

Gender and Age Influences in T-Loop Morphology

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Abstract

In the present study the influence of gender and age on the T-loop morphology is taken into account. The population based ECG-ILSA database (Italian Longitudinal Study on Aging) was used. The patient, classified as healthy (328), with cardiac diseases (172), and with hypertension (643) were included in this study. For this purpose, ten parameters characterizing T wave morphology were obtained from the VCG. In addition to the two gender groups, two age groups have been established (<75 years and ≥ 75 years old).

From this study, it turns out that age and gender influence the T-loop morphology differently in the three considered groups. The gender influences the healthy and patients with hypertension, while age influences mainly the patients with cardiac diseases.

1. Introduction

In the last years there is an interest in the analysis of the repolarization phase, and several recent publications aroused the interest in T-wave morphology [1-4]

The aim of this study is to investigate influence of gender and age on the T-loop morphology. This study is a continuation of the investigation performed in [5], in which the authors studied the gender and age influences in QT-dispersion. For this purpose, the same population based ECG database from the longitudinal ILSA study has been used. Three groups of patients have been considered: healthy subjects, patients with cardiac disease and with hypertension. Five parameters obtained from the synthesized VCG were computed with two methods, and a validation study was performed.

2. Material and methods

Particular aspects of T-wave morphology are considered for characterization and quantification of heterogeneous repolarization, using the vectorcardiogram

(VCG). The orthogonal Frank leads were synthesized from the standard 12 lead ECG [6, 7].

Five parameters were obtained from the VCG [8]:

- maximum angle between QRS and T loop axes (MA)
- T axis elevation and azimuth angle difference (DEA)
- Ratio of maximum to mean T vector magnitudes (RMMV)
- Angle of the T-loop in frontal plane (TF)
- Angle of the T-loop in the horizontal plane (TH).

In addition, as described in [8], a modified computation method was performed. The reference zero point of the VCG loop was chosen appropriately (zero*) between the two points of the loop with the maximum distance. Then five modified parameters (MAm, DEAm, RMMVm, TFm, THm) are measured with respect to the new considered zero* point.

2.1. Experimental data

The population based ECG-ILSA database (Italian Longitudinal Study on Aging) has been considered. This database is composed by 2513 ECG signals of elderly people (1337 males and 1176 females aged from 65 to 85 years old) [9-11].

The following three groups have been selected for this study:

- 328 healthy subjects
- 643 patients with only hypertension (HYPT)
- 172 patients with only cardiac diseases (CARD)

The three groups are mutually exclusive. The "healthy" group is characterized by absence of cardiovascular and chronic pulmonary diseases, by no use of drugs that can influence the electrical cardiac activity, and by no electrolyte imbalance [9].

In addition to the two gender groups, two age groups have been established (<75 years and ≥ 75 years old).

Table 1. Mean value \pm standard deviation of the parameters MA, DEA, RMMV, TF, TH and MAm, DEAm, RMMVm, TFm, THm in Male and Female in the Healthy group.

Parameter	M	F	p
MA	87.8 \pm 52.3	67.3 \pm 50.0	p<0.001
DEA	62.7 \pm 17.0	54.8 \pm 16.0	p< 0.001
RMMV	2.2 \pm 0.3	2.2 \pm 0.3	n.s.
TF	33.9 \pm 17.3	38.6 \pm 13.2	p<0.01
TH	-23.5 \pm 24.0	-8.9 \pm 17.9	p<0.001
MAm	91.6 \pm 55.5	69.5 \pm 52.0	p<0.001
DEAm	57.2 \pm 18.5	56.1 \pm 20.4	n.s.
RMMVm	2.4 \pm 0.3	2.4 \pm 0.3	n.s.
TFm	33.0 \pm 19.3	37.8 \pm 15.4	p=0.017
THm	-21.6 \pm 27.8	-5.6 \pm 22.6	p<0.001

Table 3. Mean value \pm standard deviation of the parameters MA, DEA, RMMV, TF, TH and MAm, DEAm, RMMVm, TFm, THm in M and F in the HYPT group.

