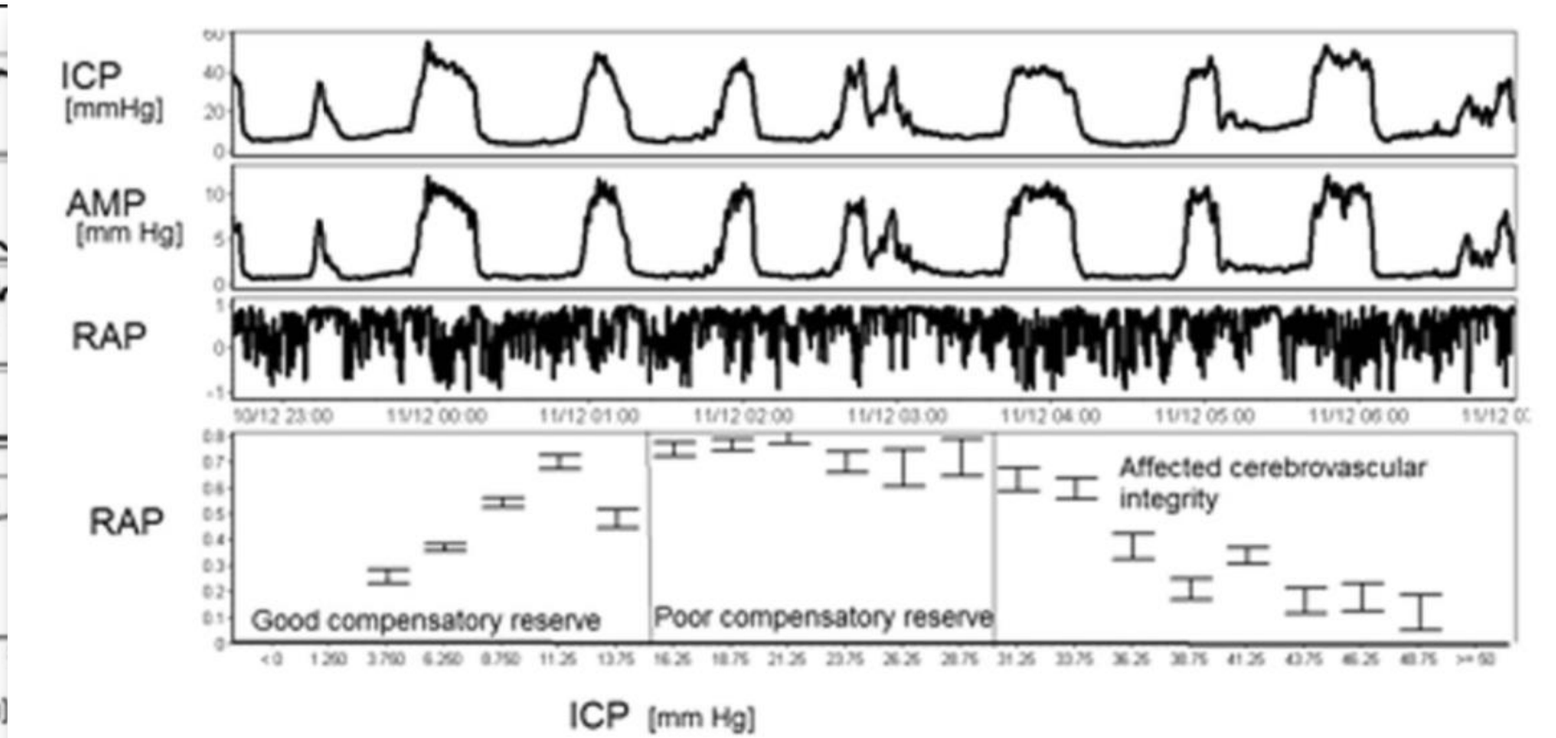

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- loss of correlation of ICP amplitude (AMP) to mean ICP

mild: no breakpoint

moderate: upper breakpoint **25.4 mmHg**

severe: upper breakpoint **23.9 mmHg**

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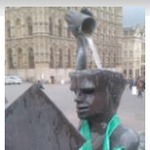
- in doubt go the extra mile

  because our decisions influence decades of life ahead



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