Volume assessment at the bedside

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AKI Academy meeting

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Assessing the circulation - the 3 key questions

- Is my patient ‘adequately’ filled ?
- What’s the cardiac output ?
- Is tissue perfusion adequate?

Ensure that your patient is ***'adequately'*** filled

- quickly!
- before starting vaso-active agents

Early goal directed therapy in the treatment of severe sepsis

Rivers E, Nguyen B, Havstad S

Depts Emergency & Internal Medicine & Surgery
Henry Ford Health Systems, Detroit, USA

NEJM 2001; 345: 1368-77

Case History

- 74 yr old man admitted to HDU with acute abdomen

- HR 110/min; MAP 77; cold; CRP>3secs
- oligo-anuric: 10/5/5 ml/hr
- RR 24/min
- confused
- vomiting
- PMH: Smoker, COPD, Diabetes, old MI

So - how do you know if he needs filling?

When you arrive, what do you need to know?

- ✓ History/ drugs etc from staff, family, patient
- ✓ Conventional examination to include:
  - ? peripheral perfusion: CRT, temp, estimate SVR
  - ? pulse characteristics: rate, rhythm, estimate SV
  - ? skin turgor/mucous membranes /peripheral oedema
  - ? MAP
  - ? JVP/CVP/RAP
  - ? HS: ? Gallup/3rd HS
  - ? central temp
- ✓ Review charts: urine output, fluid balance, drugs
- ✓ Key Ix: CXR/ECG/ABG/lactate/urine Na/AXR/U/S/Echo

How are you going to prevent ?

.....

Key points

- hypotension is a late sign:
  - MAP no guarantee of ***adequate*** filling or CO
- splanchnic hypo-perfusion occurs early
- oliguria: resist the frusemide reflex!
- beware unexplained ↑ HR & RR
- explain base deficit on ABG: watch trend
- ***timely*** response: fluids/ antibiotics/ CPAP etc

Intervene **EARLY** to prevent → 'late' 'shock'

