

Contents

1	Introduction	1
1.1	The Importance of Monitoring Transient Changes	1
1.2	Non-invasive Recording of the Cardiac Parameters and its Significance	2
1.3	Ambulatory Monitoring and Implementations of it.	2
1.4	Ambulatory Monitoring Using Impedance Cardiography Signals	3
	References	4
2	Impedance Cardiography	7
2.1	Bioimpedance Measurement: Applications and Importance	7
2.2	Electrical Properties of the Biological Tissues	8
2.3	Tissue as a Conductor	9
2.4	Frequency and Current Values	10
2.5	Bioimpedance Measurement Methods	11
2.5.1	Biopolar and Tetrapolar Method	11
2.5.2	Alternating Constant-Current Source	11
2.5.3	Receiving Unit	12
2.5.4	Demodulation Unit	12
2.5.5	Automatic Balance Systems	13
2.6	Electrodes Types and Topography	13
2.6.1	Band Electrodes, Spot Electrodes and Mixed Spot/Band Electrodes	13
2.6.2	Other Solutions	14
2.7	Signal Description and Analysis	15
2.7.1	Impedance Cardiography Traces	15
2.7.2	Characteristic Points on Impedance Cardiography Curves	15
2.7.3	Characteristic Periods in Impedance Cardiography	17
2.7.4	Hemodynamic Indices	18
2.7.5	The Influence of Breathing	20

2.7.6	The Origin of the Impedance Cardiography Signals	21
2.7.7	The Methods of Stroke Volume Calculation	23
2.7.8	Blood Resistivity Impact.	28
2.8	Signal Conditioning	28
2.8.1	Ensemble Averaging Method	29
2.8.2	Large-Scale Ensemble Averaging Method.	30
2.9	Technical Aspects of ICG-Limitations, Errors and Patients' Safety	30
2.10	Modifications of ICG, and Other Impedance Techniques	31
2.11	Physiological and Clinical Applications of Impedance Cardiography.	31
2.12	Conclusions.	32
	References	33
3	Ambulatory Impedance Cardiography	39
3.1	The Idea of Ambulatory Impedance Cardiography	39
3.2	ReoMonitor: The Research System	40
3.2.1	The Ambulatory Recorder.	41
3.2.2	The Analogue Unit	41
3.2.3	The Digital Unit	43
3.2.4	The User Interface	44
3.2.5	Software for Hemodynamics Parameters Calculations . .	45
3.3	VU-AMS: The Vrije Universiteit Ambulatory Monitoring System.	47
3.4	MW1000A: The MindWare System	49
3.5	PhysioFlow Enduro System.	49
3.6	AIM-8-V3: Wearable Cardiac Performance Monitor.	51
3.7	Ambulatory Impedance Cardiograph: AZCG	53
3.8	Other Systems	54
	References	55
4	Validation of the Ambulatory Impedance Cardiography Method	57
4.1	Introduction.	57
4.2	Validation using Reference Methods	58
4.2.1	Background and Motivation	58
4.2.2	Experimental Studies	59
4.2.3	Results of the Own Experimental Studies	60
4.2.4	Discussion and Conclusions	63
4.3	The Quality of the Ambulatory Impedance Cardiography Recordings	64
4.3.1	Background and Motivation	64
4.3.2	Experimental Studies	65
4.3.3	Results of the Experimental Studies	66

4.3.4 Discussion and Conclusions	67
References	69
5 Clinical and Physiological Applications of Impedance	
Cardiography Ambulatory Monitoring	73
5.1 Introduction.	73
5.2 Atrial Fibrillation	74
5.3 Ventricular Extrasystole Beats (VEB) Monitoring	78
5.4 Ambulatory ICG and Pacemaker Monitoring	82
5.4.1 Cardiac Pacing Optimisation	82
5.4.2 Pacemaker Syndrome Detection.	84
5.5 Cardiac Parameters Monitoring During the Tilt Test	86
5.6 Other Applications	91
References	93
6 Final Conclusions and Future Directions.	99
6.1 Prospects for Impedance Ambulatory Monitoring.	99
6.2 Clinical Importance of the Ambulatory Impedance Cardiography Monitoring	100
References	101
Appendix	103
Index	111



<http://www.springer.com/978-3-642-11986-6>

Ambulatory Impedance Cardiography

The Systems and their Applications

Cybulski, G.

2011, XIV, 114 p., Hardcover

ISBN: 978-3-642-11986-6