Parameter	M	F	p
MA	96.2 \pm 52.2	82.9 \pm 51.3	p<0.001
DEA	62.1 \pm 15.1	57.2 \pm 19.5	p<0.001
RMMV	2.2 \pm 0.3	2.1 \pm 0.4	p=0.022
TF	32.4 \pm 28.5	38.2 \pm 35.1	p=0.024
TH	-23.0 \pm 29.4	-13.0 \pm 37.6	p<0.001
MAm	102.1 \pm 55.3	84.9 \pm 55.4	p<0.001
DEAm	59.9 \pm 19.9	57.6 \pm 21.2	n.s.
RMMVm	2.3 \pm 0.3	2.3 \pm 0.4	n.s.
TFm	31.1 \pm 32.9	35.9 \pm 37.4	n.s.
THm	-22.9 \pm 34.7	-9.1 \pm 40.5	p<0.001

Table 2. Mean value \pm standard deviation of the parameters MA, DEA, RMMV, TF, TH and MAm, DEAm, RMMVm, TFm, THm in M and F in the CARD group.

Parameter	M	F	p
MA	100.9 \pm 52.4	92.1 \pm 54.9	n.s.
DEA	62.3 \pm 1.8	60.3 \pm 20.1	n.s.
RMMV	2.1 \pm 0.4	2.1 \pm 0.5	n.s.
TF	25.1 \pm 53.4	30.6 \pm 50.7	n.s.
TH	-30.9 \pm 48.9	-26.3 \pm 45.1	n.s.
MAm	106.7 \pm 57.4	97.6 \pm 59.7	n.s.
DEAm	58.4 \pm 23.6	64.8 \pm 22.6	n.s.
RMMVm	2.2 \pm 0.4	2.2 \pm 0.5	n.s.
TFm	22.8 \pm 57.5	25.3 \pm 51.8	n.s.
THm	-29.3 \pm 54.7	-20.1 \pm 56.8	n.s.

Table 4. Mean value \pm standard deviation of the parameters MA, DEA, RMMV, TF, TH and MAm, DEAm, RMMVm, TFm, THm in <75 and \geq 75 in the Healthy group.

Parameter	<75	\geq 75	p
MA	78.4 \pm 51.8	80.1 \pm 53.3	n.s.
DEA	58.8 \pm 17.4	60.2 \pm 16.3	n.s.
RMMV	2.2 \pm 0.3	2.2 \pm 0.3	n.s.
TF	35.7 \pm 15.0	36.4 \pm 17.5	n.s.
TH	-17.5 \pm 24.1	-16.5 \pm 19.6	n.s.
MAm	80.0 \pm 54.6	86.4 \pm 55.8	n.s.
DEAm	56.2 \pm 18.9	57.7 \pm 20.2	n.s.
RMMVm	2.3 \pm 0.3	2.4 \pm 0.3	n.s.
TFm	34.8 \pm 16.0	35.5 \pm 21.2	n.s.
THm	-15.0 \pm 28.7	-14.1 \pm 22.5	n.s.

Table 5. Mean value \pm standard deviation of the parameters MA, DEA, RMMV, TF, TH and MAm, DEAm, RMMVm, TFm, THm in <75 and \geq 75 in the CARD group.

Parameter	<75	\geq 75	p
MA	88.0 \pm 51.4	109.5 \pm 53.6	p<0.01
DEA	61.6 \pm 18.2	61.6 \pm 20.5	n.s.
RMMV	2.1 \pm 0.4	2.1 \pm 0.5	n.s.
TF	27.9 \pm 47.7	26.2 \pm 57.8	n.s.
TH	-22.9 \pm 44.7	-36.9 \pm 49.8	n.s.
MAm	90.4 \pm 56.6	119.3 \pm 56.6	p=0.001
DEAm	60.0 \pm 21.2	61.8 \pm 26.0	n.s.
RMMVm	2.2 \pm 0.4	2.2 \pm 0.5	n.s.
TFm	26.1 \pm 51.8	20.7 \pm 59.6	n.s.
THm	-19.7 \pm 51.1	-33.4 \pm 60.0	n.s.