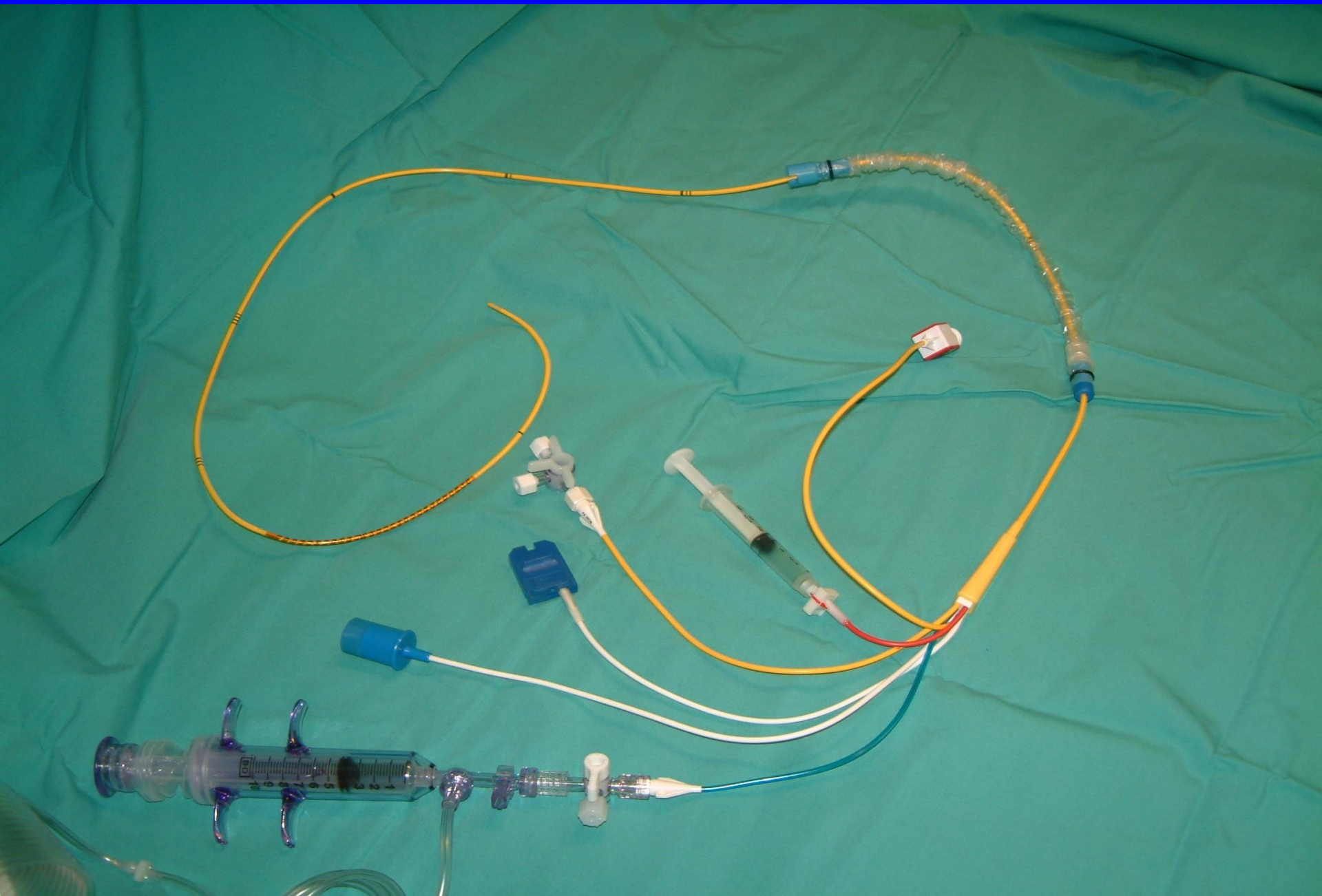
Six Key CirculatoryVariables

- RAP or CVP — Pre- load
- LAP or PAOP/PAWP — pressures

- MAP — After- load
- PAP — pressures

- Cardiac output — Stroke
- Heart rate — Volume

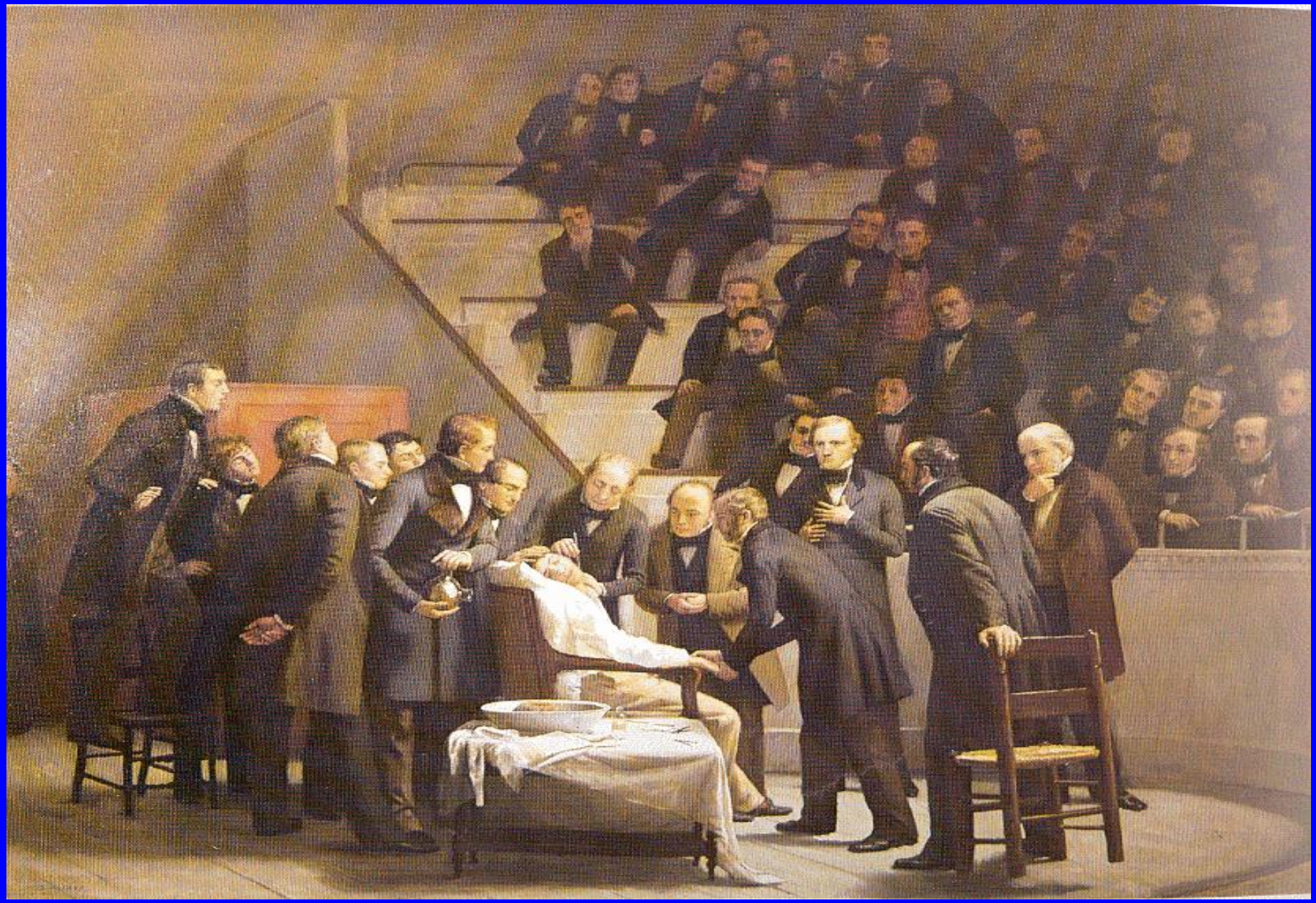
Pulmonary artery catheter : conventional for LAP/PAOP/CO & PAP



Based on bedside clinical skills

"Well, it's not a good sign, that's for sure ..."

Juniors being taught central line insertion at St Thomas' ICU….



? Adequately filled – Key Clinical Observations

- Peripheral perfusion/ skin turgor
- Mucous membranes
- Central pulse volume, HR
- Urine output (don't forget urinary Na)
- Na & Creatinine/urea relationship – but ..
- CVP, 'wedge' or PAOP pressures -pitfalls?

* Intra-vascular vs Extra-vascular depletion *

Pitfalls in relying on CVP/RAP to assess adequacy of iv filling

- RV function
- PAP – RA to LA relationship
- Intrathoracic pressure
- Systemic venous compliance

Subsequent progress of our 74yr old

- JVP/CVP/RA +1 (+7)
- ECG – no evidence of ant MI on ECG
- Estimated CO 3.1l/min (SVR:25; SV 30; VO2 240ml/min)
- Filled ++ : 1.5L Hartmanns & Gelo (!) & RBC ordered
- Transferred to ICU & intubated prior to theatre
- MAP 79; JVP/CVP/RA +4; SVR 18; CO 4.1, U/O:25,30
- Lactate 2.6mmol/l; SijO2 63%;
- ? fill further; ? vaso-active agent
- Dynamic tests: Valsalva ……

Bedside tests of intravascular volume

Dynamic tests > Static

BP – resp ‘swing’

