

Why Non-Invasive Blood Pressure Monitoring During Sleep is Important

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History of Non-Reactive Continuous Blood Pressure Measurement

1711 Stephen Hales: first blood pressure measurement - horse

1880 von Basch: first blood pressure measurement with a Sphygmomanometer

1896 Scipione Riva-Rocci: arm-cuff and palpatoric acquisition

1896 Nikolai Sergejewitsch Korotkow: auscultation of the blood flow sound

1912 H. Brooks: first blood pressure measurement during sleep

**99 % of all data for blood pressure during sleep
are done by the RR / Korotkow method !**

**RR- blood pressure measuring is
the standard for long-term-recording (24h)**

Blood Pressure recording - Standard methods

Indirect:

- Discontinuous recording
according to Riva-Rocci / Korotkow (RR)
auscultatoric or oszillometric
24h blood pressure monitoring: 2/h night, 4/h day
- Continuous beat to beat
Plethysmographic FINAPRES/PORTAPRES
PTT- based method



Direct:

- Continuous **invasive** blood pressure recording

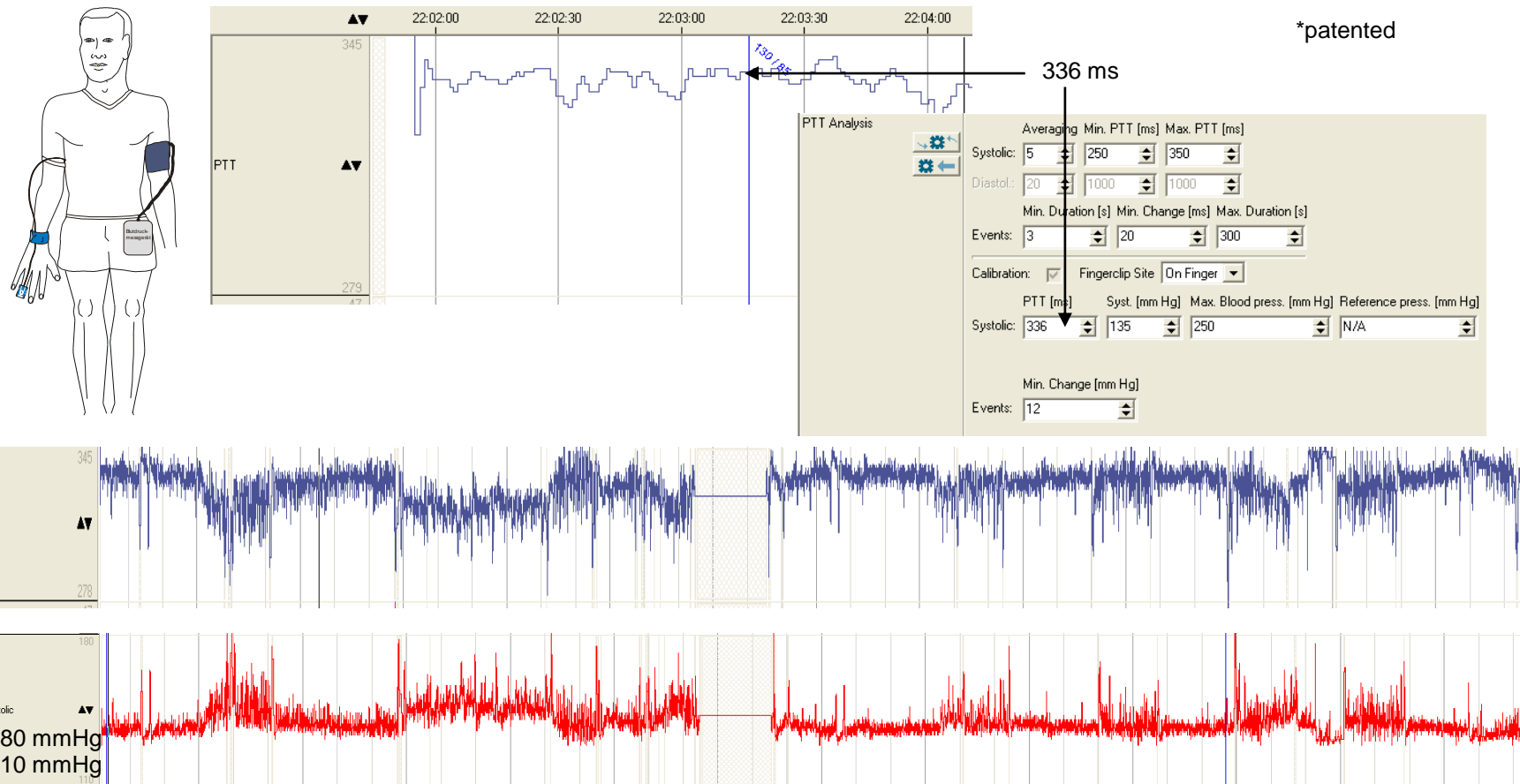


Importance of Non-Invasive Blood Pressure Monitoring During a Sleep Test

Clinically Relevant Questions

- Do patients with Sleep Apnea have clinically relevant hypertension during sleep?
- Do patients with Primary Snoring have clinically relevant hypertension during sleep?
- How do sleep related events influence a patients blood pressure during sleep?