Table 6. Mean value \pm standard deviation of the parameters MA, DEA, RMMV, TF, TH and MAm, DEAm, RMMVm, TFm, THm in <75 and \geq 75 in the HYPT group.

Parameter	<75	\geq 75	p
MA	87.9 \pm 51.5	90.3 \pm 53.2	n.s.
DEA	59.4 \pm 17.3	59.4 \pm 18.8	n.s.
RMMV	2.1 \pm 0.4	2.1 \pm 0.3	n.s.
TF	35.4 \pm 29.2	36.1 \pm 38.0	n.s.
TH	-15.3 \pm 33.3	-21.4 \pm 36.4	p=0.031
MAm	92.1 \pm 55.5	93.2 \pm 57.0	n.s.
DEAm	59.2 \pm 20.5	57.5 \pm 20.9	n.s.
RMMVm	2.3 \pm 0.4	2.3 \pm 0.3	n.s.
TFm	34.2 \pm 32.1	32.9 \pm 41.4	n.s.
THm	-13.2 \pm 36.9	-18.9 \pm 41.6	n.s.

Table 7. Summary of p values of the paired t-test of the parameters MA, DEA, RMMV, TF, TH and MAm, DEAm, RMMVm, TFm, THm in considering the Healthy, CARD, HYPT groups (s.l. 5%).

Parameter	Healthy		Card		Hytp	
	M-F	age	M-F	age	M-F	age
MA	<.01	n.s.	n.s.	<.01	<.01	n.s.
DEA	<.01	n.s.	n.s.	n.s.	<.01	n.s.
RMMV	n.s.	n.s.	n.s.	n.s.	.02	n.s.
TF	<.01	n.s.	n.s.	n.s.	.02	n.s.
TH	<.01	n.s.	n.s.	n.s.	<.01	.03
MAm	<.01	n.s.	n.s.	<.01	<.01	n.s.
DEAm	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
RMMVm	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
TFm	.022	n.s.	n.s.	n.s.	n.s.	n.s.
THm	<.01	n.s.	n.s.	n.s.	<.01	n.s.

3. Results and discussion

The 5 'original' parameters (MA, DEA, RMMV, TF, TH) and the 5 modified parameters (MAm, DEAm, RMMVm, TFm, THm) have been computed in the 3 groups of patients selected from the ECG-ILSA database.

First, the gender influence has been investigated. Table 1 reports the mean value and the standard deviation of the considered parameters in Male and Female in the healthy group and the p-value of the t-test. Table 2 and Table 3 report respectively the corresponding results in the CARD and HYPT groups.

Analysing these tables, it is possible to observe that age influences only the healthy and the HYPT groups. For example, the MA index in the healthy group shows the values of 87.8 \pm 52.3 in male and 67.3 \pm 50.0 in female (p<0,001); in the hypertension group 96.2 \pm 52.2 in M and 82.7 \pm 51.3 in F (p=0,001), while in patients with cardiac disease no significant differences were observed. The remaining 9 parameters show "substantially" a similar behaviour.

The subsequent analysis consider the two age subgroups (<75 years and \geq 75 years old). Table 4 reports the mean value and the standard deviation of the considered parameters in <75 and \geq 75 in the healthy group and the p-value of the t-test.

Table 5 and Table 6 report respectively the corresponding results in the CARD and HYPT groups.

Considering the MA index in the two age subgroups, the following results were respectively observed: no significant differences in the healthy group and in the hypertension group, while 88.0 ± 51.4 (<75 years old) and 109.5 ± 53.6 (≥ 75 years old) in patients with cardiac diseases ($p < 0,01$).

Table 7 report the summary of all the p-value of the t-test of the previous Tables 1-6.

These results are in agreement with the results obtained in [5], where QT-dispersion indices are influenced in the healthy group by gender, in the group of subjects with cardiac disease by age, while in the hypertension group by age and gender.

From this study, it turns out that age and gender influence the T-loop morphology differently in the three considered groups.

Considering that ventricular repolarization can be differently modified by various pathologies, further investigations are needed to study the clinical meaning of this differentiated behaviour of T-loop morphology and QT dispersion.

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