Ventilator disconnect

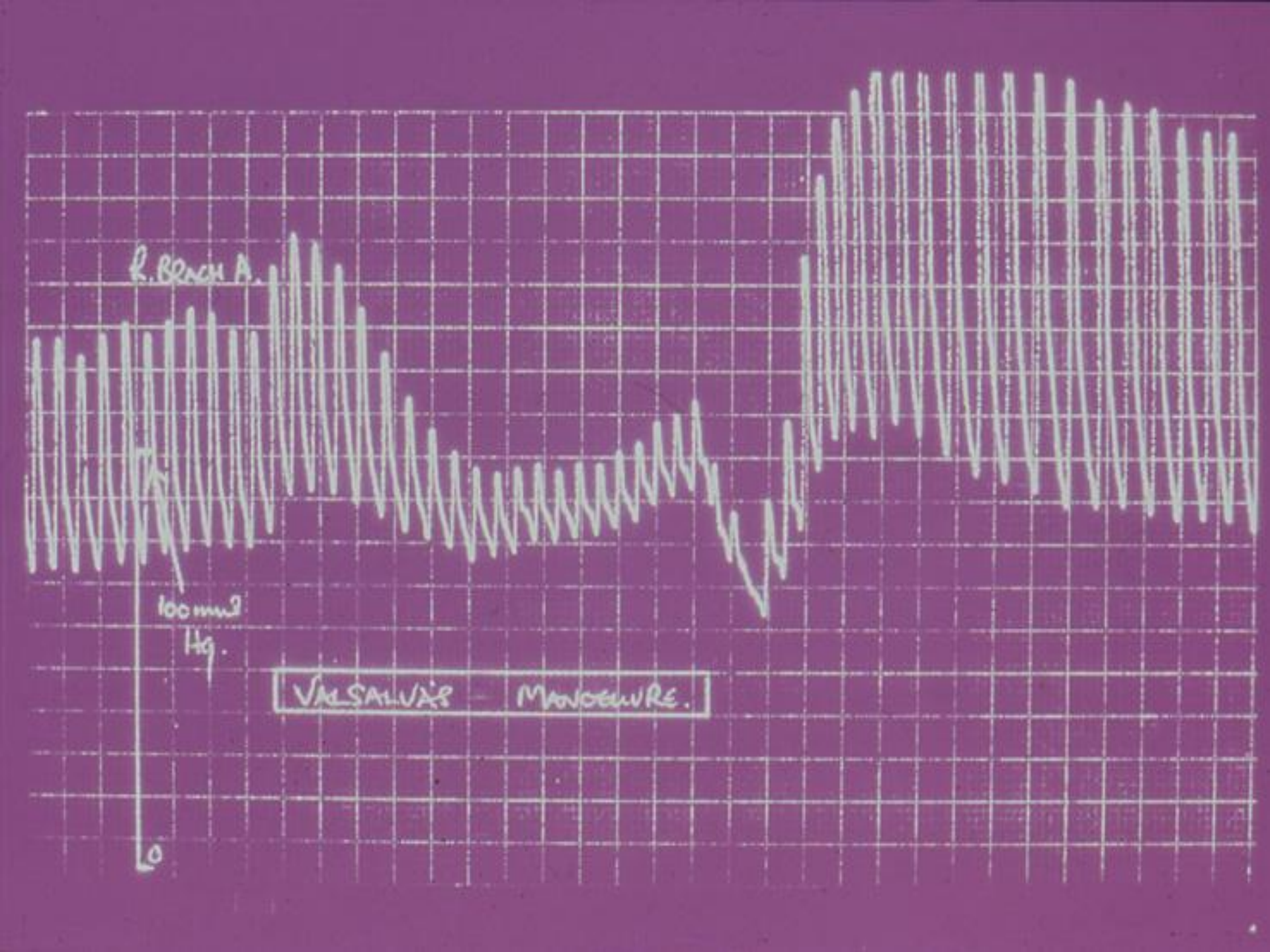
Effects of sedation

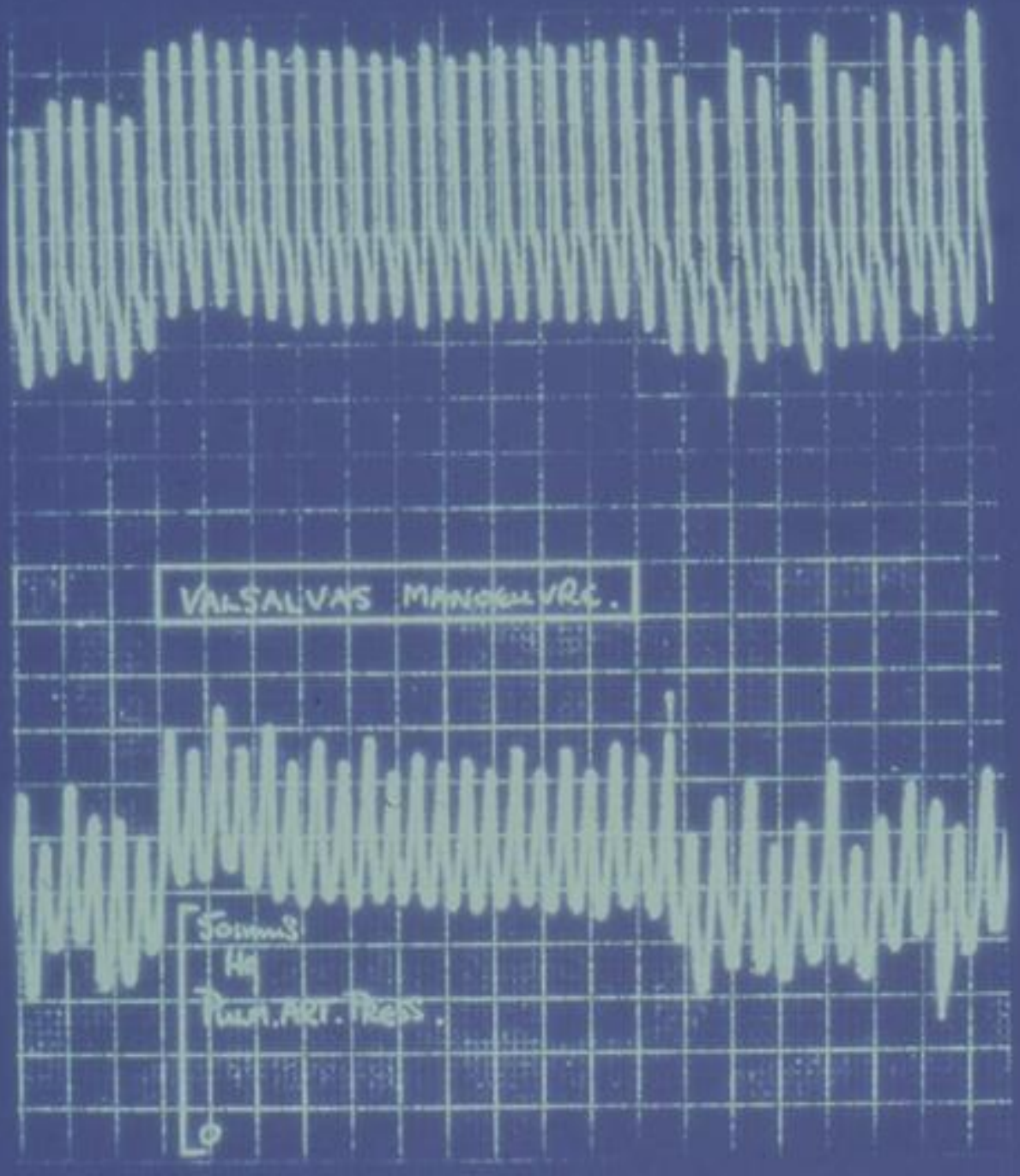
Straight leg raise

Valsalva manoeuvre

