Measurement *versus* Calculation of Training Heart Rate in Patients with Coronary Artery Disease Receiving Betablockers

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Background

- In patients with coronary artery disease, target intensity level of exercise training is usually adjusted by a Training Heart Rate (THR) which aims to be close to the Anaerobic Threshold Heart Rate measured measured during an exercise test with gas analysis (THRm)
- But it is often calculated (THRck) from the Karvonen formula after a conventional exercise test : THRck = RHR+0.6*(MHR- RHR)
- However, this formula was only assessed in 6 normal subjects.

Abbreviations

- **THR** : Training Heart Rate
- **THRm** : measured Training Heart Rate
- **THRck** : Training Heart Rate calculated from Karvonen Formula :

  RHR+0.6*(MHR- RHR)
- **mTHRck** :Training Heart Rate calculated from modified Karvonen Formula :

  RHR+0.8*(MHR- RHR)
- **MHR** : Maximal Heart Rate
- **RHR** : Rest Heart Rate

Objectives

1-To evaluate the validity of the Karvonen formula in patients receiving beta blockers less than one month after an acute myocardial infarction

2-To propose a new formula allowing to calculate THR during a conventional exercise test if Karvonen formula is not valid.

Methods

- Multicentric prospective study
- All patients receiving beta blockers, less than one month after an acute myocardial infarction, were eligible.
- Patients underwent a cardiopulmonary exercise test (10w/mn) before and after a training program.

  When the anaerobic threshold was not obtained, patients were excluded
- THRck was compared to THRm

Population was divided in two samples

- Derivation sample : *(n = 58 patients, from january 2003 to july 2003)*
  - THRck (calculated with Karvonen formula) was prospectively compared to THRm
  - THRck was found significantly different from THRm, so we determined,by linear regression a new formula : the modified Karvonen formula to obtain, a THR closer to theTHRm (mTHRck).
- Validating population : (*n = 57 patients, from august 2003 to january 2004)*
  - THRck and mTHRck were prospectively compared to THRm in the following 57 patients.

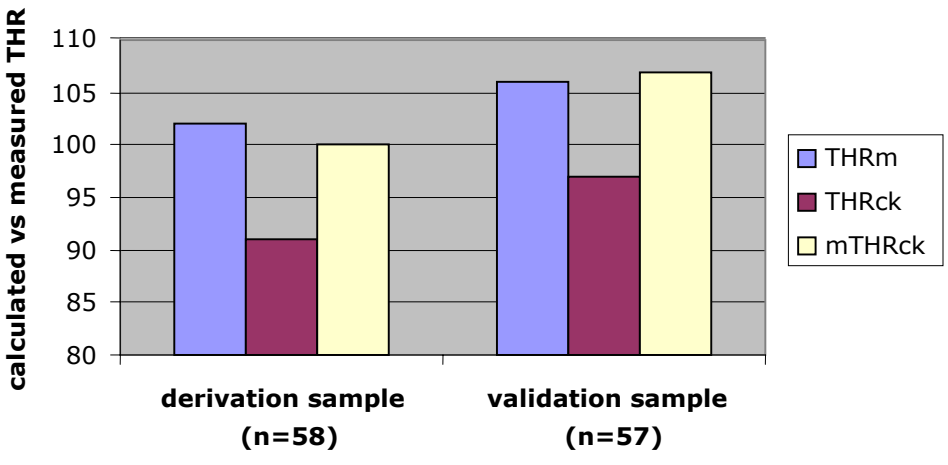
Results : population

- 130 patients were eligible
- 15 patients were excluded (anaerobic threshold not obtained)

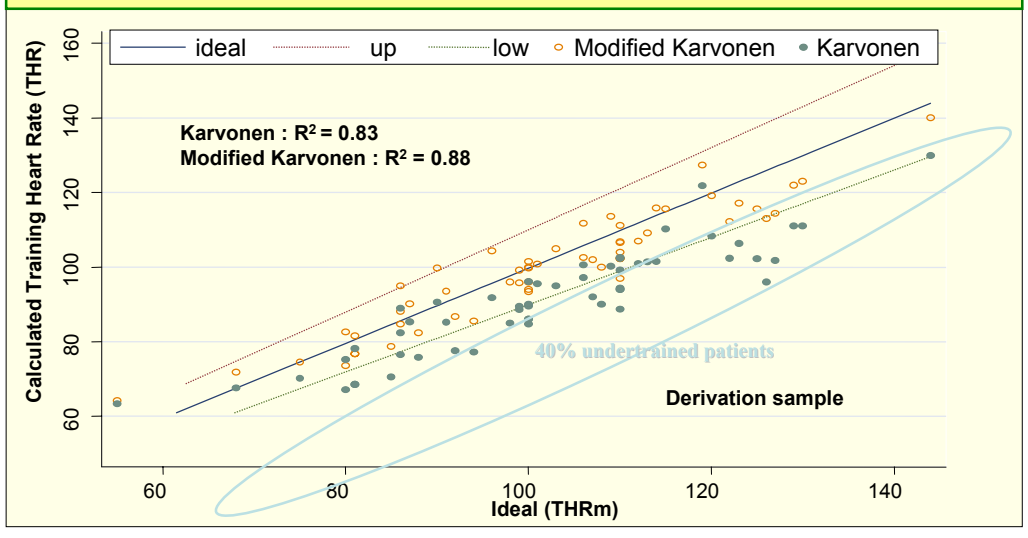
Results

- On the derivation sample, THRck was significantly different from THRm, the best correlation determined by linear regression was THR=0.80*(MHR- RHR) +RHR
- So we used this "modified Karvonen Formula" defined by : **mTHRck = 0.80*(MHR- RHR) +RHR**

