

Measurement of blood pressure, technics, results and pitfalls

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**5th Pan Arab Hypertension Conference,
Tunis, september 14 -17, 2005**



Factors affecting BP

- Depend of intrinsic and extrinsic factors :
 - Cardiac cycle, respiration, circadien rythm,
 - position of the patient, physical activity, nutrition, temperature of the room,
 - Ingestion of tobacco, cafeine, alcohol, drugs,
 - Depend upon the **Accuracy of the devices** :
 - **aneroid devices**
 - **Electronic devices should be validated** :
 - - **AAMI** : Association for the Advancement of Medical Instrumentation
 - - **BHS** : British Hypertension Society
 - - Working Group on blood pressure monitoring of the ESH
- International Protocol** for validation of BP measuring devices in adults;

The observer

- Audition,
- Stethoscope,
- Korotkoff sounds,
- Digits preference,
- Digit bias,

Office blood pressure : the devices

- Depends on the experience of the student/nurse/doctor, devices, cuffs, bladders, tubing, valves, Problem of white coat diagnosis,



Variability

- Variability of the measures :
 - Mean and standard deviation
 - Regression to the mean;
- reproductibility :
 - Confidence interval 95%
- S.D. is 17.9 mmHg for systolic B.P. and 8.9 mmHg for diastolic B.P.

*** Armitage et Rose, The variability of measurements of casual blood pressure; Clin Sci 1996, 30, 337-344**

To limit variability

- Increase the number of visits,
- Increase the number of measures
- The mean of the measures of 4 visits help to decrease :
 - By 33 % overdiagnosis of HT;
 - By 5 % underdiagnosis of HT;

*** Armitage et Rose, The variability of measurements of casual blood pressure; Clin Sci 1996, 30, 337-344**



Follow-up of 2151 « hypertensive » patients N Chraibi and al. Arch. Mal. Coeur 1998

- 2151 « hypertensive » patients with moderate hypertension from the hospital outpatient department;
- All drugs stopped for one month;
- 8 measurements with dynamap : 842 (37,8 %)
patients normotensive;
- 1 month : repeat measurements : 93
patients normotensive;
- 3 months : repeat measurements ; 161
patients normotensive;
- The last group : 588 patients : use of ABPM 281
patients normotensive;
- In the end only 802 (37,3 %) were truly hypertensive !

2- Ambulatory blood pressure monitoring

- Automated technique using oscillatory or auscultatory techniques (or both);
- Limit the variability by increasing the number of measures,
- Record BP at specific intervals,
- Gives 24 h BP, daytime BP, night time BP;
- without errors due to observer preference,
- Devices must be validated (hardware and software);
- Special attention to the bladders, tubings, cuffs, batteries, etc.



methods

- Sitting patient,
- Resting for five mn;
- On the non dominant arm, or the arm with the highest BP if the difference > 5 mmHg,
- Performed on a weekday,
- Patients's diary
- Information and training of the patient (HT, CVRF, drugs, devices...);

ABPM

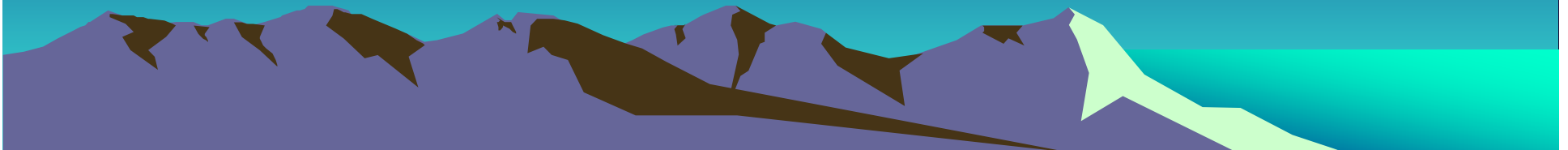
- The recording is done at rest and in activity;
- Beginning usually before 10 00 h a.m.
- Every 15 or 20 mn during the day,
- Every 30 mn at night,
- Daytime from : 07 00 to 22 00
- Night time from : 22 00 to 07 00
- Push button for manual measurement by the patient;

ABPM

- Link to a computer, data transfer;
- Statistics and graphic presentation of data;
- SBP & DBP : maxima, minima, mean for 24 hour, daytime, night time; heart rate;
- S.D. : 15 mmHg for SBP and 12.5 mmHg for DBP;
- % of measures out of range ;
- means for every hour ;
- Double product;
- Through to peak ratio;
- smoothness index,
- Morning evening ratio,