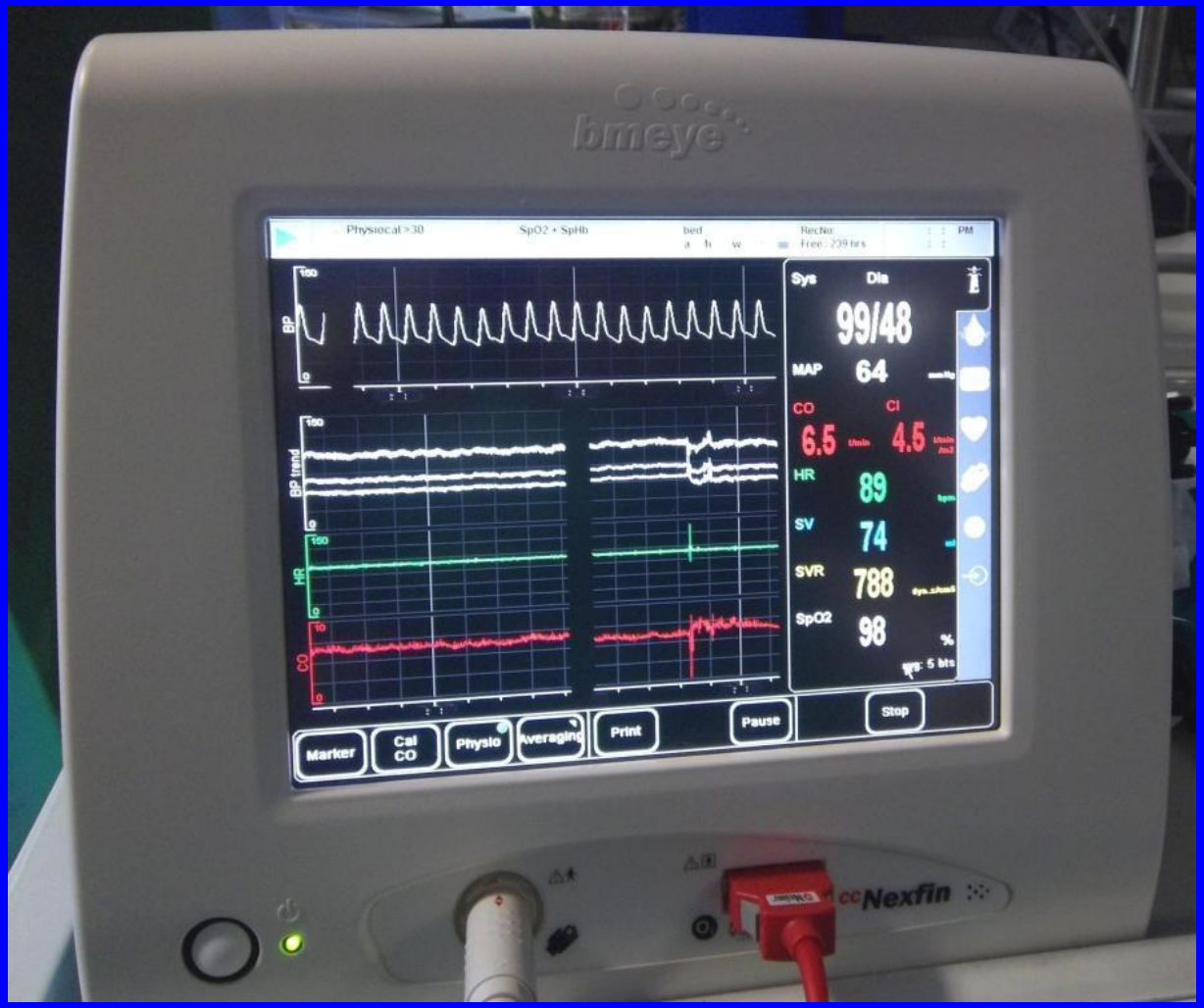
EPSS

- Cambridge – UCH
- Hammersmith
- STH 1948 - 1963


L. BRACH A.
100 mm Hg.
0
VALSALVA MANOEUVRE.


VALSALVAS MANOEUVRE.
PULM. ART. PRESS.