mTHRck is close to the ideal (THRm) Training Heart Rate



Modified Karvonen Formula Determination



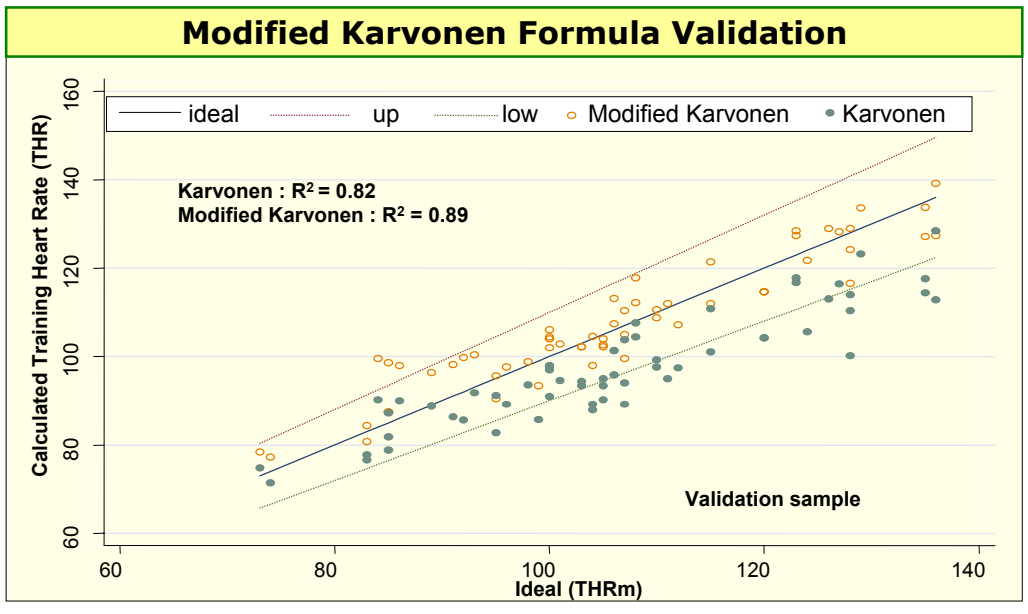
Results : populations

	Derivation sample (n=58)	Validation sample (n=57)	p
Age	56 ± 11	54 ± 11	NS
Male (%)	81	91	NS
LVEF (%)	49 ± 8	47 ± 9	NS
Diabetes (%)	12	12	NS
Height(cm)	170 ± 8	172 ± 7	NS
Weight(kg)	75 ± 12	79 ± 14	NS
ACE inhibitors (%)	71	92	0.002
Betablockers (%)	100	100	NS

Results : initial test

	Derivation sample (n=58)	Validation sample (n=57)	p
Rest HR (bpm)	65 ± 13	67 ± 11	NS
Max HR (bpm)	108 ± 17	117 ± 17	0.004
THRm (bpm)	102 ± 16	106 ± 15	NS
THRck (bpm)	91 ± 14	97 ± 12	0.02
mTHRck (bpm)	100 ± 15	107 ± 14	0.008

Modified Karvonen Formula Validation



Exercise Tolerance Improvement

- Patients underwent 3 to 5 training sessions (30-45mn) per week during 3-5weeks with a THR close to the THRm
- No adverse event occurs.

	Initial execise test	Final exercise test	p
Rest HR (bpm)	65 ± 13	64 ± 10	NS
Max HR (bpm)	108 ± 17	122 ± 21	0.0002
Max load (watt)	97 ± 28	127 ± 38	<0.0001
ATHR (bpm)	102 ± 17	106 ± 17	NS
PVO_2 (mlO_2/kg/mn)	18.8 ±5.5	23 ± 6.5	<0.0001
% PVO_2	58.7 ± 17.6	67.3 ± 18.7	0.003
AT (mlO_2/kg/mn)	15.8 ± 5.1	18.7 ± 5.7	<0.0001

CONCLUSION

- Karvonen formula leads to undertrain patients receiving betablockers after an acute myocardial infarction.
- Modified Karvonen formula can be used to determine a training heart rate, which aims to be close to the Anaerobic Threshold Heart Rate.
- Training patients at Anaerobic Threshold Heart Rate is safe and seems to be effective.