Dipping

- Nocturnal fall in BP greater than 10 % of daytime values; attention to extreme dippers
- Night time values are better correlated with organ damage and cardiovascular risk;
- Non-dippers : BP at night is elevated;
 - Correlates with organ damage;
 - Look for secondary hypertension;
 - Associated with sleep apnea syndrome;



ABPM : indications

- to exclude white coat hypertension,
- to confirm diagnosis : borderline hypertension, elderly patients, pregnancy;
- to evaluate therapy,
- to confirm resistant hypertension,
- to identify nocturnal hypertension,
- to diagnose hypotension under antihypertensive medication,
- to diagnose paroxysmic hypertension ;
- to confirm and evaluate autonomic dysfunction ;
- is not accurate in patients with atrial fibrillation;

Comparative profile of masked and white coat hypertension

	Office BP	Self BP
Normal	Normal	Normal
Hypertension	Elevated	Elevated
White coat hypertension	Elevated	Normal
Masked hypertension	Normal	Elevated

White coat hypertension

- Characterized by an elevated BP at the office, and a normal BP at home (ABPM or SBPM);
- About 10 to 15 % of the population;
- Caution before initiating drug therapy when HT is diagnosed for the first time;
- Prognosis : controversed;
- No drug therapy, unless cardiovascular risk factors, or organ damage;
- Close follow-up ;



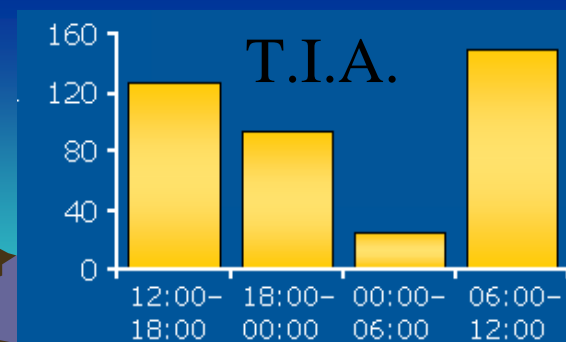
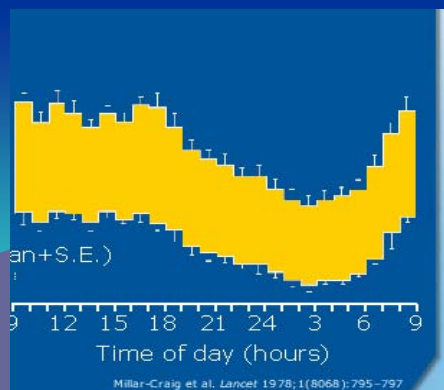
Masked hypertension

- BP is normal at the office, elevated at home (ABPM or SBPM);
- Prevalence 10 %
- Predictor of cardiovascular risk and morbidity;



The morning surge

- defined as a rise in BP > 50 mmHg during early morning
- Abrupt or progressive increase;
- associated with an increased occurrence of
 - myocardial infarction,
 - ischemic events, stroke;
- Explained by increased sympatho-activity, platelet agregability, decreased fibrinolytic activity;