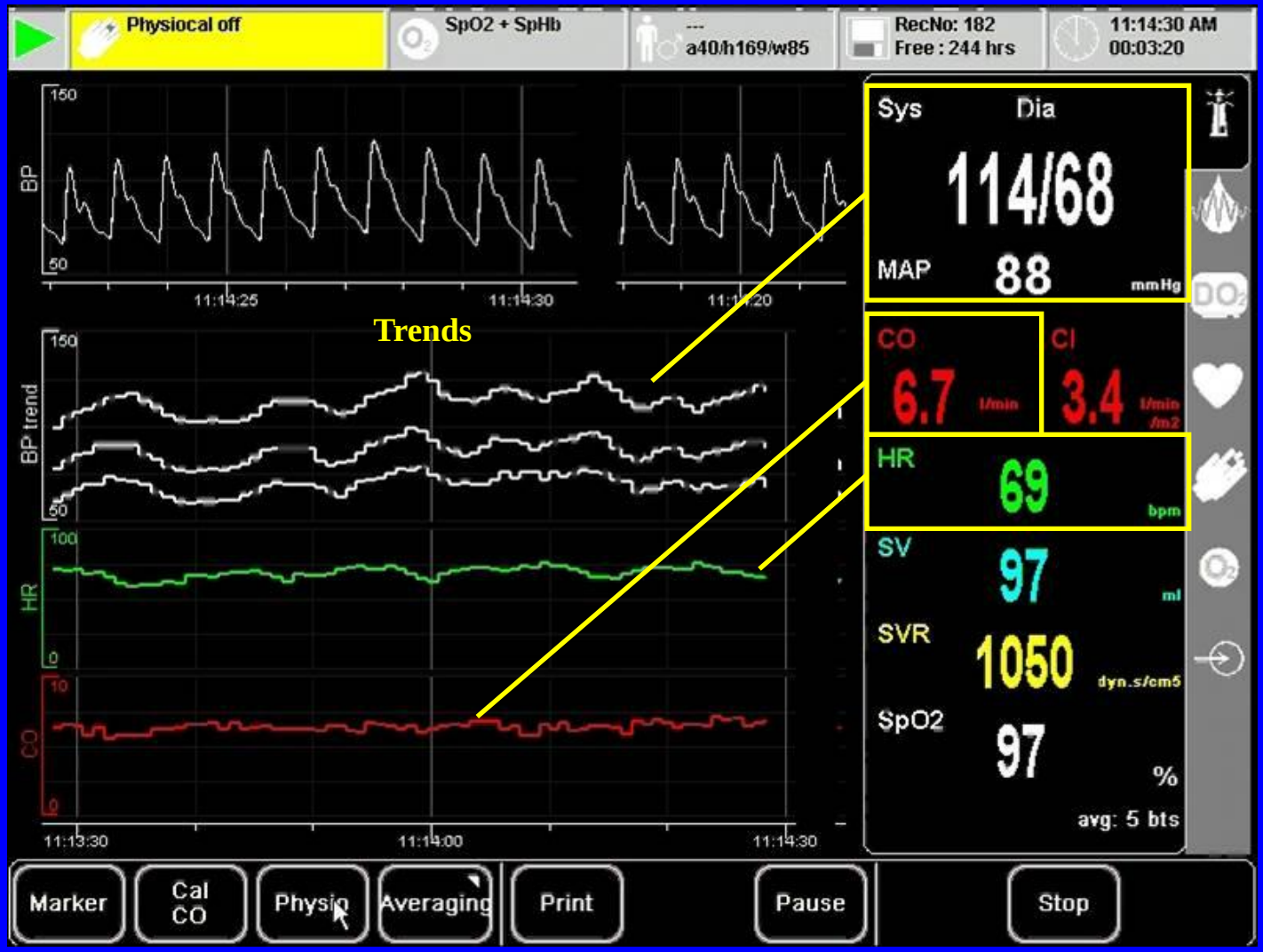
The Nexfin monitor



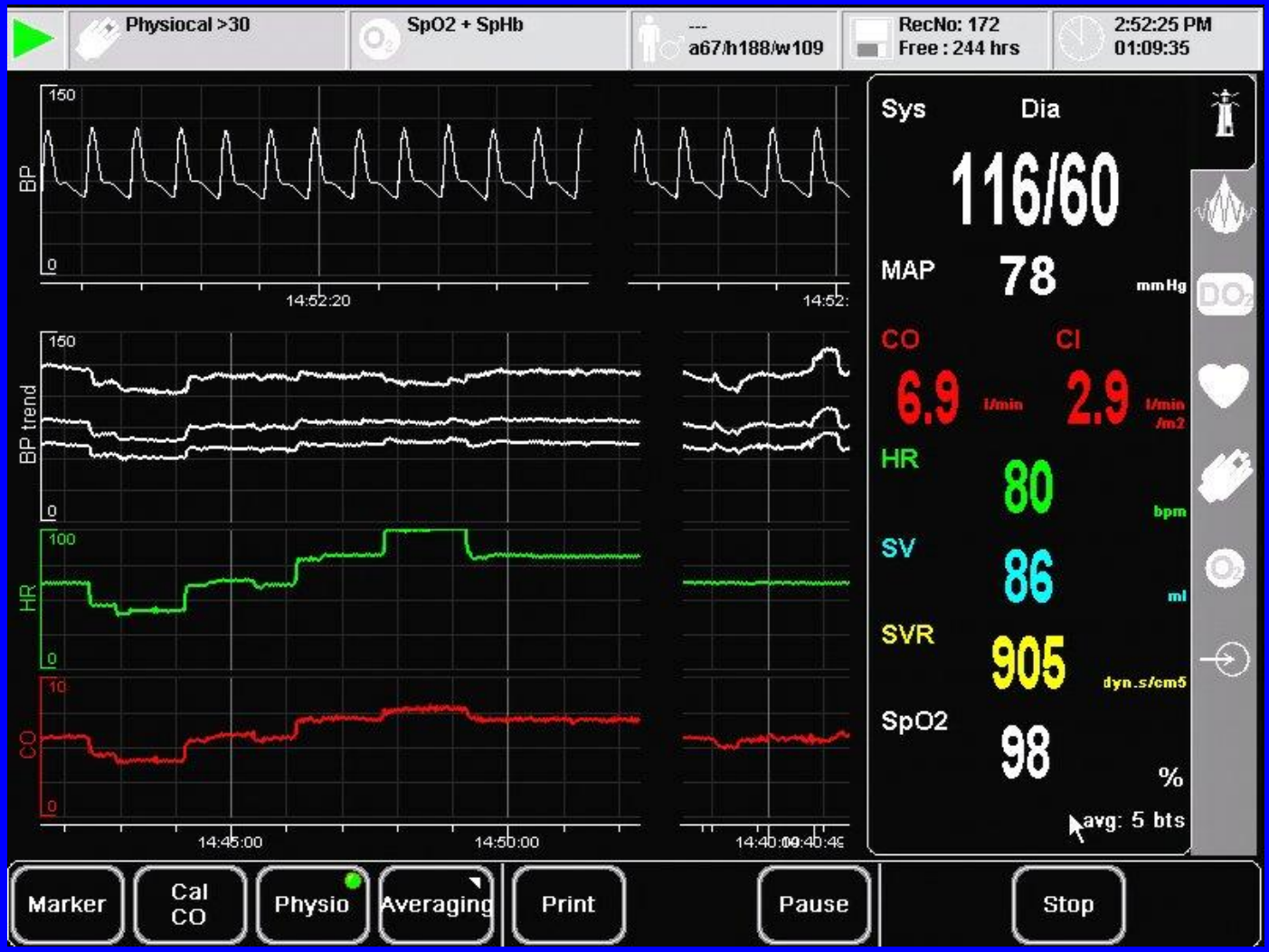
- **Beat to beat**
- **Non-invasive**
- **Blood pressure**
- **Cardiac output**

The Nexfin kit

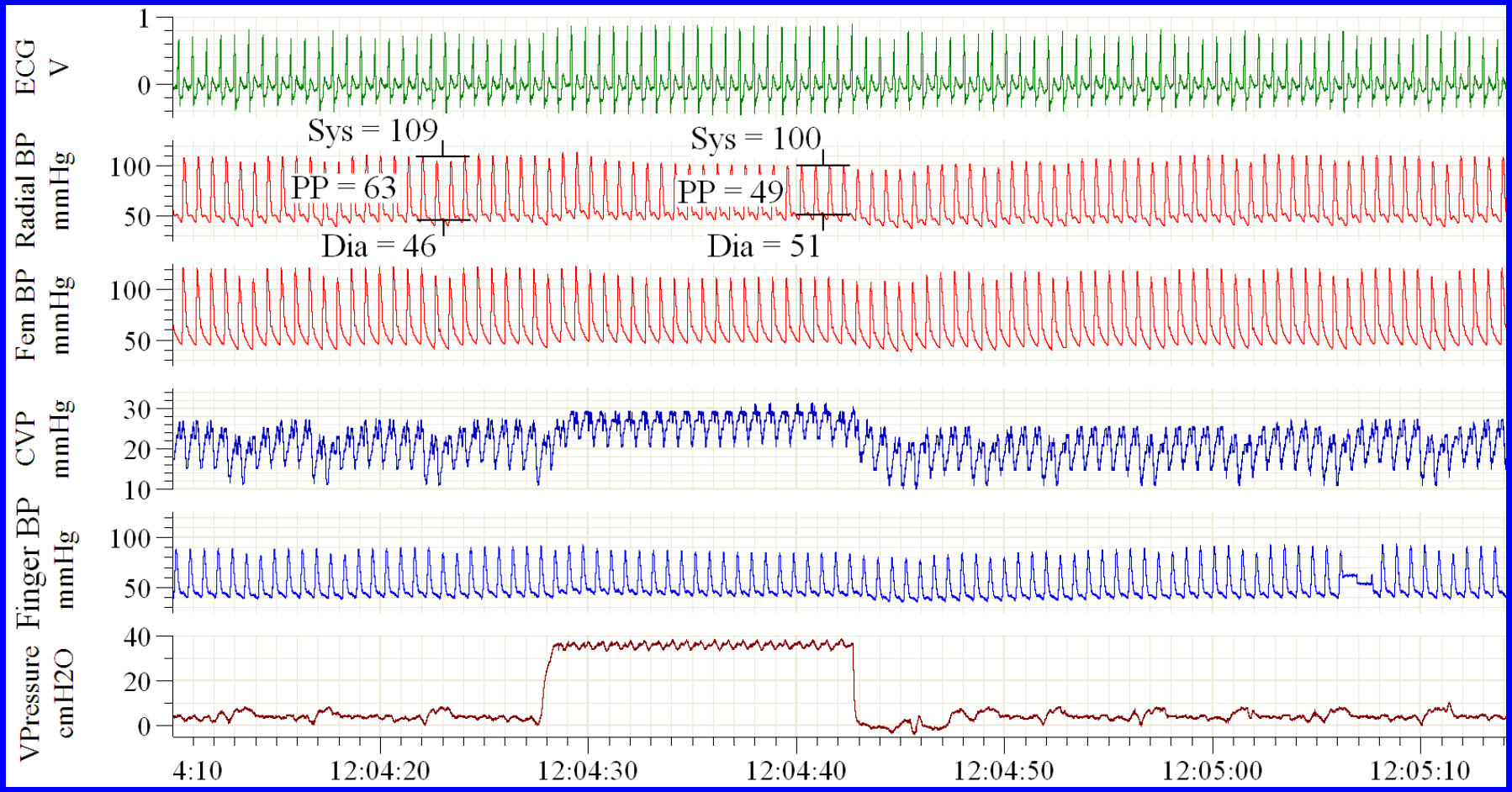
Non-invasive measurement of BP, HR & CO



Note step-changes in BP and CO with HR over trend.