- How do different Sleep Apnea Therapies/Treatments influence blood pressure during sleep?
- Why do many people suffer Heart Attacks or Strokes during sleep?
- Is 50% of hypertension caused by sleep related breathing disorders?
- When is the best time for Hypertensive patients to take their medication, in the morning or before they go to bed?

SOMNOmedics uses a non-linear algorithm* to calculate the blood pressure based on the PTT using a one point calibration

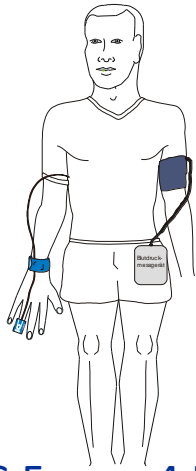


Problems of the RR method during the day

- Recording can be unpleasant and painful
 - Especially by patients with hypertonia, the cuff generates a pressure up to 200 mmHg
- No evidence for cardiological events using cuff-method
- No correlation to the activity level
 - Physiological blood pressure peaks during or after physical activity
 - Psychogenic blood pressure peaks because of exciting discussions

Problems of the RR method during the night

- The inflation of the cuff disturbs sleep – changes up to 35 mmHg occur
 - EEG arousal reaction and/or direct awakening of the patient
- Discontinuous recording 1-2/h
 - Max- Min values won't be detected correctly
REM-sleep associated OSAS / supine associated OSAS
- Changes of the blood pressure due to hydrostatic pressure components according to body position changes can falsify the results up to 25 mmHG
- Recorded values can't be correlated to sleep or wake e.g. Insomnia or WASO