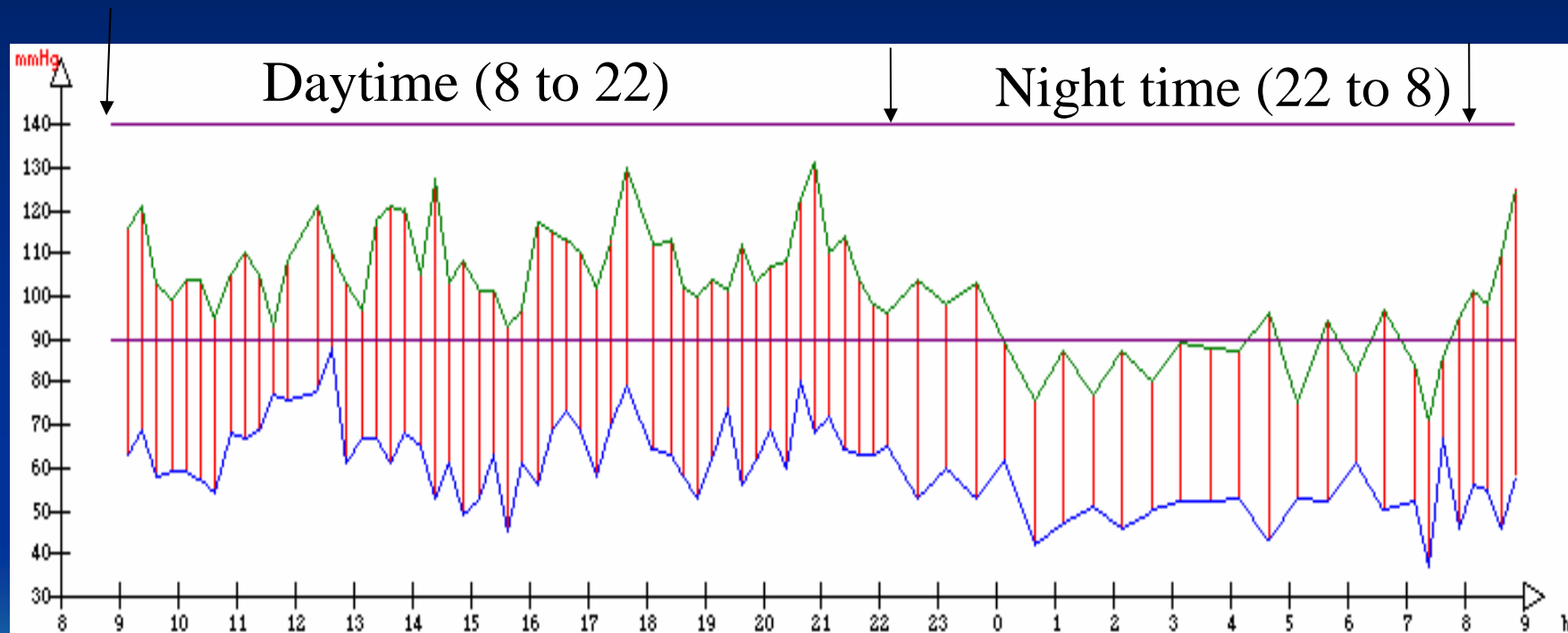


Elliot,
Stroke,
1998

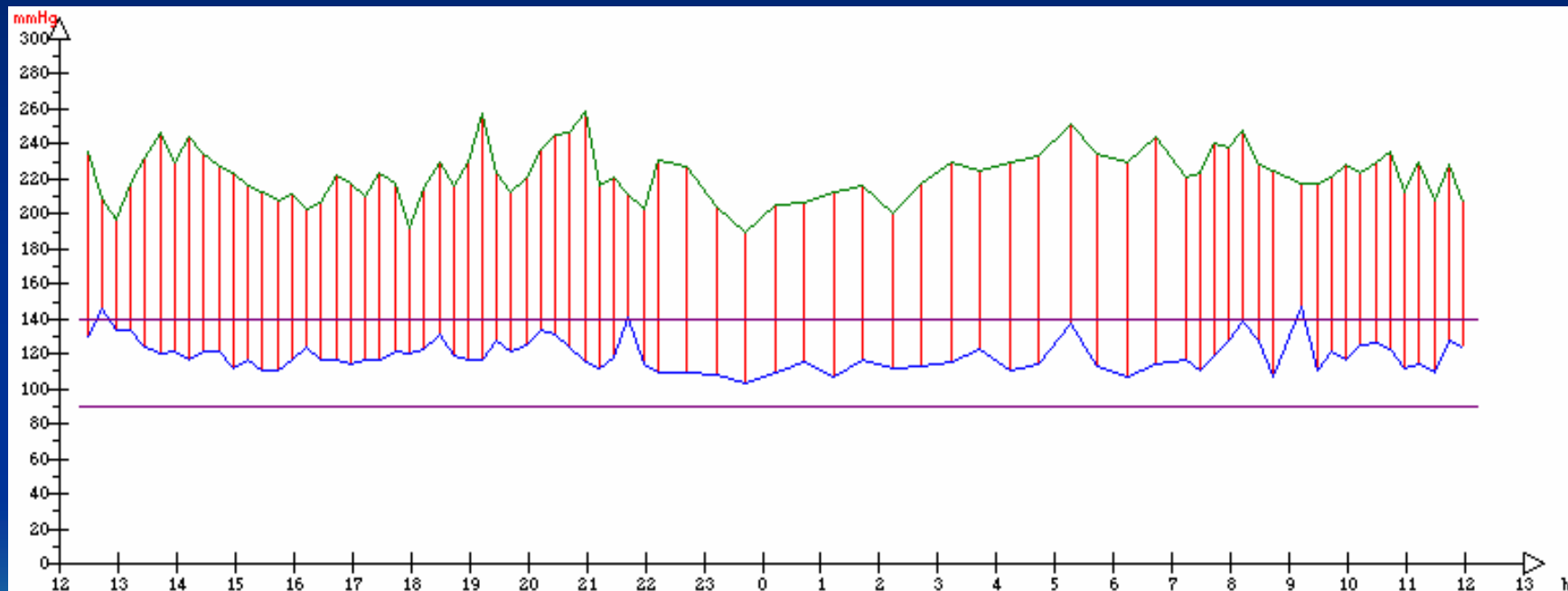
Recommended norms for ABPM (ESH)