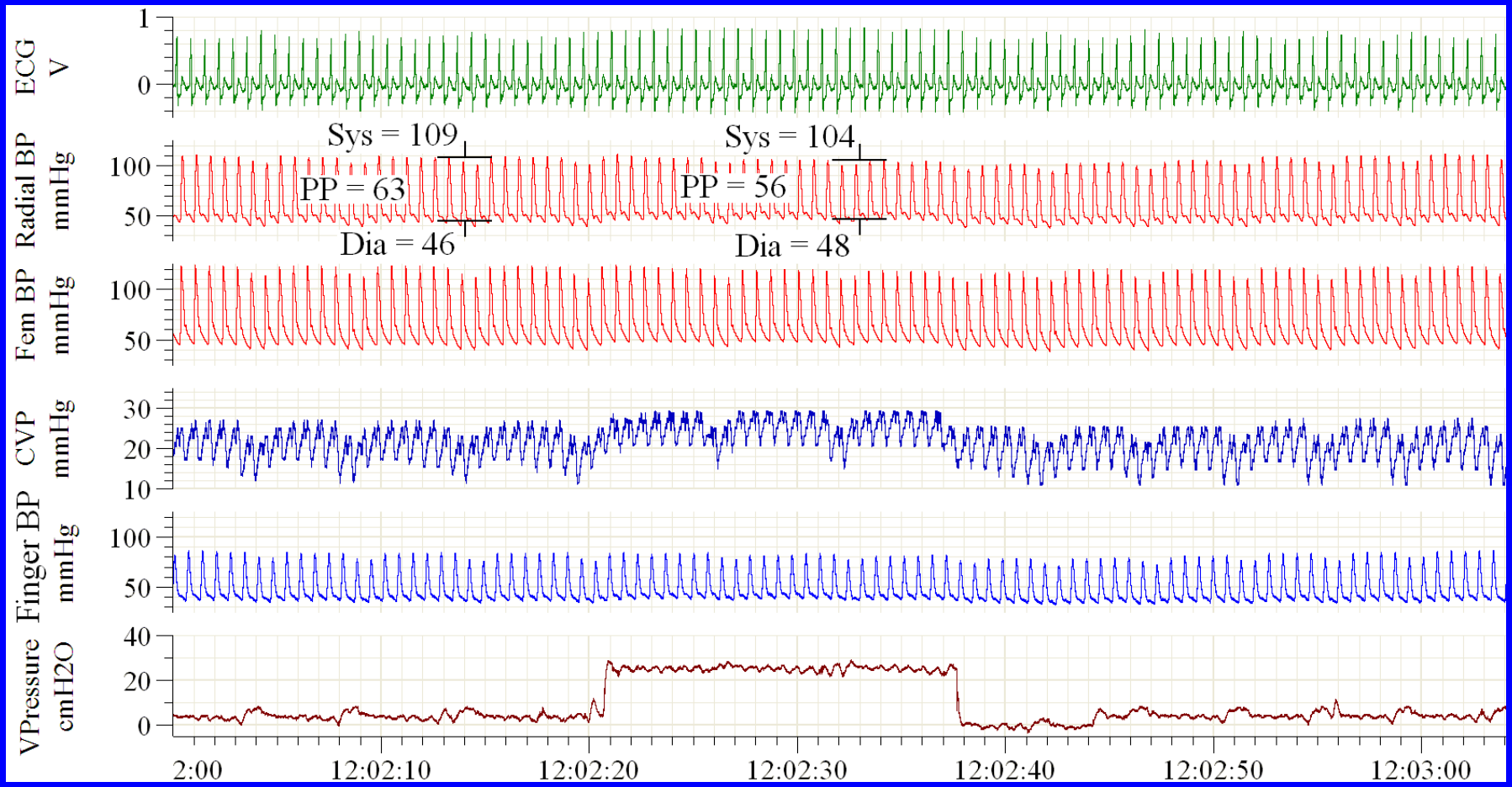


Valsalva before ….