EEG Freq.+ 4 Hz,
max. 10,6 Hz

Heart Rate +15 bpm

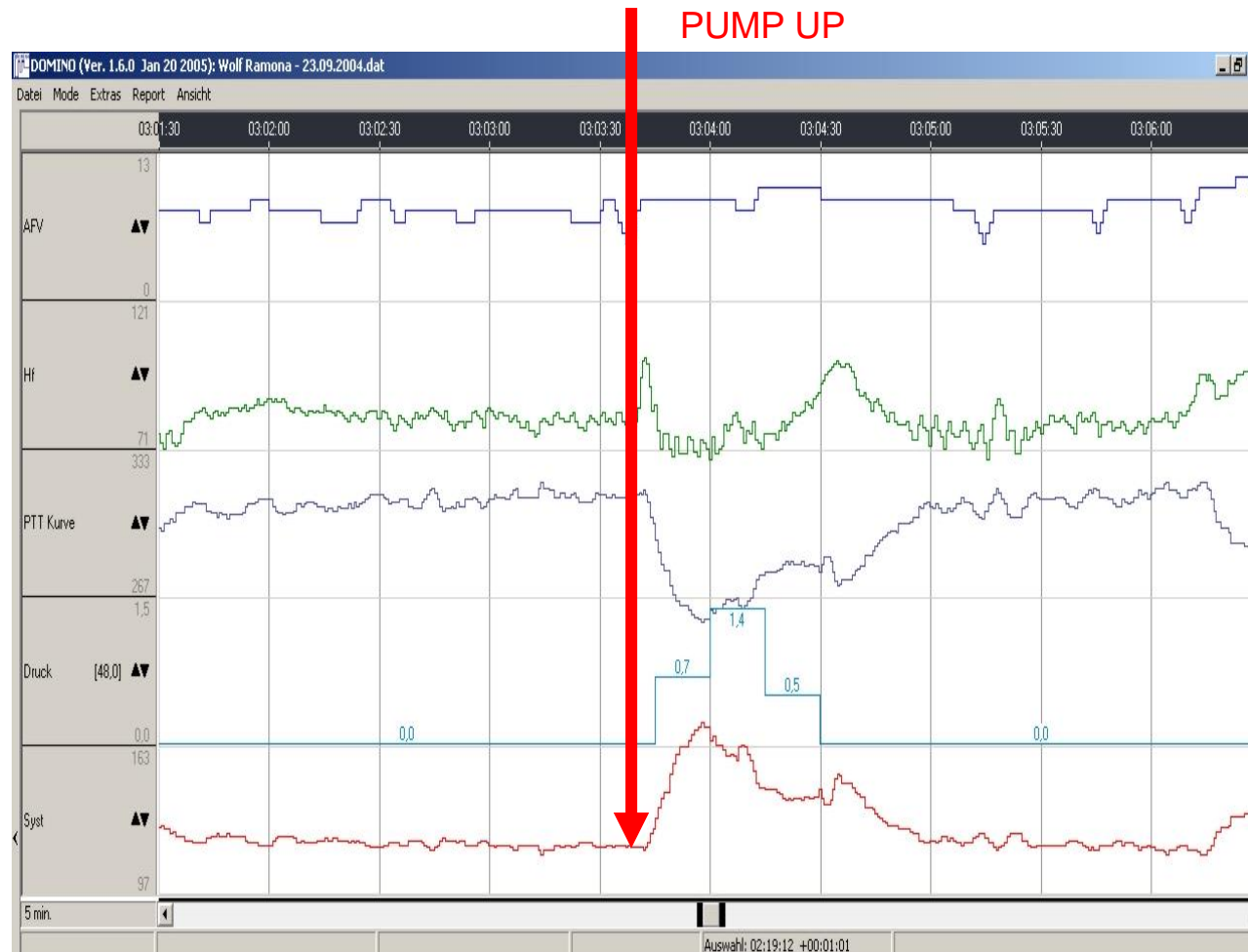
PTT

Cuff Pressure

Syst. Blood Pressure
+ 35 mmHg

Arousal caused by inflation of the cuff

Increase of the syst. Blood Pressure for 10 s caused by Arousal reaction with following Blood pressure fluctuation for app. 20 s.



Advantages of the PTT-Method offered by SOMNOmedics

- **NON-REACTIVE** – maximum patient comfort without cuff
- **CONTINUOUS** - (beat to beat)
- **NON-INVASIVE**
- **ADDITIONAL CLINICAL INFORMATION:** Activity, EKG, Oximetry
- **Easy application of Device**
- **One point calibration for the whole recording**
- **Automatic DOMINO Software Artifact Detection**

Validation: On 20 patients the correlation between RR and PTT based Blood Pressure were investigated during stress test on bike ergometer.

Result: Correlation = 0.87 Validation 2: On 60 youth healthy humans the correlation between RR and PTT based Blood Pressure were investigated during stress test on bike ergometer.

Results: Correlation coefficients for systolic BP measured by cuff and calculated from PVW varied between $r=0.69$ and $r=0.99$ in the volunteers. The mean correlation coefficient was $r=0.92$. In the Bland-Altman-Plot only 13 from 247 measurements were beyond the range of ± 1.96 x standard deviation of the differences of BP between both methods.

Conclusion: There was significant correlation between BP determined by both methods. Furthermore, the Bland-Altman-Plot also showed a good agreement between both methods. The results encourage performing further evaluation of the PTT based method for use in sleep medicine

Summary

- Manipulations, especially the inflation of the cuff disturb sleep and cause arousal reactions. Falsification of the blood pressure up to **+35 mmHg or – 30 mmHg**
- Discontinuous recording 1-2/h
 - Max and Min won't be detected
 - Fluctuations of the blood pressure can be missed
- Hydrostatic pressure components according to body position changes cause errors up to **25 mmHg!**
- No clear correlation of the recorded values to Sleep and Wake e.g. Insomnia and WASO, Error **+25 mmHg**

Summary

- Cuff method does not take into consideration motoric activity as reason for High Blood Pressure values during day.
- Cuff based device do not correlate the blood pressure with corresponding signals of EKG, Oximetry, Movement, Body Position.
- PTT based method is much more comfortable for the patient and gives a beat to beat measurement of their Blood Pressure!