	24 hour	daytime	Night T.
Normal <	130/80	135/85	120/70
Abnormal >	135/85	140/90	

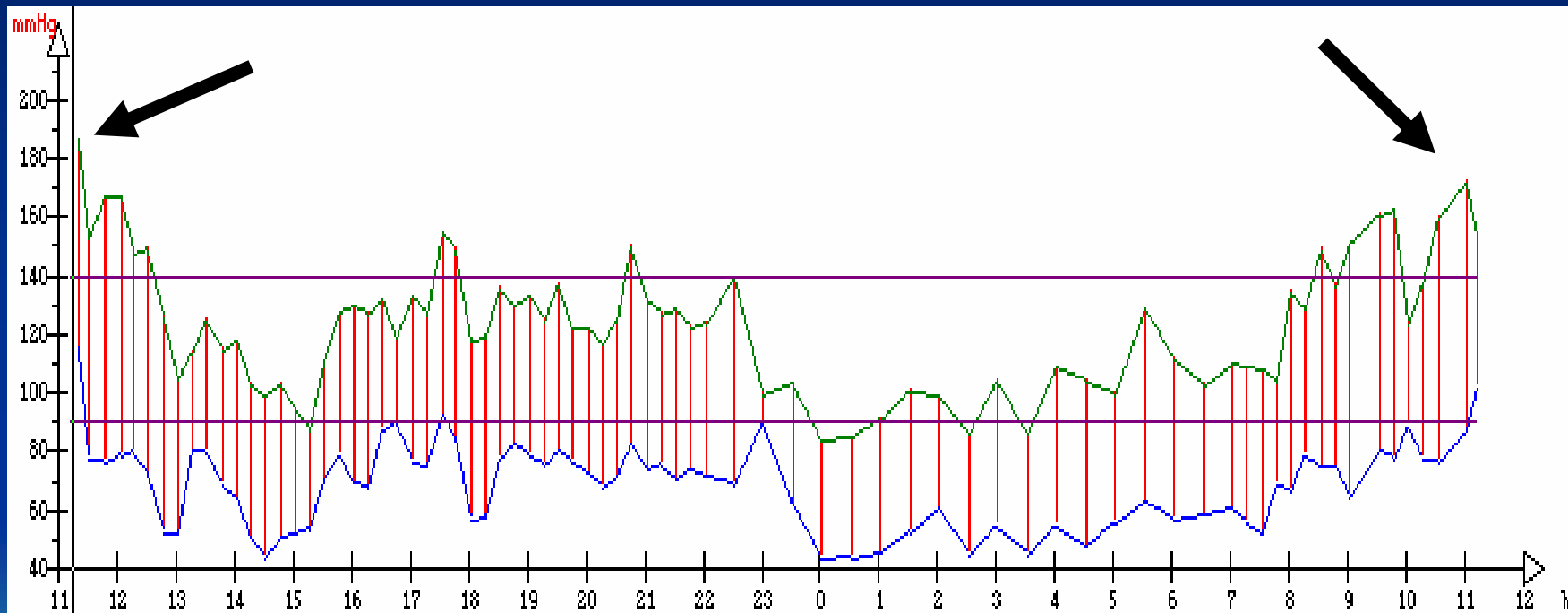
Graphic display of ABPM data



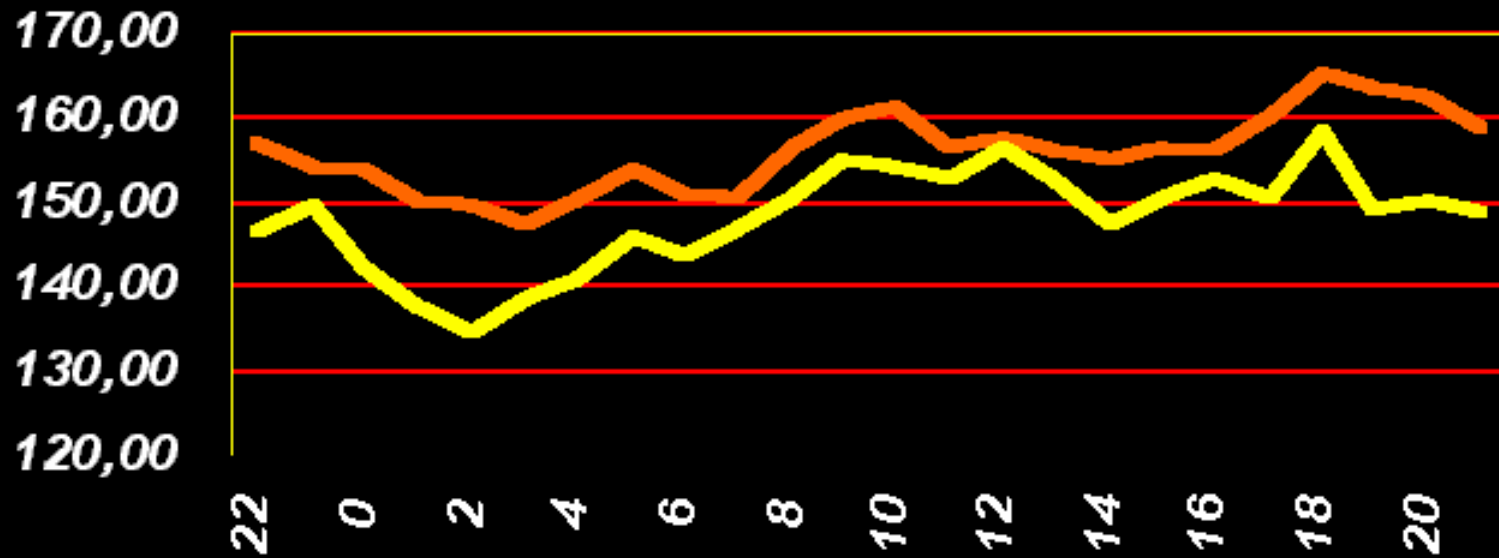
ABPM profile of a hypertensive patient



ABPM profile of a patient with white coat hypertension



Comparison of successive ABPM recordings in a treated hypertensive patient



3 – Self blood pressure measurement

- **Patient** : same conditions as ABPM
 - Sitting,
 - Rest,
 - Bladder at the same level as the heart,
 - Non dominant arm, or highest BP;
 - Information and training of the patient (HT, CVRF, drugs, devices...);
- **Frequency** :
 - **3 measures** morning and evening,
 - **On 3, 5 or 7 consecutive days,**
- **Reference values** :
 - N** < 135/85 mmHg
- - should be used under medical supervision

SBPM

- **Measures are lower than conventional BP;**
- **Similar to daytime BP of ABPM;**
- **Results are the same, whether with a manual or automatic device;**
- **SBPM is more reproducible than conventional BP:**
- **May increase BP control under therapy;**
- **Correlates with cardiovascular risk and morbidity;**
- **Eliminates WCHT;**
- **Can help in the follow-up of refractory HT;**
- **Used now in clinical trials**
- **May become in the future the diagnostic tool ?**

Indications

- **Diagnosis : borderline hypertension, white-coat HT, masked HT,**
- **Special groups : diabetics, pregnancy, elderly;**
- **Better control of drug therapy,**
- **Low cost, may be repeated,**
- **Is not accurate in patients with atrial fibrillation,**
- **Can generate anxiety in some patients,**



CONCLUSION

- Although conventional blood pressure is widely used and is the actual reference method, it is subject to many critics;
- **Ambulatory monitoring** eliminates borderline hypertension, white-coat hypertension; correlates well with end-organ damage and cardiovascular risk; the only drawback is the cost;
- **Self BPM** is a low cost method; it eliminates borderline and white-coat hypertension; Correlation with cardiovascular risk is under study.