

Contents

List of Figures	xvii
List of Tables	xxiii
Acronyms	xxv
1 Motivation, hypothesis and objectives	1
1.1 Motivation	1
1.2 Initial hypothesis	3
1.3 Objectives	4
1.4 Thesis structure	5
2 Heart physiology, Electrocardiography and Atrial Fibrillation	7
2.1 Heart physiology	8
2.1.1 Heart anatomy	8
2.1.2 Cardiac cycle	9
2.2 Electrical activity of the heart	11
2.2.1 Cardiac muscle cells	11
2.2.2 Cardiac electrical conduction system	12
2.3 The electrocardiogram	15
2.3.1 Leads of the electrocardiogram	16
2.3.2 Characterization of the ECG	22
2.3.3 The ECG as a clinical tool for cardiac diagnosis	24
2.4 Atrial Fibrillation	25
2.4.1 Epidemiology and Causes	28
2.4.2 Classification	31
2.4.3 Mechanisms	32
2.4.4 Atrial fibrillation study from ECG	34
2.4.5 Treatment	35
2.5 Cox-Maze surgery	36
3 Materials and methods	41
3.1 Database	42
3.2 Methodology	43
3.3 Signal processing	45
3.3.1 Preprocessing	45
3.3.2 Ventricular activity cancelation	46
3.4 Clinical indices	52
3.4.1 Preoperative atrial fibrillation duration	52
3.4.2 Left atrial size	53
3.4.3 Patient's age	53
3.4.4 Patient's weight	54
3.5 Electrocardiographic indices	55
3.5.1 Dominant atrial frequency	55
3.5.2 Sample Entropy	57
3.5.3 Fibrillatory waves mean power	59
3.6 Prediction model development	60
3.6.1 Classification tree	60
3.6.2 Logistic Regression	61
3.7 Statistical analysis	64
4 Results	67
4.1 Nonlinearity and nonstationarity	68
4.2 MAZE outcome prediction at discharge	68
4.3 MAZE outcome prediction after a 6 months-length follow up	78
4.4 MAZE outcome prediction after a 12 months-length follow up	87

5 Discussion	97
5.1 ECG indices	100
5.1.1 AF organization	100
5.1.2 Fibrillatory waves mean power	101
5.2 Clinical indices	102
5.2.1 AF duration	102
5.2.2 LA size	103
5.2.3 Age	103
5.2.4 Obesity	104
5.3 Prediction models development	104
5.4 Overall analysis	105
5.5 Limitations of the study	105
6. Conclusions	107
6.1 Global Conclusions	108
6.2 Future Lines of Research	109
6.3 Scientific contributions	110
6.3.1 Main Thesis Publications	110
6.4 Funding	112
Bibliography	113