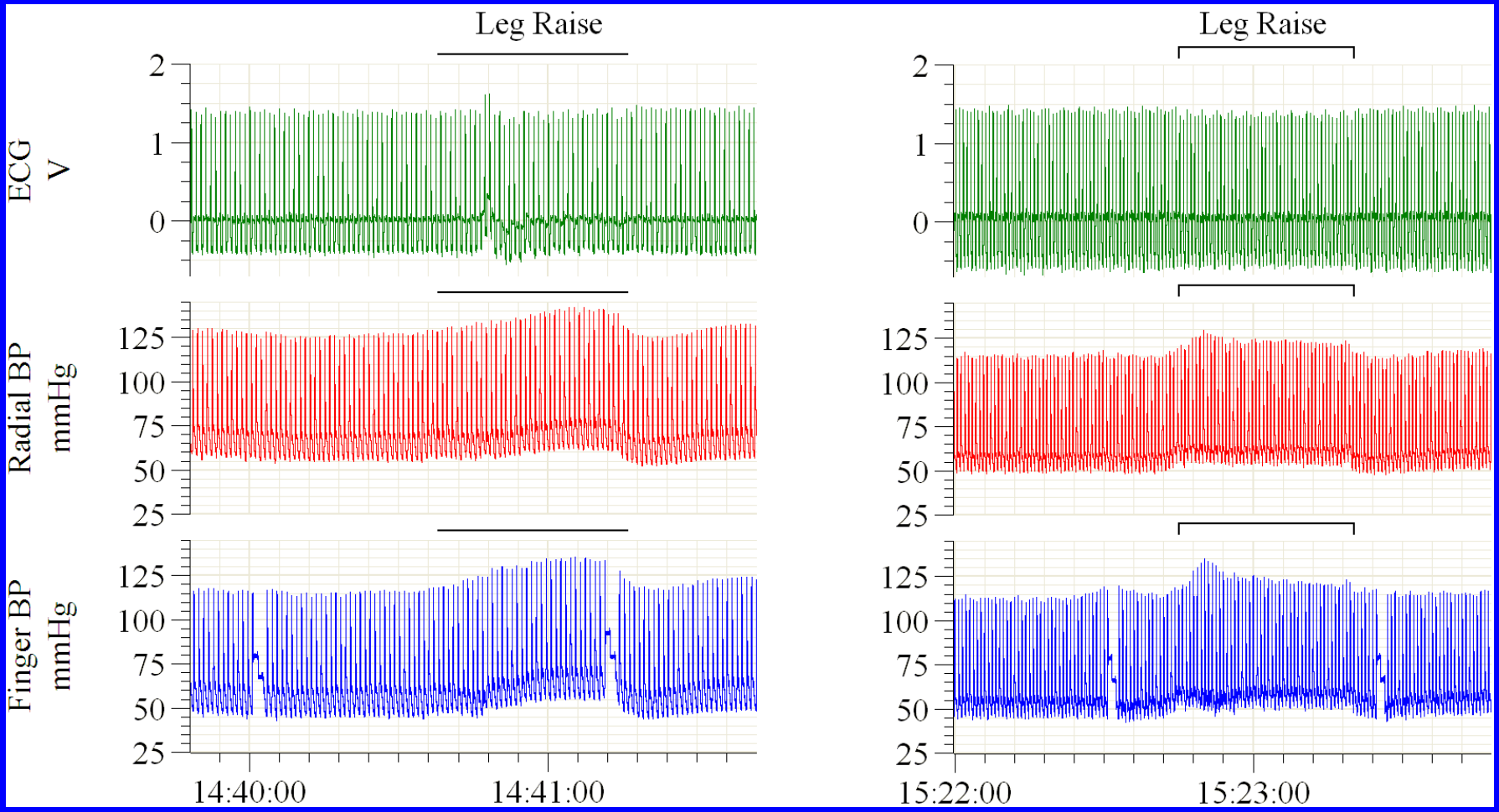
SPV = 11% **DPV = 14%** **PPV = 22%**

Valsalva after filling



SPV = 4% **DPV = 4%** **PPV = 10%**

Response to Leg Raises before & after

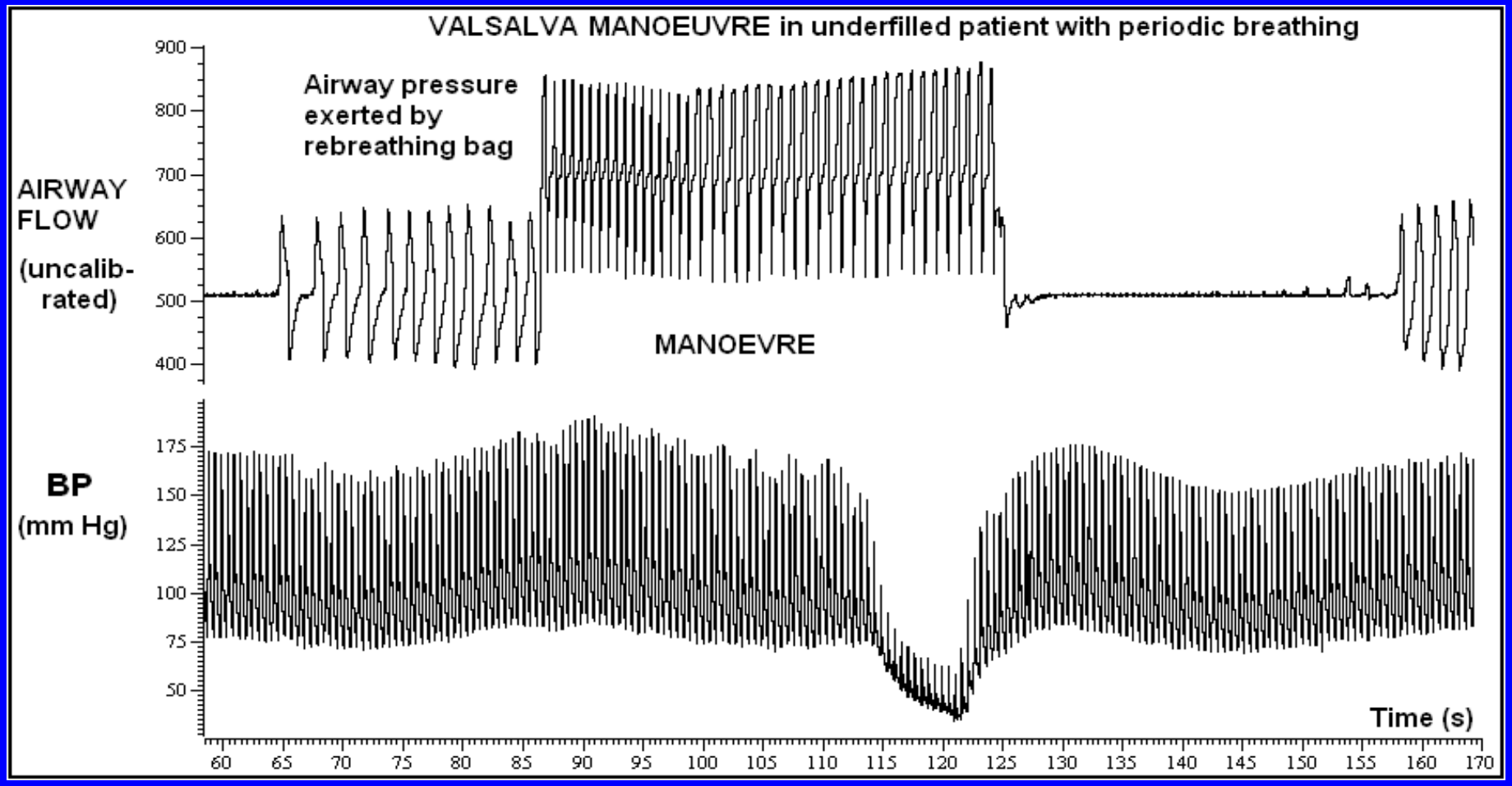


Fluid challenge

- 200 ml of colloid over 10min
- Observe effect on CVP/MAP/HR/CO
  5min later
- CVP ↑ <3mmg Hg & improvement – consider further fluid
- CVP ↑ >3mmHg & no improvement – no further fluids at that stage

Valsalva Manoeuvre –

Is this patient underfilled?



Conclusions

Dynamic > static tests

Rapid, bedside assessment

+

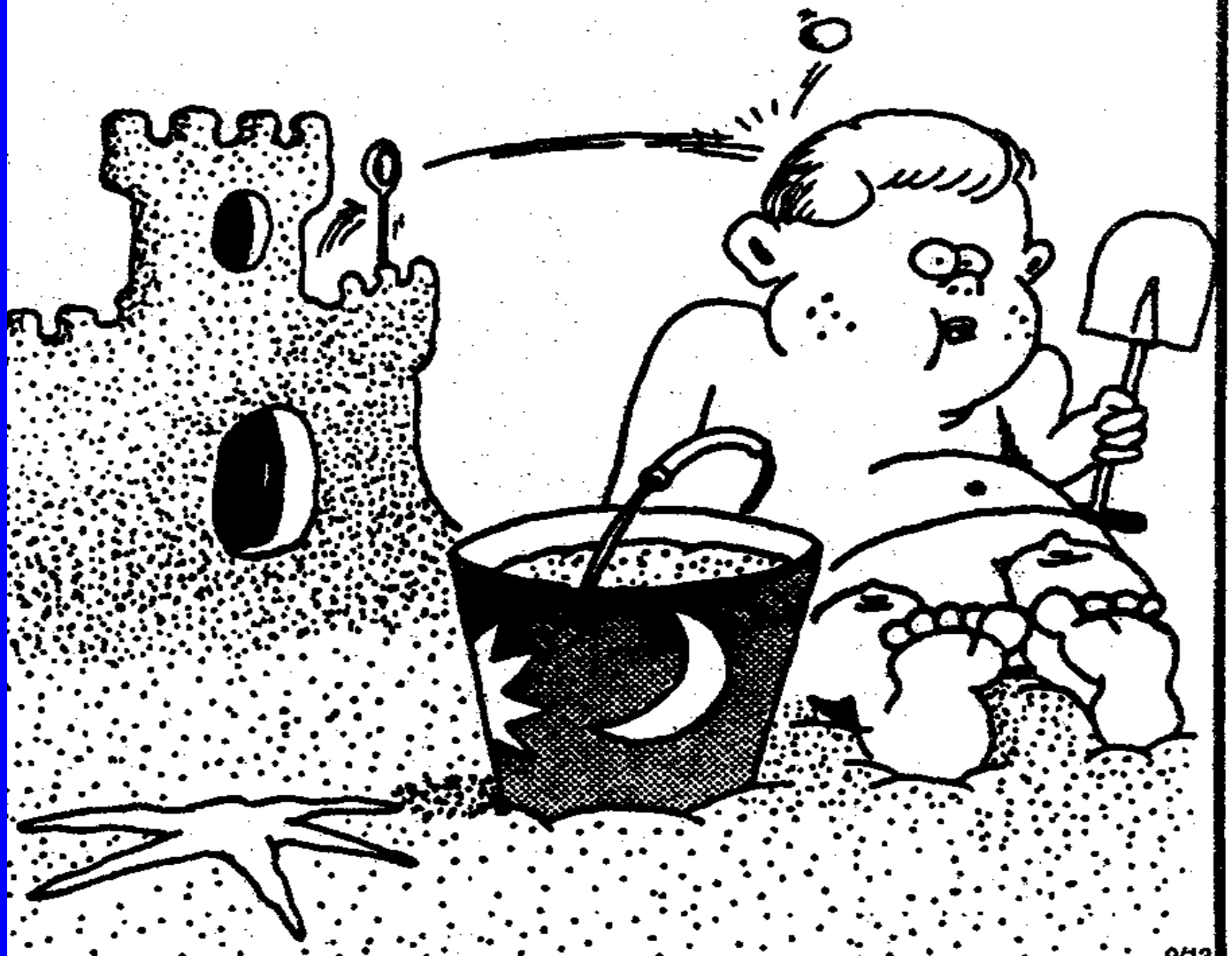
Prompt treatment

⇓

Avoids……

Larson

Thank you for your attention … ?




Questions?

We now have

- SijO2
- SpO2
- Hb

If I like what I find ….

If not …..

Invade & measure!

Timing and need for admission to ICU

- 46% patients receive inadequate care on ward prior to admission
- referred and admitted late
- substantial number could have been avoided

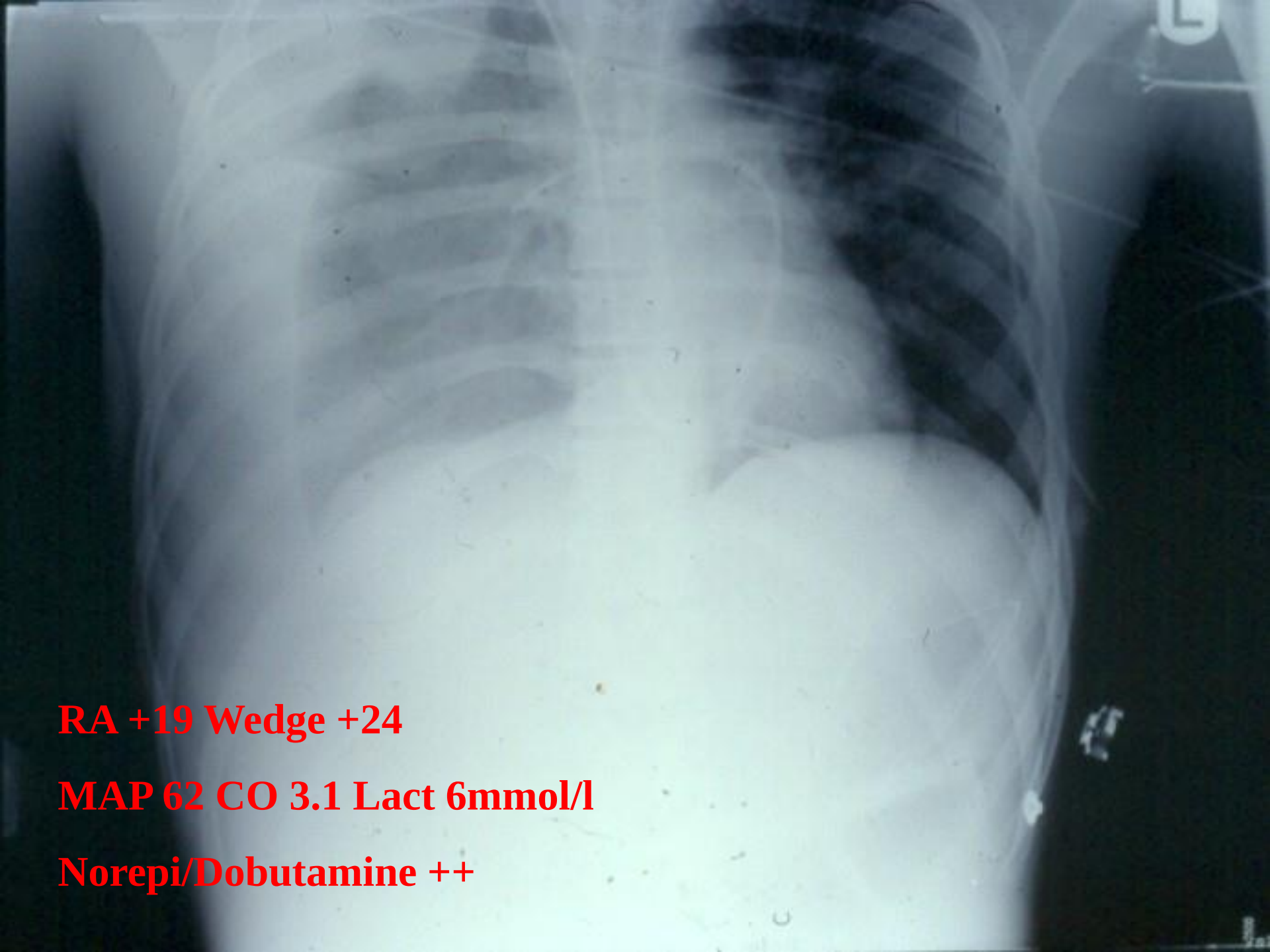
McQuillan P BMJ 1998;316:1853

Identification

Signs are there but no-one does anything!

Clinical antecedents to in-hospital cardiac arrest.

Schein MH Chest 1990;98:1388-92


RA +19 Wedge +24
MAP 62 CO 3.1 Lact 6mmol/l
Norepi/Dobutamine ++